Mendota Pool Bypass and Reach 2B Improvements Project

Biological Assessment for the United States Fish and Wildlife Service

February 2016

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List of Abbreviations and Acronyms

BA	biological assessment
BCC	Bird of Conservation Concern
BO	biological opinion
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CL	critical low (water year)
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Corps	U.S. Army Corps of Engineers
DFW	California Department of Fish and Wildlife (formerly the California Department of Fish and Game)
DWR	California Department of Water Resources

EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
°F	degrees Fahrenheit
FC	Candidate for Federal listing
FE	Federally listed as Endangered
FP	(California) Fully Protected
FT	Federally listed as Threatened
GIS	Geographic Information System
LiDAR	light detection and ranging
MBTA	Migratory Bird Treaty Act
ND	normal dry (water year)
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NRDC	Natural Resources Defense Council
NW	normal wet (water year)
PEIS/R	Program Environmental Impact Statement/ Environmental Impact Report
PIT	passive integrated transponder
Project	Mendota Pool Bypass and Reach 2B Improvements Project
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RM	River Mile
ROD	Record of Decision
SCADA	supervisory control and data acquisition
SE	State listed as Endangered
Settlement	Stipulation of Settlement in NRDC, et al., v. Kirk Rodgers, et al.
Settling Parties	Natural Resources Defense Council, Friant Water Authority, and the U.S. Departments of the Interior and Commerce
SJRNWR	San Joaquin River National Wildlife Refuge
SJRRP	San Joaquin River Restoration Program
SSC	Species of Special Concern
ST	State listed as Threatened
USFWS	U.S. Fish and Wildlife Service
W	wet (water year)
WHR	Wildlife-Habitat Relationships

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1.0 Introduction

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC) filed a lawsuit, known as *NRDC, et al., v. Kirk Rodgers, et al.*, challenging the renewal of long-term water service contracts between the United States and the Central Valley Project Friant Division contractors. On September 13, 2006, after more than 18 years of litigation, the Settling Parties, including NRDC, Friant Water Authority, and the U.S. Departments of the Interior and Commerce, agreed on terms and conditions for a Settlement. The Settlement establishes two primary goals:

- **Restoration Goal** – To restore and maintain fish populations in "good condition" in the main stem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.
- **Water Management Goal** – To reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim and Restoration flows provided for in the Settlement.

The Settlement establishes a framework for accomplishing the Restoration and Water Management goals that will require environmental compliance, design, construction, and monitoring of projects over a multiple-year period. To achieve the Restoration Goal, the Settlement calls for a combination of channel and structural modifications along the San Joaquin River below Friant Dam, releases of water from Friant Dam to the confluence of the Merced River (referred to as Interim and Restoration flows), and reintroduction of Chinook salmon. To achieve the Water Management Goal, the Settlement calls for recirculation, recapture, reuse, exchange or transfer of the Interim and Restoration flows to reduce or avoid impacts to water deliveries to all of the Friant Division long-term contractors caused by the Interim and Restoration flows.

The San Joaquin River Restoration Program (SJRRP) is the program established to implement the Settlement. Implementing agencies responsible for managing and implementing the SJRRP are U.S. Department of the Interior, Bureau of Reclamation (Reclamation), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), the California Department of Water Resources (DWR), and California Department of Fish and Wildlife (DFW). The Settlement Act, included in Public Law 111-11, the Omnibus Public Lands Management Act of 2009, authorizes and directs the Secretary of the Interior to implement the terms and conditions of the Settlement. The anticipated benefits and potential impacts of implementing the SJRRP were analyzed in the Program Environmental Impact Statement/Environmental Impact Report (PEIS/R) (SJRRP 2011a).

The SJRRP's Restoration Area includes a 149–mile section of the San Joaquin River from Friant Dam to the confluence with the Merced River in Fresno and Madera counties, California. The SJRRP's Restoration Area is divided into separate reaches

(Figure 1-1). In order to implement the SJRRP, a comprehensive strategy for the conservation of listed and sensitive species and habitats—termed the Conservation Strategy—was prepared in coordination with the Implementing agencies.

This biological assessment (BA) analyzes the potential effects of both phases of the proposed Mendota Pool Bypass and Reach 2B Improvements Project (Project) for consultation with the USFWS under Section 7 of the Endangered Species Act. The first phase of the Project is construction of the Mendota Pool bypass, also referred to as the Compact Bypass. The second phase of the Project is construction of the Reach 2B floodplain and channel improvements. Based on historically and recently collected data of species occurrence, habitat assessment, and research of species distribution data, the following threatened or endangered species may be affected by the Project:

- Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)
- Blunt-nosed leopard lizard (*Gambelia sila*)
- Giant garter snake (*Thamnophis gigas*)
- Least Bell's vireo (*Vireo bellii pusillus*)
- Fresno kangaroo rat (*Dipodomys nitratoides*)
- San Joaquin kit fox (*Vulpes macrotis mutica*)
- California jewelflower (*Caulanthus californicus*)
- Palmate-bracted bird's beak (*Cordylanthus palmatus*)
- San Joaquin woolly threads (*Monolopia* (=*Lembertia*) *congdonii*)

Reclamation is also consulting with NMFS on potential effects of the proposed action on anadromous fishes and Essential Fish Habitat.

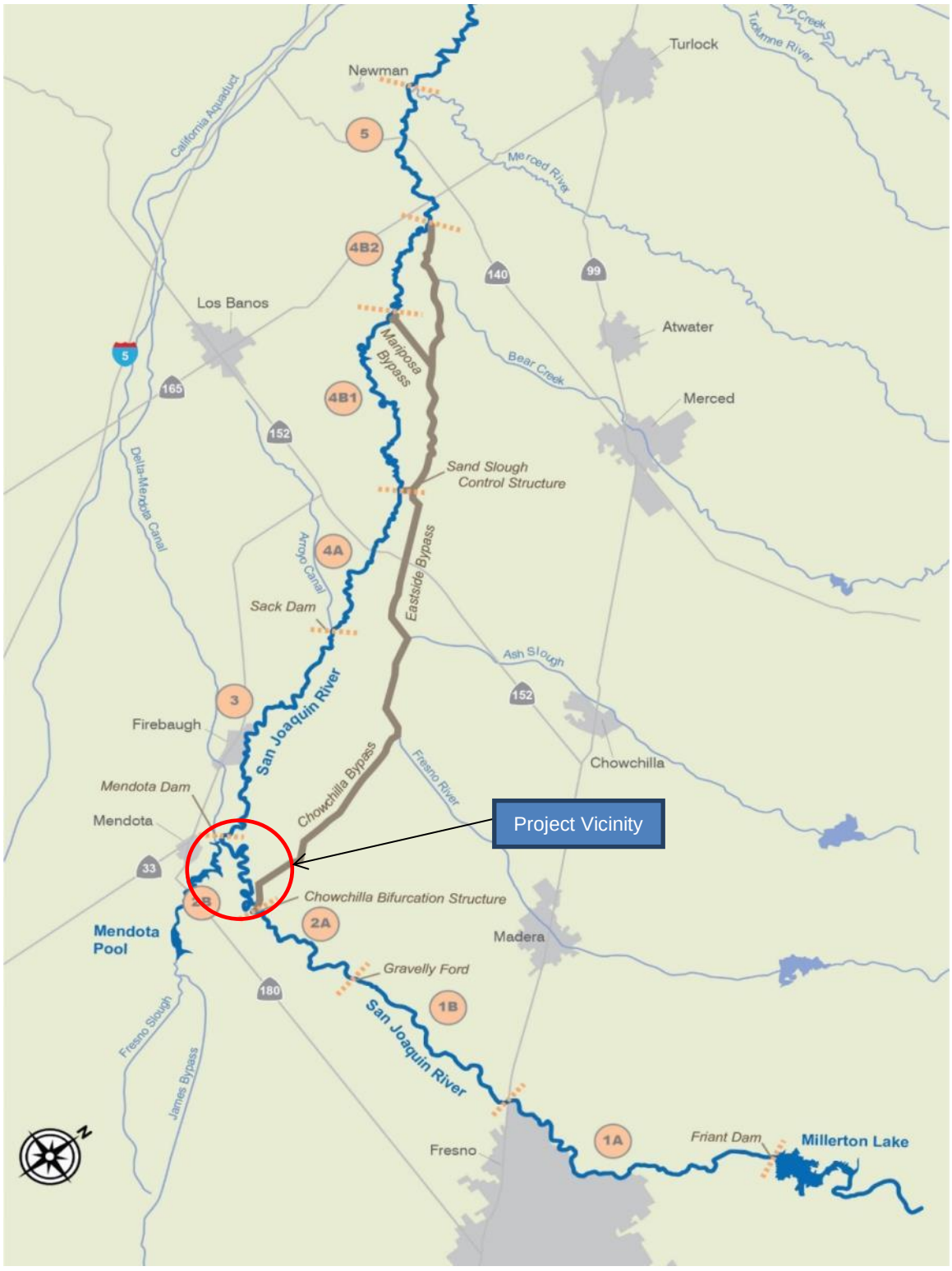


Figure 1-1.
Overview of the SJRRP Restoration Area and the Project Vicinity

1.1 Consultation History

Coordination between Reclamation and USFWS regarding the SJRRP has occurred regularly since 2008. The SJRRP Programmatic BA contains a detailed record of Environmental Compliance Permitting and Work Group meetings, Federal Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*) (ESA) and California Endangered Species Act meetings, and written correspondence between USFWS and Reclamation between the period of March 2008 and June 2011 (SJRRP 2011b). Reclamation submitted a Programmatic BA in November 2011 (SJRRP 2011b), and USFWS issued a biological opinion (BO) in August 2012.

Correspondence between Reclamation and USFWS occurred in 2012 related to the SJRRP Invasive Vegetation Monitoring and Management Project. Reclamation submitted a consultation letter and BA to USFWS in April 2012. USFWS reviewed the BA and provided comments to Reclamation.

Reclamation submitted a request for informal consultation to the USFWS for the SJRRP Mendota Pool Bypass and Reach 2B Improvements Project geological investigation in April 2014. USFWS issued a letter of concurrence that the proposed actions were not likely to adversely affect any federally threatened or endangered species in May 2014. The USFWS updated their concurrence letter in May 2014 and again in August 2014, based on additional information provided by Reclamation.

USFWS has regularly participated in other SJRRP work group meetings, including the Restoration Goal Technical Feedback Group and the Fisheries Management Working Group, both prior to submission of the Programmatic BA and since. USFWS has also participated in bi-weekly Mendota Pool Bypass and Reach 2B Project team meetings since 2010. Reclamation and USFWS had meetings regarding ESA consultation on this Project on January 14, 2015, January 27, 2015, March 17, 2015, a site visit on May 28, 2015, and September 29, 2015.

The draft Reach 2B BA was provided to USFWS for review on December 11, 2015. Reclamation received draft comments from USFWS and met with USFWS to discuss the comments on January 13, 2015. On February 10, 2016 Reclamation presented an overview of the Project and the BA to USFWS, with focus on giant garter snake impacts and compensatory mitigation.

1.2 Proposed Action

The Mendota Pool bypass and Reach 2B improvements defined in the Settlement are (Settlement Paragraph 11[a]):

> *(1) Creation of a bypass channel around Mendota Pool to ensure conveyance of at least 4,500 cubic feet per second (cfs) from Reach 2B downstream to Reach 3. This improvement requires construction of a structure capable of directing flow down the bypass and allowing the*

> *Secretary to make deliveries of San Joaquin River water into Mendota Pool when necessary;*
>
> *(2) Modifications in channel capacity (incorporating new floodplain and related riparian habitat) to ensure conveyance of at least 4,500 cfs in Reach 2B between the Chowchilla Bifurcation Structure and the new Mendota Pool bypass channel.*

Since the functions of these channels may be interrelated, the design, environmental compliance, and construction of the two are being addressed as one project. The Project would be implemented consistent with the Settlement and the Settlement Act.

The Project includes the following features, which are described in more detail below:

- Constructing a channel and structures capable of conveying up to 4,500 cfs of Restoration Flows around the Mendota Pool.
- Constructing structures capable of conveying up to 2,500 cfs from Reach 2B to Mendota Pool.
- Building setback levees capable of conveying flows up to 4,500 cfs with 3 feet of freeboard, and breaching portions of the existing levees.
- Restoring floodplain habitat with an average width of approximately 4,200 feet to provide benefit to salmonids and other native fishes.
- Providing upstream and downstream fish passage for adult salmonids and other native fishes, and downstream fish passage for juvenile salmonids, between Reach 2A and Reach 3.

These features are described in further detail below, as well as in Section 2. See Figures 1-2 and 1-3 for a plan view of the Project's features.

The Project would construct a channel between Reach 2B and Reach 3, the Compact Bypass channel, in order to bypass the Mendota Pool (Figures 1-2 and 1-3). Restoration Flows would enter Reach 2B at the Chowchilla Bifurcation Structure, flow through Reach 2B, then downstream to Reach 3 via the Compact Bypass channel. The existing Chowchilla Bifurcation Structure would continue to divert San Joaquin River flows into the Chowchilla Bypass during flood operations, and a fish passage facility and control structure modifications would be included at the San Joaquin River control structure at the Chowchilla Bifurcation Structure. This action would also include constructing two new structures in Reach 2B, the Compact Bypass control structure and the Mendota Pool control structure (collectively referred to as the Compact Bypass structures), to divert up to 2,500 cfs to the Mendota Pool. Fish passage facilities would be built at the Compact Bypass control structure to provide passage around the structure when gates are closed during times of water delivery. Most of the time, fish would pass through the Compact Bypass control structure into the bypass channel and gates would be closed on the Mendota Pool control structure, preventing fish entrainment to the Mendota Pool.

Improvements to Reach 2B would include modifications to the San Joaquin River channel from the Chowchilla Bifurcation Structure to the Compact Bypass structures to provide a capacity of at least 4,500 cfs, with integrated floodplain habitat. New levees would be constructed along Reach 2B to increase the channel capacity while allowing for new floodplain habitat. The existing crossing at San Mateo Avenue would be removed.

Project implementation will be phased. Construction of the Compact Bypass portion of the Project will occur first from approximately 2017 to 2020 and will be followed by construction of the Reach 2B channel improvements from approximately 2020 to 2025. For these reasons, the Project description is divided into separate sections, one describing the Compact Bypass, and one describing the Reach 2B channel improvements. Reclamation respectfully requests that USFWS review the BA and issue one BO for both of the phases described within.

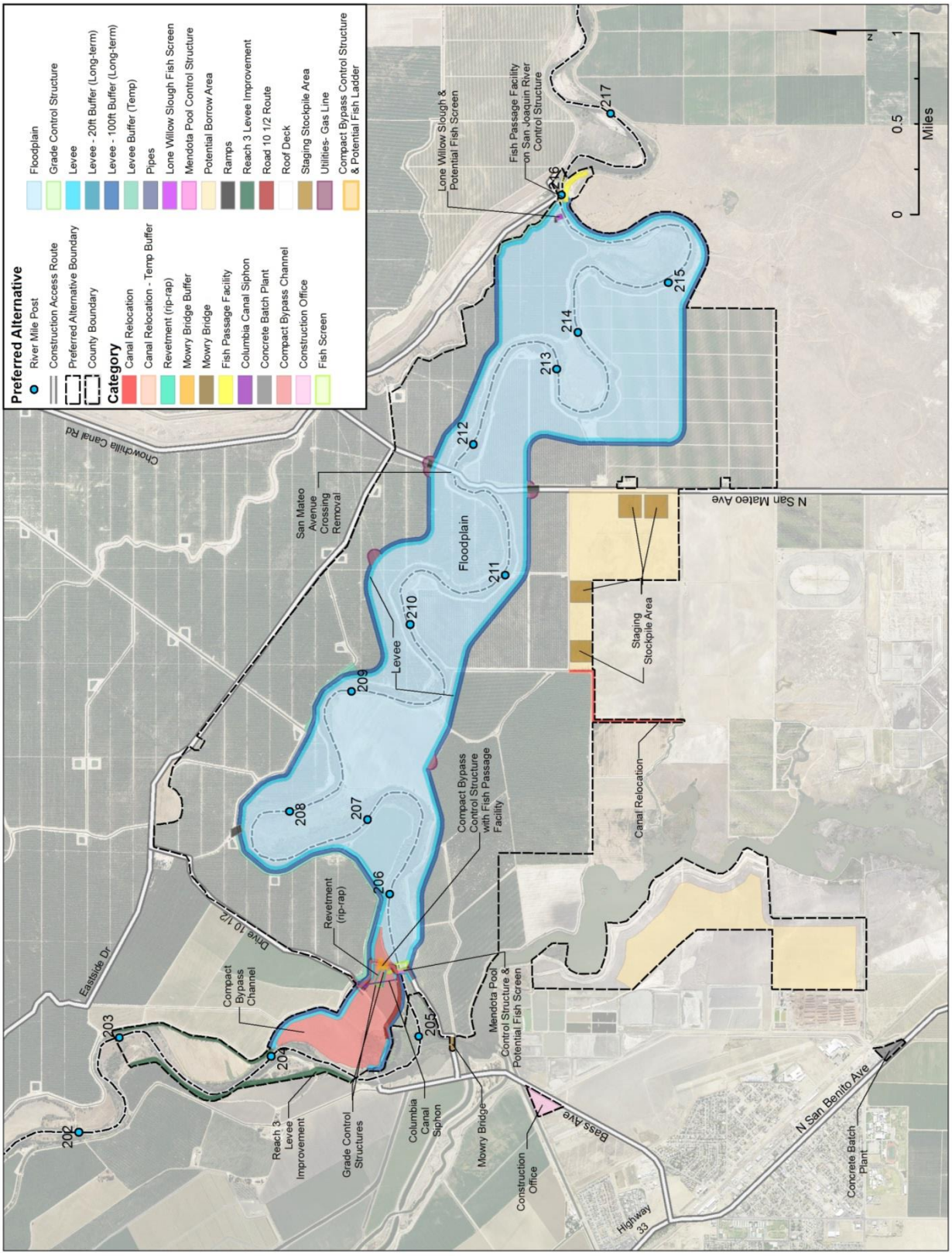


Figure 1-2.
Plan View of Project

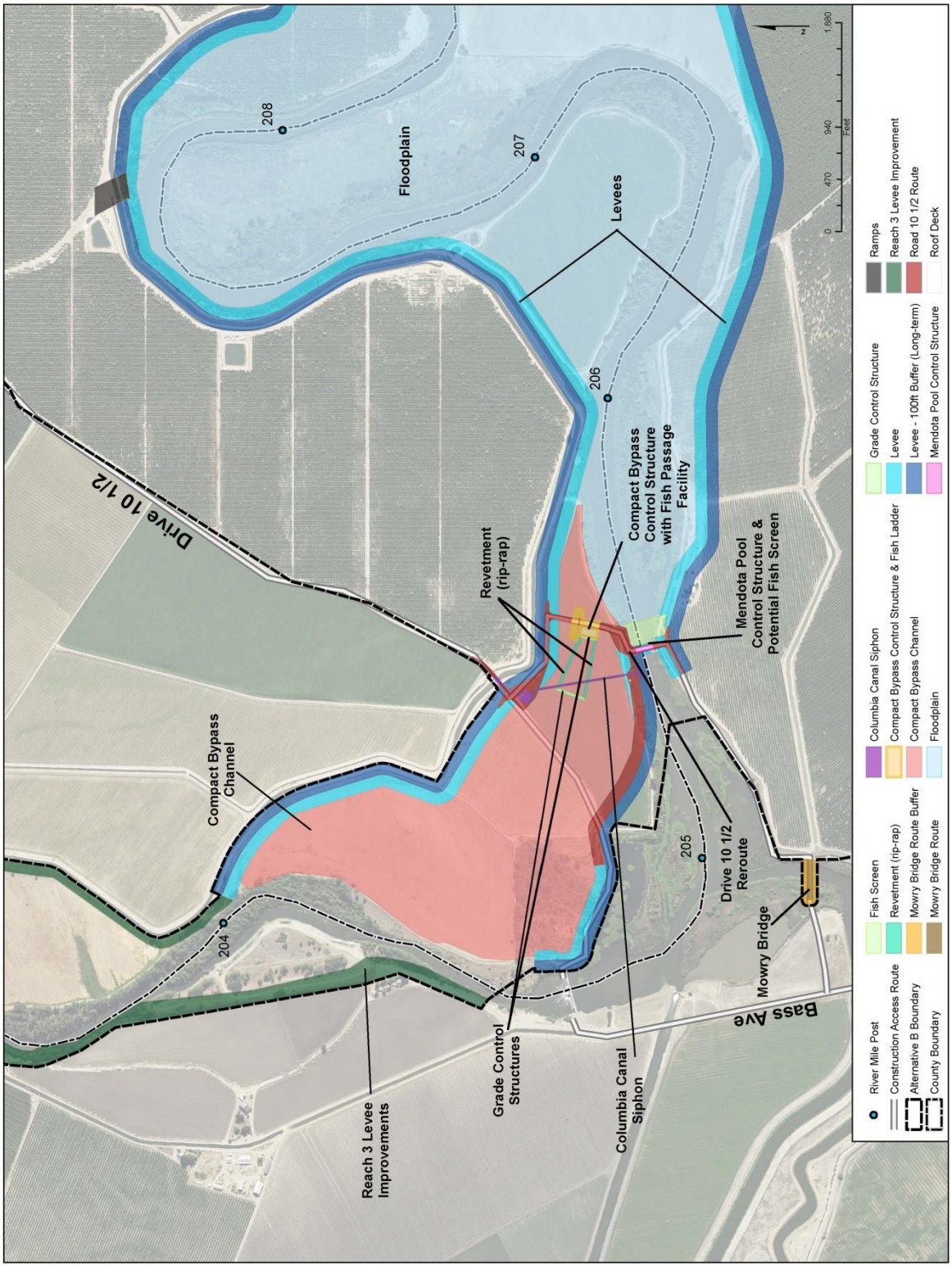


Figure 1-3.
Inset Map of Project

2.0 Project Description

The Project would use a phased approach to implementation. Phased implementation would involve building selected components of the Project in separate construction phases, allowing Project funding to be secured over time. It is anticipated that the bypass channel and Compact Bypass structures would be built in a first phase, described below in Section 2.2, Compact Bypass. Construction of fish passage facilities at existing structures, setback levees, and Reach 2B floodplain areas would occur in a second phase described below in Section 2.3, Reach 2B Channel Improvements. Environmental commitments and Conservation Measures (discussed below in Section 2.5) would apply during both phases of construction.

2.1 Action Area

The Action Area includes the portion of the Project that may be directly or indirectly affected by Project activities. This includes the entire Project footprint, including Reach 2B, a section of the San Joaquin River which begins at the Chowchilla Bifurcation Structure and the bypass channel 0.6 miles downstream of Mendota Dam (Figure 1-2). The Action Area extends beyond the Project footprint to areas where Project-related activities may cause high levels of noise, dust, vibrations, or other disturbances. This includes any areas where equipment, personnel, or any other Project-associated elements may cause disturbances to wildlife; such as road improvements needed to access the Project footprint, and any other areas required for operating, storing, and refueling construction equipment.

2.2 Compact Bypass

This section describes the Compact Bypass, including construction and operations, maintenance, and monitoring.

2.2.1 Construction of the Compact Bypass

This section describes the features of the Compact Bypass proposed to be constructed in the first phase of the Project.

Compact Bypass Channel

The bypass channel would convey 4,500 cfs around the Mendota Pool by constructing a channel just southwest of the existing Columbia Canal alignment. Once constructed, the bypass channel would become the new river channel. The Project includes excavating the bypass channel, constructing setback levees and in-channel structures, breaching existing levees but leaving some segments that provide valuable habitat and seed source in place, relocating or modifying existing infrastructure, and acquiring land. The in-channel structures include the Compact Bypass control structure, Mendota Pool control structure,

grade control structures, fish screen,[1] fish passage facility at the Compact Bypass control structure, Columbia Canal siphon and pumping plant, as well as the Drive 10 ½ realignment. The bypass channel and associated structures provide downstream passage of juvenile Chinook salmon and upstream passage of adult Chinook salmon, as well as passage for other native fishes, while isolating Mendota Pool from Restoration Flows.

The bypass channel would connect to Reach 3 approximately 0.6 mile downstream from Mendota Dam (approximately River Mile [RM] 204), bypass the Mendota Pool to the north, and connect to Reach 2B approximately 0.9 mile upstream from Mendota Dam (approximately RM 205.5). The bypass channel would have a total length of approximately 0.8 mile. A siphon under the bypass channel would be constructed to connect the Columbia Canal to the Mendota Pool.

The bypass channel would be a multi-stage channel designed to facilitate fish passage at low flows, channel stability at moderate flows, and contain high flows. The low flow channel is approximately 70 feet wide and has an average depth of approximately 3 feet deep. It is designed to contain approximately 200 cfs (Figures 2-1 and 2-2), and is sinuous. The overbank slopes toward the low flow channel. The bank slope of 67 feet horizontal to 1 foot vertical (67H:1V) and a flow of 1,200 cfs is designed to have about 1 foot of depth in the overbank. The overbank slope increases to 20H:1V at a distance of 135 feet from the center of the channel. The floodplain is intended to produce a range of channel depths regardless of the flow.

The elevation of the Compact Bypass control structure is set at 141 feet in order to promote sediment stability throughout Reaches 2 and 3 and minimize the need for grade control in the Compact Bypass channel. Because the entrance to the bypass is located approximately 7 feet below the current thalweg of Reach 2B, a pilot channel will be constructed to create a smoother transition between Reach 2B and the bypass channel (Figure 2-3; shown in red) and reduce sedimentation downstream into Reach 3. The pilot channel will be a 70-foot-wide channel with 2H:1V side slopes. It will be excavated within Reach 2B, upstream of the junction between the bypass and San Joaquin River. The excavation will be performed just prior to the reintroduction of high flows to the bypass so that sediment does not refill the channel. Some of the material excavated from the pilot channel could be placed in the bed of the low flow channel located in the bypass to a maximum depth of 1 foot.

The Compact Bypass channel, designed as an unlined earthen channel, would be approximately 4,000 feet long with a total corridor width of approximately 510 feet. The average slope of the channel would be approximately 0.0005 (approximately 2.6 feet per mile), while the total elevation drop in the Compact Bypass after channel stabilization would be approximately 2 feet. Two grade-control structures just downstream of the Compact Bypass control structure would be included to achieve the necessary elevation change (see Grade Control Structures). Channel complexity is incorporated as appropriate per the Rearing Habitat Design Objectives (SJRRP 2014).

[1] The need for the Mendota Pool fish screen will be further evaluated as Project planning and design continues. This screen is included in the Project in the event that it is determined necessary.

Figure 2-1.
Plan View of Compact Bypass

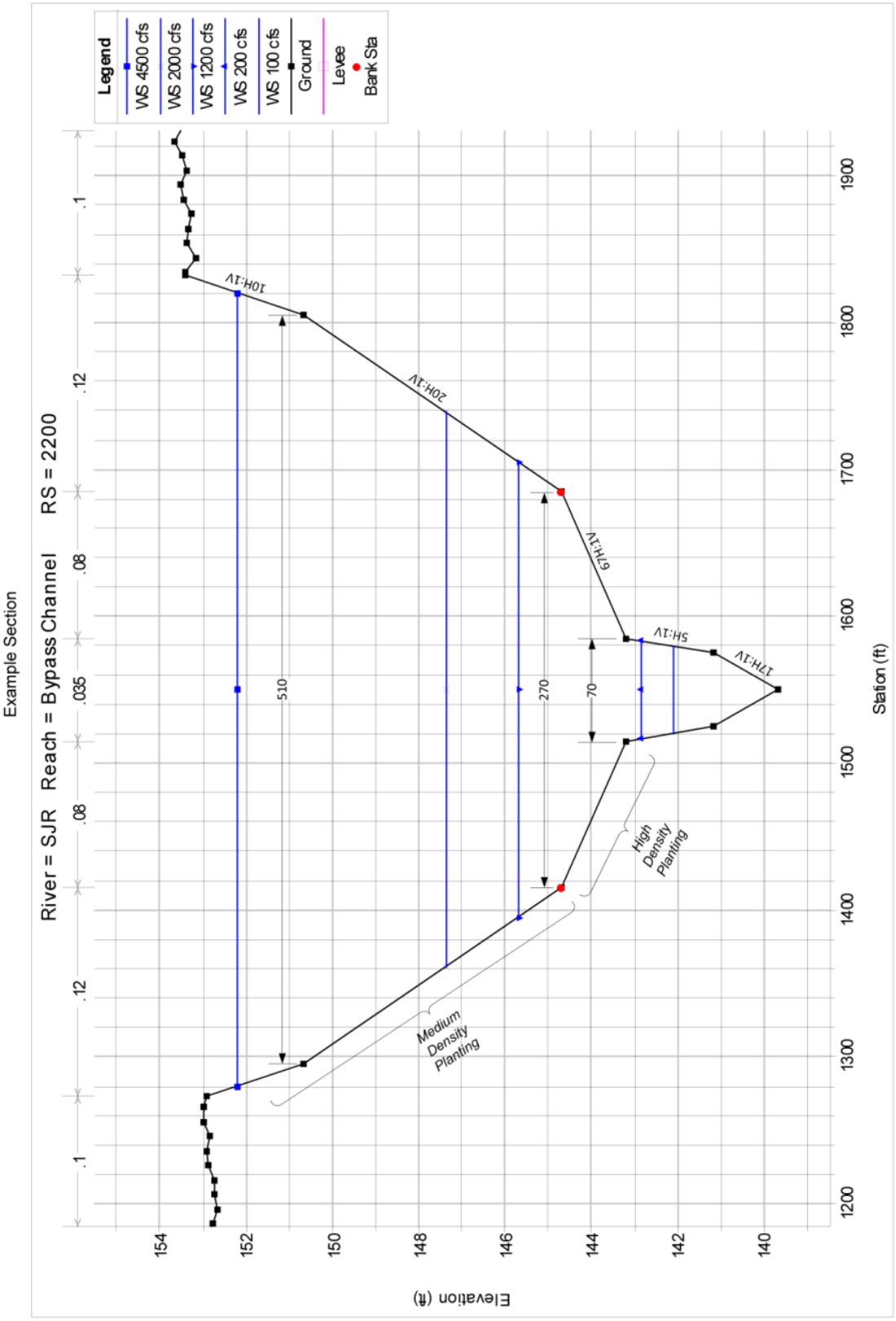


Figure 2-2.
Typical Cross Section in Compact Bypass

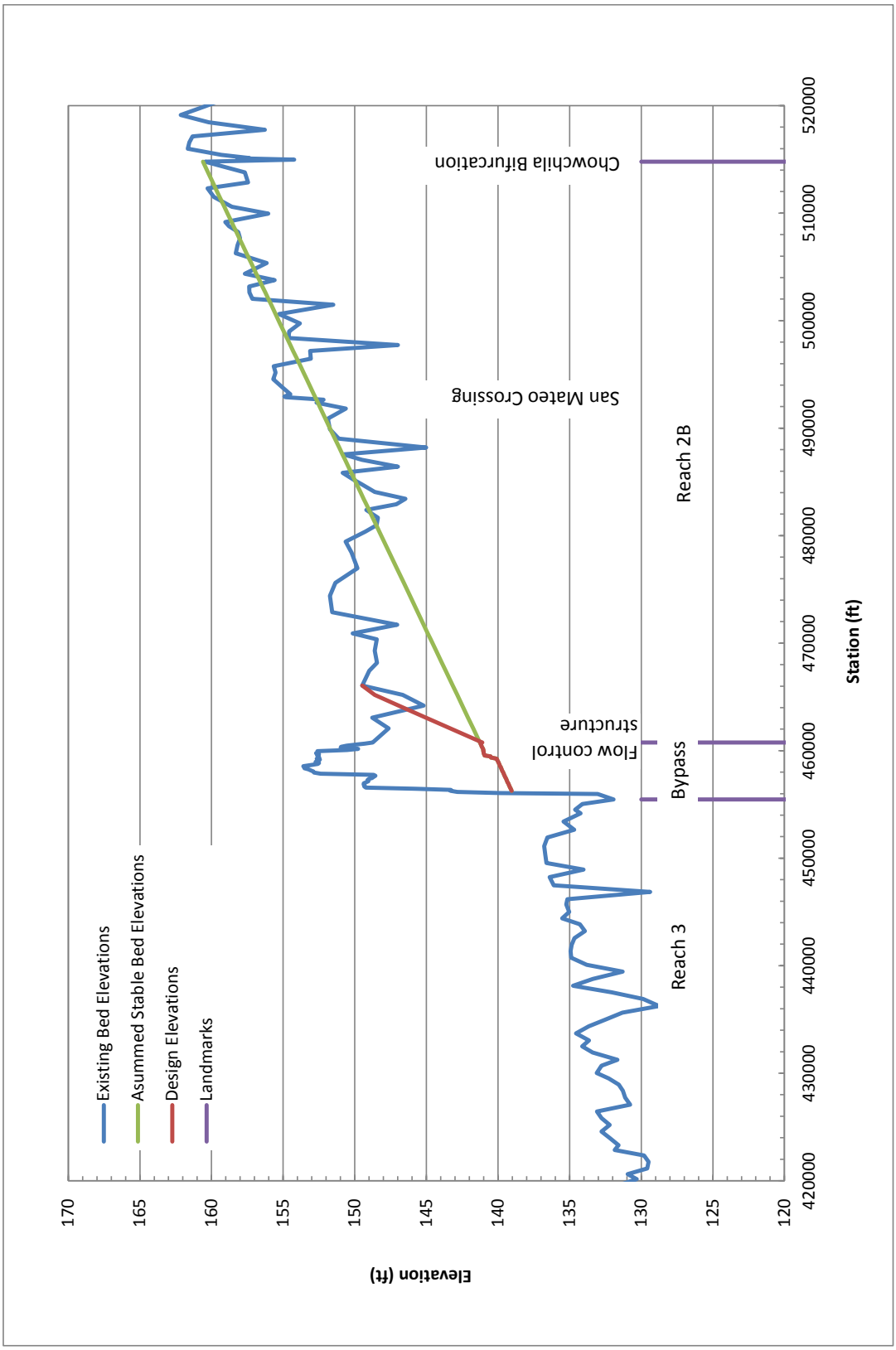


Figure 2-3.
Existing and Design Profiles in Reach 2B through the Compact Bypass

Structures

The structures described below would be required to provide the operational flexibility to divert water to the Mendota Pool, provide fish passage, allow maintenance access to Mendota Dam, and provide a controlled elevation drop between Reach 2B and Reach 3.

Grade Control Structures

There would be two grade control structures, designed as rock ramps per the *Rock Ramp Design Guidelines* (Reclamation 2007) and *Hydraulic Design of Flood Control Channels, EM 1110-2-1601* (Corps 1994). The most upstream one would be located immediately downstream of the Compact Bypass control structure. The second grade control structure would be located near the Columbia Canal siphon crossing. The siphon crossing would be located approximately underneath the second grade control structure so that the grade control structure would also serve to protect the siphon crossing. Each grade control structure will have approximately 0.4 feet of drop across it. Each structure will have a maximum downstream slope of 0.04 and be a minimum of 25 feet in length in the streamwise direction (see Figure 2-4). Rocks would be approximately 12 inches in diameter. Two filter layers would be constructed underneath the rock ramps, one of gravel and one of sand.

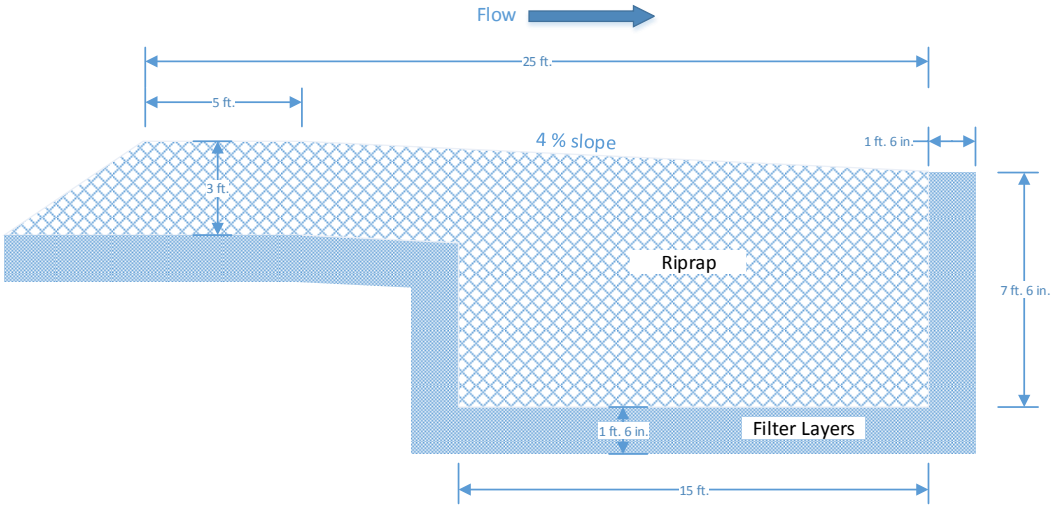


Figure 2-4.
Conceptual Profile View of Grade Control Rock Ramps

Rock ramps have benefits for native fish migration, but they present construction challenges in the sandy substrate of the Reach 2B and Reach 3 area. The flow over constructed rock riffles may reduce the disorienting effects on juveniles from rapidly changing hydraulics otherwise created at weir structures, and they are more favorable to sturgeon, which do not jump. Constructed rock riffles may be less favorable to predators which can hold in the quiescent pools below weir structures. However, placing rock in sandy substrate requires engineered foundation materials (layers of rock in gradually decreasing sizes) to prevent undermining the structure.

Each grade control structure would extend across the main channel and key into the overbanks to protect against flanking, resulting in a total structure width of about 270 feet.

Bank protection measures would be incorporated into the bypass between the Compact Bypass control structure and the downstream most grade control structure, totaling about 500 linear feet of bank protection on either side of the Compact Bypass channel. Downstream of the grade control structure, no bank protection would be necessary after establishment of riparian vegetation. Bank protection measures could include: vegetated revetment, rock vanes, bioengineering techniques, and riparian vegetation. It is assumed that the vegetated revetment would consist of buried riprap of approximately 12 inches in diameter, covered with topsoil, erosion control fabric, and native woody vegetation, so that fish would experience natural channel banks. Rock vanes would be constructed to only interact with the flow if erosion occurs (i.e., the top of the vane will be level with the constructed overbank surface). Bioengineering techniques could include vegetated geogrids, fabric encapsulated soil banks, brush mattresses, and root wads. Native woody vegetation directly upstream, downstream, and adjacent to the grade control structures would provide shading and opportunities for juveniles to hide from predators.

Compact Bypass Structures

Two control structures would be constructed at the upstream end of the Compact Bypass: one across the path of Restoration Flows (Compact Bypass), also known as the Compact Bypass control structure, and one across the path of water deliveries to Mendota Pool (San Joaquin River), also known as the Mendota Pool control structure. The Compact Bypass control structure includes a fish passage facility on the side of the structure (i.e., the Compact Bypass Fish Passage Facility) and the Mendota Pool control structure may include a fish screen upstream of the structure (i.e., the Mendota Pool Fish Screen), if appropriate. Each control structure would be placed in the middle of the channel and has earthen embankments, which are designed as dams as they may have water on both sides, connecting the structure to the proposed levees. A 16-foot-wide roadway and 20-foot-wide maintenance/operations platform would be provided over each control structure.

Compact Bypass Control Structure

The Compact Bypass control structure would be designed to accommodate up to 4,500 cfs and would consist of eight 14-foot-wide bays. Conditions in this control structure would be designed based on the *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001) and *Anadromous Salmonid Passage Facility Design* (NMFS 2008) fish passage criteria. The bays would be outfitted with radial gates. Approximately 95 percent of the time, fish and Restoration Flow would pass through this structure and all gates would be open.

When deliveries are occurring, most of the gates of the Compact Bypass control structure would be shut nearly all the way. The water surface elevation would increase by several feet on the upstream side of the structure. The gates of the Mendota Pool control structure would open and water would be delivered to Mendota Pool. In the delivery situation, fish and Restoration Flows would pass primarily through the fish passage facility, described below. Water that passes through the Compact Bypass control structure would be forced

through a small opening, and a hydraulic jump would form downstream of the structure. A stilling basin would be located on the downstream side of the Compact Bypass control structure to contain the hydraulic jump that would form when deliveries are occurring to Mendota Pool.

Mendota Pool Control Structure
The control structure across the San Joaquin River (the path of the water deliveries) would be designed to accommodate up to 2,500 cfs. The structure would have twelve bays that are 10 feet wide, and would contain slide gates to control the flow of water rather than radial gates, since Mendota Pool would be impounded on the downstream side of the structure at all times. Guides for stop logs would be provided in all bays to allow for maintenance. A 5-foot barrier wall could be added to the upstream side of the structure in several decades, to allow continued operation with subsidence.

Compact Bypass Fish Passage Facility
The Compact Bypass control structure (across the Restoration Flow path) includes a fish passage facility. The fish passage facility would be necessary to provide passage during water deliveries. The design of the fish passage facility is a vertical slot ladder with a sloped bottom, with approximately 12H:1V slope, 12 feet of drop across the fish passage facility, and approximately 3 feet of flow depth. Fish would only pass through this facility when deliveries are occurring to Mendota Pool, approximately 5 percent of the time when fish could be present. Approximately 95 percent of the time, fish would migrate through the Compact Bypass control structure bays under the open gates.

Drive 10 ½ Crossing
The Compact Bypass channel would cross existing Drive 10 ½, which provides access for the operations and maintenance of Mendota Dam. To continue the current level of access, the road would be rerouted along the bypass channel levees and cross the head of the bypass channel at the proposed Compact Bypass control structure. A road deck would also be provided over the fish passage facility adjacent to the control structure. The road would be designed for HS-20/HL-93 loading (e.g., sufficient to allow transport of a 25-ton maintenance crane to Mendota Dam).

Columbia Canal Facilities
The Columbia Canal water intake facility would be located in Mendota Pool, and likely would consist of 15-foot-wide, 7-foot-tall bays, with a bar screen to prevent aquatic vegetation entering the siphon. The extensive intake area would be required to maintain appropriate velocities and minimize sediment and vegetation issues. Intake bays would be 7 feet tall to account for 5 feet of subsidence. Existing water surface elevations in Mendota Pool would rise to approximately 2 feet above the intake crest elevation. The bar screen would be cleaned by an automatic trash rake. A sediment sump would be provided in the center bay to allow for sediment removal. The top of the intake facility would be covered with grating to allow for easy access for maintenance.

The Columbia Canal siphon would cross underneath the Compact Bypass channel from the intake facility on Mendota Pool to the pumping plant located near the existing Columbia Canal, approximately 1,000 feet. The siphon would be two adjacent 4-foot by

6-foot concrete box culverts, that would be buried a minimum of 5 feet below the low flow channel in the Compact Bypass. The discharge facility for the Columbia Canal siphon would be located where Drive 10 ½ crosses the Columbia Canal, on the north side of the future Compact Bypass (Figure 2-5). The pumping plant would be located adjacent to this facility. The Columbia Canal intake facility and pumping plant would be constructed with SCADA (supervisory control and data acquisition) capability, but able to be manually operated as well. The pumping plant would include a steel plate door and cinder block walls and would be enclosed within a fenced and gated area to minimize vandalism.

Electronics Building

A separate, approximately 12-foot by 10-foot electronics building would house power controls for trash rack cleaning systems, fish monitoring equipment, SCADA, etc. The building would be located adjacent to the Columbia Canal pumping plant, or on the other side of the Compact Bypass near the Mendota Pool control structure. The building would include a steel plate door and cinder block walls and would be enclosed within a fenced and gated area to minimize vandalism.

Mendota Pool Fish Screen

A fish screen may be included adjacent to the head of the Compact Bypass, at the Mendota Pool Control Structure, where water deliveries would be diverted from the river to Mendota Pool, if appropriate. The fish screen would keep or return out-migrating juvenile salmon to the Compact Bypass (the path of Restoration Flows) during water deliveries. The Compact Bypass structures are only operated for Exchange Contractor diversions in summer months in highly infrequent dry years or during flood flow deliveries, when flows split several times before entering Mendota Pool and fish survival through the bypasses is high.

The screen would be designed to pass flow up to 2,500 cfs. The type of fish screen could be a fixed flat plate in "V" configuration, vertical flat plate, inclined flat plate, cone, or cylindrical screens. Depending on the design type, the fish screen facility may include trash racks, stainless steel wedge wire fish screens, flow control baffle systems behind the screens, screen cleaning systems for the trash racks and screens, bypass flow control weirs, fish-friendly pumps, and/or fish bypass pressure pipelines. The trash racks would be installed at the entrance to the screen structures to protect screens from trash, logs, and other large debris.

Approach, sweeping, and bypass entrance velocities would be kept within established fish screen criteria (NMFS 2008). Flow through the fish screens may be controlled by baffles behind the fish screens. Cleaning of the screens would be accomplished using an automated brush system. Electric power would be needed for fish friendly pumps, if included, and screen cleaning systems. Operation of the fish screens would include methods to reduce predation of juvenile fish (e.g., noise systems to scatter predators, netting, and periodic draining of the screen return pipes).

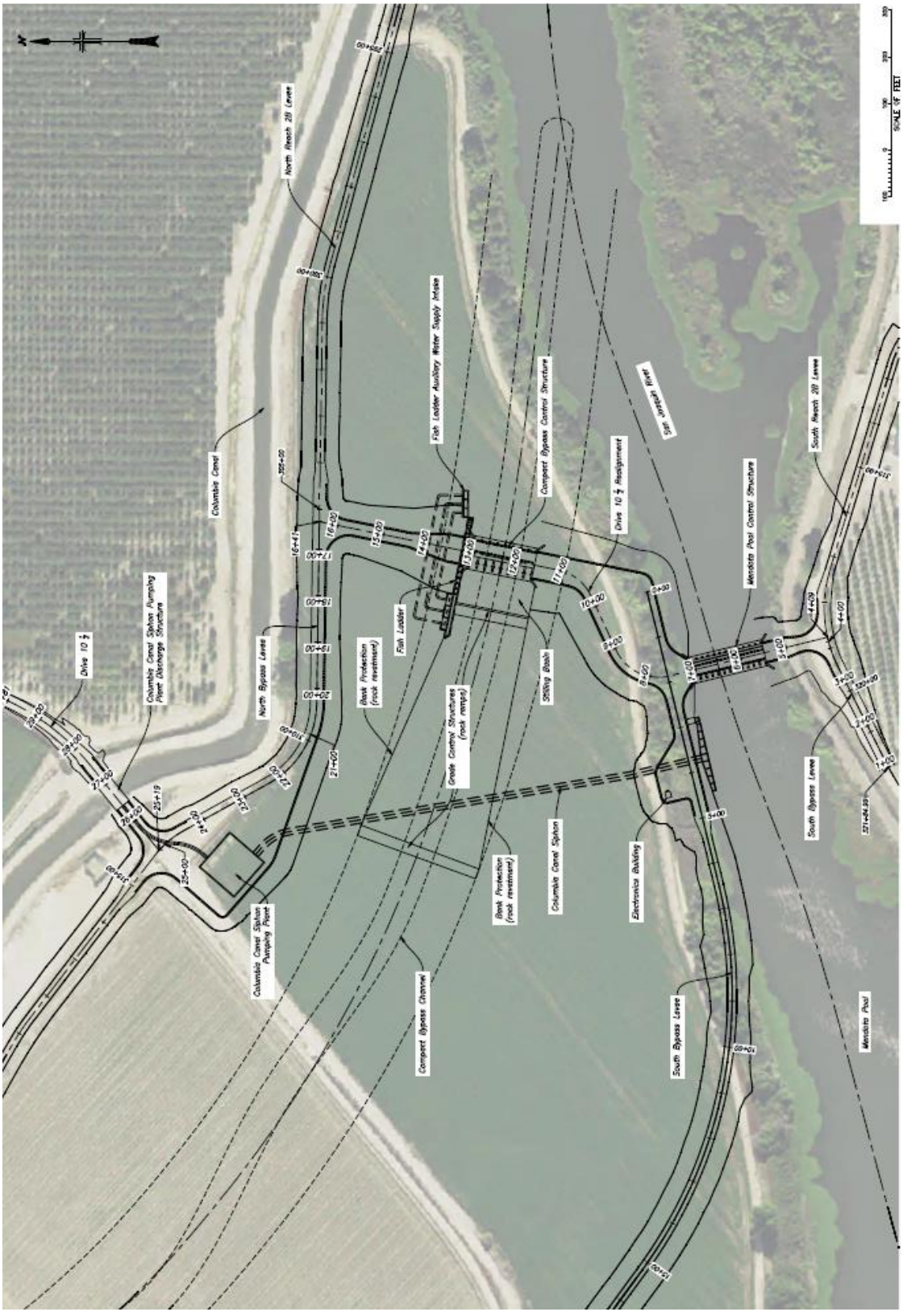


Figure 2-5.
Preliminary Site Plan for the Compact Bypass Structures

Fish Passage Criteria

The Project includes provision of fish passage at structures for salmonids and other native fish. These structures can include fish screens, fish passage facilities, grade control structures, and bifurcation structures (under certain flows). The designs for structures with fish passage components would be based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001). Specifically, the Project would provide suitable hydraulic conditions for passage of up-migrating adult salmonids, out-migrating juvenile salmonids, and inter-reach migration of other native fish between Reach 2A and Reach 3. Suitable hydraulic conditions include those conditions which the species is physically capable of passing and do not cause undue stress on the animal. The passage features would be designed to cause no physical harm to fish. The design criteria are structured around the life stages of the target anadromous species and the timing of the runs for upstream movement of adult fall and spring run Chinook and winter steelhead and the downstream movement of juvenile life stages spawned from these runs. Recommended criteria are based on a combination of swimming ability of the fish species as reported in scientific papers and criteria in agency design guidelines. Recommended design criteria to provide for successful fish passage (depth of flow, suitable velocity ranges and jump height) are provided in Table 2-1. The design criteria for a particular species would be met over the associated flow range (minimum flow to maximum flow). For sturgeon, lamprey, and other native fish, criteria would be met for some portion of the applicable fish migration period.

The Project includes facilities that fish would encounter or need to pass to migrate between Reach 3 and Reach 2A (from downstream to upstream). The need for fish screens at diversion facilities will be further evaluated as Project planning and design continues. Each structure represents a potential stressor for adult salmon and potential predation site for juvenile salmon. However, each structure would be designed to perform according to fish passage and screening design criteria. In addition, the channel and floodplain elements of the Project incorporate riparian areas to provide cover, woody material, and velocity variability, while the design footprint allows sufficient space to accommodate channel structure variability, all of which may help to reduce stress and predation.

Table 2-1.
Fish Passage Design Criteria

Species	Life-stage	Migration Timeframe	Frequency	Minimum Flow	Maximum Flow	Maximum Velocity [1]	Minimum Water Depth [2]	Maximum Jump Height [3]	Minimum Pool Depth
			years	cfs	cfs	fps	feet	feet	feet
Chinook salmon	Adult	Spring and fall pulse	All years except CL	115 [4]	4,500	4.0	1.2	1.0	[5]
	Juvenile (downstream)	Nov-May	All years except CL	85 [6]	n/a	n/a	1.0	n/a	[5]
Steelhead	Adult	Spring and fall pulse	All years except CL	115 [4]	4,500	4.0	1.2	1.0	[5]
	Juvenile (downstream)	Nov-May	All years except CL	85 [6]	n/a	n/a	1.0	n/a	[5]
Sturgeon	Adult	Spring pulse	W and NW years	-	-	6.6	3.3	None – swim through	n/a
Lamprey	Adult	Spring pulse	All years except CL	-	-	[7]	[7]	[7]	n/a
Other native fish	Adult	Spring pulse	W, NW, and ND years	-	-	2.5 [8]	1.0 [8]	None – swim through	n/a

W = wet; NW = normal wet; ND = normal dry; CL = critical low

[1] Recommended maximum velocities shown are for grade control structures or structures with short longitudinal lengths based on *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001). For structures with longer lengths (e.g., culverts and bifurcation structures under certain conditions), maximum velocities would be developed based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[2] Minimum water depth criteria based on 1.5 times body depth or 1 foot depth, whichever is greater based on *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[3] Maximum jump height criteria based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[4] Based on Exhibit B lowest flow in the fall spawning period (starts Oct 1) for the desired frequency; all Spring Pulse Flows are higher.

[5] Pool depths to be based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[6] Based on lowest flow within desired migration period for the desired frequency.

[7] Lamprey designs to be based on criteria in *Best Management Practices for Pacific Lamprey* (USFWS 2010a)

[8] Based on hardhead and hitch

Floodplain and Riparian Habitat

The Project includes a mixture of active and passive riparian and floodplain habitat restoration and floodplain compatible agricultural activities. Active restoration planting of native riparian species would occur along both banks of the low flow channel of the river up to 450 feet from the bank, and would be irrigated with a planting density of approximately 545 plants per acre. In accordance with the Rearing Habitat Design Objectives, it would include native species that would provide shade and reduce air

temperatures to help minimize water temperatures, provide large woody debris and organic matter needed to provide habitat and food, and help stabilize the low-flow channel. The irrigated area would include 16-foot spacing between irrigation lines for equipment access and 5-foot spacing along irrigation lines to maximize density. Forbs and grasses would be planted as plugs or transplants in between irrigation lines in order to encourage structural diversity. Some areas may be passively revegetated by creating riparian establishment areas that provide a riparian seed bank of native species. The remaining areas would be seeded with native grasses and forbs to minimize erosion and to help control invasive species. These upland areas will be broadcast seeded or drilled with incorporation as necessary. Active revegetation activities would likely include a combination of seeding, transplanting, and pole/live stake plantings. Plantings may be designed as either clusters of trees and shrubs with larger areas of seeded grasses and forbs or as dense forests. Spacing and alignment of plantings would take into account species growth patterns, potential equipment access needs for monitoring and maintenance, and desired future stand development. Passive restoration would occur in areas that rely on Restoration Flows for additional vegetation recruitment. Natural riparian recruitment (passive restoration) would promote continual habitat succession, particularly in areas where sediment is deposited or vegetation is removed by natural processes. Table 2-2 lists the species that are likely to be planted or seeded during active restoration, and is draft and subject to change. Emergent wetlands and water tolerant woody species of riparian scrub would be selected for development within the main channel, woody shrubs and trees with an herbaceous understory would be selected for development along the main river channel banks, and bands of other habitat types (e.g., grasses) would be selected for development at higher elevations along the channel corridor. Active vegetation restoration would occur following construction and these areas would be irrigated and managed as necessary during the establishment period. Phased implementation of active vegetation restoration at strategic locations could occur concurrently with phased implementation of construction and physical infrastructure.

Agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) could occur on the floodplain in previous agricultural areas outside of State-owned and public trust lands. Growers would be required to leave cover on the ground and would be required to develop and implement a water quality plan, approved by the Reclamation, to meet current water quality standards for aquatic resources and coldwater fisheries, as well as meeting the specific needs for anadromous fishes in adjacent and downstream areas. If grazing occurs the lessee would be required to develop and implement a Grazing Plan, approved by Reclamation, in addition to the Water Quality Plan.

Table 2-2.
Potential Species for Revegetation

Common Name	Scientific Name	Vegetation Type
Riparian Shrub and Wetland Areas (0 to 2 feet above summer baseflow elevations)		
Fremont cottonwood	*Populus fremontii*	Tree
Gooding's willow	*Salix gooddingii*	Tree
box elder	*Acer negundo*	Tree
Oregon ash	*Fraxinus latifolia*	Tree
red willow	*Salix laevigata*	Tree
yerba mansa	*Anemopsis californica*	Forb
common buttonbrush	*Cephalanthus occidentalis*	Shrub
baltic rush	*Juncus balticus*	Tule
California blackberry	*Rubus ursinus*	Shrub
sandbar willow	*Salix exigua*	Shrub
arroyo willow	*Salix lasiolepis*	Shrub
shining willow	*Salix lucida ssp. Lasiandra*	Tree
blue elderberry	*Sambucus nigra ssp. caerulea*	Shrub
meadow barley	*Hordeum brachyantherum*	Grass
Creeping wildrye	*Elymus triticoides*	Grass
dwarf barley	*Hordeum depressum*	Grass
Douglas' sagewort	*Artemisia douglasiana*	Forb
Great Valley gumweed	*Grindelia camporum*	Forb
Western goldenrod	*Euthamia occidentalis*	Forb
meadow barley	*Hordeum brachyantherum*	Grass
Creeping wildrye	*Elymus triticoides*	Grass
dwarf barley	*Hordeum depressum*	Grass
Dense Riparian Areas (2 to 8 feet above summer baseflow elevations)		
meadow barley	*Hordeum brachyantherum*	Grass
Creeping wildrye	*Elymus triticoides*	Grass
dwarf barley	*Hordeum depressum*	Grass
Douglas' sagewort	*Artemisia douglasiana*	Forb
Great Valley gumweed	*Grindelia camporum*	Forb
Western goldenrod	*Euthamia occidentalis*	Forb
meadow barley	*Hordeum brachyantherum*	Grass
creeping wildrye	*Elymus triticoides*	Grass
red willow	*Salix laevigata*	Tree
shining willow	*Salix lasiandra var. lasiandra*	Tree
arroyo willow	*Salix lasiolepis*	Shrub
box elder	*Acer negundo*	Tree
narrow-leafed milkweed	*Asclepias fascicularis*	Herb
coyote brush	*Baccharis pilularis*	Shrub
buttonbush	*Cephalanthus occidentalis*	Shrub
blue wildrye	*Elymus glaucus*	Grass
valley oak	*Quercus lobata*	Tree
golden currant	*Ribes aureum*	Shrub
California wildrose	*Rosa californica*	Shrub
California blackberry	*Rubus ursinus*	Shrub

Table 2-2.
Potential Species for Revegetation

Common Name	Scientific Name	Vegetation Type
Gooding's willow	*Salix gooddingii*	Tree
blue elderberry	*Sambucus nigra ssp. caerulea*	Shrub
Upland Areas (greater than 8 feet above summer baseflow elevations)		
creeping wildrye	*Elymus triticoides*	Grass
California wildrose	*Rosa californica*	shrub
narrow-leafed milkweed	*Asclepias fascicularis*	Forb
valley oak	*Quercus lobata*	Tree
golden currant	*Ribes aureum*	shrub
quail bush	*Atriplex lentiformis*	Forb
western goldenrod	*Euthamia occidentalis*	Forb
small fescue	*Festuca microstachys*	Grass
purple needlegrass	*Stipa pulchra*	Grass
yarrow	*Achillea millefolium*	Forb
Spanish lotus	*Acmispon americanus var. americanus*	Forb
Great Valley gumweed	*Grindelia camporum*	Forb
telegraph weed	*Heterotheca grandiflora*	Forb
tomcat clover	*Trifolium willdenovii*	Forb

Existing Native Vegetation Protection

The existing native vegetation in the Action Area designated to remain would be temporarily fenced with orange snow fencing (or equivalent) to prevent entry, driving, parking, or storing equipment or material within these areas during construction. Existing vegetation would be left in place or only minimally trimmed to facilitate access and work at the site. The existing soil is suitable for growing all of the desired native plants. In order to maximize plant growth and planting success, existing soil and topsoil would be preserved, and in areas where excavation is required, would be stockpiled to later place on top of the excavated bypass channel for planting. If the soil contains invasive non-native seed or fragmented stems and rhizomes, it would not be preserved. Native vegetation likely to provide a good seed source or wildlife habitat will be preserved where practicable.

Invasive Species Control

Invasive, non-native species would be removed from the Action Area during the installation, plant establishment and maintenance periods. Invasive species management would consist of removal of the most invasive non-native species within the reach such as giant reed grass (*Arundo donax*), perennial pepperweed (*Lepidium latifolium*) and poison hemlock (*Conium maculatum*). Invasive species management would also include removal of other invasive species that are currently found in upstream reaches and may eventually colonize in the Action Area such as red sesbania (*Sesbania punicea*), salt cedar (*Tamarix* spp.), and Chinese tallow (*Sapium sebiferum*). Invasive plant removal techniques may

include mechanical removal, root excavation, hand pulling, mowing, disking, controlled burning, grazing, aquatic-safe herbicides, or a combination of techniques as appropriate.

The SJRRP has an existing invasive species management plan, and completed the *Invasive Vegetation Monitoring and Management Environmental Assessment* in 2012 that describes the methods that would be followed for Reach 2B invasive species removal. Details are provided in Section 2.2 of the Environmental Assessment (SJRRP 2012).

Temporary Irrigation System and Water Supply

Proposed plantings that are wetland species or borderline wetland species would need regular aboveground irrigation (typically April through October) during their establishment period (typically 3 to 5 years depending on rainfall conditions and the plants' growth rates and vigor). The amount of water needed is estimated to be approximately 2.4 acre feet per year. An extensive temporary aboveground irrigation system, such as aerial spray, would provide water for the plants several times a week during the hot months of the year. If an aerial spray irrigation system is installed, the irrigation distribution piping would be installed aboveground and anchored to the ground so that it would not be damaged during high flows inundating the floodplain. If an aerial spray system is used, sprinkler heads would likely be installed on braced standpipes so that their irrigation stream would not be blocked or diverted by growing vegetation. The irrigation system would be disassembled and removed at the end of the establishment period.

The Program would pursue options for irrigation water supply, including groundwater wells or water pumped from the river with portable, skid-mounted, diesel- or gas-powered pumps and stored in tanks. Additionally, purchases from willing sellers may be required to withdraw water from the river or other nearby water sources (e.g., Mendota Pool). If water is pumped from the river, the amount of water diverted will be controlled so that river water temperatures do not increase and passage for salmonids is not impaired. The diversion from the river would also be screened if necessary to prevent entraining juvenile salmonids.

Maintenance and Monitoring

Maintenance and monitoring would be conducted following revegetation for 10 years, yearly for the first 3 years, every other year until year 7, and a final assessment at year 10. Monitoring activities include monitoring of the installed plants for drought stress and overwatering, identification of competitive, invasive, non-native species for removal, identification of diseased, dead and washed-out plants, irrigation system function, and identification of trash and debris for removal. Maintenance activities would include controlling invasive plant species, mitigating animal damage, irrigation, replacement of diseased, dead, or washed-out plants, irrigation system maintenance, and removal of trash and debris. Management of invasive species would ensure that the desirable vegetation dominates the landscape and provides habitat diversity, productivity, and sustainability. Animal damage to newly planted or germinated vegetation could be alleviated with screens, aquatic-safe chemical deterrents, or other exclusion methods.

Temporary irrigation of wetland and riparian areas during establishment, especially if precipitation is below normal, would facilitate root system development into the alluvium groundwater. Irrigation infrastructure would need to be installed and remain in place for at least 3 years. The irrigation system would be used each year on a biweekly to daily basis during the hot part of the growing season. The landscape contractor would be required to regularly check the integrity of the system and make sure that system is not clogged or damaged. Upland areas would be seeded in the fall before the winter precipitation season, and it is likely that these areas would become established to an acceptable level after one season of normal precipitation. (There may be more than one active revegetation effort required to establish a dense riparian corridor necessary to naturally stabilize the Compact Bypass channel.) Removal of trash and debris from the restoration areas on both sides of the river would be performed on an as-needed basis for the duration of the entire monitoring period. Monitoring is anticipated in years 1, 2, 3, 5, 7, and 10 after planting. After 10 years of monitoring and replacement as necessary, vegetation would be established.

Long-Term Management

While it is not anticipated that major management actions would be needed, the key objective of management would be to monitor and identify any environmental issues that arise, and use adaptive management to determine what actions would be most appropriate to correct these issues.

The general management approach to the long-term maintenance of the floodplain areas would be to maintain quality habitat for each natural resource, with on-going monitoring and maintenance of key environmental characteristics of the entire floodplain area within the reach. An adaptive management approach would be used to incorporate changes to management practices, including corrective actions as determined to be appropriate by Reclamation and/or the California State Lands Commission. Adaptive management includes those activities necessary to address the effects of climate change, fire, flood, or other natural events, force majeure, etc.

The expected long-term management needs (and activities necessary to maintain any on-site mitigation sites) would be:

- Resource specific long-term maintenance activities and other general maintenance activities such as exotic species elimination, grazing management, clean-up and trash removal,
- Infrastructure management such as gate, fence, road, culvert, signage and drainage-feature repair, and
- Other maintenance activities necessary to maintain the riparian and floodplain habitat quality.

These activities are expected to continue for the life of the Project.

Water Deliveries

The Project includes a diversion at the head of the Compact Bypass – the Mendota Pool control structure – for making up to 2,500 cfs in water deliveries from the San Joaquin River to Mendota Pool. This diversion would directly deliver water from the river to Mendota Pool without the need for a canal. Water deliveries to the Pool would include diversion of Friant Dam releases that are meant to satisfy the Exchange Contract as well as diversion of San Joaquin River flood flows up to 2,500 cfs if there is demand in Mendota Pool.

When water deliveries occur, the gates at the Compact Bypass structures would be manipulated to control flows into the Compact Bypass and allow flows into Mendota Pool. Since the Mendota Pool operating elevation is several feet higher than the bottom of the Compact Bypass channel, operation of the gates would include backwatering a portion of the San Joaquin River upstream of the Compact Bypass structures. The extent of the backwater is anticipated to be similar to the extent of the Mendota Pool backwater under existing conditions (i.e., upstream to approximately the existing San Mateo Avenue crossing). Up-migrating fish passage from the Compact Bypass into Reach 2B would occur through the Compact Bypass fish passage facility during water deliveries. The Mendota Pool fish screen, if determined necessary, would capture out-migrating fish entering the diversion and return them to the Compact Bypass. Sufficient flow to support adult and juvenile fish passage through the Compact Bypass fish passage facility would be maintained during water delivery operations during fish migration periods.

Floodplain and Channel Grading

Floodplain and channel grading would be included with the Project. Floodplain and channel grading would include any or all of the following at locations to be determined during design:

- Creating high-flow channels through the floodplain to increase the inundation extent at lower flows.
- Connecting low-lying areas on the floodplain to the river to prevent stranding.
- Removing high areas where flow connectivity would be impeded (e.g., farm road grades).
- Excavating floodplain benches adjacent to the river channel to increase the frequency of inundation.
- Creating greater inundation depth diversity on the floodplain.
- Excavating channels in portions of the Action Area to tie into existing elevations upstream and downstream of the Project or to create desirable sediment transport conditions.

Floodplain and channel grading can provide benefits to salmon and other native fish by allowing inundation to occur at lower flows, by distributing suitable rearing habitats further into the floodplain, by connecting rearing habitat to primary production areas (shallow water habitat), by providing escape routes during receding flows, and by confining flows to a deeper, narrower channel to limit temperature increases.

Figures 2-6 and 2-7 provide an example of how various floodplain grading approaches can be used to expand inundation on the floodplain. The Existing Channel graphic shows an example of how inundation would occur without floodplain grading. The Lowered Floodplain example shows an example of how floodplain benches, lowered areas to either side of the channel, could be used to inundate floodplain areas at lesser flows. This graphic also shows how lowered floodplains could affect inundation at moderate flows. The High Flow Channels graphic shows an example of how high flow channels, side channels that initiate at larger flows than the main channel, could be used to expand floodplain inundation.

Levees

Set-back levees would be required within the Project limits to contain Restoration Flows. While the height and footprint of the levees vary according to their location along the channel and the ground elevation, the capacity, freeboard, and cross-section would be consistent. Localized backwater and redirection effects at Project structures would be considered during design of levee heights. Levees would be designed to maintain at least 3 feet of freeboard on the levees at 4,500 cfs. Levee design would be based on the U.S. Army Corps of Engineers (Corps) *Engineer Manual 1110-2-1913 Design and Construction of Levees* guidelines (Corps 2000) and *Engineer Technical Letter 1110-2-583 Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams and Appurtenant Structures* (Corps 2014). The design includes seepage control measures, maintenance roads, and inspection and drainage trenches to direct off-site drainage where required.

Levee alignments maintain a 300-foot buffer zone, where appropriate, between the levee and river channel to avoid impact to levees over time due to potential channel migration. In areas where a minimum 300-foot buffer zone between the main river channel and levee cannot be maintained, bank revetment would be incorporated in the design.

New levees would be designed to have sideslopes of 3 horizontal to 1 vertical (3H:1V) on the waterside and landside. A maintenance road and surface drainage ditch would also be included. Surface drainage ditches would only be intended to capture and direct runoff; they are not intended to address groundwater seepage or through-levee seepage. By following the Corps standards, all levees would have an inspection trench or would include a cut-off wall. Additional data collection and analysis would be required to verify the groundwater conductivity rates of the *in situ* and borrow soils and to finalize the design of seepage control measures.

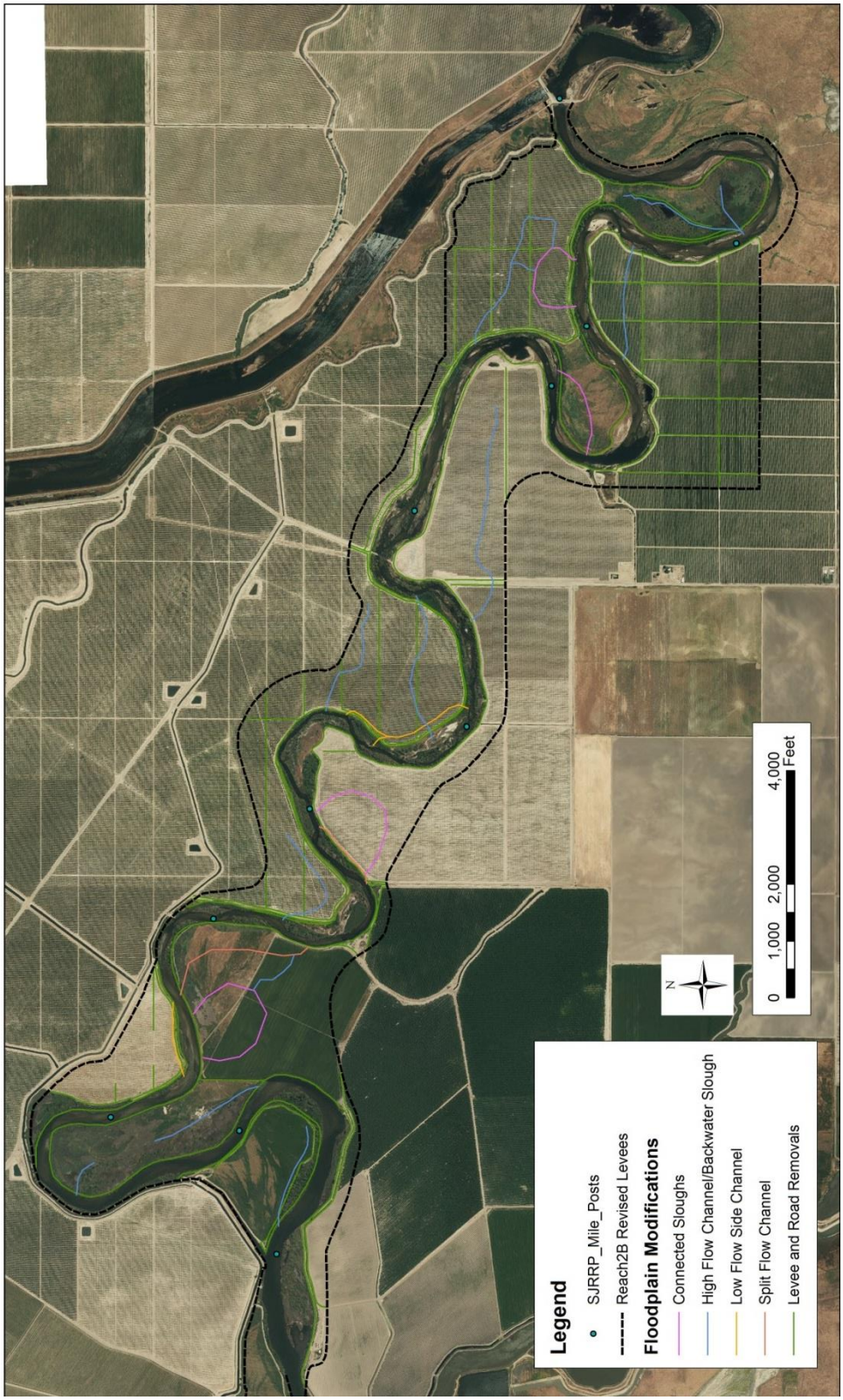


Figure 2-6.
Example Floodplain Grading Approach – Plan View

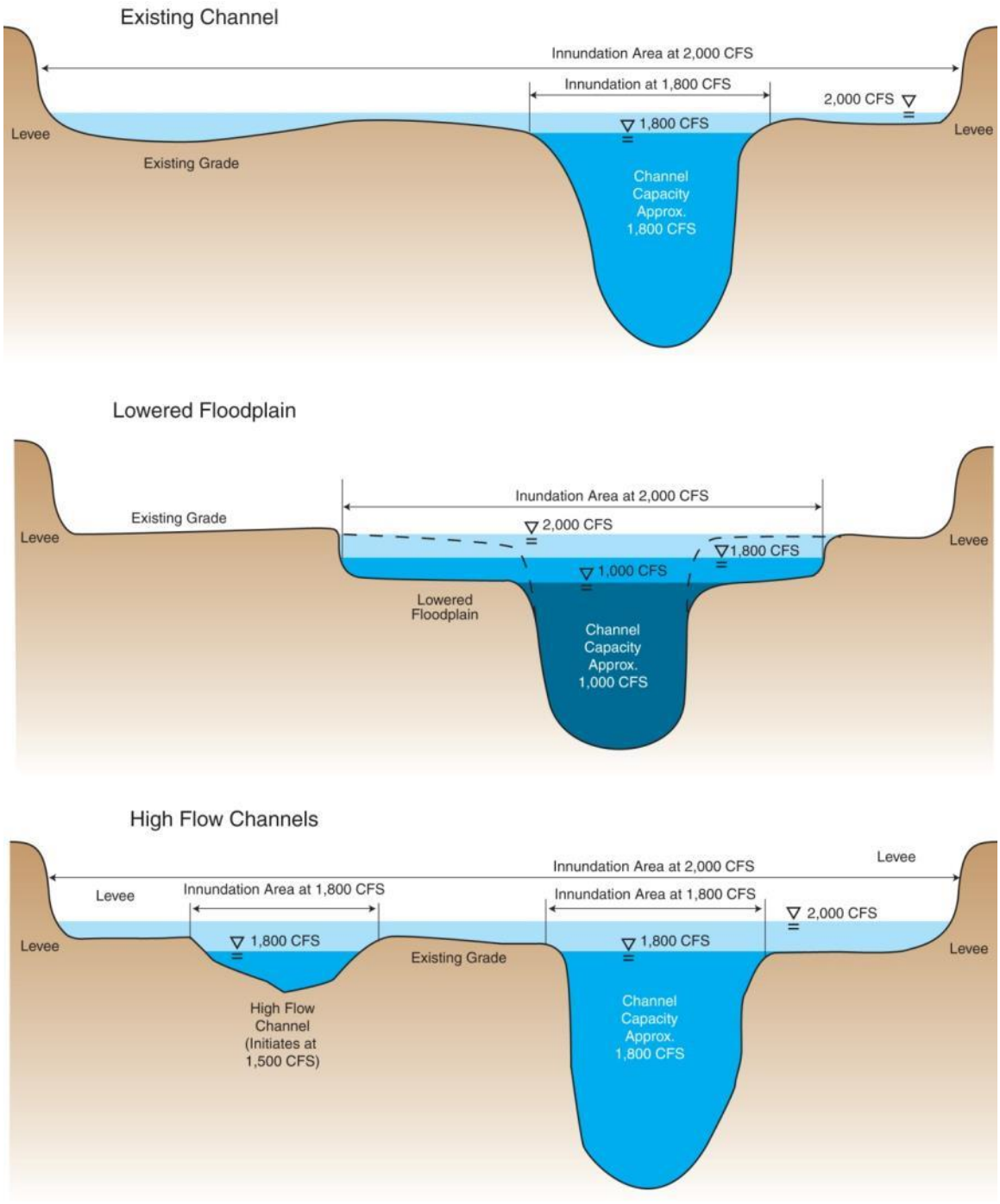


Figure 2-7.
Example Floodplain Grading Approaches – Cross Section

The levee alignments shown on the plan views of the Project may be adjusted during final design. Adjustments may be made for several reasons, including: to improve flow conditions on the floodplain; to improve habitat conditions on the floodplain; to reduce potential erosion; to accommodate adverse soil conditions; and to avoid existing

infrastructure. The final levee alignments will be within the impact areas evaluated in this document.

Levee and Structure Protection

The Project generally provides a minimum 300-foot buffer between the existing channel and the proposed levee, where appropriate and feasible. For locations where the 300-foot buffer was not included, erosion protection for the levee in the form of revetment would be included. The revetment would be riprap material covered by soil and then planted to provide a vegetated surface. However, softer approaches, such as bioengineering or dense planting, may be considered during design depending on velocities and scour potential. Locations that require revetment include areas where the 300-foot buffer was not included due to the proximity of existing infrastructure, near the proposed structures, and along river bends less than 300 feet from the levee in areas that have the potential to erode, as determined in the design process.

Channel Bank Protection

The Project could include riparian vegetation, rock vanes, woody materials, revetment, or other measures designed to protect channel banks from erosion. Bank protection measures would be installed in locations susceptible to and likely to experience bank erosion.

Removal of Existing Levees

Removal of portions of the existing levees is included and designed to expand the inundation area of the floodplain out to the proposed levees and improve connectivity between the river channel and proposed floodplain. The locations of existing levee removal would be based upon the hydraulic performance of the channel and floodplain. In certain locations, however, highly desirable existing vegetation (native and sensitive vegetation communities that can serve as seed banks for future vegetation communities) can be found on the existing levees. Where hydraulic performance and connectivity of the floodplain would not be negatively affected, portions of the existing levees with highly desirable vegetation would remain in place. Materials that are removed from the existing levees would likely be reused within the Action Area.

Seepage Control Measures

Seepage of river water through or under levees is a concern for levee integrity and adjacent land uses. Through-seepage, water that seeps laterally through the levee section, would be addressed through proper levee design and construction (e.g., selection of low porosity materials and proper compaction). Under-seepage, water that seeps laterally by travelling under the levee section, is primarily controlled by the native soils beneath the levee and seepage control measures would be included where native soils do not provide sufficient control. Seepage control measures would be included, as necessary, in the Project in areas where under-seepage is likely to affect adjacent land uses. Seepage control measures could include: cut-off walls, interceptor drains or ditches, seepage

wells, seepage berms, seepage easements and other measures that can be implemented within the Action Area.[2]

Infrastructure for Fish Monitoring

The designs for control structures, fish passage facilities, and fish screens include security fences and gates, mounting hardware, and electrical supply in order to conduct fish monitoring activities. Fish monitoring activities are expected to include connections for PIT (passive integrated transponder) tag arrays at the Compact Bypass control structure and the San Joaquin River control structure at the Chowchilla Bifurcation Structure and Didson camera mounts at the edges of the Compact Bypass control structure and San Joaquin River control structure, as well as a vault and connection for a visual fish imaging technology in the Compact Bypass fish ladder. Acoustic tagging receivers can be placed at various locations within the reach and anchor points will be provided at structures, where appropriate. Construction, operations, and maintenance of the fish monitoring infrastructure are included as part of this Project. The fish monitoring activities themselves are not included in this Project, and will be addressed in subsequent environmental analysis, as appropriate.

Existing Infrastructure Relocations or Floodproofing

Existing infrastructure (see Figure 2-8) such as groundwater wells, pumps, electrical and gas distribution lines, water pipelines, and canals located in the Action Area require relocation, retrofitting, or floodproofing to protect the structures from future Restoration Flows and increased floodplain area. Although the relocations, retrofits, and floodproofing are included as part of the Project, the actual relocation, retrofit, or floodproofing work may be performed by others. As a result of the Project, some existing infrastructure may be unnecessary in the future (e.g., power lines that service pumps relocated to outside the Project limits). In these cases, infrastructure may be demolished or abandoned in place.

Specific plans for relocations, where known, are identified below:

- Natural gas pipelines will be buried lower in the soil column to avoid interference with Project activities.
- Water pipelines will be either buried lower in the soil column or relocated outside of levees but within the action area.
- City of Mendota's three groundwater wells will remain in place. Two of them are outside of the levee alignments and will remain unaffected. The third well is

[2] A cut-off 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 and interceptor ditches are surface ditches, both of which intercept groundwater and redirect it to a discharge point. Because the drains and ditches have lower resistance to flow, the groundwater table can be kept artificially low in areas near the pipe or ditch. The discharge point could include a lift pump to move drained water over the levees, or it could be discharged directly to a surface water body (e.g., agricultural canal). 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.

immediately adjacent to the San Joaquin River and will be floodproofed, with the adjacent levee extending to protect the well.

- The Mowry Bridge, which holds the city of Mendota's water pipeline, will be replaced for construction access and the water pipeline will be replaced across the new bridge.

Electrical and Gas Distribution
Approximately 48,500 feet of electrical distribution lines and 11,000 feet of gas distribution lines were identified for possible relocation. Information from Pacific Gas and Electric Company was available for portions of the area in Geographic Information System (GIS) shapefile format and was supplemented by field data. At the current level of design, it was assumed that a portion of the existing electrical and gas distribution lines found within the Action Area would need to be replaced and/or excavated and buried lower in the soil column. Three gas pipelines are buried under the San Joaquin River in this reach. They will need to be re-buried deeper or floodproofed. This may involve trenching and excavation along the pipeline length, within and outside of the future floodplain area to re-bury it deeper in the soil column below any potential impacts from floodplain grading within the Action Area.

Canals and Drains
Approximately 31,500 feet of canals were identified for possible relocation. On-farm canals and drains were visible on the light detection and ranging (LiDAR) imagery (CVFED 2009) and/or identified during on-site field meetings with landowners were quantified. No canals or drains outside the Project footprint have been identified for redesign. Some portions of canals and drains could be discontinued in the future; the extent of discontinued and replaced canals will be considered during landowner negotiations. No subsurface drains were able to be quantified; however, some are believed to exist within the area.

Lift Pumps
Ten lift pumps were identified for possible relocation. Lift pumps visible on the LiDAR imagery (CVFED 2009) or noted in the CalFish Passage Assessment Database (CalFish 2014) were assumed to require relocation to new facilities on the edge of the proposed levees. A pilot channel dug from the low flow river channel to the intake of the relocated pumps was also assumed. Locations in the CalFish Passage Assessment database were confirmed using the LiDAR imagery when possible.

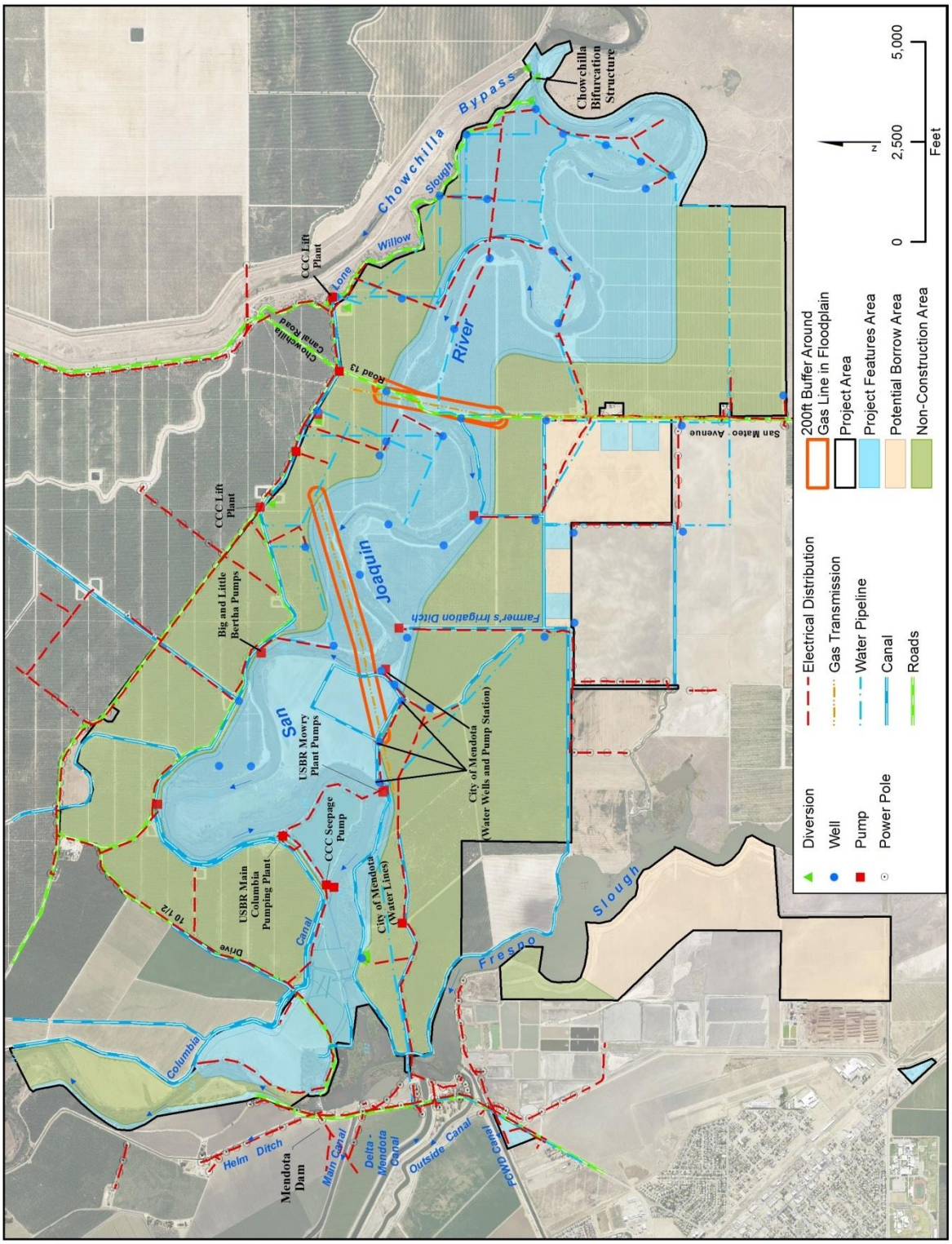


Figure 2-8.
Existing Infrastructure in the Action Area

Groundwater Wells
Thirty-two (32) groundwater wells were identified for possible flood-proofing or relocation, including the city of Mendota groundwater wells. Wells were identified within the area using aerial photography. During design, the DWR well database would be consulted to find abandoned wells that have not been destroyed, so that these old wells could be filled in to prevent a flood water conduit to the groundwater. A formal well canvas would also be conducted. Floodproofed wells would be provided with year-round vehicular access via a raised roadbed across the floodplain. The roadbed could include multiple culverts to support floodplain connectivity, depending on the length of the access road and its effect on floodplain flows. Wells relocated by the Project would provide equal utility. Wells taken out of service by the Project would be abandoned in accordance with U.S. Environmental Protection Agency (EPA), DWR, and/or local regulations.

The levee alignment has been designed so that two of the city of Mendota's three groundwater wells will be outside of the levees and floodplain area, and unaffected by the Project. The remaining well is inside the levee and right next to the river, and will be flood-proofed. The setback levee will be extended around the groundwater well to allow access and prevent flooding.

Oil and Gas Wells
Two closed or active oil and gas wells have been identified within the Action Area for potential closure, relocation, or buyout. If active oil and gas wells cannot be avoided, the destruction or closure of those wells would be conducted in accordance with the California Department of Conservation, Division of Oil, Gas, and Geothermal Resources regulations.

Other Utilities
Other infrastructure was identified within the impacted areas. These other facilities include high voltage transmission lines and water pipelines. High voltage transmission lines are assumed to be high enough to not be impacted. Water pipelines were quantified from existing maps and discussions with landowners. Water pipelines may be relocated or abandoned depending on their future use requirements. The city of Mendota has a water pipeline from their three groundwater wells that crosses Mowry Bridge. This pipeline may need to be modified as the setback levee will cross it, and Mowry Bridge will likely need replacement for construction access. Service line crossings (e.g., gas, water, electrical) would be considered during levee design.

Construction Access
Access for vehicles carrying materials, equipment, and personnel to and from the construction area would be provided via several existing roadways in the Project vicinity (see Figure 2-9). Improvements may be required to upgrade roadways, pavements, and crossings for anticipated construction traffic and loads, provide adequate turning radii and site distances, or to control dust on non-paved roads. Anticipated improvements include:

- Eastside Drive – Approximately 0.6 mile of dirt road starting at Road 10 ½ will likely require overlaying, and the implementation of dust control measures.

- Chowchilla Canal Road/Road 13 – Approximately 0.3 mile of road starting at Eastside Drive will likely require some overlaying and the implementation of dust control measures.
- San Mateo Avenue – Approximately 0.5 mile of gravel and 1.5 miles of oil-dirt road starting at the existing San Joaquin River levees will likely require some overlying and the implementation of dust control measures.
- Bass Avenue Canal Crossings – These crossings may need additional bracing and shoring to ensure that they will be able to support the load of the construction equipment and activities. All the construction equipment on Bass Avenue will be within the legal loads (see note below). This crossing is on the Fresno County replacement list.
- Delta-Mendota Canal Crossing – This crossing may need additional bracing and supports to ensure that it will be able to support the load of the construction equipment activities.
- Mowry Bridge – This bridge will need replacement as it is currently condemned due to beaver activity. It would provide convenient access to the site of the Mendota Pool control structure.

Dust control measures for non-paved roads could include the use of water trucks or dust palliative for dust control or gravel placement where necessary. Legal loads would be used on all roads, and once construction is completed, the roads would be returned to the same condition as they were prior to the Project.

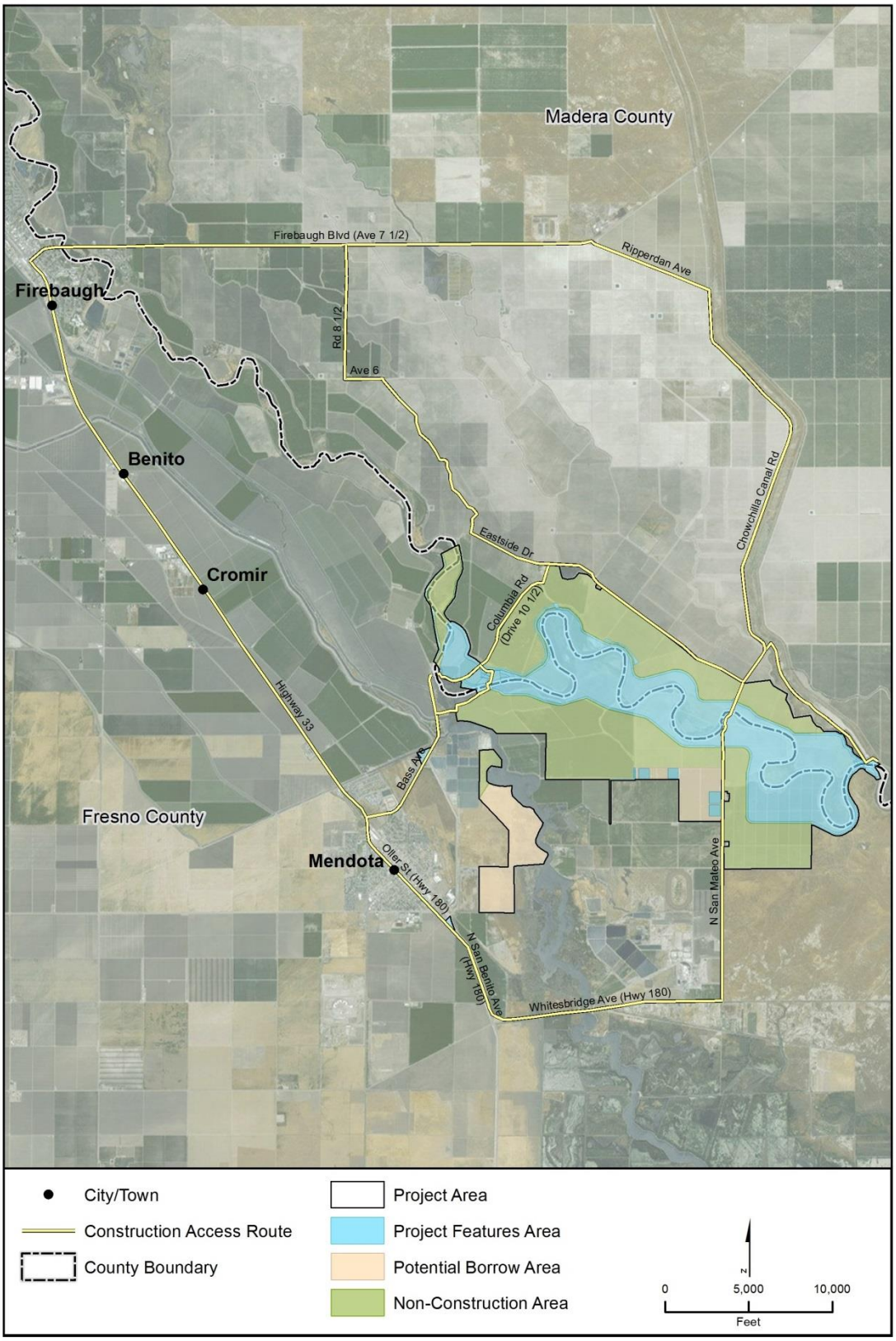


Figure 2-9.
Construction Access Routes

Revegetation of Temporary Disturbance Areas

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. Staging and borrow areas will occur on annual cropland or land purchased for the Project and not on permanent cropland outside of the Project levees.

Structure Design and Subsidence

All design work would be completed in general accordance with Reclamation Design Standards, applicable design codes, and commonly accepted industry standards. Where design criteria are missing for a specific Project element, either Reclamation would be consulted for design specifications or standard engineering practice methods would be employed.

In addition, ground subsidence effects are anticipated to be experienced in the Action Area. Based on subsidence data collected from December 2011 to July of 2015, Reclamation is designing this Project for 5 feet of subsidence, which is equal to the current rate for 25 years. In 2042 (25 years from the start of construction of this Project) the Sustainable Groundwater Management Act requires Groundwater Sustainability Agencies to have reached sustainable levels of withdrawal in all State groundwater basins, presumably meaning subsidence will have stopped. Methods to mitigate this anticipated ground subsidence included are additional freeboard on levees, additional height of control structures and intake facilities, and additional stoplogs or concrete walls to maintain the same low flow elevation after years of subsidence on control structures.

Geotechnical Investigations

Geotechnical investigations are required to evaluate soil suitability for final design of the Project, and may be required to conduct monitoring of seepage after construction of the Project. Geotechnical investigations may include hydraulic conductivity tests, soil sampling, soil salinity testing, installation of monitoring wells, back-hoe pits, Standard Penetration Tests, Cone Penetrometer Tests, or other forms of geotechnical investigations. All of these investigations are included as part of this Project, may occur anywhere within the Action Area, are not limited in time, and do not require subsequent environmental analysis.

Surveys

Biological, cultural resources, and elevation surveys are required to complete final design of the Project and conduct post-Project monitoring. Surveys may include trapping of species, monitoring of vegetation on transects or plots, visual, habitat assessment, reconnaissance, and protocol-level endangered species act surveys, vegetation mapping, bathymetry surveys, elevation surveys, digging of cultural resource inspection trenches, water quality sampling, or any other surveys required for environmental compliance, permitting, design data collection, or monitoring activities. All of these investigations are included as part of this Project, may occur anywhere within the Action Area, are not limited in time, and do not require subsequent environmental analysis. Species-specific

surveys will be conducted by a qualified biologist(s) as described in Section 2.5, Conservation Measures.

Land Acquisition

The approximate amount of additional lands to be acquired to accommodate the floodplain, levees, bypass channel, structures, and borrow was quantified based on parcel data in GIS shapefile format from Fresno and Madera counties. Since remaining portions of parcels that fall outside the Project limits may not be as easily used by the land owners, the entire parcels were considered, where appropriate. The amount of land acquisition for the Project would be 2,900 acres.

Construction Considerations

The total construction timeline for the Project is currently estimated to range approximately from 106 to 157 months (9 to 13 years); the Compact Bypass portion of the Project is expected to be complete in the first 3 years. Opportunities to shorten the overall schedule through construction efficiencies will be studied during the detailed design process.

Soil improvements for possible liquefiable soils may be required to protect proposed structures from damage or failure during an earthquake. All proposed structures would be designed to account for potential liquefaction. Soil improvements could include removing and replacing soils with adequate materials, injecting soil-cement slurry, vibrofloatation, dynamic compaction, structural foundation piles (stone or reinforced concrete), and other techniques.[3]

Flow in the San Joaquin River, operations at the existing Mendota Dam, operations at the Chowchilla Bifurcation Structure, and operation of the existing Columbia Canal must be maintained during construction. The majority of the Compact Bypass channel will be constructed without interruption to the San Joaquin River flow or the Columbia Canal, by conducting the excavation in the dry and constructing the Compact Bypass control structure last.

The construction of the Mendota Pool control structure across the existing river channel would require removable cofferdams in two phases to facilitate the construction without blocking the flow. If flow is present in the river during the construction period, flow would be diverted around the work area via a temporary diversion pipe or canal and fish passage would be provided. Cofferdams include two rows of braced sheet piling filled with dirt for stability and seepage control. The total height of the cofferdam is assumed to be 24 feet of which 12 feet would be above the channel bed. The control structures to be constructed on dry land (e.g., the Compact Bypass control structure) would not require cofferdams.

Stone slope protection (riprap) would be provided on the upstream and downstream slopes of the control structure embankment including some portions of the side slopes of

[3] Vibrofloatation uses a vibrating probe that penetrates the soil and causes the grain structure to collapse and increase the density of the soil. Dynamic compaction involves dropping a heavy weight onto soil to compact it.

the channel itself to prevent scouring. Riprap would be placed on bedding over geotextile fabric. Riprap would be filled with soil and planted with native vegetation.

Construction of the fish screen, which is located in the San Joaquin River (if determined necessary), would require removable cofferdams in two phases to facilitate the construction without blocking the flow. The exception to this is the return/bypass fish pipes and outlet, which would take place in the dry using conventional construction methods. All fish facility structures and pipes with surfaces exposed to fish require additional attention to surface-smoothness.

For construction of the control structures and fish passage facilities, it will be necessary to maintain a minimum flow during construction during fish migration periods; the amount or range of flows during construction has not yet been identified. The construction of the Compact Bypass channel would be undertaken in the dry. The levee between the Compact Bypass and the Mendota Pool would be one of the first components constructed, as it includes a cement-bentonite wall that would assist in dewatering the rest of the site. This cement-bentonite wall would extend around the site of the Compact Bypass control structure on existing land, providing dewatering for the construction of this structure as well. Soil would remain in the location of the Compact Bypass control structure until the entire bypass is graded, levees are constructed, and the bypass is revegetated, at which time the Compact Bypass control structure would be constructed. The pilot channel would be excavated when the Mendota Pool control structure is complete and flows will start passing through the Compact Bypass.

2.2.2 Compact Bypass Operations, Maintenance, and Monitoring

This section describes the operations, maintenance, and monitoring of the Compact Bypass.

Operations and Maintenance

The Project includes long-term operations and maintenance of the proposed facilities and features as described below.

Maintenance

Levees will require maintenance for vegetation management, access roads, levee inspections, levee restoration, rodent control, minor structures, encroachment removal, levee patrolling during flood events, and equipment. Levee vegetation management includes equipment to drag or mow the levee banks or aquatic-safe herbicide applications. Maintenance of access roads includes replacing gravel or scraping and filling of ruts to keep the roads in good condition. Levee restoration includes restoring areas with erosion or settlement problems or adding armor. Rodent control includes setting traps with bait and periodically checking the traps. Minor structures maintenance includes repair or replacement of gates, locks or fences. Encroachment removal involves removing illegally dumped materials.

Floodplain maintenance includes vegetation management for invasive species, periodic floodplain and channel shaping to retain capacity and prevent fish stranding, and other

floodplain maintenance activities such as debris removal and repair of channel banks and bank protection measures.

Control structures maintenance includes annual operating maintenance for control gates, lubricating the fittings, greasing and inspecting the motors, replacing parts and equipment, in-channel sediment removal in the structure vicinity, and cleaning the trash rack. Work needed for the radial gates includes inspection of gates and seals and periodic replacement of seals. Work needed for the trash rack includes periodic repair or replacement of components, inspecting for operation, and greasing and inspecting the motors.

Fish screen maintenance would be needed to ensure that screens are functioning to NMFS standards and capable of diverting the required flow, if a fish screen is constructed. Fish screen maintenance includes removing the screens for cleaning, replacing screens when needed, periodic repair or replacement of brush cleaning system components, periodic repair or replacement of trash rack components, inspection for operation, greasing and inspecting motors, and in-channel sediment removal in the structure vicinity.

Fish passage facility maintenance is needed to ensure that the passage facility is functioning to NMFS standards. Depending on the type of fish passage facility built, fish passage facility maintenance could include removing sediment and debris from the facility, in-channel sediment removal in the structure vicinity, inspection of gates and seals and periodic replacement of seals, periodic repair or replacement of weir gates, periodic repair or replacement of supplementary water system components, inspection for operation, greasing and inspecting motors, and replacement of riprap, grouting, boulders, large woody debris, or other "natural" features of the fish passage facility.

Seepage control measure maintenance is dependent on the type of measures implemented but could include activities such as periodic sediment removal and channel re-shaping for interceptor ditches, cleaning or flushing of interceptor drains, repair and replacement of pump parts for seepage wells and lift pumps, and vegetation management, berm restoration, and rodent control for seepage berms. If 15-foot-deep slurry walls are constructed at all setback levees, similar to what is expected in the Compact Bypass area, maintenance efforts associated with the seepage control measure is expected to be minimal.

Levee and structure protection maintenance includes repair restoration of protection measures due to erosion or degradation and vegetation management.

Water diversion canal maintenance includes sediment removal and channel re-shaping.

Maintenance Schedule

All maintenance activities, when possible, would be timed to minimize the impacts to fish. Access and safety concerns, as well as timing of flows, may affect timing of the maintenance activities, but can be scheduled around fish migration.

Maintenance of levees and floodplains with aquatic-safe herbicide treatment would occur sometime between spring and fall and would depend on the plant species that are being treated. Typically the herbicide would be administered prior to the plant going to seed and may need to be sprayed more than once. Disking for vegetation management usually occurs twice within the year; once in early spring after the rainfall season and then again in late summer prior to plants going to seed. Access road and levee restoration work would likely be done in the summer after the rainfall season, and timing and projects would be dependent on environmental clearance for small mammals, nesting birds or burrowing owls, and other wildlife species. Rodent control would likely be done by a pest control advisor and would likely be done in the spring through fall and not during the rainfall season. All levee and floodplain work can be impacted by the presence of nesting birds, so in some areas work may not begin until the nesting birds have fledged or if there is some other biological reason to believe that the maintenance activities would not impact the nesting birds.

Timing of the maintenance of structures within the waterways would depend on the flow hydrograph and forecasted flows, but can typically be expected in the summer/fall after high spring flows have receded. Cleaning of the in-channel structures would typically occur when flows are low enough to allow crews and equipment to enter the river safely to access the structures. San Mateo Avenue may be cleared earlier for access as soon as flows recede and are not likely to increase for the remainder of the water year. If earlier, this work would only be for road access and would not be located in the channel itself.

Debris that collects on trash racks, screens, ladders, or other fish passage structures will need to be periodically removed but will likely be scheduled based on the operation permits for these structures. Annual maintenance cleaning would be expected after the fish migration, but will need to be timed when flows have receded.

Lubing and annual gate maintenance would likely be in the late summer or early fall prior to winter and spring flows to make sure the structures are operating properly and to provide time for repairs and ordering parts if needed.

Water diversion canals that require maintenance could be isolated from the river system by closing the headgates at the canals which will not impact fish migration.

Operations
There are no operations for levees, floodplains, or levee and structure protection.

Control structures operations include operating the motors for the control gates, inspecting and assessing the gates, adjusting the gates for various stages of flows, adding short walls to the stop-log guides after years of subsidence, and running the automatic trash sweep.

Fish screen operations could occur every day when diversions are occurring, if a fish screen is constructed. Operations include visually inspecting screens, verifying flow, clearing obstructions and debris, adjusting the baffles, permitting and regulatory compliance measures, estimating performance (i.e., velocity measurements), powering

the screen, running the pumps for the sediment removal system, running automatic brush cleaning and trash rake motors, and running pumps for the fish diversion pipe. Operations also could include methods to reduce predation of juvenile fish (e.g., noise systems to scatter predators, netting, and periodic draining of the screen return pipes) and may include the addition of juvenile and/or adult fish traps.

Fish passage facility operations could occur every day during fish migration. Operations include visually inspecting the facility, verifying flow, clearing obstructions and debris, adjusting the weirs, permitting and regulatory compliance measures, estimating performance (i.e., velocity measurements), fish monitoring, and powering mechanically controlled weirs.

Seepage control measure operations are primarily passive, but seepage well operations would include running the pumps to lower the water table, and interceptor drain and ditch operations could involve running lift pumps.

Monitoring Activities

Monitoring activities would include physical and nonphysical activities within the Action Area. Several monitoring components would be covered by the Program's *Physical Monitoring and Management Plan* (PEIS/R pages 2-49 to 2-52, and Appendix D.1, SJRRP 2011a), which provides guidelines for observing conditions as well as adjusting to changes in physical conditions within the Action Area. The Program's *Physical Monitoring and Management Plan* consists of multiple component plans, addressing physical conditions such as flow, groundwater seepage, channel capacity, and propagation of native vegetation. Each component plan identifies objectives for the physical conditions within the Action Area, and provides guidelines for the monitoring and management of those conditions. The component plans identify potential actions that could be taken to further enhance the achievement of the objectives. Finally, the Plan includes a description of monitoring activities which apply to one or more of the component plans. The component plans include the following monitoring objectives, all of which are identified in the Program's *Physical Monitoring and Management Plan*:

- **Flow** – To ensure compliance with the hydrograph releases in Exhibit B of the Settlement and any other applicable flow releases (e.g., buffer flows) (detail is provided in the Program's *Restoration Flow Guidelines*).
- **Seepage** – To reduce or avoid adverse or undesirable seepage impacts (detail is provided in the Program's *Seepage Management Plan*).
- **Channel capacity** – To maintain flood conveyance capacity (detail is provided in the Program's *Channel Capacity Report*).
- **Native vegetation** – To establish and maintain native riparian habitat.

Project specific components of the monitoring will include addressing effectiveness monitoring of fish screens and fish passage at structures within the Action Area. The monitoring objective is the following:

- **Passage and screening effectiveness** – To maintain effective fish passage and fish screening at structures and diversions.

Monitoring activities, as they are described in the Program's *Physical Monitoring and Management Plan*, are guidelines for monitoring and could change during Project implementation. Monitoring activities in Reach 2B could include the following Program-level activities:

- **Flow monitoring** – Flow, cross sections, and surface water stage at gaging stations, and at additional locations during high-flow events.
- **Groundwater level monitoring** – Groundwater elevation in monitoring wells (detail is provided in the Program's *Seepage Management Plan*).
- **Aerial and topographic surveys** – True color aerial photographs and topographic surveys to assess river stage, hydraulic roughness, river width, bed elevation, and vegetation conditions.
- **Vegetation surveys** – Surveys of seed dispersal start and peak times, and native riparian vegetation establishment.
- **Sediment mobilization monitoring** – Sediment mobilization, bar formation, and bank erosion through aerial and topographic surveys of areas with elevated erosion potential (detail is provided in the Program's *Sediment Management Plan*).

Project specific monitoring activities will include the following:

- **Passage and screening effectiveness** – Flow, cross-sections, water surface, and velocity measurements near and within structures that provide passage or screening. Fish counting devices and rotary screw traps to count and measure fish passage and fish size.

2.3 Reach 2B Channel Improvements

This section describes the Reach 2B channel improvements phase of the Project, including construction and operations, maintenance, and monitoring.

2.3.1 Construction of the Reach 2B Channel Improvements

This section describes the features to be constructed as part of the Reach 2B channel improvements phase of the Project.

Structures

The structures described below would be required to provide fish passage.

Fish Passage Facility on the San Joaquin River Control Structure at the Chowchilla Bifurcation Structure

The existing San Joaquin River control structure at the Chowchilla Bifurcation Structure would not be passable by up-migrating salmon and native fish for all flows and flow

splits between the river and the Chowchilla Bypass. The undershot gates, sill across the downstream side of the structure, and trash rack on the upstream side contribute to upstream passage difficulties at high, low, and all flows, respectively. A fish passage facility would be required for upmigrating salmon and other native fish to swim into Reach 2A from Reach 2B under most conditions.

Passage Facility Design

The design of the fish passage facility would be based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008). The size and geometry of the fish passage facility would be dictated by the flow requirements for juvenile and adult fish. Several types of fish passage facility may be considered in detailed design: vertical slot weir ladder design was included for its ability to accommodate a greater range of water depths (hydraulic head at the upstream and downstream ends), but the design may also consider ice-harbor, pool and chute, rock ramp fishway, or other passage facility designs.

Attraction Flows

The attraction flow magnitude will be 5 to 10 percent of the total flow through the control structure over the path of Restoration Flows. The Project requires conveyance of at least 4,500 cfs, so the attraction flow at the passage facility entrance could be as high as 450 cfs. The passage facility itself may have a design flow rate less than the maximum attraction flow. In this case, the balance of attraction flows could be provided at the passage facility entrance (downstream side) through supplementary water, described below.

Supplementary Water

Supplementary water is water already in the river and which is piped to the fish passage facility entrance to augment attraction flows (see Figure 2-10). No additional water supply beyond what would be flowing in the river is required. The supplementary water allows the passage facility to operate under a wider range of river flows by supplying additional attraction flow when the need exceeds the design flow rate through the passage facility. Supplementary water would also be used to control the hydraulic head at the passage facility entrance. Supplementary flow would be collected by a water delivery intake structure located upstream from the fish passage facility. The intake structure would include a trash rack and a fish screen to prevent migrating fish from entering the intake. River water would enter the intake structure, and travel downriver through pipes to the passage facility entrance.

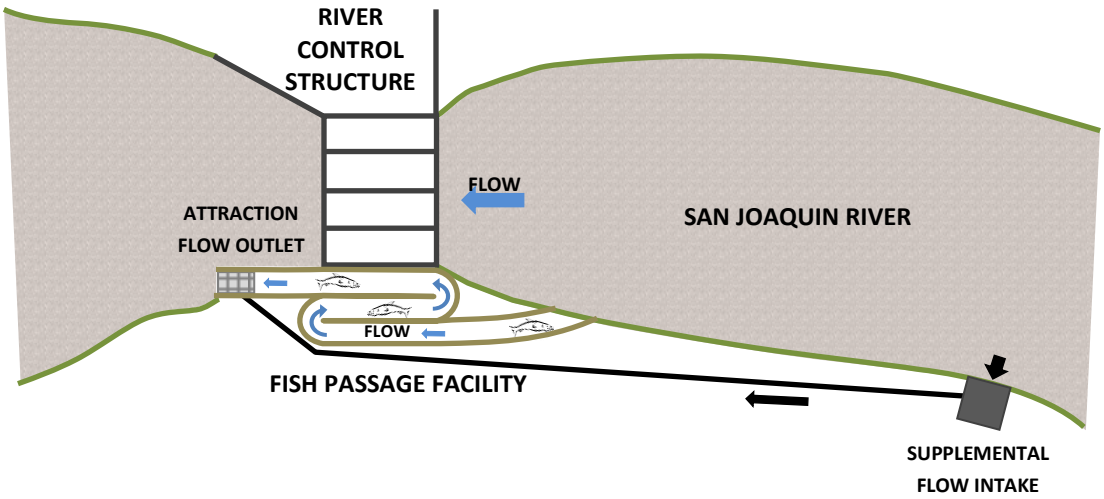


Figure 2-10.
Supplementary Flow System Plan-view Diagram

San Joaquin River Control Structure at the Chowchilla Bifurcation Structure Modifications

In addition to the passage facility, the San Joaquin River control structure at the Chowchilla Bifurcation Structure would be modified to improve fish passage through the control structure itself or to improve operations of the passage facility. Fish passage through the modified river control structure may meet passage criteria only for certain flows, so the fish passage facility described above would still be required.

Improvements to the river control structure could include removing the trash racks, replacing one or more radial gates with over-shot gates (e.g., inflatable Obermeyer weir gates), notching or removal of the baffle wall or weir, removing the dragon's teeth, and replacing or modifying the scour protection. Improvements would be designed based on NMFS 2001 and NMFS 2008 passage criteria. Improvements would not affect the ability of the structure to divert flood water into the Chowchilla Bypass.

San Mateo Avenue Crossing Removal

The San Mateo Avenue crossing is an existing river crossing located within a public right-of-way in Madera County and on private land in Fresno County at approximately RM 211.8. The crossing transitions from public right-of-way to private land at the center of the river. The crossing consists of a low flow or dip crossing with a single culvert. As part of the Project, the culvert and road embankments would be demolished, and no river crossing would be provided at this location.

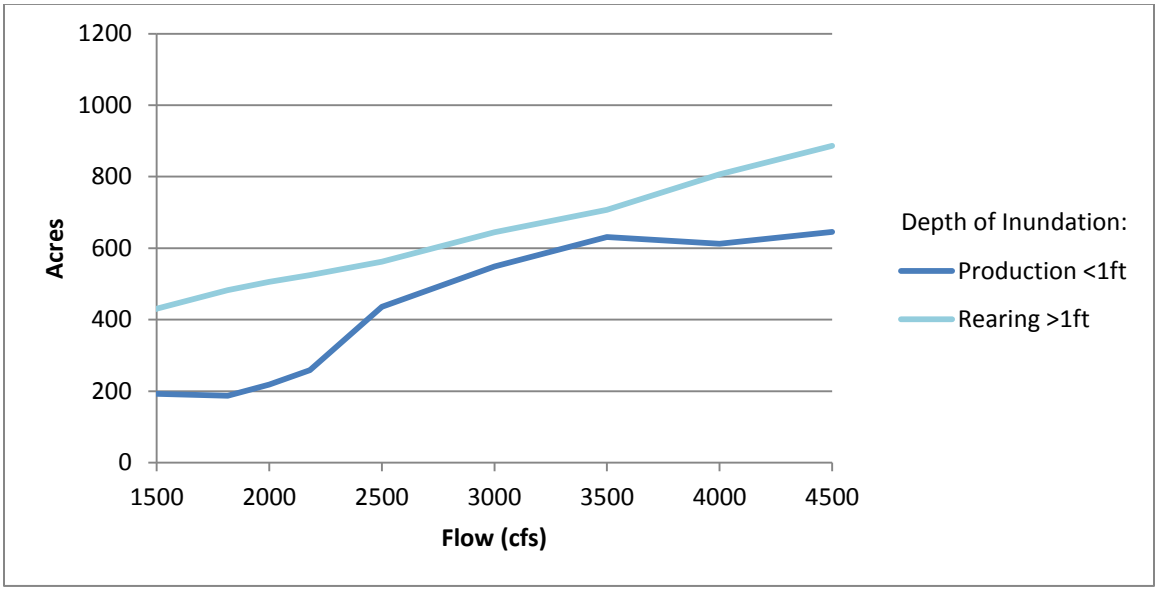
Fish Passage Criteria

Fish habitat and passage criteria for the Reach 2B channel improvements are the same as those presented above for the bypass channel.

Fish Habitat and Passage

The purpose of the floodplain would be to provide riparian and floodplain habitat and support the migration and seasonal rearing of salmonids and other native fishes in Reach 2B. Floodplains would be developed in accordance with the Rearing Habitat Design Objectives. The floodplain has an average width of approximately 4,200 feet and an inundated area of approximately 1,000 acres at 2,500 cfs.

The Project provides floodplain habitat resulting in approximately 440 acres of shallow water habitat for primary production as well as approximately 560 acres of habitat that supports direct rearing at 2,500 cfs. Approximately 44 percent of the floodplain would inundate less than 1 foot deep at 2,500 cfs. The Project also retains approximately 650 acres of shallow water habitat at flows of 4,500 cfs. Figure 2-11 below presents conceptual inundation areas for primary production and rearing habitats as they vary by flow. Inundation acreages may change during the design process.



Source: Reclamation 2015

Figure 2-11.
Potential Inundation Acreage by Flow

The Project includes several facilities that fish may encounter or need to pass to migrate between Reach 3 and Reach 2B. Those facilities associated with the Reach 2B channel improvements include the following (from downstream to upstream):

- Fish screens at Lone Willow Slough, Big and Little Bertha pumps, and other smaller diversions, if determined necessary.
- The San Joaquin River control structure at the Chowchilla Bifurcation Structure with a fish passage facility.

Each structure would be designed to perform according to the fish passage design criteria. In addition, the channel and floodplain incorporate riparian plantings to provide cover,

woody material, and velocity variability, while the design footprint allows sufficient space to incorporate channel structure variability during detailed design, all of which may help to reduce stress and predation.

Floodplain and Riparian Habitat

Riparian and floodplain habitat restoration associated with the Reach 2B channel improvements are the same as those presented above for the bypass channel.

Floodplain and Channel Grading

Floodplain and channel grading associated with the Reach 2B channel improvements would be similar to methods presented above for the bypass channel.

Levees

Levee design requirements for the Reach 2B channel improvements are the same as those presented above for the bypass channel.

Levee and Structure Protection

Levee and structure protection measures associated with the Reach 2B channel improvements are the same as those presented above for the bypass channel.

Channel Bank Protection

Channel bank protection measures associated with the Reach 2B channel improvements are the same as those presented above for the bypass channel.

Removal of Existing Levees

The removal of existing levees along the Reach 2B channel would be similar to methods presented above for the bypass channel.

Seepage Control Measures

Seepage control measures associated with the Reach 2B channel improvements are the same as those presented above for the bypass channel.

Borrow

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. Geotechnical investigations to date indicate that local borrow may be sufficient, so it is assumed that all levee fill will come from local borrow sites. Topsoil from local borrow areas would be stockpiled for reuse at the borrow site or within the Action Area.

The locations of borrow areas are dependent on the locations of suitable materials. To the extent that suitable materials and the locations for floodplain grading coincide, borrow from those areas is preferred. Borrow from within the Project levees will be designed to be compatible with native fish habitat and uses by either reconnecting to the river channel or by restoring to an appropriate elevation to prevent excessive stranding.

It is estimated that up to 350 acres of land total will be needed for borrow areas. This includes borrow locations inside and outside the Project levees (identified as Potential Borrow Area on Figures 1-2 and 1-3). Borrow areas will avoid sensitive biological resources to the extent practicable. Borrow areas will also avoid permanent crops outside of the Project levees.

Lone Willow Slough Fish and Riparian Diversions Screens

Lone Willow Slough connects to the river at approximately RM 215.9 just downstream of the Chowchilla Bifurcation Structure. The Project includes construction of a fish screen at this diversion, if determined necessary. During flood control releases from Friant Dam and when the San Joaquin River Exchange Contractors are exercising their water rights on the San Joaquin River, in lieu of taking substitute water from the Delta-Mendota Canal, up to 125 cfs of water may be diverted for irrigation from Reach 2B into the Lone Willow Slough. A screen, if determined necessary, would prevent fish from entering the canal when flows are being diverted. The fish screen structure would consist of a 15-foot by 21-foot concrete hollow box, with the river side of the box open to river flows and the back of the box fitted with a board guide to control diversion into the irrigation canal. The opening at the riverside would include an automated cleaner system, trash rack and a fish screen to prevent migrating fish from entering the intake. The screen would be designed to meet *Anadromous Salmonid Passage Facility Design* (NMFS 2008) criteria.

There are existing diversion pumps located along Reach 2B (e.g., Big and Little Bertha pumps). These pumps would be retrofitted with fish screens, where required, to prevent migrating fish from entering the intakes. The screens would be designed to meet *Anadromous Salmonid Passage Facility Design* (NMFS 2008) criteria.

Infrastructure for Fish Monitoring

Fish monitoring infrastructure along the Reach 2B channel would be the same as presented above for the bypass channel.

Existing Infrastructure Relocations or Floodproofing

Measures associated with relocation or floodproofing of existing infrastructures within the Reach 2B channel would be the same as those presented above for the bypass channel.

Construction Access

Construction access routes associated with the Reach 2B channel improvements are the same as those presented above for the bypass channel.

Revegetation of Temporary Disturbance Areas

Requirements for revegetation of temporary disturbed areas associated with the Reach 2B channel improvements are the same as those presented above for the bypass channel.

Structure Design and Subsidence

Protection measures associated with structure design and subsidence for Reach 2B channel improvements are the same as those presented above for the bypass channel.

Geotechnical Investigations

Measures associated with geotechnical investigations and associated data collection activities within the Reach 2B channel would be the same as those presented above for the bypass channel.

Surveys

Measures associated with biological, cultural resources, and elevation surveys within the Reach 2B channel improvement area would be the same as those presented above for the bypass channel.

Land Acquisition

The description of land acquisition associated with the Reach 2B channel improvements is the same as presented above for the bypass channel.

Construction Considerations

The total construction timeline for the Project is currently estimated to range approximately from 106 to 157 months (9 to 13 years); the Reach 2B channel improvements are expected to be constructed in the latter half of this time period. Opportunities to shorten the overall schedule through construction efficiencies will be studied during the detailed design process.

Demolition of the San Mateo Avenue crossing would be timed so that the lesser Restoration Flows (5 to 195 cfs) can be routed around the structure during demolition.

2.3.2 Operations, Maintenance, and Monitoring of the Reach 2B Channel Improvements

Operations and Maintenance

Operations and maintenance activities are the same as those described in Section 2.2.2.

Monitoring Activities

Monitoring activities are the same as those described in Section 2.2.2.

2.4 Summary

Table 2-3 summarizes the levees, relocations, land acquisition, and construction schedule associated with the Project based on design, field, and evaluation criteria data

Table 2-3.
Levees, Relocations, and Land Acquisition

	Left Levee	Right Levee
Levee Length	8.1 miles	6.8 miles
Average Levee Height	5.6 feet	4.7 feet
Fill Volume	328,600 cubic yards	226,900 cubic yards

Relocations			
Electrical Distribution	48,500 feet	Barn/Shed	1
Gas Transmission	11,000 feet	Facility	1
Water Pipeline	41,000 feet	Groundwater Well	32
Canal	31,500 feet	Lift Pump	10
Culvert	1	Power Pole	162
Diversion	3	Dwelling	2

Land Acquisition and Construction Schedule	
Land Acquisition[1]	2,900 acres
Time to Build[2]	157 months

[1] Total acreage includes areas that are sovereign and public trust lands.

[2] Construction timeline does not include the time that would also be needed to complete the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) documentation process, obtain permits, appraise and acquire land, and perform pre-construction surveys.

2.5 Conservation Measures

Environmental commitments are measures or practices adopted by a project proponent to reduce or avoid adverse effects that could otherwise result from project construction or operations. The following section describes additional environmental commitments that would be implemented with the Project to avoid potentially adverse environmental consequences.

The Project includes conservation measures based on the Program's Conservation Strategy, developed with the USFWS, NMFS, and DFW, which would be implemented in a manner that is consistent with adopted conservation plans for sensitive species, and for wetland and riparian ecosystems of the Restoration Area. Those measures address all potentially affected Federally-listed and/or State-listed species, and all other species identified by USFWS, NMFS or DFW as candidates, sensitive, or special-status in local or regional plans, policies, or regulations. The applicable, feasible measures would guide development of action-specific conservation strategies. Table 2-4 presents the elements of the Program's Conservation Strategy as applicable to the Project's USFWS BA. The measures presented here are based on those presented in the PEIS/R.

Table 2-4.
Conservation Measures for Biological Resources that May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
VELB	**Valley Elderberry Longhorn Beetle**	
VELB-1. Avoid and Minimize Effects to Species	Within 1 year before the commencement of ground-disturbing activities, a qualified biologist will identify any elderberry shrubs in the Project footprint. If elderberry shrubs are found on or adjacent to the construction Project footprint, if feasible, a 100-foot-wide avoidance buffer—measured from the dripline of the plant—will be established around elderberry shrubs with stems greater than 1 inch in diameter at ground level and will be clearly identified in the field by staking, flagging, or fencing. No activities will occur within the buffer areas and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	USFWS
BNLL	**Blunt-Nosed Leopard Lizard**	
BNLL-1. Avoid and Minimize Effects to Species	Within 1 year before the commencement of ground-disturbing activities protocol-level surveys will be conducted according to the *Blunt-Nosed Leopard Lizard Survey Protocols for the San Joaquin River Restoration Program* (USFWS 2009a) on lands identified as potentially suitable for blunt-nosed leopard lizard, which consist of annual grassland and elderberry savannah habitats on the south side of the San Joaquin River near the Chowchilla Bifurcation Structure. If blunt-nosed leopard lizard is not detected within the Action Area, additional avoidance, minimization, and compensation for this species will not be required. If blunt-nosed leopard lizard are detected within or adjacent to the Action Area, additional avoidance and minimization measures, including measures that will avoid direct take of this species, will be developed in coordination with USFWS and DFW and implemented before ground-disturbing activities, and construction activities within blunt-nosed leopard lizard habitat will occur outside of the peak activity period (April to July). In addition, if blunt-nosed leopard lizard are detected within or adjacent to the Action Area, BNLL-2 (Compensate for Loss of Habitat or Species) from the PEIS/R will be implemented. If blunt-nosed leopard lizard are not detected within or adjacent to the Action Area, additional avoidance, minimization, and compensation will not be required.	USFWS DFW
GGS	**Giant Garter Snake**	
GGS-1. Avoid and Minimize Loss of Habitat for Giant Garter Snake	For work that would occur during the active season for giant garter snakes (between May 1 and October 1), preconstruction surveys will be completed by a qualified biologist approved by USFWS and DFW within a 24-hour period before any ground disturbance of potential giant garter snake habitat. If ground-disturbing activities stop on the Project site for a period of 2 weeks or more, a new giant garter snake survey will be completed no more than 24 hours before the restart of	Reclamation USFWS DFW

Table 2-4.
Conservation Measures for Biological Resources that May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	ground-disturbing activities. Avoidance of suitable giant garter snake habitat, as defined by USFWS (USFWS 1999a) and DFW will occur, where feasible, by demarcating and maintaining a 300-foot-wide buffer around these areas. To the extent feasible, all activity involving disturbance of potential giant garter snake habitat will be restricted to the active season for giant garter snakes (between May 1 and October 1). For Project activities that cannot feasibly occur within this window, a cofferdam will be constructed in coordination with USFWS and work will be conducted in the dried area. If cofferdam construction is infeasible, work will be conducted during one active season (May 1 to October 1) and the following inactive season. Exclusion fencing and increased monitoring of wintering sites will occur in coordination with USFWS during this inactive period construction. Construction will be minimized within 200 feet of banks of habitat, especially during the inactive period (Oct 2 to April 30) and movement of heavy equipment will be confined to existing roadways, to the extent feasible. Stockpiles and staging areas will be established more than 200 feet from the bank/edge of aquatic habitat. Clearing will be confined to the contractor use area which should be considered the minimal area necessary to facilitate construction activities. Giant garter snake habitat within or adjacent to the Project will be flagged, staked, or fenced and designated as an Environmentally Sensitive Area. No activity will occur within this area, to the extent feasible, and USFWS-approved worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented. Vegetation will be hand-cleared in areas where suitable giant garter snake habitat is documented to occur, based on mapping provided in this BA or future, USFWS-approved mapping. Exclusionary fencing with one-way exit funnels will be installed at least 1 month before activities to allow the species to passively leave the area and to prevent reentry into work zones, per USFWS and/or DFW guidance. If a giant garter snake is found during construction activities, USFWS, DFW, and the Project's biological monitor will immediately be notified. The biological monitor, or his/her assignee, will stop construction in the vicinity of the find and allow the snake to leave on its own. The monitor will remain in the area for the remainder of the work day to ensure the snake is not harmed. Escape routes for giant garter snake should be determined in advance of construction and snakes will be allowed to leave on their own. If a giant garter snake does not leave on its own within 1 working day, USFWS and DFW will be consulted. All construction-related holes will be covered to prevent entrapment of individuals. Where applicable and feasible, construction areas will be dewatered 2 weeks before the start of activities to allow giant garter	

Table 2-4.
Conservation Measures for Biological Resources that May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	snakes and their prey to move out of the area before any disturbance.	
GGS-2. Compensate for Temporary or Permanent Loss of Habitat	Temporarily disturbed giant garter snake aquatic habitat will be restored in accordance with criteria listed in the USFWS Mitigation Criteria for Restoration and/or Replacement of Giant Garter Snake Habitat (Appendix A to *Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake Within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties, California* (USFWS 1997)), or the most current criteria from USFWS or DFW. Permanent loss of giant garter snake habitat will be compensated at a ratio and in a manner that has been consulted on with USFWS and DFW and may include dedication of conservation easements, purchase of mitigation credits, and/or other off-site conservation measures.	USFWS DFW
RNB	**Riparian Nesting Birds: Least Bell's Vireo**	
RNB-1. Avoid and Minimize Effects to Species	Prior to ground disturbance, a qualified biologist will conduct surveys for least Bell's vireo in all riparian habitats within 500 feet of ground-disturbing activities at the start of the spring nesting season adhering to guidance offered in *Least Bell's Vireo Survey Guidelines* (USFWS 2001). If full protocol surveys cannot be implemented prior to initiation of ground-disturbing activities, the monitoring biologist approved by USFWS will be present for all activities within 500 feet of potentially suitable habitat. The monitoring biologist will perform a minimum of three focused surveys on three separate days prior to ground disturbance to determine the presence of least Bell's vireo, nest building, egg incubation, or brood rearing activities within 500 feet of the Project footprint. The surveys will begin a maximum of 7 days prior to Project construction and one survey will be conducted the day before ground disturbance. If any least Bell's vireo are detected, Reclamation will postpone work within 500 feet of the location and contact USFWS within 24 hours. Upon notification, USFWS will discuss the best approach to avoid/minimize impacts to nesting least Bell's vireo and a nest monitoring program acceptable to USFWS. Subsequent to these discussions, work may be initiated subject to implementation of the agreed upon avoidance/minimization approach and nest monitoring program. In addition, if least Bell's vireo are detected in the Action Area, RNB-2 (Compensate for Loss of Habitat or Species) from the PEIS/R will be implemented. If least Bell's vireo are not detected in riparian habitats within 500 feet of ground-disturbing activities, additional avoidance, minimization, and compensation for this species will not be required.	USFWS DFW

Table 2-4.
Conservation Measures for Biological Resources that May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
FKR	**Fresno Kangaroo Rat**	
FKR-1. Avoid and Minimize Effects to Species	Preconstruction surveys will be conducted by a qualified biologist to determine if potential burrows for Fresno kangaroo rat are present in the Project footprint in annual grassland and elderberry savannah identified as potential Fresno kangaroo rat habitat on the south side of the San Joaquin River near the Chowchilla Bifurcation Structure. Surveys will be conducted well in advance of ground-disturbing activities. The biologist will conduct burrow searches by systematically walking transects, which will be adjusted based on vegetation height and topography, and in coordination with USFWS and DFW. Transects will be used to identify the presence of kangaroo rat burrows. When burrows are found within 100 feet of the Project footprint, focused live trapping surveys will be conducted by a biologist permitted to handle Fresno kangaroo rat by both the USFWS and DFW, and following a methodology approved in advance by USFWS and DFW. If Fresno kangaroo rat are detected within or adjacent to the Action Area, additional avoidance and minimization measures will be developed in coordination with USFWS and DFW, as appropriate, and construction activities will be conducted when they are least likely to affect the species (i.e., after the normal breeding season of December through September [Ahlborn 1999]). This timing will be coordinated with USFWS and DFW. In addition, if Fresno kangaroo rat are detected within or adjacent to the Action Area, FKR-3 (Compensate for Loss of Habitat or Species) from the PEIS/R will be implemented. If Fresno kangaroo rat are not detected within or adjacent to the Action Area, additional avoidance, minimization, and compensation will not be required.	USFWS DFW
SJKF	**San Joaquin Kit Fox**	
SJKF-1. Avoid and Minimize Effects to Species	A qualified biologist will conduct preconstruction surveys in the Action Area no less than 14 days and no more than 30 days before the commencement of ground-disturbing activities to identify potential dens more than 5 inches in diameter. The Project proponent will implement USFWS' *Standardized Recommendations for Protection of San Joaquin Kit Fox Prior to or During Ground Disturbance* (USFWS 1999b). The Project proponent will notify USFWS and DFW in writing of the results of the preconstruction survey within 30 days after these activities are completed. If San Joaquin kit fox are detected within or adjacent to the Action Area, additional avoidance and minimization measures, including measures that will avoid direct take of this species, will be developed in coordination with USFWS and DFW and implemented before ground-disturbing activities. If dens are located within the proposed work area, and cannot be avoided during construction activities, a	USFWS DFW

Table 2-4.
Conservation Measures for Biological Resources that May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	USFWS-approved biologist will determine if the dens are occupied. The Project proponent will present the results of preactivity den searches within 5 days after these activities are completed and before the start of ground-disturbing activities in the Action Area. The Project proponent will notify USFWS and DFW immediately if a natal or pupping den is found in the survey area. If occupied dens are present within the proposed work area, their disturbance and destruction will be avoided, to the extent feasible. Exclusion zones will be implemented following the latest USFWS procedures, and construction activities in occupied San Joaquin kit fox habitat shall be conducted when they are least likely to affect the species (i.e., after the normal breeding season of December to April ([Ahlborn 2000]). This timing will be coordinated with USFWS and DFW. In addition, if San Joaquin kit fox are detected within or adjacent to the Action Area, SJKF-2 (Compensate for Loss of Habitat or Species) from the PEIS/R will be implemented. If San Joaquin kit fox are not detected within or adjacent to the Action Area, additional avoidance, minimization, and compensation will not be required.	
PLANTS	**Other Special-Status Plants**	
PLANTS-1. Avoid and Minimize Effects to Special-Status Plants	Within 1 year before the commencement of ground-disturbing activities, protocol-level surveys for the special-status plants listed in Table 1 of Appendix L of the PEIS/R, "Biological Resources – Vegetation and Wildlife," that are applicable to Reach 2B, will be conducted in grassland, elderberry savannah, fresh emergent wetland, and wet herbaceous habitats by a qualified botanist, in accordance with *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (DFW 2009). If detected, locations of special-status plant populations that can be avoided will be clearly identified in the field by staking, flagging, or fencing a minimum 100-foot-wide buffer around them before the commencement of ground-disturbing activities. No activity will occur within the buffer area, and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented. If federally listed plants are detected within or adjacent to the Action Area, additional avoidance and minimization measures, including measures that will avoid direct take of this species, will be developed in coordination with USFWS and DFW. In addition, if federally listed plants are detected within or adjacent to the Action Area and complete avoidance is not possible, PLANTS-2 (Compensate for Loss of Special-Status Plants) from the PEIS/R will be implemented. If federally listed plants are not detected within or adjacent to the Action Area, additional avoidance, minimization, and compensation	USFWS DFW

Table 2-4.
Conservation Measures for Biological Resources that May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	will not be required.	

Acronyms:
DFW = California Department of Fish and Wildlife
PEIS/R = Program Environmental Impacts Statement/Report
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
USFWS = U.S. Fish and Wildlife Service

2.6 Minimize Flood Risk from Restoration Flows

The Program's strategy for minimizing flood risk is to limit the maximum downstream extent and rate of Restoration Flows for the given reach to then-existing channel capacities. This strategy is incorporated by reference from the PEIS/R (SJRRP 2011a, pages 2-22 through 2-28) and summarized here. These Program-wide commitments are documented in the PEIS/R Record of Decision (ROD). No new Project-level actions to minimize flood risk from Restoration Flows are being proposed.

Throughout Settlement implementation, the maximum downstream extent and rate of Restoration Flows to be released through a reach will be maintained at or below then-existing channel capacities. As channel or structure modifications are completed, maximum Restoration Flow releases will be correspondingly increased in accordance with then-existing channel capacities and with the release schedule. Consistent with the San Joaquin River Restoration Settlement Act, Interim Flows (2009-2014) were reduced, as needed, to address material seepage impacts, as identified through the monitoring program (see the Program's *Physical Monitoring and Management Plan* and *Seepage Management Plan* (PEIS/R Appendices D.1 and D.2, SJRRP 2011a)). If release of water from Friant Dam is required for flood control purposes, concurrent Restoration Flows will be reduced by an amount equivalent to the required flood control release. If flood control releases from Friant exceed the concurrent scheduled Restoration Flows, no additional releases above those required for flood control will be made for SJRRP purposes.

Then-existing channel capacities within the Restoration Area correspond to flows that would not significantly increase flood risk from Interim and Restoration flows in the Restoration Area (see the *Channel Capacity Report* (SJRRP 2015a)). The action to release Restoration Flows includes measures that would achieve the following objectives: (1) commit Reclamation to implementing actions that would meet performance standards that minimize increases in flood risk as a result of Restoration Flows, (2) limit the release and conveyance of Restoration Flows to those flows that would remain in-channel until adequate data are available to apply the performance standards and until the performance standards are satisfied, and (3) enable the Settlement to be implemented in coordination

with other ongoing and future actions outside of the Settlement that could address channel capacity issues identified in the Settlement or through the SJRRP or other programs. Implementation of measures that achieve these objectives will allow for the safe release and conveyance of Restoration Flows throughout the duration of Settlement implementation.

Reclamation will continue to implement the following three integrated measures that collectively minimize increases in flood risk as a result of Restoration Flows during Settlement implementation:

- **Facilitate a Channel Capacity Advisory Group and Determine and Update Estimates of Then-Existing Channel Capacities as Needed –** The establishment and administration of a Channel Capacity Advisory Group to provide independent review of estimated then-existing channel capacities, monitoring results, and management actions to address vegetation and sediment transport within the system as identified by Reclamation.
- **Maintain Restoration Flows at or Below Estimates of Then-Existing Channel Capacities –** The process for limiting Restoration Flows to reduce the risk of levee failure due to underseepage, through-seepage, and associated levee stability issues to less-than-significant levels.
- **Closely Monitor Erosion and Perform Maintenance and/or Reduce Restoration Flows as Necessary to Avoid Erosion-Related Impacts –** The commitment by Reclamation to implement erosion monitoring and management, including monitoring potential erosion sites, reducing Restoration Flows as necessary, and reporting ongoing results of monitoring and management actions to the Channel Capacity Advisory Group.

Only limited data are currently available on San Joaquin River channel capacities and levee conditions. The levee design criteria developed by the Corps and presented in *Design and Construction of Levees Engineering and Design Manual* (Manual No. 1110-2-1913) (Corps 2000), *Slope Stability* (Manual No. 1110-2-1902) (Corps 2003), and *Design Guidance for Levee Underseepage* (Engineering Technical Letter No. 1110-2-569) (Corps 2005) will be applied throughout the Restoration Area to identify the Interim or Restoration Flows that would not cause the levee slope stability Factor of Safety to be reduced below 1.4, or the underseepage Factor of Safety to be reduced below the value corresponding to an exit gradient at the toe of the levee of 0.5. The levee slope stability Factor of Safety is defined as the ratio of available shear strength of the top stratum of the levee slope to the necessary shear strength to keep the slope stable (Corps 2003), and minimum levee slope stability factors of safety are given by the Corps levee criteria shown in Table 2-5. The application of the levee slope stability Factor of Safety of 1.4 is required for federally authorized flood control projects. Through-seepage is calculated as part of the slope stability analysis and does not have a separate Factor of Safety. The underseepage Factor of Safety is defined as a ratio of the critical hydraulic gradient to the actual exit gradient of seepage on the levee. Corps design guidance recommends that the allowable underseepage factor of safety for use in evaluations and/or design of seepage control measures should correspond to an exit gradient at the toe of the levee of 0.5 (in

general, this would provide a Factor of Safety of 1.6), but states that deviation from recommended design guidance is acceptable when based and documented on sound engineering judgment and experience (Corps 2005).

Until adequate data are available to determine the Factor of Safety, Reclamation would limit the release of Restoration Flows to those which would remain in-channel. In-channel flows are flows that maintain a water surface elevation at or below the elevation of the landside levee toe (i.e., the base of the levee). When sufficient data are available to determine the Factor of Safety, Reclamation will limit restoration flows to levels that would correspond to a Factor of Safety of 1.4 or higher and an underseepage Factor of Safety corresponding to an exit gradient at the toe of the levee of 0.5 or lower at all times. Observation of levee erosion, seepage, boils, impaired emergency levee access, or other indications of increased flood risk identified through ongoing monitoring at potential erosion sites would indicate that the minimum Factor of Safety is not met and would trigger immediate reductions in restoration flows at the site. Such observations would supersede channel capacity estimates, and restoration flows will be reduced in areas where these conditions occur.

DWR has performed levee evaluations on Project levees in Reach 2A, Reach 3, the Middle Eastside Bypass, Mariposa Bypass, and Reach 4B2 of the San Joaquin River, and will be performing levee evaluations on the rest of Reaches 3 and 4A in the next two years. These levee evaluations are informing the channel capacity allowed in each annual Channel Capacity Report. Prior to construction of the Project, DWR will evaluate the downstream levees and compare the obtained geotechnical information with the levee failure points established in the redirected flood impacts Flood Damage Assessment modeling performed as part of the PEIS/R.

Table 2-5.
Minimum Factors of Safety – Levee Slope Stability

Type of Slope	Applicable Stability Conditions and Required Factors of Safety			
	End-of-Construction	Long-Term (Steady Seepage)	Rapid Drawdown[a]	Earthquake[b]
New Levees	1.3	1.4	1.0 to 1.2	(see below)
Existing Levees	--	1.4[c]	1.0 to 1.2	(see below)
Other Embankments and Dikes[d]	1.3[e,f]	1.4[c,f]	1.0 to 1.2[f]	(see below)

Source: U.S. Army Corps of Engineers 2000. Design and Construction of Levees Engineering and Design Manual. Manual No. 1110-2-1913. April. Table 6-1b, page 6-5.

Notes:

[a] Sudden drawdown analyses. F. S. = 1.0 applies to pool levels prior to drawdown for conditions where these water levels are unlikely to persist for long periods preceding drawdown. F. S. = 1.2 applies to pool level, likely to persist for long periods prior to drawdown.

[b] See Engineer Regulation, ER 1110-2-1806 for guidance. An Engineer Manual for seismic stability analysis is under preparation.

[c] For existing slopes where either sliding or large deformation have occurred previously and back analyses have been performed to establish design shear strengths lower factors of safety may be used. In such cases probabilistic analyses may be useful in supporting the use of lower factors of safety for design.

[d] Includes slopes which are part of cofferdams, retention dikes, stockpiles, navigation channels, breakwater, river banks, and excavation slopes.

[e] Temporary excavated slopes are sometimes designed for only short-term stability with the knowledge that long-term stability is not adequate. In such cases higher factors of safety may be required for end-of-construction to ensure stability during the time the excavation is to remain open. Special care is required in design of temporary slopes, which do not have adequate stability for the long-term (steady seepage) condition.

[f] Lower factors of safety may be appropriate when the consequences of failure in terms of safety, environmental damage and economic losses are small.

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3.0 Environmental Setting and Biotic Resources

The environmental setting focuses on Reach 2B, the section of the San Joaquin River which begins at the Chowchilla Bifurcation Structure and ends at Mendota Dam. The 5,600 acre Action Area includes a floodplain improvement area of 2,100 acres (Compact Bypass and Reach 2B Channel Improvements phases of the Project combined), as well as the associated equipment access routes and disturbance buffer.

3.1 Study Methods

3.1.1 Database Search

Database searches were conducted to identify special-status species that could potentially occur in the Action Area. Two primary databases were reviewed:

- California Natural Diversity Database (CNDDB; DFW 2015): All records from the Bonita Ranch, Coit Ranch, Firebaugh, Firebaugh NE, Gravelly Ford, Jamesan, Mendota Dam, Poso Farm, and Tranquility USGS 7.5-minute quadrangles in this database were reviewed.
- USFWS Sacramento Field Office Species List (USFWS 2015a): All species on this list were generated at the Sacramento USFWS website for Fresno and Madera counties.

3.1.2 Field Surveys

Biologists initiated field surveys in August 2010 and conducted wildlife habitat assessment and special-status vegetation alliance surveys. Access to private property in the Action Area was not granted in time to initiate some field surveys in 2010. Additional surveys to identify rare plants and wetland habitat were completed in 2011. In 2015, access to additional areas of private land, not accessible during the initial efforts, was granted. These areas were surveyed in April 2015 to assess habitat potentially suitable for listed species. The extent of access in the Action Area at each of these times is shown on Figure 3-1. Habitat throughout the Action Area was evaluated by aerial photos, and field-verified by pedestrian surveys where permission to enter was granted, or from public right-of-way. Where permission to enter was not granted, habitat assessments were made from the edges of agricultural fields where they bordered the edge of banks.

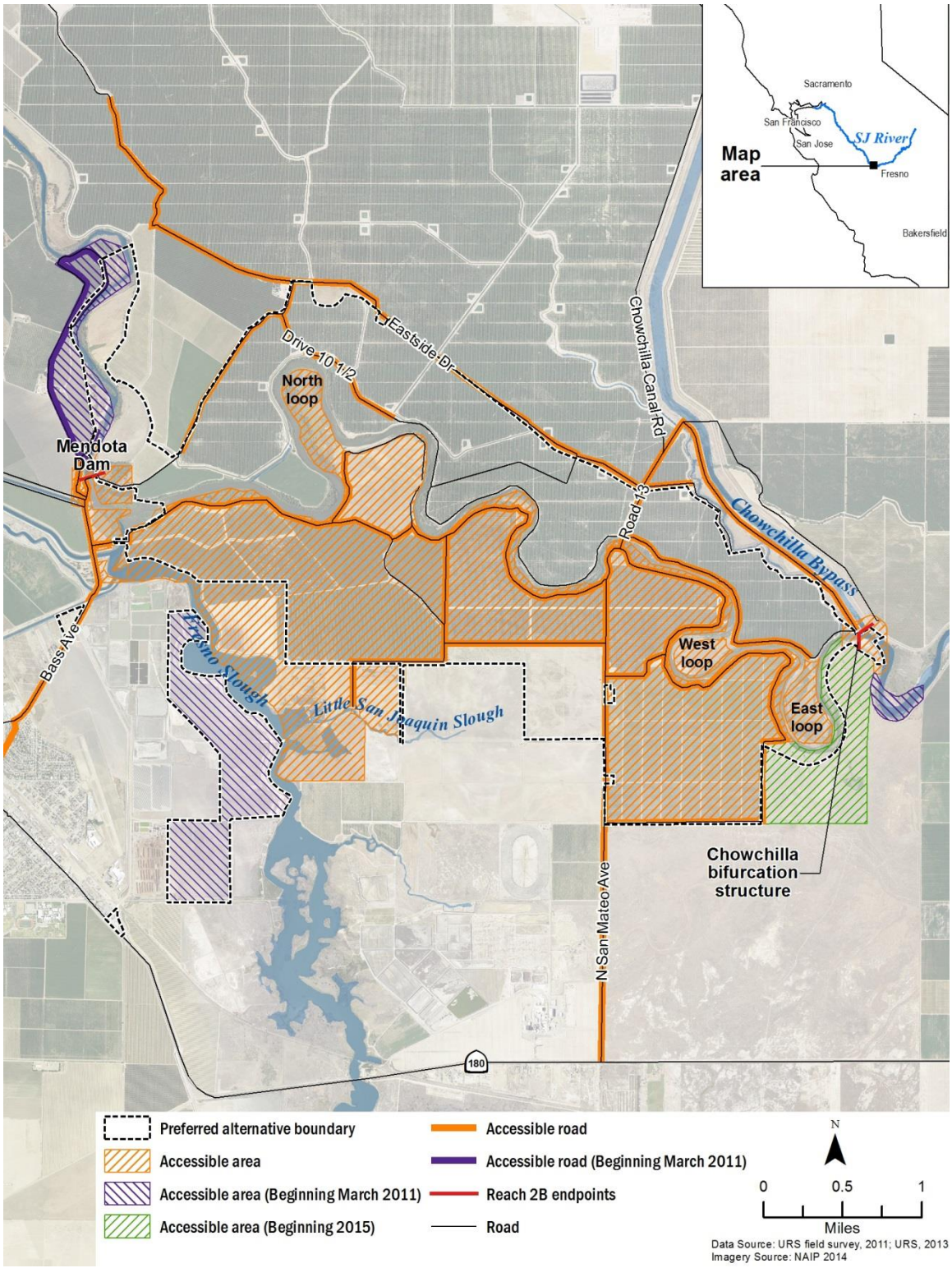

Figure 3-1.
Access During Field Surveys

Initial Site Visits and Habitat Assessment Surveys

Prior to the habitat assessment surveys, site visits were conducted on December 15, 2009 and May 19, 2010 by Project team biologists Jonathan Stead and Jessie Golding, along with other Project team staff and agency personnel. Although a biological reconnaissance survey was planned for March 2010 and the habitat assessment survey for May 2010 (SJRRP 2010), permission to enter property in the study area was not obtained until August 2010, shortly after which the habitat assessment surveys were initiated.

Wildlife habitat assessment surveys were conducted in the study area from August 23 through 27, 2010. Surveys were conducted by a field team composed of three and four biologists, including Andrea Coleman, Matthew Bettelheim, Ode Bernstein, and Foung Vang. Additional details are available in the 2011 *San Joaquin River Restoration Program Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRPP 2011c).

Additional wildlife habitat assessment and vegetation surveys were conducted in 2015 in some areas where access had not been available during previous surveys, notably including habitat at the eastern end of the study area, south of the San Joaquin River, previously identified as potentially suitable for listed species based on aerial photograph interpretation. Biologists performed wildlife habitat assessments and vegetation surveys in this portion of the study area from April 28-30, 2015. Wildlife surveys consisted of meandering walking surveys. Biologists mapped habitat types and recorded all wildlife observations – both direct observations and indicators of wildlife such as tracks and calls. Particular attention was paid to assessing habitat for species which initial potential-to-occur determinations were made pending surveys at the Frusetta study area, which is described as "unsurveyed land in southeast of the study area" in the technical memo (SJRRP 2011c).

Habitat Mapping

Habitat types in the study area were classified and mapped based on cover type and with consideration of the habitat requirements of special-status wildlife species potentially occurring in the study area. The cover type was determined based on a combination of structure and plant species composition—for example, shrub-dominated communities were classified as scrub due to structure, and then further categorized as willow or riparian scrub depending on the dominant species present. Many of the habitat types were defined following the California Wildlife-Habitat Relationships System (WHR) (WHR 2010). Additional details are available in the 2011 *San Joaquin River Restoration Program Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRPP 2011c). The field crews also mapped special-status vegetation alliances. Habitat type and special-status vegetation alliance maps were confirmed or updated based on additional access gained in 2015 (Figure 3-1).

Focused surveys

Additional surveys were conducted to identify specific sensitive resources within the Action Area. The initial effort conducted in 2010 focused on birds, valley elderberry longhorn beetle, Fresno kangaroo rat, and special-status (federally listed) plant species. A

detailed account of these surveys, including the methods, results, and conclusions can be found in the 2011 *San Joaquin River Restoration Program Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRPP 2011c). USFWS protocol least Bell's vireo surveys were conducted along Reach 2B in 2014 (URS 2014) and 2015 (SJRRP 2015b) in preparation for geotechnical investigations. The protocol least Bell's vireo surveys were conducted in accordance with the USFWS' Least Bell's Vireo Survey Guidelines (2001) and included sixteen discreet survey events over the 2 years. The portions of the Action Area that were accessible to the field teams, as well as public roads outside those parcels that were used to gain visual access to some areas where permission to enter had not been granted, are shown on Figure 3-1.

Fresno Kangaroo Rat Surveys

Fresno kangaroo rat surveys were conducted in the study area on July 17 through 22, 2011. The trap locations were selected based initially on habitat assessment surveys, followed by more focused reconnaissance. Areas within the East Loop, West Loop, and near the Chowchilla Bifurcation Structure (Figure 3-1) were visually surveyed on July 15, 2011 to establish the best Fresno kangaroo rat trapping locations. The best trapping locations were ones that contained signs of recent kangaroo rat activity, including burrows, tracks, and droppings, as well as representative habitat, including sandy soils and arid, open habitat. During the July 15 assessment, the majority of the potentially suitable habitat to which access had been granted was determined to be largely unsuitable for Fresno kangaroo rat for one or more reasons: vegetation was too dense (e.g., annual grassland); areas did not contain sandy soil; and/or areas did not contain sign of recent kangaroo rat activity. A total of 150 traps were set, 50 at each of the three trapping locations. Trapping was conducted for 5 consecutive nights and resulted in a total of 750 trap nights. All animals captured were identified to species, sexed, weighed, marked, and released. Additional details regarding the methods used can be found in the 2011 *San Joaquin River Restoration Program Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRPP 2011c).

Rare Plant Surveys

Initial botanical surveys were conducted in 2010 and 2011 in accordance with CDFG's *Protocols for Surveying and Evaluating Impacts to Special-Status Native Plant Populations and Natural Communities* (DFW 2009), in a manner sufficient to locate any listed species that may have been present in the areas surveyed (Figure 3-1). Access to private property was not obtained in time to conduct early and mid-season special-status plant surveys in 2010. Only late season surveys were conducted in 2010 (August) and early and mid-season surveys were conducted in 2011 (March to July). Surveys were conducted in the field at the time of year when special-status species were both evident and identifiable, during flowering or fruiting. Visits were spaced throughout the growing season to accurately determine what plants exist on site. This involved multiple visits to the same site (e.g., in early, mid, and late-season for flowering plants) to capture the floristic diversity at a level necessary to determine if special-status plants were present. The initial plant surveys were performed in four phases at four different times of the year. Protocol surveys for the California jewelflower and San Joaquin woolly threads were performed in the first phase, on March 4, 11, 17, 18, and 19, 2011. San Joaquin Valley

Orcutt grass (*Orcuttia inaequalis*) surveys were performed in the second phase, on April 7, 2011. Surveys for late flowering species including palmate-bracted bird's beak and hairy Orcutt grass (*Orcuttia pilosa*) were performed in the third phase, on May 28, June 24, and June 25, 2011, and in the fourth phase, which was conducted in the previous year on August 23 through 27, 2010. Additional details regarding the methods used for these initial surveys can be found in the 2011 *San Joaquin River Restoration Program Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRPP 2011c).

Additional botanical surveys were performed in the southeastern portion of the Project area where additional access was gained in 2015 (Figure 3-1). These surveys were conducted April 28 through 30, 2015 following methods similar to those described above and in the 2011 *San Joaquin River Restoration Program Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRPP 2011c).

3.2 Description of Action Area

3.2.1 Climate

The Action Area is in the San Joaquin Valley, characterized by a semi-arid climate, with long, hot, dry summers and relatively mild winters. Winter temperatures are usually mild, but drop below freezing during occasional cold spells. The monthly average of the minimum daily temperature ranges from 36 to 66 degrees Fahrenheit (°F), and the monthly average of the maximum daily temperature ranges from 54 to 100°F (WRCC 2011). Based on long-term records of precipitation, the average annual precipitation in the vicinity of the Action Area is approximately 8.0 inches but increases moving easterly towards the mountains as the elevation increases. Approximately 90 percent of precipitation in the Action Area occurs from November through April.

3.2.2 Aquatic Habitat

Mendota Pool is situated at the confluence of Fresno Slough and the San Joaquin River (Figure 1-1). The San Joaquin River arm of Mendota Pool extends from Mendota Dam to San Mateo Avenue. San Mateo Avenue has a low-flow crossing consisting of a culvert and an earthen embankment supporting the roadbed which is overtopped during higher flows.

Water is typically delivered to Mendota Pool from the Delta-Mendota Canal and is withdrawn at several canal or pump locations in the Mendota Pool including Columbia Canal, Helm Ditch, Main Canal, Outside Canal, Fresno County Waterworks District Canal, Mowry pumps, and others. Water is also delivered to the Mendota Pool by the Mendota Pool Pumpers group as well as by river flows. Mendota Pool was previously dewatered biennially in mid-winter for maintenance of the Dam, but some locations held standing water during this several week period. Mendota Pool was most recently dewatered for maintenance in the winter of 2011 to 2012. Recent repairs at Mendota Dam have reduced the need to dewater the Pool for dam inspections, and it is expected that 2016 will be the next dewatering.

Prior to the start of Interim Flows in October 2009, the section of Reach 2B between the Chowchilla Bifurcation Structure and San Mateo Avenue was mostly dry (SJRRP 2010). Surface flows throughout Reach 2B occurred during very wet periods (about every 3 to 5 years). Water released from Mendota Dam was typically delivered to downstream water users. Downstream of the last diversion point, the river was typically dry.

Aquatic habitat in Reach 2B was either mostly absent within the dry section of the channel or was backwatered in the impounded water body. The river channel was composed of a sand bed with margins occupied by sparse riparian or ruderal vegetation (SJRRP 2010). The portion of the Reach 2B channel upstream of San Mateo Avenue was composed of unconsolidated fine sand. Aquatic habitat was seasonal because flow was not sustained in the channel. The channel bed was generally devoid of a defined low-flow channel or aquatic habitat features such as pools and bars. Riparian vegetation was sparse and limited to the levees along the channel. Downstream of San Mateo Avenue, aquatic habitat was affected by the backwatering of Mendota Dam and sedimentation in Mendota Pool. The channel was defined by emergent, wetland, and riparian vegetation, including mature cottonwood trees, established along the backwatered portion of Mendota Pool. Most of the Mendota Pool was fairly shallow, and some areas also contained submerged aquatic vegetation. Mendota Pool contained mostly introduced fish and a few native fish.

Since the start of Interim Flows there have been some changes in Reach 2B, mostly between the Chowchilla Bifurcation Structure and San Mateo Avenue. The changes primarily consist of more regular inundation due to increased water releases from Friant Dam and the associated establishment of hydrophilic vegetation. Aquatic habitat includes a series of low gradient riffles, flatwater glides, and mid-channel pools (DFW 2010). However, in dry years, portions of the channel still experience extended periods of desiccation. The section of Reach 2B affected by backwater is visibly unchanged by Interim Flows and generally persists as described above because it continues to have water year-round.

Currently, the habitat types present in the Reach 2B channel upstream of San Mateo Avenue include riverine, lacustrine, river wash, riparian scrub, willow scrub, and wet herbaceous. The habitat types present in the Reach 2B channel below San Mateo Avenue include lacustrine, fresh emergent wetland, willow scrub, valley foothill riparian, and river wash.

3.2.3 Terrestrial Habitat

The habitat surrounding the Action Area consists of a narrow and fragmented corridor of woody and scrub vegetation along Reach 2B upstream of Mendota Pool with a somewhat healthier stand, supported by the presence of water, along the San Joaquin River arm of the Mendota Pool (Figure 3-2). The backwater area of the Mendota Pool supports riparian vegetation that is primarily composed of Fremont cottonwood (*Populus fremontii*), willow (*Salix* spp.), box elder (*Acer negundo*), and ash (*Fraxinus latifolia*). Emergent wetland communities are also present in the Mendota Pool backwater area. Starting a few miles upstream from Mendota Dam and especially upstream of San Mateo Avenue, the channel banks contain riparian scrub and willow scrub communities. Much of the valley foothill riparian habitat is defined by dense, broad-leaved deciduous forest composed of

species that favor fine-grained alluvial soils with yearly flooding. Dominant species are Fremont cottonwood and Gooding's black willow (*Salix goodingii*); other willow species include red willow (*S. laevigata*) and arroyo willow (*S. lasiolepis*). Box elder and ash are also common in the area. Cottonwood canopy heights in mature sections of forest may reach 40 to 60 feet, with the other species forming a mid-level canopy and understory. The understory is typically dense with young willows, wild rose (*Rosa californica*) and the introduced Himalayan blackberry (*Rubus discolor*). Some older or grazed stands have little woody understory vegetation may consist of grasses or herbs such as mugwort (*Artemisia douglasiana*). Gravelly stretches of the channel with lower densities of woody vegetation with tree cover less than 50 percent are often invaded by non-native weedy vegetation. The open nature of the vegetation is probably maintained by disturbance, creating suitable habitat for eucalyptus and giant reed.

The San Joaquin River is dominated by willows, frequently almost exclusively by black willow. Red willow and arroyo willow may also appear. Occasional scattered cottonwoods, ashes or alders may be present but are never an important part of the canopy cover. Buttonwillow (*Cephalanthus occidentalis*) is often present and may even dominate the riverbank for stretches. Sand and gravel bars in the more disturbed areas of the open channel frequently support open to dense shrubby stands of willow vegetation less than 15 feet in height. These sites are subject to deeper flooding and higher flows, burying and breaking of woody stems. Gooding's black willow and narrow-leaved willow (*Salix exigua*) are able to bend with the flows and recover, or re-sprout from the base. They are the most common dominants, with the narrow-leaved willows frequently forming dense clonal stands. Cottonwood seedlings are usually present but rarely reach reproductive size due to the dense cover created by willows. Mixed riparian communities form under conditions with less disturbance and flooding than the willow and cottonwood riparian communities, usually somewhat further back from the active channel. Willows are usually present, and other species include valley oak (*Quercus lobata*), black walnut (*Juglans hindsii*), alder (*Alnus rhombifolia*), sycamore (*Platanus racemosa*), and cottonwood in various proportions.

Annual grasslands in the study area intergraded with communities dominated by annual forbs and biennial or perennial herbs. These contained varying percentages of native elements, sometimes as native perennials such as *Leymus triticoides*. Herbaceous communities comprise the dominant vegetation type throughout the study area. Characteristic herbaceous riparian species in the study area include Bermuda grass (*Cynodon dactylon*), sunflower (*Helianthus* spp.), cocklebur (*Xanthium strumarium*), goosefoot (*Chenopodium* spp.), and beggar's tick (*Bidens frondosa*). Characteristic marsh species include bulrushes (*Scirpus* spp.) and cattails (*Typha* spp.). Riparian scrub in the study area is dominated by mugwort together with nettle (*Urtica dioica*) and various tall weedy herbs.

Dry sandy areas and well drained gravel are colonized by herbaceous vegetation similar to that of the wetland intergrade areas with the notable additions of California poppy (*Eschscholzia californica*) and bush lupine (*Lupinus albifrons*). These are the first areas colonized by willow scrub, and also the first to be scoured by high flows. The frequent

disturbance and poor substrate quality allow very little vegetation establishment, resulting in a Barren habitat type.

Land use within and surrounding the Action Area is primarily agriculture and is interspersed with native scrub and grassland habitat, public parks, and other areas kept free of vegetation by regular disturbance. Disturbed areas include dirt roads, canals, levees, structures, and landscaping. Upland areas within the study area are typical of the San Joaquin Valley and include a mixture of cultivated land interspersed with patches of native scrub or grasslands. Grassland is a forb- and grass-dominated plant community. Generally, sites with grassland are well drained and flood occasionally under existing hydrologic conditions. The grassland vegetation type is composed of an assemblage of nonnative annual and perennial grasses and occasional nonnative and native forbs. The most abundant species are nonnative grasses ripgut brome (*Bromus diandrus*), foxtail fescue (*Vulpia myuros*), and foxtail barley (*Hordeum murinum ssp. leporinum*) and forbs red-stemmed filaree (*Erodium cicutarium*) and horseweed (*Erigeron sp.*).

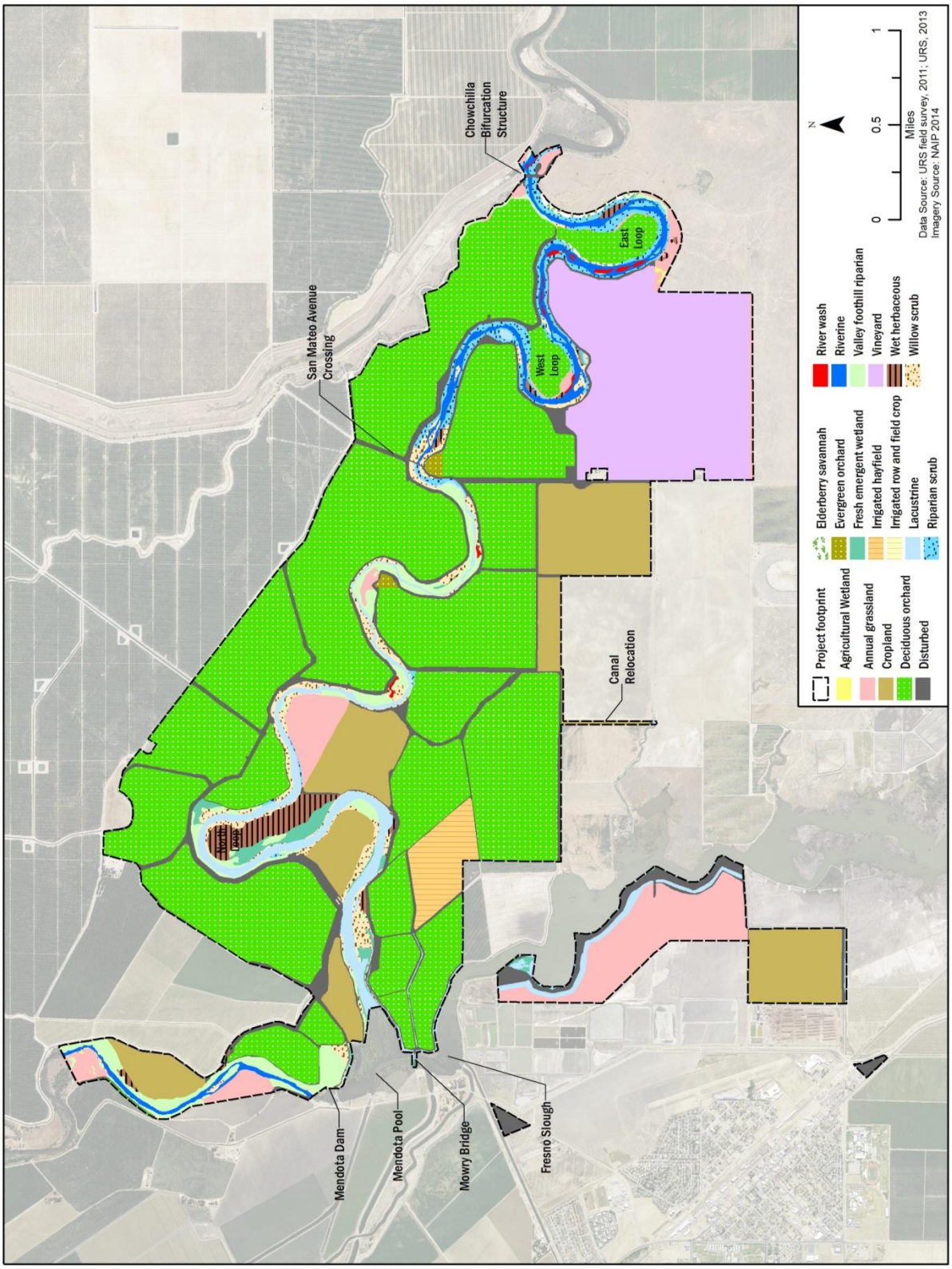

Figure 3-2.
Habitat Types within the Compact Bypass and Reach 2B Channel Improvements Phases of the Project

3.3 Federally Listed Species and Designated Critical Habitat

The CNDDB and USFWS Sacramento Field Office database searches returned a number of special-status biological resources (eleven wildlife and six plant species) that may potentially occur in the region (Tables 3-1 and 3-2). Special-status biological resources are defined in this document to include those wildlife and plant species that are federally listed, proposed for Federal listing, or Federal candidate species. Special-status biological resources not anticipated to occur in the Project vicinity or be affected by the proposed action are not further discussed in this BA.

3.3.1 Critical Habitat

Critical habitat for Fresno kangaroo rat has been designated in the region approximately 2 miles south of the Action Area. No designated critical habitat for any species occurs within the Action Area, and critical habitat is not addressed further in this BA.

3.3.2 Federally Listed Species in the Action Area

Table 3-1 summarizes the results of the background review and presents the special-status wildlife species that were evaluated for their potential to occur within the Action Area. Based upon the findings of the review and the environmental baseline conditions, potential for presence of the federally listed species is inferred within the Action Area.

Results of the database search included six species of special-status plants (Table 3-2). Subsequent protocol-level botanical field surveys failed to detect any evidence of these species. Due to the lack of vernal pool habitat in the Action Area, vernal pool associated species will not be further addressed in this BA. Although only the three plant species with the highest likelihood of occurrence are being addressed in this BA, Conservation Measure PLANTS-1 (Table 2-4) will be implemented to detect latent populations of other special status plants.

Potential adverse effects to species with potential to occur, including valley elderberry longhorn beetle, blunt-nosed leopard lizard, giant garter snake, least Bell's vireo, Fresno kangaroo rat, San Joaquin kit fox, California jewelflower, palmate-bracted bird's beak, and San Joaquin woolly threads, are discussed in Section 4.

Table 3-1.
Special-Status Wildlife Species

Scientific Name Common Name	Federal/ State Status	Preferred Habitat	Potential to Occur in the Action 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.	None: No suitable habitat observed during habitat assessment surveys. Suitable habitat absent from Action Area. Areas identified as potential habitat based on aerial photographs (SJRRP 2011c) were found to be unsuitable (agricultural wetlands) during 2015 field surveys.
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.	None: No suitable habitat observed during habitat assessment surveys. Suitable habitat absent from Action Area. Areas identified as potential habitat based on aerial photographs (SJRRP 2011c) were found to be unsuitable (agricultural wetlands) during 2015 field surveys.
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.	Low: Elderberry shrubs are abundant in the Action Area. However, USFWS has redefined the range of the valley elderberry longhorn beetle to exclude the Action Area (USFWS 2015b).
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: Action Area outside known current and historic range. Suitable habitat absent from Action Area. Areas identified as potential habitat based on aerial photographs (SJRRP 2011c) were found to be unsuitable (agricultural wetlands) during 2015 field surveys.
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 Action Area and vicinity, based on current known distribution, presence of two nonnative ranid frog species, and presence of nonnative, predatory fish species.

Table 3-1.
Special-Status Wildlife Species

Scientific Name Common Name	Federal/ State Status	Preferred Habitat	Potential to Occur in the Action Area
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.	Low: Potentially suitable habitat exists in annual grassland and elderberry savannah located south of the Chowchilla Bifurcation Structure (see Figure 3-5). Occurrence to be confirmed by protocol-level surveys.
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 within Action Area (DFW 2015). Suitable habitat observed in portions of the Action Area, including San Joaquin River affected by Mendota Dam, and in Fresno Slough (see Figure 3-6).
Birds			
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.	None: Action 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.
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 conducted in in the Action Area in 2014 and 2015. Nearest known occurrence is San Luis Reservoir (approximately 55 miles northwest).

Table 3-1.
Special-Status Wildlife Species

Scientific Name Common Name	Federal/ State Status	Preferred Habitat	Potential to Occur in the Action Area
Mammals			
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.	Low: Despite efforts to trap this species, it has not been detected at nearby sites where it was previously present in 1992. Kangaroo rat sign (e.g., tail drags, potential burrows) has been observed in the Action Area (East and West loops prior to agricultural conversion, see Figure 3-2), although 2011 trapping efforts at these and other locations within the study area captured only Heermann's kangaroo rat. Potentially suitable habitat exists in annual grassland and elderberry savannah located south of the Chowchilla Bifurcation Structure (see Figure 3-7). Occurrence to be confirmed by protocol-level surveys.
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 potential foraging and denning habitat was observed during the habitat assessment survey, sign was not observed and prior surveys in portions of the Action Area and vicinity have failed to confirm presence of this species.

Key:
U.S. Fish and Wildlife Service and Federal Listing Categories:
BCC = Bird of Conservation Concern
FC = Candidate for Federal Listing
FE = Federally Listed as Endangered
FT = Federally Listed as Threatened
MBTA = Protected under the Migratory Bird Treaty Act
California Department of Fish and Game State Listing Categories:
FP = Fully Protected
SE = State Listed as Endangered
SSC = Species of Special Concern
ST = State Listed as Threatened

Table 3-2.
Special-Status Plant Species

Scientific Name Common Name	Federal/ State/CNPS Status	Habitat/Communities	Potential to Occur in Inaccessible Portions of Action Area and Survey Results	Blooming Period/ Survey Date
Castilleja campestris ssp. *succulenta* succulent owl's-clover	FT/SE/1B.2	Vernal pools (often acidic)	No potential to occur based on absence of vernal pools in the Action Area. Not observed during surveys.	Apr-May/ late April
Caulanthus californicus California jewelflower	FE/SE/1B.1	Chenopod scrub, pinyon and juniper woodland, and sandy valley and foothill grassland	Very low potential to occur based on absence during surveys; limited suitable habitat present in Action Area. There are no records of this species within 10 miles of the Action Area. Not observed during surveys.	Feb-May/ mid-March
Cordylanthus palmatus palmate-bracted bird's beak	FE/SE/1B.1	Chenopod scrub and alkaline valley and foothill grassland	Low potential to occur based on absence during surveys; limited suitable habitat present in Action Area. CNDDB observations reported within 5 miles of the Action Area. Not observed during surveys.	May-Oct/ mid-June
Monolopia (=Lembertia) congdonii San Joaquin woolly threads	FE/--/1B.2	Chenopod scrub and sandy valley and foothill grassland	Low potential to occur based on absence during surveys; limited suitable habitat present in Action Area. One CNDDB observation recorded within 10 miles of the Action Area. Not observed during surveys.	Feb-May/ mid-March
Orcuttia inaequalis San Joaquin Valley Orcutt grass	FT/SE/1B.1	Vernal pool obligate species	No potential to occur based on absence of vernal pools in the Action Area. Not observed during surveys.	Apr-Sep/ late April
Orcuttia pilosa hairy Orcutt grass	FE/SE/1B.1	Vernal pool obligate species	No potential to occur based on absence of vernal pools in Action Area. Not observed during surveys.	May-Sep/ mid-June

Key:
CNDDB = California Natural Diversity Database
CNPS = California Native Plant Society
FE = Federally Listed as Endangered
FT = Federally Listed as Threatened
SE = State Listed as Endangered
1B.1 = California Rare Plant Rank 1B (rare, threatened, or endangered plant), seriously threatened in California
1B.2 = California Rare Plant Rank 1B (rare, threatened, or endangered plant), fairly threatened in California
2.1 = California Rare Plant Rank 2 (rare, threatened, or endangered in California, but more common elsewhere)
-- = not listed

3.4 Species Considered

The following species are discussed in detail based on their potential to occur within the Action Area.

3.4.1 Valley Elderberry Longhorn Beetle

Valley elderberry longhorn beetle was listed as threatened under the ESA on August 8, 1980 (45 FR 52803). Valley elderberry longhorn beetle is endemic to the Central Valley and ranges from southern Shasta County south to Fresno County. It is dependent on elderberry shrubs (*Sambucus* spp.) in which it lays its eggs. Elderberry shrubs are typically found within riparian habitats (USFWS 1984; USFWS 2006a).

There are four stages in the valley elderberry longhorn beetle's life cycle: egg, larva, pupa, and adult. Adults are found from March to early June, and generally remain within elderberry habitats, but occasionally disperse up to 1 mile. They rest on the leaves of the elderberry shrubs, fly between the shrubs, and feed on the elderberry foliage. Mating also occurs from March to early June, and females lay eggs on living elderberry plants. They require elderberry plants with stems greater than 1 inch at ground level in order for larvae to have an adequate food source (USFWS 2006a; USFWS 2009b).

First instar larvae hatch and bore to the center of stems where they develop for one to 2 years feeding on the pith. Near the end of their larval stage they chew through the elderberry bark, creating an exit hole, then turn around and return to the pith, plugging the exit hole with frass. Back in the pith, they metamorphose into pupae and then into adults. After transformation, adult beetles break through the frass plug at the exit hole. Adult emergence typically occurs as elderberries are flowering (77 FR 60237, October 2, 2012; USFWS 1984; USFWS 2009b).

Known Occurrences

Since earlier Project documents were published, including the *Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRRP 2011c), USFWS has published range information for the valley elderberry longhorn beetle that excludes the Project location (USFWS 2015b). The species' range as currently mapped by USFWS includes portions of the Sacramento and San Joaquin valleys but terminates northwest of Firebaugh, approximately 9 miles northwest of the Action Area (Figure 3-3). Based on this information, valley elderberry longhorn beetle is no longer expected to occur in the Action Area.

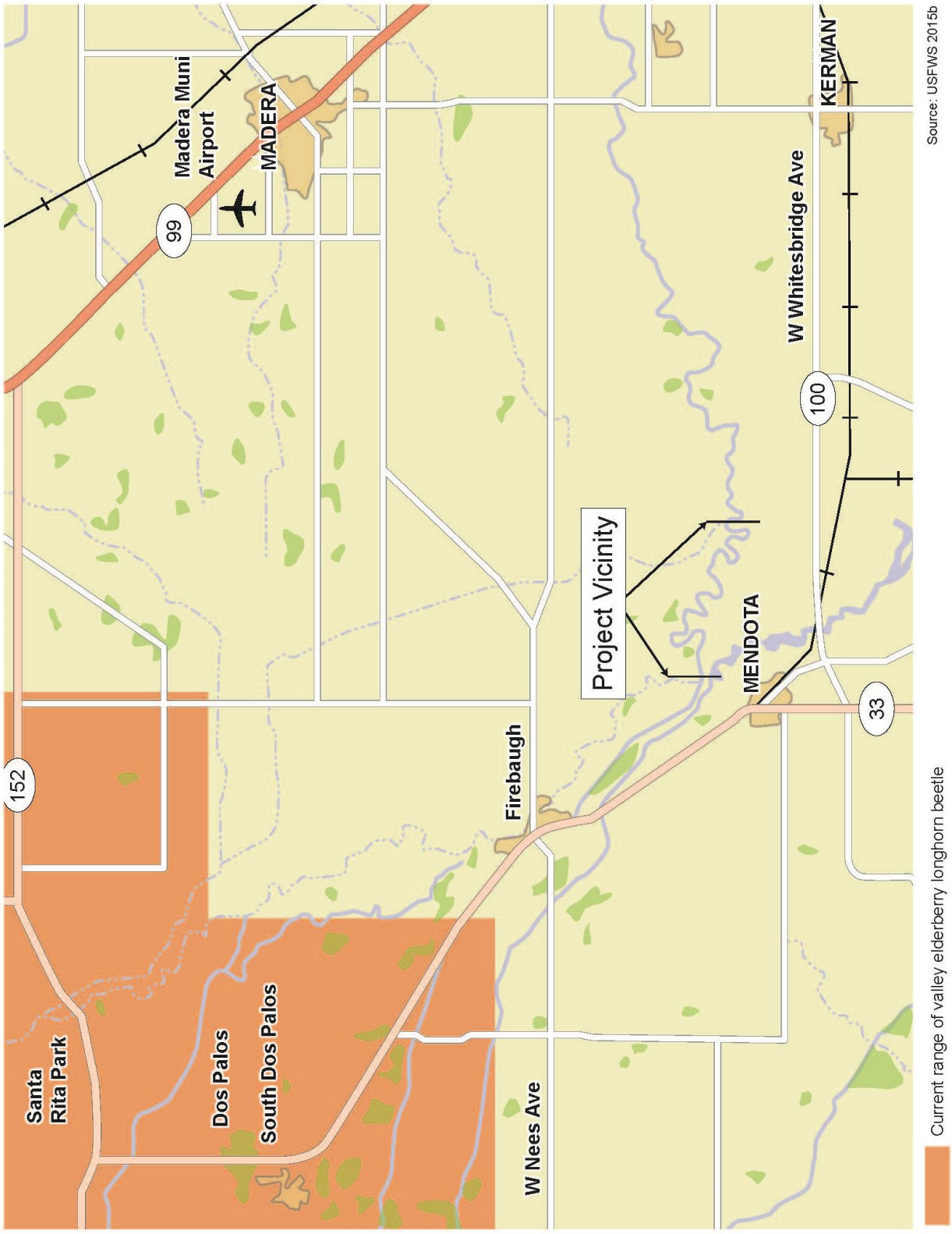

Figure 3-3.
The USFWS-Mapped Range of Valley Elderberry Longhorn Beetle (in Orange) Terminating Northwest of the Action Area.

Prior to when this updated species range information was available, valley elderberry longhorn beetle surveys were conducted according to USFWS protocol where access was available in the Action Area in 2011 (SJRRP 2011c) (Figure 3-4). Exit holes were noted in a majority of the shrubs surveyed; however, not all exit holes could be conclusively identified as having been created by an elderberry longhorn beetle. Additionally, exit holes made by the valley elderberry longhorn beetle are not distinguishable from exit holes made by the non-listed California elderberry longhorn beetle (*Desmocerus californicus californicus*) (USFWS 2012a).

The exit holes noted during the 2011 protocol-level survey were generally round to ovular, and ranged from 0.1 to 0.8 inch in diameter. As stated in the 1991 USFWS status review for the species, valley elderberry longhorn beetles create exit holes that are round to ovular, clean-edged, and range from 0.3 to 0.4 inch in diameter (Barr 1991). Some of the holes observed fit this description; however, many of the holes observed were outside the size range expected for holes created by elderberry longhorn beetles, or did not have clean edges. Evaluation of photographs collected during the survey revealed that some of the exit holes noted during the field survey were not created by elderberry longhorn beetles. Some of the larger holes may be old elderberry longhorn beetle holes (presumably California elderberry longhorn beetle) that were subject to secondary damage by birds or other insects. Some of the smaller holes were likely created by another species of insect, such as ants or termites, which are known to burrow in old wood.

In addition to the 2011 protocol survey, elderberry shrub locations have been documented through field surveys conducted for the SJRRP (ICF 2014), and incidental observations made while conducting other Project activities (Figure 3-4). Since the 2011 survey was conducted, portions of the Action Area known informally as the East Loop and the West Loop (Figure 3-2) that previously supported elderberry shrubs have been converted into deciduous orchard. Using GIS and aerial imagery, the 2011 results have been updated to exclude shrubs that are presumed to have been removed due to agricultural conversion. The total number of elderberry shrubs documented in the Action Area from all sources (excluding those presumed to have been removed due to agricultural conversion) is summarized in Table 3-3.

Table 3-3.
Number of Elderberry Shrubs Documented in Surveys

Number of Documented Elderberry Shrubs			
ICF	**URS (protocol surveys, 2011)**	**URS (incidental observations)**	**Total**
107	326	216	649

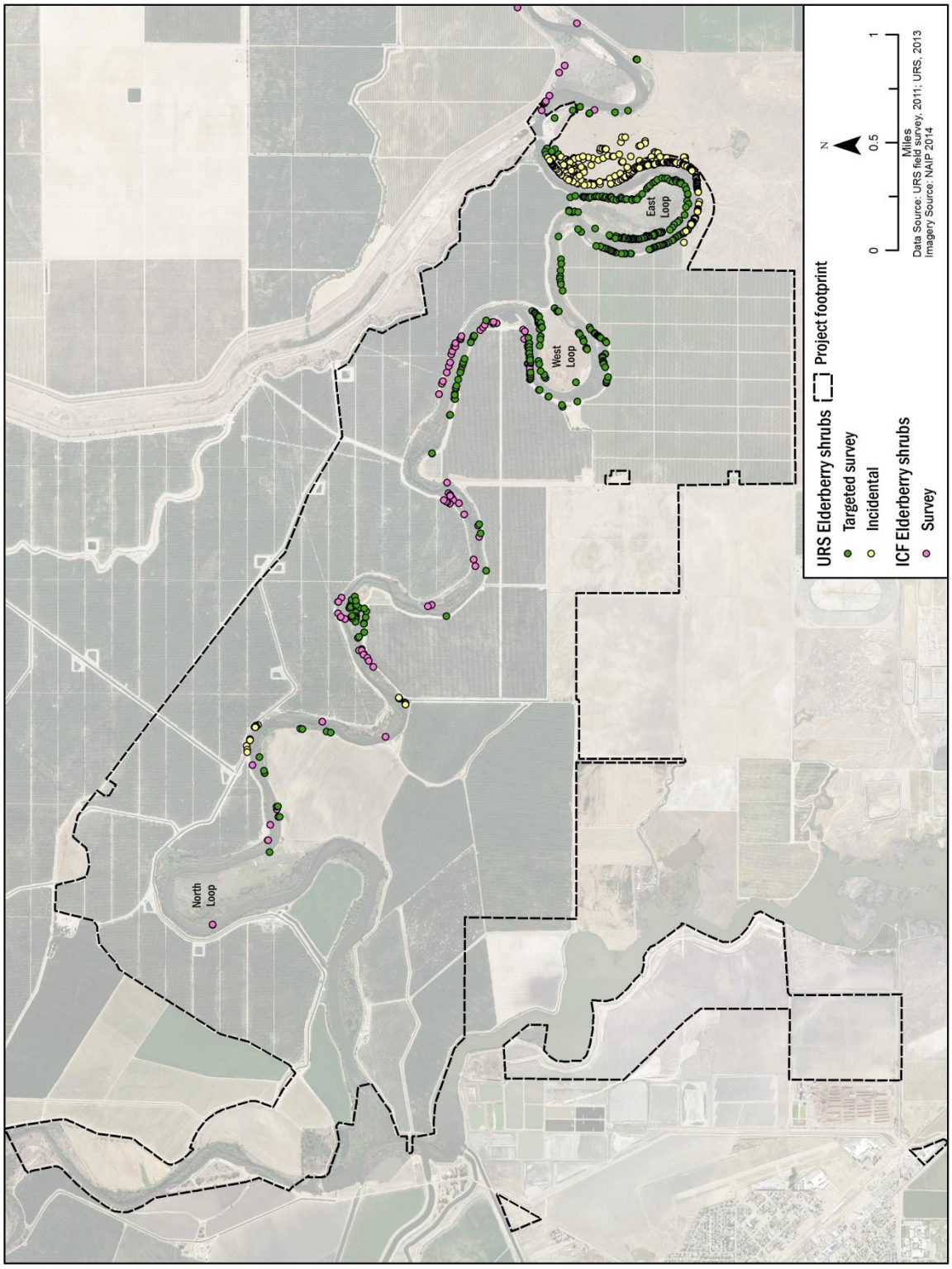

Figure 3-4.
Potential Elderberry Beetle Habitat in the Action Area

3.4.2 Blunt-nosed Leopard Lizard

Blunt-nosed leopard lizard was listed as endangered under the ESA on March 11, 1967 (32 FR 4001). The blunt-nosed leopard lizard has been found in nonnative grasslands and valley sink scrub communities of the San Joaquin Valley (USFWS 2010b). They have also been found in valley needle grassland, alkali playa, and Atriplex grassland.

Blunt-nosed leopard lizards feed opportunistically, primarily on grasshoppers, crickets, moths, and other lizards (USFWS 1998a). Their seasonal above-ground activity correlates with current weather conditions, specifically the temperature. Above-ground activity usually occurs when daytime temperatures are between 74°F and 104°F (USFWS 1998a). Due to their temperature-dependent activity, the lizards tend to be more active between late morning and late afternoon, which is the hottest part of the day from March through mid-October or November (USFWS 1998a). Blunt-nosed leopard lizards breed within a month after the end of their dormant period. Breeding continues from the end of April through early June (USFWS 2010b).

Known Occurrences

Blunt-nose leopard lizard is known to occur at the Alkali Sink Ecological Reserve approximately 2 miles south of the Action Area. Initially the suitability of the Action Area for blunt-nosed leopard lizard was assessed in the *Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRRP 2011c) as moderate. At that time it was determined that suitable habitat was largely lacking from the majority of the Action Area. Although some habitats contained sandy or alkali soils, including riparian scrub and annual grassland, blunt-nosed leopard lizard was not expected to occur in these areas because of regular inundation during seasonal flood flow or the presence of dense vegetation, two habitat characteristics that are not suitable for the species (USFWS 1998a). It was primarily the proximity of known occurrences and lack of on-the-ground access to the portion of the Action Area most proximal to the known occurrences that led to an assessment of moderate potential to occur in the 2011 document.

In 2015 access had been granted to the portion of the Action Area previously identified as potentially suitable for blunt-nosed leopard lizard, shown in Figure 3-5. This area includes annual grassland and elderberry savannah and lies at the southeast extent of the Action Area, south of the San Joaquin River and Chowchilla Bifurcation Structure. On-the-ground inspection of this area confirmed that potentially suitable habitat that had been identified consists of annual grassland and elderberry savannah, is densely vegetated and frequently inundated, and therefore provides less suitable habitat than the alkali sink/scrub habitat located south of the Action Area. Based on the best available information, including these supplemental observations, there is a low potential for blunt-nosed leopard lizard to occur in the Action Area. The acreage of potentially suitable habitat documented to occur in the Action Area for blunt-nosed leopard lizard is summarized in Table 3-4.

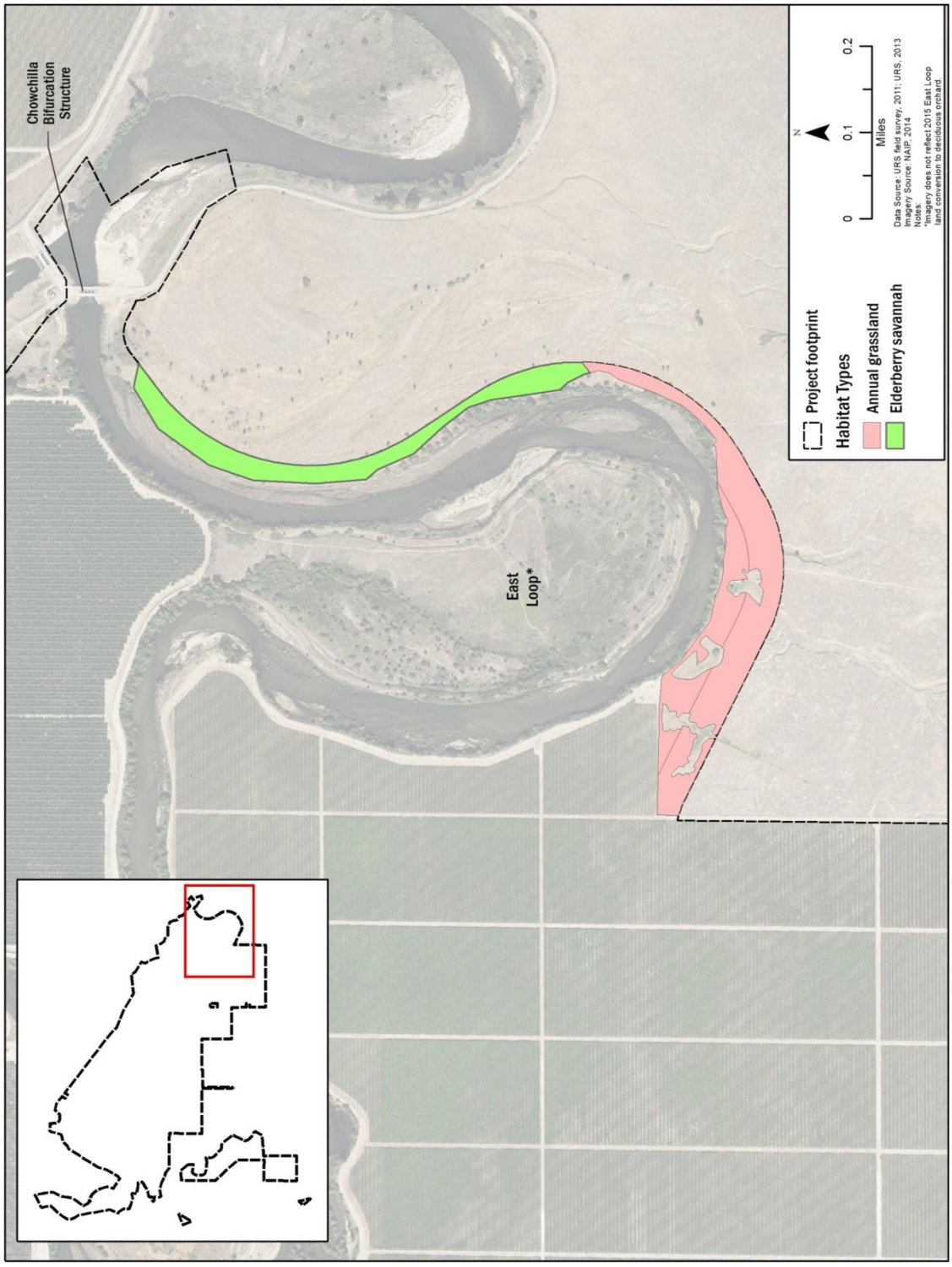

Figure 3-5.
Potential Blunt-Nosed Leopard Lizard Habitat in the Action Area

Table 3-4.
Potential Blunt-Nosed Leopard Lizard Habitat

Scientific Name	Common Name	Habitat Type	Potential Impacts (acres)			
			Floodplain	Infrastructure	Borrow	Other
Gambelia sila	blunt-nosed leopard lizard	Habitat	5	20	0	0

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)

3.4.3 Giant Garter Snake

Giant garter snake was listed as threatened under the ESA on October 20, 1993 (58 FR 54053). Giant garter snake is endemic to the Central Valley, from Butte Creek south to the Mendota Wildlife Area. The species occurs in tributaries, freshwater marshes and floodplains, and other freshwater wetland habitats within the Central Valley of California. Giant garter snakes typically inhabit still or slow moving, freshwater habitats during their active season (early spring through mid-fall). These habitats include wetlands, ponds, streams, or other waterways, including agricultural canals and wetlands. Emergent wetland vegetation, such as cattails and bulrushes, is necessary for escape from predators as well as foraging. Adjacent upland habitat provides area for basking. Giant garter snakes are not usually found in larger rivers or wetlands with sand, gravel, or rock substrates due to the lack of suitable habitat and emergent vegetative cover. Most riparian woodlands do not provide suitable habitat because of excessive shade, lack of basking sites, and absence of prey populations. The giant garter snake needs adequate water during their active season to provide food and cover. Giant garter snakes feed primarily on small fishes, insects, tadpoles, and frogs (USFWS 2007, USFWS 2012b).

The giant garter snake uses higher elevation uplands for cover and refuge from flood waters during the inactive, winter season. Giant garter snakes inhabit small mammal burrows and other soil crevices, above prevailing flood elevations, throughout the inactive period. They typically select burrows with sunny exposure along south and west facing slopes (USFWS 2007, USFWS 2012b).

The breeding season is in March and April; and females give birth to live young from late July through early September. Brood size varies from 10 to 46 young. Although growth rates are variable, young typically more than double in size within the first year. Sexual maturity averages three years for males and five years for females (USFWS 2007, USFWS 2012b).

Known Occurrences

At present, within the San Joaquin Valley, only the Volta Wildlife Area in Merced County is known to support a giant garter snake population characterized by the normal

age and size distribution suggesting active population recruitment (Hansen, pers. comm., 2015a). The primary habitat of the southern-most remnant population is Mendota Wildlife Area, roughly 3 miles south of the Action Area and hydrologically connected to Mendota Pool via Fresno Slough. The status of this population, however, is uncertain. There are no current survey data from the Mendota Wildlife Area but the most recent surveys suggest a potentially senescing population. In 2001 DFW trapped 18 giant garter snakes among five unique sites (Dickert 2005). In 2007 and 2008, trapping was conducted by E. Hansen and only one giant garter snake was trapped among 12 sites (Hansen 2008).

No surveys have been conducted north of the Mendota Wildlife Area (Fresno Slough and Mendota Pool north of Highway 180/Whites Bridge Road), or in the Action Area, since the mid-1990s. A single giant garter snake was collected from a slough near the San Joaquin River in the Mendota Pool Area in 1976 (SJRRP 2011c).

Aquatic and upland habitats potentially suitable for giant garter snake in and around the Project Action Area were documented during habitat assessments (Figure 3-6). Please note that Figure 3-6 includes a much greater extent of habitat than what will be affected by the Project. Habitat mapping for giant garter snake includes two habitat types: aquatic and upland. Aquatic habitat consists of open water and aquatic areas with emergent vegetation, and is used for foraging, basking, and escape cover. Upland habitat is used for basking adjacent to foraging habitat, dispersal, or shelter during the inactive season.

Suitable aquatic habitat is essential for the survival of the giant garter snake (USFWS 2015c). Highly suitable aquatic habitat for giant garter snake exists in areas of fresh emergent wetland vegetation in lacustrine habitat from the Mendota Pool to the eastern side of the North Loop (Figure 3-6). Aquatic habitat in this area is largely characterized as having slow moving or static water present March through November, mud substrate, areas of emergent bankside vegetation for cover and thermoregulation, absence of continuous riparian canopy, and available prey. These are among the key attributes of ideal aquatic giant garter snake habitat (USFWS 2015c).

Further upstream in the San Joaquin River arm of the Mendota Pool, habitat transitions and becomes less suitable for giant garter snake. There is less emergent vegetation, stream banks and substrate are sandier and support vegetation more typical of riparian scrub and forest than emergent wetland (Figure 3-6), reducing opportunities for cover and thermoregulation. This change in habitat, from highly suitable habitat in the downstream portion of the San Joaquin arm of Mendota Pool to sandier, scrubbier habitat in the upstream portions of the San Joaquin arm of Mendota Pool were observed in the field by USFWS, Reclamation, and their consultants (including giant garter snake expert Eric Hansen) on May 28, 2015 (Hansen, pers. comm., 2015a). Based on conversations with USFWS (see Section 1.1, Consultation History) the entire extent of this reach, upstream to San Mateo Avenue, has been mapped as suitable aquatic habitat.

Aquatic habitat was also mapped at other locations in the Action Area. Highly suitable aquatic habitat is present in Fresno Slough (Figure 3-6). Elsewhere in the Action Area sparsely vegetated, non-wetland habitat was present in some irrigation canals at the west

end of the study area, between the San Joaquin River, Mendota Pool, and Fresno Slough. It has been found that water conveyance infrastructure consisting of a matrix of canals, levees, and ditches, when present among active rice fields, can serve as alternative habitat for giant garter snakes in the absence of suitable natural marsh habitat (USFWS 2015b). Suitable marsh habitat surrounds the canals at the west end of the Action Area on three sides, increasing the likelihood that giant garter snakes would use these un-vegetated features. Thus, the canals at the west end of the Action Area were mapped as suitable aquatic habitat in Figure 3-6.

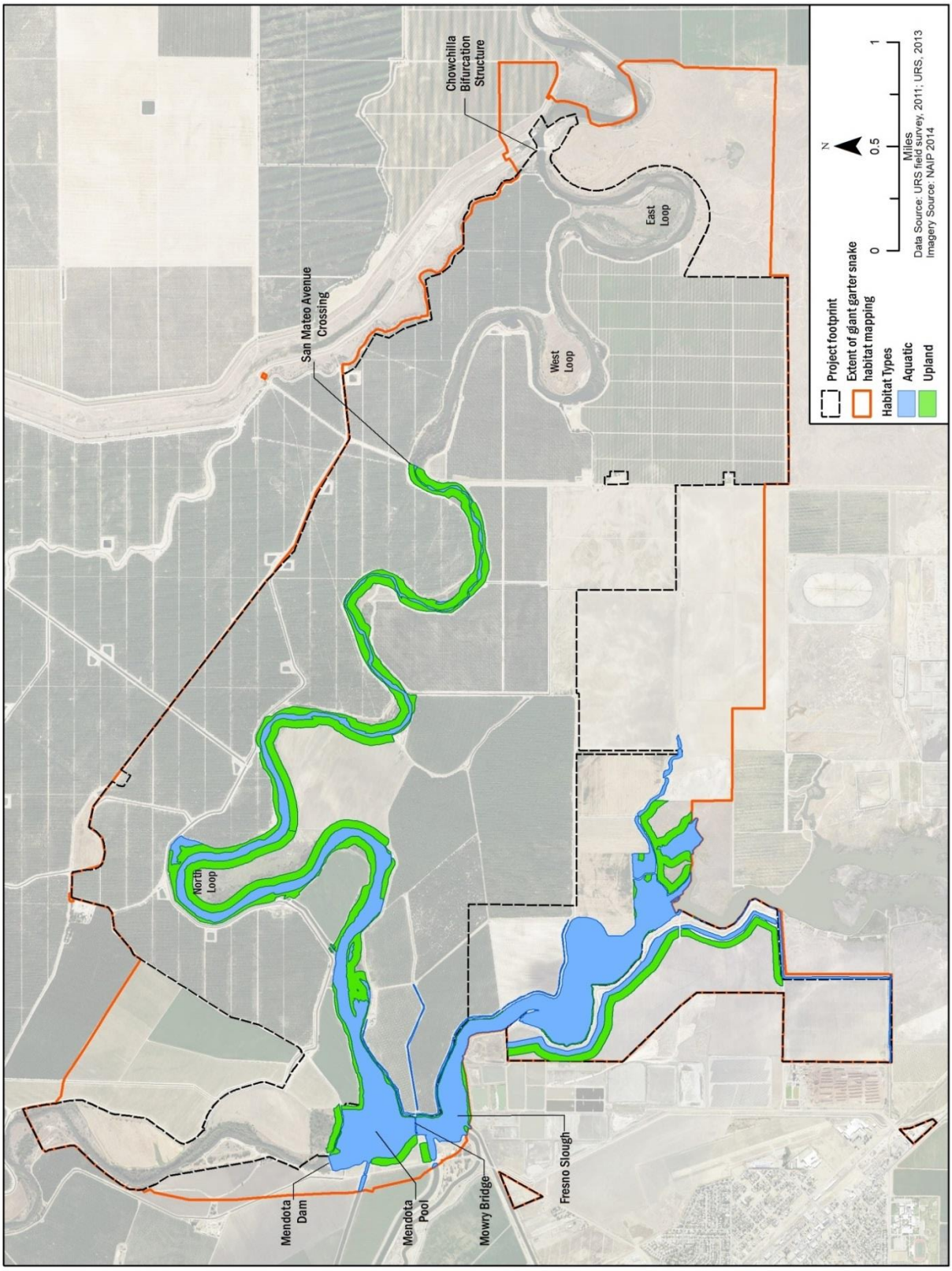

Figure 3-6.
Potential Giant Garter Snake Habitat around the Action Area

At other locations in the study area smaller agricultural irrigation ditches and drains were not mapped as suitable aquatic habitat. They typically lack aquatic or emergent vegetation and do not consistently contain water March through November, although some are vegetated with grasses due to infrequent and inconsistent inundation. They tend to be highly managed, somewhat temporary (they may not be located in the same places year after year), and surrounded by intensively managed agricultural uplands. Prey populations are expected to be small or absent, although bullfrogs may move into these habitats when they are inundated. In most cases the substrate is sandy. Unlike Mendota Pool and Fresno Slough, these features lack most key elements of suitable aquatic habitat. In the Action Area these ditches serve orchards and row crops that do not provide suitable habitat for giant garter snake, and are therefore less likely to be used by giant garter snake than similar features that serve rice fields (not present in the Action Area). For the purposes of calculating impacts (Section 4) these features are not considered to be suitable habitat for the species.

Upland habitat is used by giant garter snakes for temperature regulation regulate, cover, retreat into mammal burrows and crevices during shedding of skin, to avoid predation, and to overwinter (USFWS 2015c). All habitat with 200 feet of aquatic habitat mapped as potentially suitable for giant garter snake was evaluated for its potential to provide suitable upland habitat. However, at some locations the upland habitat was found to be unsuitable for giant garter snake and was not mapped as suitable habitat in Figure 3-6. For example, a strip of upland habitat west of Fresno Slough, between Fresno Slough and another canal, was found to be highly disturbed as if mechanically scraped, devoid of vegetation, and lacking small mammal burrows. This habitat is mapped as “disturbed” in Figure 3-2 and was not mapped as suitable giant garter snake upland habitat. However, habitat further west on the same parcel was mapped as annual grassland in Figure 3-2 was included as suitable upland habitat for giant garter snake in Figure 3-6.

Areas used intensively for agriculture (primarily vineyard and orchard, Figure 3-2), were not mapped as suitable habitat regardless of their location or proximity to suitable aquatic habitats. As small mammals are pests to the agricultural crops, these areas are managed intensively and burrows in these areas are scarce. Overhead cover in orchards and vineyards limits opportunities for thermoregulation, and this type of vegetation does not provide good escape cover for snakes. Row crops are also intensively managed, with regular disking or tilling of the soil preventing burrowing mammals and snakes from effectively utilizing underground refugia. Due to the homogeneity of the habitat provided in these monocultures and also due to control of burrowing agricultural pests, intensively managed agricultural uplands typically do not contain appropriate upland refugia for giant garter snakes, and are not mapped as suitable habitat in this Action Area.

Although the current population status is unknown, based on the continuous nature of suitable upland and aquatic habitats between the known occurrences of giant garter snake and Mendota Pool, as well as the historical occurrence from the pool itself, this species is inferred to have high potential to occur within suitable habitats in the Action Area. It is less likely to occur in the riparian scrub and forest upland and aquatic habitats within the portion of the Action Area further upstream in the San Joaquin River arm of the Mendota Pool.

3.4.4 Least Bell's Vireo

Least Bell's vireo was listed as endangered under the ESA on May 2, 1986 (51 FR 16474). Least Bell's vireo is restricted to riparian habitats that are dominated by willows and that have dense vegetation and a well-developed understory. Due to these specific habitat requirements, they are found only in areas characterized by mature riparian forest. Currently, 99 percent of the species occurs in southern California. Historically, the San Joaquin and Sacramento valleys supported the majority of breeding populations (60 to 80 percent), but vireos no longer inhabit these regions in significant numbers (DFW 2005; USFWS 2006b)

Birds migrate to breeding areas in southern California in late March and depart to wintering areas in Baja California by late September. Individuals typically return to the same areas to nest over multiple breeding seasons. Nests are most often constructed in willows near thicket edges and approximately 3.3 feet from the ground, although nests may be built in other tree or shrub species (51 FR 16474, May 2, 1986; DFW 2005). Foraging occurs in dense vegetation in the riparian zone and the adjacent upland areas up to 900 feet from nests (51 FR 16474, May 2, 1986; 59 FR 4845, February 2, 1994).

One of the primary threats to least Bell's vireos is loss and degradation of the riparian vegetation community on which they rely for nesting, foraging, and sheltering. Activities that have negatively impacted riparian habitat include agriculture, urban development, livestock grazing, and flood control and water development (e.g., river channelization, dams, water impoundments, and altered hydrology resulting from urban development). Invasion by nonnative plants, specifically the giant reed, has also led to a reduction in quality and quantity of suitable riparian habitat (51 FR 16474, May 2, 1986; DFW 2005).

Prior to recovery actions being implemented, nest parasitism by the brown-headed cowbird (*Molothrus ater*) may have significantly impacted least Bell vireo abundance. The brown-headed cowbird was relatively rare in California, but greatly increased in numbers as agriculture expanded. These birds lay eggs in the nests of other birds (like least Bell's vireo), which usually results in the loss of some of the host's chicks. Cowbird trapping has been used in the recovery of least Bell's vireo since the mid-1980s, and appears to be effective. Other predators, like domestic cats, may have easier access to least Bell's vireo in developed areas or where riparian habitat is small and fragmented (51 FR 16474, May 2, 1986; DFW 2005).

Known Occurrences

As discussed above, the San Joaquin Valley lies within the historic range of least Bell's vireo. However until 2005, breeding in the San Joaquin Valley had not been observed for over 50 years and since prior to the species' listing in 1986. In 2005, Howell and others (2010) detected a Least Bell's vireo nest in riparian habitat on the San Joaquin River National Wildlife Refuge (SJRNWR). Several similar nesting attempts have since been documented in the vicinity of the SJRNWR through 2007 (Howell et al. 2010). The SJRNWR is approximately 75 miles northwest of the Action Area and is characterized by large uninterrupted tracts of complex, mature riparian forest. These sightings represent the nearest documentation of the species in the Central Valley outside the established populations in southern California since its listing. Besides this documented breeding

activity in the San Joaquin Valley, there has been no other documented breeding in any other previously occupied areas including the Sacramento or Salinas valleys.

Prior to geotechnical investigation, USFWS protocol least Bell's vireo surveys were conducted along Reach 2B in 2014 (URS 2014) and 2015. The protocol least Bell's vireo surveys were conducted in accordance with the USFWS' Least Bell's Vireo Survey Guidelines (2001) and included sixteen discreet survey events over the 2 years. Least Bell's vireo were not detected during the protocol-level surveys.

Prior to conducting any surveys in 2014 desktop and field review of habitat was conducted to assess the suitability of habitat in the Action Area for least Bell's vireo (URS 2014). Vegetation data from previous biological investigations in the Project were analyzed for general suitability. After conducting a review of aerial imagery and previous survey results, portions of the Action Area that required a field assessment and/or verification were identified (URS 2014). Following the field assessment, suitable nesting habitat within 500 feet of geotechnical drilling locations was delineated, including areas near the Chowchilla Bifurcation Structure, proposed Mendota Bypass, and the San Mateo Crossing.

Habitat in the Survey Area was considered potentially suitable for least Bell's vireo foraging and nesting due to its species composition and general structure. However, when compared to confirmed breeding habitat in other portions of the species' range, habitat identified in the Action Area is lacking. Ideal habitat for nesting least Bell's vireo includes early to mid-successional riparian habitat that contains a dense shrub layer and a structurally diverse canopy for foraging (Kus 2002). Common plant species include Fremont cottonwood, arroyo willow, and black willow. Much of the potentially suitable habitat in the Survey Area consists of thin strips of either dense monotypic shrubs or mature cottonwood groves, with only a small percentage of the habitat containing the diverse canopy typically required by nesting least Bell's vireos.

The most suitable habitat in the Action Area was located in the San Mateo Avenue crossing and proposed Compact Bypass areas. These areas were typified by tall mature riparian trees such as willow and cottonwood and a dense shrub understory. However, most of the habitat was present as relatively thin strips immediately adjacent to the San Joaquin River. These narrow bands of habitat occurred on the right bank of the river; the other bank was primarily used as agricultural fields. More typical least Bell's vireo habitat is usually characterized by wider tracts of riparian habitat. Habitat evaluated near the Chowchilla Bifurcation Structure was similar to the San Mateo Avenue crossing and proposed Compact Bypass areas along the right bank of the San Joaquin River. The majority of the left bank of the channel contained only widely spaced individual trees.

Despite disparities in habitat quality, the 2014 and 2015 surveys included all potential least Bell's vireo breeding habitat within a 500-foot buffer of roughly 50 drilling locations. Surveys were conducted by qualified biologists that were approved by USFWS to conduct protocol surveys and who were familiar with behaviors and vocalizations of the target species as well as similar species with overlapping ranges. Supplemental nesting bird surveys conducted immediately prior to each drill shift were also conducted

each year, when drilling occurred prior to completion of the protocol surveys. Despite nearly 60 days spent surveying for vireo and other birds in the Action Area in 2014 and a similar level of effort in 2015 no least Bell's vireo were detected in the Action Area. Numerous occurrences of brown-headed cow bird and other nesting birds were detected. These surveys provide conclusive evidence that least Bell's vireo did not occur in the Action Area at the time of the surveys.

Based on recent occurrence and distribution records and the recent negative surveys, the potential for least Bell's vireo to occur is low. Evidence of dispersal into its historical range is emerging, and it is possible that least Bell's vireo could colonize the Action Area prior to construction of the Project. Although detections of least Bell's vireo at the SJRNWR in recent years demonstrate the ability for the species to return to portions of its historical range, results from protocol surveys in the Action Area may indicate that the re-colonization of the Central Valley by least Bell's vireo is potentially restricted by several factors, including lack of suitable habitat. This species may be more likely to re-establish in Reach 2B as flows are restored to the San Joaquin River and adequate riparian habitat develops, following implementation of the Project and other elements of the SJRRP.

3.4.5 Fresno Kangaroo Rat

Fresno kangaroo rat was listed as endangered under the ESA on January 30, 1985 (50 FR 4222). Fresno kangaroo rats subsist primarily on the seeds of perennial and annual grasses and annual forbs, as well as the seeds of saltbush (*Atriplex sp.*), iodine bush (*Allenrolfea occidentalis*) and seepweed (*Suaeda nigra*) (USFWS 1998a). Fresno kangaroo rats are nocturnal and active throughout the year; they do not hibernate. During foraging outings, seeds are collected and stored in external fur-lined cheek pouches. The contents of the cheek pouches are deposited in small pits on the soil surface in the home range of the individual kangaroo rat, and used during times of seed scarcity.

Fresno kangaroo rats use their stout, clawed fore-limbs to excavate burrows in light, sandy soils in raised areas to escape flooding. Each burrow is occupied by a single individual, except when young are being weaned within the natal burrow. Burrows are often found at the base of shrubs or around patches of grass where friable, wind-blown soil has accumulated; but burrows may also be found in open areas. San Joaquin kangaroo rats are territorial and intolerant of other kangaroo rats when individuals are in close proximity (USFWS 1998a).

No information exists regarding the mating habits of Fresno kangaroo rats in the wild. Observations of reproductive behavior are only from captive individuals or other species of kangaroo rat. Mating most likely begins after the start of the rainy season in late fall or early winter, with the first young born in February or March after 32 days of gestation (USFWS 1998a). Females breed with multiple males during a single breeding cycle, and may produce two or three litters per year. Litter size is assumed to be similar to the closely related short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*), at one to three young per litter. Young are probably born underground in a nest of dry vegetation, and weaned between 21 and 24 days (USFWS 1998a).

Known Occurrences

The current status of the Fresno kangaroo rat is not known. The last verified capture, a single male, occurred in 1992 on the Alkali Sink Ecological Reserve (USFWS 2010c), an area approximately 2 miles south of the Action Area. This 565-acre Ecological Reserve is within the 857 acres of Designated Critical Habitat for the species. According to an unpublished DFW report, since 1992 DFW grid surveys and independent research efforts, including reconnaissance trapping of active burrows conducted systematically over large portions of the reserve at some of the locations where Fresno kangaroo rats are most likely to persist, have failed to detect this species (Entrix 2008). The lack of connectivity from this Ecological Reserve to what remains of suitable habitat prevents dispersal and increases environmental and genetic pressures in any existing population (USFWS 2010c).

Trapping efforts in the Project Action Area have failed to detect Fresno kangaroo rat. In 2001 trapping was conducted over a 5-mile stretch of the San Joaquin River corridor, primarily immediately upstream of the study area, with the trap lines farthest downstream extending into the Reach 2B study area, near the Chowchilla Bifurcation Structure (ESRP 2001). This effort consisted of 1,200 total trap nights but failed to detect the species, although 121 individual Heermann's kangaroo rats (*D. heermanni*) were captured. Trapping was also conducted in Reach 2 before the installation of groundwater monitoring equipment in 2001 and 2002, and Heermann's was the only kangaroo rat captured during that effort as well (Wolfe, pers. comm., 2009). Trapping was conducted specifically for the Project on the north side of the San Joaquin River in 2011 (SJRRP 2011c). The 750 trap night effort in the Reach 2B study area consisting of 150 traps open for 5 consecutive nights, similarly resulted in Heermann's kangaroo rat as the single kangaroo rat species captured. These Project-specific surveys in 2011 targeted the best habitat associated with the East and West loops, as well as an area on the south side of the San Joaquin River near the Chowchilla Bifurcation Structure (Figure 3-2). Habitat in these loops has since been converted to agriculture and the East and West loops are no longer considered suitable for Fresno kangaroo rat. The current status of the species at other locations is unknown but there is potentially suitable (heavily grazed annual grassland and elderberry savannah) habitat for Fresno kangaroo rat in the portion of the Action Area on the south side of the San Joaquin River near the East Loop (Figure 3-7).

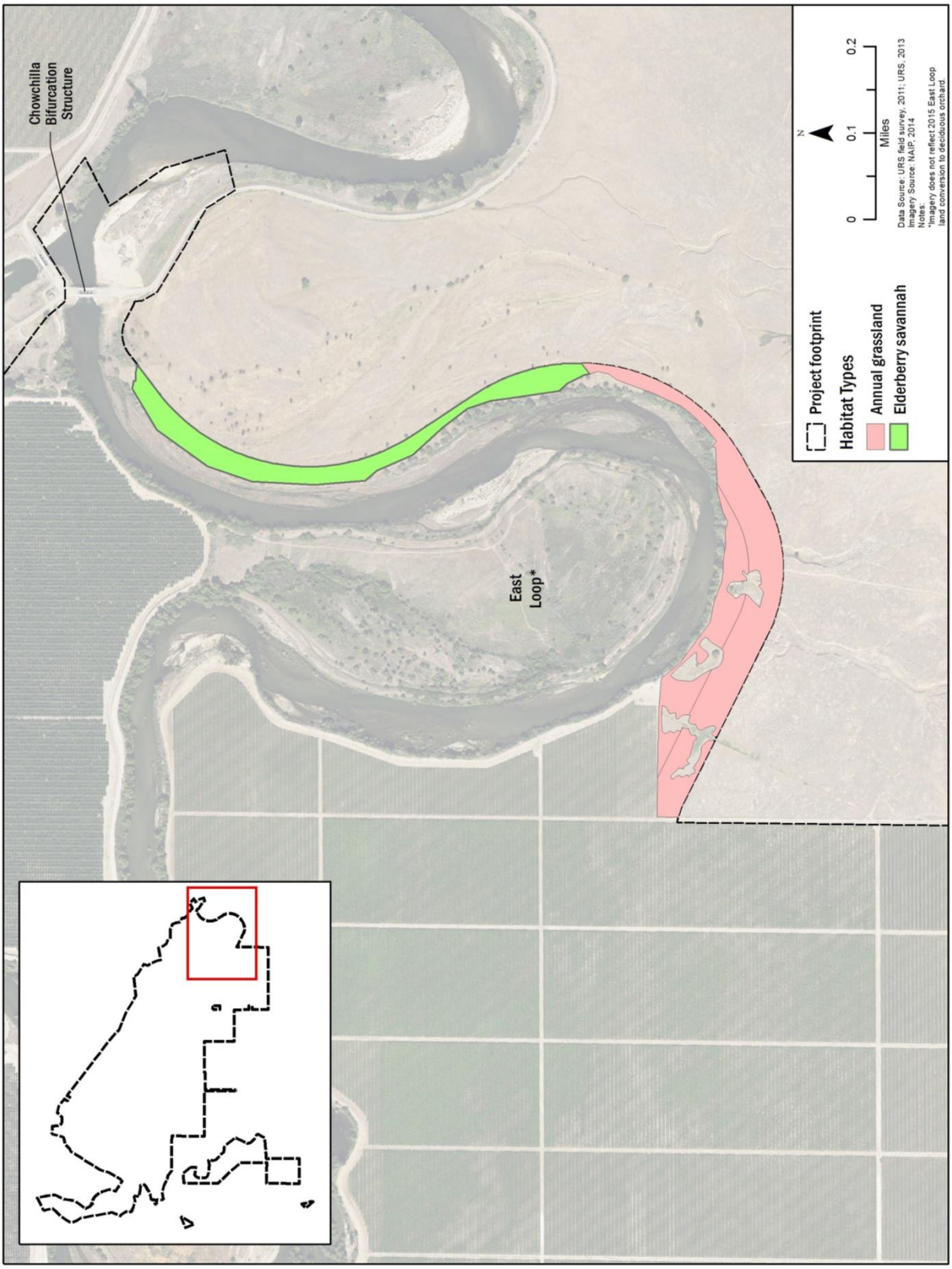

Figure 3-7.
Potential Fresno Kangaroo Rat Habitat in the Action Area

Similar to blunt-nosed leopard lizard, potential for Fresno kangaroo rat to occur in the Action Area was assessed in 2011 as moderate (SJRRP 2011c). However, that assessment was based in part on lack of access to the portion of the Action Area closest to historical occurrences of this species. Based on the information presented above and more recent, on-the- ground, 2015 habitat assessments of the portion of the Action Area south of the Chowchilla Bifurcation Structure, where suitable habitat was originally identified, the potential for Fresno kangaroo rat to occur in the Action Area has been reassessed as low. The acreage of potentially suitable habitat documented to occur in the Action Area for Fresno kangaroo rat is summarized in Table 3-5.

Table 3-5.
Potential Fresno Kangaroo Rat Habitat

Scientific Name	Common Name	Habitat Type	Potential Impacts (acres)			
			Floodplain	Infrastructure	Borrow	Other
Dipodomys nitratoides exilis	Fresno kangaroo rat	Habitat	5	20	0	0

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)

Fresno kangaroo rat has not been observed in the Project vicinity since 1992, despite focused survey efforts. Potentially suitable habitat is present at the eastern end of the Action Area, near the East Loop, south of the San Joaquin River (Figure 3-7). The Action Area at this location supports heavily grazed grassland and elderberry savannah, and is separated from the Alkali Sink Ecological Reserve by about two linear miles of potentially suitable habitat and Highway 180. The habitat suitability for this species increases moving south, away from the Action Area, and towards the reserve. It has been noted by one species expert that if there are extant populations of Fresno kangaroo rat, it may be that they are most likely to be found between Alkali Sink Ecological Reserve, the land between the Action Area and the reserve, and in suitable habitat along the San Joaquin River between Gravelly Ford and Mendota (Kelley, pers. comm., 2009). While this does include portions of the Action Area, the highest-quality suitable habitat is south of the Action Area and the habitat in the Project footprint is less likely to support this species as described above. Habitat most commonly associated with Fresno kangaroo rat is dominated by alkali-sink and chenopod scrub vegetation with relatively abundant bare ground. Habitat for this species within the Action Area is composed of heavily grazed dense annual grassland and elderberry savannah with evidence of periodic flooding and high groundwater table. While it is possible for this species to persist in limited locations within the Action Area, the paucity of suitable habitat and uncertain status of the species makes it unlikely to be present based on the best currently available information. There have been no captures of this species since 1992 and no populations are known to be present within the species' current range (USFWS 2010c).

3.4.6 San Joaquin Kit Fox

San Joaquin kit fox was listed as endangered under the ESA on March 11, 1967 (32 FR 4001). San Joaquin kit fox are mostly nocturnal, although they can be seen during the day, particularly with pups in late spring and early summer (USFWS 1998a). Kit fox diet varies geographically, seasonally, and annually. Prey consists primarily of nocturnal rodents such as kangaroo rats and mice, and can also include other small animals and occasionally insects (USFWS 2010d). Despite the variety of potential prey, kangaroo rats are most strongly linked with the kit fox ecologically, and are the major prey item in natural areas throughout the kit fox range. Kit fox density and population stability are highest in areas where kangaroo rats are abundant (Cypher et al. 2000).

Variation in home range size throughout the species' range is attributed to changes in prey abundance. Kit fox home range size can vary from 1 to 12 square miles (USFWS 1998a), and one fox will use multiple dens within its home range. Kit fox use underground dens for temperature regulation, shelter, and predator avoidance. They will dig their own dens and modify burrows constructed by other ground-dwelling animals such as ground squirrels, badgers, or coyotes. They also use human-made structures such as culverts or abandoned pipelines for denning. Relatively flat, level denning habitat with slopes of less than 5 percent appears to be optimal for kit fox. Slopes of 5 to 15 percent are suitable, and over 15 percent is unsuitable (Cypher, Phillips, and Kelly 2007).

Mating occurs between December and March, between an adult pair that will remain together for the year (ESRP 2006). The reproductive success of San Joaquin kit fox is correlated with prey abundance. Decreases in prey abundance caused by environmental stressors such as drought or excessive rainfall result in a decrease in the reproductive success of kit fox (USFWS 1998a; ESRP 2006). The average life expectancy of a kit fox in the wild is 7 years (ESRP 2006).

Known Occurrences

All of the occurrences of San Joaquin kit fox documented within 10 miles of the Action Area are over 15 years old, and the one occurrence from 2.5 miles away from the Action Area is over 60 years old (SJRRP 2011c), so these occurrences may not represent current populations. The occurrences suggest a historic presence in the Project vicinity, and are within dispersal distance of the species to the study area, but surveys conducted in 2001, 2003, and 2004 failed to confirm presence of the species in the Project vicinity (ESRP 2001, 2004). Both surveys took place along a 5-mile stretch of the San Joaquin River immediately upstream of Reach 2B, extending into the study area at the Chowchilla Bifurcation Structure, and neither resulted in positive detection of kit fox or kit fox sign.

Although the USFWS' 2010 San Joaquin Kit Fox 5-year review states at one location that kit fox is "presumed extirpated" from an area that includes the Action Area and Alkali Sink Ecological Reserve, at another location the same document states kit fox are currently documented to occur on, or directly adjacent to Alkali Sink Ecological Reserve (where "occurrences may consist of residence, foraging, or dispersal use") (USFWS 2010d). USFWS has clarified that they do not presume kit fox extirpated from the region (Raabe, pers. comm., 2015). DFW, the organization that manages the Alkali Sink Ecological Reserve, does not know of any resident population at the reserve, but points

out it could be used for dispersal or foraging (Espino, pers. comm., 2015). However, when surveyed for other species there has been no sign of kit fox observed at the Alkali Ecological Reserve.

Potentially suitable foraging and dispersal habitat for San Joaquin kit fox, including annual grassland, elderberry savannah, barren land, and agricultural lands are present in the Action Area. Based on direct observation or observation of sign, prey species including California ground squirrel and kangaroo rat are present in these habitat types at various locations in the study area. Meandering transects provided opportunities to observe kit fox dens or potential dens, but no canid dens or burrows large enough to shelter a kit fox were detected during initial habitat assessment survey (SJRRP 2011c), nor in areas on the south side of the San Joaquin River near the East Loop surveyed in 2015. Other habitats, including irrigated hayfield, valley foothill riparian, and the margins of other agricultural areas may provide some foraging and dispersal opportunities for kit fox but do not meet all of the requirements of kit fox including denning and pupping habitat. Because kit fox are a highly mobile and wide-ranging species and the Project is within their historic range it is possible, though unlikely, that they could disperse through any part of the Action Area; therefore a figure showing "suitable" habitat is not included in this BA.

Intensive agricultural activity presents a number of impediments to permanent use by kit fox. Frequent alterations to the land, including flood irrigation, tilling or discing, and mowing not only disrupt kit fox dens but also significantly reduce populations of prey species. Agricultural use and areas near human habitations are known to attract coyotes and red foxes. The competitive interactions between kit fox and other canids can have undesirable effects on the fitness of individual fit fox (Cypher et al. 2001). Historical distribution suggest that San Joaquin kit fox could be present in the study area; however, based on current distribution records and recent surveys, this species is not expected to breed or create pupping dens in the Action Area and their presence is most likely to be transitory.

3.4.7 California Jewelflower

California jewelflower was federally listed as endangered under the ESA in July 19, 1990 (55 FR 29361). No critical habitat has been designated for this species. California jewelflower is an annual herb in the mustard family (Brassicaceae) and ranges from 4 to 20 inches tall. The stems of this species are typically branching and feature oblong leaves at the base that transition to clasping, egg-shaped leaves near the top. The stems feature clusters of maroon buds that reveal translucent white flowers during the blooming period, generally between February and May. For individuals to successfully set seed, this species requires specific insect pollinators, sufficient rainfall, and temperatures which do not rise above average for the season. Seed dispersal mechanisms are not precisely known but likely include gravity, fruit-eating animals, wind, and water (USFWS 1998b).

California jewelflower is typically found at elevations ranging from 240 feet to 2,950 feet in subalkaline sandy loam soils. California jewelflower is associated with desert scrub, annual or perennial grasslands, and juniper and pinyon-juniper woodland. Historically, this species may also have been associated with alkali desert scrub. This species

historically occurred in Fresno, San Luis Obispo, Santa Barbara, Kings, Tulare, and Kern counties. Currently, this species is known to have limited occurrences in Santa Barbara, Fresno, and San Luis Obispo counties.

Known Occurrences

There are three areas where concentrated extant metapopulations of California jewelflower are known to occur; Santa Barbara Canyon, the Carrizo Plain in San Luis Obispo County, and Kreyenhagen Hills in Fresno County (USFWS 1998a). As discussed in the *Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRRP 2011c), and summarized in Section 3.1.2, protocol-level surveys for the California jewelflower were conducted in portions of the Action Area in 2011 and 2015 (see Figure 3-2). After completing protocol surveys in portions of the Action Area, California jewelflower have not been documented to occur in the Action Area. The nearest occurrence of this species is a record from over 10 miles away from the Action Area. Based on the habitat assessment survey, suitable habitat for this species is lacking from the majority of the Action Area and botanical surveys conducted in the Action Area failed to detect this species. Due to the presence of limited suitable habitat, the absence of observations from protocol-level surveys, and location of the Action Area outside of the known range of the species, there is a very low potential for California jewelflower to occur in portions of the Action Area that support grassland and elderberry savannah habitats.

3.4.8 Palmate-bracted Bird's Beak

Palmate-bracted bird's beak was listed as endangered under the ESA on July 1, 1986 (51 FR 23765). No critical habitat has been designated for this species. Palmate-bracted bird's beak is a highly branched annual in the Orobonchaceae family with gray-green and glandular vegetation between 4 and 12 inches in height. Small, pale-whitish flowers emerge from a dense spike with leaf-like outer bracts and lavender inner bracts. The petals are divided into two lips. The upper one is shaped like a bird's beak, leading to the common name of the genus. Palmate-bracted bird's beak is hemi-parasitic and grows on seasonally flooded, saline alkali soils in lowland plains and basins. Saltgrass (*Distichlis spicata*) is the most likely host plant for palmate-bracted bird's beak. Palmate-bracted bird's beak is pollinated by three species of bumble bees, sweat bees, semi-social and solitary bees, and bee flies (USFWS 1998a).

Palmate-bracted bird's beak is typically found at elevations below 500 feet in alkali soils of valley lowland, alkali scrub, Chenopod scrub, and grasslands. The current range of this species covers Alameda, Colusa, Fresno, Glenn, Madera, San Joaquin, and Yolo counties. Historically, this species covered large areas of the San Joaquin Valley, Solano-Colusa, and Livermore vernal pool regions.

Known Occurrences

Palmate-bracted bird's beak occurs at the Alkali Sink Ecological Reserve and Mendota National Wildlife Refuge. California Native Plant Society (CNPS) records indicate occurrences in the Kerman (359A), Tranquility (360A), Firebaugh Northeast (381A) and Poso Farm (381B) quadrangles. These are immediately adjacent to the study area quadrangle Mendota Dam (381D). As discussed in the *Mendota Pool Bypass and*

Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results (SJRRP 2011c), and summarized in Section 3.1.2, protocol-level surveys for the palmate-bracted bird's beak were conducted in portions of the Action Area in 2010, 2011, and 2015 (see Figure 3-2). No palmate-bracted bird's beak plants were observed during botanical surveys of the Action Area. Based on the habitat assessment survey, suitable habitat for this species is largely lacking from the majority of the Action Area and botanical surveys conducted in portions the Action Area failed to detect this species. Due to the presence of limited suitable habitat and the absence of observations from protocol-level surveys, there is a low potential for palmate-bracted bird's beak to occur in grassland and elderberry savannah habitat in portions of the Action Area.

3.4.9 San Joaquin Woolly Threads

San Joaquin woolly threads was listed as endangered under the ESA on July 19, 1990 (55 FR 29361). No critical habitat has been designated for this species. San Joaquin woolly threads is an annual herb in the composite family (Asteraceae) that typically features many long, trailing stems. The branching stems are tipped with clusters of tiny, yellow flower heads that typically bloom between late February and early April, depending on precipitation levels. Seeds fall upon reaching maturity, and dispersal mechanisms are not precisely known but likely include wind, water, and wildlife. The number of seeds that germinate depends on precipitation levels, and seeds that do not germinate remain viable in the soil seed bank (USFWS 1998a).

This annual herb is generally found in neutral to subalkaline soils of sand to sandy loam texture, in chenopod scrub or grasslands at elevations between 200 and 2,600 feet. Currently this species is known to occur in San Luis Obispo, Kern, Kings, Fresno, San Benito, and Santa Barbara counties in alkali desert scrub, annual grassland, and pasture. Historically, this species was also known to occur in Tulare County. Priority areas for recovery of this species include the Carrizo Plain Natural Area, and areas in the Lost Hills, Jacalitos Hills, Kettleman Hills, and Panoche Hills. Species that may co-occur with San Joaquin woolly threads include red brome, red-stemmed filaree, goldfields, Mediterranean grass (*Schismus* spp.), and fescue.

Known Occurrences

The nearest occurrence of this species in the region is a 1935 collection record approximately 10 miles south of the Action Area. The majority of the habitat in the vicinity of that occurrence has been converted to irrigated agriculture (DFW 2015). As discussed in the *Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRRP 2011c), and summarized in Section 3.1.2, protocol-level surveys for the San Joaquin woolly threads were conducted in portions of the Action Area in 2011 and 2015 (see Figure 3-2). After completing protocol surveys, San Joaquin woolly threads have not been documented to occur in the Action Area. Based on the habitat assessment survey, suitable habitat for this species is largely lacking from the majority of the Action Area and botanical surveys conducted in portions of the Action Area failed to detect this species. Due to the presence of limited suitable habitat, the absence of observations from protocol-level surveys, and location of the Action Area outside of the known range of the species, there is a low

potential for San Joaquin woolly threads to occur in grassland and elderberry savannah habitats present in portions of the Action Area.

4.0 Potential Effects and Avoidance, Minimization, and Compensation Measures

The proposed action as described in Section 2 of this BA is divided into two distinct activities: construction of the Compact Bypass channel and construction of the Reach 2B channel improvements. The effects of each of these activities are considered separately in the following discussion of potential effects and avoidance, minimization, and mitigation measures. Project-related environmental commitments and other avoidance and minimization measures intended to mitigate potential impacts from the Project addressed in Section 2.5.

4.1 Valley Elderberry Longhorn Beetle

The range of the valley elderberry longhorn beetle was recently updated by the USFWS and no longer includes the Action Area (USFWS 2015b, Figure 3-3). The Project will permanently remove elderberry shrubs present in the Action Area, primarily in the Reach 2B channel improvements portion of the Action Area, but it is not expected to result in direct or indirect effects to valley elderberry longhorn beetle because the Action Area is outside of the current range of the species. Following construction, portions of the Action Area are expected to continue providing suitable habitat for elderberry shrubs.

4.1.1 Compact Bypass

USFWS protocol surveys were conducted in 2011, along with other surveys and incidental observations of elderberry shrubs in the portion of the Action Area within the Compact Bypass. This portion of the Action Area has very few mapped elderberry shrubs (Figure 3-4). If there are any elderberry shrubs located in this portion of the Action Area, the proposed construction activities may result in increased noise and vibrations from the construction of a new levee. One shrub mapped on the west side of the North Loop could be affected by activities associated with construction of the Compact Bypass. However, due to the recent changes in the species range the potential for this species to occur in the Compact Bypass area is discountable.

4.1.2 Reach 2B Channel Improvements

Although there are hundreds of elderberry shrubs present in the Reach 2B channel improvements portion of the Action Area (Figure 3-4), valley elderberry longhorn beetles are not expected to occur in the Action Area which lies outside the species' range as currently mapped by USFWS. Elderberry shrubs in this portion of the Action Area could be impacted by construction of new levees, breaching of existing levees, and modification of potentially suitable habitat that falls within the levee and floodplain. After the Project is complete, portions of the Action Area are anticipated to again provide suitable habitat for elderberry shrubs.

The proposed construction activities are not expected to result in direct or indirect effects to valley elderberry longhorn beetle because the Action Area is outside of the current range of the species. If the species were present within the Action Area, the disturbance or removal of elderberry shrubs, soil disturbance, erosion, soil compaction, or creation and dispersal of dust from the operation of construction equipment may result in disruption of the valley elderberry longhorn beetle's breeding, feeding, or foraging activities in the Action Area. The total number of elderberry shrubs documented to date in the Action Area is presented in Table 3-3.

Overall, long-term operation of the Project is expected to be benefit elderberry shrub habitat. Post-construction activities include active and passive restoration of riparian habitat within the Reach 2B channel improvements portion of the Action Area. It is anticipated that the completed Project will continue to provide suitable habitat for elderberry shrubs, and may provide more suitable habitat than is present currently, after construction is complete.

4.1.3 Avoidance and Minimization Measures for Valley Elderberry Longhorn Beetle

The Conservation Strategy described in Section 2.5, Table 2-4, outlines conservation measures for biological resources that may be affected by Project actions and includes avoidance and minimization measures. Conservation Measure VELB-1 will be implemented to avoid or minimize potential adverse effects to valley elderberry longhorn beetle to the extent possible. This includes identifying elderberry shrubs in the Project footprint within 1 year of ground-disturbing activities, and if feasible, establishing a 100-foot-wide buffer around elderberry shrubs with greater than one inch in diameter stems at ground level in or adjacent to the Action Area.

4.1.4 Summary of Effects to Valley Elderberry Longhorn Beetle

Project activities, primarily in the Reach 2B channel improvements portion of the Project, will result in the permanent loss of elderberry shrubs, the host plant for the valley elderberry longhorn beetle. Due to recent changes in the geographic range of the species from USFWS, the valley elderberry longhorn beetle is not expected to occur in the Action Area and therefore, the potential for adverse effectswould be discountable. Conservation Measure VELB-1 will be implemented to avoid and minimize Project effects to the species. Although, as mentioned above, valley elderberry longhorn beetle are not expected to occur in the action area, impacts to elderberry shrubs would be reduced through implementation of Conservation Measure VELB-1. As a result, the Project ***may affect, but is not likely to adversely affect,*** valley elderberry longhorn beetle.

4.2 Blunt-nosed Leopard Lizard

The Project will result in impacts to potentially suitable habitat in the Action Area for blunt-nosed leopard lizard. If the species occurs in the Action Area, impacts during construction may include the loss of suitable habitat for the species.

4.2.1 Compact Bypass

The portion of the Action Area in the Compact Bypass does not contain suitable habitat for blunt-nosed leopard lizard. Construction of the Compact Bypass is expected to have no adverse effect on this species.

4.2.2 Reach 2B Channel Improvements

A limited amount of potentially suitable habitat for blunt-nosed leopard lizard is present in the Reach 2B channel improvements portion of the Action Area (Figure 3-5, Table 3-4). These areas are primarily densely vegetated, periodically inundated or subjected to a high groundwater table which results in habitat that is periodically unsuitable for blunt-nosed leopard lizard. Effects to this portion of the Action Area will include construction of a new levee (infrastructure in Table 3-4) and conversion of potentially suitable habitat that falls within the levee and floodplain. After the Project is complete, the area occupied by the levee is expected to provide less suitable habitat for the blunt-nosed leopard lizard. The area identified as floodplain in Table 3-4 will lay on the river side of the new levee. It will be subject to more frequent inundation than currently, and will be isolated from more suitable habitat to the south by the new levee, so following construction this habitat will be less suitable than it is currently for blunt-nosed leopard lizard.

In the unlikely event that blunt-nosed leopard lizard were present in the Action Area, adverse effects to the species could be both direct and indirect. If the species were present, the Project may increase the amount of noise, light, vibration, and dust, resulting in disruption of the species' breeding, feeding, or sheltering behaviors; inducing dispersal behavior; or abandonment of active burrows. However, due to the presence of the densely vegetated habitat along the existing river channel, periodic inundation, and the use of existing roads for construction access, adverse effects to this species are unlikely to occur.

4.2.3 Avoidance and Minimization Measures for Blunt-nosed Leopard Lizard

Focused surveys are planned to be conducted in grassland and elderberry savannah habitat identified as potential blunt-nosed leopard lizard habitat on the south side of the San Joaquin River near the Chowchilla Bifurcation Structure in 2016 (Figure 3-5). These surveys will be conducted within the Action Area plus a 330-foot buffer in accordance with the *Blunt-Nosed Leopard Lizard Survey Protocols for the San Joaquin River Restoration Program* (USFWS 2009a) and after the survey proposal has been reviewed by USFWS and DFW.

The Conservation Strategy described in Section 2.5, Table 2-4, outlines conservation measures for biological resources that may be affected by Project actions and includes avoidance and minimization measures. Conservation Measure BNLL-1, which includes additional surveys, will be implemented to avoid or minimize potential adverse effects to blunt-nosed leopard lizards. If the species is not detected within the Action Area by any of these surveys, avoidance, minimization, and compensation measures for this species will not be implemented. If blunt-nosed leopard lizard is found within the Action Area, Reclamation will reinitiate consultation with USFWS and DFW will also be contacted to determine the approach for avoidance and minimization of potential effects, as necessary.

4.2.4 Summary of Effects to Blunt-nosed Leopard Lizard

Project construction activities in the Reach 2B channel improvements portion of the Project may result in the permanent loss of habitat for blunt-nosed leopard lizards. This action has the potential to degrade habitat quality, and produce high levels of noise, vibration, and other disturbances but it is unlikely to adversely affect blunt-nosed leopard lizards during construction, if they are present. Much of the suitable habitat in the Project area is periodically inundated and densely vegetated, which could prevent blunt-nosed leopard lizard populations from becoming established. Based on an assessment of potentially suitable habitat within the Action Area and the distance between the Action Area and the species' known occurrence, these effects would be discountable and insignificant unless the protocol-level surveys within the Action Area plus a 330-foot buffer scheduled to occur in 2016 (and again prior to ground disturbance, per Conservation Measure BNLL-1 in Table 2-4, if 2016 surveys expire) detect blunt-nosed leopard lizards in the Action Area. If protocol surveys do not detect individuals, Project effects to blunt-nosed leopard lizards associated with construction activities are not expected. If protocol surveys do detect individuals in the Action Area, consultation will be reinitiated with the USFWS as described in Conservation Measure BNLL-1. As a result, the Project ***may affect, but is not likely to adversely affect,*** blunt-nosed leopard lizard.

4.3 Giant Garter Snake

The Project will result in impacts to potentially suitable habitat in the Action Area for giant garter snake. Highly suitable habitat for giant garter snake exists in areas of fresh emergent wetland vegetation in lacustrine habitat within the Mendota Pool. Further upstream in the San Joaquin River arm of the Mendota Pool, habitat transitions gradually and is unsuitable for giant garter snake upstream of San Mateo Avenue. Impacts during construction may include the loss of suitable upland and aquatic habitat for the species.

4.3.1 Compact Bypass

The portion of the Action Area affected by construction of the Compact Bypass contains suitable upland and aquatic habitats for the giant garter snake (i.e., areas backwatered by Mendota Dam) (Figure 3-6). If giant garter snake is present in the portion of the Action Area affected by construction of the Compact Bypass, adverse effects to the species may be both direct and indirect. Highly suitable giant garter snake habitat in the Action Area is located primarily in the lower portion of Mendota Pool near Mendota Dam. The eastern portion of the river towards San Mateo Crossing is less suitable for giant garter snake, and upstream of San Mateo Avenue the habitat is unsuitable. In this portion of the Action Area, the river is characterized by sandy banks and willow riparian vegetation; both are negatively correlated with giant garter snake habitat (Figure 4-1). See Section 3.4.3 for detailed descriptions of habitat in the Action Area. Table 4-1 presents an estimate of the acreage of potentially suitable habitat that may be impacted by the Project, based on the design information available at this time. It is possible that impacts could be reduced as the design progresses.

Where suitable habitat exists, the Project may increase the amount of noise, light, vibration, and dust, resulting in disruption of the species' breeding, feeding, or foraging; inducing dispersal behavior; or abandonment of suitable habitat in the Action Area. The proposed construction activities may result in harm, harassment, or mortality of giant garter snakes. Mortality may occur if vehicles, equipment, or construction personnel working in suitable upland and aquatic habitat trample this species; collapse their underground refugia; or individuals may become entrapped in open, excavated areas used for construction. Indirect effects may occur from habitat modifications that reduce suitable breeding, feeding, or foraging opportunities; and restrictions of movement between suitable upland and aquatic habitats in Mendota Pool. Upon completion of construction, the portion of the Action Area between the Mendota Dam and Mendota Pool control structure will continue to function as Mendota Pool, which will continue to provide suitable habitat for giant garter snake after construction.

Table 4-1.
Potential Impacts to Giant Garter Snake Suitable Habitat

Scientific Name	Common Name	Habitat Type	Potential Impacts (acres)				
			Floodplain	Infrastructure	Borrow	Other	Total
Thamnophis gigas	giant garter snake	Aquatic	122.5	14.1	0.0	5.7	142.3
		Upland	200.8	18.7	0.0	1.2	220.7
		All	323.3	32.7	0.0	7.0	363.0

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

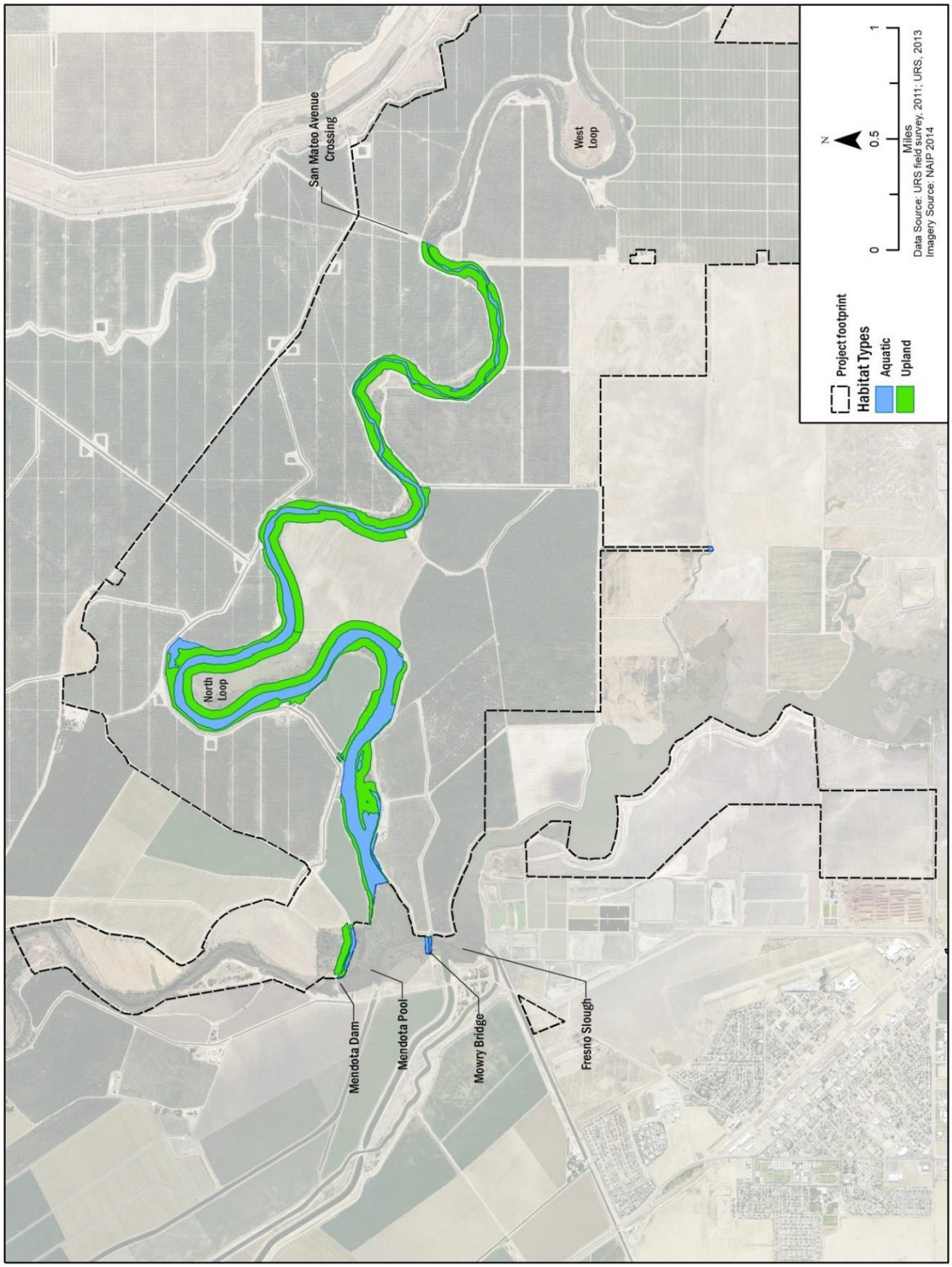

Figure 4-1.
Potential Impacts to Giant Garter Snake Habitat

Figure 4-1 is a map of areas where potential habitat for giant garter snake may be impacted by the Project. The extent of potential impacts extends well upstream of where the construction impacts will occur because upon completion of construction, operation of the Compact Bypass will result in conversion of highly suitable lacustrine habitat upstream of the bypass to riparian habitat that is less desirable for the species. Initial operation of the Compact Bypass will result in elimination of lentic aquatic habitat upstream of the Compact Bypass control structure in the San Joaquin River arm of Mendota Pool. The Mendota Pool currently backs up the San Joaquin River from Mendota Dam to near the San Mateo Avenue crossing. When water in what is currently a lentic environment between the proposed Compact Bypass control structure and the San Mateo Avenue crossing is allowed to flow freely through the Compact Bypass and down the San Joaquin River, this aquatic habitat will be permanently converted from lentic aquatic habitat to lotic aquatic habitat, and will become largely unsuitable for giant garter snake. Therefore, this analysis assumes that the suitable aquatic, upland, and wetland habitat in the western half of Reach 2B and upstream of the Compact Bypass control structure will be eliminated upon completion and initial operation of the Compact Bypass portion of the Project. The acreages of habitat presumed to be effected by this action are shown in Table 4-1.

4.3.2 Reach 2B Channel Improvements

An earlier draft of the BA indicated that impacts to this portion of the Action Area would be primarily focused in the potential borrow area location within the Fresno Slough portion of the Project (Figure 1-2). However, based on discussions with USFWS the extent of the borrow area near Fresno Slough has been revised to avoid giant garter snake habitat. Therefore, there should be no impact to giant garter snake along Fresno Slough associated with borrow.

There may be incidental impacts from the construction of a new levee and conversion of suitable habitat that falls within the levee and floodplain in the San Joaquin River arm of the Mendota Pool. However, when Reach 2B channel improvements phase of the Project is constructed, it is assumed that all suitable habitats for giant garter snake will have already been eliminated from this portion of the Action Area due to the construction and operation of the Compact Bypass phase of the Project. Therefore, no additional direct or indirect effects are anticipated to occur in the portion of the Action Area that surrounds the San Joaquin River arm of the Mendota Pool (Figure 4-1).

There may be some potential to incorporate suitable habitat into the design of this portion of the Project, to offset impacts that would occur during construction of the Compact Bypass. This could include construction of off-channel pools, sloughs, and wetland habitats that would capture higher flows and retain water in a lentic state during the giant garter snake's active season. This type of feature, however, may be in conflict with the Project goal of having all off-channel habitats drain quickly back to the main channel to avoid stranding any migratory fishes in off-channel pools. Detailed design for the Reach 2B channel improvements part of the Project is not yet developed and the feasibility of incorporating suitable giant garter snake habitat into the floodplain design will be evaluated as the design progresses.

4.3.3 Avoidance and Minimization Measures for Giant Garter Snake

Protocol-level trapping surveys and detailed habitat mapping are planned to be conducted in suitable habitat for giant garter snake in 2016. These surveys will be conducted by a biologist permitted by both the USFWS and DFW, and in accordance with survey protocols approved by both agencies. These surveys will inform the extent of suitable habitat and the current status of the species in the Action Area, will allow for better protection of snakes during Project implementation if they are present, and will inform compensatory mitigation strategies proposed in Section 4.3.5.

The Conservation Strategy described in Section 2.5, Table 2-4, outlines conservation measures for biological resources that may be affected by Project actions and includes avoidance, minimization, and compensation measures. Conservation Measure GGS-1 will be implemented to avoid or minimize potential adverse effects to giant garter snake. General conservation measures to avoid and minimize effects include completing preconstruction surveys within 24 hours of ground-disturbance of potential giant garter snake habitat, restricting disturbance of potential giant garter snake habitat to the period between May 1 and October 1 to the extent feasible, and hand clearing of vegetation in areas where suitable giant garter snake habitat is documented to occur, based on mapping provided in this BA or future, USFWS-approved mapping. In addition to avoidance and minimization, compensatory mitigation (Conservation Measure GGS-2) is proposed in Section 4.3.5.

4.3.4 Summary of Effects to Giant Garter Snake

Project construction activities in the Compact Bypass and Reach 2B channel improvements portion of the Project will result in the permanent loss of suitable upland and aquatic habitat for giant garter snake. Project construction activities have the potential to harm, harass, or kill giant garter snake through the degradation of habitat quality, and production of high levels of noise, vibration, and other disturbances during construction. Some suitable habitat will be eliminated due to conversion of portions of Mendota Pool to riverine habitat, and associated conversion of lentic to lotic aquatic habitat. Conservation Measure GGS-1 would be implemented to avoid and minimize Project effects and the risk of take associated with construction activities. The Project ***is likely to adversely affect*** giant garter snake.

4.3.5 Compensatory Mitigation

A suite of compensatory mitigation options are proposed for potential effects to giant garter snake. Compensation will consist of 1) focused trapping surveys and detailed habitat mapping following USFWS protocols in the Action Area that will contribute to recovery planning for the species scheduled to occur in 2016; 2) preservation, enhancement, restoration, or creation of giant garter snake habitat in Fresno Slough and/or the Volta Wildlife Area (i.e. water supply augmentation, creating wetland and slough habitat that would meet the needs of giant garter snake, or creating earthen ridges that would support burrow creation by small mammals and provide underground refuge for giant garter snake). Implementation of compensatory mitigation measures for giant garter snake will occur in coordination with USFWS and DFW, and are described in this section. Where possible, temporarily disturbed habitat within the Action Area will be restored in accordance with the USFWS *Mitigation Criteria for Restoration and/or*

Replacement of Giant Garter Snake Habitat (USFWS 1997) and consistent with the *Revised Draft Recovery Plan for Giant Garter Snake* (USFWS 2015c). Compensation for permanently destroyed habitat may include preservation and enhancement of existing habitat or restoration and creation of suitable habitat at mitigated ratios as described below.

Reclamation is planning a major trapping survey for giant garter snake in the Action Area in 2016 that will inform both Project planning and larger giant garter snake recovery efforts and planning. The 2016 giant garter snake trapping survey is designed primarily to evaluate habitat suitability and to ascertain the presence, distribution, and relative abundance of giant garter snakes within and near the Action Area. Whether or not giant garter snakes are caught during surveys, the results will inform habitat occupancy analysis and yield critical data on the status of this species in the Mendota area, the southernmost extent of its current range. This information will directly benefit a number of Draft Recovery Plan Priority 1 actions, including: development of management plans, monitoring programs, habitat assessment protocols; and increasing our understanding of giant garter snake habitat use (USFWS 2015c). The trapping survey will be conducted in coordination with USFWS and DFW, who will be provided an opportunity to review the survey protocol. The survey will be conducted under permits issued by the USFWS and DFW (Recovery Permit and Scientific Collecting Permit with Memorandum of Understanding, respectively).

Compensatory mitigation through preservation and enhancement of existing habitat or restoration and creation of suitable habitat may be developed on-site or at an appropriate off-site location. The Action Area lies on the southern boundary of the Merced Management Unit of the San Joaquin Basin Recovery Unit and the northern boundary of the Mendota Management Unit within the Tulare Basin Recovery Unit as defined in the *Revised Draft Recovery Plan for the Giant Garter Snake* (USFWS 2015c). Compensatory mitigation for the Project will be sited in these management and recovery units or immediately adjacent to the Action Area and could be achieved by wetland creation along Fresno Slough and the construction of backwater channels (designed to limit fish entrainment) along the San Joaquin River in the restored floodplain (these potential actions are collectively referred to as on-site compensatory mitigation). Because USFWS prefers on-site mitigation, confirmed presence of giant garter snake in the Action Area or Fresno Slough will not be required in order to implement on-site mitigation.

Off-site compensatory mitigation may be sought in the San Luis/Volta Management Unit of the San Joaquin Basin Recovery Unit. The most viable population currently known within this Recovery Unit is confined to the Volta Wildlife Area (Hansen, pers. comm., 2015b). Any off-site compensatory mitigation, such as the dedication of conservation easements, purchase of mitigation credits, and/or other off-site conservation measures (Conservation Measure GGS-2), will be directed towards benefiting this population.

Reclamation proposes the following suite of compensatory mitigation options for giant garter snake.

1. Trapping surveys in 2016 to inform both Project planning and larger giant garter snake recovery efforts and planning.

2. If giant garter snake is detected during the 2016 trapping surveys, a pre-construction trapping survey will be conducted within the appropriate work areas and giant garter snakes will be relocated to a nearby, safe location outside of harm's way (likely either within Fresno Slough or Mendota Pool) prior to construction, in consultation with the USFWS and coordination with DFW. If simply moving the snakes outside of the immediate area of disturbance is not feasible, then a relocation plan will be developed for longer-distance relocations (e.g., Volta Wildlife Area). The relocation plan will include information such as relocation methods, disease control methods, a habitat and giant garter snake population assessment at the recipient site, and post relocation monitoring methods.

3. On-site and off-site compensatory mitigation will occur in both Fresno Slough and the Volta Wildlife Area, to provide benefits to both populations.

4. Compensatory mitigation will occur in all feasible locations of those identified below, up to a 3.5:1 replacement ratio for impacted acres identified as suitable habitat

5. Compensatory mitigation will include:

    a. A new turn-key mitigation site, or sites, in Fresno Slough and/or

    b. A new turn-key mitigation site or purchase of credits at a mitigation bank near the Volta Wildlife Area

6. In addition to the above up to 3.5:1 acreage compensation, installation of a groundwater well at Volta Wildlife Area, construction of ridges for burrows in an existing area of habitat, or creating additional wetland habitat at the existing Volta Wildlife Area may be pursued to provide benefits to the existing population.

Compensatory mitigation acreages will be calculated based on the latest available design information and habitat mapping provided in this BA or more recent habitat mapping accepted by Reclamation and approved by the USFWS (e.g., results of 2016 habitat mapping and trapping surveys). The total impact acreage, including aquatic and upland habitats, will be summed and multiplied by 3.5 to obtain the target total compensatory mitigation acreage. Of this total acreage target, approximately one third will be aquatic habitat and the other two thirds will be surrounding upland habitat. In other words, each acre of created or preserved aquatic habitat will be supported by two acres of surrounding upland habitat, with the aquatic and upland habitat combined equaling 3 times the acres permanently impacted. Compensation may include creating upland refuges and hibernacula for the giant garter snake that are above the 100-year flood plain.

Estimated compensatory mitigation acreages, based on design information and habitat mapping are shown below in Table 4-2. This table is for planning purposes and is

provided as an example of how mitigation acreages will be calculated. Final mitigation acreages may differ if the Project design can be adjusted to reduce impacts to giant garter snake habitat or if the mapped extent of suitable habitat is adjusted, as described above, based on more current or better information, in consultation with USFWS. Additionally, the compensatory mitigation proposed here is contingent upon cooperation with private landowners. Suitable compensatory mitigation properties totaling the approximately 1,270 acres shown in Table 4-2 may not be available, in which case the compensation package will include the maximum habitat available that would benefit giant garter snake populations in the San Joaquin Basin Recovery and Mendota Management units. If the target acreage for giant garter snake compensatory mitigation cannot be obtained as described above, potential enhancements at the existing Volta Wildlife Area, including predator control, will be considered as an alternate way of fulfilling compensatory mitigation requirements in consultation with USFWS. This action is described in the Draft Recovery Plan (USFWS 2015c) as a Priority 2 task.

Table 4-2.
Giant Garter Snake - Estimated Mitigation Acreages

Anticipated GGS Impacts	Potential Impacts (acres)	Mitigation Target (acres)
Aquatic	142	423
Upland	221	848
TOTAL	**363**	**1,271**

Compensatory mitigation will be in place prior to completion of the Project (approximately 2025), and all compensatory mitigation sites will be permanently protected in perpetuity. Reclamation anticipates beginning to pursue entering into specific compensation agreements in 2016, following completion of the Mendota Pool Bypass and Reach 2B Improvements Project EIS/R and Record of Decision. Minor construction impacts would begin as early as the last half of 2016 and would continue through the time when the San Joaquin River flows through the new Compact Bypass, estimated to be in 2019 or 2020. At that time the largest impact would occur due to conversion of lentic aquatic habitat upstream of the Compact Bypass to lotic habitat. Specific mitigation properties being considered by Reclamation are described in the following paragraphs.

Potential On-site Compensatory Mitigation

On-site compensatory mitigation may include the development of turn-key mitigation sites and the enhancement of giant garter snake habitat along Fresno Slough. There are two properties on the west side of Fresno Slough that may be available as compensatory mitigation (Figure 4-2). Property 1 includes some giant garter snake suitable habitat (Figure 3-6) and other lands currently identified for possible material borrow for the Project (Figure 1-2). If the property west of Fresno Slough is used for borrow, following borrow the pits could be manipulated in a way to create a network of aquatic and wetland habitat (e.g., sloughs) surrounded by suitable upland habitat. Approximately 420 acres of compensatory mitigation may be available at Property 1, but the landowner has not yet been contacted. The owner of Property 2, which is located immediately south of Property 1 and immediately northwest of the Mendota Wildlife Area, has been contacted and

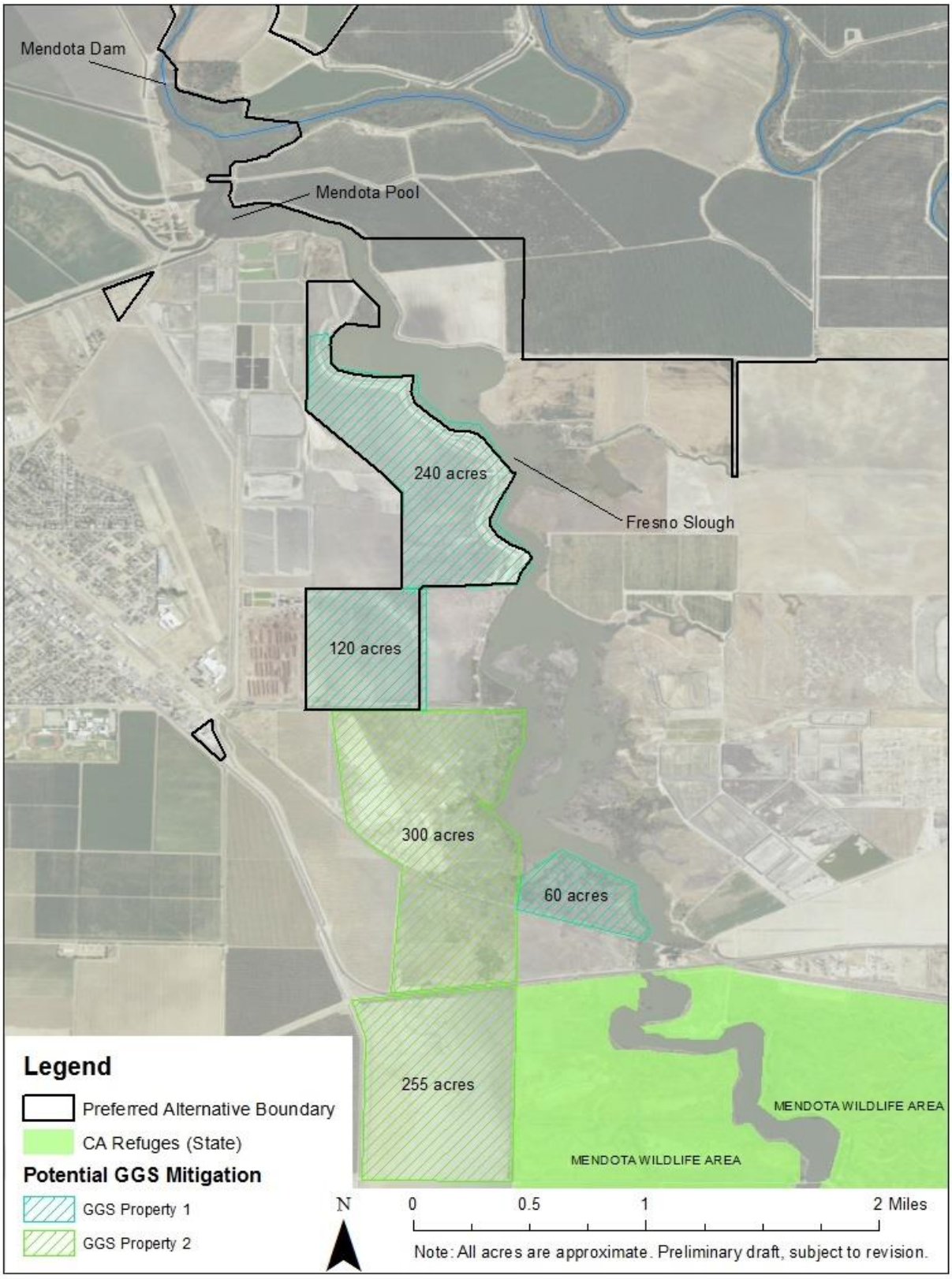

Figure 4-2.
Potential Fresno Slough Giant Garter Snake Compensation Area

preliminary discussion suggests that 300 acres are likely available for compensatory mitigation, with an additional 255 acres that may be possible. Property 2 is not within the Action Area and suitable habitat has not been mapped on the property but suitable habitat appears to be present, with opportunities for restoration, enhancement, or creation. Together these properties could provide between 300 and 975 acres of compensatory mitigation lands.

Another option that will be explored further during the Project design process is creating wetland and slough habitat that would meet the needs of giant garter snake in the restored San Joaquin River Reach 2B floodplain. This option would provide replacement habitat at the exact location where it was lost. One key consideration will be the ability of off-channel sloughs, ponds, or wetlands to provide aquatic lentic aquatic habitat through the majority of the snake's active season while simultaneously minimizing habitat for predatory fishes and minimizing potential for stranding of salmonids. Currently there is no specific acreage proposed for this type of mitigation as its feasibility is still being determined.

Preservation, enhancement, restoration, and creation of suitable giant garter snake habitat is a Priority 1 action under the Draft Recovery Plan (USFWS 2015c). Within the Mendota Management Unit of the Tulare Basin Recovery Unit, the Draft Recovery Plan goal is a minimum of two habitat block pairs (Recovery Criteria for Factor A). A two-block pair is described as two 539-acre blocks of buffered perennial wetland, or a total of 1078 acres in this unit. If the proposed properties along the Fresno Slough are available, compensatory mitigation within the Mendota Management Unit could provide between 300 and 975 acres or between 28 and 90 percent of the recovery goal acreage of giant garter snake habitat in this unit. The areas proposed are contiguous, with two large parcels on the west side of Fresno Slough; all of the proposed areas are adjacent to or just north of the Mendota Wildlife Area.

Potential Off-site Compensatory Mitigation

Off-site compensatory mitigation may include conservation of lands adjacent to the Volta Wildlife Area by development of turn-key mitigation sites, purchase of credits at Grasslands Mitigation Bank, and/or improvement of existing habitat through installation of a groundwater well, wetland creation, or creation of small earthen ridges that would support burrow creation by small mammals. Grasslands Mitigation Bank, which sells credits for giant garter snake mitigation, was recently established and approved adjacent to the Volta Wildlife Area (Figure 4-3). This wildlife area hosts what may be the last viable population of giant garter snake in its southern range and the concentration of mitigation actions at this location could improve the long-term viability of the population.

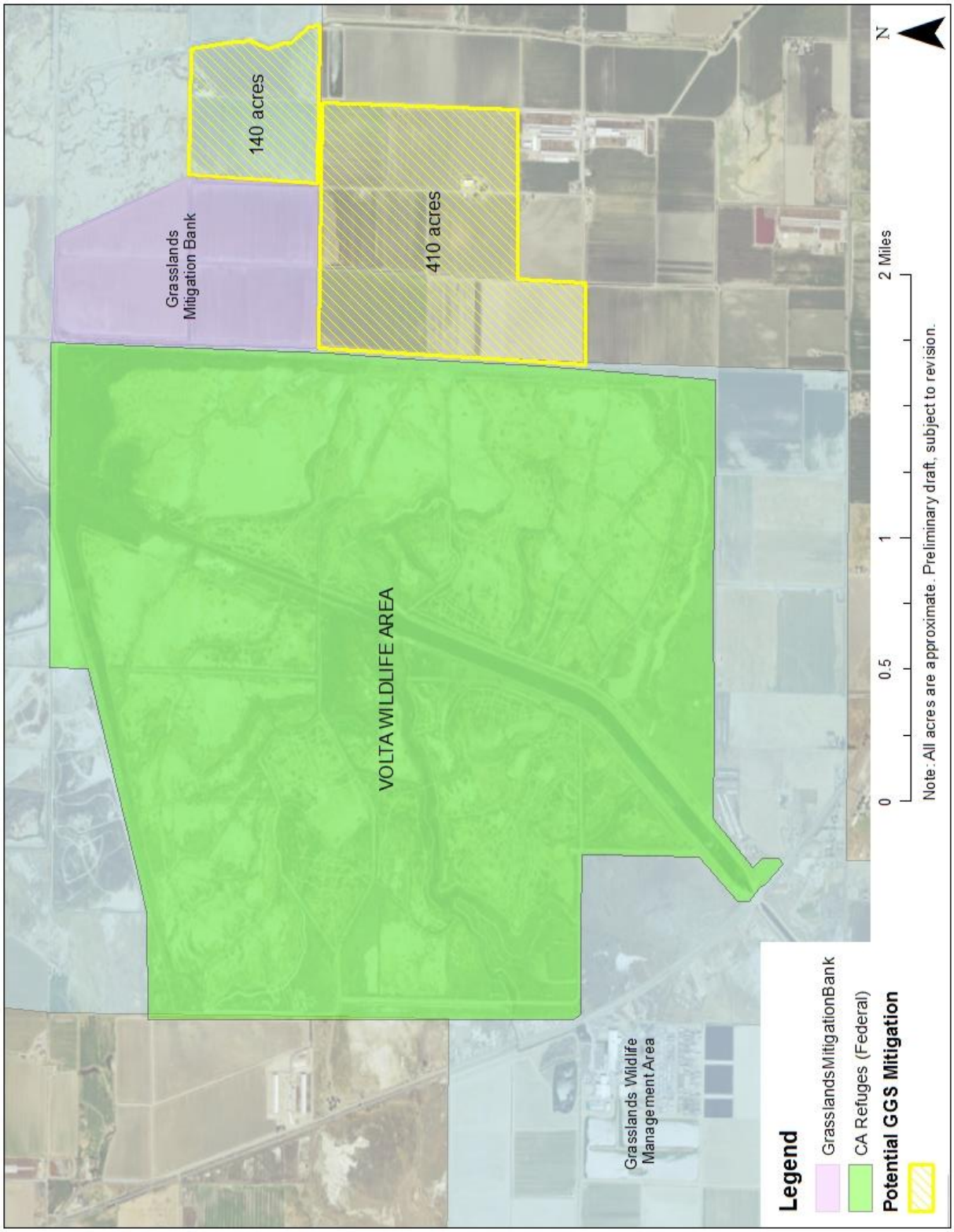

Figure 4-3.
Potential Volta Giant Garter Snake Compensation Area

Reclamation has been indirectly in touch with a landowner that owns approximately 550 acres of property adjacent to the Volta Wildlife Area and Grasslands Mitigation Bank. That landowner may be willing to make some acreage available for giant garter snake compensatory mitigation. Additionally, upon last inquiry, the Grasslands Mitigation Bank had approximately 50 credits (or acres) remaining for giant garter snake mitigation. For the San Joaquin Basin Recovery Unit, where the Volta Wildlife Area is located, the recovery goal is a minimum of ten habitat block pairs with no less than two block pairs per management unit (USFWS 2015c). Development of up to 600 acres of giant garter snake habitat near Volta Wildlife Area would fulfill one of the 539-acre blocks of habitat desired by the USFWS for recovery in this Management Unit.

Another compensatory mitigation option is to enhance existing habitat at the Volta Wildlife Area. This could include development of a water supply, such as a groundwater well for the Volta Wildlife Area, creation of additional wetland habitat, or funding to create ridges in existing ponds to enhance burrows. One of the limitations in developing giant garter snake compensatory mitigation at this location is not just habitat acreage, but the reliability of the water supply during the summer months. A groundwater well on the wildlife area may allow for seasonally-appropriate inundation of a greater acreage of wetlands throughout the summer, providing foraging habitat for giant garter snake. The Volta Wildlife Area has recently performed some work to create giant garter snake habitat to the north of the wildlife area. Giant garter snake has not been observed in this created habitat, and enhancements could improve the habitat characteristics. Table 4-3 below summarizes the potentially available acreage for compensatory mitigation for giant garter snake in all areas. Reclamation will continue to coordinate with USFWS on compensatory mitigation planning efforts as they develop.

Table 4-3.
Giant Garter Snake – Potential Mitigation Available

	Fresno Slough	Near Volta	Total
Likely	300	140	440
Uncertain	675	410	1,085
TOTAL	**975**	**550**	**1,525**

4.4 Least Bell's Vireo

The least Bell's vireo has not been identified during 2 years of protocol surveys conducted in portions of the Action Area and is currently not known to occur within the area surrounding the Project. However, due to the potential dispersal of individuals from core population areas, it is unlikely but possible that least Bell's vireo could establish a new population in the Action Area prior to construction. If that were to occur, then there would be potential for impacts to this species. Impacts could include disturbance to nests or birds during the breeding season. Although the species is not known to occur in the Action Area, implementation of the SJRRP and the Project is expected to improve

potential habitat for least Bell's vireo in the Action Area by increasing the availability of riparian habitat. The chances of this species colonizing the Action Area may increase following construction.

4.4.1 Compact Bypass

The portion of the Action Area within the Compact Bypass currently contains limited habitat that could potentially be colonized by this species in the future, in the form of narrow riparian habitat bands (Section 3.4.4). If individual least Bell's vireos colonize the Action Area and are present during construction they could be directly affected during vegetation removal. Project construction activities may produce noise that has the potential to induce dispersal behavior or abandonment of active nesting sites if least Bell's vireo are present in the Action Area during construction. However, due to the recent negative surveys and the lack of a nearby source population, the potential for this species to occur in the Compact Bypass area is discountable.

Overall, long-term operation of the Project is expected to be beneficial to the species. Post-construction activities will include active and passive restoration of riparian habitat within the Compact Bypass channel. Expansion of riparian habitat in the Action Area may have a positive impact on this species and allow least Bell's vireo to potentially expand into areas of its historic range.

4.4.2 Reach 2B Channel Improvements

The potential effects from the construction of the Reach 2B channel improvements to least Bell's vireo are similar to those described above in construction of the Compact Bypass. Due to the recent negative surveys and the lack of a nearby source population, the potential for this species to occur in the Reach 2B channel improvements area is discountable.

After construction, the SJRRP and the Project may have a positive impact on this species through the restoration of more natural hydrology and the establishment of additional riparian forest habitat. Overall, long-term operations are expected to be beneficial to the species because this would expand and improve the condition of riparian habitat, which could potentially increase the range for least Bell's vireo.

4.4.3 Avoidance and Minimization Measures for Least Bell's Vireo

The Conservation Strategy described in Section 2.5, Table 2-4, outlines conservation measures for biological resources that may be affected by Project actions and includes avoidance and minimization measures. Conservation Measure RNB-1 will be implemented to avoid or minimize potential adverse effects to least Bell's vireo. According to RNB-1, protocol-level surveys during the breeding season will be conducted for least Bell's vireo. If the species is not detected within the Action Area through protocol surveys, avoidance, minimization, and compensation measures for this species will not be implemented. If least Bell's vireo is detected within the Action Area, information would be collected according to established survey guidelines and Reclamation will reinitiate consultation with USFWS and DFW will be contacted to determine the approach for avoidance, minimization, and compensation measures, as necessary.

4.4.4 Summary of Effects to Least Bell's Vireo

Although the Project is expected to improve the condition of riparian habitat in the Action Area and could potentially facilitate an increasing range for this species, Project construction activities have the potential to degrade habitat quality, and produce high levels of noise and other disturbances but they are unlikely to adversely affect least Bell's vireo, because they are not anticipated to be present.. Based on the absence of species observations from 2 years of protocol-level surveys and the limited amount of suitable habitat in the Project footprint, the adverse effects of the Project would be discountable and insignificant. If protocol-level surveys during the breeding season or incidental observations do detect individuals in the Action Area, consultation will be reinitiated with the USFWS. Conservation Measure RNB-1 would be implemented to avoid and minimize Project effects associated with construction activities. As a result, the Project ***may affect, but is not likely to adversely affect,*** least Bell's vireo.

4.5 Fresno Kangaroo Rat

Trapping efforts in the Action Area have failed to detect Fresno kangaroo rat, and the last verified capture of Fresno kangaroo rat occurred at the Alkali Sink Ecological Reserve in 1992 (USFWS 2010c). The Project will result in impacts to potentially suitable habitat in the Action Area for Fresno kangaroo rat, but that habitat is separated from the Alkali Sink Ecological Reserve by 2 miles of heavily grazed grassland habitat and Highway 180. If the species were to occur in the Action Area, impacts during construction may include the loss of suitable habitat for the species.

4.5.1 Compact Bypass

The portion of the Action Area in the Compact Bypass does not contain suitable habitat for Fresno kangaroo rat. Construction of the Compact Bypass is expected to have no adverse effect on this species.

4.5.2 Reach 2B Channel Improvements

Fresno kangaroo rat habitat in the Reach 2B channel improvements portion of the Action Area (Figure 3-7) consists of heavily grazed annual grassland and elderberry savannah. This habitat is along the edge of the existing river channel and, based on the presence of dense grasses, is influenced by a periodic high groundwater table. Despite the presence of friable soils and visual evidence of kangaroo rat occupancy, the vegetation composition of the area reduces the likelihood that the listed species will occur and instead favors Heermann's kangaroo rat, consistent with prior trapping survey results in adjacent areas. Effects to this portion of the Action Area would include construction of a new levee (infrastructure in Table 3-5), and conversion of potentially suitable habitat that falls within the levee and floodplain. However, the current habitat is not expected to support this species. After the Project is complete, the area occupied by the levee is expected to provide less suitable habitat for the Fresno kangaroo rat than it does currently. The area identified as floodplain in Table 3-5 will lay on the river side of the new levee. It would be subject to more frequent inundation than currently, and would be isolated from more suitable habitat to the south by the new levee, so following construction this habitat also would be less suitable than it is currently for Fresno kangaroo rat.

In the unlikely event that Fresno kangaroo rat were present in the Action Area, adverse effects to the species could be both direct and indirect. Where suitable habitat exists in the Action Area, the Project may increase the amount of noise, light, vibration, and dust, resulting in disruption of the species' breeding, feeding, or sheltering behaviors; inducing dispersal behavior; or abandonment of active burrows. However, given the status of the Fresno kangaroo rat and the location of this habitat along the existing river channel, adverse effects to this species are very unlikely to occur.

4.5.3 Avoidance and Minimization Measures for Fresno Kangaroo Rat

Protocol-level surveys are planned to be conducted in grassland and elderberry savannah habitat identified as potential Fresno kangaroo rat habitat on the south side of the San Joaquin River near the Chowchilla Bifurcation Structure in 2016. These surveys will be conducted by a biologist permitted to handle Fresno kangaroo rat by both the USFWS and DFW, and in accordance with survey protocols approved by both agencies and after the survey proposal has been reviewed by USFWS and DFW.

The Conservation Strategy described in Section 2.5, Table 2-4, outlines conservation measures for biological resources that may be affected by Project actions and includes avoidance and minimization measures. Conservation Measure FKR-1 will be implemented to avoid or minimize potential adverse effects to Fresno kangaroo rat. If the species is not detected within the Action Area during protocol-level surveys, avoidance, minimization, and compensation measures for this species will not be implemented. If Fresno kangaroo rat is found within the Action Area, Reclamation will reinitiate consultation with USFWS and DFW will be contacted to determine the approach for avoidance, minimization, and compensation measures, as necessary.

4.5.4 Summary of Effects to Fresno Kangaroo Rat

Project construction activities in the Reach 2B channel improvements portion of the Project may result in the conversion of Fresno kangaroo rat habitat to a permanent levee structure. This action has the potential to degrade habitat quality, and produce high levels of noise, vibration, and other disturbances but it is unlikely to adversely affect kangaroo rats during construction, as they are not anticipated to be present. Based on the status of the species, the location of Fresno kangaroo rat habitat within the Action Area, the limited amount of suitable habitat adjacent to the Action Area, and the existing poor habitat and highway between the Action Area and the Alkali Sink Ecological Reserve, these effects would be discountable (pending additional survey results). Evidence of periodic flooding and dense vegetation in areas identified as potential Fresno kangaroo habitat reduce the likelihood that these areas are occupied by this species. Additionally, the inability to trap this species in the vicinity for over 20 years despite repeated efforts indicates that the species is unlikely to be present, and thus unlikely to be affected by Project activities. If protocol surveys do detect individuals in the Action Area, consultation will be reinitiated with the USFWS. Conservation Measure FKR-1 would be implemented to avoid and minimize Project effects associated with construction activities. As a result, the Project ***may affect, but is not likely to adversely affect,*** Fresno kangaroo rat.

4.6 San Joaquin Kit Fox

The Project will result in impacts to potentially suitable foraging and dispersal habitat in the Action Area for San Joaquin kit fox. Although San Joaquin kit fox is not expected to occur in the Action Area, impacts during construction may include impacts to habitat and harassment of any animals that may be moving through the area.

4.6.1 Compact Bypass

The portion of the Action Area in the Compact Bypass is dominated by a mixture of agricultural habitat types (deciduous orchards, cropland, irrigated row and field crop) with willow scrub, valley foothill riparian, and lacustrine habitats found near the San Joaquin River and Mendota Dam (see Figure 3-2). Due to the thick cover which can harbor their predators, these habitats are not considered to be suitable for San Joaquin kit fox.

Kit fox are known to move through agricultural lands and forage despite the documented low quality of these habitats for this species (USFWS 2010d). Kit fox are highly mobile and due to the varied land cover of the Action Area, could be encountered across the entire site. Despite the wide-ranging nature and adaptability of this species, requirements for denning and reproduction are specific and not met in agricultural areas. Habitat suitability analyses of the area indicate that, with the exception of the Alkali Sink and Kerman Ecological reserves and a few other, smaller, isolated areas, the habitat in the Project vicinity does not contain elements necessary to support permanent use by kit fox (Cypher et. al 2013).

In the unlikely event that an individual San Joaquin kit fox occurs in this portion of the Action Area, the proposed construction activities in the Compact Bypass may result in adverse effects from construction noise and vibrations. The most likely consequences of noise on this species may include inducing dispersal behavior or abandonment of potential foraging sites. Permanent changes to habitats in this portion of the Action Area are not expected to decrease the potential for kit fox to move through the area.

4.6.2 Reach 2B Channel Improvements

Potentially suitable habitat for San Joaquin kit fox in the Reach 2B channel improvements portion of the Action Area consists of heavily grazed annual grassland and elderberry savannah, and a mosaic of deciduous orchards and row crops. As described above in Section 4.6.1., kit fox primarily use agricultural lands for foraging and dispersal (USFWS 2010d). Impacts to this portion of the Action Area would include construction of a new levee, and conversion of potentially suitable habitat that falls within the levee and floodplain.

If San Joaquin kit fox is present in the Action Area, adverse effects to the species may be both direct and indirect. Where suitable habitat exists, the Project may increase the amount of noise, light, vibration, and dust, resulting in disruption of the species' feeding or foraging, and inducing dispersal behavior.

If San Joaquin kit fox were present in the Action Area, indirect effects may occur from habitat modifications that reduce suitable breeding, feeding, or foraging opportunities; restrictions of movement between satellite population areas; or an increase in predation. Although habitat type and location would change during long-term Project operations, the overall suitability of the Action Area after the Project is complete would continue to provide a mix of habitats that could be used by kit fox for foraging or dispersal. Due to the absence of known individual kit foxes in the Action Area and the ability of the available habitat to continue to provide for dispersing San Joaquin kit foxes after construction, adverse effects to this species are unlikely to occur.

4.6.3 Avoidance and Minimization Measures for San Joaquin Kit Fox

A qualified biologist will identify any potential dens greater than 5 inches in diameter in the Project footprint during surveys in 2016. The Conservation Strategy described in Section 2.5, Table 2-4, outlines conservation measures for biological resources that may be affected by Project actions and includes avoidance and minimization measures that will be implemented as part of the proposed action. Conservation Measure SKJF-1 will be implemented to avoid or minimize potential adverse effects to San Joaquin kit fox. If the species is not present within the Action Area, additional avoidance, minimization, or compensation measures beyond the *Standardized Recommendations for Protection of San Joaquin Kit Fox Prior to or During Ground Disturbance* (USFWS 1999b) (as described in SJKF-1) for this species will not be implemented. If San Joaquin kit fox is found within the Action Area, Reclamation will reinitiate consultation with USFWS and DFW will be contacted to determine the approach for avoidance, minimization, and compensation measures, as necessary.

4.6.4 Summary of Effects to San Joaquin Kit Fox

Project construction activities in the Reach 2B channel improvements portion of the Project may result in minor alterations to dispersal and foraging habitat for San Joaquin kit fox. San Joaquin kit fox is not expected to occur in the Action Area but because they are a wide ranging species a dispersing kit fox could move through the Action Area, in which case the entire Action Area could potentially provide foraging or dispersal habitat. Construction related activities have the potential to degrade habitat quality, and produce high levels of noise, vibration, and other disturbances but they are unlikely to adversely affect San Joaquin kit fox. Based on the absence of current distribution records or recent survey data that confirm the presence of the species and the lack of areas suitable for denning in the vicinity of the Action Area, and the implementation of the previously described avoidance and minimization measures as part of the proposed action, the adverse effects of the Project are considered to be discountable and insignificant. If pre-construction surveys detect individuals in the Action Area, consultation will be reinitiated with the USFWS. Conservation Measure SJKF-1 will be implemented to avoid and minimize Project effects associated with construction activities. As a result, the Project ***may affect, but is not likely to adversely affect,*** San Joaquin kit fox.

4.7 Federally Listed Plant Species

As described in Table 3-2, there are three federally listed plants with limited potential to occur in the Action Area: California jewelflower, palmate-bracted bird's beak, and San Joaquin woolly threads. The Project will result in the modification of habitats in the Action Area that are largely not considered to be suitable for the species, but they have limited potential to occur in grassland and elderberry savannah habitats present in portions of the Action Area. As described in the *Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRRP 2011c), all three species are unlikely to occur in the Action Area based on negative protocol botanical survey results in portions of the Action Area (see Section 3.1.2 for summary of survey methods and locations), the presence of limited suitable habitats and soils, and/or the absence of any CNDDB results recorded within 10 miles of the Action Area (SJRRP 2011c). Additional surveys will be conducted prior to ground disturbance in grassland and elderberry savannah habitat, as described in Table 2-4, Conservation Measure PLANTS-1.

4.7.1 Compact Bypass

The portion of the Action Area in the Compact Bypass does not contain suitable habitat for the California jewelflower, palmate-bracted bird's beak, or San Joaquin woolly threads. Construction of the Compact Bypass is expected to have no adverse effect on this species.

4.7.2 Reach 2B Channel Improvements

The heavily grazed annual grassland habitat and elderberry savannah habitats at the eastern end of the Reach 2B channel improvements portion of the Action Area, on the south side of the San Joaquin River, provides limited opportunity for California jewelflower, palmate-bracted bird's beak, and San Joaquin woolly threads. The species are unlikely to occur based on the disturbed nature of the annual grassland and the lack of alkaline soils in the Action Area.

4.7.3 Avoidance and Minimization Measures for Federally Listed Plants

The Conservation Strategy described in Section 2.5, Table 2-4, outlines conservation measures for biological resources that may be affected by Project actions and includes avoidance and minimization measures. Conservation Measure PLANTS-1 will be implemented to avoid or minimize potential adverse effects. If California jewelflower, palmate-bracted bird's beak, or San Joaquin woolly threads are detected or suspected to be present in the Project footprint, information would be collected according to established survey guidelines.

- Special-status plant populations will be identified by staking, flagging, or fencing a 100-foot-wide buffer before Project activities.
- No activities will occur within the buffer area.
- Worker awareness training and biological monitoring will be conducted.

4.7.4 Summary of Effects to Federally Listed Plants

Project construction activities in the Reach 2B channel improvements portion of the Project may result in the permanent loss of heavily grazed annual grassland and elderberry savannah habitats that may support three federally listed plants: California jewelflower, palmate-bracted bird's beak, and San Joaquin woolly threads. However, all three species are unlikely to occur in the Action Area based on limited suitable habitats, lack of suitable soils, negative protocol botanical survey results in portions of the Action Area, and/or the absence of any CNDDB results recorded within 10 miles of the Project.

Based on the current status of the species' and their limited potential to occur in the Action Area, the adverse effects of the Project are considered to be discountable and insignificant. Conservation Measures PLANT-1 would be implemented to avoid and minimize Project effects associated with construction activities. If protocol surveys do detect individuals in the Action Area and complete avoidance is not possible, consultation will be reinitiated with the USFWS. As a result, the Project ***may affect, but is not likely to adversely affect,*** California jewelflower, palmate-bracted bird's beak, and San Joaquin woolly threads.

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5.0 Cumulative Effects

Cumulative effects as defined by the ESA are those effects of future State or private activities that are reasonably certain to occur within the Action Area (ESA, Section 402.14[g][4]). Future federal actions that are unrelated to the completed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA (16 U.S.C. 1536). The Project, in combination with other non-federal Projects in the Reach 2B area, could contribute to effects on valley elderberry longhorn beetle, blunt-nosed leopard lizard, giant garter snake, least Bell's vireo, Fresno kangaroo rat, San Joaquin kit fox, California jewelflower, palmate-bracted bird's beak, and San Joaquin woolly threads as a result of construction noise and vibration and elimination of and changes in suitable habitats. If present within the Action Area, these species may be adversely affected by removal, destruction, covering or unearthing of individuals or populations, which in turn could facilitate changes in habitat heterogeneity, hydrology, fragmentation, and introduction of non-native plant species as long-term impacts of the Project and implementation of SJRRP.

None of the State and private projects or plans referenced in the PEIS/R would likely cumulatively adversely affect wildlife and plant species in the Action Area based on their location relative to the Project (SJRRP 2011a, pages 26-3 to 26-33).

The creation of bypass and the channel improvements in Reach 2B that could result in adverse effects on wildlife and plant species would be minimized by implementing species-specific avoidance and minimization measures and, as necessary, compensatory mitigation. The intention to improve aquatic habitat conditions will be beneficial to least Bell's vireo through restoration of a more natural hydrology and establishment of additional riparian forest habitat that this species prefer. No other notable projects would cumulatively contribute to the incremental effects to the listed wildlife and plant species.

Based on the information presented above, there is no identified State or private projects or programs that occur within the Action Area and which have the potential to produce adverse cumulative effects. Therefore, the Project would have ***no cumulative effects*** on valley elderberry longhorn beetle, blunt-nosed leopard lizard, giant garter snake, least Bell's vireo, Fresno kangaroo rat, San Joaquin kit fox, California jewelflower, palmate-bracted bird's beak, and San Joaquin woolly threads.

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