UPPER SAR HCP

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STAKEHOLDER DRAFT

UPPER SANTA ANA RIVER HABITAT CONSERVATION PLAN

Prepared for:
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Municipal Water District
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Upper Santa Ana River
• HABITAT CONSERVATION PLAN •

Southwestern Willow Flycatcher: Kelly Colgan Azar/Flickr Creative Commons
Santa Ana Sucker: https://sawpa.org/
Santa Ana River: yoursocaltapwater.org
San Bernardino Kangaroo Rat: Marshal Hedin

Stakeholder Review Draft

Upper Santa Ana River Habitat Conservation Plan

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Permittee Agencies:

City of Rialto Public Works
East Valley Water District
Inland Empire Utilities Agency
Metropolitan Water District of Southern California
Orange County Water District
Riverside Public Utilities
San Bernardino Municipal Water Department
San Bernardino Valley Water Conservation District
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Acronyms and Abbreviations

Abbreviation	Definition
°F	degrees Fahrenheit
AF	acre-feet
afy	acre-feet per year
Alliance	Upper Santa Ana River Sustainable Resources Alliance
AMMP	Adaptive Management and Monitoring Plan
AMMs	avoidance and minimization measures
AMs	avoidance measures
APNs	Assessor Parcel Numbers
Basin Plans	Regional Water Quality Plans
BIOS	Biogeographic Information and Observation System
BLS	Bureau of Labor Statistics
BMPs	best management practices
CAL FIRE	California Department of Forestry and Fire Protection
Cal-IPC	California Invasive Plant Council
CAMMP	Comprehensive Adaptive Management and Monitoring Program
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
COI	Certificate of Inclusion
Consortium	Louis Rubidoux Nature Center Consortium
CPAD	California Protected Areas Database
CWA	Clean Water Act
East Valley	East Valley Water District
EDB	East Declez Basin
eDNA	Environmental DNA
EPA	U.S Environmental Protection Agency
ESA	Environmentally Sensitive Area
FEIR	Final Environmental Impact Report
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FESA	Federal Endangered Species Act

Abbreviation	Definition
FR	Federal Register
FTE	full-time employee
GDE	a groundwater-dependent ecosystem
Geoscience	Geoscience Support Services, Inc.
GIS	geographic information system
GSAs	Groundwater Sustainability Agencies
HCP	Habitat Conservation Plan
HCP Handbook	2016 Habitat Conservation Planning Handbook
HdV	Huerta del Valle
HMMP	Habitat Management and Monitoring Plan Implementation
HSPF	Hydrologic Simulation Program Fortran
HTAC	Hydrology Technical Advisory Committee
I-	Interstate
IEMM	Institute for Ecological Monitoring and Management
IERCD	Inland Empire Resource Conservation District
IEUA	Inland Empire Utilities Agency
IFIM	Instream Flow Incremental Methodology
IFSAR	interferometric synthetic aperture radar
IP	Individual Permit
ITP	Incidental Take Permit
IWMP	integrated weed management plan
JPA	Joint Powers Authority
Lake Mathews MSHCP	Lake Mathews Multiple Species HCP
LOP	letter of permission
LRNC	Louis Rubidoux Nature Center
LSAA	Lake and Streambed Alteration Agreement
MBTA	Migratory Bird Treaty Act of 1918
MCV	Manual of California Vegetation
Metropolitan	Metropolitan Water District of Southern California
mgd	million gallons per day
MOU	Memorandum of Understanding
MW	megawatts
NCCP	Natural Community Conservation Plan
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporationv
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NPV	net present value

Abbreviation	Definition
NWI	National Wetlands Inventory
O&M	operations and maintenance
OCWD	Orange County Water District
PBFs	physical and biological features
PBFs	Primary Biological Features
PCW	Prado Constructed Wetlands
PFA	Participation and Financing Agreement
PHABSIM	Physical Habitat Simulation System
PMSP	Prolonged Mate Searching Polygyny
Porter-Cologne	Porter-Cologne Water Quality Control Act
PUPs	Preserve Unit Plans
RAFSS	Riversidian alluvial fan sage scrub
RCHCA	Riverside County Habitat Conservation Agency
RCIS	Regional Conservation Investment Strategy
RCRCD	Riverside-Corona Resource Conservation District
Rialto	City of Rialto Public Works
RIX	Rapid Infiltration and Extraction
ROW	right-of-way
RPU	Riverside Public Utilities
RPU.5	Riverside North Aquifer Storage and Recovery Project
RWIPP	Right-of-Way and Infrastructure Protection Program
RWQCBs	Regional Water Quality Control Boards
RWQCP	Regional Water Quality Control Plant
RWRPs	regional water recycling plants
SAR	Santa Ana River
SARMP	Santa Ana River Mainstem Project
SAS	anta Ana sucker
SBCFCD	San Bernardino County Flood Control District
SBKR	San Bernardino kangaroo rat
SCADA	supervisory control and data acquisition
SCE	Southern California Edison
SCS	Soil Conservation Service
SDMMP	San Diego Multi-Species Management Plan
SGMA	Sustainable Groundwater Management Act
SKR	Stephens' kangaroo rat
SKR HCP	Stephens' Kangaroo Rat Habitat Conservation Plan
SNRC	Sterling Natural Resource Center
State Water Board	State Water Resources Control Board

Abbreviation	Definition
SWAMP	Surface Water Ambient Monitoring Program
SWP	State Water Project
SWPPP	stormwater pollution prevention plan
TDS	total dissolved solids
the Wildlife Agencies	USFWS and CDFW
TIN	total inorganic nitrogen
USACE	U.S Army Corps of Engineers
USC	United States Code
USFS	U.S. Forest Service
USFWS	U.S Fish and Wildlife Service
USGS	U.S. Geological Survey
Valley District	San Bernardino Valley Municipal Water District
Wash Plan	Upper Santa Ana River Wash HCP
Water Department	San Bernardino Municipal Water Department
WDRs	Waste Discharge Requirements
West Valley	West Valley Water District
Western	Western Municipal Water District of Riverside County
WFF	Water Filtration Facility
Wildermuth	Wildermuth Environmental, Inc.
WLAM	Wasteload Allocation Model
WRC MSHCP	Western Riverside County Multiple Species HCP
WRCRWA	Western Riverside Regional Wastewater Authority
WRDA	Water Resources Development Act
WWRF	Western Water Recycling Facility

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Executive Summary

ES.1 Overview of the Habitat Conservation Plan

The Upper Santa Ana River (SAR) watershed is home to dozens of water districts, flood control districts, and other local water management agencies (collectively and generally referred to as *water agencies*) with an interest in the responsible management of water supply resources (e.g., storage, conveyance, treatment, flood protection, and recreation) and sustainable stewardship (e.g., water quality and biological resource protection) of the watershed. The challenges facing water districts and other local agencies in the Upper SAR include the effects of population growth that increase water demand and decrease natural hydrological processes and groundwater recharge, the reduction of imported water availability, and the effects of climate change. As a result of these pressures of urbanization, many of the species in the Upper SAR watershed are listed as threatened or endangered under the California and federal Endangered Species Acts (CESA and FESA, respectively). Therefore, many water agency activities potentially impacting these species, such as the Santa Ana sucker and San Bernardino kangaroo rat (see Section ES.3, *Covered Species*, below), may require permits from the United States Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW) (collectively referred to as the *Wildlife Agencies*).

The Upper SAR Habitat Conservation Plan (HCP) has been developed to address the potential effects of water agency activities on the sensitive species and habitats in the watershed in order to receive Incidental Take Permits (ITPs) under Section 10 of FESA.

ES.1.1 Purpose of the Habitat Conservation Plan

The Upper SAR HCP is a regional, comprehensive program that would provide a framework to protect, enhance, and restore the habitat for Covered Species (Chapter 3, *Planning Area and Existing Environment*), while streamlining permitting for Covered Activities (Chapter 2). Within this framework, the Upper SAR HCP would achieve conservation goals and objectives and comply with FESA while streamlining planning and permitting for anticipated water resource management projects needed to serve the water resource needs of the public. The HCP will achieve the conservation goals and objectives through the establishment of the HCP Preserve System and implementation of the conservation actions as described in Chapter 5, *Conservation Strategy,* of this HCP.

ES.1.2 Cost and Benefit of the Habitat Conservation Plan

The HCP is estimated to cost approximately $187.5 million, paid incrementally over the 50-year permit term and excluding inflation, and shared among the water agencies receiving ITPs under this HCP (see Section ES.2, *Incidental Take Permits*, below).

Over 50 years, the $187.5 million in HCP costs will allow Permittee Agencies to develop over 4 million acre-feet of water for local use, or approximately 87,000 acre-feet per year (afy) by year 15 of HCP implementation. These water resources will reduce reliance on costly imports from other parts of the state, increasing the area's resilience to drought and regulatory restrictions that hamper water deliveries from the State Water Project, while also keeping more of the project spending in the local economy.

While there is a high initial investment cost, the economic benefits of the plan to water users and the local economy as a whole are substantially greater than the costs. Without the HCP in place, Permittee Agencies would need to acquire this additional 87,000 afy of water supply from more costly alternative sources. Even if it was possible to purchase that volume of water either from wholesalers or elsewhere in the market, the HCP is projected to save the region approximately $952 million over the life of the HCP on a net present value basis, and create secondary benefits from investment in the local economy.[1] This represents a benefit-cost ratio of over 7.3,[2] which illustrates the enormity and importance of this effort. See Chapter 7, *Funding*, for additional information.

ES.1.3 Evolution of the Habitat Conservation Plan

The current set of Covered Activities in the Upper SAR HCP was determined through the partnership and the collaborative efforts with the Permittee Agencies, Wildlife Agencies, and involved stakeholders. The complete HCP conservation strategy for all Covered Species was also developed through this collaborative partnership, and includes a comprehensive strategy for long-term protection, restoration, and conservation to manage the natural resources and species of the Upper SAR watershed in a way that ensures long-term ecological value to the region and species recovery. Through this collaborative partnership, many modifications were made to the HCP to further reduce impacts on the Santa Ana River and increase conservation values to species in a way that protects and enhances the ecological function of the system.

Previous HCP iterations included Covered Activities that resulted in greater impacts on species and the riverine system than were acceptable or likely to be permittable under FESA and CESA. Preliminary impact analyses, including substantial hydrology modeling, led to the modifications to the Covered Activities to substantially reduce the potential biological and hydrological impacts resulting from the Covered Activities. Similarly, many iterations and additions to the conservation strategy led to substantial improvements in the measures to avoid and minimize take and the expected outcomes for each species covered by the HCP. The modifications resulted in reduced impact on the Santa Ana River and increased conservation values to species in a way that protects and enhances the ecological function of the system far more than earlier iterations of the HCP.

ES.2 Incidental Take Permits

ES.2.1 Permittee Agencies

The HCP was collaboratively developed for 11 water agencies with planned water supply or other infrastructure projects needing incidental take permit coverage for endangered and threatened species in the Santa Ana River watershed. These 11 water agencies (Permittee Agencies), together with Southern California Edison (SCE).which may receive its own incidental take permit in accordance with the HCP, comprise the 12 entities that will receive incidental take coverage through

[1] Refer to Section 7.6, *HCP Benefits*, for a detailed accounting of this estimate. Net present value (NPV) calculations are made using an interest rate of 4.61% based on the rate used by the State Water Project in calculating water prices. A general inflation rate is assumed to be 2%. The net discount rate is 2.61%.

[2] The benefit-cost ratio is the net present value of the benefits divided by the net present value of the costs. In this case, the benefits are the avoided future costs of more expensive water sources. A ratio above 1.0 indicates net positive benefits over the life or a project or program.

the HCP. The 11 water agencies will be issued a single joint ITP. The Permittee Agencies are listed in alphabetical order below.

- City of Rialto Public Works
- East Valley Water District
- Inland Empire Utilities Agency
- Metropolitan Water District of Southern California
- Orange County Water District
- Riverside Public Utilities
- San Bernardino Municipal Water Department
- San Bernardino Valley Municipal Water District
- San Bernardino Valley Water Conservation District
- West Valley Water District
- Western Municipal Water District of Riverside County

Southern California Edison Incidental Take Permit

A second ITP is expected to be issued to SCE to provide incidental take coverage for any Santa Ana suckers that may be translocated to waters covered by their licenses from the Federal Energy Regulatory Commission (FERC).

ES.2.2 Habitat Conservation Plan Planning Area and Permit Area

The Planning Area encompasses approximately 862,966 acres and was developed to ensure that the natural resources that might be affected by Covered Activities can be adequately assessed at a regional scale and that sufficient mitigation opportunities are available. The Permit Area is the geographic area where the impacts of the Covered Activities are expected to occur and is depicted as the ownership, easements, and areas of operation and maintenance where all Covered Activities are located within natural habitats. The Permit Area also includes the HCP Preserve System so that the ITPs cover the potential take associated with habitat mitigation, management, and monitoring. The Planning Area and Permit Area are shown on Figures 1-2 and 1-3 in Chapter 1, *Introduction and Background*.

ES.2.3 Permit Term

The Permittee Agencies are seeking a 50-year ITP, which would accommodate the expected schedule for construction of projects in the Permit Area and ongoing associated operations and maintenance. The permit term for the ITP for SCE will be independent of that of the Permittee Agencies' ITP. SCE operates and maintains hydroelectric facilities in accordance with three, 30-year licenses issued by the FERC in 2003, and the SCE ITP permit term may be established to coincide with the FERC relicensing cycles.

ES.3 Covered Species

There are 20 species covered by the HCP, including 9 listed and 11 non-listed species. There are also two additional Fully Avoided species that are listed but are not Covered Species and will be fully avoided during Covered Activities (Table ES-1). The avoidance and minimization measures included in Chapter 5 are expected to reduce any adverse effects on these species so that they would not result in take.

The incidental take authorization under Section 10 of FESA will apply to the wildlife species. The take of listed plant species is not prohibited under FESA or authorized under a Section 10(a)(1)(B) permit. However, the two plant species conserved by this HCP are listed in the 10(a)(1)(B) permit in recognition of the conservation measures and benefits provided for them under the HCP such that the Permittee Agencies will receive assurances pursuant to the USFWS "No Surprises" rule. Similarly, the unlisted species covered in the HCP will also receive assurances under the "No Surprises" rule should they become listed in the future. Federal authorization for incidental take of other species may be sought through the amendment process and in accordance with FESA Sections 10(a) and 7 (Table 1-1).

As noted above, this HCP establishes conservation strategies for a number of state-listed species. Although CDFW will not approve the HCP, the conservation strategies established for the HCP are intended to also support the issuance of state ITPs.

Table ES-1. Species Addressed in the Upper SAR HCP

		Status	
Common Name	**Scientific Name**	**Federal**	**State**
Covered Species			
Slender-horned spineflower	*Dodecahema leptoceras*	Endangered	Endangered
Santa Ana River woolly-star	*Eriastrum densifolium* ssp. *sanctorum*	Endangered	Endangered
Santa Ana sucker	*Catostomus santaanae*	Threatened	None
Arroyo chub	*Gila Orcuttii*	None	SSC
Santa Ana speckled dace	*Rhinichthys osculus* ssp.	None	SSC
Mountain yellow-legged frog (Southern California DPS)	*Rana muscosa*	Endangered	Endangered
Western spadefoot	*Spea hammondii*	None	SSC
California glossy snake	*Arizona elegans occidentalis*	None	SSC
South coast garter snake	*Thamnophis sirtalis* sp.	None	SSC
Southwestern pond turtle	*Emys pallida*	None	SSC
Tricolored blackbird	*Agelaius tricolor*	None	Threatened
Burrowing owl	*Athene cunicularia*	None	SSC
Cactus wren	*Campylorhynchus brunneicapillus*	None	SSC
Yellow-breasted chat	*Icteria virens*	None	SSC
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	Threatened	Endangered
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Endangered

Common Name	Scientific Name	Status	
		Federal	State
Coastal California gnatcatcher	*Polioptila californica*	Threatened	SSC
Least Bell's vireo	*Vireo bellii pusillus*	Endangered	Endangered
Los Angeles little pocket mouse	*Perognathus longimembris brevinasus*	None	SSC
San Bernardino Merriam's kangaroo rat	*Dipodomys merriami parvus*	Endangered	Candidate
Fully Avoided Species[1]			
Delhi Sands flower-loving fly	*Rhaphiomida terminatus abdominalis*	Endangered	None
Arroyo toad	*Anaxyrus californicus*	Endangered	None

[1] Implementation of avoidance measures as described in Chapter 5 of this HCP would prevent the take of these species.
DPS = Distinct Population Segment; SSC = CDFW Species of Special Concern.

ES.4 Covered Activities

The Upper SAR HCP must identify the activities that could result in take of Covered Species within the Planning Area. The types of activities covered by the HCP (Covered Activities) should include all actions that the Permittee Agencies want to have covered by FESA Section 10 and CESA 2081(b) permits. Covered Activities include both specific projects and ongoing activities (e.g., operations and maintenance).

- *Projects* are well-defined actions that occur **once** in a discrete location (e.g., construction of new facilities, infrastructure development, capital improvement projects).
- *Operations and maintenance activities* are actions that occur **repeatedly** in one area or over a wide area (e.g., bank stabilization, storm-damage repair, maintenance of facilities).

Covered Activity types are listed in Table ES-2, and include construction, infrastructure development, and operations and maintenance of water conservation, water infrastructure development, flood control, habitat restoration, and solar energy facility activities. The Covered Activities are described in detail in Chapter 2, *Covered Activities*, including the size of the impacted area, frequency of activity, and the type and intensity of impact. The potential effects of the Covered Activities on Covered Species are analyzed in Chapter 4, *Take Assessment and Impact Analysis*.

Table ES-2. Covered Activity Types Included in the Upper SAR HCP

Activity Type	Description
Water Reuse Projects (Figure 2-1)	Activities related to projects associated with water reuse, including construction of new water treatment plants and associated facilities, and operations and maintenance of existing and new water treatment plants and associated facilities.
Groundwater Recharge (Figure 2-4)	Activities related to construction of new structures associated with diversions, operations and maintenance of existing and new diversion structures for groundwater recharge, activities related to construction of new recharge basins, and operations and maintenance of existing and new recharge basins.

Activity Type	Description
Wells and Water Conveyance Infrastructure (Figure 2-14)	Activities related to the creation of new wells and associated development (e.g., pipelines, access roads, reservoirs, bridges) and the operations and maintenance of this infrastructure and associated development.
Solar Energy Development (Figure 2-21)	Activities related to the construction and the operations and maintenance of new solar facilities.
Routine Operations and Maintenance (See other figures)	Activities that occur repeatedly in one location and/or in many locations over a wide area and include minor construction, earth-moving, or vegetation clearing activities to infrastructure.
Habitat Enhancement, Management, and Monitoring (Figure 2-21)	Activities that support the restoration and management of habitat values in the Planning Area, including species surveys, monitoring, research, and adaptive management activities.

Covered Activities are also anticipated to occur in different phases during implementation of the HCP. These HCP phases are as follows:

- **Phase 1**—0 to 5 years from permit issuance
- **Phase 2**—6 to 10 years from permit issuance
- **Phase 3**—11 to 15 years from permit issuance
- **Phase 4**—16 years from permit issuance to end of permit term

Activities not covered by the HCP and the incidental take authorizations are described in Chapter 2, Section 2.3, *Projects and Activities Not Covered by the HCP*.

ES.5 Take Assessment and Impact Analysis

The Covered Activities will have effects on Covered Species through the alternation of hydrology in the Santa Ana River and tributaries, which in turn may affect depth to groundwater for some groundwater-dependent ecosystems. Alteration of hydrology may also affect sediment transport, a natural ecological process that shapes the ecology of the alluvial fan sage scrub community and the aquatic and riparian communities. Other Covered Activities will affect Covered Species by direct ground-disturbing impacts on the vegetation supporting their habitat. Chapter 3 describes the current distribution of species and habitats in the Planning Area, and uses hydrology modelling to describe the sediment transport processes in the watershed. The hydrology model is integrated with a groundwater model to describe the existing surface water and groundwater conditions as they relate to aquatic habitats and groundwater-dependent ecosystems. These models are used in Chapter 4 to estimate the effects that Covered Activities have on sediment transport, surface water flows, and groundwater so that an estimate of potential incidental take of Covered Species can be made. The Covered Activities are also evaluated to determine the amount of Covered Species habitat directly lost due to ground-disturbing impacts.

These take estimates are as accurate as possible using the methods described in Chapter 4 and given the available details of the Covered Activities at the time of HCP preparation. These take estimates

represent a maximum potential take estimate for each species. With the implementation of avoidance and minimization measures and more precise project-specific design, the take is expected to be lower than estimated in most cases. In no case will the take of any species be allowed to exceed the take estimate established by this HCP. Furthermore, these methods to estimate take are based on habitat suitability models and the potential impacts on modeled habitat, not occupied habitat. The area of potentially suitable habitat predicted by the models is much larger than the area of occupied habitat at any given moment in time, such that the actual impacts on occupied habitat will be substantially less. Actual impacts will be further minimized through the implementation of general and species-specific avoidance and minimization measures.

ES.5.1 Summary of Effects on Species

The mitigation provided by the conservation actions (Chapter 5) will provide significant net benefits to Covered Species through the addition of permanent protections, restoration and enhancement, monitoring, and management. The potential impacts from Covered Activities should be considered in the context of the net benefit to species resulting from the implementation of the conservation strategy.

Table ES-3. Summary of Estimated Impacts and Expected Outcome of Actual Take

Common Name	Estimated Total Impacts on Modeled Habitat (acres)	Mitigation (acres of Modeled and restored Habitat in the HCP Preserve System)	Expected Outcome of Actual Take of Species
Covered Species			
Slender-horned spineflower	400[1] (no impacts on extant occurrences)	**877**	Strict avoidance and minimization measures will ensure direct take of individual plants is near zero. Suitable habitat will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Santa Ana River woolly-star	446	**728**	Strict avoidance and minimization measures will ensure direct take of individual plants is near zero. Suitable habitat will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Santa Ana sucker	1.25	**5.1** (including 1.5 acres of enhancement in mainstem Santa Ana River and 3.6 acres of tributary restoration) Santa Ana sucker will also be translocated to a minimum of three montane streams and actively managed	A majority of actions in the USFWS Recovery Plan for this species will be implemented within the HCP Preserve System through implementation of the HCP Conservation Strategy. Habitat enhancement and restoration will occur ahead of any impacts on suitable habitat. Population stability and distribution will be substantially improved through tributary restoration and translocation before

Common Name	Estimated Total Impacts on Modeled Habitat (acres)	Mitigation (acres of Modeled and restored Habitat in the HCP Preserve System)	Expected Outcome of Actual Take of Species
			any direct impacts on the species can occur. Suitable habitat will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. While the suitable habitat in the mainstem of the Santa Ana River will be reduced as a result of implementation of Covered Activities, the restoration, enhancements and translocation actions within the HCP Preserve System will offset these impacts and make major contributions to the recovery of the Santa Ana Sucker.
Arroyo chub	2.4	**5.1** (1.5 acres of enhancement in mainstem Santa Ana River and 3.6 acres of tributary restoration)	Population stability and distribution will be substantially improved through tributary restoration before any direct impacts on the species can occur. Suitable habitat in all occupied reaches of the Santa Ana River and tributaries will be monitored and managed to enhance habitat conditions for this species. All areas of suitable habitat within the HCP Preserve System will be protected in perpetuity.
Santa Ana speckled dace	0.01	**0.0**	Strict avoidance and minimization measures will ensure direct take of this species is near zero. Any individuals found in downstream reaches during surveys will be relocated back to occupied reaches of montane streams. Direct impacts on habitat are very limited.
Mountain yellow-legged frog	128 (including 4 acres of aquatic habitat)	**264** (including 16 acres of aquatic habitat)	Less than 2% of the impacted habitat is aquatic habitat. The remaining 124 acres are refugia, foraging, and dispersal upland habitats. Strict avoidance and minimization measures will ensure direct take of this species is near zero. Population stability and distribution will be improved through HCP contributions to the mountain yellow-legged frog translocation program. Suitable habitat will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Western spadefoot	723	**987**	Avoidance and minimization measures will ensure direct take of this species is

Common Name	Estimated Total Impacts on Modeled Habitat (acres)	Mitigation (acres of Modeled and restored Habitat in the HCP Preserve System)	Expected Outcome of Actual Take of Species
			substantially lower than the estimated impact on modeled habitat. Suitable habitat within the HCP Preserve System, including ephemeral pools and groundwater recharge basins used for breeding, will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
California glossy snake	897	**1,209**	Avoidance and minimization measures will ensure direct take of this species is substantially lower than the estimated impact on modeled habitat. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
South coast garter snake	21	**193** (including restoration of 129 acres of riparian and 3.5 miles of aquatic stream habitat)	Avoidance and minimization measures will ensure direct take of this species is substantially lower than the estimated impact on modeled habitat. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Southwestern pond turtle	34 (including 2 acres of aquatic habitat)	**344** (29 acres aquatic habitat and 315 upland habitat, including restoration of 193 acres riparian habitat and 3.5 miles of aquatic stream habitat)	Avoidance and minimization measures will ensure direct take of this species is substantially lower than the estimated impact on modeled habitat. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Tricolored blackbird	425 (including 54 acres of unoccupied but suitable colony habitat and 370 acres of foraging habitat)	**387** (including 86 acres of modeled colony habitat, 131 acres of created colony habitat, 157 acres of modeled foraging habitat, and 14 acres of created foraging habitat)	Avoidance and minimization measures will ensure no occupied colonies are disturbed. An additional 30 acres of suitable colony habitat will be restored. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Burrowing owl	876	**1,031**	Avoidance and minimization measures will reduce the potential for occupied burrows to be disturbed. Suitable habitat within the HCP Preserve

Common Name	Estimated Total Impacts on Modeled Habitat (acres)	Mitigation (acres of Modeled and restored Habitat in the HCP Preserve System)	Expected Outcome of Actual Take of Species
			System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Cactus wren	821	**1,069**	Avoidance and minimization measures will ensure active nests are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Yellow-breasted chat	150	**257** (including restoration of 221 acres of riparian habitat)	Avoidance and minimization measures will ensure active nests are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total of 221 acres of habitat will be restored, including restoration of 51 acres that are not currently identified as modeled habitat.
Western yellow-billed cuckoo	17	**143**	Avoidance and minimization measures will ensure active nests and occupied habitat are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Southwestern willow flycatcher	150	**257** (including restoration of 221 acres of riparian habitat)	Avoidance and minimization measures will ensure active nests and occupied habitat are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total of 221 acres of habitat will be restored, including restoration of 51 acres that are not currently identified as modeled habitat.
Coastal California gnatcatcher	444	**843** (including 222 acres of alluvial fan sage scrub restoration)	Avoidance and minimization measures will ensure active nests are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total

Common Name	Estimated Total Impacts on Modeled Habitat (acres)	Mitigation (acres of Modeled Habitat in the HCP Preserve System)	Expected Outcome of Actual Take of Species
			of 222 acres of alluvial fan sage scrub habitat will be enhanced and restored.
Least Bell's vireo	150	257 (including restoration of 221 acres of riparian habitat)	Avoidance and minimization measures will ensure active nests are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total of 221 acres of habitat will be restored, including restoration of 51 acres that are not currently identified as modeled habitat.
Los Angeles little pocket mouse	739	1,007 (including 220 acres of alluvial fan sage scrub restoration)	Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total of 220 acres of alluvial fan sage scrub habitat will be enhanced and restored.
San Bernardino Merriam's kangaroo rat	552	894 (including 220 acres of alluvial fan sage scrub restoration)	Avoidance and minimization measures will ensure that will ensure that take of individuals and occupied habitat is reduced to the greatest extent practicable. These measures include habitat assessments, exclusionary fencing, trapping surveys, relocation, topsoil sequestration, and timing and night-lighting limitations. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total of 220 acres of alluvial fan sage scrub habitat will be enhanced and restored to be suitable for this species.
Fully Avoided Species ("No Take" Species)[1]			
Delhi Sands flower-loving fly	101[1] (No impact on occupied habitat)		Strict avoidance measures will ensure no take of this species.
Arroyo toad	82[1] (No impact on occupied habitat)		Strict avoidance measures will ensure no take of this species.

[1] Implementation of avoidance measures as described in Chapter 5 would prevent the direct take of these species.

ES.6 Habitat Conservation Plan Conservation Strategy

The Upper SAR HCP conservation strategy (Chapter 5) is designed to avoid, minimize, and mitigate impacts of the taking of the Covered Species to the maximum extent practicable. The strategy meets the regulatory requirements of FESA and CESA.

Implementation of the Conservation Strategy is the responsibility of the Upper SAR Sustainable Resources Alliance (Alliance), which will be established as a Joint Powers Authority (JPA) of the HCP. The Alliance will be responsible for implementing the HCP and all conservation actions described in the Conservation Strategy and assisting the other Permittee Agencies in complying with the conditions of the HCP Incidental Take Permit in connection with their Covered Activities.

ES.6.1 Elements of the Conservation Strategy

The conservation strategy includes all conservation actions as mitigation to offset the impacts of take of Covered Species. The conservation actions are based on the biological needs of the Covered Species and, when fully implemented, will meet the biological goals and objectives of the HCP. The elements of the conservation strategy are listed below and are described in more detail in the sections that follow. The phasing of the implementation of these conservation actions in relationship to the implementation of Covered Activities is also described below.

Elements of the Upper SAR HCP Conservation Strategy:

- Biological Goals and Objectives
- HCP Preserve System
  - Conservation Areas (acquisitions and easements)
  - Restoration Areas (Santa Ana sucker, wetland/riparian, and alluvial fan scrub)
- Hydrologic Manipulation and Substrate Management
- Captive Rearing and Translocation
- Species and Habitat Research
- Conservation Bank Credits
- Species-Specific Conservation Strategies
- Fully Avoided Species
- Measures to Avoid and Minimize Take
- Comprehensive Adaptive Management and Monitoring Program (CAMMP)

ES.6.2 Habitat Conservation Plan Goals and Objectives

The Upper SAR HCP has four overarching goals and seven HCP Objectives as listed below.

The HCP Goals will be accomplished within the HCP Preserve System and are as follows:

- **HCP Goal 1:** Conserve Covered Species and their habitats to contribute to the recovery of listed species or those that may become listed under the ESA.
- **HCP Goal 2**: Sustain the ecological processes necessary to maintain the functionality of the natural communities and habitats upon which the Covered Species depend.
- **HCP Goal 3:** Maintain and improve habitat connectivity in the HCP Preserve System and to adjacent protected habitat areas to facilitate movement and genetic exchange between populations of Covered Species.
- **HCP Goal 4:** Actively manage lands within the HCP Preserve System to maintain or improve conditions for the benefit of Covered Species.

The following seven HCP Objectives will support the HCP Goals:

- **HCP Objective 1:** Conserve and manage 1,901.5 acres of native habitat in the HCP Preserve System.
- **HCP Objective 2:** Restore and re-establish 538.6 acres of habitat for Covered Species.
- **HCP Objective 3**: Reduce anthropogenic and environmental threats to the HCP Preserve System.
- **HCP Objective 4**: Maintain and enhance existing Santa Ana sucker habitat.
- **HCP Objective 5:** Maintain and enhance existing San Bernardino kangaroo rat habitat.
- **HCP Objective 6:** Implement Relocation or Translocation of Covered Species.
- **HCP Objective 7**: Improve knowledge of Covered Species.

ES.6.3 Habitat Conservation Plan Preserve System

The Alliance—as the HCP Implementing Entity—will provide for the permanent conservation of approximately 1,902 acres within the HCP Preserve System. The HCP Preserve System will be assembled through a combination of property acquisitions, establishment of conservation easements, and other permanent conservation land designations. All habitat restoration will occur on land within the HCP Preserve System. The HCP Preserve System will be managed and monitored through the CAMMP that will be implemented by the Alliance. The HCP Preserve System is divided into five Preserve Units(Figure 5-1).

HCP implementation has been separated into four phases that align with the phases of Covered Activity implementation (Table ES-4). Conservation actions and associated mitigation will occur before, and stay ahead of, the impacts of Covered Activities (Table ES-5). The phasing is based on best estimates for approximate timing. The actual implementation of Covered Activities, restoration, and conservation may vary. Regardless, the restoration and conservation as mitigation established by the HCP will stay ahead of the impacts by a minimum of 10%. The Alliance will ensure that HCP implementation is in compliance with this Stay Ahead Provision by monitoring and tracking the establishment of the HCP Preserve System and restoration projects along with tracking of impacts using the impact and mitigation tracking of the Mitigation Reserve Program described below.

Table ES-4. Approximate Phasing of Conservation of Vegetation Communities in the HCP Preserve System (acres)

Conserved Vegetation Types	Implementation Period (years) Phase 1 (0–5)	Phase 2 (6–10)	Phase 3 (11–15)	Phase 4 (>15)	HCP Preserve System Total
Riparian	126.9	92.7	--	--	219.6
Wetlands	64.0	25.4	--	--	89.3
Permanent Water	35.5	17.2	--	--	52.7
Water in Existing Basins	--	--	--	--	--
Dry Channel/Shrubland[1]	121.0 (98.0)	48.2 (4.7)	--	--	169.3 (102.7)
Shrublands[1]	856.0 (741.9)	266.6 (35.1)	--	--	1,122.6 (776.9)
Woodlands	21.0	--	--	--	21.0
Grasslands	155.2	44.8	--	--	200.0
Rock Outcrops	26.7	0.2	--	--	26.9
Total by Phase	**1,406.3**	**495.2**	**--**	**--**	**1,901.5**
Total Alluvial Fan Sage Scrub by Phase[1]	*839.9*	*39.8*	--	--	*879.6*

[1] Shrublands and Dry Channel/Shrubland include alluvial fan sage scrub acres as shown in parentheses.

Table ES-5. Stay Ahead Provision Tracking by HCP Phase

	Implementation Period (years) Phase 1 (0–5)	Phase 2 (6–10)	Phase 3 (11–15)	Phase 4 (>15)	Total
Conservation	65%	35%	--	--	100%
Restoration	43%	51%	6%	--	100%
Covered Activity Impacts	46%	35%	10%	9%	100%

Mitigation Reserve Program (Mitigation Accounting)

The Alliance will establish a Mitigation Reserve Program to account for and track the development of mitigation value (i.e., "credits") and application of those mitigation values to future permit requirements for HCP Covered Activities. The purpose of the Mitigation Reserve Program is to establish a common understanding and legal framework for the conservation and mitigation values created by HCP conservation actions, and to establish a transparent mechanism for tracking those values (debits and credits) over time. In this way, the Mitigation Reserve Program will be used to inform and track regulatory compliance of the HCP Covered Activities, including species and aquatic resource mitigation, and ensure that HCP implementation is in compliance with the Stay Ahead Provision.

ES.6.4 Comprehensive Adaptive Management and Monitoring Program Framework

The HCP includes an adaptive management and monitoring framework for the HCP, including guidelines, and specific recommendations that will help the Alliance develop the Upper SAR HCP CAMMP. The purposes of this CAMMP framework—and one of the primary purposes of the CAMMP itself—are to ensure compliance with the HCP, to assess the status of Covered Species within the HCP Preserve System, and to evaluate the effects of management actions such that the conservation strategy, including the biological goals and objectives of the HCP, are achieved. Adaptive management and monitoring are integrated processes in the CAMMP, and monitoring will inform and change management actions to continually improve outcomes for Covered Species.

ES.7 Funding Implementation of the Habitat Conservation Plan

Chapter 7 provides planning-level estimates of the costs to implement the HCP, identifies funding sources to pay for implementation, and describes the rationale for funding assurances. The HCP is estimated to cost approximately $187.5 million in 2020 dollars, including costs over 50 years without discounting and inflation. Tables ES-6 through ES-8 summarize the total, capital, and operational costs estimated to be necessary to carry out the HCP.

The cost analysis is based on a number of assumptions regarding the timing of implementation of various components of the HCP and the estimated unit costs of land, labor, and materials. Unit cost estimates were based on the best available information and represent average unit costs. The costs of individual items will fluctuate above and below these averages. The total cost presented herein should therefore be regarded as a planning-level estimate to aid in the determination of the approximate amount of funding needed to implement the HCP. Specific costs will be refined as they are ascertained during the first years of HCP implementation, and any adjustments to the overall costs, cost-sharing agreements among Permittee Agencies, and endowment requirements will be made as needed.

Table ES-6. Summary of Upper SAR HCP Total Implementation Costs (1,000s 2018 dollars)

	Implementation Period (years)					
Total Costs[1]	**Initial 0[2]**	**Phase 1 1–5**	**Phase 2 6–10**	**Phase 3 11–15**	**Phase 4 16–20**	**Total Costs[3]**
Land Acquisition & Easements	$0	$26,372	$6,843	$0	$0	$33,215
Restoration	$24,350	$5,811	$4,548	$973	$1,561	$37,243
Fish Translocation	$255	$381	$122	$72	$504	$1,334
Management and Maintenance	$0	$1,788	$2,065	$2,138	$14,966	$20,957
Monitoring and Reporting	$0	$722	$722	$722	$4,798	$6,964

	Implementation Period (years)					
Total Costs[1]	**Initial 0[2]**	**Phase 1 1–5**	**Phase 2 6–10**	**Phase 3 11–15**	**Phase 4 16–20**	**Total Costs[3]**
Staffing and Program Administration	$0	$6,245	$6,245	$6,117	$42,819	$61,426
Endowment Fund	$0	$1,484	$1,484	$1,484	$10,388	$14,840
Changed Circumstance Reserve	$3,660	$3,809	$1,659	$392	$1,952	$11,472
Total	$28,265	$46,612	$23,688	$11,898	$76,988	$187,451
Total Per Year		**$9,322**	**$4,738**	**$2,380**	**$2,200**	**$3,749**

[1] All costs rounded to the nearest $1,000.
[2] Year 0 costs are costs that will have been incurred prior to the start of the HCP.
[3] Total Costs sum across all years with no discounting

Table ES-7. Summary of Upper SAR HCP Capital Costs (1,000s 2018 dollars)

	Implementation Period (years)					
Capital Costs[1]	**Initial 0[2]**	**Phase 1 1–5**	**Phase 2 6–10**	**Phase 3 11–15**	**Phase 4 16–20**	**Total Costs[3]**
Land Acquisition & Easements	$0	$26,372	$6,843	$0	$0	$33,215
Restoration	$24,350	$3,711	$800	$750	$0	$29,611
Fish Translocation	$255	$0	$0	$0	$0	$255
Management and Maintenance	$0	$0	$0	$0	$0	$0
Monitoring and Reporting	$0	$0	$0	$0	$0	$0
Staffing and Program Administration	$0	$0	$0	$0	$0	$0
Endowment Fund	$0	$0	$0	$0	$0	$0
Changed Circumstance Reserve	$3,660	$3,194	$804	$113	$0	$7,771
Total	$28,266	$33,277	$8,447	$863	$0	$70,852
Total Per Year		**$6,655**	**$1,689**	**$173**	**$0**	**$1,417**

[1] All costs rounded to the nearest $1,000.
[2] Year 0 costs are costs that will have been incurred prior to the start of the HCP.
[3] Total Costs sum across all years with no discounting.

Table ES-8. Summary of Upper SAR HCP Operating Costs (1,000s 2018 dollars)

	Implementation Period (Years)					
Operating Costs[1]	**Initial 0[2]**	**Phase 1 1–5**	**Phase 2 6–10**	**Phase 3 11–15**	**Phase 4 16–20**	**Total Costs[3]**
Land Acquisition & Easements	$0	$0	$0	$0	$0	$0
Restoration	$0	$3,065	$4,713	$922	$6,453	$15,153
Fish Translocation	$0	$1,108	$849	$547	$3,832	$6,337
Management and Maintenance	$0	$2,978	$3,256	$3,626	$25,385	$35,245
Monitoring and Reporting	$0	$1,744	$1,744	$1,964	$13,494	$18,946
Staffing and Program Administration	$0	$2,340	$2,340	$2,212	$15,484	$22,376
Endowment Fund	$0	$1,484	$1,484	$1,484	$10,386	$14,837
Changed Circumstance Reserve	$0	$616	$855	$280	$1,952	$3,703
Total	$0	$13,335	$15,240	$11,036	$76,986	$116,597
Total Per Year		**$2,667**	**$3,048**	**$2,207**	**$2,200**	**$2,332**

[1] All costs rounded to the nearest $1,000.
[2] Year 0 costs are costs that will have been incurred prior to the start of the HCP.
[3] Total Costs sum across all years with no discounting.

ES.7.1 Funding Sources and Assurances

The single joint ITP permit structure was determined to be the best arrangement to facilitate ongoing coordination among the Permittee Agencies. In particular, this structure will allow the Permittee Agencies to enter into enforceable arrangements to allocate operational and funding responsibilities and rectify any occurrence of non-compliance by a Permittee Agency. The costs of the HCP will be borne by the Permittee Agencies in accordance with the Joint Powers Authority Agreement and a separate Participation and Financing Agreement (PFA) that fully accounts for and assigns financial responsibility of the Alliance among the Permittee Agencies. The PFA will describe the financial responsibilities of each of the Permittee Agencies with respect to the HCP and the Alliance. The cost of plan implementation will be shared among the Permittee Agencies, based on a cost-sharing mechanism developed and approved by all agencies. The cost-sharing mechanism will account for impacts of the individual Covered Activity, as well as both the financial and in-kind contributions by the Permittee Agencies

Each of the Permittee Agencies will be fully responsible for any Covered Activity undertaken by that agency under the HCP and will be required to coordinate with the Alliance staff in order to ensure consistency of the Covered Activity with the HCP. Any cost resulting from non-compliance with the terms of the ITP by any Permittee Agency will be the responsibility of the non-complying agency.

ES.7.2 Cost-Effectiveness of the Habitat Conservation Plan

Over the 50-year life of the HCP, the $187.5 million investment will allow Permittee Agencies to develop over 4 million acre-feet of water cumulatively for local use, or approximately 87,000 afy by year 15. These water resources will reduce reliance on imported water from other parts of the state, increasing the area's resilience to drought and regulatory restrictions that hamper water deliveries from the State Water Project. The net benefits of this investment to water users and the local economy amount to an estimated $952 million as a whole, generating a benefit-cost ratio in excess of 7.3. This total net benefit illustrates the enormity of this HCP effort.

Without the benefit of the water projects facilitated by the HCP, potential alternatives to meet the full 87,000 acre-feet of water include purchasing additional water or desalination, options that are costly compared to both current water supplies and to alternatives facilitated by the HCP. Imported water from the Metropolitan Water District of Southern California (Metropolitan) currently costs $2,007 per acre-foot for treated Tier 2 water. This Tier 2 rate is set at Metropolitan's cost of purchasing water transfers north of the Sacramento-San Joaquin Delta and includes all costs associated with moving that water to Southern California. The Tier 2 rate is the best proxy for the price Permittee Agencies would have to pay if they pursued their own private water transfers. Desalination is the other alternative water supply option available to Southern California that does not depend on moving water through the Delta. It is estimated to cost about $2,019 per acre-foot based on the midpoint of existing desalination projects in Southern California. Using the lower Metropolitan price as a proxy for what HCP partner agencies would need to spend to acquire new supplies, the same volume of water would cost $3.2 billion over the life of the HCP, on a net present value (NPV) basis.[3] However, there is no guarantee that such a large volume of water would even be reliably available for purchase, and developing sufficient equivalent capacity of desalination projects presents its own regulatory and geographic hurdles. For these reasons, the $3.2 billion cost for an alternative portfolio is considered to be conservative and biased toward a low estimate of projected savings made possible by the HCP.

With the HCP Covered Activities in place, Permittee Agencies will be able to develop the same amount of water at an NPV cost of approximately $2.2 billion. The NPV of water supply costs without the HCP is $3.2 billion, compared to an NPV of $2.2 billion with the HCP. This is an estimated savings of over $1.1 billion from water supply projects.

This potential savings puts the HCP total cost in perspective. The $187.5 million undiscounted total HCP cost translates to a NPV of $129 million. Based on the savings estimated from water supply projects and the cost of the HCP, pursuing the HCP over alternative water supply options could result in net savings of $952 million or more in NPV. This cost saving will be passed on to commercial and residential water customers throughout the HCP area (Table ES-9).

Table ES-9. HCP Net Savings Estimate in Net Present Value ($1,000s)

	Water Supply Cost	HCP Cost	Net Savings (cost)
With HCP	$2,162	$129[1]	
Without HCP	$3,243	$0	
Total savings (cost)	**$1,081**	**-$129**	**$952**

[3] NPV calculations are made using an interest rate of 4.61% based on the rate used by the State Water Project in calculating water prices. The general inflation rate is assumed to be 2%. The net discount rate is 2.61%.

[1] Note that this total HCP cost is presented in NPV. It is equivalent to the $187.5 million undiscounted total cost presented elsewhere in this chapter, but shown in NPV so that it can be compared to alternative scenarios on a comparable basis.

ES.8 From Conflict to Collaboration

Remarkably, this HCP was born from the depths of conflict and legal battles over the listing of the Santa Ana sucker as a federally threatened species and the subsequent designation of Critical Habitat. The growing population of the Upper SAR watershed was in need of a reliable source of water, resilient to the extended droughts, effects of climate change, reduced State Water Project supplies, and increasing costs. The listings of the Santa Ana sucker and the other Federal and State listed species were standing in the way, pitting people against fish, water agencies against regulatory agencies, and human needs against the needs of the environment. It was a fight with no winners, and it became increasingly clear that the only path forward was a path of collaboration. Failure was not an option.

Through the acceptance that people need water and so do fish and what's good for the River is good for people too, a spirit of interagency collaboration emerged. The water agencies, regulatory agencies, and other stakeholders each took a seat at the table with a firm commitment to work together, understanding each other's needs and interests, finding common ground to craft a solution that was good for everyone—the people, the species, the water.

The preparation of this HCP is *the* viable solution to balancing the competing demands on the limited availability of water. This HCP exists through the partnership and the collaborative efforts of the Permittee Agencies, Wildlife Agencies, and involved stakeholders. Through this collaboration, this regional, comprehensive program will provide the necessary framework to protect, enhance, and restore the habitat for Covered Species, while streamlining permitting of Covered Activities, providing a reliable source of water for people. This HCP will enable the water agencies to continue to provide and maintain a secure source of water for the residents and businesses in the watershed, and to conserve and maintain natural habitats that provide a home for the diversity of unique and rare species in the watershed.

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Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Chapter 1
Introduction and Background

1.1 Overview

1.1.1 Background and Integrated Habitat Conservation Plan Approach

The Santa Ana River (SAR) watershed is the largest coastal stream system in Southern California, and has been the subject of many important water use and water rights agreements, judicial orders, judgments, and accords dating back to the early twentieth century.

The Upper SAR is home to dozens of water districts, flood control districts, and other local water management agencies (collectively and generally referred to as *water agencies*) with an interest in the responsible management of water supply resources (storage, conveyance, treatment, flood protection, and recreation) and sustainable stewardship (water quality and biological resource protection) of the watershed. Many of these entities have participated in integrated regional watershed management coordination efforts in the Upper SAR since the 1960s. Recent cooperative planning initiatives among the water districts and stakeholders have resulted in a comprehensive vision for sustainable stewardship and watershed management (e.g., One Water, One Watershed 2.0 Plan finalized in 2014). However, several considerable challenges remain in the Upper SAR watershed, including ongoing modification of the Santa Ana River hydrogeomorphology, reduction of river flow, alteration of natural habitats, and the long-term effects of these changes on the functional ecology and native species of the watershed. The challenges facing water districts and other local agencies in the Upper SAR include the effects of population growth that increase water demand and decrease natural hydrological processes and groundwater recharge, the reduction of imported water availability, and the effects of climate change.

Many of the species in the Upper SAR watershed are listed as threatened or endangered under the state and federal Endangered Species Acts (CESA and FESA, respectively). Therefore, many agency activities potentially impacting these species may require permits from the United States Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW). In 2013, several water agencies, led by the San Bernardino Valley Municipal Water District (Valley District), made a decision to prepare the Upper SAR Habitat Conservation Plan (HCP) to address the potential effects of water agency activities on the sensitive species and habitats in the watershed in order to receive Incidental Take Permits (ITPs) under Section 10 of FESA. The conservation measures contained in this HCP may also serve as the basis for the issuance incidental take permits under CESA for state-listed species. Development of an HCP is a comprehensive planning process with careful consideration taken to address the FESA compliance needs of project proponents. The regional location of the Upper SAR HCP is provided in Figure 1-1.

Upper Santa Ana River HCP Team

The Upper SAR HCP development process was intended and designed from the beginning to be a collaborative and transparent process. The challenges that the HCP is addressing are complex and multifaceted, and therefore need input, support, and commitment from a variety of agencies,

organizations, and the public. The stakeholders involved in this process (the HCP Team) included, the following participants, among others:

- All 11 participating water agencies seeking ITPs through the HCP (Permittee Agencies)
- Southern California Edison
- U.S. Fish and Wildlife Service
- California Department of Fish and Wildlife
- U.S. Forest Service
- U.S. Army Corps of Engineers
- U.S. Geological Survey
- Santa Ana Regional Water Quality Control Board
- Riverside-Corona Resource Conservation District
- Santa Ana Watershed Project Authority
- Southern California Coastal Water Research Project
- Endangered Habitats League
- Center for Biological Diversity
- Other interested members of the public

The HCP Team met on a regular (bi-monthly) schedule for the first few years of HCP development, and then as needed during the final year of plan preparation. HCP Team members were kept up to date through emails, board meetings of the participating entities, and the HCP public outreach and public participation program. Information and access to the HCP preparers and the lead agency were provided through the HCP website throughout the HCP development process (www.uppersarhcp.com).

During certain periods of HCP development, subsets of the HCP Team members met as the **Biological Technical Advisory Committee** and the **Hydrologic Technical Advisory Committee**. The Biological Technical Advisory Committee convened periodically throughout 2016 and 2017. providing input on development of the Covered Species list and profiles, and the use of the best available scientific data. The committee also provided input toward the creation of conceptual models for each Covered Species that identified anthropogenic threats, natural drivers, and conservation targets for each Covered Species. These conceptual models were used to develop preliminary biological goals and objectives for the Covered Species.

The Hydrologic Technical Advisory Committee met approximately bi-monthly from 2015 to 2018 and provided input into the hydrologic modeling conducted for the HCP, including development of the methodological approach to modelling of the whole Upper Santa Ana River and tributaries system affected by Covered Activities. The Hydrologic Technical Advisory Committee provided critical review and input to the establishment of the hydrological base period, and key assumptions driving the 2D hydraulic model that was were to estimate the effects on aquatic habitats in terms of low flow habitat suitability and high flow sediment transport. This modeling created the foundation

for quantifying existing hydrologic conditions and future conditions with implementation of the Covered Activities on the Upper Santa Ana River and its tributaries.

Upper Santa Ana River Sustainable Resources Alliance as HCP Implementing Entity

The Upper SAR HCP will be implemented by the Upper Santa Ana River Sustainable Resources Alliance (established as a Joint Powers Authority [JPA] and the HCP Implementing Entity). While the Upper Santa Ana River Sustainable Resources Alliance (Alliance) will be the HCP Implementing Entity, the Alliance will also oversee and support other components of regulatory compliance, conservation of water and species habitat, and water supply. The ultimate goal of the Alliance is to maintain a sustainable watershed for water resources and species resources, of which the HCP is a substantial part. The HCP and other watershed sustainability components overseen by the Alliance will bring together a variety of organizations, agencies, and the public to create a forum for collaborative problem-solving to meet diverse needs and missions that include the protection of endangered species and timely approval and reliability of water supply projects.

The main components of the Upper Santa Ana River Sustainable Resources Alliance are presented below.

- **Habitat Conservation Plan**
  - HCP Implementing Entity.
  - Endangered Species Act compliance.
  - Conservation for species impacts.
  - Long-term monitoring and management of species and habitats.
- **Stream, Riparian, and Alluvial Fan Habitat Restoration**
  - Restoration for Santa Ana sucker and other aquatic and riparian species covered by the HCP.
  - Restoration for San Bernardino kangaroo rat and other alluvial fan scrub species covered by the HCP.
  - Mitigation for aquatic resource impacts.
  - Mitigation credits for inclusion in waters and species conservation bank.
- **Mitigation Banking**
  - Documentation of mitigation credit value from restoration sites.
  - Common currency for aquatic resources and species credits.
  - Monetization and mechanism for sale of credits as needed.
- **Translocation**
  - Conservation for Santa Ana sucker.
  - Improved population stability and security with multiple subpopulations.

  - Substantial increase in baseline condition of population and offset of potential impacts from water projects.

- **Programmatic Permitting**
  - Streamlining of the aquatic resources permitting process (Clean Water Act [CWA] Sections 401 and 404, California Fish and Game Code Section 1600).
  - Mechanism to link aquatic resource impacts to mitigation bank credits.
  - Coordination with Endangered Species Act permitting.

To support these components the Alliance will serve a broad variety of roles, including the following:

- Overall plan administration and management, such as HCP budgeting and finance, monitoring, and enforcement.
- HCP implementation of the conservation strategy, ensuring HCP compliance, project consistency review, and allocation of incidental take and mitigation credit.
- Implementation of the Adaptive Management and Monitoring Program and updates, maintenance, and management of the HCP geographic information system (GIS) database and implementation and tracking tools.
- Liaison between the Permittee Agencies and USFWS relative to HCP implementation and compliance, including annual reporting.
- Implementation and compliance oversight of Section 2081 Multi-Project ITP for take under CESA.
- Implementation and compliance oversight of all programmatic permits (e.g., 404, 401, 1600), including assistance to Permittee Agencies in securing any necessary sub-permits for their respective Covered Activities.
- Sponsor of the Upper Santa Ana River HCP mitigation and conservation banks.
- Land acquisition, and HCP Preserve management and monitoring, all in coordination with the San Bernardino Valley Conservation Trust as described below.
- Public outreach and education (including establishment and management of the technical advisory and stakeholder committees).
- Other administration functions, including GIS and other technical support to Permittee Agencies, grant administration, and third-party contracting (including contracts between the JPA and Permittee Agencies or other parties for activities related to plan implementation).

The roles and responsibilities of the Alliance (the JPA of the Upper SAR HCP) are described in more detail in Chapter 6, *Plan Implementation*.

1.1.2 Purpose

The Upper SAR HCP is a regional, comprehensive program that would provide a framework to protect, enhance, and restore the habitat for Covered Species, while streamlining permitting for

Covered Activities. Within this framework, the Upper SAR HCP would achieve conservation goals and objectives and comply with FESA while streamlining planning and permitting for anticipated water resource management projects needed to serve the water resource needs of the public. The HCP will achieve the conservation goals and objectives through the establishment of the HCP Preserve System and implementation of the conservation actions as described in the Conservation Strategy of the HCP (Chapter 5).

By providing FESA compliance, the Upper SAR HCP and associated ITPs will facilitate the ability of the Permittee Agencies to construct and operate identified projects (Covered Activities) that would impact endangered species covered by the HCP (Covered Species). The Covered Activities are public infrastructure projects that have tremendous public value because they will increase regional water supply reliability. The Permittee Agencies will provide long-term commitments to native resources by agreeing to conserve, monitor, and manage Covered Species and their habitats in perpetuity. In exchange, the Permittee Agencies will receive assurances that USFWS will not require additional land, water, or other natural resources beyond the level agreed upon in the HCP as long as the Permittee Agencies are honoring the terms and conditions of the permit.

The Upper SAR HCP will also provide Southern California Edison with the basis to request incidental take authority for its operations in the Upper Santa Ana River watershed to the extent those operations affect the listed Santa Ana sucker.

The HCP as a conservation tool provides many valuable benefits to the region by providing a mechanism that allows the Agency Permittees, USFWS and CDFW (the Wildlife Agencies), and other stakeholders to collaboratively address endangered species issues on a regional scale and with long-term funding assurances. Operating through stakeholder and other committees to be established and coordinated by the Alliance as the HCP Implementing Entity, this multi-stakeholder group can anticipate, prevent, and resolve potential conflicts over current and future resource needs through the HCP planning and implementation process. This includes development of strategies to meet minimum in-stream flow requirements to protect native aquatic species and riparian communities in the Santa Ana River and tributaries. The breadth of the Permittee Agencies' jurisdiction also allows creative solutions to be implemented for tributary restoration and long-term water supply for these habitats, even in the face of climate change and statewide water conservation efforts. Finally, through the partnership and the collaborative efforts with the Wildlife Agencies, a comprehensive strategy for long-term protection, restoration, and conservation is being developed that will manage the natural resources and species of the Upper SAR watershed in a way that ensures long-term ecological value to the region.

This HCP supports the permit application submitted by the San Bernardino Valley Municipal Water District to USFWS on behalf of all 11 of the Permittee Agencies. That application requests authorization from USFWS for the incidental take of the seven federally listed species shown below. The Permittee Agencies are seeking state authorization through a separate process for take of Covered Species that are also State listed species from CDFW under Section 2081 subdivision (b) of the State Fish and Game Code.

- Santa Ana sucker (*Catostomus santaanae*)
- Mountain yellow-legged frog (*Rana muscosa*)
- Coastal California gnatcatcher (*Polioptila californica californica*)
- Least Bell's vireo (*Vireo bellii pusillus*)

- Southwestern willow flycatcher (*Empidonax traillii extimus*)
- Yellow-billed cuckoo (*Coccyzus americanus*)
- San Bernardino Merriam's kangaroo rat (*Dipodomys merriami parvus*)

Although FESA does not prohibit the incidental take of listed plants in most instances, in consideration of the conservation benefits provided by the HCP, USFWS is being asked to include coverage for two listed plant species:

- Santa Ana River woolly-star (*Eriastrum densifolium* ssp. *sanctorum*)
- Slender-horned spineflower (*Dodecahema leptoceras*)

In consideration of the conservation benefits provided by the HCP, USFWS is also being asked to include coverage for 11 wildlife species that are not currently listed but which, if they are listed in the future, will be exempt from incidental take prohibitions under the permit to be issued by USFWS:

- Arroyo chub (*Gila orcutti*)
- Santa Ana speckled dace (*Rhinichthys osculus subspecies*)
- California glossy snake (*Arizona elegans occidentalis*)
- South coast garter snake (*Thamnophis sirtalis* sp.)
- Southwestern pond turtle (*Emys pallida*)
- Western spadefoot (*Spea hammondii*)
- Burrowing owl (*Athene cunicularia*)
- Cactus wren (*Campylorhynchus brunneicapillus*)
- Tricolored blackbird (*Agelaius tricolor*)
- Yellow-breasted chat (*Icteria virens*)
- Los Angeles little pocket mouse (*Perognathus longimembris brevinasus*)

Two other listed wildlife species are included in the HCP so that implementation of Covered Activities will include appropriate full avoidance measures because take authorization is not being requested (i.e., full avoidance or no-take species):

- Arroyo toad (*Anaxyrus californicus*)
- Delhi Sands flower-loving fly (*Rhaphiomidas terminates abdominalis*)

The completion and implementation of this HCP will accomplish the following:

1. Provide for the conservation of populations of the 20 Covered Species (defined in Section 1.2.5, *Covered Species,* below) and their habitat within the Planning Area (see Section 1.2.2, *Planning Area,* below) as mitigation for the effects of incidental take (animals) and other adverse impacts (plants) from water supply management activities, and avoid all impacts on two additional species not covered by the HCP.

2. Fulfill the requirements for an ITP as specified in Section 10(a)(1)(B) of FESA, implementing regulations (50 Code of Federal Regulations [CFR] 17.22[b][2][i] and 17.32[b][2][i]), and the 2016 *Habitat Conservation Planning Handbook* (HCP Handbook).
3. Support the Permittee Agencies' request to CDFW for CESA ITPs under Section 2081 subdivision (b) of the State Fish and Game Code.
4. Support the Permittee Agencies' application to CDFW for a Master Lake and Streambed Alteration Agreement under Section 1602 of the State Fish and Game Code.
5. Serve as a "watershed plan" to support (i) the issuance by the Santa Ana Regional Water Quality Control Board of authorizations required under Section 401 of the CWA, or the Porter-Cologne Water Quality Control Act (Porter-Cologne), for activities resulting in the discharge of dredged or fill material into waters of the State and (ii) the issuance by the U.S. Army Corps of Engineers (USACE) under Section 404 of the CWA for the discharge of dredged or fill material into the navigable waters.
6. Standardize avoidance, minimization, and mitigation requirements of FESA, CESA, the California Environmental Quality Act (CEQA), the National Environmental Policy Act (NEPA), and other applicable laws and regulations relating to biological and natural resources in the Planning Area (Section 1.2.2), so that water agency actions will be governed consistently, thus reducing delays, expenses, and regulatory duplication.
7. Support the development and coordinated implementation of the Upper SAR Programmatic Aquatic Resource permits under Sections 404 and 401 of the CWA, Porter-Cologne, and Section 1602 of the California Fish and Game Code.

1.1.3 HCP Program Goals and Objectives

A primary goal of the HCP is to streamline permitting for Covered Activities by protecting, enhancing, and restoring the habitat for Covered Species to mitigate the effects of water supply management activities in the Planning Area (Section 1.2.2). To meet this goal, the Upper SAR HCP includes a Conservation Strategy (Chapter 5) that ensures the long-term ecological health and resilience of native species within the Santa Ana River watershed.

The Upper SAR HCP will achieve the following specific objectives:

- Provide federal ITPs that facilitate the ability of the Permittee Agencies to construct new facilities and/or operate and maintain facilities associated with their mission.
- Establish the HCP Preserve System.
- Maintain or restore self-sustaining populations of the species covered by the HCP.
- Sustain the ecological processes necessary to maintain the functionality of the natural communities and habitats upon which the Covered Species depend.
- Maintain habitat connectivity in the HCP Preserve System and to adjacent protected habitat areas to prevent isolation of populations of Covered Species.
- Actively manage lands within the HCP Preserve System for the benefit of Covered Species to maintain or increase populations and ensure persistence.

- Provide a reliable water supply to maintain habitat for sensitive, threatened, or endangered species.

To achieve these objectives, the Upper SAR HCP calls for a combination of habitat conservation strategies, impact avoidance and mitigation measures, compatible joint uses of lands, and land use restrictions.

1.2 Scope of the Habitat Conservation Plan

This section identifies the Incidental Take Permittee Agencies, Planning Area, Permit Area, Covered Species, Covered Activities, and the term of the ITPs.

1.2.1 Permittee Agencies

The HCP was collaboratively developed by staffs from Valley District and 10 other local water agencies in Southern California with planned water supply or other infrastructure projects needing incidental take permit coverage for endangered and threatened species in the Santa Ana River watershed. On April 15, 2014, the Valley District Board of Directors authorized their role as lead agency for the development of the HCP, with the 10 other water agencies described below. These 11 water agencies (Permittee Agencies), together with Southern California Edison (which may receive its own incidental take permit in accordance with the HCP), comprise the 12 entities that will receive incidental take coverage through the HCP.

When public agencies jointly prepare and implement a programmatic HCP, they typically use a co-permittee structure. In this approach, all Permittee Agencies are named on one permit issued to all of them jointly. Following this approach, the 11 water agencies will be issued a single joint ITP. This approach provides the greatest flexibility in implementation and ensures that all Permittee Agencies share equally in the obligations and risks associated with the HCP. The HCP delineates the responsibilities of each of the water agencies for HCP implementation (see Chapter 6, *Plan Implementation*) and funding (see Chapter 7, *Funding*).

Habitat Conservation Plan Permittee Agencies

The Permittee Agencies are listed in alphabetical order below, and the following sections provide a short description of those agencies. The service area boundaries of each Permittee Agency within the Planning Area are shown in Figure 1-2.

- City of Rialto Public Works
- East Valley Water District
- Inland Empire Utilities Agency
- Metropolitan Water District of Southern California
- Orange County Water District
- Riverside Public Utilities
- San Bernardino Municipal Water Department

- San Bernardino Valley Municipal Water District
- San Bernardino Valley Water Conservation District
- West Valley Water District
- Western Municipal Water District of Riverside County

City of Rialto Public Works

The City of Rialto Public Works (Rialto) coordinates and provides direct services related to engineering, capital improvement projects, infrastructure, parks, streets, waste management, utilities, tree trimming, graffiti removal, and traffic and transportation, which includes, but is not limited to, traffic signals and signing and striping throughout the city. As noted in in Chapter 3, *Planning Area and Existing Environment*, Table 3-2, *Counties and Cities/Jurisdictions in the Planning Area*, Rialto services approximately 103,000 people in San Bernardino County.

East Valley Water District

The East Valley Water District (East Valley) is a California Special District that provides water and wastewater services to approximately 101,700 residents within the City of Highland and portions of both the City and County of San Bernardino. East Valley was originally formed to provide domestic water service to the unincorporated and agricultural-based communities of Highland and East Highlands. Later, as the population increased, the need for a modern sewer system to replace existing septic tanks became apparent. East Valley's previously agriculturally dominated service area is now urbanized. Before September 2000, East Valley's service area was approximately 14,750 acres (28.5 square miles). An annexation in September 2000 increased the service area by 3,228 acres and included the Greenspot Ranch Area.

Inland Empire Utilities Agency

The Inland Empire Utilities Agency (IEUA) is a regional wastewater treatment agency and wholesale distributor of imported water. IEUA is responsible for serving approximately 875,000 people over 242 square miles in western San Bernardino County. The agency is focused on providing three key services: (1) treating wastewater and developing recycled water, local water resources, and water conservation programs to reduce the region's dependence on imported water supplies and drought-proof the service area; (2) converting biosolids and waste products into a high-quality compost made from recycled materials; and (3) generating electrical energy from renewable sources. As a regional wastewater treatment agency, IEUA provides sewage utility services to seven contracting agencies under the Chino Basin Regional Sewage Service Contract: the Cities of Chino, Chino Hills, Fontana, Montclair, Ontario, and Upland; and the Cucamonga Valley Water District in the City of Rancho Cucamonga. In addition to the contracting agencies, IEUA provides wholesale imported water from the Metropolitan Water District of Southern California (see below) to seven retail agencies: the Cities of Chino, Chino Hills, Ontario, and Upland; the Cucamonga Valley Water District in the City of Rancho Cucamonga; the Fontana Water Company in the City of Fontana, and the Monte Vista Water District in the City of Montclair.

Metropolitan Water District of Southern California

The Metropolitan Water District of Southern California (Metropolitan) is a regional wholesaler that delivers water to 26 member public agencies—14 cities, 11 municipal water districts, and 1 county water authority—which in turn provide water to more than 19 million people in Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura Counties. Metropolitan is the largest distributor of treated drinking water in the United States. To supply the more than 300 cities and unincorporated areas in Southern California with reliable and safe water, Metropolitan owns and operates an extensive water system, including the Colorado River Aqueduct, 16 hydroelectric facilities, 9 reservoirs, 819 miles of large-scale pipes, and 5 water treatment plants. Metropolitan currently delivers an average of 1.5 billion gallons of water per day to a 5,200-square-mile service area. In the Planning Area, Metropolitan provides water to IEUA (see above) and the Western Municipal Water District of Riverside County (see below).

Orange County Water District

The Orange County Water District (OCWD) provides water for 2.4 million people in Orange County. Since 1933, OCWD has been entrusted to guard the region's groundwater basin. OCWD manages and replenishes the basin, ensures water reliability and quality, prevents seawater intrusion, and protects Orange County's rights to Santa Ana River water. As discussed in Chapter 2, *Covered Activities*, OCWD is implementing a sand mining habitat enhancement project in the Prado Basin.

Riverside Public Utilities

Established in 1895, the Riverside Public Utilities (RPU) is a consumer-owned water and electric utility governed by a board of nine community volunteers and the City Council of Riverside. RPU services more than 106,000 electric customers and over 64,000 water customers (serving a population of more than 300,000) in and around the City of Riverside.

San Bernardino Municipal Water Department

The San Bernardino Municipal Water Department (Water Department) provides customer service in water supply, water reclamation, and geothermal heating. It produces all of its own water using 60 wells located in 45 square miles of water service area and delivers to more than 40,000 service connections through 551 miles of water mains. The Water Department also operates two waste water treatment plants along the Santa Ana River.

San Bernardino Valley Municipal Water District

Valley District was formed in 1954 as a regional wholesale agency to ensure long-term water supply for the San Bernardino Valley. Valley District imports water into its service area through participation in the State Water Project and manages groundwater storage within its basin boundaries. Valley District has authority to provide water and wastewater services along with stormwater disposal, recreation, and fire protection services. Valley District covers about 353 square miles in southwestern San Bernardino County and serves a population of about 660,000 people through delivery of water to the retail water agencies within its service area. It spans the eastern two-thirds of the San Bernardino Valley, the Crafton Hills, and a portion of the Yucaipa Valley and includes the cities and communities of San Bernardino, Colton, Loma Linda, Redlands, Rialto, Bloomington, Highland, East Highland, Mentone, Grand Terrace, and Yucaipa.

San Bernardino Valley Water Conservation District

The San Bernardino Valley Water Conservation District (Conservation District) was created in 1932 to recharge the groundwater basin with local water supply in order to conserve that water for future use. At that time, the water was primarily used for agriculture; however, today this water is used for agricultural, municipal, and industrial purposes. The Conservation District's mission is to ensure recharge of the Bunker Hill Groundwater Basin in an environmentally and economically responsible way, using local native surface water to the maximum extent practicable. The Conservation District serves an area totaling 50,000 acres. It owns or has water recharge easements over 3,600 acres in the Santa Ana River and Mill Creek alluvial washes.

West Valley Water District

The West Valley Water District (West Valley) serves approximately 80,000 customers in the communities of Bloomington, Colton, Fontana, and Rialto; parts of unincorporated areas in San Bernardino; and Jurupa Valley in Riverside County. West Valley's water comes from groundwater wells, surface water, and direct delivery from Valley District. Groundwater wells pump from the Lytle, Rialto, Bunkerhill, and North Riverside Basins. Treated surface water comes from Lytle Creek and Lake Silverwood.

Western Municipal Water District of Riverside County

The Western Municipal Water District of Riverside County (Western) provides water and wastewater services to retail customers and wholesale agencies from Corona to Temecula, a service area stretching 527 square miles in Riverside County. This regional area includes the cities of Corona, Norco, and Riverside, and the water agencies serving Box Springs, Eagle Valley, Lake Elsinore, Lee Lake, and Temecula. Western is a member agency of Metropolitan. See Figure 1-2 for the boundaries of water resource agencies' service areas.

Southern California Edison Incidental Take Permit

A second ITP is expected to be issued to Southern California Edison (SCE) to provide incidental take coverage for any Santa Ana suckers that may be translocated to waters covered by their licenses from the Federal Energy Regulatory Commission (FERC).

SCE is the primary electricity supply company for much of Southern California. It provides 15 million people with electricity (hydro generated) across a service territory of approximately 50,000 square miles. SCE has several water intakes and powerhouses located in the Planning Area on Mill Creek, Bear Creek, Lytle Creek, and the Santa Ana River.

1.2.2 Planning Area

The Planning Area is located in San Bernardino and Riverside Counties, California (Figure 1-1), and encompasses approximately 862,966 acres. It was developed to ensure that the natural resources that might be affected by Covered Activities can be adequately assessed at a regional scale and that sufficient mitigation opportunities are available.

The Planning Area is based on sub-watershed boundaries within the Santa Ana River watershed, except in areas where the water resource agency boundaries extend beyond the Santa Ana River watershed or where the Planning Area is constrained by the Los Angeles County and Orange County

lines. The Santa Ana River watershed below Prado Dam is not included in the Planning Area because the Covered Activities and conservation activities under the HCP are not planned there.

The following description is organized clockwise from the north through all features used to assemble the Planning Area. The northern boundary follows the Santa Ana River watershed boundary, including the Upper Cajon Wash, Cable Creek, East Twin Creek, City Creek, Plunge Creek, Alder Creek-Santa Ana River, Siberia Creek-Bear Creek, and Deer Creek-Santa Ana River sub-watersheds. Each of these sub-watersheds is intersected by at least one water resource agency service area boundary and contains habitat for the Covered Species where conservation activities could occur.

The eastern boundary follows the boundaries of the Deer Creek-Santa Ana River, Mill Creek, Yucaipa Creek, and San Timoteo Canyon-San Timoteo Wash sub-watersheds. These sub-watersheds contain Covered Species habitat where conservation activities could occur, and their lower reaches lie within water resource agency boundaries.

The southern boundary includes sub-watersheds that intersect water resource agency boundaries, including San Timoteo Canyon-San Timoteo Wash, Reche Canyon, East Etiwanda Creek-Santa Ana River, Tequesquite Arroyo, Lake Matthews, Arroyo Del Torro-Temescal Wash, and Dawson Canyon-Temescal Wash. The East Etiwanda Creek-Santa Ana River watershed is the largest sub-watershed included in the Planning Area, and its downstream extent terminates at Prado Dam.

The western boundary of the Planning Area corresponds with the San Bernardino-Los Angeles and San Bernardino-Orange County lines. The western region of the Planning Area includes the full extent of the IEUA service area and the Middle Chino Creek, Lower Chino Creek, and Upper Cucamonga Creek sub-watersheds. The southwest portion includes Bedford Wash-Temescal Wash, Main Street Wash-Temescal Wash, and Lake Norconian-Temescal Wash sub-watersheds. The northwest portion includes the North Fork Lytle Creek, Upper Cajon Wash, and Lower Cajon Wash sub-watersheds.

1.2.3 Permit Area

The area covered by the ITP, which falls within but does not include the entire Planning Area, is referred to as the Permit Area. The Upper SAR HCP Permit Area is the geographic area where the impacts of the Covered Activities are expected to occur and is depicted as the ownership, easements, and areas of operation and maintenance where all Covered Activities are located within natural habitats. The Permit Area also includes the HCP Preserve System so that the ITPs cover the potential take associated with habitat mitigation, management, and monitoring. While a number of mitigation areas are already known (e.g., tributary restoration sites), others will be identified during HCP implementation. If the HCP Preserve System is expanded in the future, the Permit Area will also include any new areas of the HCP Preserve System. Figure 1-3 depicts the Permit Area based on mapping of the Covered Activities and the currently proposed HCP Preserve System.

1.2.4 Species Addressed in this HCP

The ITP issued by USFWS must name specific species for which take resulting from Covered Activities is authorized. These species, called *Covered Species*, are either currently listed as threatened or endangered or may become listed during the permit term. Although the primary intent of this HCP is to provide mitigation for effects on Covered Species, it would also contribute

to the protection of native biological diversity, habitat for native species, natural communities, and local ecosystems. This broad scope would conserve a wide range of natural resources, including native species that are common as well as those that are rare.

There are 20 species covered by the HCP, including 9 listed and 11 non-listed species. There are also 2 additional Fully Avoided species that are listed but are not Covered Species and will be fully avoided during Covered Activities (Table 1-1). The incidental take authorization under Section 10 of FESA will apply to the wildlife species. The take of listed plant species is not prohibited under FESA or authorized under a Section 10(a)(1)(B) permit. However, the two plant species conserved by this HCP are listed in the 10(a)(1)(B) permit in recognition of the conservation measures and benefits provided for them under the HCP such that the Permittee Agencies will receive assurances pursuant to the USFWS "No Surprises" rule. Similarly, the unlisted species covered in the HCP will also receive assurances under the "No Surprises" rule should they become listed in the future. Federal authorization for incidental take of other species may be sought through the amendment process and in accordance with FESA Sections 10(a) and 7 (Table 1-1).

In addition to Covered Species for which take authorization is requested, two species addressed in this HCP are Fully Avoided species: Delhi Sands flower-loving fly and arroyo toad. The avoidance and minimization measures included in Chapter 5, *Conservation Strategy*, are expected to reduce any adverse effects on these species so that they would not result in take. As noted above, this HCP establishes conservation strategies for a number of state-listed species. Although CDFW will not approve the HCP, the conservation strategies established for the HCP are intended to also support the issuance of state ITPs. Species covered by the HCP and for which incidental take authorization will be requested under CESA are indicated as state-listed species in Table 1-1.

Table 1-1. Species Addressed in the Upper SAR HCP

		Status	
Common Name	**Scientific Name**	**Federal**	**State**
Covered Species			
Slender-horned spineflower	*Dodecahema leptoceras*	Endangered	Endangered
Santa Ana River woolly-star	*Eriastrum densifolium* ssp. *sanctorum*	Endangered	Endangered
Santa Ana sucker	*Catostomus santaanae*	Threatened	None
Arroyo chub	*Gila Orcuttii*	None	SSC
Santa Ana speckled dace	*Rhinichthys osculus* ssp.	None	SSC
Mountain yellow-legged frog (Southern California DPS)	*Rana muscosa*	Endangered	Endangered
Western spadefoot	*Spea hammondii*	None	SSC
California glossy snake	*Arizona elegans occidentalis*	None	SSC
South coast garter snake	*Thamnophis sirtalis* sp.	None	SSC
Southwestern pond turtle	*Emys pallida*	None	SSC
Tricolored blackbird	*Agelaius tricolor*	None	Threatened
Burrowing owl	*Athene cunicularia*	None	SSC
Cactus wren	*Campylorhynchus brunneicapillus*	None	SSC
Yellow-breasted chat	*Icteria virens*	None	SSC

		Status	
Common Name	**Scientific Name**	**Federal**	**State**
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	Threatened	Endangered
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Endangered
Coastal California gnatcatcher	*Polioptila californica*	Threatened	SSC
Least Bell's vireo	*Vireo bellii pusillus*	Endangered	Endangered
Los Angeles little pocket mouse	*Perognathus longimembris brevinasus*	None	SSC
San Bernardino Merriam's kangaroo rat	*Dipodomys merriami parvus*	Endangered	Candidate
Fully Avoided Species[1]			
Delhi Sands flower-loving fly	*Rhaphiomida terminatus abdominalis*	Endangered	None
Arroyo toad	*Anaxyrus californicus*	Endangered	None

[1] Implementation of avoidance measures as described in Chapter 5 of this HCP would prevent the take of these species.
DPS = Distinct Population Segment; SSC = CDFW Species of Special Concern.

Federal and State Definitions of Take

Under FESA, the term *take* (sometimes referred to as *taking*) is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." *Harm* is defined as "an act which actually kills or injures wildlife [and] may include significant habitat modification." Note that, under the Supreme Court's decision in *Babbit v Sweet Home Chapter Communities for a Great Oregon*, not every action that modifies habitat results in a take under FESA.

The definition of take under CESA is narrower than the federal definition (Section 86 of the California Fish and Game Code defines take as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill"). In considering issuance of an ITP under Section 2081 of CESA, however, CDFW must consider all of the impacts on state-listed species that are caused by the action to be permitted, even if not all of those impacts arise to the level of take under CESA.

Take Authorizations for Non-Listed Covered Species

Non-listed species covered by the HCP must be treated as if they were already listed. All conservation measures described in the HCP for non-listed species must satisfy the permit issuance criteria under Section 10(a)(2)(B) of FESA that would otherwise apply if the unlisted species covered by the plan were actually listed (50 CFR 17.3). The federal ITP will identify all Covered Species regardless of federal listing status. The federal ITP will take effect for listed Covered Species at the time the federal ITP is issued, and, subject to compliance with the terms of the federal ITP, will take effect for an unlisted Covered Species upon the listing of such species. Any reference in this HCP to incidental take of Covered Species refers to potential impacts on all Covered Species, regardless of current federal listing status.

1.2.5 Covered Activities

The Upper SAR HCP must identify the activities that could result in take of Covered Species within the Planning Area. The types of activities covered by the HCP (Covered Activities) should include all actions that the Permittee Agencies want to have covered by FESA Section 10 and CESA 2081(b) permits. Covered Activities include both specific projects and ongoing activities (e.g., operations and maintenance).

- *Projects* are well-defined actions that occur **once** in a discrete location (e.g., construction of new facilities, infrastructure development, capital improvement projects).
- *Operations and maintenance activities* are actions that occur **repeatedly** in one area or over a wide area (e.g., bank stabilization, storm-damage repair, maintenance of facilities).

Covered Activity types are listed in Table 1-2, and include construction, infrastructure development, and operations and maintenance of water conservation, water infrastructure development, flood control, habitat restoration, and solar energy facility activities. The Covered Activities are described in detail in Chapter 2, including the size of the impacted area, frequency of activity, and the type and intensity of impact.

Table 1-2. Covered Activity Types Included in the Upper SAR HCP

Activity Type	Description
Water Reuse Projects	Activities related to projects associated with water reuse, including construction of new water treatment plants and associated facilities, and operations and maintenance of existing and new water treatment plants and associated facilities.
Groundwater Recharge	Activities related to construction of new structures associated with diversions, operations and maintenance of existing and new diversion structures for groundwater recharge, activities related to construction of new recharge basins, and operations and maintenance of existing and new recharge basins.
Wells and Water Conveyance Infrastructure	Activities related to the creation of new wells and associated development (pipelines, access roads, reservoirs, bridges) and the operations and maintenance of this infrastructure and associated development.
Solar Energy Development	Activities related to the construction and maintenance of new solar facilities.
Routine Operations and Maintenance	Activities that occur repeatedly in one location and/or in many locations over a wide area periodically and include minor construction, earth-moving, or vegetation clearing activities to infrastructure.
Habitat Enhancement, Management, and Monitoring	Activities that support the restoration and management of habitat values in the Planning Area, including species surveys, monitoring, research, and adaptive management activities.

Activities not covered by the HCP and the incidental take authorizations are described in Chapter 2, Section 2.3, *Projects and Activities Not Covered by the HCP.*

1.2.6 Permit Term

The Permittee Agencies are seeking a 50-year ITP, which would accommodate the expected schedule for construction of projects in the Permit Area and ongoing associated operations and maintenance.

Covered Activities involving infrastructure for water supply reliability (i.e., groundwater replenishment, direct reuse, conservation) and associated operations and maintenance are expected to extend beyond the 50-year period. Prior to expiration of the take permits, each Permittee may apply to USFWS and CDFW to renew them. The permit may be renewed in accordance with applicable federal and state laws and regulations in effect at the time of application for renewal. The Permittee Agencies will initiate the permit renewal process prior to the expiration of the permit term with ample time to allow for the review and processing of the renewal application.

The permit term for the ITP for SCE will be independent of that of the Permittee Agencies ITP. SCE operates and maintains hydroelectric facilities in accordance with three, 30-year licenses issued by the FERC in 2003, and the SCE ITP permit term may be established to coincide with the FERC relicensing cycles.

1.3 Regulatory Framework

The Upper SAR HCP is designed to comply with FESA and CESA. Implementation of the HCP will occur in compliance with the other state and federal wildlife and related laws and regulations, each of which is referenced below and described in greater detail in subsequent sections, including the following:

- California Fish and Game Code Sections 3511, 4700, 5050, and 5515 (Fully Protected Species)
- California Fish and Game Code Section 3503 (Bird Nests)
- California Fish and Game Code Section 3503.5 (Birds of Prey)
- Migratory Bird Treaty Act
- Bald and Golden Eagle Protection Act
- California Environmental Quality Act of 1970
- National Environmental Policy Act of 1969
- Clean Water Act Sections 401, 402, and 404
- Porter-Cologne Water Quality Control Act
- Fish and Game Code Sections 1601–1607 (Lake or Streambed Alteration Agreement)
- National Historic Preservation Act

For a complete list of state and federal permits that may be required for activities covered by the HCP, refer to Appendix A, *Covered Activities Permit Matrix*.

1.3.1 Federal Endangered Species Act (U.S. Code, Title 16, Section 153 et seq.)

Section 9

Section 9 of FESA and federal regulation pursuant to Section 4(d) of FESA prohibit the take of endangered and threatened wildlife species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by USFWS to include significant habitat modification or degradation that results in death or injury to listed wildlife species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

Pursuant to Section 11(a) and (b) of FESA, any person who knowingly violates Section 9 of FESA or any permit, certificate, or regulation related to Section 9 may be subject to civil penalties of up to $25,000 for each violation, or criminal penalties up to $100,000 for individuals or $200,000 for corporations and/or imprisonment of up to 1 year.

Section 10

Individuals and state and local agencies proposing an action that is expected to result in the take of federally listed species are encouraged to apply for an ITP under Section 10(a)(1)(B) of FESA. Such permits are issued by USFWS when take is not the intention of and is incidental to otherwise legal activities. An application for an ITP must be accompanied by an HCP that meets the requirements outlined in Section 10(a)(2)(A). Section 10(a)(2)(B) of FESA identifies the criteria that must be met for USFWS to issue a permit.

Section 10(a)(1)(B) Process – Habitat Conservation Plan Requirements and Guidelines

The Section 10(a)(1)(B) process for obtaining an ITP has three primary stages: (1) the HCP development stage, (2) the formal permit processing stage, and (3) the post-issuance stage.

During the HCP development stage, the project applicant prepares a plan that integrates the proposed project or activity with the protection of listed species. An HCP submitted in support of an ITP application must include the following information:

- Impacts likely to result from the proposed taking of the species for which permit coverage is requested.
- Measures that will be implemented to monitor, minimize, and mitigate impacts; funding that will be made available to undertake such measures; and procedures to deal with unforeseen circumstances.
- Alternative actions to the proposed taking considered by the applicant.
- Additional measures USFWS may require as necessary or appropriate for purposes of the plan.

The HCP development stage concludes and the permit processing stage begins when a complete application package is submitted to the appropriate permit-issuing office. A complete application package consists of (1) an HCP, (2) an Implementation Agreement, as appropriate, (3) a permit

application, and (4) a $100 fee from the applicant. USFWS must also publish a Notice of Availability of the HCP package in the *Federal Register* to allow for public comment. USFWS also prepares an Intra-Service Section 7 Biological Opinion; and prepares a Set of Findings, which evaluates the Section 10(a)(1)(B) permit application as in the context of permit issuance criteria (see below).

An Environmental Action Statement, Environmental Assessment, or Environmental Impact Statement serves as USFWS' record of compliance with NEPA, which has gone out for a 30-, 60-, or 90-day public comment period. An Implementation Agreement may be required for HCPs unless the HCP qualifies as a low-effect HCP. A Section 10(a)(1)(B) ITP is granted upon a determination by USFWS that all requirements for permit issuance have been met. Statutory criteria for issuance of the permit specify the following:

1. The taking will be incidental.
2. The impacts of incidental take will be minimized and mitigated to the maximum extent practicable.
3. Adequate funding for the HCP and procedures to handle unforeseen circumstances will be provided.
4. The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild.
5. The applicant will provide additional measures that USFWS requires as being necessary or appropriate.
6. USFWS has received assurances, as may be required, that the HCP will be implemented.
7. During the post-issuance stage, the Permittees and other responsible entities implement the HCP, and USFWS monitors the Permittees' compliance with the HCP as well as the long-term progress and success of the HCP. The public is notified of permit issuance by means of the *Federal Register*.
8. The required key elements to be included in the HCP document include the following:
    a) Area, time-frame, species, and activities covered by the plan and permit
    b) An estimate of the incidental take and associated impacts
9. A conservation plan is provided (with all of the items below):
    a) Biological goals and objectives
    b) Measures to avoid, minimize, mitigate, and monitor take and its effects
    c) Implementation and effectiveness monitoring
    d) Adaptive management provisions
    e) Measures for changed and unforeseen circumstances
    f) Provisions for amending the plan and permit
    g) Funding provisions and assurances
    h) Implementation assurances
    i) Alternatives to the taking of listed species and the reasons why not selected

The Upper SAR HCP has been developed to address and include all of these key elements.

Section 7

Section 7 of FESA requires federal agencies to ensure that their actions, including issuing permits, do not jeopardize the continued existence of listed species or destroy or adversely modify listed species' critical habitat. "Jeopardize the continued existence of…" pursuant to 50 CFR 402.02, means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

Issuance of an ITP under Section 10(a)(1)(B) of FESA by USFWS is a federal action subject to Section 7 of the Act. As a federal agency issuing a discretionary permit, USFWS is required to consult with itself (i.e., conduct an internal consultation). Delivery of the HCP and a Section 10(a)(1)(B) permit application initiates the Section 7 consultation process within USFWS.

The requirements of Section 7 and Section 10 overlap in some respects. Elements unique to Section 7 include analyses of impacts on designated critical habitat, analyses of impacts on listed plant species, if any, and analyses of indirect and cumulative impacts on listed species. Cumulative effects are effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area, pursuant to Section 7(a)(2) of the Act. The action area is defined by the influence of direct and indirect impacts of Covered Activities. The action area may or may not be solely contained within the HCP boundary. These additional analyses are included in this HCP to meet the requirements of Section 7 and to assist USFWS with its internal consultation.

USFWS will conduct an internal Section 7 consultation and prepare a biological opinion on its action, the issuance of the Permittees' ITP for the Upper SAR HCP.

1.3.2 California Endangered Species Act

CESA is part of the California Fish and Game Code (Section 2050 et seq.) and is administered by CDFW as the trustee for fish and wildlife resources in California. CESA authorizes the California Fish and Game Commission to establish a list of endangered and threatened species.

Section 2081

Section 2081(b) of CESA authorizes CDFW to allow, by permit, the take of an endangered, threatened, or candidate species. Such a "Section 2081 permit" may be issued only if the following permit issuance criteria are met:

1. The take is incidental to an otherwise lawful activity.
2. The impacts of the authorized take shall be minimized and fully mitigated. The measures required to meet this obligation shall be roughly proportional in extent to the impact of the authorized taking on the species. Where various measures are available to meet this obligation, the measures required shall maintain the applicant's objectives to the greatest extent practicable. All required measures shall be capable of successful implementation. For purposes of this section only, impacts of taking include all impacts on the species that result from an act that would cause the proposed taking.
3. The permit is consistent with regulations adopted pursuant to Sections 2112 and 2114.

4. The applicant shall ensure adequate funding to implement the measures required by paragraph (2), and for monitoring compliance with, and effectiveness of, those measures. (CESA Section 2081[b])

CESA further requires that no permit may be issued if issuance of the permit would jeopardize the continued existence of the species, a determination that CDFW must make based on the best scientific and other information that is reasonably available. This must include consideration of the species' capability to survive and reproduce in light of known population trends, known threats to the species, and reasonably foreseeable impacts on the species from other related projects and activities. The conditions and measures in the Upper SAR HCP were designed to meet the issuance criteria for 2081 permits for all Covered Species; therefore, separate 2081 permits are expected to be obtained from CDFW largely based on the HCP.

1.3.3 Other Federal and State Wildlife Laws and Regulations

Federal Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA), as amended, implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under the MBTA, taking, killing, or possessing migratory birds is unlawful, as is taking of any parts, nests, or eggs of such birds (16 United States Code [USC] 703). The conservation measures for covered birds under this HCP are intended to be consistent with the MBTA.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions. USFWS provides guidance regarding the incidental take of bald and golden eagles (Chapters 3 and 7 in the *HCP Handbook;* USFWS and NOAA Fisheries 2016). Under the Act, it is a violation to "…take, possess, sell, purchase, barter, offer to sell, transport, export or import, at any time or in any manner, any bald eagle commonly known as the American eagle, or golden eagle, alive or dead, or any part, nest, or egg, thereof." Here, take is defined as to include pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, and disturb. *Disturb* is further defined in 50 CFR 22.3 as follows:

> To agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

Recent revisions to regulations implementing the Bald and Golden Eagle Protection Act authorize take of bald eagles and golden eagles under the following conditions: where the take (1) is compatible with the preservation of the bald eagle and golden eagle, (2) is necessary to protect an interest in a particular locality, and (3) is associated with, but not the purpose of, the activity and the applicant has applied all appropriate and practicable avoidance and minimization measures and appropriate and practicable compensatory mitigation measures, as required (50 CFR 22.26).

Neither the bald eagle nor the golden eagle is a Covered Species under the HCP. The HCP does not seek a permit under the Bald and Golden Eagle Protection Act because disturbance, injury, or death

of eagles or eggs, or disturbance of nests, are not anticipated in association with Covered Activities or overall HCP implementation.

California Fully Protected Species

In the 1960s, before CESA was enacted, the California Legislature identified species for specific protection under the California Fish and Game Code. These fully protected species may not be taken or possessed at any time, and no licenses or permits may be issued for their take except for collecting these species for necessary scientific research and relocation of the bird species for the protection of livestock.[1] Fully protected species are described in Sections 3511 (birds), 4700 (mammals), 5050 (reptiles and amphibians), and 5515 (fish) of the California Fish and Game Code. These protections state that "…no provision of this code or any other law shall be construed to authorize the issuance of permits or licenses to take any fully protected [bird], [mammal], [reptile or amphibian], [fish]." No fully protected species are covered by the HCP, and CDFW cannot issue a 2081 permit for fully protected species. Fully protected species expected to occur in the Planning Area include, but are not restricted to, those listed below.

- White-tailed kite (*Elanus leucurus*)
- Golden eagle (*Aquila chrysaetos*)
- Bald eagle (*Haliaeetus leucocephalus*)

Fully protected species are not Covered Species under the HCP. The HCP does not seek a permit for fully protected species because take is not anticipated in association with Covered Activities or overall HCP implementation.

California Fish and Game Code 3503 (Bird Nests)

Section 3503 of the Fish and Game Code makes it "unlawful to take, possess or needlessly destroy the nests or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto." Therefore, CDFW may issue permits authorizing take pursuant to CESA**.** The HCP contains conservation measures to avoid such take to the maximum extent practicable in order to comply with Section 3503. However, some take of covered birds still may occur; the 2081 permit will serve as the state authorization for take of nests or eggs of covered birds pursuant to Section 3503.[2]

California Fish and Game Code 3503.5 (Birds of Prey)

Section 3503.5 of the Fish and Game Code prohibits the take, possession, or destruction of any birds of prey or their nests or eggs "except as otherwise provided by this code or any regulation adopted pursuant thereto." CDFW may issue permits authorizing take pursuant to CESA. The burrowing owl is the only bird of prey covered by the HCP, and the HCP contains conservation measures to avoid such take in order to comply with Section 3503.5.

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[1] CDFW can issue permits authorizing the incidental take of fully protected species under CESA, so long as any take authorization is issued in conjunction with the approval of a Natural Community Conservation Plan (NCCP). The Permittees are not seeking an NCCP Permit.

[2] Because cactus wren is not a federally listed species, no MBTA coverage can be provided for this species through the HCP. Therefore, take of its eggs or nests will still be prohibited under MBTA.

California Fish and Game Code 1900–1913 (Native Plant Protection Act)

The Native Plant Protection Act prohibits taking of endangered and rare plants from the wild and requires that CDFW be notified at least 10 days in advance of certain specified changes in land use that would adversely impact listed plants. There are two rare and endangered plants that occur in the Planning Area and that are protected by the Native Plan Protection Act. Both plants are Covered Species (Santa Ana River woolly-star and slender-horned spineflower); therefore, take of these species will be covered by the 2081 permits.

1.3.4 National Environmental Policy Act

The purpose of NEPA is twofold: to ensure that federal agencies examine environmental impacts of their actions (in this case deciding whether to issue an ITP) and to provide a mechanism for public participation. NEPA serves as an analytical tool on direct, indirect, and cumulative impacts of the proposed project alternatives to help USFWS decide whether to issue an ITP. NEPA analysis must be done by USFWS as the lead agency for each HCP as part of the ITP application process.

1.3.5 California Environmental Quality Act

CEQA is similar to but more extensive than NEPA in that it requires significant environmental impacts of proposed projects to be reduced to a less-than-significant level through adoption of feasible avoidance, minimization, or mitigation measures unless overriding considerations are identified and documented. CDFW's action on a 2081 permit is subject to CEQA and will be addressed by the NEPA/CEQA environmental review process for the HCP.

1.3.6 Federal and State Wetland Laws and Regulations

Note that the HCP has been developed to support permitting under FESA and CESA. Compliance with federal and state Wetland Laws and Regulations must be achieved through the permit processes established by the aquatic resources regulatory agencies. To this end, the Upper SAR Programmatic Aquatic Resource permits will be developed to assist the Permittee Agencies with streamlined regulatory compliance for these federal and state wetland laws and regulations.

The CWA is the primary federal law that protects the physical, chemical, and biological integrity of the nation's waters, including lakes, rivers, wetlands, and coastal waters. Programs conducted under the CWA are directed at both point-source pollution (e.g., waste discharged from outfalls and filling of waters) and nonpoint-source pollution (e.g., runoff from roads, freeways, and bridges). Under Sections 401, 402, and 404 of the CWA, the U.S. Environmental Protection Agency (EPA), federal agencies, and state agencies set effluent limitations and issue permits. These permits are the primary regulatory tools of the CWA. EPA oversees all CWA permits.

Definition of Jurisdictional Wetlands and Waters

The term *jurisdictional waters* is used to refer to state and federally regulated wetlands and other waterbodies that cannot be filled without permits from the USACE under CWA Section 404 or from the State Water Resources Control Board (SWRCB) or the Regional Water Quality Control Boards (RWQCBs) under either CWA Section 401 or Porter-Cologne.

Federally regulated wetlands and other waters are defined under the CWA as "waters of the United States" (WoUS). WoUS include traditionally navigable waters such as rivers, lakes, and the territorial seas, and other wetlands and waters that may not be navigable, such as tributaries of navigable waters and wetlands adjacent to navigable waters. WoUS are more specifically defined by USACE regulations as interpreted by the courts. USACE relies on several published technical manuals for determining the scope of federally jurisdictional wetlands.

The SWRCB and RWQCBs regulate the discharge of dredged or fill material to waters of the State of California, which includes any surface or groundwater within the state. The permit process for discharges to waters of the State were established by the SWRCB in 2019 with the adoption of a statewide wetlands definition and "procedures" for the discharge of dredged or fill material.

Mitigation is typically required for activities permitted under CWA Sections 401 and 404, and Porter-Cologne.

Clean Water Act Section 404

Pursuant to CWA Section 404, USACE regulates the discharge of dredged or fill material into WoUS, including wetlands. A discharge of fill material includes activities such as grading, placing riprap for erosion control, pouring concrete, laying sod, and stockpiling excavated material into WoUS. Activities that generally do not involve a regulated discharge (if performed specifically in a manner to avoid discharges) include driving pilings, performing certain drainage channel maintenance activities, constructing temporary mining and farm/forest roads, and excavating without stockpiling.

USACE issues two types of permits under Section 404: general permits (either nationwide permits or regional permits) and standard permits (referred to as individual permits). General permits are issued by USACE to streamline the Section 404 process for nationwide, statewide, or regional activities that have minimal direct or cumulative environmental impacts on the aquatic environment. Individual permits are issued for activities that do not qualify for a general permit (i.e., that may have more than a minimal adverse environmental impact). The Los Angeles District of USACE will review and consider issuing permits for projects in the Planning Area that propose to fill WoUS.

The HCP will not provide permits under CWA Section 404 for impacts on wetlands or other waters from Covered Activities. However, the Section 404 permitting process is expected to be streamlined as a result of the HCP. Issuance of a Section 404 permit often requires USACE to consult with USFWS to comply with FESA Section 7. This consultation would address the federally listed species covered by the HCP. Accordingly, provided that Covered Activities requiring Section 404 permits are implemented consistently with the HCP, it is expected that there will not be mitigation or other offsetting measures for effects on Covered Species beyond those already required by the HCP. The Section 7 biological opinion issued for the HCP also can serve as the basis for any future biological opinions in the Planning Area for Covered Activities.

Clean Water Act Section 401 and the Porter-Cologne Water Quality Control Act

Under CWA Section 401, states are required to certify that federal permits for discharges to waters in the state comply with state water quality standards. In California, these standards are established under Porter-Cologne. A federal permit cannot be issued if the state denies certification. In

California, the SWRCB and the RWQCBs are responsible for the issuance of CWA Section 401 certifications. The Planning Area is within the Santa Ana RWQCB.

Porter-Cologne is the primary state law concerning water quality. It authorizes the SWRCB and RWQCBs to prepare management plans such as Regional Water Quality Plans (Basin Plans) to address the quality of groundwater and surface water. Porter-Cologne also authorizes the RWQCBs to issue Waste Discharge Requirements (WDRs) defining limitations on allowable discharge to waters of the State, including wetlands. In addition to issuing CWA Section 401 certifications on CWA Section 404 applications to fill waters, the RWQCBs may issue WDRs for such activities.

The HCP does not include certifications under Section 401 or WDRs under Porter-Cologne. However, the HCP should provide some streamlining benefits for Covered Activities requiring a certification or WDRs. Under SWRCB regulations, the alternatives analysis and mitigation required for a proposed discharge to waters of the State are required to be evaluated in a watershed context. In particular, if a watershed plan has been adopted for an area that includes a proposed discharge, the permit for that discharge will be evaluated in light of the watershed plan. This HCP is intended to serve as such a watershed plan within the meaning of SWRCB regulations.

Clean Water Act Section 402, National Pollutant Discharge Elimination System

CWA Section 402 controls direct discharges into navigable waters. Direct discharges or “point–source” discharges are from sources such as pipes and sewers. National Pollutant Discharge Elimination System (NPDES) permits are issued by the state with oversight by EPA. A facility that intends to discharge into the nation's waters must obtain a permit before initiating a discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The Section 402 permit then will set forth the conditions and effluent limitations under which a facility may make a discharge. The HCP does not include certifications under Section 402 or NPDES permits under the CWA. These authorizations, if required, must be obtained separately.

California Water Code and Wastewater Change Petitions

If a water re-use project will decrease the amount of water in a stream or other waterway, the owner of the wastewater treatment plant needs to file a wastewater change petition with the Division of Water Rights. To approve a wastewater change petition, the SWRCB must be able to find that the proposed change will not injure other legal users of water, will not unreasonably harm instream uses, and is not contrary to the public interest. A petition is not needed for changes in the discharge or use of treated wastewater that do not result in decreasing the flow in any portion of a watercourse. Also, reductions in discharge associated with reduced plant influent due to water conservation measures are not subject to the petition requirement. Wastewater change petitions are sent to SWRCB. Specifically, as stated in Water Code Section 1211 “(a) Prior to making any change in the point of discharge, place of use, or purpose of use of treated wastewater, the owner of any wastewater treatment plant shall obtain approval of the board for that change.” This approval is typically referred to as a “Change of Use 1211 Permit.” CEQA applies to non-exempt wastewater change petitions, and the SWRCB must either undertake CEQA review as a lead agency, or review CEQA documents as a responsible agency before making a decision.

Lake or Streambed Alteration Agreement

CDFW has jurisdictional authority over rivers, streams and lakes under California Fish and Game Code Section 1600 et seq. CDFW has the authority to regulate work that will "substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake." Traditionally, CDFW exerted jurisdiction to the top of the bank or out to the edge of the riparian zone (whichever is farther). In recent years, CDFW has begun to assert jurisdiction more broadly, often requiring permits (in the form of Lake and Streambed Alteration Agreements) for impacts on areas including the "maximum expression" of a stream on the landscape over the prior 200 years.

Activities of any person, state or local governmental agency, or public utility are regulated by CDFW under Section 1602 of the California Fish and Game Code. CDFW enters into a streambed or lakebed alteration agreement with the project proponent and is authorized to impose "reasonable" conditions on the agreement to protect fish and wildlife resources.

The lake or streambed alteration agreement is not a permit, but rather a mutual agreement between CDFW and the project proponent. To secure such an agreement, a project proponent must submit a notification of proposed streambed alteration to CDFW before construction. CDFW will review the notification and, within 60 days following such notice having been deemed complete, will issue a draft agreement to the project proponent. The Fish and Game Code establishes a dispute resolution process to address any disagreements between CDFW and the proponent over CDFW's proposed conditions to the activity. CDFW can enter into streambed alteration agreements that cover recurring operation and maintenance activities and can enter into long-term agreements to cover development and other activities described in regional plans.

The CDFW Streambed Program Guidance outlines the process for project-level Lake or Streambed Alteration Agreement notifications for the Covered Activities pursuant to California Fish and Game Code Sections 1600–1616. The Streambed Program will guide streambed permitting within the Planning Area through individual project review and the associated CEQA process.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended (16 USC 470 et seq.), requires federal agencies to take into account the effects of their proposed actions on properties eligible for inclusion in the National Register of Historic Places. *Properties* are defined as cultural resources, which include prehistoric and historic sites, buildings, and structures that are listed on or eligible for listing on the National Register of Historic Places. An *undertaking* is defined as a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of a federal agency; those carried out with federal financial assistance; those requiring a federal permit, license, or approval; and those subject to state or local regulation administered pursuant to a delegation or approval by a federal agency.

The issuance of an ITP is an undertaking subject to Section 106 of the NHPA. USFWS has determined that the area of potential effects for the present undertaking is that area where on-the-ground Covered Activities will result in take of species.

1.4 Relationship to Other Conservation Plans in the Planning Area

The Upper SAR HCP overlaps with four other HCPs and one Natural Community Conservation Plan (NCCP)/HCP that are approved and active (i.e., within the permit duration). A brief description of these overlapping HCPs and NCCPs is provided below. There are an additional four NCCP/HCPs and one HCP that are near the Planning Area: (1) Coachella Valley Multiple Species NCCP/HCP, (2) Orange County Central/Coastal Subregion NCCP/HCP, (3) Orange County Southern Subregion HCP, (4) Apple Valley Multi-Species Conservation Plan NCCP/HCP, and (5) Orange County Transportation Authority NCCP/HCP (Figure 1-4).

1.4.1 Upper Santa Ana River Wash HCP

The Upper Santa Ana River Wash HCP (Wash Plan) planning area (4,892 acres) is entirely within the Upper SAR HCP Planning Area and includes the area from approximately 1 mile downstream of the Seven Oaks Dam to approximately 6 miles westward from Greenspot Road in the City of Highland to Alabama Street in the City of Redlands. The primary goal of the Wash Plan is to balance the ground-disturbing activities of water conservation, aggregate mining, recreation activities, and other public services with the conservation of natural communities and populations of Santa Ana River woolly-star, slender-horned spineflower, coastal California gnatcatcher, cactus wren, and San Bernardino Merriam's kangaroo rat (all of which are also covered by the Upper SAR HCP). The Wash Plan was permitted in July 2020. The City of Redlands, City of Highland, Valley District, East Valley, Cemex, Inc., and Robertson's Ready-Mix will participate in the implementation of the HCP through a Certificate of Inclusion to receive coverage for their planned projects in the Wash Plan planning area.

Given the overlap of some participating water agencies and the similar name and geographic location, the Wash Plan may be confused with the Upper SAR HCP. The Covered Activities and associated ITPs of the Wash Plan are independent of the Covered Activities and ITPs of the Upper SAR HCP.

1.4.2 Western Riverside Multiple Species NCCP/HCP

The Western Riverside County Multiple Species NCCP and HCP (WRC MSHCP), a comprehensive regional NCCP/HCP, was adopted in June 2003. The WRC MSHCP provides impact mitigation for future County infrastructure, particularly transportation and development projects in the covered area of western Riverside County. The southern portion of the Upper SAR HCP occurs within the boundaries of the WRC MSHCP planning area (Figure 1-4). There are 146 listed and non-listed Covered Species in the WRC MSHCP, including the following species also included in the Upper SAR HCP: Santa Ana River woolly-star, slender-horned spineflower, Delhi Sands flower-loving fly, Santa Ana sucker, arroyo chub, arroyo toad, mountain yellow-legged frog, western spadefoot, burrowing owl, coastal California gnatcatcher, cactus wren, least Bell's vireo, southwestern willow flycatcher, tricolored blackbird, western yellow-billed cuckoo, yellow-breasted chat, San Bernardino Merriam's kangaroo rat, and Los Angeles little pocket mouse.

The Covered Activities in the Upper SAR HCP were not explicitly covered in the WRC MSHCP; therefore, all Upper SAR HCP Covered Activities will be mitigated through this HCP and all WRC

MSHCP covered activities must be mitigated through that plan and are not allowed to be mitigated through this HCP.

1.4.3 West Valley HCP

The City of Colton obtained an ITP from USFWS for the Delhi Sands flower-loving fly within the West Valley HCP planning area. The purpose of the West Valley HCP is to fulfill the permit requirements for proposed activities under the plan in areas containing occupied and suitable habitat for Delhi Sands flower-loving fly in order to maximize economic development in the City of Colton while also conserving the fly. The West Valley HCP focuses on preserving populations of the species north of Interstate 10. The goals of the plan include preserving large blocks of habitat north of Interstate 10, protecting populations of Delhi Sands flower-loving fly, providing connections between local populations, and providing long-term conservation management of populations (RBF 2014).

The West Valley HCP occurs entirely within the Upper SAR HCP Planning Area (Figure 1-4). The West Valley HCP planning area consists of 416 acres, of which approximately 149 acres is potentially suitable habitat for Delhi Sands flower-loving fly. There are five conservation areas organized into four distinct management units within the planning area, which are managed and monitored by the Riverside Land Conservancy. The Delhi Sands flower-loving fly is also covered by the Upper SAR HCP.

1.4.4 Lake Matthews Multiple Species HCP

The Lake Mathews Multiple Species HCP (Lake Mathews MSHCP) is a joint conservation effort initiated by Metropolitan and the Riverside County Habitat Conservation Agency (RCHCA) in cooperation with USFWS. There are 65 listed and non-listed species covered under the Lake Mathews MSHCP (MWD/RCHCA 1995); 31 of the species covered under the Lake Mathews MSHCP are also covered under the Upper SAR HCP.

The Lake Mathews MSHCP occurs entirely within the Upper SAR HCP Planning Area (Figure 1-4). It consists of approximately 6,000 acres of open land surrounding Lake Mathews in northwestern Riverside County. La Sierra Avenue runs north/south along the Lake Mathews shore near the western boundary, Cajalco Road runs east/west near the southern shore and boundary, and El Sobrante Road runs east/west along the northern shore and boundary of the Lake Mathews MSHCP.

1.4.5 Stephen's Kangaroo Rat HCP

The RCHCA obtained ITPs from USFWS and CDFW for Stephens' kangaroo rat (*Dipodomys stephensi*; SKR) within the Stephens' Kangaroo Rat Habitat Conservation Plan (SKR HCP) area. Conservation goals included the acquisition and conservation of Stephens' kangaroo rat habitat within a regional reserve system and establishes conservation of 15,000 acres in seven core reserves within the plan's boundary for SKR. The Upper SAR HCP Planning Area encompasses three SKR HCP core reserve areas: Lake Mathews/Estelle Core Reserve, Steele Peak Core Reserve, and Sycamore Canyon Core Reserve (RCHCA 1996) (Figure 1-4); however, none of the Upper SAR HCP Covered Activities considered in the HCP are anticipated to impact SKR. Therefore, SKR is not a Covered Species under the Upper SAR HCP. Should Covered Activities (listed in Table 2-1) occurring within the SKR HCP fee area need take authorization for SKR, they would obtain that through a certificate of inclusion in the SKR HCP.

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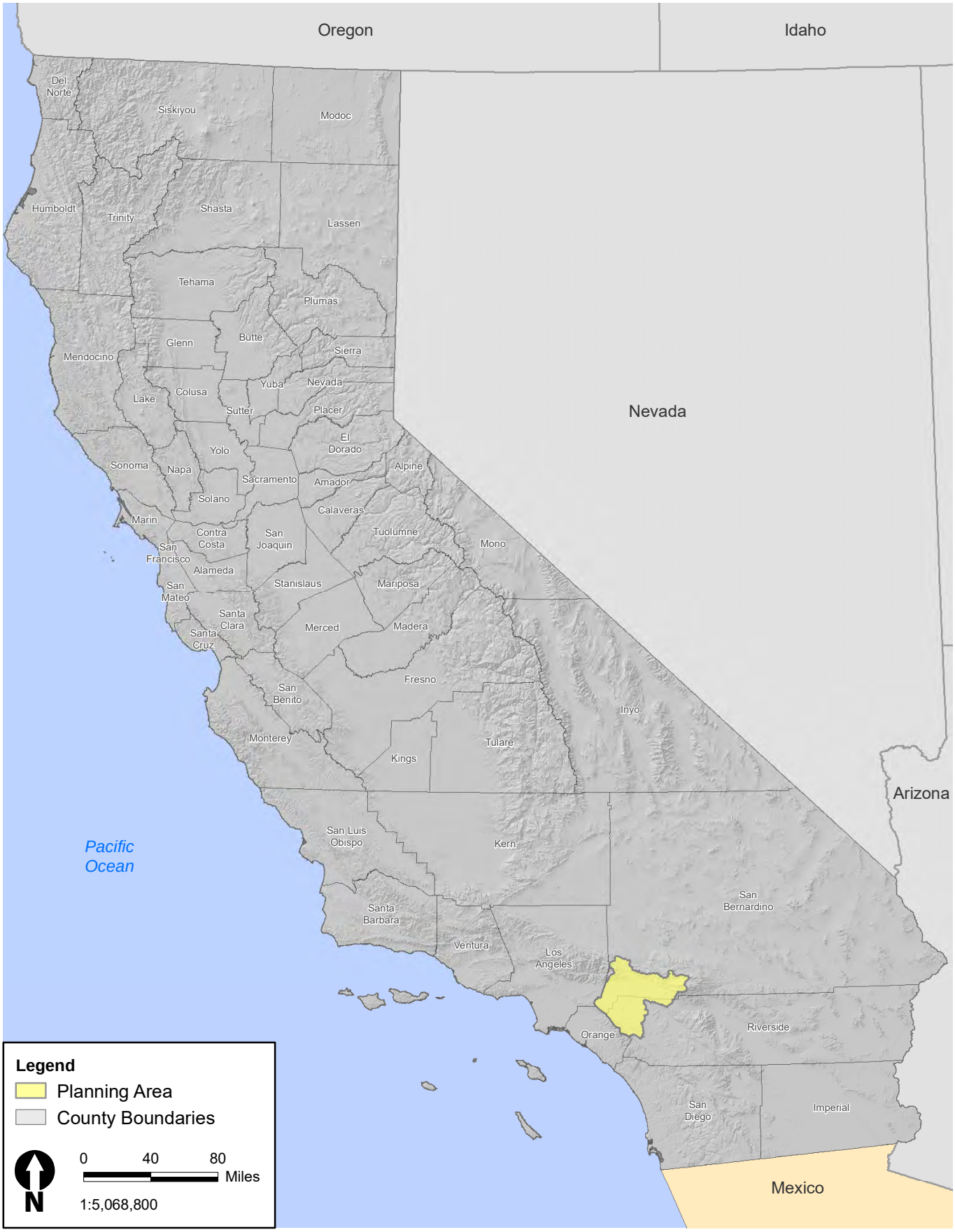
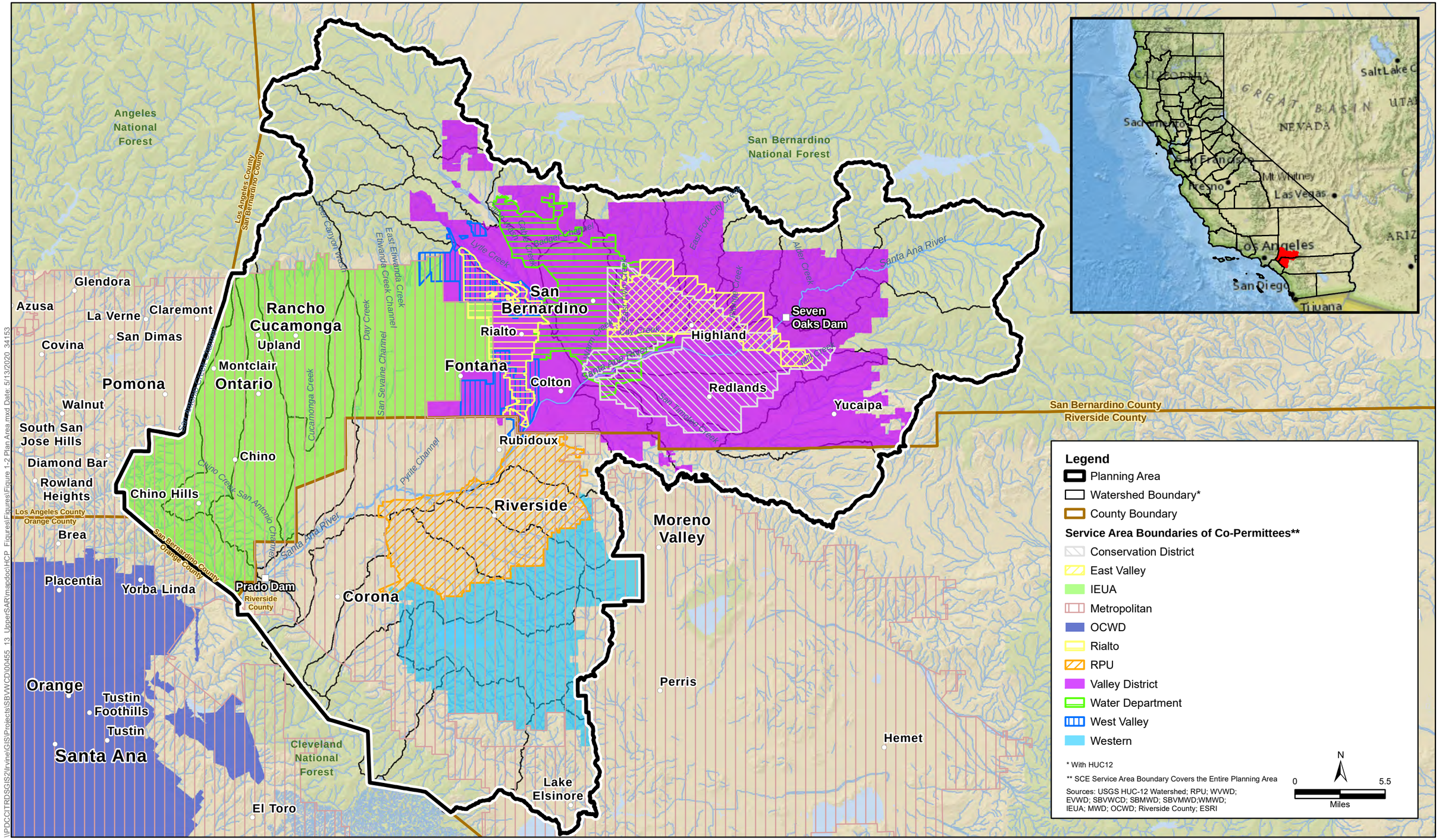


Figure 1-1
Regional Location Map
Upper Santa Ana River Habitat Conservation Plan



Upper Santa Ana River Habitat Conservation Plan

Figure 1-2
Planning Area

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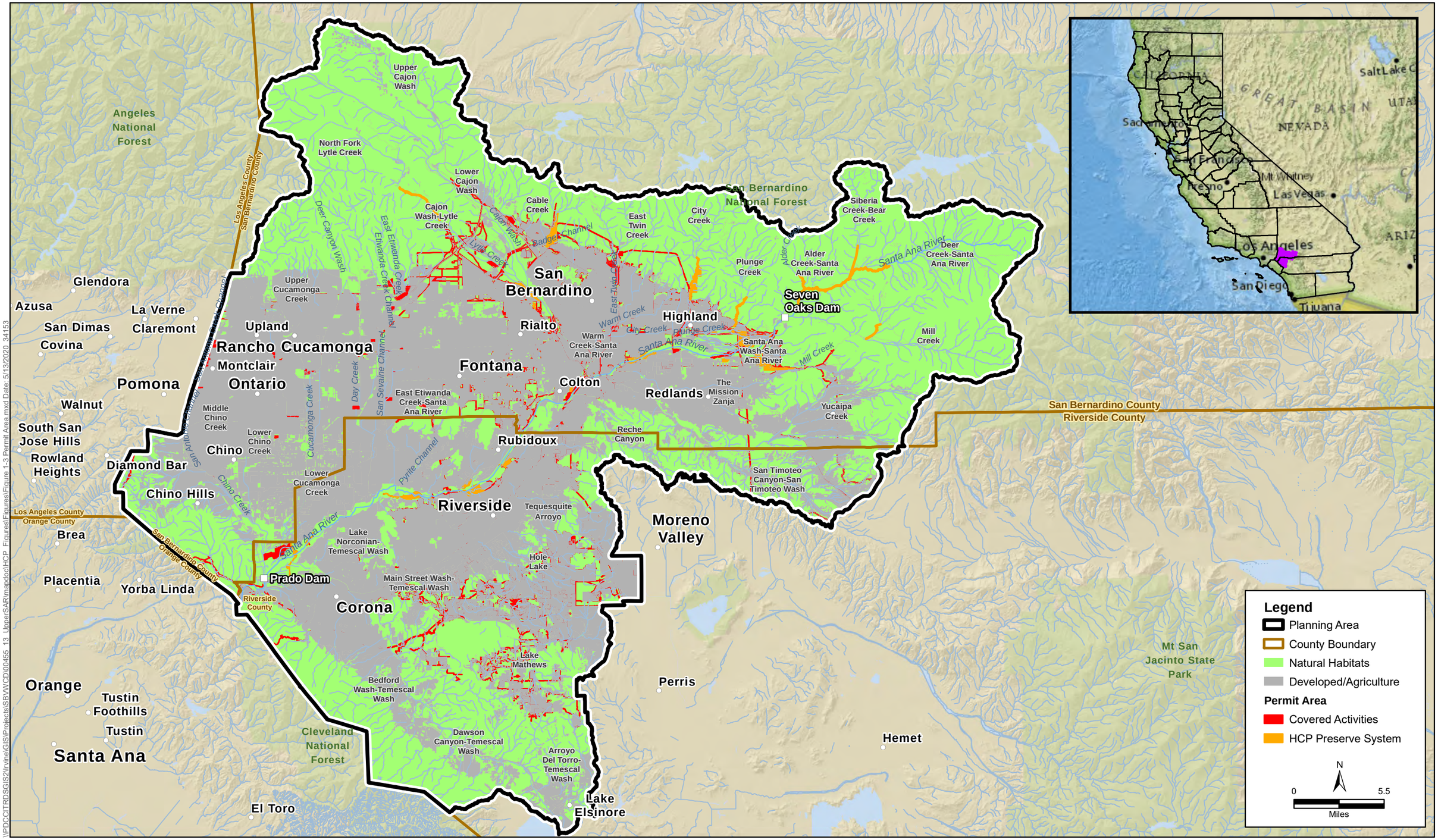

Upper Santa Ana River Habitat Conservation Plan

Figure 1-3
Permit Area

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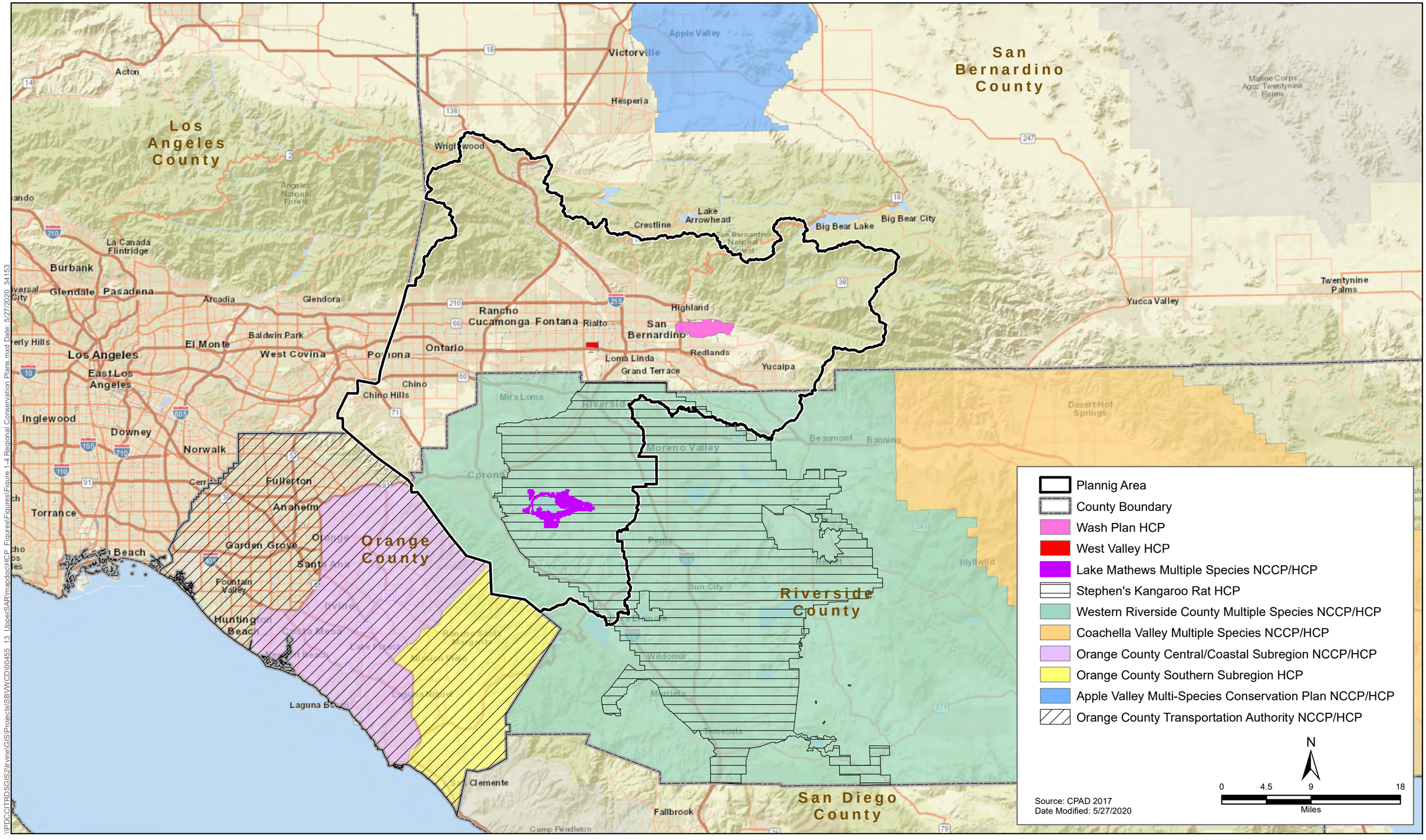

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Upper Santa Ana River
Habitat Conservation Plan

Figure 1-4
Regional Habitat Conservation Plans in the vicinity of the Planning Area

Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Chapter 2
Covered Activities

2.1 Description of Covered Activities

The Upper Santa Ana River (SAR) Habitat Conservation Plan (HCP) covers two types of activities: (1) new or expanded facilities planned in the Planning Area, and (2) activities related to the operations and maintenance (O&M) of existing facilities or associated with new facilities constructed as a Covered Activity.

All Covered Activities have been subdivided into the following categories:

1. **Water Reuse Projects**—Activities related to projects associated with water reuse, including construction of new water treatment plants and associated facilities, and operations and maintenance of existing and new water treatment plants and associated facilities.
2. **Groundwater Recharge**— Activities related to construction of new structures associated with diversions, operations and maintenance of existing and new diversion structures for groundwater recharge, activities related to construction of new recharge basins, and operations and maintenance of existing and new recharge basins.
3. **Wells and Water Conveyance Infrastructure**—Activities related to the creation of new wells and associated development (pipelines, access roads, reservoirs, bridges) and the operations and maintenance of this infrastructure and associated development.
4. **Solar Energy Development**—Activities related to the construction and maintenance of new solar facilities.
5. **Routine Operations and Maintenance**—Activities that occur repeatedly in one location and/or in many locations over a wide area periodically and include minor construction, earth moving, or vegetation clearing activities to infrastructure.
6. **Habitat Enhancement, Management, and Monitoring**—Activities that support the restoration and maintenance of habitat values in the Planning Area, including species surveys, monitoring, research, and adaptive management activities.

The impacts of all Covered Activities are analyzed and described in Chapter 4, *Take Assessment and Impact Analysis*. All Covered Activities will be implemented with appropriate avoidance and minimization measures. These avoidance and minimization measures are described in Chapter 5, Section 5.11, *Measures to Avoid and Minimize Take*.

In certain instances, a covered project may include multiple components (e.g., conveyance infrastructure and recharge basins). In these cases, the project is categorized in the component anticipated to result in the greatest effects.

Covered Activities are also anticipated to occur in different phases during implementation of the HCP. These HCP phases are as follows:

- **Phase 1**—0 to 5 years from permit issuance
- **Phase 2**—6 to 10 years from permit issuance

- **Phase 3**—11 to 15 years from permit issuance
- **Phase 4**—16 years from permit issuance to end of permit term

Covered Activities result in permanent and/or temporary ground disturbance from construction or maintenance activities and/or changes to hydrology that affect Covered Species or their habitat. Projects covered under the HCP are in various stages of planning, and, therefore, project descriptions may vary in detail according to how far along in planning a project is. For example, a project occurring in Phase 1 may have very detailed descriptions (specific location, site layout, etc.) while activities in earlier planning stages may have more general descriptions (general location and/or development envelope).

To account for some uncertainty as to the extent and location of Covered Activities, this HCP assumes disturbance footprints conservatively to ensure that the potential effects on Covered Species are adequately assessed. Figures 2-1 through 2-24 illustrate the areas where this HCP assumes Covered Activities will occur for the purposes of estimating effects. All activities described in this chapter have been analyzed in Chapter 4, unless specifically identified as not covered. Acreages of ground disturbance associated with construction, operations, or maintenance are reported in Chapter 4.

Geotechnical drilling (e.g., cone penetration testing) to understand subsurface conditions may be necessary prior to construction of water infrastructure (e.g., recharge basin, pipeline, well, or storage tank). This activity is assumed to occur within the Covered Activity ground disturbance footprint analyzed in Chapter 4. Holes drilled for geotechnical studies will be backfilled with native material or other material following the conditions of Clean Water Act Section 404 Nationwide Permit 6 and approved by the Regional Water Quality Control Board (RWQCB).

The Covered Activities described in Sections 2.1.1 through 2.1.5 describe new projects and are organized by the activity types covered by the HCP. Section 2.1.6 describes routine operations and maintenance activities to be covered that generally apply to all water agencies. All ground-disturbing and hydrology-changing activities covered by the Incidental Take Permit (ITP) for the HCP are described in this section and mapped in a Geographical Information System (GIS) database. Operations and maintenance activities covered by the ITP are described generally in Section 2.1.6, and also mapped in the GIS database. Additionally, Section 2.2 describes specific activities not covered by the ITP.

In order to track Covered Activities in tabular impact calculations and locate projects in the figures in this document, the Covered Activities have been assigned a unique identification code. Table 2-1 lists the code associated with each Covered Activity. Table 2-2 summarizes all Covered Activities that propose aquatic effects.

Table 2-1. Summary of Covered Activities

ID (Phase)	Owner	Project/Activity Name	Activity Type
CD.1 (1)	Conservation District	Mill Creek Diversion Maintenance	Groundwater Recharge
CD.2 (1)	Conservation District	Santa Ana Levee and Cuttle Weir Diversion	Groundwater Recharge
EV.1 (1)	East Valley	Future Development Surface Water/ Imported Water Treatment Plant	Water Reuse Projects
EV.2 (1)	East Valley	East Valley Water District Pipelines Maintenance	Wells and Water Conveyance Infrastructure
EV.3 (1)	East Valley	East Valley Water District Existing Facilities Maintenance	Wells and Water Conveyance Infrastructure
EV.4.01–4.03 (1)	East Valley	Sterling Natural Resource Center	Water Reuse Projects
EV.5 (3)	East Valley	East Valley Water District New Reservoirs and Pipelines	Wells and Water Conveyance Infrastructure
IEUA.1.01–1.12 (1)	IEUA	Groundwater Recharge Basins with New Construction and Maintenance	Groundwater Recharge
IEUA.1.13 (1)	IEUA	RP3 Basin Habitat Mitigation Area (IEUA)	Habitat Enhancement, Management, and Monitoring
IEUA.2.01–2.08 (1)	IEUA	Existing Basins and Maintenance Areas	Groundwater Recharge
IEUA.3.01–3.06 (1)	IEUA	Creek Diversion Projects	Groundwater Recharge
IEUA.4 (1)	IEUA	IEUA Recycled Water Project	Water Reuse Projects
Met.1 (1)	Metropolitan	Upper Feeder Santa Ana River Bridge Project	Wells and Water Conveyance Infrastructure
Met.2 (1)[1]	Metropolitan	Metropolitan Water District Pipeline Maintenance	Wells and Water Conveyance Infrastructure
Met.3 (1)[1]	Metropolitan	Metropolitan Water District Right-of-Way and Patrol Road Maintenance	Wells and Water Conveyance Infrastructure
OCWD.1 (1)	OCWD	Ongoing Maintenance of Prado Constructed Wetlands	Wells and Water Conveyance Infrastructure
Rial.1 (2)	City of Rialto	Rialto Wastewater Diversion and Reuse Project	Water Reuse Projects
RPU.1 (1)	RPU	Pipeline Crossing from Rapid Infiltration and Extraction Facility	Wells and Water Conveyance Infrastructure

ID (Phase)	Owner	Project/Activity Name	Activity Type
RPU.2 (1)	RPU	Future Gage Canal Transmission Main	Wells and Water Conveyance Infrastructure
RPU.3 (1)	RPU	Flume and Riverside Canal Pipeline Replacements	Wells and Water Conveyance Infrastructure
RPU.4 (1)	RPU	Jurupa Ditch Company Well Field	Wells and Water Conveyance Infrastructure
RPU.5 (2)	RPU/Valley District/ Western	Riverside North Aquifer Storage and Recovery Project	Groundwater Recharge
RPU.6 (1)	RPU	Bunker Hill Basin Proposed Wells and Pipelines	Wells and Water Conveyance Infrastructure
RPU.7 (1)	RPU	Gage Canal Transmission Main Replacement	Wells and Water Conveyance Infrastructure
RPU.8 (2)[1]	RPU	Riverside Basin Recharge Project	Groundwater Recharge
RPU.9 (1)	RPU	North Waterman Treatment Plant	Water Reuse Projects
RPU.10 (1)[1]	RPU/Valley District/ Upper SAR HCP	Santa Ana River Sustainable Parks and Tributaries Water Reuse Project	Wells and Water Conveyance Infrastructure
RPU.11 (1)	RPU	Riverside Public Utilities Various Solar Projects	Solar Energy Development
RPU.12 (1)	RPU	Riverside Public Utilities Weed Abatement and Property Maintenance	Wells and Water Conveyance Infrastructure
RPU.13 (2)	RPU	Drainage A Modification	Wells and Water Conveyance Infrastructure
RPU.14 (1)	RPU	Waterman Pipeline Upsizing Project	Wells and Water Conveyance Infrastructure
RPU.15 (1)[1]	RPU	Riverside Public Utilities Maintenance of Supply Transmission Mains	Wells and Water Conveyance Infrastructure
Rest.1 (1)[1]	RPU	Hidden Valley Creek	Habitat Enhancement, Management, and Monitoring
Rest.2 (1)	RPU	Hidden Valley Ponds	Habitat Enhancement, Management, and Monitoring
Rest.3 (3)	RPU	Lower Hidden Valley Creek	Habitat Enhancement, Management, and Monitoring
Rest.4 (1)[1]	RPU	Lower Hole Creek	Habitat Enhancement, Management, and Monitoring
Rest.5 (1)[1]	RPU	Anza Creek and Old Ranch Creek	Habitat Enhancement, Management, and Monitoring

ID (Phase)	Owner	Project/Activity Name	Activity Type
Rest.6 (1)	RPU	Evans Lake	Habitat Enhancement, Management, and Monitoring
Rest.7 (1)	Valley District	Louis Rubidoux Nature Center and Sunnyslope Creek	Habitat Enhancement, Management, and Monitoring
Rest.8 (1)[1]	Valley District	Tequesquite Creek Aquatic Habitat Restoration	Habitat Enhancement, Management, and Monitoring
Rest.9 (2)[1]	Valley District	Pedley Landfill Restoration	Habitat Enhancement, Management, and Monitoring
Rest.10 (1)	OCWD	Habitat Enhancement at Prado Basin	Habitat Enhancement, Management, and Monitoring
Rest.11 (1)	OCWD	Management of Santa Ana Sucker Restoration on Sunnyslope Creek	Habitat Enhancement, Management, and Monitoring
Rest.12 (1)	Valley District	Enhanced Recharge Basin Restoration	Habitat Enhancement, Management, and Monitoring
Rest.13 (1)	Valley District	North Enhanced Recharge Basin Restoration	Habitat Enhancement, Management, and Monitoring
Rest.14 (2)	Valley District	Alluvial Fan Restoration	Habitat Enhancement, Management, and Monitoring
Rest.15 (2)	Valley District	Drainage A Woolly-star Restoration	Habitat Enhancement, Management, and Monitoring
SCE.1 (1)	SCE	Mill Creek Powerhouse	Groundwater Recharge
SCE.2 (1)	SCE	Santa Ana River Powerhouse	Groundwater Recharge
SCE.3 (1)	SCE	Lytle Creek Powerhouse	Groundwater Recharge
VD.1 (1)	Valley District	Cactus Basin Recharge Project Maintenance	Groundwater Recharge
VD.2.02 (3)	Valley District/RPU/ Western/ Conservation District	Active Recharge Project – Cable Creek Diversion and Basin	Groundwater Recharge
VD.2.03 (4)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Lytle Creek Diversion and Basin	Groundwater Recharge
VD.2.04 (4)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Mill Creek Diversion	Groundwater Recharge
VD.2.05 (4)	Valley District/RPU/ Western/ Conservation District	Active Recharge Project – City Creek Diversion and Basin	Groundwater Recharge

ID (Phase)	Owner	Project/Activity Name	Activity Type
VD.2.06 (2)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Plunge Creek – Basin 1	Groundwater Recharge
VD.2.07 (4)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Cajon-Vulcan 1 Diversion and Basin	Groundwater Recharge
VD.2.08 (4)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Vulcan 2 Diversion and Basin	Groundwater Recharge
VD.2.09 (3)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Lytle-Cajon Diversion and Basin	Groundwater Recharge
VD.2.10 (3)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Plunge Creek – Basin 2	Groundwater Recharge
VD.2.11 (2)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Devil Creek Diversion and Basins	Groundwater Recharge
VD.2.12 (1)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Waterman Basin Spreading Grounds Channel Maintenance	Groundwater Recharge
VD.2.13 (2)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Twin Creek Spreading Grounds	Groundwater Recharge
VD.2.14 (4)	Valley District/RPU/ Western/Conservation District	Active Recharge Project – Badger Basin spreading Grounds Channel Maintenance	Groundwater Recharge
VD.3 (1)	Valley District/ Western/RPU	Enhanced Recharge Project – Seven Oaks Dam Water Conservation Improvements	Groundwater Recharge
VD.4 (1)	Valley District	Valley District Existing Pipelines and Pipeline Crossings	Wells and Water Conveyance Infrastructure
WD.1 (1)	Water Department	SBMWD Recycled Water Project	Water Reuse Projects
WD.2 (1)	Water Department	San Bernardino Municipal Water Department Other Pipelines	Wells and Water Conveyance Infrastructure
WD.3 (1)	Water Department	Kenwood Well Field and Pipeline	Wells and Water Conveyance Infrastructure
WD.4 (4)	Water Department	Vulcan Mining Groundwater Recharge Basins	Groundwater Recharge
WD.5 (1)	Water Department	San Bernardino Municipal Water Department Existing Facilities Maintenance	Wells and Water Conveyance Infrastructure
West.1 (2)[1]	Western	Western Municipal Water District Pipeline Rehabilitation and Replacement Program	Wells and Water Conveyance Infrastructure

ID (Phase)	Owner	Project/Activity Name	Activity Type
West.2 (1)[1]	Western	Western Municipal Water District Water Delivery and Wastewater Collection System Operation	Wells and Water Conveyance Infrastructure
West.3 (1)[1]	Western	Recycled Water Live Stream Discharge	Wells and Water Conveyance Infrastructure
West.4 (1)[1]	Western	Recycled Water Crossing to South AFC	Wells and Water Conveyance Infrastructure
West.5 (1)[1]	Western	Stormwater Channel and Recycled Water Impoundment Upgrades to Western Water Recycling Facility	Water Reuse Projects
West.6 (1)[1]	Western	Arlington Basin Water Quality Improvement Project	Groundwater Recharge
West.7 (1)[1]	Western	Riverside Corona Feeder Project	Wells and Water Conveyance Infrastructure
West.8 (1)[1]	Western	Replacement of the Owl Tree and March Line Pipelines	Wells and Water Conveyance Infrastructure
West.9 (1)[1]	Western	Lake Mathews and Burwood Drive Pipeline Construction	Wells and Water Conveyance Infrastructure
West.10	Western	Construction of Potable Water/Recycled Water Tanks	Wells and Water Conveyance Infrastructure
WV.1 (1)	West Valley	Southern California Edison Afterbay Recharge Basins and Maintenance	Groundwater Recharge
WV.2 (1)	West Valley	West Valley Pipeline Maintenance	Wells and Water Conveyance Infrastructure
WV.3 (1)	West Valley	8-3 Reservoir and Access Roads	Wells and Water Conveyance Infrastructure
WV.4 (1)	West Valley	Lord Ranch Facility	Water Reuse Projects
WV.5 (1)	West Valley	West Valley Other Routine Maintenance	Wells and Water Conveyance Infrastructure
WV.6 (1)	West Valley	West Valley Facilities Maintenance	Wells and Water Conveyance Infrastructure

[1] Covered activity occurs within the Stephen's Kangaroo Rat HCP. This Covered Activity will need to be evaluated for potential effects on the Stephen's kangaroo rat (*Dipodomys stephensi*) and if take is anticipated to occur, it will need to be obtained through that HCP.

Conservation District (CD) = San Bernardino Valley Water Conservation District, East Valley (EV) = East Valley Water District; IEUA = Inland Empire Utilities Agency; Metropolitan (Met) = Metropolitan Water District of Southern California; OCWD = Orange County Water District; Rialto (Rial) = City of Rialto Public Works; RPU = Riverside Public Utilities; SBMWD = San Bernardino Municipal Water Department; SCE = Southern California Edison; Valley District (VD) = San Bernardino Valley Municipal Water District; Water Department (WD) = San Bernardino Municipal Water Department; West Valley (WV) = West Valley Water District; Western (West.) = Western Municipal Water District of Riverside County.

Table 2-2. Summary of Covered Activities with Aquatic Effects

ID (Phase)	Proposed Covered Activity	Type of Modification	Average Annual Amount[1]
EV.4.01–4.03 (1)	Sterling Natural Resource Center: Wastewater Treatment Plant	Effluent Discharge Reduction	6,733 afy/9.3 cfs/5.0 mgd reduction in flow to SAR
IEUA.1.01 (1)	Wineville Basin (2010 RMPU)	Groundwater Recharge	Increase capture by 2,960 afy/4.1 cfs/2.2 mgd (combined with IEUA.1.06 and IEUA.1.10)
IEUA.1.02 (1)	Lower Day Basin (2010 RMPU)	Groundwater Recharge	Increase capture by 993 afy/1.4 cfs/0.7 mgd
IEUA.1.03 (1)	San Sevaine Basin Cells 1–5 (2013 RMPU)	Groundwater Recharge	Increase capture by 669 afy/0.9 cfs/0.5 mgd
IEUA.1.04 (1)	Victoria Basin (2013 RMPU)	Groundwater Recharge	Increase capture by 90 afy/0.1 cfs/0.07 mgd
IEUA.1.05 (1)	Montclair Basin Cells 1–4 (2013 RMPU)	Groundwater Recharge	Increase capture by 96 afy/0.1 cfs/0.07 mgd
IEUA.1.06 (1)	Jurupa Basin (2010 RMPU)	Groundwater Recharge	Increase capture by 2,968 afy/4.1 cfs/2.2 mgd (combined with IEUA.1.01 and IEUA.1.10)
IEUA.1.07 (1)	Declez Basin (2010 RMPU)	Groundwater Recharge	Increase capture by 507 afy/0.7 cfs/0.4 mgd
IEUA.1.08 (1)	CSI Basin (2010 RMPU)	Groundwater Recharge	Increase capture by 100 afy/0.1 cfs/0.1 mgd
IEUA.1.09 (1)	Ely Basin (2010 RMPU)	Groundwater Recharge	Increase capture by 201 afy/0.3 cfs/0.2 mgd
IEUA.1.10 (1)	RP3 Basin (2010 RMPU)	Groundwater Recharge	Increase capture by 2,961 afy/4.1 cfs/2.2 mgd (combined with IEUA.1.01 and IEUA.1.06)
IEUA.1.11 (1)	Turner Basin (2010 RMPU)	Groundwater Recharge	Increase capture by 23 afy/0.03 cfs/0.02 mgd
IEUA.1.12 (1)	East Declez Basin	Groundwater Recharge	Increase capture by 414 afy/0.6 cfs/0.3 mgd
IEUA.3.01 (1)	Cucamonga Creek Dry-Weather Flow Diversion	Groundwater Recharge	Increase capture by 652 afy/0.9 cfs/0.5 mgd (combined with IEUA.3.02 and IEUA.3.06)
IEUA.3.02 (1)	Cucamonga Creek at Interstate 10 Dry-Weather Flow Diversion	Groundwater Recharge	Increase capture by 652 afy/0.9 cfs/0.5 mgd (combined with IEUA.3.01 and IEUA.3.06)
IEUA.3.03 (1)	Chino Creek at Chino Hills Parkway Dry-Weather Flow Diversion	Groundwater Recharge	Increase capture by 145 afy/0.2 cfs/0.1 mgd

ID (Phase)	Proposed Covered Activity	Type of Modification	Average Annual Amount[1]
IEUA.3.04 (1)	Day Creek at Wineville Basin Outflow Diversion	Groundwater Recharge	Increase capture by 362 afy/0.5 cfs/0.3 mgd
IEUA.3.05 (1)	San Sevaine Creek Diversion	Groundwater Recharge	Increase capture by 652 afy/0.9 cfs/0.5 mgd
IEUA.3.06 (1)	Lower Deer Creek Diversion	Groundwater Recharge	Increase capture by 579 afy/0.8 cfs/0.5 mgd (combined with IEUA.3.01 and IEUA.3.02)
IEUA.4 (1)	IEUA Regional Wastewater Treatment Expansion	Water Reuse Projects	Increase capture by 9,991 afy/13.8 cfs/7.4 mgd
Rial.1 (2)	Rialto Wastewater Diversion and Reuse Project	Discharge Reduction	Phase 1 – 1,665 afy/ 2.3 cfs/1.2 mgd Phase 2 – 1,448/2.0 cfs/ 1.1 mgd
RPU.5 (2)	Riverside North Aquifer Storage and Recovery Project	In-Stream and Off-Stream Recharge	Increase capture by 9,861 afy/13.6 cfs/8.8 mgd
RPU.8 (2)	Riverside Basin Recharge Project	Groundwater Recharge[2]	Columbia – 362 afy/ 0.5 cfs/0.3 mgd Marlborough – 290 afy/ 0.4 cfs/0.2 mgd Spring Brook – 290 afy/ 0.4 cfs/0.2 mgd Van Buren – 579 afy/ 0.8 cfs/0.5 mgd
RPU.10 (1)	Santa Ana River Sustainable Parks and Tributaries Water Reuse Project	Effluent Reduction/ Redistribution	4,995 afy/6.9 cfs/4.5 mgd
VD.2.02 (3)	Cable Creek Diversion and Basin	Groundwater Recharge	Increase capture by 2,389 afy/3.3 cfs/1.8 mgd
VD.2.03 (4)	Lytle Creek Diversion and Basin	Groundwater Recharge	Increase capture by 3,620 afy/5.0 cfs/2.7 mgd
VD.2.04 (4)	Mill Creek Diversion	Groundwater Recharge	Increase capture by 7,935 afy/11.0 cfs/7.1 mgd
VD.2.05 (4)	City Creek Diversion and Basin	Groundwater Recharge	Increase capture by 4,662 afy/6.4 cfs/3.4 mgd
VD.2.06 (2)	Plunge Creek – Basin 1	Groundwater Recharge	Increase capture by 3,113 afy/4.3 cfs/2.3 mgd
VD.2.07 (4)	Cajon-Vulcan 1 Diversion and Basin	Groundwater Recharge	Increase capture by 579 afy/0.8 cfs/0.4 mgd
VD.2.08 (4)	Vulcan 2 Diversion and Basin	Groundwater Recharge	Increase capture by 782 afy/1.1 cfs/0.6 mgd
VD.2.09 (3)	Lytle-Cajon Diversion and Basin	In-channel recharge basin	Increase capture by 1,090 afy/1.5 cfs/1.0 mgd

ID (Phase)	Proposed Covered Activity	Type of Modification	Average Annual Amount[1]
VD.2.10 (3)	Plunge Creek – Basin 2	Groundwater Recharge	Accounted for in VD.2.06
VD.2.11 (2)	Devil Creek Diversion and Basins	Groundwater Recharge	Increase capture by 2,051 afy /2.8 cfs/1.5 mgd
VD.2.12 (1)	Waterman Basin Spreading Grounds Channel Maintenance	Groundwater Recharge	Increase capture by 1,448 afy/2.0 cfs/1.1 mgd
VD.2.13 (2)	Twin Creek Spreading Grounds	Groundwater Recharge	Increase capture by 1,927 afy/2.7 cfs/1.4 mgd
VD.3 (1)	Enhanced Recharge Project – Seven Oaks Dam Water Conservation Improvements	Groundwater Recharge	Phase 1b – Increase capture by 3,692 afy/5.1 cfs/2.8 mgd
WD.1 (1, 3)	SBMWD Recycled Water Project	Effluent Discharge Reduction	Phase 1 – 9,556 afy/13.2 cfs 7.1 mgd reduction in flow from RIX to River Phase 3 – 3,620 afy/5 cfs/ 2.7 mgd reduction (minimum 16,651 afy/23 cfs/12.4 mgd discharge)
West.3 (1)	Recycled Water Live Stream Discharge	Groundwater Recharge*	6,733 afy/9.3 cfs/5.0 mgd capacity
West.6 (1)	Arlington Basin Water Quality Improvement Project	Groundwater Recharge*	1,810 – 2,534 afy/ 2.5–3.5 cfs/1.5–1.9 mgd

[1] Average annual amount is the volume of water estimated to be diverted, captured, discharged over a year in (i.e., acre-feet per year).

[2] The source of the water captured by new recharge basins is urban runoff that currently flows to Lake Evans, where it percolates and evaporates. As such, increasing capture of this water would not directly affect surface hydrology of the main stem of Santa Ana River.

afy = acre-feet per year; cfs= cubic feet per second; mgd = million gallons per day; RIX = Rapid Infiltration and Extraction facility; RMPU = Recharge Master Plan Update; RWQCP = Riverside Regional Water Quality Control Plant; SBMWD = San Bernardino Municipal Water Department.

2.1.1 Water Reuse Projects

This section describes projects related to construction of new water treatment plants and associated facilities and activities for operating and maintaining existing and new water treatment plants and associated facilities. The location of these activities is shown on Figure 2-1.

East Valley Water District Activities

Future Development Surface Water/Imported Water Treatment Plant (EV.1) – Phase 1

The Future Development Surface Water/Imported Water Treatment Plant is a new facility for which a final location has not yet been determined, as it is currently in the planning stage; however, a preliminary location has been identified: on a combination of previously disturbed lands and inactive citrus groves. New construction would include construction of the plant and conveyance pipelines within a public right-of-way (ROW) (Figure 2-2). There will be no new reduction of streamflow associated with operations for this plant.

New Construction

The water treatment plant would be located on land that was previously used as a source of impervious material for the construction of Seven Oaks Dam and on inactive citrus groves. It is possible that the plant will provide water to a development being proposed that is not covered by this HCP. The development's water supply infrastructure would be built by the developer within the project site boundaries but would then be turned over to East Valley Water District (East Valley) for long-term management.

East Valley is including the construction of pipelines needed to deliver water to the new water treatment plant. Once raw water is processed at the treatment plant, underground water pipelines will convey potable water throughout the new development and surrounding communities. The conveyance pipelines will be constructed within the public ROW. Because this project is currently pursuing its independent planning and permitting, a timeframe and expected duration for construction have not yet been determined.

Operations

These diversions under consideration are pre-existing and are thus part of the baseline conditions because the water rights and diversions have been occurring for many decades. There will be no new reduction of streamflow as part of this Covered Activity.

East Valley will supply domestic (potable) water to the future development area within the eastern limits of the East Valley service area. There are no existing East Valley facilities adjacent to the future development project, which will have an expected average water demand of approximately 3.15 cubic feet per second (cfs) (1.7 million gallons per day [mgd]) for domestic water and 1.82 cfs (1.0 mgd) for irrigation water, for a total of 5.0 cfs (2.7 mgd). Potable water will be supplied to the development by combination of sources that include (1) an extension of existing East Valley facilities located in Greenspot Road; (2) optional treatment of imported (State Water Project [SWP]) raw water from the San Bernardino Valley Municipal Water District (Valley District); and (3) treatment of raw water from the North Fork Pipeline based on existing water rights and diversions. Onsite water supply, system hydraulics, and facility planning are based on a conceptual plan. There are existing East Valley water facilities capable of providing service to the future development approximately 3 miles west at the Intersection of Greenspot Road and Santa Paula Street. According to East Valley infrastructure standards based on the size of development, the future development is projected to require 4.5 million gallons of storage, 4,900 gallons per minute pumping capacity, and transmission water mains ranging in size from 8 to 24 inches.

Maintenance

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Sterling Natural Resource Center (EV.4)

The proposed Sterling Natural Resource Center (SNRC) would include a new wastewater treatment facility, treated water conveyance system, and reuse of defunct recharge basins. The SNRC would treat wastewater generated within the East Valley service area, which is entirely within the Valley District wholesale water agency service area. Currently, East Valley conveys its waste to the City of San Bernardino for secondary treatment at the San Bernardino Water Reclamation Plant and for tertiary treatment at the Rapid Infiltration and Extraction (RIX) facility, and from City Creek to

Redlands Basins. Water discharged into either of these two locations would recharge the local groundwater basin.

Construction and operational impacts of this project have been covered through Section 7 in a Biological Opinion signed by the U.S. Fish and Wildlife Service (USFWS) on March 9, 2017.[1] Conservation Measures included in the Biological Opinion are intended to be implemented, monitored, and managed by the HCP and therefore have been included herein, however, take coverage for long-term monitoring and management of the conservation measures has been covered in the Biological Opinion should the HCP not be completed prior to the SNRC project being completed. This HCP will only cover operations and maintenance associated with the pipelines, as described below.

Sterling Natural Resource Center: Wastewater Treatment Plant (EV.4.01) – Phase 1

The plant is located within three municipalities: City of Highland, City of San Bernardino, and City of Redlands (Figure 2-2). Portions of the treated water conveyance pipelines for the City Creek and Redlands Basins alternatives would also traverse unincorporated areas within the County of San Bernardino.

The SNRC would produce tertiary-treated water for reuse. A conveyance system including a pumping station and pipeline would be constructed to convey treated water from the SNRC to discharge locations in City Creek and/or the Redlands Basins.

The SNRC would provide tertiary treatment of wastewater generated within the East Valley service area. The SNRC would have a maximum capacity of 10–12 mgd and produce tertiary-treated water in compliance with California Code of Regulations Title 22 recycled water quality requirements for unrestricted use. Refer to Table 2-2 for the average annual hydrological changes anticipated from this Covered Activity.

Sterling Natural Resource Center: Treated Water Conveyance System (EV.4.02) – Phase 1

A treated water conveyance system is required to convey tertiary effluent from the SNRC wastewater treatment plant to the Redlands Basins for groundwater recharge and to City Creek (Figure 2-2). The system requires 18,000 linear feet of up to a 24-inch-diameter pipeline. A 24-inch-diameter conveyance pipeline would be installed within the existing ROW of East 6th Street (or a parallel street) from the SNRC property for approximately 3 miles to Alabama Street. The pipeline would run south on Alabama Street from East 6th Street for approximately 1.3 miles before crossing the Santa Ana River within an existing conduit attached to the Alabama Street Bridge. Valley District owns an existing 30-inch-diameter pipe within the bridge deck, and the existing pipeline would act as a casing for the proposed 24-inch pipeline. No trenching within sensitive habitat will be necessary when crossing the Santa Ana River. Additional conveyance pipelines would also be installed to convey treated water for discharge into City Creek. From 6th Street, the pipeline would continue within the City Creek levee or through other public ROWs north for approximately 2,500 feet where a discharge structure would be constructed. The tertiary-treated water would be discharged to City Creek. City Creek is currently an ephemeral creek at this location, with no perennial flows.

[1] Biological Opinion_16BO0182-17F0387_BO_Sterling Natural Resource Center

Various collection system improvements are required within the service area in order to convey flows to the SNRC. The new facilities would include at least two sewer lift stations and associated force mains as well as several sewer trunk improvements within city streets.

Sterling Natural Resource Center: Redlands Recharge Basin (EV.4.03) – Phase 1

A discharge structure would be constructed at the Redlands Basins to convey flows from the proposed conveyance pipeline described above (EV.4.02) into multiple basins (Figure 2-2). The discharge structure would be partially buried. with a less than 30- by 30-foot permanent footprint. Alternatively, a pipeline manifold would be installed in the basin with multiple valves at a predetermined spacing that can be opened or closed at different times based on the incoming flow. Construction and operation of the Sterling Natural Resource Center is covered by a Section 7 permit (USFWS 2017).

Maintenance

Future maintenance work will occur annually and will include the plant, pipelines, pumps, and associated infrastructure. See Section 2.1.6 for a discussion of general O&M activities at East Valley's existing or planned facilities.

Inland Empire Utilities Agency Activities

Inland Empire Utilities Agency Recycled Water Project (IEUA.4)

This project will be implemented to increase the reuse of local recycled water within the Inland Empire Utilities Agency's (IEUA's) service area (Figure 2-2). This project involves maximizing the reuse of 9,991 acre-feet per year (afy)/13.8 cfs/7.4 mgd of effluent flow discharges from IEUA's regional water recycling plants (RWRPs), which would be diverted from the current effluent discharge and directed to groundwater recharge. Since 1972, IEUA has operated RWRPs to produce recycled water that meets Title 22 standards for indirect reuse, groundwater recharge, and local discharge.

New Construction

There is no construction associated with this project that will be covered by this HCP.

Operations

Effluent flow discharges from the RWRPs would be reduced at four discharge points during the cooler shoulder and winter months (November to March). Discharge reduction would take place at Prado Lake near the Prado Park Equestrian Center, on Cucamonga Creek at Highway 60, and at two locations on Chino Creek near Fairfield Ranch Park and near the crossing of Chino Hills Parkway. This reduction of up to a maximum of 13.8 cfs (7.4 mgd) would be allocated to groundwater recharge. Summer flows would remain at current levels.

Maintenance

There is no maintenance associated with this project. The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

City of Rialto Public Works Activities

Rialto Wastewater Diversion and Reuse Project (Rial.1) – Phase 2

The City of Rialto Public Works (Rialto) plans to reduce the amount of treated effluent that is discharged from the Rialto Wastewater Treatment Plant into the Rialto Channel, which is a tributary to the Santa Ana River (Figure 2-2). The reduction of flow would occur in two parts as infrastructure is constructed, demand for recycled water increases, and certain habitat modifications are implemented within the Rialto Channel. The City of Rialto would recycle/reuse the wastewater by transporting treated wastewater through a pipeline system to recycled water consumers within their service area for direct application.

New Construction

Capital improvements may be required depending on demand for recycled water. Improvements would include construction of the pipeline infrastructure necessary to transport the recycled water from the facility to the customers. Pipelines would be constructed within existing public roadway ROW.

Operations

The average discharge of the Rialto Wastewater Treatment Plant to Rialto Channel is approximately 6,733 afy/9.3 cfs/6.0 mgd, with a maximum capacity of 12,742 afy/17.6 cfs/11.7 mgd. Seasonal changes to the amount of water discharged are due to periodic rain events adding to the flow in the channel. The planned reuse of the effluent is meant to help Rialto comply with potential mandates for recycled water and to implement the City of Rialto's Recycled Water Master Plan.

Part 1 of the project would reduce the current wastewater discharge by about 25%, or an annual average of 1,665 afy/2.3 cfs/1.2 mgd. A potential Part 2 could reduce flow by an additional 1,448 afy/2 cfs/1.1 mgd (Table 2-2) (for a total reduction of 3,113 afy/4.3 cfs/2.3 mgd). However, Part 2 reduction would be dependent upon a collaborative project between the San Bernardino County Flood Control District (SBCFCD) (owner of Rialto Channel) and the City of Rialto. In order for Rialto to meet its objective of securing additional wastewater for a recycle/reuse projects and for SBCFCD to meet its objective of expanding the width of Rialto Channel it will be necessary to cooperate on a Rialto Channel improvement design that protects key habitat criteria for Santa Ana sucker such as depth, velocity, temperature, and suitable substrate and other criteria developed in the future that are determined important for aquatic species. In order for Rialto to reduce discharge from 6,733 afy/9.3 cfs/5.0 mgd to 3,620 afy/5 cfs/2.7 mgd or to 54% of the baseline flow, the two agencies and the HCP would cooperatively develop a project to constrict effluent baseflow to a confined inset channel located within an expanded Rialto Channel footprint. By confining the baseflow to a narrower, meandering inset channel the velocity and substrate availability would improve for sucker and the improved hydrology would eliminate habitat suitability for nonnative predators. The Part 2 reduction would be contingent upon USFWS and California Department of Fish and Wildlife (CDFW) (the Wildlife Agencies) approval of a Rialto Channel design and implementation of modifications benefitting native fishes and protecting riparian vegetation and covered avian species prior to reduction of discharge into Rialto Channel.

Maintenance

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Riverside Public Utilities Activities

North Waterman Treatment Plant (RPU.9) – Phase 1

The North Waterman Treatment Plant is a 2.5-acre water treatment plant to potentially be constructed at Riverside Public Utilities' (RPU's) Cooley property (Figure 2-3). In addition to construction, there would also be ongoing maintenance of access roads, vegetation and vector control, and preventative maintenance and repair.

New Construction

The project proposes to construct a 2.5-acre water treatment plant at either RPU's Cooley property (18 acres) or Garner property (25 acres). For the purposes of analyzing the project in the HCP, the project is assumed to be located on the Cooley site. Both sites are cleared regularly for weed abatement as described in RPU.12; therefore, construction of the treatment plant at either site would have roughly the same residual impact. The treatment plant will consist of clearing and grubbing the site, grading and compacting the soil, and installing above and below ground equipment. Construction is anticipated to last up to 6 months. Some releases of water may occur during startup O&M.

Maintenance

Ongoing activities for this plant will entail maintenance of access roads, releases of water (confined to the site) for inspections and preventative maintenance, and excavations for preventative maintenance and repair. Maintenance activities may include vegetation and vector control. See Section 2.1.6 for general O&M activities conducted by the RPU for their existing or planned facilities.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.82.1.6,.

San Bernardino Municipal Water Department Activities

SBMWD Recycled Water Project (WD.1) – Phase 1, Phase 3

The City of San Bernardino Municipal Water Department (Water Department) plans to develop a recycled water project that would permanently reduce the amount of treated effluent discharged from the Water Department's RIX facility into the Santa Ana River (Figure 2-3). This project would include construction of pipeline infrastructure. The proposed effluent discharge reduction would occur in two parts corresponding to Phases 1 and 3 of the HCP implementation (Table 2-2). In Phase 1 the Water Department will reduce flows from the RIX facility to the Santa Ana River from the baseline of 41.2 cfs (22.2 mgd) to 28 cfs (15.1 mgd). In Phase 3 of RIX, effluent reduction could occur if the HCP demonstrates that the success criteria for mitigation actions in this HCP for Santa Ana sucker are being met or exceeded. If the success criteria are not met until Phase 4, then implementation would be delayed until Phase 4 of the HCP. In this phase the RIX effluent discharge could be reduced to a minimum of 16,651 afy/23 cfs/12.4 mgd (Table 2-2).

New Construction

Capital improvements may be required for this project depending on demand for recycled water. Improvements would include construction of the pipeline infrastructure necessary to transport the recycled water from the facility to customers. Pipelines may be constructed within existing public roadway ROW.

Operations

The Phase 1 portion of the Water Department's recycled water project will reduce discharge into the Santa Ana River by approximately 9,556 afy/13.2 cfs/7.1 mgd, from 29,828 afy/41.2 cfs/22.1 mgd to 20,271 afy/28 cfs/15.1 mgd. A commitment will be made by the Water Department to provide 20,271 afy/28 cfs/15.1 mgd of discharge to the river for habitat and downstream benefits on behalf of the HCP. As mentioned above, a future part of the project (in Phase 3 or 4 of the HCP) could take place that would reduce discharge into the river by an additional 3,620 afy/5 cfs/2.7 mgd, to 16,651 afy/23 cfs/12.4 mgd; however, this is dependent upon the HCP meeting or exceeding USFWS-approved success criteria for adult suitable habitat availability.

Maintenance

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Western Municipal Water District of Riverside County Activities

Stormwater Channel and Recycled Water Impoundment Upgrades to Western Water Recycling Facility (West.5) – Phase 1

These upgrades are proposed for the Western Water Recycling Facility and would include bank stabilization with rip-rap to improve drainage (Figure 2-3). Pipelines, pumps, and values would provide recycled water to the impoundment during operations, and regular maintenance would include periodic cleaning to remove accumulated sediment, bank repair, and vegetation and vector control.

New Construction

This project will consist of upgrades to the stormwater channel that crosses the Western Water Recycling Facility (WWRF) site to minimize erosion and sediment transport and ensure spills at the treatment plant do not enter the drainage). Upgrades to the recycled water impoundment may include bank stabilization with non-grouted rip-rap and improved drainage throughout the property. The proposed location is the WWRF site at 22751 Nandina Avenue, Riverside, California 92518.

Construction of the upgrades would be scheduled in the late spring through fall to avoid wet weather delays. Construction activities are expected be completed within weeks or a month. Once constructed, the upgrades would not increase any discharges from the WWRF.

Operations

Operation of the project would consist of the use of pipelines, pumps, and valves to provide recycled water to the impoundment.

Maintenance

Maintenance activities for these recharge basins will consist of periodic cleaning to remove accumulated sediment, bank repair, and vegetation and vector control. Excavations may also be required for preventative maintenance and repair. Maintenance activities will likely be scheduled during dry seasons to minimize impacts. Repair could occur during wet seasons. See Section 2.1.6 for general operations and maintenance activities conducted by the Western Municipal Water District of Riverside County(Western) for their existing or planned facilities as well as general O&M activities common to most of the Permittee Agencies.

West Valley Water District Activities

Lord Ranch Facility (WV.4) – Phase 1

This facility is on the east side of Pepper Avenue, north of Winchester Avenue and south of Interstate (I-) 210 in the City of Rialto (Figure 2-3). Construction would include a new booster pump station, a 1.0-million-gallon aeration reservoir, an arsenic treatment plant, new site fencing and pipeline installation, grading, and paving. The project also includes construction of a retaining wall to raise an existing well on site. Maintenance includes weed abatement, vegetation removal from slopes, berm repair, rodent control, bottom scarification, and facility maintenance.

New Construction

The site contains two separate parcels. West Valley Water District (West Valley) is planning to expand facilities at this site which will include a new booster pump station, a 1.0 million gallon aeration reservoir, an arsenic treatment plant, new site fencing along with associated pipeline installation, grading and paving. The proposed arsenic treatment plant will treat water pumped from three existing wells on the site through existing and new pipelines before entering the reservoir. This project is anticipated to be constructed prior to the HCP, and coverage is being sought only for maintenance activities.

West Valley is planning to raise the existing well #36 at the site by construction of a retaining wall to allow the raising of the current grade and fencing.

Maintenance

Existing facilities on site include three groundwater wells, a 1.0-million-gallon aeration tank, a booster pump station, and pipelines connecting the facilities. Pipelines leaving the facility connect to West Valley's distribution system. Existing facilities will continue to be maintained by West Valley.

There is an existing earthen basin on the northeast corner of the property that has been at this location for over 50 years and is maintained by West Valley staff. Maintenance activities for the basin include weed abatement, vegetation removal from slopes, berm repair, rodent control, and bottom scarification. Maintenance activities will occur approximately twice a year in the summer and fall.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

2.1.2 Groundwater Recharge

This section describes projects related to construction of new structures that divert stream or channel flow, activities to operate and maintain existing and new diversion structures, and activities related to construction of new recharge basins and O&M of existing and new recharge basins. The locations of these activities are illustrated on Figure 2-4.

San Bernardino Valley Water Conservation District

Mill Creek Diversion Maintenance (CD.1) – Phase 1

Mill Creek is approximately 3.0 miles south of Seven Oaks Dam and confluences with the Santa Ana River approximately 2 miles southwest of the dam. The existing Mill Creek diversion system consists of three locations that include the main diversion structure, two intake structures, and canals that connect all three locations. These locations are points where storm flow or imported water flow is routed from within the natural Mill Creek channel to downstream facilities outside of Mill Creek (Figure 2-5). Starting at the upstream end of the system, storm flow within Mill Creek is directed to the diversion structure using a series of earthen berms. These berms are referred to as *soft plugs,* and they are constructed to direct low flows into the diversion system while not impacting peak storm conditions.

Flow is conveyed by way of a channel to the diversion structure that diverts flow from Mill Creek into a concrete diversion canal. The diversion structure consists of four gates: one to direct water toward the intake structure, and three to return water back to Mill Creek's natural river channel. When the three return gates are open and the intake gate is closed the structure directs water back to Mill Creek's natural river channel. When the three return gates are closed and the intake gate is open, water is directed towards the additional downstream intake structures and basins.

Downstream of the diversion structure is a secondary structure: the main intake. The main intake structure consists of three gates, a weir for flow measurement, and a catwalk structure. This structure is approximately 200 feet downstream of the main diversion structure and functions to direct water (1) to the upper basins through the south canal, (2) into the lower basins through the North Canal, or (3) to return flows back to the Mill Creek natural channel. The third gate structure location, referred to as the North Canal intake, is downstream of the main intake structure within Mill Creek. This structure is approximately 3,800 feet downstream of the diversion structure and 1,100 feet downstream of Garnet Street. When open, it allows water to pass underneath the Mill Creek levee system and into the lower basins, when closed flows return to the Mill Creek natural river channel.

These three locations of gated structures provide operational flexibility to maximize infiltration of the diverted water into a system of basins used for groundwater recharge. A project is underway to improve the diversion structure (and initial point of diversion), which will allow for the protection of the structure from washout due to debris-laden flows.

Maintenance

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6. The maintenance activities specific to the Mill Creek Diversion are described below.

Mill Creek Soft Plugs

The Conservation District maintains four low (24-inch maximum) sand and gravel earthen berms (soft plugs)—three to direct flow from Mill Creek to the diversion structure and one to direct flow to the North Canal intake structure. The soft plugs direct flows to an earthen channel that leads to the diversion structure (described above) that functions to divert water into the District's recharge basins or back into Mill Creek's natural channel. The soft plugs are composed of native material designed to naturally erode at higher flows. As flows increase, the soft plugs begin to deteriorate and break apart at approximately 400 cfs (215 mgd), a function that helps to reduce debris damage at the diversion structure following inundation and damage from high flow rates. Once the soft plugs are completely disintegrated, all flow remains within the Mill Creek natural channel.

To rebuild and maintain these soft plugs, bulldozers access the diversion channel and proceed upstream of the diversion structure as frequently as annually but more commonly every 3 to 5 years, dependent on Mill Creek flow conditions. The entrance of the main access road to the soft plug maintenance area is to the east of Garnet Street. Activities may also include rebuilding and maintaining the soft plugs, which could include disturbance to gather the sand and gravel materials that are needed. Soft plug maintenance includes patch repair of erosional features and would result in up to two re-creations per soft plug per year. Existing roads and reestablished roads would be used to the extent possible.

Mill Creek Diversion and Intake Structures

The Mill Creek diversion and intake structure maintenance area includes areas upstream and downstream of the diversion and intake structures. Maintenance of the diversion and intake structure includes the upkeep of the structures and gates, levee replacement, large debris and vegetation removal within the existing channel, removal of sediment from the concrete apron at the gates, and grading to reestablish access roads after storm events.

The diversion and intake structures typically consist of concrete or cement block with wooden gates and associated structures and hardware. Maintenance includes cleaning and greasing the gates on an annual basis or more frequent basis depending on storms.

The North Canal intake is maintained less frequently than the intake or main diversion structure. Maintenance activities are similar to those described above and are assumed to occur every 5 years on average.

The diversion structure is typically maintained frequently. Levees may need to be replaced occasionally when they are washed out, which is assumed to happen on average every 2.5 years. Other routine maintenance occurs annually.

Mill Creek Diversion Channels

The diversion channels that connect the three described structures are inspected throughout the year, and maintenance is conducted on an as-needed basis, or as often as annually. Ongoing maintenance activities include clearing encroaching vegetation, debris, and/or sediment removal, as well as structural repairs. Repair of the conveyance channel between the soft plugs and the diversion structure and the channel between the main intake structure and the North Canal intake structure may be necessary due to erosion or washout of the channel side slopes. Repair is typically accomplished by filling in the eroded area with native material. Grouted rock is only used in those areas that already had grouted rock or concrete prior to the damage occurring. The conveyance

channel can also be used to provide access for heavy equipment (i.e., bulldozer) for channel repair and vegetation/debris management.

Vegetation control occurs annually, removal of sediment occurs every 2 years, and all other activities occur infrequently, or as necessary. Most portions of the conveyance channel can be accessed from existing unpaved access roads, but some walking and equipment movement through unmaintained areas may be required.

Mill Creek Diversion Access Road

The existing access road is graded dirt, and runs between Garnet Street and the main diversion structure. The access road is near the flood wall slope protection and is outside of the wetted area of typical storm flows. It is utilized to access the main intake and diversion structure for maintenance activities. The access road is infrequently maintained, but may require occasional new grading as well as vegetation control as needed (e.g., after storm events).

Santa Ana Levee and Cuttle Weir Diversion (CD.2) – Phase 1

The Santa Ana levee and cuttle weir diversion structure is just downstream of the Seven Oaks Dam (Figure 2-5). Associated activities include maintenance of the cuttle weir, diversion structure, and Greenspot Road canal.

Maintenance

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6. The maintenance activities described below are specific to this Covered Activity.

Cuttle Weir and Diversion Structure

Maintenance of the Cuttle Weir and diversion structure, located just downstream of the Seven Oaks Dam, includes regular mechanical maintenance of the diversion structure and gates, vegetation management, streambed recontouring, and levee maintenance. Streambed recontouring requires removal of vegetation, large boulders, and rock and debris that inhibit flow. Excess vegetation is removed because it damages the capacity of the channel or basin. Nonnative invasive species such as salt cedar (*Tamarix ramosissima*), castor bean (*Ricinus communis*), and giant cane (*Arundo donax*) will be removed and treated to prevent re-establishment. These plants are cut down to a stump, and an herbicide[2] designed for aquatic environments is applied to the stump. If necessary, native vegetation may be cut and removed to protect the diversion structure, although this will be minimized, if possible. Vegetation is removed using hand tools and hauled from the site via truck. Vegetation management typically occurs annually in the late spring in order to maximize the removal of accumulated debris from the preceding storm season.

Levee maintenance and recontouring would occur approximately every 3 years in the spring. It requires the use of mechanical equipment within the riverbed, with access occurring from existing paved and non-paved roads. Maintenance on diversion structures would take place on an as-needed basis at no specific time during the year.

[2] Activities associated with the application of herbicide that may result in take of a Covered Species (e.g., the operation of an all-terrain vehicle in San Bernardino kangaroo rat habitat resulting in the collapse of a burrow) are covered by the HCP. Applicators must use pesticides according to the label. This includes limits on applications to avoid impacts on wildlife. This HCP does not cover take from herbicide or pesticide use.

The Conservation District is seeking coverage for routine maintenance associated with ensuring that debris and vegetation do not obstruct the flow path of the water. See Section 2.1.6 for general O&M activities conducted by the Conservation District for their existing or planned facilities. Planned improvements that increase capacity to divert up to 500 cfs (270 mgd) at the Cuttle Weir (from current capacity of 300 cfs [161.5 mgd]) is described in the Valley District's Covered Activities for this HCP.

Cuttle-Weir – Greenspot Road Canal

The Conservation District canal that extends between the Cuttle Weir and Greenspot Road is a natural earth and rock surface. The canal fills with sediment that periodically requires removal. Maintenance would include removing sediment and possibly some portion of vegetation.

Inland Empire Utilities Agency Activities

Wineville Basin (2010 RMPU) (IEUA.1.01) – Phase 2

This proposed construction project will convert the existing Wineville Basin to also function as a groundwater recharge basin. The Wineville Basin is east of I-15 and south of Jurupa Street in the City of Ontario (Figure 2-5).

New Construction

The basin bottom will be cleared of vegetation and a soil layer may be cleared in order to enhance infiltration. Basin bottom soils may also be configured to create earthen berms in order to compartmentalize activities such as infiltration or maintenance. Vegetation on the existing basin slopes would be removed and slopes may be reinforced.

Additional improvements to this basin include constructing a dam with a pneumatic gate on the low-level outlet and raising the existing maximum storage elevation of the basin by approximately 9 feet (from 869 feet to 878 feet). A small permanent footprint for construction of the dam and pneumatic gate will be required. Staging areas and access roads will be strategically planned to utilize disturbed areas of the basin where no habitat values currently exist for Delhi Sands flower loving fly or other species. Construction of the dam and pneumatic gate is not yet scheduled, as this project is still being conceptually developed.

Operations

Stormwater recharge would increase by an annual average of 2,960 afy/4.1 cfs/2.2 mgd (Table 2-2) from the current incidental value of 296 afy to a total of 3,256 afy/4.5 cfs/2.4 mgd. The yield of the Wineville Basin is combined with the yields of Jurupa Basin (IEUA.1.06) and the RP3 Basin Habitat Mitigation Area (IEUA.1.13). The Wineville Basin is in line with Day Creek and the Santa Ana River. Stormwater will be captured in the basin up to 3,256 afy/4.5 cfs/2.4 mgd, and excess will flow in Day Creek. The final design would be expected to capture 100% of storm flows during low and average storm events. In a large storm event the first flushing flow would be allowed to pass in order to minimize debris captured in the basin and minimize maintenance needs. Stormwater recharge at this facility would be dependent on when storm events occur, which can vary from year to year. However, the majority of stormwater recharge would occur between October and April.

Maintenance

Maintenance of Wineville Basin specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the bottom and sides of the basin. See Section 2.1.6 for general O&M activities for basins conducted by IEUA for their existing or planned facilities.

Lower Day Basin (2010 RMPU) (IEUA.1.02) – Phase 2

Currently Lower Day Basin is used as a water recharge facility. Lower Day Basin is south of I-210, north of Victoria Park Lane, and east of Rochester Avenue in the City of Rancho Cucamonga. Day Creek flows into the basin from the north. The terminus of this drainage is Santa Ana River at the Goose Creek Golf Club (Figure 2-5).

New Construction

In order to enhance the basin's recharge capacity a secondary diversion structure will be constructed downstream of the current rubber dam diversion to capture water that over flows the rubber dam (currently occurs at greater than 18,111 afy/25 cfs/13.5 mgd).

Additionally, the current rubber dam will be improved so it may remain inflated during high storm events (72,445 afy/>100 cfs/53.8 mgd). Current capacity is limited to less than 72,4445 afy/<100 cfs/53.8 mgd flows to maintain structural integrity. The eastern embankment will be reconstructed with earthen materials, and the mid-level outlet at the southeast corner of the basin will be eliminated so that the capacity of the basin for water recharge would be increased as it will be able to hold a greater volume of water.

The project would raise the existing maximum storage elevation of the basin by 16 feet (from a 1,382-foot contour elevation to a 1,398-foot elevation) with an additional storage volume of 163 acre-feet.

Operations

It is estimated that stormwater recharge would increase by an annual average of 993 afy/1.4 cfs/ 0.7 mgd (Table 2-2) from the current baseline value (395 afy/0.6 cfs/0.3 mgd) to a total of 1,388 afy/1.9 cfs/1.0 mgd. Stormwater recharge at this facility would be dependent on when storm events occur, which can be variable from year to year. However, the majority of stormwater recharge would occur from October to April. State water could be used in the future at this recharge facility as it is made available.

Maintenance

Currently, SBCFCD and IEUA are responsible for maintenance of Lower Day Basin for flood protection and water recharge. Maintenance specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities as well as the general O&M activities common to most of the Permittee Agencies.

San Sevaine Basin Cells 1–5 (2013 RMPU) (IEUA.1.03) – Phase 2

Currently San Sevaine Basins 1–5 are used as a water recharge facility operated for recharge by IEUA and will need construction of a conveyance pipeline, inlet structure, and an internal berm. San Sevaine Basin is north of I-210 and east of I-15 and Cherry Avenue. San Sevaine Creek and Etiwanda

Channel flow into the basin from the north, and its downstream tributary is San Sevaine Creek (Figure 2-5).

New Construction

A temporary construction footprint will be necessary to construct the conveyance pipeline from basin 5 to the upstream basins. A portion of this temporary construction area is located within existing disturbed maintenance areas, and the remainder falls outside of the currently permitted maintenance area. Basins 1–3 will include construction of an inlet structure. An internal berm will also be constructed in Basin 5.

Basin 3 has very high percolation rates, while Basin 5 is much slower. To maximize the recharge capabilities a pump station will be constructed to pump excess water from Basin 5 back up to Basins 1, 2, or 3 for percolation. A permanent construction footprint for the pump station would be required. Staging areas and access roads will be strategically planned to utilize existing disturbed areas of the basin.

For Basin Cells 1–5, the basin bottom will be cleared of vegetation and a soil layer may be cleared in order to enhance infiltration. Basin bottom soils may also be configured to create earthen berms in order to compartmentalize activities such as infiltration or maintenance. Vegetation on the existing basin slopes would be removed, and some reinforcement of the slopes may be required to meet flood protection requirements.

Operations

It is estimated that stormwater recharge would increase by an annual average of 669 afy/0.9 cfs/ 0.5 mgd (Table 2-2) from the current baseline value (3,975 afy/5.5 cfs/3.0 mgd) to a total of 4,644 afy/6.4 cfs/3.5 mgd. The San Sevaine Basin Cells 1–5 are in line with San Sevaine Creek. Stormwater will be captured in the basin at 4,644 afy/6.4 cfs/3.5 mgd, and excess will flow in the San Sevaine Creek.

Stormwater recharge at this facility would be dependent on when storm events occur, which can be variable from year to year. However, the majority of stormwater recharge would occur from October through April. State water could be used in the future at this recharge facility as it is made available.

Maintenance

Maintenance of the basin would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities

Victoria Basin (2013 RMPU) (IEUA.1.04) – Phase 1

Victoria Basin is currently used as a water recharge facility. Victoria Basin is northwest of I-15 and north of Victoria Street in the City of Rancho Cucamonga. Etiwanda Creek Channel and the San Sevaine Channel flow into the basin from the north. The terminus of this drainage is the San Sevaine Channel (Figure 2-5).

New Construction

The proposed project will improve the recharge capabilities of the existing Victoria basin (owned by SBCFCD) by abandoning the mid-level outlet that allows flows to the San Sevaine Channel. By

blocking the outlet and extending the existing lysimeter stations, the capacity of the basin for water recharge would be increased as it will be able to hold a greater volume of water.

Additional construction activities would include blocking the mid-level outlet that will occur within the already disturbed, currently permitted maintenance area. The existing lysimeter stations would also need to be extended. Staging areas and access roads will be strategically planned to utilize existing disturbed areas of the basin.

The basin bottom will be cleared of vegetation, and a soil layer may be cleared in order to enhance infiltration. Basin bottom soils may also be configured to create earthen berms in order to compartmentalize activities such as infiltration or maintenance. Vegetation on the existing basin slopes would be removed and some reinforcement of the slopes may be required.

Operations

It is estimated that stormwater recharge would increase by an annual average of 90 afy/0.1 cfs/ 0.07 mgd (Table 2-2) from the current baseline value (439 afy/0.6 cfs/0.3 mgd) to a total of 529 afy/0.7 cfs/0.4 mgd. The new recharge capacity is expected to only be realized in high flow storms/years. This design is expected to capture 100% of storm flows during low and average storm events. Stormwater recharge at this facility would be dependent on when storm events occur, which can be variable from year to year. However, the majority of stormwater recharge would occur from October to April. State water could be used at this recharge facility in the future as it is made available.

Maintenance

Maintenance specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities as well as the general O&M activities common to most of the Permittee Agencies.

Montclair Basin Cells 1–4 (2013 RMPU) (IEUA.1.05) – Phase 1

This project includes modifying the Montclair Basin Cells 1–4 to enhance their groundwater recharge capacity. Currently the Montclair Basins are owned by the Chino Basin Water Conservation District, which IEUA operates as recharge basins. The Montclair Basins are north and south of I-10, west of Monte Vista Avenue, in the City of Montclair (Figure 2-6). San Antonio Creek flows into Montclair basins from the north, where flow is regulated by U.S. Army Corps of Engineers (USACE) operation of the San Antonio Dam. This drainage is a tributary to Chino Creek, with a terminus at the Santa Ana River near Prado Dam.

New Construction

Construction activities for the Montclair Basin Cells 1–4 would enhance the basin's recharge capacity. Low level drains will be constructed from Basins 1 to 2 and from Basins 2 to 3. Basin 4 may be deepened. New drop inlet structures to Basins 2 and 3 will be constructed, and an automated inlet will be constructed to Basin 1. Temporary staging areas would be needed for these new structures. These improvements will allow for a more efficient transfer of water between recharge basins, which would be especially important when imported water is available for recharge.

Operations

It is estimated that stormwater recharge would increase by an annual average of 96 afy/0.1 cfs/ 0.07 mgd (Table 2-2) from the current baseline value (1,188 afy/1.64 cfs/0.09 mgd) to a total of 1,284 afy/1.7 cfs/1.0 mgd. Stormwater recharge at this facility would be dependent on storm events, which can be variable from year to year, as well as on the release schedule from San Antonio Dam. However, the majority of stormwater recharge would occur from October through April. State water would be used at this recharge facility as it is made available.

Maintenance

Currently, IEUA is responsible for maintenance of the Montclair Basins for water recharge. Maintenance specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities as well as general O&M activities common to most of the Permittee Agencies.

Jurupa Basin (2010 RMPU) (IEUA.1.06) – Phase 1

The Jurupa Basin currently functions as a reservoir and will be expanded to become a recharge basin. Jurupa Basin is south of I-10, north of Jurupa Avenue, and east of Etiwanda Avenue in the City of Fontana (Figure 2-6). San Sevaine Channel can be diverted into the basin from the north, and its downstream tributary is San Sevaine Channel.

New Construction

The Jurupa Basin improvements involve expanding the capacities of an existing diversion from San Sevaine Creek and an existing pump station that is used to convey stormwater from the Jurupa Basin to the RP3 Basins from 14,429 afy/20 cfs/10.8 mgd to 28,979 afy/40 cfs/21.5 mgd. All new construction will occur within the existing pump station and on the concrete wall. Refer to Table 2-2 for the average annual hydrological change associated with this Covered Activity.

Operations

The yield of the Jurupa Basin is combined with the yields of Wineville Basin (IEUA.1.01) and the RP3 Basin Habitat Mitigation Area (IEUA.1.13). Stormwater recharge at this facility would be dependent on when storm events occur, which can vary from year to year. However, the majority of stormwater recharge would occur from October through April. State water could be used in the future at this recharge facility as it is made available.

Maintenance

Currently, SBCFCD and IEUA are responsible for maintenance for flood protection and water recharge. Maintenance specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities as well as general O&M activities common to most of the Permittee Agencies.

Declez Basin (2010 RMPU) (IEUA.1.07) – Phase 1

Currently Declez Basin is used as a water recharge facility operated for recharge by IEUA. Declez Basin is north of I-60, north of the Jurupa Mountains, and east of Country Village Road in the City of Fontana (Figure 2-6).

New Construction

The Declez Basin project improvements include replacing the existing embankment with a dam and installing a gate on the low level outlet.

Operations

Stormwater recharge at this facility would be dependent on when storm events occur, which can vary from year to year. However, the majority of stormwater recharge would occur from October through April. Improvements to Declez Basin will increase the useable storage of the basin to 541 acre-feet and will increase the stormwater recharge by an annual average of 507 afy/0.7 cfs/ 0.4 mgd (Table 2-2). State water could be used in the future at this recharge facility as it is made available.

Maintenance

Currently, SBCFCD and IEUA are responsible for maintenance for flood protection and water recharge. Maintenance specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities as well as general O&M activities common to most of the Permittee Agencies.

CSI Basin (2010 RMPU) (IEUA.1.08) – Phase 1

Currently CSI Basin is used as water recharge facility operated for recharge by IEUA. CSI Basin is north of I-10 and east of I-15, north of the Jurupa Hills, and south of the Auto Club Speedway (Figure 2-6).

New Construction

The CSI Basin project involves deepening the existing basin by 10 feet while maintaining the existing diversion, outlet, and spillway. The excavation will take place within the existing basin floor. Activities include deepening the existing basin and maintaining the existing diversion, outlet, and spillway. The stormwater recharge in this project comes from a drainage area north of the CSI Basin, east of the San Sevaine Channel, south of the Auto Club Speedway, and west of Cherry Avenue. If not recharged in the CSI Basin, the stormwater would flow through various human-made channels and eventually discharge into San Sevaine Creek.

Operations

Stormwater recharge at this facility would be dependent on when storm events occur, which can be variable from year to year. However, the majority of stormwater recharge would occur from October through April and increase the useable storage of the basin to 47 acre-feet and increase stormwater recharge by an annual average of 100 afy/0.1 cfs/0.1 mgd (Table 2-2). State water could be used in the future at this recharge facility as it is made available.

Maintenance

CSI Basin is not currently operated or maintained by IEUA. Maintenance specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities as well as general O&M activities common to most of the Permittee Agencies.

Ely Basin (2010 RMPU) (IEUA.1.09) – Phase 1

Currently Ely Basin is used as a water recharge facility operated for recharge by IEUA. Ely Basin is north of I-60, west of Vineyard Avenue, and east of Archibald Avenue in the City of Ontario (Figure 2-6). West Cucamonga Creek flows into the basin for the north. The terminus of this drainage is Santa Ana River.

New Construction

The Ely Basin improvements include excavating the basin and increasing its drainage area. Frequency of basin maintenance will also be increased to ensure optimal recharge.

Operations

Stormwater recharge at this facility would be dependent on when storm events occur, which can vary from year to year. However, the majority of stormwater recharge would occur from October through April. Proposed improvements to the basin will increase the useable storage to 672 acre-feet and provide an annual average of 201 afy/0.3 cfs/0.2 mgd (Table 2-2) of stormwater to the Chino Basin. State water could be used in the future at this recharge facility as it is made available.

Maintenance

Currently, SBCFCD and IEUA are responsible for maintenance for flood protection and water recharge. Maintenance specific to water recharge occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities as well as general O&M activities common to most of the Permittee Agencies.

RP3 Basin (2010 RMPU) (IEUA.1.10) – Phase 1

Currently RP3 Basin is used as a water recharge facility owned by and operated for recharge by IEUA. The site consists of four existing basins, three of which are recharge sites, and the most southeasterly cell is a habitat mitigation site. RP3 Basin is south of I-10, north of the Jurupa Mountains, and south of Beach Avenue in the City of Fontana (Figure 2-6). Declez Channel flows into the basin from the south. The terminus of this drainage is the Declez Channel.

New Construction

The RP3 Basin improvements include enhancing the inlet structures, increasing the conservation storage, and constructing a fifth new basin on the site. New construction will occur in areas outside of the existing facility but in previously disturbed areas. Activities would include improving existing inlet structures and increasing conservation storage as well as constructing the new basin.

Operations

The yield of the RP3 Basin is combined with the yields of Wineville Basin (IEUA.1.01) and Jurupa Basin (IEUA.1.06). Stormwater recharge at this facility would be dependent on when storm events occur, which can be variable from year to year. However, the majority of stormwater recharge would occur from October through April. State water could be used in the future at this recharge facility as it is made available. Refer to Table 2-2 for the average annual hydrological change associated with this Covered Activity.

Maintenance

Currently, SBCFCD and IEUA are responsible for maintenance for flood protection and water recharge in the existing basins. Maintenance specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities.

Additional maintenance activities include habitat mitigation site maintenance, limited to trash removal and weed control of invasive plant species. Trash removal occurs by using nets on long poles and/or wader outfits to comb through the wetlands to remove litter/debris that has come to the site via the incoming water flow or wind. Weed removal services involve hand weeding low growing annual weeds and removal of nonnative trees, such as eucalyptus. All weeds and tree material are removed from the site or shredded for use as weed-control ground mulch.

Turner Basin (2010 RMPU) (IEUA.1.11) – Phase 1

Currently Turner Basin is used as a water recharge facility operated for recharge by IEUA. Turner Basins is north of I-10, west of Archibald Avenue, and east of Vineyard Avenue in the City of Ontario (Figure 2-7). Cucamonga and Deer Creeks flow into the basin from the north and east. The terminus of this drainage is Cucamonga Creek.

New Construction

The Turner Basins improvements include raising the spillway in Turner Basin 2. Stormwater is diverted into Turner Basins 2, 3, and 4.

Operations

Stormwater recharge at this facility would be dependent on when storm events occur, which can vary from year to year. However, the majority of stormwater recharge would occur from October through April. Proposed improvements will increase stormwater recharge by an average of 23 afy/0.03 cfs/0.02 mgd (Table 2-2). State water could be used in the future at this recharge facility as it is made available.

Maintenance

SBCFCD and IEUA have a pending permit filed with USFWS for maintenance for flood protection and water recharge at these basins. Maintenance specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities as well as general O&M activities common to most of the Permittee Agencies.

East Declez Basin (IEUA.1.12) – Phase 1

This project would include the construction of a new recharge basin. East Declez Basin will be north of I-60, north of the Jurupa Mountains, and east of Country Village Road in the City of Fontana (Figure 2-7). San Sevaine Channel and Declez Creek will flow into the basin, and its downstream tributary will be Declez Creek.

New Construction

The East Declez Basin project involves constructing a new basin in land east of and adjacent to the existing Declez Basin and about 6,000 feet southwest and downstream of the RP3 recharge facility. Water will be diverted from two sources to the East Declez Basin. Stormwater in Declez Channel will be diverted in a new East Declez Basin Diversion from Declez Channel to the East Declez Basin through a pipeline. This will be done by constructing a drop inlet in the Declez Channel near the southerly crossing with Cherry Avenue to divert up to 108,667 afy/150 cfs/80.7 mgd of stormwater to the East Declez Basin. Stormwater will be conveyed in a 54-inch pipe that will be constructed in the channel, parallel to the existing channel alignment, and then due east along the north side of Declez Basin. The stormwater will then discharge to the EDB parallel to the existing channel alignment and continue due east along the north side of Declez Basin before discharging to the East Declez Basin.

Stormwater will be diverted from San Sevaine Creek Channel into Jurupa Basin, then pumped to the Declez Channel through a new 43,567 afy/60 cfs/32.3 mgd (Table 2-2) pump station and pipeline, and will subsequently be diverted through the new East Declez Basin Diversion from Declez Channel to the EDB through a pipeline. The diversion will be accomplished by constructing a rubber dam in San Sevaine Channel to increase the amount of stormwater that can be diverted into Jurupa Basin, expanding the Jurupa Basin pump station from 28,978 to 72445 afy/40 to 100 cfs/21.5 to 53.8 mgd, constructing a new pipeline to convey up to 43,467 afy/60 cfs/32.3 mgd to a 72-inch storm drain that subsequently discharges to the Declez Channel upstream of the new East Declez Basin Diversion. The inlet expansion from San Sevaine Channel to the Jurupa Basin included in the recommended 2013 RMPU Project ID 23a is required for this alternative.

Operations

Stormwater recharge at this facility would be dependent on when storm events occur, which can vary from year to year. However, the majority of stormwater recharge would occur from October through April. The new East Declez Basin storage will be 300 acre-feet, and the project will increase stormwater recharge by an average of 414 afy/0.6 cfs/0.3 mgd (Table 2-2). The East Declez Basin will contain an overflow spillway to permit the East Declez Basin to overflow into the Declez Basin. State water could be used in the future at this recharge facility as it is made available.

Maintenance

Maintenance specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. See Section 2.1.6 for general O&M activities for recharge basins conducted by IEUA for their existing or planned facilities.

Existing Basins and Maintenance Areas (IEUA.2)

The following basins are operated for groundwater recharge by IEUA and would require periodic maintenance to be covered under this HCP. These basins are currently permitted and will have no

change in O&M. Stormwater recharge at these would be dependent on when storm events occur, which can vary from year to year. However, the majority of stormwater recharge would occur from October through April. State water could be used in the future at these recharge facilities as it is made available. Maintenance specific to water recharge would occur on an annual basis in the fall to limit the amount of vegetation on the basin bottom and sides. The general O&M activities common to most of the Permittee Agencies, including groundwater recharge basin maintenance, are described in Section 2.1.6.

7th and 8th Street Basin (2010 RMPU) (IEUA.2.01) – Phase 1

7th & 8th Street Basin is south of I-10, west of North Campus Avenue, in the City of Upland (Figure 2-7). West Cucamonga Creek flows into the basin from the north, and its downstream tributary is the West Cucamonga Creek.

Banana Basin (2010 RMPU) (IEUA.2.02) – Phase 1

Banana Basin is south of I-210, south of Foothill Boulevard, and west of Etiwanda Avenue in the City of Fontana (Figure 2-7). Its downstream tributary is West Fontana Channel.

Brooks Basin (2010 RMPU) (IEUA.2.03) – Phase 1

Brooks Basin is south of I-10, north of Holt Boulevard, and east of Ramona Avenue in the City of Chino (Figure 2-7). San Antonio Channel flows into the basin from the east; the terminus of this drainage is San Antonio Creek.

College Heights Basin (2010 RMPU) (IEUA.2.04) – Phase 1

College Heights Basin is north of I-10, north of Arrow Highway, and east of Central Avenue in the City of Upland (Figure 2-7). San Antonio Creek flows into the basin from the north; the downstream tributary of this drainage is San Antonio Creek.

Etiwanda Debris Basin (2010 RMPU) (IEUA.2.05) – Phase 1

Etiwanda Debris Basin is north of I-210, north of Banyan Street, and west of Etiwanda Avenue in the City of Etiwanda Avenue (Figure 2-8). East Etiwanda Creek flows into the basin from the north. The terminus of this drainage is Etiwanda Creek.

Grove Basin (2010 RMPU) (IEUA.2.06) – Phase 1

Grove Basin is south of I-60, north of Schaefer Avenue, and east of Grove Avenue in the City of Ontario (Figure 2-8). Local storm drains flow into the basin from the north. The terminus of this drainage is Grove Avenue.

Hickory Basin (2010 RMPU) (IEUA.2.07) – Phase 1

Hickory Basin is north of I-10, east of Etiwanda Avenue, and west of Cherry Avenue in the City of Fontana (Figure 2-8). West Fontana Channel and San Sevaine Creek flow into the basin from the north and its downstream tributary is San Sevaine Creek.

Upland Basin (2010 RMPU) (IEUA.2.08) – Phase 1

Upland Basin is south of I-210, just south of Route 66, and west of Central Avenue in the City of Upland. San Antonio Creek flows into the basin from the north, and the terminus of this drainage is San Antonio Creek (Figure 2-8).

Cucamonga Creek Dry-Weather Flow Diversion (IEUA.3.01) – Phase 1

This project involves the diversion of an average of 0.8 cfs (0.4 mgd) of dry-weather flow (i.e., urban runoff) from Cucamonga Creek south of I-10 and conveyance of that flow to IEUA's RP1 Water Recycling Facility. The dry-weather flow will then be treated to Title 22 Groundwater Replenishment – Surface Application standards. Once treated, the water will go into IEUA's recycled water system for subsequent direct non-potable reuse or groundwater replenishment (Figure 2-8).

New Construction

The diversion project will involve connecting the existing stream channel with the existing regional sewage pipeline. The project would require construction in public ROW near the creek and road to convey dry-weather flows from the Cucamonga Creek to the regional sewage pipeline.

Operations

Dry-weather diversions to this facility would occur from April to October at a maximum flow of 2,171 afy/3 cfs/1.6 mgd. Diversions from IEAU.3.01 would combine with Cucamonga Creek at Interstate 10 Dry-Weather Flow Diversion (IEUA.3.02) and Lower Deer Creek Diversion (IEUA.3.06), amounting to an approximate annual average of 652 afy/0.9 cfs/0.5 mgd (Table 2-2) of flow diverted to the RP1 Water Recycling Facility. State water could be used in the future at this recharge facility as it is made available.

Maintenance

IEUA is responsible for maintenance for flood protection and water recharge. Maintenance specific to water recharge would occur on an annual basis in the fall. IEUA conducts many of the maintenance activities described in Section 2.1.6 for general O&M activities for their basins and creek conveyance as well as general O&M activities common to most of the Permittee Agencies.

Cucamonga Creek at Interstate 10 Dry-Weather Flow Diversion (IEUA.3.02) – Phase 1

This project involves the diversion of dry-weather flow (i.e., urban runoff) of 652 afy/0.9 cfs/0.5 mgd from Cucamonga Creek north of I-10 and conveyance of that flow to IEUA's RP1 Water Recycling Facility. The dry-weather flow will then be treated to Title 22 Groundwater Replenishment – Surface Application standards. Once treated, the water will go into IEUA's recycled water system for subsequent direct non-potable reuse or groundwater replenishment (Figure 2-8).

New Construction

The diversion project will involve connecting the existing stream channel with the existing regional sewage pipeline. The project would require construction in public ROWs near the creek and road to convey dry-weather flows from the Cucamonga Creek to the regional sewage pipeline.

Operations

Dry-weather diversions to this facility would occur from April to October at a maximum rate of 3 cfs (1.6 mgd) amounting to an approximate annual average of 652 afy/0.9 cfs/0.5 mgd (Table 2-2) combined with the Cucamonga Creek Dry-Weather Flow Diversion (IEUA.3.01) and the Lower Deer Creek Diversion (IEUA.3.06).

Maintenance

IEUA is responsible for maintenance for flood protection and water recharge. Maintenance specific to water recharge would occur on an annual basis in the fall.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Chino Creek at Chino Hills Parkway Dry-Weather Flow Diversion (IEUA.3.03) – Phase 1

This project involves the diversion of an average of 145 afy/0.2 cfs/0.1 mgd (Table 2-2) of dry-weather flow from Chino Creek and conveyance of the diverted water to IEUA's Carbon Canyon Water Recycling Facility. The dry-weather flow will then be treated to Title 22 Groundwater Replenishment – Surface Application standards. Once treated, the water will go into IEUA's recycled water system for subsequent direct non-potable reuse or groundwater replenishment (Figure 2-9).

New Construction

The diversion project will involve connecting the existing stream channel with the existing regional sewage pipeline. The project would require construction in public ROWs near the creek and road to convey dry-weather flows from the Chino Creek to the regional sewage pipeline.

Operations

Dry-weather diversions to this facility would typically occur from April to October at a maximum rate of 2,174 afy/3 cfs/1.6 mgd, amounting to an approximate annual average rate of 145 afy/0.2 cfs/0.1 mgd (Table 2-2).

Maintenance

Currently, SBCFCD and IEUA are responsible for maintenance for flood protection and water recharge. Maintenance specific to water recharge would occur on an annual basis in the fall.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Day Creek at Wineville Basin Outflow Diversion (IEUA.3.04) – Phase 1

This project involves the diversion of dry-weather flow of an annual average of 362 afy/0.5 cfs/ 0.3 mgd (Table 2-2) at the outflow of Wineville Basin to Day Creek and conveyance of the diverted water to IEUA's RP1 Water Recycling Facility. The dry-weather flow will then be treated to Title 22 Groundwater Replenishment – Surface Application standards. Once treated, the water will go into IEUA's recycled water system for subsequent direct non-potable reuse or groundwater replenishment (Figure 2-9).

New Construction

The diversion project will involve connecting the existing stream channel with the existing regional sewage pipeline. The project would require construction in public ROWs near the creek and road to convey dry-weather flows from the Day Creek to the regional sewage pipeline.

Operations

Dry-weather diversions to this facility would typically occur from April to October at a maximum rate of 3 cfs (1.6 mgd), amounting to an approximate annual average of 362 afy/0.5 cfs/0.3 mgd (Table 2-2).

Maintenance

Maintenance specific to water recharge would occur on an annual basis in the fall. The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

San Sevaine Creek Diversion (IEUA.3.05)

This project involves the diversion of an annual average dry-weather flow of 652 afy/0.9 cfs/ 0.5 mgd from San Sevaine Creek below Jurupa Basin and conveyance of the diverted water to IEUA's RP1 Water Recycling Facility. The dry-weather flow will then be treated to Title 22 Groundwater Replenishment – Surface Application standards. Dry-weather flows are currently limited at this location, but the project could assist in capturing basin drainage for maintenance purposes (Figure 2-9).

New Construction

The diversion project will involve connecting the existing stream channel with the existing regional sewage pipeline. The project would require construction in public ROWs near the creek and road to convey dry-weather flows from the San Sevaine Creek to the regional sewage pipeline.

Operations

Dry-weather diversions to this facility would typically occur from April to October at a maximum rate of 2,172 afy/3 cfs/1.6 mgd, amounting to an approximate annual average of 652 afy/0.9 cfs/ 0.5 mgd (Table 2-2).

Maintenance

Currently, SBCFCD and IEUA are responsible for maintenance for flood protection and water recharge. Maintenance specific to water recharge would occur on an annual basis in the fall. The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Lower Deer Creek Diversion (IEUA.3.06)

This project involves the diversion of an annual average dry-weather flow of 579 afy/0.8 cfs/ 0.5 mgd from Lower Deer Creek above Chris Basin at Archibald Avenue and conveyance of the diverted water to IEUA's RP5 Water Recycling Facility. The dry-weather flow will then be treated to Title 22 Groundwater Replenishment – Surface Application standards.

New Construction

The diversion project will involve connecting the existing stream channel with the existing regional sewage pipeline. The project would require construction in public ROWs near the creek and road to convey dry-weather flows from the Lower Deer Creek to the regional sewage pipeline (Figure 2-9).

Operation

Dry-weather diversions to this facility would occur from April to October at a maximum rate of 2,172 afy/3 cfs/1.6 mgd, amounting to an approximate annual average of 579 afy/0.8 cfs/0.5 mgd (Table 2-2) combined with the Cucamonga Creek Dry-Weather Flow Diversion (IEUA.3.01) and the Cucamonga Creek at Interstate 10 Dry-Weather Flow Diversion (IEUA.3.06).

Maintenance

Currently, SBCFCD and IEUA are responsible for maintenance for flood protection and water recharge. Maintenance specific to water recharge would occur on an annual basis in the fall. See Section 2.1.6 for general O&M activities for basins and creek conveyance conducted by IEUA for their existing or planned facilities as well as general O&M activities common to most of the Permittee Agencies.

Riverside Public Utilities Activities

Riverside North Aquifer Storage and Recovery Project (RPU.5) (shared equally with Western and Valley District) – Phase 2

The proposed Riverside North Aquifer Storage and Recovery Project is located in the southern portion of the City of Colton and north of the City of Grand Terrace. The project consists of proposed in-channel and off-channel recharge. The proposed off-channel recharge facility location is along the west side of the Santa Ana River. The in-channel recharge basin dam (i.e., rubber dam) alignment is proposed at a location on the Santa Ana River channel about 1 mile south of the I-215/I-10 interchange and the confluence of the Santa Ana River and Warm Creek (Figure 2-9). The dam, SWP pipeline, levee modifications, diversion structure, and in- and off-stream recharge basins are anticipated to be constructed once development of the project commences. Construction is anticipated to last approximately 24 to 36 months. This project will require facilities associated with a recharge site, such as fencing, lighting, aboveground utilities, parking, or other supporting infrastructure.

New infrastructure that will be required is described below.

New Construction

In-Stream Recharge Component

In-stream recharge activities would include the construction of an inflatable dam across the Santa Ana River channel, which can be raised and lowered depending on the amount of water flowing in the river. The proposed dam would span approximately 810 feet across the Santa Ana River and would inflate to a height of about 6 feet. The dam would consist of two to four sections across the channel, and the sections would be attached to one to three newly constructed abutment piers. The area behind the inflatable dam would encompass approximately 24 acres and is anticipated to have an initial infiltration rate of 3 feet per day.

Additional activities include potential removal/reconstruction of approximately 100 linear feet of new levees downstream of the proposed dam location and potential modification of approximately 2,400 linear feet of USACE levees upstream of the proposed dam location. The in-stream recharge project would also include construction of a water diversion outlet structure through the west levee north of the proposed inflatable dam. Miscellaneous rip-rap/energy dissipater devices downstream of the proposed dam location would be installed to reduce the potential for erosion at the base of the dam structure.

Off-Stream Recharge Component

The project proposes the construction of up to five individual recharge basins. It is anticipated that the depths of these basins will range from 6 to 11 feet and be connected in series with pipes and gate structures. An initial infiltration rate of 5 feet per day is expected. The off-stream basins may be constructed to allow for drainage back to the river using gravity. Implementation of this component will require the construction of a diversion structure located within the levee wall. The diversion of headworks will include a sillwall and trash rack.

Other Project Components

Other project components would include the placement of a 42-inch-diameter steel casing across the Santa Ana River, located adjacent to the inflatable dam. This casing will contain multiple conduits allowing a utility crossing under the Santa Ana River. The diversion headworks will also be tied into the existing Riverside Canal and diversions to the canal would follow the off-stream basin diversions. A temporary access road would be needed during construction.

Operations

Raising and lowering of the dam would be automated based on flow volume. When flows in the river are greater than 4,000 cfs/2,152 mgd the inflatable dam would be lowered. When flows are at or less than this amount, the dam would inflate and begin impounding water. The specific discharge value used to lower and raise the dam will ultimately be based on the design of the project, which is currently in progress. Once the basins are full, diversions to the Riverside Canal would begin. The initial infiltration rates will diminish with time due to sediment deposition within the basin. Any flows greater than the infiltration rates and/or diversion structure capacity would flow over the dam and continue downstream.

The project is designed to divert a maximum annual average of 16,570 afy/22.9 cfs/14.8 mgd. Ultimately, the project yield will depend on the design and maintenance of the project facilities and how effective the facilities are at recharging the available flows. Current estimates indicate that the likely project yield will be up to 9,861 afy/13.6 cfs/8.8 mgd.

Maintenance

Maintenance will be required for access roads, the rubber dam, pipelines, basins (in-stream and off-stream), culverts, canals, the diversion structure, and outlet structure; and will be conducted annually or as needed. Typical in-stream maintenance actions will include mechanized land clearing for sediment and vegetation removal during summer months when storm flow is not present in the river. Occasionally, in-stream maintenance may be necessary during the storm season when flows are present in the river channel. Typically, the routine maintenance activities can be completed within 90 days per year.

Off-stream maintenance activities would include about three basin cleanings during the storm season and one basin cleaning during the non-storm season. A material stockpile/laydown area will be used to assist with basin cleanings. See Section 2.1.6 for general O&M activities conducted by the RPU for their existing or planned facilities as well as general O&M activities common to most of the Permittee Agencies.

Riverside Basin Recharge Project (RPU.8) – Phase 2

New Construction

RPU plans to construct new recharge basins and/or repurpose existing retention basins within the northern part of the Riverside Basin (Figure 2-9). These basins will be used to recharge the Riverside Groundwater Basin and therefore increase the operating yield from the basin. The source of the water will be onsite stormwater, imported water, and/or water from the Riverside North Aquifer Storage and Recovery Project (RPU.5) via the existing Riverside Canal and associated delivery systems, if necessary.

Construction activities will include the modification of Columbia and Marlborough basins, and construction of the Spring Brook facilities, followed by construction of the Highgrove facilities at Van Buren. Construction at each site is anticipated to take anywhere from 6 to 18 months. Geotechnical drilling and cone penetrating testing will occur prior to construction at each site and should take about 2 weeks to conduct.

Operations

Typical recharge operations would include recharging onsite stormwater, imported water, and water diverted from the Riverside North Aquifer Storage and Recovery Project (RPU.5) via the Riverside Canal and associated delivery systems. Additional recharge of recycled water may occur in the future; however, it was not considered for this HCP analysis. The recharge basins would be operated to meet all California Department of Drinking Water standards and all RWQCB standards, should they apply. A few of the basins utilize existing flood control facilities and would be operated for groundwater recharge.

RPU conducted a preliminary analysis that assessed each site's runoff capture area and analyzed historical rainfall data to evaluate how much stormwater runoff each site could have potentially captured assuming a 1-foot per day infiltration rate. Columbia and Marlborough basins were found to yield an annual average of 362 and 290 afy/0.5 and 0.4 cfs/0.3 and 0.2 mgd (Table 2-2), respectively, for a total of 652 afy/0.9 cfs/0.5 mgd captured. The source of the water is urban runoff that is currently captured in basins and sent downstream. Under the project conditions the water would percolate rather than flow to Lake Evans. The Spring Brook and Van Buren facilities were found to yield approximately 290 and 579 afy/0.4 and 0.8 cfs/0.2 and 0.4 mgd, respectively for a total of 941 afy/1.3 cfs/0.7 mgd captured.

Maintenance

Routine maintenance will be conducted annually at the new recharge basins during summer months when storm flow is not present. Typically, the routine maintenance activities can be completed within 60 days per year. Maintenance activities will include maintenance of diversion structures, use

of pesticides[3] to control invasive plant species and rodents, vegetation removal, and mechanized land clearing for sediment removal. Sediment removal maintenance will also occur as needed during storm seasons, to maintain basin infiltration performance. See Section 2.1.6 for general O&M activities conducted by the RPU for their existing or planned facilities as well as general O&M activities common to most of the Permittee Agencies.

Southern California Edison Activities

Southern California Edison (SCE) operates hydropower facilities and associated diversions within the Planning Area. SCE's Eastern Hydro geography overlaps the Planning Area and includes 3 FERC licenses, 9 powerhouses, 17 generating units, and an electric capacity of 14.86 megawatts (MW).

There are no listed species where SCE operates hydropower facilities within the Planning Area. This HCP covers the potential impacts of O&M of SCE's diversion structures on potential future covered-species fish populations established through translocation as part of the HCP Conservation Strategy. The following sections describe diversions associated with O&M of SCE's hydropower facilities that could affect fish populations translocated to these stream reaches as a conservation measure in this Plan.

Mill Creek Powerhouse (SCE.1) – Phase 1

The Mill Creek facilities are located on Mill Creek in San Bernardino County, California. These facilities are approximately 15 miles east of the City of Redlands on the lower coastal slopes of the San Bernardino Mountains. Elevations in the project area range from approximately 2,950 feet at the Mill Creek 1 Diversion to 5,000 feet at the Mill Creek 3 Diversion (Figure 2-10).

Mill Creek 1 Diversion

The Mill Creek 1 Diversion is a typical concrete diversion dam. Maintenance of this facility requires removal of debris at the intake and repairs to the soft plug; material may also be placed at the toe and heel of the dam. An excavator and bulldozer are necessary to repair the soft plug and realign the stream to ensure that it flows into the diversion, which would take approximately 1 day. Prior to maintenance activities, water is diverted, using a small dike or sand bags, and is then directed through a diversion dam drain gate or around and over the diversion dam to provide a dry working area.

Mill Creek 3 Diversion

The Mill Creek 3 Diversion includes a rubble concrete diversion dam, an intake structure with a steel debris grad and fish wheel, and a concrete sandbox. Maintenance of this facility requires removal of debris in the intake, repairs to the soft plug, realignment of the stream where needed, and replacement of material at the toe and heel of the dam. Maintenance activities typically last for up to 2 days using a backhoe and bulldozer on tracks. Prior to maintenance activities, water is diverted, using a small dike or sand bags, and is then directed through a diversion dam drain gate or around and over the diversion dam to provide a dry working area.

[3] Activities associated with the application of pesticides that may result in take of a Covered Species (e.g., the operation of an all-terrain vehicle in San Bernardino kangaroo rat habitat resulting in the collapse of a burrow) are covered by the HCP. However, take resulting from the pesticide itself would not be covered. Applicators must use pesticides according to the label. This includes limits on applications to avoid impacts on wildlife.

Santa Ana River Powerhouse (SCE.2) – Phase 2

Bear Creek Diversion

The Bear Creek Diversion consists of a concrete diversion dam and intake with a fixed trashrack as well as a soft plug. Maintenance of this facility requires removal of debris in the intake, repairs to the soft plug, realignment of the stream where needed, and replacement of the material at the toe and heel of the dam. Prior to construction, water is diverted upstream of the diversion so that it bypasses the diversion (Figure 2-10).

Santa Ana River 1 Diversion

The Santa Ana River 1 Diversion is a concrete diversion dam and intake with a fixed trashrack on the Santa Ana River. No soft plug is present. Maintenance of his facility requires removal of sediment and debris with hand tools; water cannot be diverted around this diversion prior to activities. Maintenance activities typically last up to 2 days.

Santa Ana River 3 Diversion

The Santa Ana River 3 Diversion consists of an earthen embankment and concrete diversion weir adjacent to the Santa Ana River 1 powerhouse and a circular concrete sandbox. Maintenance of this facility may require removal of debris, repairs to the diversion structures, and realignment of the stream where needed.

Alder Creek Diversion

The Alder Creek Diversion is a small rubble concrete diversion dam with a broad-crested weir that creates a minimum water depth of about 2 feet at the diversion. Below the intake structure is a low-level outlet to lower the water level to below the spillway elevation when necessary. The maximum diversion capacity is approximately 15 cfs (8.1 mgd).

Lytle Creek Powerhouse (SCE.3) – Phase 1

Lytle Creek Diversion

The Lytle Creek Diversion is a rubble masonry gravity dam and two adjacent soft plugs, a concrete intake structure with trashracks and a revolving fish screen, and a concrete-lined sandbox (Figure 2-10). Additionally, there is a berm that runs perpendicular to the concrete dam. Maintenance of this facility requires removal of debris in the intake, repairs to the two soft plugs, and maintaining the berm; material may also be placed at the toe and heel of the dam. Repair activities would typically last up to 2 days to repair the two soft plugs and berm and realign the stream using a bulldozer and excavator. Water is diverted upstream during repairs so that it bypasses the diversion dam. In addition to repairs following flooding damage, the secondary soft plug often requires repairs as a result of vandalism.

San Bernardino Valley Municipal Water District Activities

Cactus Basin Recharge Project Maintenance (VD.1) – Phase 1

Valley District is working to recharge SWP supplemental water in the Cactus Basins (Figure 2-10). Recharge of SWP water will initially occur in the existing Basins 3 and 3A.

Improvements to Basins 3 and 3A began in 2016 and include installation of a bypass pipeline along the perimeter of the basins and water conservation berms that will be constructed within Basins 3 and 3A. This construction was independently permitted and completed in 2017. In the future, imported water may also be discharged into one or more of these basins, depending on conditions. Expansion of Basins 4 and 5 is not proposed by Valley District; however, maintenance of these facilities for the purposes of groundwater recharge is proposed for coverage under the HCP and included below. The bottoms of the basins will be kept permanently clear of vegetation to facilitate effective recharge.

Diversion

SWP water will be conveyed to the Cactus Basins from the Devil Canyon – Azusa Pipeline to the Cactus Basins for groundwater recharge through a series of new pipeline and existing stormwater drainage facilities owned by the City of Rialto and SBCFCD, respectively. Water will be directed to a specific basin or a combination of basins, depending on operational needs, through the bypass pipeline. The recharge of imported water will occur from April to October.

Operations

Operations for water conservation purposes will be managed by Valley District (1, 2, 3, and 3A, 4, and 5) in cooperation with SBCFCD. The Cactus Basins are hydrologically connected to Rialto Channel, which enters the Santa Ana River just upstream of the RIX facility. The recharge of imported water from the SWP is planned to occur during the dry season, from April to October. There will be no diversion of existing surface flow.

Maintenance

Routine maintenance activities include maintenance of levees and access roads; bank repair; concrete structure repair; and removal of debris, sediment, and vegetation from the basins, culverts, and diversion structures. Routine maintenance will begin from a post-construction baseline condition; therefore, no existing vegetation will be removed as a result of this project. The bottoms of each basin would be kept clear of emergent vegetation, algae, and debris using heavy equipment. Ongoing maintenance activities are proposed for coverage under the HCP.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Active Recharge Project (VD.2) (Partnered with Western, RPU, and Conservation District)

The Active Recharge Project will divert a portion of stormflow from tributaries of the Santa Ana River for use in recharging groundwater supply. Eleven creeks have been identified as potential areas for new recharge basins, and three existing basins have been identified for modification to increase the current recharge capabilities. These two components collectively make up the Active Recharge Project. Water will be diverted from storm flows in the tributaries and directed into new and existing basins to recharge the San Bernardino Basin Area. The Active Recharge Project projects will be constructed in phases over approximately 15 to 20 years, based on funding availability, permitting schedules, and mitigation opportunities. A priority list has been developed for project implementation.

Ongoing maintenance activities are proposed for coverage under the HCP. See Section 2.1.6 for general O&M activities conducted by the Valley District for their existing or planned facilities.

Cable Creek Diversion and Basin (VD.2.02) – Phase 3

The proposed improvements at Cable Creek for the Active Recharge Project will construct a 245-foot-long by 6-foot-diameter inflatable rubber dam diversion, three recharge basins covering a total wetted area of 37.9 acres, a 361,984 afy/500 cfs/269.1 mgd capacity basin inlet structure and piping, two surface transfer structures, and six basin drain tubes (Figure 2-10). The diversion, recharge basins, and drain tubes have been developed to utilize a gravity conveyance system and to maximize usage of the available area on the site. The northeast edge of the new basins will act as a levee to isolate uncontrolled high flows from the basin system. An inflatable rubber dam was selected for this site due to the frequent and high flow rates predicted to occur at the diversion site.

In general, the perimeter basin berms will be approximately 10 feet in height. The divider berms between the basins will be also be approximately 10 feet high with slightly increased heights on the downstream slopes to terrace the basins to match the slope of the site. The maximum operating level within the basin will be approximately 8–10 feet deep for a storage volume of 281 acre-feet.

The area above the rubber dam diversion will act as the forebay for the diversion structure. While the dam is inflated the forebay area will pool water and increase the wetted area, thereby increasing the groundwater recharge yield in Cable Creek. The wetted area above the rubber dam (while the dam is inflated) has a volume capacity of approximately 8.6 acre-feet.

A series of model iterations were performed to help determine a target design flow rate of 361,984 afy/500 cfs/269.1 mgd for the diversion capacity. Based on the model results it was determined that the project benefit of an annual average flow of approximately 2,389 afy/3.3 cfs/ 1.9 mgd would be realized by constructing the Cable Creek Basin Project (Table 2-2).

Lytle Creek Diversion and Basin (VD.2.03) – Phase 4

This project has a relatively low probability of being implemented. If it is implemented it would occur in Phase 4 of HCP implementation (after year 15), and area-specific conservation actions would be implemented in this portion of Lytle Creek in conjunction with the project. Area-specific conservation actions would focus on enhancement of San Bernardino kangaroo rat habitat in the vicinity of the projects and connectivity of habitat from one side of the creek to the other.

The proposed diversion and basin system would be situated 3,200 feet to the northwest of the active CEMEX screening plant with the in-channel recharge site located immediately upstream of the basin inlet (Figure 2-10).

The basin area is currently open to flows from Lytle Creek; however, CEMEX is planning a project to construct a berm that would isolate the basin site from Lytle Creek. There is a potential opportunity to construct a basin inlet and internal basin berms to enhance groundwater recharge in the basin area. CEMEX has future plans to excavate the basin deeper, which would require an agreement between the Valley District and CEMEX to define the duration, or other operational plans, for groundwater recharge operations in the basin.

The proposed improvements at Lytle Creek for the Active Recharge Project will construct a sand diversion berm, in-channel recharge berms, and a basin inlet structure and piping with a series of cells within the larger CEMEX basin area. The in-channel recharge area and basin cells have been

developed to utilize gravity conveyance throughout the system and to maximize usage of the available area on the site.

The upstream end of the in-channel recharge area would require the construction and regular rebuilding of a sand diversion berm. The sand diversion berm would help to direct flows to the southern side of the existing island. The berm would be self-leveling during high flows to maintain the full flood control capacity of the creek. The basin inlet would be cooperatively designed and constructed with CEMEX's isolation berm planned for the basin area. A series of inner berms would be constructed within the basin area to terrace the site, create storage volume, and maximize the wetted area of the cells.

The in-channel recharge berms will be approximately 6 feet high. The cell berms within the basin area will be approximately 15 feet high with slightly increased heights on the downstream slopes to terrace the basins to match the slope of the site. The maximum operating level within the basin will be approximately 12–14 feet deep for a storage volume of 460 acre-feet.

The area above the CEMEX isolation berm will act as the forebay for the diversion structure. The forebay area will pool water and increase the wetted area, thereby increasing the groundwater recharge yield in Lytle Creek. The wetted area above the isolation berm has a volume capacity of approximately 223 acre-feet.

A series of model iterations were performed to help determine a target design flow rate of 500 cfs (269.1 mgd) for the diversion capacity. Based on these model iterations it was determined that a design diversion capacity of 500 cfs (269.1 mgd) would yield an annual average of approximately 3,620 afy/5.0 cfs/2.7 mgd (Table 2-2).

Mill Creek Diversion (VD.2.04) – Phase 4

The Mill Creek Diversion is an upgrade to existing Conservation District facilities that turns out flow from Mill Creek adjacent to a USACE flood control wall, into a series of spreading basins that lay outside of the natural stream course. The spreading basins include approximately 53 small (each less than 3 acres) recharge basins with a total maximum wetted are of 47 acres and total storage volume of approximately 160 acre-feet. The diversion structure diverts flow using two separate discharge points. The upstream diversion outlet discharges directly into spreading grounds. The second outlet discharges into the spreading grounds by way of a channel named the North Canal. Restrictions in the diversion and canal inlet structures result in an underutilization of the full wetted area and storage volume of the existing Mill Creek Basins.

Proposed improvements for the Active Recharge Project Mill Creek Diversion include removal of the existing canal inlet structure, construction of a new North Canal inlet with a capacity of 210 cfs, construction a new South Canal inlet gate, construction a new bypass outlet structure with sediment transport features, and improvements to increase the capacity of the conveyance under the USACE flood control wall. Construction of these improvements would first demolish the existing inlet and reconstruct the canal inlet structure while at the same time increasing the diversion flow capacity of the North Canal Inlet. Additionally, the bypass outlet of the structure will be redesigned and reconstructed to increase the sediment bypass function of the structure (Figure 2-11). This project entails increasing the size or number of the outlet pipes and gates and does not have any additional permanent impacts within the active stream. The Mill Creek Diversion Active Recharge Project improvements will result in reduction in flow in Mill Creek of up to 7,935 afy/11.0 cfs/7.1 mgd.

The Conservation District's Mill Creek Diversion and Debris Management Improvement Project (to be permitted outside of this HCP) will increase the diversion flow capacity to accommodate the larger diversion potential created by the Active Recharge Project Mill Creek.

City Creek Diversion and Basin (VD.2.05) – Phase 4

The proposed project will be located approximately one-half mile east of the I-210/Baseline Avenue crossing in the City of Highland. The projects require a diversion structure to direct flows from within the main flow path of adjacent creeks and into the proposed basins. The basin(s) will be situated generally in upland areas but within the outer banks of the creeks with only the diversion structure being constructed within the active channels (Figure 2-11).

The proposed diversion structures within City Creek and in Bledsoe Creek will be designed to divert only a small portion of the stormwater peak flows and most or all of the stormwater low flows. One potential option is an inflatable rubber dam diversion with a series of basins in and around Baseline Avenue and Boulder Avenue bridge crossings. The basin layout will utilize a gravity conveyance system and will maximize the available area on the site while maintaining adequate flood control capacity in City Creek Channel and Bledsoe Creek. The northwest and southerly edges of the new basins will act as a levee to isolate high flows from the basin system. The proposed diversion will be installed at the upstream end of the basins system to maximize the distribution into the percolation basins. Improvements may also include reconstruction of an existing levee along Bledsoe Creek.

In general, the perimeter basin berms will be less than 6 high feet higher than the adjacent ground. The divider berms between the basins will also be approximately 5 feet high with slightly increased heights on the downstream slopes to terrace the basins to match the slope of the site. The basins may be as large as 40 acres overall, including the perimeter berms.

The area above the rubber dam diversion will act as the forebay for the diversion structure. While the dam is inflated the forebay area will pool water and increase the wetted area, thereby increasing the groundwater recharge yield in City Creek. The wetted area above the rubber dam (while the dam is inflated) will encompass approximately 0.06 acre, with a volume capacity of approximately 0.23 acre-feet. A series of model iterations were performed to help determine a target design flow rate of 361,984 afy/500 cfs/269.1 mgd for the diversion capacity. Based on the model results it was determined that the project would yield an annual average benefit of 4,662 afy/6.44 cfs/3.4 mgd (Table 2-2).

Plunge Creek – Basin 1 (VD.2.06) – Phase 2

The proposed project will be located in the proximity of the I-210/5th Street Avenue crossing in the City of Highland (Figure 2-11). The proposed improvements along Plunge Creek will be within the reach from Palm Avenue (Alabama Avenue to the south) and Boulder Avenue (Orange Street to the south). The basins will be within upland areas. The project may include multiple diverter structures within Plunge Creek but will be constructed within existing structures and near existing structures that serve as invert stabilizers for the creek.

Project improvements will be designed to not impact the current floodplain or adjacent levees to the north. Portions of this project may be located within permanently impacted areas of the Wash Plan. Also, most the basins may be constructed outside of the 100-year flood plain. The basins may be as deep as 40 feet below and 25 feet above adjacent ground, but the maximum ponding height with the

basins will be kept to within 6 feet of the adjacent ground. The project will also include a structure to return flow back into City Creek if the recharge capacity is less than the system inflow.

A series of model iterations was performed to help determine a target design flow rate of 180,992 afy/250 cfs/135.0 mgd for the diversion capacity. Based on the model results it was determined that the project benefit would be an annual average of approximately 3,113 afy/4.3 cfs/2.3 mgd (Table 2-2).

The proposed improvements for the Active Recharge Project at the Plunge Creek Basin 1 site include the construction of a basin, a 165-foot-long by 8-foot-tall inflatable rubber dam, a 180,992 afy/ 250 cfs/135.0 mgd diversion/inlet structure, a basin overflow structure, and a 36-inch-diameter basin drain. The site should also include installing a flow measuring station in Plunge Creek at the diversion and flow metering in the diversion conduits to help facilitate operations.

Cajon-Vulcan 1 Diversion and Basin (VD.2.07) – Phase 4

The Cajon-Vulcan 1 site is located adjacent to Cajon Creek along the site's western edge and crosses Institution Road along the its northern end. The proposed diversion would be located immediately upstream of Institution Road near the road's eastern end and approximately 4,700 feet southwest of the I-215/Palm Avenue crossing in the City of San Bernardino (Figure 2-11). The proposed diversion would be situated parallel to, and immediately north of, Institution Road. Vulcan 1 Basin is an existing aggregate mining pit with total depth of approximately 115 feet.

Water flows in Cajon Creek from northwest to southeast past the proposed project site. The existing Institution Road alignment rests at-grade and crosses Cajon Creek. The proposed sand berm diversion would cross the entire width of Cajon Creek and provide protection for Institution Road during low flows (361,984 afy/<500 cfs/269.1 mgd). Flows greater than 361,984 afy/500 cfs/ 269.1 mgd would continue to flow across the road, as is the current condition.

The proposed improvements at the Cajon-Vulcan 1 site for the Active Recharge Project will construct a 3,000-foot-long by 8-foot-high sand berm diversion, a surface transfer bypass structure, and a 361,984 afy/500 cfs/269.1 mgd capacity diversion inlet structure and piping. A sand berm diversion was selected for this site due to the large width of Cajon Creek at the diversion location.

The sand berm diversion will provide a means to collect the stormwater flows and focus them into the diversion inlet structure. Once in the structure, the flows will be conveyed via pipeline underneath Institution Road and into the existing Vulcan 1 Basin. The surface transfer bypass structure will provide a means to send flows across the diversion berm without a berm wash-out. Once flows in Cajon Creek reach a predetermined flow rate, a section (or multiple sections) of the diversion berm will be designed to washout or self-level, thereby preserving the flood control capacity of the creek.

The area above the sand berm diversion will act as the forebay for the diversion structure. While in operation, the forebay area will pool water and increase the wetted area, thereby increasing the groundwater recharge yield in Cajon Creek. The wetted area above the sand berm diversion has a volume capacity of approximately 24.1 acre-feet.

A series of model iterations was performed to help determine a target design flow rate of 361,984 afy/500 cfs/269.1 mgd for the diversion capacity. Based on the model results it was determined that the project would yield an annual benefit of approximately 579 afy/0.8 cfs/0.4 mgd.

Flows that enter the diversion will be delivered to the existing Vulcan 1 Basin via a 361,984 afy/ 500 cfs/269.1 mgd pipeline. An energy dissipating structure will be required in Vulcan 1 Basin along with remote level sensing equipment. The basin may require a cleaning or over-excavation prior to use as a groundwater recharge basin.

Vulcan 2 Diversion and Basin (VD.2.08) – Phase 4

The Vulcan 2 site is located adjacent to the Devil Creek Diversion Channel, which borders the southeast edge of the proposed Vulcan 2 Basin. The proposed diversion would be located within the Devil Creek Diversion Channel immediately downstream of the Cajon Boulevard/Devil Creek Diversion Channel crossing. The basin site is southwest of Cajon Boulevard and approximately 7,500 feet south of the I-215/Palm Avenue crossing in the City of San Bernardino (Figure 2-11).

The Devil Creek Diversion Channel is a concrete-lined trapezoidal channel that delivers flow from the Devil Creek and Cable Creek drainage areas into Cajon Creek. The Vulcan 2 Basin site is currently an open space area/unimproved site planned for future aggregate mining. Overall the Vulcan 2 Basin site has an elevation differential of approximately 35 feet from the diversion location to the southwest end of the basin site (0.88% grade).

The proposed improvements at Vulcan 2 Basin for the Active Recharge Project will construct an inflatable rubber dam diversion across Devil Creek Diversion Channel and a series of basins from Cajon Boulevard extending southwest 4,000 feet (approximately four basins total). The basin layout has been developed to utilize a gravity conveyance system and to maximize usage of the available area on the site. The basin invert will be slightly lower than the Devil Creek Diversion Channel invert near the diversion point and slightly higher than the channel invert at the downstream most end of the basins.

An inflatable rubber dam (selected because the channel is trapezoidal in shape and concrete lined) will be constructed in the channel diversion. A diversion structure and inlet piping will be constructed from the channel to the first basin. A series of surface transfer structures and basin drains will be constructed between each basin as well as from each basin directly back into the channel.

In general, the perimeter of the basin will be constructed at existing grade with low perimeter berms. The average basin depth will range between 12 and 15 feet, with the maximum operating level within the basins at approximately 10–13 feet deep. The total wetted area of the basins will have a storage volume of 383 acre-feet.

The area above the rubber dam diversion will act as the forebay for the diversion structure. While the dam is inflated the forebay area will pool water above the dam; however, because the channel is concrete lined there will be no increase to groundwater recharge yield in the forebay.

A series of model iterations was performed to help determine a target design flow rate of 750 cfs (403.6 mgd) for the diversion capacity. Based on the model results it was determined that the project benefit would be approximately 782 afy/1.1 cfs/0.6 mgd.

Lytle-Cajon Diversion and Basin (VD.2.09) – Phase 3

If this project is implemented it would occur in Phase 3 of HCP implementation (after year 10), and area-specific conservation actions would be implemented adjacent to Lytle-Cajon Basin in conjunction with the project. Area-specific conservation actions would focus on enhancement of San

Bernardino kangaroo rat habitat in the vicinity of the projects and connectivity of habitat from one side of the creek to the other.

The Lytle-Cajon Basin site is located within Lytle Creek Wash. The proposed in-channel recharge basin system would be located within the flow path of Lytle Creek Wash immediately downstream of West Baseline Road/Lytle Creek Wash crossing. The basin site is approximately 1.9 miles southwest of the I-215/I-210 Interchange in the City of San Bernardino (Figure 2-11).

The proposed improvements at the Lytle-Cajon Basin site for the Active Recharge Project include constructing a series of in-channel recharge basins. The basins would increase the wetted area of Lytle Creek Wash and provide storage volume for stormwater capture and recharge. There would be eight basins constructed in series and operated as flow-through basins. The basin berms would be approximately 8–10 feet high, and the basins would be constructed of native creek bed materials. Sections of the basin berms perpendicular to the flow would self-level during high flow events to preserve the flood control capacity of Lytle Creek Wash. Each in-channel recharge basin would have an overflow surface transfer structure and a low-level drain tube.

The average operating level within the proposed basins will be approximately 6 feet, for a total wetted area of 43 acres and a storage volume of 244 acre-feet. There will be no groundwater recharge operations in the zones directly adjacent to the Radial Gate or USACE levees.

The proposed project would be placed in an existing flow-through system, and therefore there is no diversion or inlet restriction associated with this project. There were no model iterations needed to determine an optimum diversion flow rate. Based on the model results it was determined that the project benefit would be approximately 1,090 afy/1.5 cfs/1.0 mgd.

The proposed physical improvements for the Active Recharge Project at the Lytle-Cajon Basin Project include the construction of eight in-channel recharge basins, and eight new surface transfer structures and low-level outlets/drains. Each of the basins should include the construction of remote level sensing and inflow/outflow metering.

Plunge Creek – Basin 2 (VD.2.10) – Phase 3

The Plunge Creek – Basin 2 site is approximately 350 feet west of the I-210/Plunge Creek crossing in the City of Highland. The proposed diversion and basin would be situated within the existing flow path of Plunge Creek. The site is located in a wide area of the Plunge Creek Channel (Figure 2-12) and is currently bisected by the low flow channel of the creek. The proposed project would reroute the creek's flow path along the southern edge of the site.

Water flows through the site from east to west under I-210 and then continues west for approximately 2,000 feet before draining into City Creek. The southwest tip of the site is at the confluence of Plunge and City Creeks.

The northern edge of the Plunge Creek – Basin 2 site is immediately adjacent to the southernmost basin of the City Creek Diversion and Basin (refer to Covered Activity VD.2.05). If both sites are selected for further development a transfer pipe should be constructed from City Creek Basin to Plunge Creek – Basin 2 in order to provide operational flexibility and better utilize Plunge Creek – Basin 2.

The proposed improvements for the Active Recharge Project at the Plunge Basin 2 site include the construction of 10.7 acres of basin, a 125-foot-long by 8-foot-tall inflatable rubber dam, a

253,389 afy/350 cfs/188.4 mgd diversion/inlet structure, a basin overflow structure, and a 36-inch-diameter basin drain. The site should also be improved by adding a flow measuring station in Plunge Creek at the diversion and flow meters in the diversion conduits to help facilitate operations.

The rubber dam diversion will be intentionally placed near the creek constriction to help encourage sediment transport past the dam and diversion structure. A rubber dam was selected for this site due to the frequent and high flow rates predicted to occur at the diversion site.

The perimeter berms of the basin along the east, south, and west sides will be approximately 10 feet high. The divider berm between the basins will also be approximately 10 feet high. The maximum operating level within the basin will be approximately 8 feet deep, for a storage volume of 66 acre-feet. To avoid jurisdiction from the State of California, Department of Water Resources, Division of Safety of Dams, the basin will be split into two smaller basins. The upstream basin will have a volume of 16 acre-feet. The downstream basin will encompass approximately 8.4 acres and have a volume of 50 acre-feet.

The area above the rubber dam diversion will act as the forebay for the diversion structure. When the dam is inflated this area will pool water and increase the wetted area, thereby increasing the groundwater recharge yield in Plunge Creek. The wetted area above the rubber dam (while the dam is inflated) has a volume capacity of approximately 1.5 acre-feet.

Stormwater capture of this project is accounted for in the annual average of approximately 3,111 afy/4.3 cfs/2.3 mgd attributed to the Plunge Creek – Basin 1 project (VD.2.06) (Table 2-2).

Devil Creek Diversion and Basins (VD.2.11) – Phase 2

The proposed improvements at Devil Creek Basins for the Active Recharge Project are located within the existing Devil Creek Infiltration Basin site at the intersection of Devil's Canyon Road and Ben Canyon Road. The project will construct an inflatable armored dam (Obermeyer Spillway Gate) diversion across Devil Creek to increase the diversion flow rate capacity and divert low flows that would otherwise pass by the basins. Two new recharge cells will be constructed below the existing Basin 1 and above the USACE levee. Additionally, the existing inter-basin surface transfer structures and low-level outlets/drains will be refurbished and/or replaced as a part of the project (Figure 2-12).

A new operational plan would need to be developed with SBCFCD in order to realize the project benefit at Devil Creek Basins. In general, higher flows would be diverted into the basins more frequently, and the basins would be operated at higher water surface elevations (WSEs) for longer durations to allow captured stormwater to be infiltrated into the basins. The existing basins will be cleaned to remove deposits of silt and clay. The average operating level within the basins will range from 7–10 feet, for a total storage volume of 242 acre-feet.

Based on field observations and preliminary hydraulic analysis it is estimated that the existing diversion capacity could be as high as 361,984 afy/500 cfs/269.1 mgd with the proper hydraulic conditions. In order to create adequate hydraulic head to convey that amount into the basins a new armored spillway gate will be needed. Approximately 2,051 afy/2.8 cfs/1.5 mgd would be realized by constructing the proposed improvements and re-operating the Devil Creek Basins.

The proposed physical improvements for the Active Recharge Project at the Devil Creek Basins include the construction of a 250-foot-long by 8-foot-tall spillway gate, and refurbishment of three inter-basin surface transfer structures and five low-level outlets/drains. Each of the basins should

include the construction of remote level sensing and inflow/outflow metering. The site should also be improved by adding a flow measuring station in Devil Creek at the diversion site and flow meters in the diversion structure to help facilitate operations.

Waterman Basin Spreading Grounds Channel Maintenance (VD.2.12) – Phase 1

The Waterman Basin Spreading Grounds site is located along the west branch of Waterman Creek and is bordered by North Waterman Avenue to the west and East 40th Street to the south. The basins are an existing SBCFCD facility (System # 2-403-4 A-D) located approximately 3.2 miles northeast of the I-210 /I-215 interchange in the City of San Bernardino. The existing basins attenuate storm flows from Waterman Creek. The hydrologic changes (i.e., flow captured by the basins) are proposed to be covered under this HCP.

The proposed physical improvements for the Active Recharge Project at the Waterman Basins include the construction of two approximately 17-foot-long by 8-foot-tall spillway gates, refurbishment of 2 radial gate systems, and refurbishment of 3 inner-basin surface transfer structures and 10 low-level outlets/drains. Each of the basins should include the construction of remote level sensing and inflow/outflow metering. The site should also be improved by adding a flow measuring station in Waterman Creek at the diversion site and flow meters in the diversion structure to help facilitate operations. Maintenance of the actual basins is covered under a separate permit.

Operations

Water flows into the Waterman Basins from the north and is either bypassed around the basins and sent directly into Twin Creek, or routed through the basins by a radial gate diversion system. Flows that are diverted into the basin may be discharged at the southeast corner of the site into Twin Creek. The west and south perimeter berms of the site are a USACE levee.

There are four primary basin groups within the Waterman Basins site that provide an opportunity to increase stormwater capture and groundwater recharge in the basins. The basins are interconnected by a series of surface transfer structures and low-level drain tubes. The approximate volume available for stormwater capture is 180 acre-feet. Overall the Waterman Basins have an elevation differential of approximately 90 feet over the 2,800-foot site (3.2% grade).

A new operational plan would need to be implemented in order to realize the project benefit at Waterman Basins. In general, higher flows would be diverted into the basins more frequently and the basins would be operated at higher WSEs for longer durations to allow captured stormwater to be infiltrated into the basins.

Based on field observations and preliminary hydraulic analysis it is estimated that the existing diversion capacity could be as high as 723,968 afy/1,000 cfs/538.2 mgd with the proper hydraulic conditions. In order to create adequate hydraulic head to convey that amount into the basins a new armored spillway gate will be needed. Recharge rate modelling was performed to identify the diversion flow rate to fully utilize the basins. Based on the recharge rate modelling the project benefit would be an annual average of approximately 1,448 afy/2.0 cfs/1.1 mgd (Table 2-2).

Maintenance

The existing basins were cleaned to remove algae, emergent vegetation, and deposits of silt and clay in September 2017 under a separate permitting process. Impacts from that action are mitigated

independently, and the baseline condition of the bottoms of the basins is clean sand surface. The bottoms will be maintained in that state permanently in order to ensure effective recharge of water. Channel maintenance activities are covered under this HCP, and described in Section 2.1.6.

Twin Creek Spreading Grounds (VD.2.13) – Phase 2

The proposed improvements at the Twin Creek Spreading Grounds include reconstructing and armoring the berms between each basin and adding low level outlets/drains to each basin. Additionally, portions of the basins will need to be regraded to restore infiltration rates and achieve positive drainage (Figure 2-12).

New Construction

The proposed physical improvements for the Active Recharge Project at the Twin Creek Spreading Grounds include the reconstruction and armoring of seven existing berms, construction of one new water conservation berm above East 40th Street, construction of eight new low-level outlets/drains, and basin regrading. Each of the basins should include the construction of remote level sensing and inflow/outflow metering.

Operations

In general, the basin drain tubes will remain closed and the basins will be operated at higher WSEs for longer durations to allow captured stormwater to be infiltrated into the basins. During very high flow events the basins may need to be drained in order to preserve the flood control function of the system.

There are no diversion or inlet restrictions associated with this project. Modeled recharged rates indicate that the project benefit would be approximately 2.66 cfs/1,927 afy/1.4 mgd.

Maintenance

The existing basins will be cleaned to remove deposits of silt and clay. The average operating level within the basin will range between 4 and 8 feet, for a storage volume of 372 acre-feet. The construction of the new water conservation berm will prevent groundwater recharge operations in the zones directly adjacent to the USACE levees.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Badger Basins (VD.2.14) – Phase 4

Valley District conducts groundwater recharge basins maintenance activities at Badger Basins (Figure 2-12). Maintenance of these existing basins includes vegetation clearing below the ordinary high-water mark and cleaning of the basin bottoms to remove deposits of silt and clay. The bottoms will be permanently maintained to avoid growth of algae, emergent vegetation, or debris in order to promote effective recharge.

Enhanced Recharge Project – Seven Oaks Dam Water Conservation Improvements (VD.3) – Phase 1

The Enhanced Recharge Project – Seven Oaks Dam Water Conservation Improvements is located in the wash area of the main stem of the Santa Ana River downstream of Seven Oaks Dam. It is divided

into three parts. Parts 1a and 2 are covered under separate permits or the Wash Plan and include modification of existing facilities for improved sediment management and structure protection (Parts 1a and 1b) and extension of the existing Water Conservation District canal and construction of new spreading basins for groundwater recharge (Part 2). These separate parts of the project are described in more detail in Section 2.1.5. Part 3 is proposed as Covered Activities under this HCP and described below (Figure 2-12). Refer to Table 2-2 for the average annual hydrological change for this Covered Activity.

Change in Operations of Water Diversion Structure

Valley District would change operations at the Cuttle Weir water diversion structure from the existing diversion of 141,174 afy/195 cfs/126 mgd so that up to 361,984 afy/500 cfs/269 mgd of Santa Ana River water can be diverted into the Conservation District's canal, the sedimentation basin, and the enhanced spreading basins for groundwater recharge into the San Bernardino Basin Area. The water may also be delivered for direct use through the first part of the Plunge Pool Pipeline. Valley District has the rights to 1,250 cfs, but this HCP only address the recharge of 500 cfs.

Plunge Pool Pipeline

When conditions warrant (e.g., groundwater mounding, liquefaction), all or a portion of the 500 cfs would be sent to the inland feeder pipeline for groundwater recharge via the Plunge Pool Pipeline. The Plunge Pool Pipeline would connect approximately 2 miles of 98-inch-diameter pipe to the existing Inland Feeder pipeline owned and operated by the Metropolitan Water District of Southern California (Metropolitan).

Maintenance

Ongoing maintenance activities are proposed for coverage under the HCP. See Section 2.1.6 for general O&M activities conducted by the Valley District for their existing or planned facilities.

San Bernardino Municipal Water Department Activities

Vulcan Mining Groundwater Recharge Basins (WD.4) – Phase 4

New Construction

The Vulcan Mining Groundwater Recharge Basins are located east of Lytle Creek, northerly of Devil Creek Channel, and westerly of Cajon Boulevard within existing aggregate mining pits owned by Vulcan Materials Company (Figure 2-13). The Water Department proposes to develop groundwater recharge facilities within the basins in conjunction with Vulcan Materials Company for recharge of water supplied through the SWP, which would include construction of an SWP turnout, a metering facility, and the placement of a pipeline. The project will not include water supply from surface water diversions.

Western Municipal Water District of Riverside County Activities

Arlington Basin Water Quality Improvement Project (West.6) – Phase 1

New Construction

Western is planning to construct new artificial recharge basins at three different stormwater channels within the Arlington groundwater basin to provide additional water supply to the cities of Norco and Corona. The selected sites, located in the immediate vicinity of the Arlington Desalter in the City of Riverside, are commonly referred to as the Victoria site and other potential sites (Figure 2-13). Stormwater from Mockingbird Reservoir would be captured during stormwater events within the Victoria basin, and when water is available in the channel and capacity remains at the basins. The Victoria site is located in previously disturbed, non-operational farmlands. Common to the Victoria site and other potential sites, construction will include clearing and grubbing, earth work/removal, grading, inlet works, berms, and outlet works (spillway and interconnecting pipelines). These basins would be designed to capture and recharge stormwater, as well as any other recycled water that may be available in the future.

By enabling an increase of Arlington Desalter product water by up to 1,800 afy/2.5 cfs/1.3 mgd, this project effectively integrates various water resource management goals, including improved runoff management, groundwater recharge and water quality management, and provides a cost effective solution for preserving lower-cost local groundwater supplies for those areas receiving Arlington Desalter product water including the City of Norco and the City of Corona.

The construction would be scheduled in the late spring through fall to avoid wet weather delays. Construction activities are expected be completed within several months at any specific location.

Operations

Operation of the project would consist of operation of spillways and pipelines to provide water to the basins for recharge. It is estimated that between 1,800 and 2,500 afy/2.5 and 3.5 cfs/1.3 and 1.9 mgd of stormwater and non-potable water may be recharged by these facilities.

Maintenance

Maintenance activities for these recharge basins will consist of annual cleaning to remove accumulated sediment, bank repair, and vegetation and vector control. Access road maintenance may also be required. Maintenance is expected to occur during the fall prior to the wet season. See Section 2.1.6 for general O&M activities conducted by Western for their existing or planned facilities.

West Valley Water District Activities

Southern California Edison Afterbay Recharge Basins and Maintenance (WV.1) – Phase 1

The Southern California Edison Afterbay Recharge Basin is used to recharge water originally diverted at the existing SCE hydroelectric facility located on Riverside Avenue in the City of Rialto (Figure 2-13). This water originates from Lytle Creek and is used for power production by SCE before going to West Valley or the Fontana Water Company. If West Valley takes the water it goes to the Oliver P. Roemer Water Filtration Facility (WFF) for drinking water treatment.

However, Lytle Creek surface water flows fluctuate seasonally, and highly turbid water known as *china clay* is periodically encountered during heavy rain events in the upper portion of Lytle Creek. During these events the WFF is unable to take the water due to high turbidity, and the water is diverted to the SCE Afterbay Recharge Basin through an open canal for groundwater percolation. The frequency and quantity of water turned out to the Southern California Afterbay Recharge Basin during these heavy rain events varies and is dependent on the severity of the storm. Periodic maintenance of the existing open canal and basins would be covered in this HCP.

Maintenance activities would be performed in this basin up to twice per year to include weed abatement, berm repair, sediment removal, bottom scarification using heavy equipment such as dozers, dump truck, and excavator. Sediment material may be rearranged on site or removed to offsite disposal. The components of the project involve the open canal and recharge basin. See Section 2.1.6 for general O&M activities conducted by West Valley for their existing or planned facilities.

2.1.3 Wells and Water Conveyance Infrastructure

Wells and water conveyance infrastructure activities are related to the creation or improvement of wells, storage facilities, pipelines, channels, and ancillary facilities (e.g., access roads) and the O&M of existing infrastructure and associated development. The location of these activities is illustrated on Figure 2-14.

East Valley Water District

East Valley Water District Pipelines Maintenance (EV.2) – Phase 1

The subsections below describe activities associated with East Valley's water pipeline maintenance (Figure 2-15).

Flushing

Depending on the pipeline design, low points and dead ends require regularly scheduled flushing to remove sediment or stagnant water. A "blow off" or hydrant can be flushed for anywhere from 2 to 10 minutes at a flow rate of about 1,200 gallons per minute. The flow is directed to an existing storm drain, the street or curb, or gutter. Sodium thiosulfate is used to neutralize any chlorine residual.

Repairs

Leaks may occur in all water systems. Over time the vibration of traffic, earthquakes, and water hammer can cause damage to infrastructure and cause leaks. This can happen at various points in the infrastructure including meters, air/vacuum valves, blow-offs, hydrants, fittings, and/or joints. Repairs to the damaged area would likely require a backhoe, excavator, or hand digging to expose and uncover the leak in the pipeline. Depending on the size of the leak a repair band could be used to repair it, but in cases where the leaks are large, pipe sections might need to be replaced entirely.

East Valley owns pipelines placed in bridges that cross creeks or rivers, and on occasion, these pipelines can leak. To make repairs, equipment needs to be placed underneath the pipeline, which requires backhoes or excavators be placed in the creek or river.

Replacement

When water lines begin to develop many leaks in the same area East Valley replaces the main instead of continuing to make repairs. This could mean replacing certain sections (hundreds of feet) or longer runs (thousands of feet).

New Services

Anytime a customer signs up for a new service to a property that does not have an existing service East Valley will install a new service for them. This requires exposing the water main where the new service is to be installed and welding or tapping a new line into the existing main, installing a new lateral and meter. The same equipment used to repair leaks is generally used when installing new services.

Cleaning Appurtenances

Over time, any facilities that are exposed to the elements fade and become dirty. This includes hydrants, air/vacs, and blow-offs. Once a year East Valley staff cleans and repaints such facilities.

North Fork Pipeline

East Valley is the majority shareholder in the North Fork Water Company. As majority shareholder East Valley oversees the delivery of water shares to other shareholders as well as maintenance. The North Fork pipeline consists of 7.5 miles of 24- to 58-inch pipeline, 12 weirs, 2 sand separator boxes, 2 siphons, manholes, and blow-offs. The North Fork pipeline begins at the SCE afterbay that is located near the Seven Oaks Dam and ends near the intersection of Highland and Palm Avenues. The pipeline is mostly located in an easement that was acquired when it was constructed. On occasion the weirs and sandboxes fill up with dirt and debris and require cleaning. East Valley staff uses a tractor truck to clean out all the debris. On occasion the pipeline also develops leaks. East Valley staff repairs these in a similar fashion as distribution pipelines.

East Valley Water District Existing Facilities Maintenance (EV.3) – Phase 1

Facilities and Reservoirs

East Valley currently has 27.6 million gallons of storage in its system in both concrete and steel reservoirs. East Valley properties require periodic maintenance and activities associated with property maintenance that include the following (Figure 2-15).

- Weed Control
  - Weed control consists of cutting weeds as close to the ground as is practical. Weeds and unsightly plants shall be completely removed at East Valley Plants 24, 27, 28, 33, 40, 108, 120, 134, 142,146 and 149, on regularly scheduled dates. In addition, weeds shall be removed at the following locations: Plant 150 parcel 0279-211-34 (4.56 acres) near 5th Street and County Road. Future Plant 152 parcel 0155-151-25 (2.87 acres) near Mountain Avenue and Citrus Street. Three Patton Parcels 1191-251-02, 1191-251-05, 1191-251-06 (9 acres) near Highland Avenue and Central Avenue and New District offices Parcels 1192-241-01, 1196-231-01 (22 acres) near Sterling Avenue and between 5th and 3rd Street, as well as the parcel 1192-421-12 behind the Highland Post Office.

  - Where practical, weed control at all East Valley Plants shall be performed at the site perimeters consisting of a 3 foot strip exterior to the compound fences.
  - Weed control at East Valley Plant 33 shall be performed in the area between the east side of the driveway and the flood control fence.
- Litter
  - Remove all nuisance litter and trimmings from the premises at each regularly scheduled maintenance visit.
- Inspection and Notification
  - Perform the site inspections at each regularly scheduled maintenance visit.
- Plant Replacement
  - Promptly remove any dead or dying trees, shrubs, groundcover and any other plants that are dedicated to the planned landscape design.

Access Roads and Ditches

East Valley currently maintains 9 miles of dirt access roads and 3 miles of paved access roads within their service area and will continue to maintain these roads as needed (monthly, quarterly, and bi-annually). East Valley also annually repairs and maintains open ditches within the service area through bank repair.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

East Valley Water District New Reservoirs and Pipelines (EV.5) – Phase 3

In the recently updated Water System Master Plan, an analysis determined that East Valley would need an additional 32 million gallons of storage for the system build out in 2035 (MWH Global 2014) (Figure 2-15). A preliminary investigation has determined some potential sites but an additional study would be needed to determine the best locations for the additional storage. East Valley will require additional reservoirs ranging in size from 1 to 5 million gallons. For the construction and maintenance of storage reservoirs the following activities would be required.

- Clearing, grubbing, and grading
- Trenching and construction of new pipelines leading into and out of the new reservoir
- New or upgraded boosters to pump into or out of the new reservoir
- Drain lines for overflow or emptying the reservoir for maintenance
- Electrical panels, conduits, and transformer
- Buildings to house water conveyance and water reuse projects

The water master plan has identified the following (zone, size, number) reservoirs are needed.

- Mountain Zone – 1 and 2 million gallons
- Canal Zone – 2.5 and 2 million gallons
- Foothill Zone – 2 and 4 million gallons

- Upper Zone – 1 and 3 million gallons
- Intermediate Zone – 5 million gallons
- Lower Zone – 2 and 3.5 million gallons

Maintenance

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Metropolitan Water District of Southern California Activities

Upper Feeder Santa Ana River Bridge Project (Met.1) – Phase 1

The Upper Feeder aboveground concrete bridge crossing of the Santa Ana River includes access roads located north and south of the Santa Ana River at the ends of the bridge (Figure 2-15). Maintenance work on this section of the pipe, bridge, and access roads would include vegetation management beneath and adjacent to the Santa Ana River Bridge Crossing and the north access road maintenance program. Metropolitan proposes to routinely maintain vegetation along the dirt access road on the north side of the river and along the entire length of the bridge (see *Vegetation Management* under Section 2.1.6).

Vegetation would be trimmed back to the edge of the access road using mechanical mowers (tractor mounted or hand-held). The access road would then be bladed and any ruts filled in with existing soil. Grading of the road would include provisions to control flow of stormwater down the road (e.g., use of water bars and energy dissipation devices/design features). If required, soil could be imported to the site during access road maintenance. It is anticipated that one to two truckloads of soil could be required in each year maintenance occurs. The finished road width would be maintained at approximately 15 feet, windrow to windrow. Vegetation would also be removed within up to approximately 26 feet from the centerline of the bridge. Vegetation clearance within the riverbed would only occur outside of areas with flowing water within the riverbed. Worker access to the area around the bridge would be on foot. Vegetation clearance would be by hand; no heavy equipment would be used within the riverbed. Vegetation would be cut flush to the ground. The cut material would be placed in a chipper and collected for disposal off site.

All vegetation maintenance and access road grading activities would be conducted between mid-September and mid-March, outside of the avian breeding season, in order to avoid direct impacts on nesting birds. Work would not be performed in the rain to ensure workers are able to safely access the work area on foot. Vegetation maintenance and access road grading would be performed annually, or more frequently as needed.

A long-term routine maintenance Streambed Alteration Agreement (Notification No. 1600-213-007-R6 Revision 2) has been issued for this maintenance work, which will expire on March 26, 2027. See Section 2.1.6 for general O&M activities conducted by Metropolitan for their existing or planned facilities.

Metropolitan Water District Pipeline Maintenance (Met.2) – Phase 1

Metropolitan's O & M activities are conducted on a regular basis and are intended to maintain existing pipelines and appurtenant pipelines structures throughout San Bernardino and Riverside

counties (Figure 2-15). See Section 2.1.6 for a discussion of the general O&M activities common to most of the Permittee Agencies.

Metropolitan Water District Right-of-Way and Patrol Road Maintenance (Met.3) – Phase 1

Metropolitan's O&M activities are conducted on a regular basis and are intended to maintain existing facilities, patrol roads, power plants, and telecommunications sites throughout San Bernardino and Riverside Counties (Figure 2-15). Metropolitan has existing, long-term encumbrances on Metropolitan lands (i.e., telecommunication sites, road and utility crossings, and trails). Any new or renewed leases, easements, permits, and licenses Metropolitan issues will be required to operate under the terms of the HCP.

Metropolitan's maintenance activities are actions that occur repeatedly in one location and/or in many locations over a wide area (e.g., bank stabilization, storm-damage repair, facility maintenance). Maintenance activities are generally performed periodically and include actions such as minor construction, earth-moving, or vegetation clearing activities that can affect listed species. Below is a list of typical Metropolitan maintenance activities. These activities also include O&M projects and activities that are being implemented under Metropolitan's Right-of-Way and Infrastructure Protection Program (RWIPP).

- Site inspections and repairs
- Stockpiling
- Access road maintenance
- Bank repair
- Structure repair
- Maintenance of culverts, canals, and diversion structures
- Dike repair
- Vegetation management, including fuel modification, and vegetation removal for maintaining water conveyance and facility infrastructure access
- Vector control

See Section 2.1.6 for descriptions of these activities, which includes the general O&M activities common to most of the Permittee Agencies.

Orange County Water District Activities

Ongoing Maintenance of Prado Constructed Wetlands (OCWD.1) – Phase 1

The Prado Constructed Wetlands (PCW) consists of 46 individual artificial ponds, 45 weir boxes, conveyance channels, and a series of intervening dikes and maintenance (Figure 2-16). Proposed maintenance activities will occur within the wetland ponds, the diversion berm, the diversion/conveyance channels, and on access roads and water conveyance structures as described below

Wetland Ponds

Once a year, one-third of the wetland ponds will be drained, and silt, sand, and vegetation will be removed to maintain their productivity. As a result, two-thirds of the ponds will be in operation at all times. The material will be removed from the wetland ponds with earth movers, bulldozers, front-end loaders, or similar equipment. The excavated material will be stored on site and used to rebuild pond levees and access roads when needed. The volume of material removed from the ponds typically will not exceed 10,000 cubic yards of material per year.

Diversion Berm

The diversion berm diverts up to half of the river's low flow into the PCW. The berm is approximately 45 feet in width, 200 feet in length, and 6 to 10 feet in height. Because the berm is washed away during high flows, it generally requires reconstruction up to six times per year. The materials used to repair and/or reconstruct the diversion berm are obtained only from the Santa Ana River at the diversion berm site. It will be necessary to excavate approximately 30,000 cubic yards of sediment from the river annually to repair and/or reconstruct the diversion berm.

Diversion/Conveyance Channels

The PCW contains a series of diversion and conveyance channels that convey surface water flows to the wetland ponds. Periodically the levees along the diversion channels wash out or erode. Existing sediment from the Santa Ana River will be excavated to rebuild the diversion channel levees. An average of 10,000 cubic yards of material will be excavated annually to maintain the diversion channels. In addition, ongoing removal activities of invasive species such as the giant reed (*Arundo donax*) occur in the channels to maintain adequate surface water flows through the channels. Diversion channels will require rebuilding and/or maintenance up to six times per year.

Additionally, up to 10,000 cubic yards of sediment would be removed from the Cattail Channel at the convergence of the Southern Conveyance Channel near Wetland Pond E-6, and along the Southern Conveyance Channel near Wetland Pond S-1.

Up to 20,000 cubic yards of sediment would be removed from the diversion channel from the 60/40 reach. The excavated material would be deposited along the existing levees on each side of the channel.

Access Roads

A network of access roads at the PCW is needed to maintain the wetlands and facilitate habitat and wildlife management. The roads are constructed on the perimeter of the site and on sand levees along channels and around ponds. Periodically the access roads wash out and require reconstruction. In addition, invasive plant growth encroaching onto roads must be periodically removed. Sediment from the river will be excavated to rebuild the access roads. Up to six times a year, access roads will require rebuilding and/or maintenance. An average of 10,000 cubic yards of material will be excavated to maintain the access roads.

Water Conveyance Structures

Periodic vegetation removal activities, typically less than 10,000 square feet, are required at the outlets and inlets of water conveyance structures. Additionally, structures such as weir boxes and culverts, may be replaced.

Maintenance

Maintenance activities for the wetland ponds, the diversion berm, the diversion/conveyance channels, Pheasant Field Levees, and access roads and water conveyance structures will routinely occur as specified previously. The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Riverside Public Utilities Activities

Pipeline Crossing from Rapid Infiltration and Extraction Facility (RPU.1) – Phase 1

New Construction

The project objective is to install a 36-inch-diameter pipeline that would transport water from the RIX facility through a pipeline, which would cross under the Santa Ana River (Figure 2-16). The recycled water would be purchased from the City of San Bernardino. In addition to being used by RPU, the pipeline could also benefit the conservation strategy of the HCP should additional recycled water supplies become available and desired at a downstream location to benefit the Santa Ana sucker and other riverine habitat needs. The project would be located east of Riverside Avenue and south of Agua Mansa Road in the City of Colton.

The new pipeline would be constructed at a depth of at least 20 feet below the existing elevation of the Santa Ana River bottom, for a stretch of about 1,000 linear feet. The total new pipeline length for the project would be approximately 3,000 linear feet. A steel conductor casing may be installed around the pipeline. Open-cut trench construction and jack and bore methods are being evaluated for construction of the pipeline. Construction is estimated to take approximately 12 months. A 50-foot construction easement would be required. A temporary 100-foot construction area may be necessary within the riverbed.

Operations

The estimated reduction in discharge from the wastewater treatment plant could be up to 13.8 cfs (7.4 mgd). This amount is accounted for in the total discharge reduction as proposed by the Water Department in their Recycled Water Project (WD.1).

Maintenance

Visual inspection of the pipeline from the levee following large storm events, in addition to routine valve exercising would be conducted when necessary.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Future Gage Canal Transmission Main (RPU.2) – Phase 1

New Construction

The project would install a 24-inch-diameter water transmission main crossing under the Santa Ana River and connect with existing pipeline facilities. The project is located west of Mountain View Avenue and south of East Central Avenue in the City of San Bernardino (Figure 2-16). The project proposes a new pipeline be constructed within property owned by RPU and connected with an

existing pipeline north of the river. The pipeline would then cross the riverbed and go west to meet with an existing pipeline. The river crossing would occur upstream and parallel to the existing Gage Canal Transmission Main at a depth of at least 20 feet below the existing elevation of the river bottom. The total pipeline length is 5,425 linear feet. Open-cut trenching construction and jack and bore methods are being evaluated for construction of the Future Gage Canal Transmission Main. The construction period will last approximately 12 months. RPU would require a 50-foot construction easement for the project.

Maintenance

Visual inspection of the pipeline from the levee following large storm events, in addition to routine valve exercising would be conducted when necessary. The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6, and pipeline maintenance may include the activities described therein under *Pipelines and Associated Facilities*.

Flume and Riverside Canal Pipeline Replacements (RPU.3) – Phase 1

New Construction

The Flume and Riverside Canal Pipeline Replacement project would replace two 42-inch-diameter pipelines crossing under the Santa Ana River in San Bernardino County. The project is located east of Union Pacific Railroad and north of Washington Street in the City of Colton (Figure 2-16).

The project proposes that the two replacement pipelines be constructed parallel to the existing Flume and Riverside Canal pipelines for a length of 1,580 linear feet at a depth of at least 20 feet below the existing elevation of the river bottom. A steel conductor casing may be installed around the pipeline. Open-cut trenching and jack and bore methods are being evaluated for construction of the pipelines. A 100-foot construction easement is anticipated for these replacements. The time period of construction is estimated to be 12 months.

Maintenance

Visual inspection of the pipeline from the levee following large storm events, in addition to routine valve exercising would be conducted when necessary.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Jurupa Ditch Company Well Field (RPU.4) – Phase 1

New Construction

As a majority shareholder, RPU operates the Jurupa Ditch Company well field. Currently, the Jurupa 7 well is used to provide non-potable water to a local golf course. This project will include the abandonment/removal of two wells and replacement with one new well to facilitate water delivery to the golf course (Figure 2-16). No hydrological changes are anticipated as a result of this project.

Maintenance

Maintenance will consist of rehabilitating the existing Jurupa 7 well until it is replaced with a new well. Rehabilitation will occur when necessary, which is estimated to be every 20 years. Rehabilitation of the well would consist of bringing in a pump rig to: remove and reinstall the well

pump, brush and bail the well, and airlift and swab the well. Redevelopment of the well would include equipping the well with a temporary pump and pumping the well to waste, which would likely consist of discharging to a baker tank. Maintenance would include vehicular ingress and egress. Additional maintenance at Jurupa 7 or a replacement well will also consist of typical facility maintenance such as mechanical or electrical equipment replacement, or securing the site.

An aboveground pipeline at the site may also need to be repaired from time to time.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Bunker Hill Basin Proposed Wells and Pipelines (RPU.6) – Phase 1

New Construction

RPU plans to construct three new wells within the southern portion of the Bunker Hill Groundwater Basin (Figure 2-16). Each well will be implemented individually. RPU anticipates construction of the three new wells during the permit term, and each well is expected to take up to 1 year to construct. This project will require new pipelines to connect with existing transmission mains, most of which will be within improved roadways and previously disturbed areas. The project will require fencing, lighting, and a pump house at each well site. At this time, RPU cannot determine the exact location for each well; however, for the purposes of this HCP, three representative sites were submitted for analysis.

Operations

New wells and their associated facilities will extract water from the underlying groundwater basin for municipal use. Generally, wells operate year-round.

Maintenance

Routine maintenance at each well site will consist of facility maintenance such as mechanical or electrical equipment replacement, or securing the site. Routine maintenance is not anticipated to have any environmental impacts. Rehabilitation at each well will occur approximately every 10 years and will consist of bringing in a pump rig to: remove and reinstall the well pump, brush and bail the well, and airlift and swab the well. Redevelopment of the well would include equipping the well with a temporary pump and pumping the well to waste utilizing onsite facilities or a baker tank. All impacts would be temporary in nature and would essentially consist of vehicular ingress and egress.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Gage Canal Transmission Main Replacement (RPU.7) – Phase 1

New Construction

The project objective is to replace a 30-inch-diameter concrete cylinder water transmission main crossing under the Santa Ana River in San Bernardino. The project is located east of Tippecanoe Avenue and south of Central Avenue in the City of San Bernardino (Figure 2-17). The project proposes that a new pipeline be constructed parallel to the existing main at a depth of at least

20 feet below the existing elevation of the river bottom. To accommodate the flow rate of future wells, it is also proposed that the new transmission main be upsized to a 42-inch-diameter steel cement mortar-lined and coated pipe. Open-cut trenching construction and jack and bore methods are being evaluated for the construction of the Gage Canal Transmission Main. The time period of construction is estimated to be 12 months. The project proposes an upsize replacement of the current transmission main to a 42-inch-diameter pipe for a length of 1,185 linear feet.

Maintenance

Routine maintenance of pipelines is described in Riverside Public Utilities Maintenance of Supply Transmission Mains (RPU.15), below. Visual inspection from the levee following large storm events, in addition to routine valve exercising, would be conducted.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Santa Ana River Sustainable Parks and Tributaries Water Reuse Project (RPU.10) – Phase 1

The proposed project is a joint project between RPU and Valley District/Upper SAR HCP to install approximately 52,000 feet of pipeline to deliver tertiary treated recycled water from the Riverside Regional Water Quality Control Plant (RWQCP) to Tributary Restoration Sites that are part of the conservation strategy of the HCP (Figure 2-17). The project is currently in the planning and design stage.

New Construction

New construction for the project includes 52,000 feet of pipeline and additional facilities. Additional facilities include a storage tank, pump station, and dechlorination stations. The pipeline would also provide recycled water irrigation to several of Riverside's high-priority parks. Construction is expected to take 24 to 36 months.

Operations

The City of Riverside plans to reduce its discharge to the Santa Ana River at RWQCP by an annual average of 14,343 afy/19.8 cfs/12.8 mgd. A portion of this volume (4,995 afy/6.9 cfs/4.5 mgd) will be used by the city, and another portion (9,348 afy/12.9 cfs/8.3 mgd) will be used for Santa Ana River tributary in-stream flows for the Tributary Restoration Sites (Table 2-2) and therefore will stay in the river and is not a reduction in discharge. Sites considered for delivery of recycled water discharge under this HCP include the following Tributary Restoration Sites via new pipeline constructed as part of the project.

- **Anza Drain:** 728 afy/1.0 cfs/0.6 mgd. In addition to new pipeline for recycled water discharge, there would be construction of a dechlorination facility, which would occur in previously disturbed, vacant areas. This facility would be utilized by both Anza Drain and the Old Ranch Road Channel.
- **Old Ranch Creek:** 1,448 afy/2.0 cfs/1.3 mgd.
- **Tequesquite Arroyo**: 728 afy/1.0 cfs/0.6 mgd. In addition to the new pipeline for recycled water discharge, there would also be construction of a dechlorination facility, which would occur in areas that are already disturbed.

- **Evans Lake**: 2,172 afy/3.0 cfs/1.9 mgd. In addition to the new pipeline for recycled water discharge, there would also be construction of channel improvements and a dechlorination facility, which would occur in the already disturbed parking area located in Fairmount Park.
- **Hidden Valley Creek**: 2,217 afy/3.09 cfs/2.0 mgd.
- **Hidden Valley Ponds**: 507 afy/0.7cfs/0.5 mgd.
- **Lower Hole Creek**: Up to 1,448 afy/2.0 cfs/1.3 mgd.

Maintenance

The proposed recycled water customers would begin receiving recycled water for use as landscape irrigation. This project will meet all Department of Drinking Water and RWQCB requirements. Given this project is still in the conceptual stage, maintenance at the restoration tributaries are not well understood at this time.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Riverside Public Utilities Weed Abatement and Property Maintenance (RPU.12) – Phase 1

RPU owns numerous vacant parcels (identified below), which require site inspections and maintenance that typically consists of weed abatement, trash removal, non-organic material cleanup, and/or removal of trespassers (Figure 2-17). Weed abatement activities are generally conducted on a quarterly basis as required by the local fire agency in order to comply with fire and public safety code requirements, and consist of fence line clearing, mowing fire breaks, and cross-cut fire breaks. Weed abatement activities are assumed to be a permanent impact because they occur quarterly.

- Cooley Ranch Parcels (six parcels: San Bernardino County Assessor Parcel Numbers [APNs] 0279-042-10, 0279-041-02, 0279-042-11, 0279-031-39, 0279-031-38, and 0279-021-38)
- Flume Tract Parcels (six parcels: San Bernardino County APNs 0163-362-08, 0163-362-09, 0276-123-11, 0163-141-15, 0163-381-07, and 0163-381-06)
- Headgates North Parcels/Gage (three parcels: San Bernardino County APNs 0282-251-25, 0280-251-18, and 0280-251-06)
- Jurupa 7 (one parcel: San Bernardino County APN 0277-021-17)
- Scheuer Parcel (four parcels: San Bernardino County APNs 0278-161-30, 0278-181-12, 0278-181-19, and 0278-161-29)
- Amazon Parcel (two parcels: San Bernardino County APNs 0292-011-32 and 0292-011-40)
- California Redlands Parcels (five parcels: San Bernardino County APNs 0167-672-03, 0292-011-43, 0167-701-04, 0167-701-04, and 0167-721-03)
- Garner Parcels (two parcels: San Bernardino County APNs 0279-041-14 and 0279-041-15)
- Tippecanoe (one parcel: San Bernardino County APN 0280-251-53)

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Drainage A Modification (RPU.13) – Phase 2

New Construction

Drainage A is an ephemeral channel the begins in the vicinity of I-10 and flows south, adjacent to Fogg Street; and then meanders across vacant land before discharging into the Santa Ana River just west of a railroad crossing (Figure 2-17). Some of the vacant land through which Drainage A flows is owned by RPU and is the area planned for the Riverside North Aquifer Storage and Recovery Project (RPU.5) off-stream recharge basins. Lytle Creek Channel historically flowed through the Colton area and comingled with the Santa Ana River in this vicinity. Lytle Creek ceased flowing through this area once SBCFCD redirected and improved the channel. Drainage A occurs within part of the historical Lytle Creek Channel. The Drainage A project site currently supports Santa Ana River woollystar (*Eriastrum densifolium*) and Riversidean alluvial fan sage scrub habitat.

The project proposes to relocate part of Drainage A to the north, along the perimeter of RPU's property. The relocation would allow RPU to utilize its property for constructing the northern off-stream basin and provide for a material laydown area for the Riverside North Aquifer Storage and Recovery Project (RPU.5). Drainage A would continue to support upland species and habitat, and continue to drain to the Santa Ana River. A culvert may also be necessary to improve the flow of the drainage channel through an access road that is currently impacted by storm flows each winter. Improvements to Drainage A have yet to be studied or designed. The relocation of Drainage A could potentially be part of an overall management plan for this area and be modified in such a way that it would provide an improved benefit to the Santa Ana River woollystar and Riversidean alluvial fan sage scrub habitat.

Operations

RPU is planning to complete a study to fully assess the hydraulics of Drainage A and its role in supporting onsite habitat. A biological expert will be retained to assist designing the Drainage A improvements and assure that the onsite habitat that Drainage A supports would remain the same or be improved.

Maintenance

This project would be constructed such that little to no maintenance would be necessary and the drainage channel would continue to support wildlife species. Site inspections would occur annually.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Waterman Pipeline Upsizing Project (RPU.14) – Phase 1

New Construction

The project objective is to replace a segment of a 36-inch-diameter concrete cylinder water transmission main crossing under the Santa Ana River in San Bernardino at Waterman Avenue (Figure 2-17). The Waterman Pipeline extends from the Bunker Hill Subbasin in the City of San Bernardino to the Linden and Evans Reservoir in the City of Riverside, and is used to convey groundwater to the City of Riverside. The project is located along Waterman Avenue at the Santa Ana River crossing in San Bernardino generally between Vanderbilt Way and Park Center Circle. The project proposes that a new pipeline be constructed to replace the existing main at a depth of at

least 20 feet below the existing elevation of the river bottom. To accommodate the flow rate, it is also proposed that the new transmission main be upsized to a 54-inch-diameter steel cement mortar-lined and coated pipe. Open-cut trenching construction and jack and bore methods are being evaluated for construction of the Waterman Pipeline. The time period of construction is estimated to be 12 months, and the project proposes an upsize replacement of the current transmission main to a 54-inch-diameter pipe for a length of approximately 500 linear feet within the riverbed area.

Maintenance

Visual inspection from the levee following large storm events, in addition to routine valve exercising, would be conducted. Given this project is relatively new, minor to no maintenance would be anticipated.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Riverside Public Utilities Maintenance of Supply Transmission Mains (RPU.15) – Phase 1

The project objective is to conduct general maintenance activities for RPU's supply transmission mains (Figure 2-17). See Section 2.1.6 for general O&M activities common to most of the Permittee Agencies. Over 95% of the transmission mains occur in developed areas; however, there are three Santa Ana River crossings that could potentially have environmental impacts should they become exposed following a large storm event and require repairs or replacement.

- 1,000 feet upstream of Tippecanoe Avenue
- At the Waterman Avenue bridge crossing
- One-half mile upstream of La Cadena Drive

The supply transmission mains would be maintained on an ongoing basis with repairs made as needed. Non-emergency repairs in the river will be conducted when the Santa Ana River is dry.

San Bernardino Valley Municipal Water District Activities

Valley District Existing Pipelines and Pipeline Crossings (VD.4) – Phase 1

Maintenance

Pipeline Maintenance and Repair

Maintenance or repair of existing pipelines and pipeline crossings may be necessary for Valley District pipelines. Valley District has two pipelines proposed for coverage that cross Mill Creek and City Creek. Greenspot pipeline is a 42-inch pipeline that crosses Mill Creek (Figure 2-18).

Valley District visual inspection patrols will occur monthly and after periods of heavy or prolonged storm activity. Patrols will consist of one or two maintenance personnel walking the pipeline alignment in the active channel area to verify the condition of the channel and pipeline. Only existing footpaths will be used for these patrols.

Maintenance or repair is expected to occur after larger storm events that cause erosion that removes the existing earthen cover and threatens to expose or does expose Valley District

structures and pipelines within active channel areas. It is expected that these conditions may occur every 5 to 10 years. The repairs may take a minimum of 5 days and up to 3 months to complete.

Repair can involve fixing or replacing sections of cement mortar lined and coated, welded, steel pipelines; replacing or repairing pipeline concrete encasement; and or restoring the channel bottom to pre-storm surface elevations along the pipeline. Valley District anticipates utilizing end or side loading dump trucks, flatbed tractor trailer trucks, small backhoe loaders, large loaders, large bulldozers, and or larger excavators as required to repair the channel or pipeline. Approximately 20-foot-wide access roads would be established to and from the nearest street or access point into the channel. It is anticipated a minimum of 50- to 100-foot-wide area upstream and downstream of the centerline of the pipeline in the channel area may be cleared in order to do all required repairs. It is anticipated that between 2 and 20 construction workers would be required depending on the size and complexity of the repairs.

Pipeline repairs can include replacing damaged or broken sections of pipeline utilizing standard practices for installation of large diameter welded steel pipeline. This work will involve heavy construction equipment such as graders, dump trucks, and excavators. Types of work involved are trenching, lifting and setting of pipes, welding of pipes, backfilling, and site restoration. Staging and stockpile areas will be located in previously disturbed areas, if possible.

Concrete Pipeline Encasement Repair

Concrete pipeline encasement repair can include removing damaged portions of encasement and replacing, or installing, new concrete steel reinforcement and pouring new concrete to replace the damaged areas. This work will involve large construction equipment normally associated with construction of concrete placement. Types of work involved are trenching, forming of encasement, steel reinforcement placement, pouring concrete, backfilling, and site restoration.

Channel Bottom Grade Repair

Existing channel bottom grade repair where erosion of soil is threatening to expose the pipeline or encasement can include the restoration of the channel bottoms utilizing native sand, rock, and boulder material. The channel bottom will be graded to the pre-storm existing elevation conditions if possible after all pipeline repairs are done. Valley District will avoid creating any abrupt changes in channel elevations that may restrict passage of aquatic wildlife. All existing rock armoring in the channel that was removed for the repairs will be replaced in-kind. After completion of the repairs the existing stream course will be restored in coordination with the resource agencies or as established in this HCP. All access roads will be returned to their pre-project conditions.

It is possible that these pipelines, or portions of these pipelines may need to be replaced during the course of the permit term. Replacement would also be covered under this HCP.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

San Bernardino Municipal Water Department Activities

San Bernardino Municipal Water Department Other Pipelines (WD.2) – Phase 1

The project objective is to conduct general maintenance activities for Water Department pipelines. See Section 2.1.6 for general O&M activities common to most of the Permittee Agencies. The Water Department maintains six pipeline stream crossings along the Santa Ana River (Figure 2-18).

- Pipeline Crossing at Tippecanoe Avenue
- Pipeline Crossing at Mountain View Avenue
- Pipeline Crossing at E Street
- Pipeline Crossing at Waterman Avenue
- Pipeline Crossing at Orange Show Road
- Geothermal Pipeline Crossing downstream of the confluence with City Creek (described below)

The pipeline crossings at Tippecanoe Avenue, Mountain View Avenue, E Street, Orange Show Road, and Waterman Avenue hang in existing bridges. Replacement of these would involve temporary impacts on the Santa Ana River channel so that equipment could access the pipeline located in the bridge structure. An approximately 25- by 100-foot temporary construction area would be required. It is estimated that each pipeline is likely to be repaired or replaced once during the life of the permit. Non-emergency repairs such as this will be conducted when the Santa Ana River is dry.

Geothermal Pipeline

The Water Department's Geothermal Facility consists of two geothermal production wells that produce up to 2.88 million gallons per day of geothermal water from within the San Jacinto Fault system. Geothermal water is extracted and delivered through insulated pipes to heat various municipal buildings in the downtown area of the City of San Bernardino. After heat exchange, waste geothermal water is then discharged into either the sanitary sewer line or to one or more of 10 outfalls. Seven outfalls feed into storm channels that drain to tributary creeks of the Santa Ana River. These creeks include Lytle Creek, Warm Creek, City Creek, and East Twin Creek. The covered project includes routine maintenance of the 12-inch geothermal pipeline where it crosses underneath the Santa Ana River downstream of the confluence with City Creek.

Geothermal pipeline facilities may also be used for future distribution of recycled water from the proposed SBMWD Recycled Water Project (WD.1) to direct use sites south of the Santa Ana River.

For example, within the portion that crosses the Santa Ana River, if a leak has been identified that would require repair, work would be performed by excavation above and around the pipeline using a backhoe or other equipment. Non-emergency repairs such as this will be conducted when the Santa Ana River is dry.

Maintenance/Operations

Routine maintenance of the geothermal pipeline includes visual inspections as needed. When leaks or other issues that need repair are identified, activities could include temporary flow diversions, pipeline excavation with heavy equipment, temporary stockpiles, leak repairs, and replacement of spoils. Pipeline maintenance may include the activities described in Section 2.1.6 under *Pipelines*

and Associated Facilities, which also includes the general O&M activities common to most of the Permittee Agencies.

Kenwood Well Field and Pipeline (WD.3) – Phase 1

The Kenwood well field is located in Cajon Creek Wash near the I-215/I-15 junction (Figure 2-18). The well field is connected to other Water Department infrastructure by an existing pipeline.

New Construction

The Water Department is proposing to add one new well and associated pipeline to the existing facility, as well as a new main pipeline from the well field to an existing 20-inch pipeline in Cajon Boulevard approximately 650 feet northwest of the Cajon Boulevard and Kenwood Avenue intersection.

Kenwood Well No. 3 will be located just north of existing Kenwood Well No. 1, approximately 4,400 feet northwest of the Cajon Boulevard and Kenwood Avenue intersection. The future groundwater well pump will be accessed through existing unimproved roads off of Cajon Boulevard and will be similar to existing Kenwood Well No. 2 in capacity and construction. Construction will consist of well drilling/development, pump and motor installation, 12-inch-diameter discharge piping, a block-type pump house measuring approximately 25 by 25 feet, and perimeter fencing measuring approximately 50 by 50 feet.

Operations

The new well is expected to produce approximately 4.90 cfs (2.6 mgd) at a total dynamic head of 140 feet.

Maintenance

Maintenance activities would cover four existing wells at the Kenwood well field site (Cajon Canyon Well, Vincent Well, Kenwood Well No. 1, and Kenwood Well No.2), and the one new well, for a total of five wells. Maintenance of the road within Cajon Wash would be completed at most annually, but more commonly every second year. Pipeline maintenance will be conducted as needed for the Kenwood pipeline between the well field and the Devore reservoir.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

San Bernardino Municipal Water Department Existing Facilities Maintenance (WD.5) – Phase 1

The project objective is to conduct general maintenance activities for the Water Department's existing or planned facilities to maintain existing access roads, pipelines, and wells (Figure 2-18). Over 95% of the facilities occur in developed areas and would be maintained on an ongoing basis with repairs made as needed. See Section 2.1.6 for general O&M activities conducted by the Water Department.

Western Municipal Water District of Riverside County Activities

Western Municipal Water District Pipeline Rehabilitation and Replacement Program (West.1) – Phase 2

The Pipeline Rehabilitation and Replacement Program will be an evaluation and replacement of aging pipeline within Western's retail service area of southeastern Riverside County (Figure 2-18). Over 75% of the aging pipeline occurs in existing roadways or other developed areas. Most pipe is between 8 and 24 inches in diameter but can be up to 8 feet. The project will begin with inspecting the condition of the existing pipelines by either videotaping inside the pipe or reading data from cathodic protection test stations to determine whether pipeline rehabilitation (relining), spot repair, or replacement can address any identified issues. The pipe condition assessment does not have a physical disturbance except along potential access roads that occur in natural areas, as well as small excavations (estimated to be less than 500 square feet of impact area along the pipeline for access at test station locations with an estimated three to four per mile of pipeline). A multi-year pipeline rehabilitation and replacement project will be developed based on the condition assessment.

The rehabilitation and replacement may require pipe lining or full replacement of pipelines with associated construction activities, including excavation;, access road grading, staging and work area creation, and attendant noise and light. For lining and replacement, an open-cut trench is used and instillation would require about a 20- by 100-foot footprint for each standard 40-foot pipe length. Typical construction equipment would include backhoes, excavators, and other heavy equipment. These activities will largely result in a temporary impact, although a permanent 12-foot width is assumed to accommodate the access road. For dewatering a section of pipeline in preparation for lining or replacement, a temporary aboveground pipeline may need to be constructed to divert the water.

Construction activities may occur year round, but construction scheduling is expected to be concentrated in the late spring through fall to avoid wet weather delays. Construction activities would generally be completed within 2 to 3 months for a specific project area. Several project areas could be completed in any specific year.

Operations

Operational activities for rehabilitated or replaced pipelines will be covered under the Water Delivery and Wastewater Collection System Operation (West.2) project (see below).

Maintenance

Maintenance activities for rehabilitated or replaced pipelines will be covered under the Water Delivery and Wastewater Collection System Operation (West.2) project.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Western Municipal Water District Water Delivery and Wastewater Collection System Operation (West.2) – Phase 1

The facilities in the water delivery and wastewater collection system include pipelines, tanks, pumping stations, valves, hydrants, air release valves, blow-offs, and other appurtenances required

to operate these systems (Figure 2-18). Approximately 95% of this pipeline system occurs in natural habitat. These facilities provide critical services to Western customers for potable water and wastewater collection. The systems continue to expand with new development, but new pipelines are almost entirely within existing ROW on public roads. Maintenance and repair of these facilities is continually required to ensure proper operation.

Maintenance and repair activities for these facilities occur year-round, and would generally be completed within hours or days for a specific issue/area.

Operations

Operation of the potable and recycled water pipelines is generally performed remotely using a supervisory control and data acquisition (SCADA) system. However, operations will require personnel to routinely visit facilities for inspections, sampling, and equipment operation and monitoring.

Maintenance

Maintenance activities for these facilities routinely requires maintenance of access roads, releases of potable or recycled water for inspections and preventative maintenance, and excavations for preventative maintenance and repair. Approximately 250,000 gallons of water would be released and permitted and reported in accordance with State Water Resources Control Board (SWRCB)/RWQCB potable water discharge permits. Between 4 and 5 million gallons of unchlorinated or dechlorinated potable water would be released in order to do major maintenance approximately once every 10–15 years. Water would likely be released into nearby fields and infiltrate into the ground. Tank maintenance may include recoating of the interior, replacement of cathodic protection, and repainting of the exterior. Collection systems require frequent maintenance including cleaning and video inspections. Approximately 7 miles of unpaved access roads are maintained with grading, removal of debris, and other associated activities to keep them smooth and drivable. Such activity occurs not more than annually. Maintenance activities may require some work within the stream channel.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Recycled Water Live Stream Discharge (West.3) – Phase 1

New Construction

Currently, Western's Water Recycling Facility has no live stream discharge point. Should excess recycled water be available during wet months, the recycled water is routed through the recycled distribution system to a discharge point on the Western Riverside Regional Wastewater Authority (WRCRWA) treatment plant's collection system. The recycled water is then taken through the WRCRWA plant and retreated for release to the Prado Basin. Rather than continue this inefficient process, Western proposes to construct an emergency discharge point for recycled water to be released into Mockingbird Creek or a drainage to Mockingbird Creek, which would include an in-stream energy diffuser, dechlorination station, and a new valve system to redirect the water (Figure 2-19). Mockingbird Creek is an ephemeral drainage that drains into Mockingbird Reservoir and a human-made reservoir that is not hydrologically connected to the Santa Ana River.

A test event would occur the first year of operations. Construction is estimated to start in 2020. The construction of the discharge point would be scheduled early in the project to avoid wet weather delays. Construction activities are expected be completed within weeks or a month. Operation of the discharge point would occur during wet weather only when storage is full and there is insufficient usage. Releases would be adaptively monitored and managed to ensure existing riparian habitat conditions are not degraded.

Operations

Operation of the facility will require periodic opening of a valve or other control equipment to allow recycled water to drain through to the discharge point. A test event is also expected to occur near the completion of construction. The dechlorination station will also require operational support when discharging. The discharge will increase flows within Mockingbird Creek when excess recycled water is available during wet months, typically November 1 to June 1.[4] Excess recycled water would generally only be released during long periods of wet weather because recycled water during short rain periods is stored for future use. Generally, releases of an annual average of up to approximately 6,733 afy/9.3 cfs/5 mgd would occur. Releases are not anticipated to be continuous during these months but could occur over several weeks (Table 2-2).

Maintenance

Maintenance of the facility may require periodic cleaning of the creek/drainage inlet structure, which is likely to occur in the fall prior to the wet season (typically November 1 to June 1). Maintenance may also be required of any associated piping and appurtenances and access roads to maintain connection of the discharge point to the recycled water distribution system. In addition, maintenance may be required on a dechlorination station that will be required for discharges. Excavations with a backhoe may be required for preventative maintenance and repair.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Recycled Water Crossing to South AFC (West.4) – Phase 1

This project will consist of construction of a crossing of the Colorado River Aqueduct with a 12-inch recycled water pipeline (Figure 2-19). The proposed location is Western's Operations Center at 16451 El Sobrante Road in the City of Riverside. Construction or repair of access roads may be required on the south side of the Colorado River Aqueduct, which is included in the maximum design consideration area for this project.

The construction of the crossing would be scheduled in the late spring through fall to avoid wet weather delays. Construction activities are expected be completed in 2 to 4 weeks. Once constructed, the crossing would operate continuously.

Operations

Operation of the facility will require periodic checks of the leak detection system and any required repairs to piping or the leak detection system.

[4] This is the time period in which demand for recycled water is low to nil due to low temperatures and precipitation. During this time sewage continues to be converted to recycled water and, without demand that equals or exceeds the sewer flow, the recycled water that exceeds demand is discharged as effluent.

Maintenance

Maintenance of the facility may require periodic maintenance of the piping and associated leak detection system. In addition, maintenance may be required of any associated access roads to maintain the piping. Excavations may also be required for preventative maintenance and repair.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Riverside Corona Feeder Project (West.7) – Phase 1

New Construction

The Riverside Corona Feeder Project is a conjunctive use project consisting of up to 20 new and existing wells and 28 miles of new pipeline that will capture, store, and deliver water in wet years in order to increase firm water supplies, reduce water costs, and improve water quality (Figure 2-19). Wellhead treatment will remediate perchlorate and other contaminants. This water will come from local runoff, including releases from Seven Oaks Dam and the SWP. Projects designed to capture this water are described elsewhere. This project does not include the construction of new water recharge facilities. Up to 40,000 acre-feet of water will be stored in San Bernardino Valley and Chino groundwater basins to be available for use in dry years. This water will be transported by pipeline through the Riverside area to the ultimate use locations. All water recharge and capture has been accounted for.

The construction of wells, treatment systems, and pipelines likely will take multiple years to complete and be conducted generally year-round.

Operations

Operation of these facilities requires personnel to routinely visit facilities for inspections, sampling, and equipment operation and monitoring. Releases of raw water will occur at well sites during startup activities. Additionally, periodically wells will require rehabilitation that will include mobilization of heavy equipment, with associated noise and water releases. If well head treatment is implemented, routine monitoring, sampling, and inspections will be required of the treatment systems.

Maintenance

Maintenance activities for these facilities will require routine maintenance of access roads, releases of raw and potable for inspections and preventative maintenance, and excavations for preventative maintenance and repair.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Replacement of the Owl Tree and March Line Pipelines (West.8) – Phase 1

The Owl Tree and March Line potable and recycled water pipelines, respectively, follow roughly the same alignment buried within an approximate 6-foot depth (Figure 2-19). This project includes replacement of both of these sections of aging infrastructure with an open-cut trench. Typical construction equipment would include backhoes, excavators, and other heavy equipment. The project includes replacement of 11,100 feet of 30-inch-diameter potable water pipeline and

8,800 feet of aging 24-inch-diameter recycled water pipeline. Replacement of the pipelines will require construction through areas under the influence of surface water drainages, such as dry washes. The expected footprint width is 25 feet, which would accommodate deep excavation as required. Preliminary staging areas will be identified for the stockpiling of materials and equipment storage. Staging areas would include existing disturbed or developed areas where possible.

Maintenance activities for these facilities routinely requires maintenance of access roads, releases of potable or recycled water for inspections and preventative maintenance, and excavations for preventative maintenance and repair.

Construction scheduling is expected to be concentrated in the late spring through fall to avoid wet weather delays. Construction activities would generally be completed within a year. No significant changes in stream flows are anticipated, and any impact would be short term on the order of hours or days. Some releases of water may occur during startup O&M but are expected to be temporary.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Lake Mathews and Burwood Drive Pipeline Construction (West.9) – Phase 1

This project will construct approximately 7,100 feet of pipeline in Lake Mathews Drive and Burwood Drive (Figure 2-19). This is a master plan pipeline that will provide higher pressure in the southwest of Western's retail area. Modeling results indicate that this pipeline facility would address low fire flow capability. Modeling indicates that under current conditions, flows in the system to respond to a fire would result in low and potentially negative pressure at some services. Replacement of the pipeline will require construction through areas under the influence of surface water drainages. Some deep excavation may be anticipated. The expected footprint width is 25 feet, which would accommodate deep excavation as required.

Maintenance activities for these facilities routinely requires maintenance of access roads, releases of potable or recycled water for inspections and preventative maintenance, and excavations for preventative maintenance and repair.

Construction scheduling is expected to be concentrated in the late spring through fall to avoid wet weather delays. Minor temporary stream impacts may occur but would be mitigated. No significant changes in stream flows are anticipated, and any impact would be short term, on the order of hours or days. Some releases of water may occur during startup O&M but are expected to be temporary. Refer to Table 2-2 for the average annual hydrological change for this Covered Activity.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

Construction of Potable Water/Recycled Water Tanks (West.10) – Phase 2

This project will construct water tanks within Western's service area and may include both potable and recycled water tanks (Figure 2-19). These tanks are needed so that there is sufficient capacity to meet system demand during a Metropolitan outage of the Mills Treatment Plant. Current contractual requirements with Metropolitan require Western to be able to meet system demand requirements for 7 days of outage. Currently, Western has only been able to meet a demands for a 6-day outage by importing water from Riverside at levels that exceeded the design capacity of the interconnection facility. It is estimated that an additional 6 million gallons of storage is needed. The initial tanks will

replace the lost storage that will occur with the decommissioning of aging tanks. Subsequent tanks will be constructed according to the facilities master plan. Tank construction sites must be on elevated areas where a gravity feed can be used. Erosion during releases is typically avoided by engineering tank releases to flow into existing stream courses or channels, which can be accomplished with concrete ditches.

Each tank will require preparation of a large pad, installation of the tank and connecting pipelines, and construction of an access road. Such activities would generally be scheduled in the late spring through fall to avoid wet weather delays with phasing of all tank construction over several years. No significant changes in stream flows are anticipated, and any impact would be short term, on the order of hours or days. Some releases of water may occur during startup O&M but will be temporary.

Operations

Operation of the tank filling and draining operation is generally performed remotely using a SCADA system. Should SCADA not be operable, tank operations can be performed at the site. Staff routinely inspect the tanks and perform sampling activities at the tank locations. Operational activities for new tanks will be covered under the Water Delivery and Wastewater Collection System Operation (West.2) project.

Maintenance

Maintenance activities for these tanks routinely requires maintenance of access roads, releases of potable or recycled water for inspections and preventative maintenance, and excavations for preventative maintenance and repair of connecting piping. Tank maintenance may include recoating of the interior, replacement of cathodic protection, and repainting of the exterior. Maintenance activities for new tanks will be covered under the Water Delivery and Wastewater Collection System Operation (West.2) project.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

West Valley Water District Activities

West Valley Pipeline Maintenance (WV.2) – Phase 1

West Valley maintains several pipelines that are not constructed within street ROW and are located in different areas of West Valley's service area and serve various facilities (Figure 2-20). Pipeline maintenance may include the activities described in Section 2.1.6 under *Pipelines and Associated Facilities*.

Pipeline maintenance would include pipeline section and/or valve replacement, as needed. Maintenance repairs of the pipelines would require excavation and trenching to reach buried components. An approximately 30- by 200-foot temporary maintenance work area would be used by heavy equipment and service trucks in order to complete the repairs. Maintenance would be expected to occur approximately once every 10 years per pipeline.

Lytle Creek Wash Pipelines

Two cement lined and mortar coated steel pipelines cross the Lytle Creek Wash from West Valley's Zone 3A pump station in San Bernardino to Terrace Road in Rialto. One pipeline is 24 inches in diameter and serves pressure zone 3, and the other one is 30 inches in diameter and serves pressure zone 3A. Both pipelines carry water from production wells on the east side of the wash to the west side.

In order to complete repairs the pipeline may need to be drained such that water would flow into Lytle Creek. An existing connection on the east side of the wash would be used to drain the line prior to maintenance activities. It is estimated that approximately 0.16 acre-feet of water would be drained during this occurrence.

Lytle Creek Turnout Pipelines

Two cement lined and mortar coated steel pipelines travel from Riverside Avenue to the Lytle Creek Turnout. These pipelines bring SWP from the San Gabriel Feeder pipeline to the Oliver P. Roemer Water Filtration Facility. The pipeline diameters are 24 and 36 inches. In order to complete repairs the pipeline may need to be drained such that water would be redirected into the Water Filtration Facility.

Eucalyptus Pipeline

An existing 16-inch steel pipeline that was installed in 1963 travels south from the intersection of San Bernardino Avenue and Eucalyptus Avenue to Valley Boulevard in the City of Colton. Approximately 600 feet of this pipeline north of Valley Boulevard is located in the existing paved street ROW. The remaining 1,960 feet of pipeline is located in an open space area. This pipeline is located east of the Colton Golf Club. In order to complete repairs, the pipeline may need to be drained such that water would be redirected into local storm drains.

Well 42 Pipeline

An existing 16-inch cement lined and mortar coated steel pipeline travels north from West Valley's Well 42 and connects to a 16-inch pipeline in San Bernardino Avenue in the City of Colton. This pipeline is located just west of Wildrose Avenue. In order to complete repairs the pipeline may need to be drained such that water would be redirected into local storm drains.

West Pepper Pipeline

An existing 24-inch cement lined and mortar coated steel pipeline travels north from Slover Avenue just west of Pepper Avenue in the City of Colton to the Southern Pacific Railway. A future 24-inch pipeline will connect the existing 24-inch pipeline west of Pepper Avenue to a newly constructed 24-inch pipeline in the new Pepper Avenue Bridge over I-10. Construction of this new pipeline would include boring under the Southern California Pacific Railway. To install this pipeline under the railway, a boring pit and a receiving pit will be constructed on either side of the railway. During construction activities, additional space adjacent to the railway will be required for vehicles and material staging.

Lord Ranch Pipeline

An existing 24-inch pipeline travels north from Base Line to West Valley's Lord Ranch Facility. This pipeline conveys Base Line Feeder water to the facility and it can transport water from the facility

south into the pressure zone 3 distribution system. In order to complete repairs, the pipeline may need to be drained such that water would flow into Lytle Creek.

Acacia Pipeline

An existing 16-inch steel pipeline installed in 1963 travels north from Slover Avenue to the Southern Pacific Railway along Acacia Avenue in the City of Colton. This pipeline conveys water from Well 18A and reservoir R2-1 south under I-10 and the Southern Pacific Railway to West Valley customers in pressure zone 2.

Walnut Pipeline

An existing 20-inch steel pipeline travels from the east end of Walnut Avenue in the City of Rialto to West Valley's Lord Ranch facility. This pipeline conveys water from wells at the facility to West Valley customers in pressure zone 4. The pipeline is within a casing as it crosses under Pepper Avenue. In order to complete repairs, the pipeline may need to be drained such that water would flow into Lytle Creek.

Golf Course Pipelines

West Valley has six wells on the outskirts of the former El Rancho Verde Golf Course. Transmission lines ranging in diameter from 10 to 24 inches traverse the former golf course, supplying water to R4-3 reservoir and to West Valley customers in pressure zone 4. There are approximately 14,000 feet of pipeline within a 6.44-acre area. In order to complete repairs, the pipeline may need to be drained into Lytle Creek.

8-3 Reservoir and Access Roads (WV.3) – Phase 1

The new 8-3 Reservoir project is located northwest of Lytle Creek Road (Figure 2-20). The project involves the construction of a 2.0 million gallon aboveground reservoir (tank) that would replace two existing reservoirs (8-1 and 8-2). Extensive grading is anticipated with approximately 15,690 cubic feet of dirt being removed from the site. There are two existing dirt access roads that will be utilized by West Valley during project construction to access the current reservoir site and for day-to-day operations. West Valley would maintain the access roads to the reservoir site in addition to weed abatement and any waterline repairs. Activities associated with the access road or pipeline alignment are assumed to occur on an annual basis. This project is currently mapped as a maximum design consideration area, but the actual project when designed would impact a fraction of this area.

See Section 2.1.6 for general O&M activities conducted by West Valley for their existing or planned facilities.

West Valley Other Routine Maintenance (WV.5) – Phase 1

West Valley currently maintains existing dirt access roads, totaling approximately 17,800 feet (3.4 miles), within their service area, and will continue to maintain these roads annually, and as necessary (Figure 2-20). Regular use of the access roads keeps maintenance requirements minimal. If needed, West Valley would perform weed abatement or grading activities to keep the roadway clear of vegetation and erosion holes, and gullies.

The general O&M activities common to most of the Permittee Agencies are described in 2.1.6.

West Valley Facilities Maintenance (WV.6) – Phase 1

Ongoing maintenance activities for existing pipelines and facilities are proposed for coverage under the HCP (Figure 2-20). Pipeline maintenance would include pipeline section and/or valve replacement, as needed. An approximately 30- by 200-foot temporary maintenance work area would be used by heavy equipment and service trucks in order to complete the repairs.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

2.1.4 Solar Energy Development

This section describes projects related to construction and maintenance of new solar energy facilities to supply electricity to existing wells. The location of these activities is illustrated on Figure 2-21 and Figure 2-22.

Riverside Public Utilities Activities

Riverside Public Utilities Various Solar Projects (RPU.11) – Phase 1

New Construction

The proposed project involves multiple solar projects on land owned by the City of Riverside in San Bernardino County, including the Tippecanoe and Gage Solar projects. Details regarding each set of projects are provided below.

Tippecanoe Solar Projects

RPU proposes to construct an approximately 1 MW solar project upon the Tippecanoe site (APN 0280-251-53). Construction will include clearing and grubbing of existing vegetation, grading the developed area to flatten the terrain, and installing the above- and below-ground equipment for solar panels, electrical equipment, and ingress and egress access paths. Construction will take approximately 12 to 16 weeks.

Gage Solar Projects

RPU proposes to construct an approximately 0.5 MW solar project upon the Headgates North Parcels/Gage site (APNs 0282-251-25 and 0280-251-18). Construction will include clearing and grubbing of existing vegetation, grading the developed area to flatten the terrain, and installing the above- and below-ground equipment for solar panels, electrical equipment, and ingress and egress access paths. Construction will take approximately 12 to 16 weeks.

Maintenance

Maintenance would be required periodically to clear vegetation and wash down the equipment.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6.

2.1.5 Habitat Restoration Management, and Monitoring

The types of habitat restoration, management, and monitoring activities covered under this HCP are grouped into three categories.

1. Existing activities or projects being planned and conducted by Permittee Agencies to benefit habitats or species for mitigation outside of this HCP. These projects are described below under *Ongoing Habitat Management Projects in the Planning Area* by each Permittee that is the owner of the project.
2. New Restoration Projects (including Tributary Stream, Riparian Restoration, and Alluvial Fan Restoration Projects).
3. Preserve management and monitoring activities implemented in the future to enhance, maintain, and monitor conserved lands that may impact Covered Species or may be used to offset impacts as part of the mitigation strategy for this HCP.

These projects are described below. The locations of these activities are illustrated on Figure 2-21.

Ongoing Habitat Enhancement and Management Projects in the Planning Area

These properties are currently protected under existing conservation obligations that predate the development of the HCP. No ongoing habitat enhancement and management projects described in this section are proposed to provide credits for impacts under the HCP; however, the ongoing management activities are included as they may require take authorization. Avoidance and minimization measures detailed in Section 5.6 will be followed for these project to avoid or reduce impacts on Covered Species.

Inland Empire Utilities Agency Activities

RP3 Basin Habitat Mitigation Area (2010 RMPU) (IEUA.1.13) – Phase 1

The RP3 Basin Habitat Mitigation Area consists of an easement area to provide mitigation for unavoidable impacts on riparian wetlands associated with the Chino Basin Facilities Improvement Program (Figure 2-22). This conservation easement is held by the Rivers & Land Conservancy. The site supports upland scrub, riparian woodland, and wetland habitats providing wildlife habitat and water quality benefits.

New Construction

No new construction is anticipated as part of this Covered Activity.

Operations

No operations activities are anticipated as part of this Covered Activity.

Maintenance

Maintenance activities in the mitigation area are limited to trash removal and weed control of invasive plant species. Trash removal occurs by using nets on long poles and/or wader outfits to comb through the wetlands to remove litter/debris that has come to the site via the incoming water flow or wind. Weed removal services involve hand weeding low growing annual weeds and removal

of nonnative trees, such as eucalyptus. Avoidance and minimization measures common to all restoration projects are described in Section 5.6.

New Restoration Projects (Tributary Stream and Riparian Floodplain Restoration)

Habitat restoration and enhancement would generally be temporary and disruptive only in the short term; these activities could involve soil disturbance, removal of undesirable plants, and limited grading. All habitat restoration and enhancement is expected to result in a net long-term benefit for Covered Species and vegetation communities. All habitat enhancement and restoration activities conducted within the Planning Area that are consistent with HCP requirements will be covered by the HCP.

Riparian Floodplain Restoration projects are discussed with the Tributary Stream Restoration projects as they are co-located within some of the Tributary Stream sites. Riparian Floodplain Restoration projects, however, will be implemented as part of Phase 2 and are therefore in their early planning stages and described below for general consideration in the HCP. This HCP considers habitat restoration activities in the following areas as components of the Conservation Strategy that would result in beneficial effects for the Covered Species.

- Hidden Valley Creek (Rest.1)
- Hidden Valley Ponds (Rest.2)
- Lower Hidden Valley Creek (Rest.3)
- Lower Hole Creek (Rest.4)
- Anza Creek and Old Ranch Creek (Rest.5)
- Evans Lake (Rest.6)
- Louis Rubidoux Nature Center and Sunnyslope Creek (Rest.7)
- Tequesquite Creek Aquatic Habitat Restoration (Rest.8)
- Pedley Landfill Restoration (Rest.9)
- Habitat Enhancement at Prado Basin (Rest.10)
- Management of Santa Ana Sucker Restoration on Sunnyslope Creek (Rest.11)

The following sections provide a brief description of each of these restoration projects. Refer to Chapter 5 for details about the restoration and habitat enhancement activities conducted at these sites. Avoidance and minimization measures common to all restoration projects are described in Section 5.6.

Hidden Valley Creek (Rest.1) – Phase 1, Phase 2

Phase 1

The Hidden Valley Creek site is on the inside of a meander bend on the south side of the Santa Ana River on approximately 112 acres (Figure 2-22). It is about 0.75 mile downstream of the Van Buren Boulevard Bridge and the City of Riverside's RWQCP (Figure 2-6). The Santa Ana River historically occupied a position farther to the northwest than it presently does, but the land that was not being

farmed was active floodplain, similar to how it is today. The alignment and shape of the Santa Ana River change regularly at the Hidden Valley Creek site in response to flood events, as scour and fill processes lead to the creation of new channels with sand and gravel bars and the filling of previous channels. Riparian vegetation colonizes new river bars and becomes more established in areas that have sufficient time for plants to grow in between flood scouring events.

The Hidden Valley Creek site and the downstream wetlands are part of the 1,500-acre Hidden Valley Nature Center wildlife area along the Santa Ana River. Currently, the Hidden Valley Creek site does not have a perennial source of water. Water at the site is limited to storm runoff generated from the surrounding hillslopes during rain events and, infrequently, the Santa Ana River during high flood events. Until infrastructure was damaged by a large flood event in 2010, the site contained a canal with flowing water and wetlands supported by wastewater that flowed from Riverside's RWQCP upstream. The canal still exists but has no reliable water source.

The restoration activities for the Hidden Valley Creek site covered under the HCP include establishment of new channel and rehabilitation of the existing channel (including native riparian buffer), new floodplain establishment, installation of fish habitat features, culvert installation and replacement, nonnative vegetation removal, enhancement of riparian vegetation, groundwater well and pump installation, maintenance, and monitoring. Additionally, human disturbance will be limited and recreation and public education opportunities provided to the public.

Phase 2

Riparian and floodplain restoration opportunities at the Hidden Valley Creek site include establishing an oxbow feature and further controlling nonnative invasive species. Restoration opportunities at the site are largely associated with enhancing habitat by removing nonnative plant species and planting native species. These activities would improve upland habitat conditions for other threatened and endangered species. The site is in an active part of the Santa Ana River floodplain that has experienced substantial erosion and deposition from flood flows. Groundwater and surface flows currently support one large perennial pond feature in the downstream portion of the site, likely a remnant of a previous river course. This feature provides a unique habitat for wildlife, as it represents a perennial, low-velocity water source with adjacent riparian habitat. Creation of a similar feature in the upstream portion of the site would increase the opportunity for wildlife to utilize this unique habitat type. Adding gently sloping shoreline habitat to the created feature would increase nesting opportunity for certain bird species and also provide benefits to southwestern pond turtle and garter snake. Due to the risk of future flooding associated with the active Santa Ana River, the proposed location for this feature is the southern portion of the floodplain outside of the regular channel migration zone. Collectively, the site has the potential to support approximately 15 acres of wetland habitat.

Hidden Valley Ponds (Rest.2) – Phase 1

The Hidden Valley Ponds restoration site is located immediately west of the Hidden Valley Creek site (Figure 2-22). CDFW owns and manages the site in partnership with Riverside County. It is in the SAR floodplain and consists of a large riparian floodplain terrace south of the mainstem SAR along with several artificial (now dry) ponds. Prior to being operated by the County of Riverside Parks and Open Space Department, the site was known as the Hidden Valley Gun Club, founded in 1957 and active until 1974 when the property was purchased by the state. The gun club promoted duck and pheasant hunting and was responsible for much of the development of the existing pond system.

The ponds were created by a series of levees that were filled with delivered water that gravity fed through the system until exiting downstream to a long channel that returned water to the river. The depth of the constructed ponds varied from 6 inches to over 5 feet. Flooding from the Santa Ana River deposited sediment and filled in some areas that used to be duck ponds (City of Riverside 1995). A flood in 2010 along the Santa Ana River lowered the riverbed by up to 8 feet and destroyed the infrastructure that delivered water to the ponds (Danelski 2014). Since that time the ponds have remained empty as they are not connected to groundwater or any other natural surface water sources. The ponds historically provided seasonal habitat for resident and migrating avian species, as well as native terrestrial and aquatic wildlife and plants. Historically, the ponds provided a variety of active and passive recreational opportunities, including hiking, hunting, fishing, bird watching, and public education. Since drying out the ponds are no longer able to support many of these services.

Habitat enhancement and management activities proposed at the site and covered under the HCP include reconfiguring Hidden Valley Wetland tributary and enhancing the channel that returns water to the SAR, restoring the eastern ponds to floodplain or transitional habitat, restoring the western ponds to aquatic habitat, controlling invasive species, and providing for recreation and public education.

Lower Hidden Valley Creek (Rest.3) – Phase 3

*[**Note to reviewer**: This activity is in its early planning stage and is described below for its general consideration in the HCP. It will be re-evaluated more specifically upon completion of the Conservation Strategy to determine the potential for take debits/credits.]*

The Lower Hidden Valley Creek restoration project includes restoring the stream channel downstream of Hidden Valley Ponds, between the ponds and the mainstem of the Santa Ana River (Figure 2-22). Restoration activities may include stabilizing the channel, enhancing habitat in the existing channel for the Santa Ana sucker, restoring the riparian corridor along the existing channel through exotics removal and replanting of native species, reestablishing floodplain, controlling invasive wildlife species, reducing human disturbance, and restoring upland buffer vegetation.

Lower Hole Creek (Rest.4) – Phase 1, Phase 2

Phase 1

The Lower Hole Creek site begins downstream of Jurupa Avenue where the stream passes under the road through a large, newly installed 40-foot concrete box culvert with extensive downstream protections that creates a 27-foot elevation difference between the channel upstream and downstream of the crossing (Figure 2-22). Lower Hole Creek consists of two drainage features: the main creek and a small tributary, which meets the SAR at the downstream end (Figure 2-6). CDFW owns most of the site with an easement on the upstream portion from Riverside-Corona Resource Conservation District (RCRCD). The City of Riverside owns the upper 260 feet of the Lower Hole Creek Channel and floodplain. Additional privately held parcels are located in the southeastern corner of the site and elevated high above the creek.

Currently, Lower Hole Creek's water sources include treated effluent and urban runoff (RCRCD 2012), including runoff from Van Buren Boulevard that enters the site from the east downstream of Jurupa Avenue, runoff from the Greenbelt area (south of Victoria), locally rising groundwater, and occasionally flow from Riverside Canal (Herzog pers. comm.). The creek is part of the

McAllister/Hole Creek drainage; the watershed is heavily urbanized, and much of the runoff is piped underground to the lower reaches of Hole Creek. The urban watershed causes rapid runoff during rain events and periodic flooding that delivers abundant trash and debris to Lower Hole Creek (RCRCD 2012). These sources provide enough water for Lower Hole Creek to be a perennial channel throughout the year, with low flows typically less than 0.5 cfs (0.3 mgd).

Restoration activities proposed for the Lower Hole Creek restoration site covered under the HCP include stabilizing the channel, enhancing habitat in the existing channel for the Santa Ana sucker, restoring the riparian corridor along the existing channel through exotics removal and replanting of native species, reestablishing floodplain, controlling invasive wildlife species, reducing human disturbance, restoring upland buffer vegetation, and including opportunities for public recreation and education.

Phase 2

Riparian and floodplain restoration opportunities at the Lower Hole Creek site include restoring upland vegetation and further controlling nonnative invasive plant and wildlife species, which would enhance covered species habitat. Restoration opportunities also exist upstream of the site that could further increase the size of contiguous riparian habitat. In addition to restoration on site, improved condition of the adjacent buffer habitat can further reduce stress to the creek. Currently, the buffer is highly accessible to the public and functions in a degraded state with high human use, soil disturbance, and nonnative cover. Restoration of the upland areas to coastal sage scrub vegetation would protect wetland conditions and create additional opportunities for Covered Species.

Anza Creek and Old Ranch Creek (Rest.5) – Phase 1, Phase 2

Anza Creek and Old Ranch Creek are part of the same site that is approximately 321 acres and is located on the SAR's south floodplain about 2 miles downstream of Mount Rubidoux (Figure 2-23). The Anza Creek/Old Ranch Creek site is bounded to the north by the SAR, to the east by the closed Tequesquite Landfill, and to the south and west by the SAR bicycle trail and Anza Narrows Park. Anza Creek is in the western half of the site while Old Ranch Creek is located generally in the eastern half of the site.

The Anza Creek Channel is a large drainage that flows along the southern edge of the site. The upper 2,000 feet of the present-day Anza Creek Channel was the active channel of the SAR in 1931 and had a large meander bend that extended south up against the present-day bicycle trail. Portions of the middle section of the present Anza Creek are on land that appears to be a terrace feature based on historical aerial photography. A flood event that occurred prior to 1980 appears to have eroded portions of this high ground where the Anza Creek Channel is presently located near Anza Narrows Park. The confluence of the present-day Anza Creek Channel with the SAR is a dynamic area, as the exact location of the confluence changes depending on shifts in the position of the SAR in response to flood events.

Anza Creek flows originate from a large 20-foot concrete box culvert under the SAR bike trail and a concrete box culvert that enters from the southeastern corner of Anza Narrows Park. Groundwater upwelling is an important contributor to surface flows in Anza Creek. The drainage becomes well defined approximately 0.6 mile upstream of the confluence with the SAR; at this location the banks are steep.

Old Ranch Creek has a 585-acre watershed area composed predominantly of impervious surfaces as a result of urban development. Stormwater enters the Old Ranch Creek Channel from a 10-foot concrete box culvert in the southeastern corner of the site. This drainage is also fed by runoff from the closed Tequesquite Landfill property to the east of the site via a culvert beneath the dirt path that runs along the eastern project boundary. The urban watershed causes rapid runoff during rain events and periodic flooding that delivers abundant trash and debris to Old Ranch Creek. Flowing water is rarely observed in the Old Ranch Creek Channel and only occurs during storm events.

Based on historic aerial imagery, the Old Ranch Creek Channel previously connected with the Santa Ana River, with the confluence occurring on the western boundary of the Old Ranch Creek site. However, several decades ago, the downstream half of Old Ranch Creek was eroded during a large flood event that caused the Santa Ana River to migrate south. Subsequent construction of the Tequesquite Landfill on the eastern (upstream) boundary of the site has constrained the river from migrating south into the former floodplain, thus eliminating any evidence of a direct connection with Old Ranch Creek. The remaining upstream half of Old Ranch Creek is still evident, consisting of an arcing swath of dense vegetation and ephemeral stream morphology.

Phase 1

Restoration activities of Anza Creek covered under the HCP include modifying and augmenting surface flows to support Santa Ana sucker, enhancing the existing channel to create suitable Santa Ana sucker habitat, constructing a well-defined channel in the uppermost portion of Anza Drain, creating new floodplain within Anza Drain, and stabilizing a steep, unvegetated portion of bank near the bicycle trail at Anza Narrows Park.

The restoration activities for the Old Ranch Creek site covered under the HCP include establishment of new channel and rehabilitation of the existing channel (including native riparian buffer), new floodplain establishment, installation of fish habitat features, culvert installation and replacement, nonnative vegetation removal, groundwater well and pump installation, and maintenance and monitoring.

Phase 2

Riparian and floodplain restoration opportunities at the Anza Creek/Old Ranch creek sites include alkali marsh rehabilitation, upland rehabilitation, floodplain expansion, and further management of invasive wildlife species. These restoration opportunities would improve habitat quality for Covered Species by reducing the threat from invasive wildlife species such as bullfrogs (*Lithobates catesbeianus*), wild boar, mosquitofish (*Gambusia affinis*), and brown-headed cowbird. Control methods are as yet undetermined and may include methods such as seasonal variation in water supply or more traditional control methods such as trapping or pesticides.

The site currently supports alkali meadow habitat at several locations in the outer floodplains that illustrate near-reference conditions for that vegetation community. There are also areas on site where historic alkali meadow has become degraded by past human use and an influx of nonnative species. In particular, the southeastern corner of this site provides an ideal opportunity for alkali marsh restoration, including control of nonnative species, planting of native species, and improvements to hydrology by connecting the area to the Old Ranch Creek drainage. This area is dominated by nonnative grasses, but there are still native alkali species present such as salt grass and creeping wild rye (*Elymus triticoides*). The presence of these species, the adjacent reference

condition, and the topography (low depression) are all indicators that this area can be successfully restored to alkali meadow. Additional restoration opportunities exist throughout the floodplain as much of these areas supports lower densities of native alkali species.

The northeastern corner of the site, immediately downstream of the landfill, is at a higher elevation than much of the site, with extensive areas of disturbed bare ground, invasive species, and human disturbance. The higher elevation appears to be a result of historic fill, potentially in association with past landfill practices. Removal of fill material would allow this area to reengage the active floodplain at a frequency similar to that of the riparian zone along the river. As this area is artificially armored by the presence of the landfill, there is also the opportunity to further excavate an area in the southern portion of this site to emulate a relic channel in the form of an oxbow. This would require excavation to and below groundwater levels to support a perennial water source.

Evans Lake (Rest.6) – Phase 1

The Evans Lake site covers approximately 65 acres in the City of Riverside's Fairmount Park and is bounded to the northeast by Evans Lake, to the west by the levee along the Santa Ana River, and to the east and south by the Santa Ana River bicycle trail (Figure 2-23). The land at the site is owned by the City of Riverside. Evans Lake was constructed in the early 1900s. The watershed area upstream of the lake is approximately 9 square miles with two major drainage channels, Spring Brook Wash and University Wash, providing most of the runoff to the lake (Northwest Hydraulic Consultants 2015). These channels were constructed by USACE and are maintained by Riverside County Flood Control District. Locally high groundwater elevations likely supported the lake's water historically but with the declines in groundwater levels the lake's water is now maintained by pumping from wells to support recreation (Northwest Hydraulic Consultants 2015). The Santa Ana River was a part of the site prior to construction of the Santa Ana River levee.

The low flow channel and spillway channel downstream of Evans Lake receive water either via a culvert or from water that is released or spilled from the lake at two locations. Evans Lake traps bedload sediment and prevents it from supplying the channel below. A sluice box located near the southwest corner of the lake allows water to flow under Dexter Drive and into the low flow channel that flows for 3,400 feet before going into twin reinforced concrete culverts at the Santa Ana River levee. A culvert that carries flows from Spring Brook Wash and a higher elevation spillway is located at the northwest section of Evans Lake. The 200-foot-long spillway is formed by a dip in Dexter Drive at an elevation of 792 feet. The 2,750-foot-long spillway channel flows to the southwest before joining the low flow channel about 1,500 feet upstream of the levee.

The Evans Lake restoration activities covered by the HCP include restoration of the spillway channel by laying back the channel banks, creation of a secondary channel, removal of nonnative species, replanting with natives, and removal of human disturbance. Portions of the channel will be enhanced to provide suitable habitat for the Santa Ana sucker. Riparian and upland buffer areas will be restored through the removal of nonnative species and replanting with native plants. Community and recreational facilities will also be part of the project site including, but not limited to, a nature trail, amphitheater, archery/BB gun range, community garden, and camping and day use area. These facilities would be constructed outside of the most sensitive areas of the project, and many would incorporate community outreach and education about the natural resources of the site.

Louis Rubidoux Nature Center and Sunnyslope Creek (Rest.7) – Phase 1

*[**Note to reviewer**: This activity is in its early planning stage and is described below for its general consideration in the HCP. It will be re-evaluated more specifically upon completion of the Conservation Strategy to determine the potential for take debits/credits.]*

Riverside County Parks and Open Space District owns the Louis Rubidoux Nature Center (LRNC), adjacent park, and Sunnyslope Creek but is leasing the property to the Louis Rubidoux Nature Center Consortium (Consortium) (Figure 2-23). Five entities—the Inland Empire Resource Conservation District (IERCD), Valley District, Orange County Water District (OCWD), Huerta del Valle (HdV), and Sunshine Haven Animal Rescue and Wildlife Rehabilitation—are part of the Consortium.

The LRNC and Sunnyslope Creek will be revitalized and enhanced to meet the needs of the Riverside County Parks and Open Space District, community, and multiple watershed entities, through refurbishment of existing site elements and development of new opportunities. The LRNC Consortium plans to rehabilitate, restore, and re-invigorate key historical elements on the site including the Nature Center, the pecan grove, the children's garden, interpretive signage, and the trails to and along the creek. In addition to incorporating historical onsite resources new uses will be brought to the site, such as sustainable agriculture, wildlife rehabilitation, local office space, group camping, science education, and restoration of the adjacent creek and riparian habitat for the benefit of dependent species and watershed health. Community engagement opportunities resulting from this work are projected to include familiar events such as the Annual Pecan Festival and professional development workshops, while updated site features will serve as the foundation to host new events such as regular farmer's markets and annual stewardship festivals.

Tequesquite Creek Aquatic Habitat Restoration (Rest.8) – Phase 1

*[**Note to reader**: This activity is in its early planning stage and is described below for its general consideration in the HCP. Conservation Actions at this location are not a part of the HCP Conservation Strategy and not considered as mitigation for Covered Activities in this HCP.]*

The Tequesquite Creek is one of the primary creeks within the City of Riverside with upper portions of its watershed originating in the Box Springs Mountains and Sycamore Canyon Wilderness Park. The drainage spans over 40,000 acres and is a tributary to the Santa Ana River. Habitat enhancement, management, and monitoring activities occur within a conservation easement of approximately 7.5 acres of city and county lands in primarily mixed riparian woodland habitat (Figure 2-23).

RCRCD completed the first portion of the project in the fall of 2013; this included removal of trash, clearing of invasive, nonnative plant species (e.g., palm, ash, fig, catalpa, eucalyptus) to improve spawning habitat and riparian vegetation for listed fish species including the Santa Ana sucker, arroyo chub, and speckled dace.

Future activities at the site will include continued invasive plant removal and control, homeless camp debris removal, streambank stabilization via native plantings, substrate enhancements, and supplemental water input, as well as activities to capture and monitor native fish in the creek.

Pedley Landfill Restoration (Rest.9) – Phase 2

*[**Note to reader**: This activity is in its early planning stage and is described below for its general consideration in the HCP. Conservation Actions at this location are not a part of the HCP Conservation Strategy and not considered as mitigation for Covered Activities in this HCP.]*

The Pedley Landfill is located on a 13.5-acre parcel, which is owned by CDFW (Figure 2-23). Previously, in 1932 the County of Riverside had a burn operation at the site, and in 1957 through 1958 used the site as a cut and fill operation before selling it to CDFW in February 1974. The parcel is at the immediate confluence of the Santa Ana River mainstem and Hole Creek, just west of Van Buren Boulevard. During an evaluation of restoration opportunities for Hole Creek, Pedley Landfill was identified as one of the largest constraints to meaningful restoration in the creek. In addition to constraining the physical movement of Hole Creek the landfill has become increasingly unstable as the mainstem Santa Ana River has moved south, resulting in damage and likely contamination issues. At least three recent site failures have occurred: in December 2010, half an acre was washed away, followed by erosion of the north slope during a spring storm in March 2014, and then again in November 2015. The repairs are costly and pose a risk to the river system downstream. In addition, the physical constraints of the landfill—which flanks the lowermost 1,200 feet of Hole Creek's east bank—limit the ecological conditions of the creek, including a lack of floodplain, riparian habitat, suitable buffer, and channel migration. As a result of the risk for continued erosion into the landfill, a project was initiated to excavate approximately 1.3 acres of the landfill and install interlocking concrete mat on the northern edge of the landfill. However, additional erosion has occurred since this repair. CDFW and the Valley District are considering complete removal or substantially reducing the size of the landfill to protect downstream water resources and facilitate additional restoration opportunities for Hole Creek.

Habitat Enhancement at Prado Basin (Rest.10) – Phase 1

The Habitat Enhancement at Prado Basin project involves periodic sediment removal at three locations in response to the sediment deposition that has occurred and continues to occur in the Prado Basin Sediment has also deposited and continues to deposit upstream from the Basin along an unknown distance within the Santa Ana River, flattening the stream gradient in some sections of the river. The majority of sediment that is removed from the river will be used for various projects unrelated to this Plan. Sorted larger sediment will be returned to the river to provide habitat enhancement benefits, further described below.

Impacts expected during construction and maintenance of the Habitat Enhancement at Prado Basin (Rest.10) are proposed as self-mitigating within lands controlled and managed by OCWD. Impacts on riparian habitats will be mitigated at Pheasant Field and/or riparian restoration in areas of Arundo that burned in recent wildfires in the Prado Basin. In-stream benefits within the mainstem of the Santa Ana River are anticipated for Santa Ana sucker and arroyo chub, and are described in detail below.

Site 1 – River Road

The River Road project work area for sand removal will encompass most of the river's unvegetated banks and stream (open water) area from just below River Road Bridge to approximately 1,000 feet upstream and cover approximately 18 acres plus an access road, similar to the area used for sand removal in the early 2000s. Up to 150,000 cubic yards of sediment will be removed per year.

Site 2 – Sand Trap

A second location, an in-stream sand trap, is also proposed for sand removal and is located approximately 2 miles downstream of River Road Bridge in Prado Basin. This location is dominated by nonnative vegetation, primarily giant reed and forbs (annual dichotomous plants). The sand trap is proposed to encompass approximately 14.3 acres of the Prado Basin and would be designed to capture the majority of the sediment that bypasses the River Road basins (located upstream) during baseflow conditions. One maintenance road (ingress and egress), approximately 0.5 mile long will be constructed from the sediment trap to a sediment stockpile area (approximately 15 acres in size) located in a weedy field west and south of the terminus of Butterfield Drive and the Corona Airport in Prado Basin. The sand trap is currently permitted as a temporary feature to test the amount and rate of sediment capture through OCWD's Prado Basin Sediment Management Demonstration Project (Permit Number SPL-2011-00961-JEM). A second permitting process is underway to cover temporary impacts expected during the future removal of 120,000 cubic yards of sediment from this site, which is projected to occur twice over the next 50 years (for a total of 240,000 additional cubic yards of sediment). More frequent sediment extraction may be needed to provide the desired upstream aquatic habitat benefits; therefore, this is considered a permanent impact under the HCP to provide the added flexibility for sediment removal. Data collected during the currently permitted temporary project (1 year) will be used to refine features associated with the permanent HCP project. Final placement of these features will be dependent of the approach that best avoids and minimizes impacts on threatened and endangered species occupied habitats.

Site 3 – Pheasant Field

A third site for sand removal is proposed at Pheasant Field (approximately 24 acres in size), which is approximately 0.75 mile north and east of the sand trap and south of the OCWD diversion channel. This area contains nonnative annual plants and open sand. If additional sediment removal is needed to achieve upstream habitat benefits, a one-time removal of surplus sand (2–4 feet) will occur on this site. The sediment removal will then be followed by planting of native riparian plant species. Management and monitoring of this habitat area will be integrated into the HCP long-term habitat management and monitoring strategy.

Gabions

There are ten existing gabions that occur approximately 0.75 mile upstream of River Road Bridge that will be maintained as a part of this Covered Activity. Gabion construction activities took place in Fall 2016 but subsequent gabions may be built in the future. Each gabion is a rock filled cage, approximately 12 feet long by 3 feet wide. These structures are intended to create localized areas of scour that expose coarse substrate (e.g., gravel) found below the surface layer of sand. Gabion maintenance will include placement of rock found during sand removal at Prado Basin. If the existing gabions are not operable, new gabions may be built, or the rock found during the sand removal will be utilized for Santa Ana sucker habitat enhancement at ten locations near the existing gabions or at a new location(s) agreed to by USFWS.

Construction scheduling is expected to be concentrated in the late summer through fall to avoid wet weather delays and nesting birds. Construction activities are generally anticipated to be completed within 4 months.

Anticipated Benefits

Monitoring will be conducted along the stream to track the change in streambed elevation and grain size. It is anticipated that a coarsening of the streambed will occur upstream of the sand removal areas due to an increase in the rate of sediment transport into the sediment basins. The *Santa Ana River Sediment Monitoring Program Phase 1* (Scheevel Engineering 2019) provides proof of concept and an example of the type of monitoring proposed. This experimental project shows that a small sediment trap (7,000 cubic yards, approximately 4 acres) downstream of River Road created a deepening of the streambed (incision) that extended more than 1.75 miles upstream. At 1.75 miles upstream of the basin the deepening was measured at 6 inches (near Dearborn Street). The average rate of sediment transported into Prado Basin during baseflow was estimated at 60 to 80 tons per day at baseflow conditions. The sediment trap was estimated to enhance sediment transport at baseflow by transporting sediment at up to 115 tons per day and causing up to 3 feet of incision of streambed at the top of the trap. Beneficial results (streambed incision) were observed when the sediment trap was functional (2 months) and diminished once the sediment trap had filled.

Maintenance

Typical maintenance of River Road basins includes the opening and closing of basin stream apertures to allow sediment clean out. The frequency of clean out will be dependent on the rate of sediment removed from the streambed and size and dimensions of each basin. Without supplemental approval from USFWS, up to two times per year basin berms will be rebuilt after large flood events.

The sand trap site will be cleaned out using either bulldozers, as in the River Road basins, or with a suction dredge that deposits sediment at the proposed stockpile area. Each activity will have its own maintenance schedule, but work within the sand trap area will be minimized to reduce impacts on surrounding resources.

No maintenance is anticipated within Pheasant Field. Post construction, this site will become riparian habitat.

The maintenance of the gabions will include the occasional addition of rock derived from sorted rock removed from the stream and/or from an alternative source, probably not more than twice annually, as the gabions sink into the riverbed over time.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.8.

Management of Santa Ana Sucker Restoration on Sunnyslope Creek (Rest.11) – Phase 1

Annual management activities of the Santa Ana sucker restoration site occur within an area on Sunnyslope Creek (Figure 2-24). These activities may include the removal of flow obstructions, deep holes, and aquatic predators; and manipulation of the channel using equipment to concentrate the creek flow in a single channel that maximizes silt scour and hydrologic connectivity with the creek. As many as 10 cubic yards per year of rock, gravel, and smaller boulders would be imported to improve substrate conditions in the creek for the Santa Ana sucker. The material would be surface gleaned from the adjacent alluvium and deposited in deeper holes in the creek to significantly reduce the depth of the pool complex where otherwise such holes have harbored large nonnative predatory fishes. Available techniques would be used to reduce the abundance of nonnative fishes

and amphibious predators including electro-shocking, trapping, seining, fishing, and dip-netting. Trash and debris will be removed by hand and potentially by installing and operating a trash boom. The possibility of augmenting creek flow with well water will also be explored to alleviate drought-associated impacts on dry-weather creek flow.

Maintenance

Maintenance activities at Sunnyslope Creek will routinely occur monthly. Repair and maintenance activities would generally be completed within a day or two for the project area. Maintenance activities may require work in streambed areas.

The general O&M activities common to most of the Permittee Agencies are described in Section 2.1.6. Avoidance and minimization measures common to all restoration projects are described in Section 5.6.

New Restoration Projects (Alluvial Fan Restoration)

There are four restoration projects that will restore alluvial fan scrub habitats:

- Enhanced Recharge Basin Restoration (Rest.12)
- North Enhanced Recharge Basin Restoration (Rest.13)
- Alluvial Fan Hydraulic Disturbance Restoration (Rest.14)
- Drainage A Woolly-star Restoration (Rest.15)

This HCP considers habitat restoration activities in these areas as components of the Conservation Strategy that would result in beneficial effects on the Covered Species. The following discussion briefly describes each of these restoration projects. Refer to Chapter 5 for details about the restoration and habitat enhancement activities conducted at these sites. Avoidance and minimization measures common to all restoration projects are described in Section 5.6.

Enhanced Recharge Basin Restoration (Rest.12) – Phase 1

The Enhanced Recharge Basin alluvial fan scrub restoration would be conducted during Phase 1 of HCP implementation. This restoration project will mitigate the impacts on San Bernardino kangaroo rat (*Dipodomys merriami parvus)*) and Santa Ana River woollystar habitat from the development of new recharge basins as a part of the Enhanced Recharge Project – Seven Oaks Dam Water Conservation Improvements (VD.3). The restoration will create and enhance 218.0 acres of habitat for these species using the best available data based on the recent research on microhabitat suitability for San Bernardino kangaroo conducted by the San Diego Zoo Institute for Conservation Research (Shier et al. 2019) and the evaluation of various methods of mechanical manipulation to simulate the effects of fluvial disturbance (ICF 2019). The project would involve managing interstitial spaces between the recharge basins, approximately 200 feet wide, for San Bernardino kangaroo rat and Santa Ana River woollystar habitat (Figure 2-24).

North Enhanced Recharge Basin Restoration (Rest.13) – Phase 1

The North Enhanced Recharge Basin alluvial fan scrub restoration is very similar to Rest.12 and would be conducted during Phase 1 of HCP implementation. This restoration project will mitigate

the impacts on San Bernardino kangaroo rat and Santa Ana River woollystar habitat. The restoration will create and enhance 34.6 acres of habitat for these species (Figure 2-24).

Alluvial Fan Restoration (Rest.14) – Phase 2

*[**Note to reader**: This activity is in its early planning stage and is described below for its general consideration in the HCP. Conservation Actions at this location are not a part of the HCP Conservation Strategy and not considered as mitigation for Covered Activities in this HCP.]*

The Alluvial Fan Restoration would be conducted during Phase 2 of HCP implementation. This restoration project will use structures made from natural materials (boulder and large cobble) that will be placed within the active channel of the Santa Ana River at several locations below the confluence with Mill Creek to manipulate water movement into inactive areas of the channel (Figure 2-24). Three locations within the main channel are under consideration and would result in fluvial disturbance to refresh habitat for San Bernardino kangaroo rat. A much larger structure would be placed in the main channel to divert the majority of flow from major storms into the 1969 breakout channel and would have the potential to create fluvial disturbance. The total acreage of new habitat from these manipulations is expected to encompass approximately 14.4 acres.

Drainage A Woollystar Restoration (Rest.15) – Phase 2

The Drainage A Woollystar alluvial fan scrub restoration would be conducted during Phase 2 of HCP implementation. The Drainage A parcel (Figure 2-24) is a portion of the diversion structure for the Riverside North Aquifer Storage and Recovery Project (RPU.5). The parcel and a smaller adjacent parcel are occupied by a large population of Santa Ana woollystar (several thousand individual plants) in spite of the degraded habitat quality of the site. The Drainage A Woollystar Restoration will enhance approximately 40 acres of degraded habitat by removing nonnative invasive species and by improving the overall protection, management, and monitoring of the site. The restoration project will benefit both the woollystar and the Riversidean alluvial fan sage scrub habitat on the site.

Preserve Management and Monitoring

The conservation and mitigation strategy (Chapter 5) is designed to mitigate impacts of Covered Activities on the Covered Species within the Planning Area and to manage and monitor those species in the future. However, implementation of some conservation and mitigation actions may result in low levels of take (for wildlife) or adverse impacts (for plants) and, therefore, are being addressed in this HCP as Covered Activities. Preserve management and monitoring may include but is not limited to the following types of activities.

- Easement monitoring to assess the condition of site facilities (e.g., pumps, gates, signage, roads) and determine management needs.
- Habitat enhancement, restoration, and creation.
- Operational changes to enhance in-stream habitat.

- Control of invasive species, including vegetation (e.g., mowing, hand clearing, targeted herbicide application[5]) and wildlife (e.g., aquatic predator control).
- Covered species captive propagation and relocation from impact sites (e.g., in cases where impacts are unavoidable and relocation has a high likelihood of success).
- Species monitoring activities in the Planning Area and mitigation areas such as tagging, population surveys, and genetic sampling.
- Species surveys and research.
- Seed collection.
- Assessment of habitat condition utilizing rapid assessment methods (e.g., RipRAM or CRAM) when available.
- Monitoring and mapping of invasive species to inform control actions.
- Vegetation management using grazing, or mechanical or hand clearing, as appropriate.
- Fire management such as prescribed burning (as conducted by the Forest Service on Forest Service Lands), mowing, hand-thinning of vegetation, and establishment of fuel breaks.
- Removal of encampment sites, including garbage and structure (e.g., trailers, vehicles, solar panels, electronic devices, fencing materials) and hazardous material (e.g., fuel) removal.
- Installation and maintenance of access control features (e.g., gates, barriers, and fences).
- Preserve patrols in coordination with local law enforcement to identify and alleviate public safety concerns. Specific details of the level of effort of preserve patrols will be determined between the Upper Santa Ana River Sustainable Resources Alliance and local law enforcement.

2.1.6 Routine Operations and Maintenance

Routine maintenance activities are actions that occur repeatedly in one location and/or in many locations over a wide area (e.g., bank stabilization, storm-damage repair, maintenance of facilities). Maintenance activities are generally performed periodically and include actions such as minor construction, earth-moving, or vegetation clearing activities that can affect listed species. Below is a list of typical water agency routine maintenance activities. Routine maintenance activities that involve repair and replacement are assumed to typically be conducted in-kind (i.e., not result in an expanded footprint or replace earthen material with grouted material). Repair or replacement activities may need to result in an enlarged footprint to accommodate new facilities or infrastructure, or an existing earthen embankment may need to be replaced with a concrete or grouted embankment.

Pipelines and Associated Facilities

Areas that may be affected by pipeline maintenance activities include those around water conveyance systems such as pipelines, pump stations, blow-offs, turnouts, and vaults. The following activities may be conducted as part of routine pipeline maintenance.

[5] Activities associated with the application of herbicide that may result in take of a Covered Species (e.g., the operation of an all-terrain vehicle in San Bernardino kangaroo rat habitat resulting in the collapse of a burrow) are covered by the HCP, However, take resulting from the herbicide itself would not be covered. Applicators must use pesticides according to the label. This includes limits on applications to avoid wildlife.

- Leak repair, which may require blow-off (dewatering of pipes that typically includes a point source of high velocity flow) to local uplands or streams and/or excavation to access pipelines.
- Internal inspection, which also may require blow-off to local uplands or streams to access the internal portion of the pipeline.
- Unscheduled releases of water, which may be due to a pressure surge in a pipeline that could damage the pipeline. Under such conditions, an automatic turnout valve will open and release the water to prevent the pipe from bursting. Flows from the pipeline may be reduced following such an event. This is a relatively self-contained process, with the valves opening for less than 1 minute and shutting as soon as system pressure drops.
- Rehabilitation and/or replacement of pipeline components, which may include, but is not limited to, air release valves, piping sections or connections, joints, and appurtenances. Activities may include excavation and trenching to access buried pipelines.
- Bank stabilization and erosion control within a creek, which may be related to pipeline maintenance and includes discharges that either come out of pipes within a stream bank and flow down the bank into the channel, or are pumped down or across a stream bank. Bank protection work, which may require some excavation, would occur prior to a planned discharge in areas where banks within 50 feet of the discharge point show signs of erosion or instability.
- Replacement/repair of buried service valves, which may include valves within creek embankments that may require excavation and minor bank stabilization activities.
- Pipeline turnout maintenance, which may include access to pipelines.
- Replacement/repair of appurtenances, fittings, manholes, and meters.
- Vault maintenance: vaults occur along segments of pipeline; pipeline components are located within vaults. There are different types of vaults and all are considered confined spaces. Structures other than the pipeline contained within vaults include valves, electrical stations, turnout piping, etc. Telemetry pull boxes, corrosion monitoring stations, and some air release valves are not located within vaults. Vaults are typically made of concrete and may be located immediately below grade (below ground level) or partially or fully above grade.
- Telemetry cable/system inspections and repairs: telemetry systems allow communication of data from the pipeline to the pipeline operator so that the operator can track the operations of the pipeline. Telemetry cables are often cited in the center of roads. May require excavation to access system components.
- Meter inspections and repairs: flow meters measure the rate of flow through a pipeline. Some meters are located in vaults while others are not.
- Maintenance of pump stations, operation yards, utility yards, and corporation yards.

Wells and Associated Facilities

Maintenance of wells and associated facilities includes rehabilitation, redevelopment, testing, and/or replacement. Typical activities associated with rehabilitation and redevelopment may include, but are not limited to, the following.

- Temporary removal of above/below ground equipment

- Brushing and bailing, chemical treatment (oxidizers, cleaning agents [surfactant and/or dispersant], and/or acid treatments)
- Redevelopment, and reinstallation of above-/below-ground equipment

Typical activities associated with aquifer pump testing may include, but are not limited to, the following.

- Step drawdown testing
- Constant rate pumping test
- Spinner surveys
- Downhole video survey
- Casing sidewall sampling
- Biological activity reaction test, and/or packer testing for isolated zone sampling

Pump testing requires a small hole be constructed to accept test discharge. A pump test and associated discharge will occur once when a new well initially comes online, and then each well, existing or new, will be tested once every 15 years.

The equipment that may be used for well rehabilitation, redevelopment, testing, and/or replacement includes the following.

- Cable-tool rig, drill rig, or pump hoist equipment
- Nylon, polypropylene, or steel brushes
- Dual-swab assembly
- Air compressor
- Test pumping equipment
- Discharge measuring device(s)
- Water level measuring device(s)

Site Inspections and Repairs

Most routine maintenance activities described in this section are initiated based on regular site inspections of facilities. Site inspections are made both by vehicle and on foot. Access, particularly in areas that are frequently maintained, is provided by paved and dirt maintenance roads. Small-scale repairs (e.g., fences and gate repairs, signage replacement and repair, graffiti removal, trash and small debris removal) may be made as part of regular site inspections, while other maintenance needs are documented and included in annual maintenance planning efforts (e.g., a site that is experiencing erosion may be noted for future bank stabilization work).

Operation of water reuse projects requires personnel to routinely be at the facilities for inspections and equipment operation and monitoring. Operations may require night lighting and generate noise.

Stockpiling

Maintenance of stockpile locations includes placement of material (i.e., debris and sediment from HCP Team facilities) at specific locations for use in repairs and temporary storage. Stockpiles are often treated to avoid the spread of invasive plants.

Mechanized Land Clearing/Excavation

Mechanized land clearing and excavation activities include, but are not limited to, the following.

- Grading basin bottoms, which is undertaken to properly convey flows downstream and debris removal, water quality control, and groundwater recharge. Debris removal includes removal of sediment, dead vegetation such as fallen boughs and leaves, and illegally dumped trash. Material is removed to maintain conveyance capacity of each facility as necessary. Sand and gravel operations may occur. Basin bottom silt and clays are removed and soil is typically broken up and kept free of vegetation to enhance groundwater recharge.
- Mechanical vegetation clearing, which includes the removal of vegetation with equipment such as dozers and graders to allow conveyance of storm flows downstream, to remove large areas of growth from regulated facilities that are certified/inspected by the U.S. Federal Emergency Management Agency, USACE, and California Department of Water Resources Division of Safety of Dams. Mechanical vegetation clearing may also be required for fuel modification purposes per state and local fire codes.

Removed sediment, vegetation, and other debris is stockpiled on- or off site prior to final disposal. Clean sediment may be used in bank repairs or as daily cover at local landfills.

Mechanized land clearing/excavation can have a significant impact on habitat, hydrology, and sediment transport. Therefore, all mechanized land clearing/excavation activities must be coordinated closely with the HCP Implementation Entity to ensure that such clearing activities fully implement avoidance and minimization measures, and do not exceed the allotted “take” allowed under the incidental take permits of the HCP.

Access Roads

Maintenance of access roads includes road grading, surface repair of potholes and wash-outs, and fencing and gate repairs. Activities may also include excavations of various sizes that may be needed to fill potholes, conduct drainage and erosion control, conduct shoulder and slope repair, or re-gravel existing access roads. Access road excavations could be very small (e.g., to repair a pothole or shoulder slump) or involve larger, linear excavations (e.g., to replace culverts or drainage ditches, or repair slope failures for elevated access road fills).

Bank Repair

Bank repairs include filling and compaction of slumped or eroded stream, ditch, and levee banks. This may also include the removal of excess sediment that has slumped into the channel bed (invert) or basin. Sometimes, additional and incidental rip-rap rock or gabion placement may be required for banks that experience frequent erosion resulting in high frequency of maintenance. Rip-rap repair includes repositioning, replacement, or placement of incidental rip-rap to stabilize the slopes. It also includes the repair of grouted and ungrouted sections of rock. Bank repair can also include the repair or replacement of steel revetment with more revetment or rip-rap rock.

Bank repair along ditches may also include using a backhoe or other heavy equipment to rough grade or stabilize banks and then hydroseeding. Hydroseeding requires the use of special machinery that is towed by a pickup truck. The machinery mixes the seeds and mulch and sprays the mixture onto the bare slope. A maintenance worker may need to spread or move hydroseed around with shovels and rakes. Hydroseeding is usually done once a year prior to rainy season.

Basins

Maintenance activities for basins consists of periodic cleaning to remove accumulated sediment, bank repair, adding sand to existing permanently disturbed areas, and clearing of encroaching vegetation to restore to as-built design specifications. Removed sediment is typically used for dike, canal, and access road maintenance or is exported off site. Routine maintenance may also include vector control (see *Vector and Pest Control* below).

Structure Repair

Existing structure repair or replacement includes, but is not limited to, maintenance and in-kind repair/replacement of concrete walls, and appurtenant structures such as diversion gates, inlets, outlets, spillways, down-drains and/or under-drains, bottom controls, and channel invert improvements.

Culverts, Canals, and Channels

This activity includes clearing encroaching vegetation and debris or sediment, filling ruts and potholes, grading, resurfacing (with gravel or compacted soil), and repairing washouts or erosion. Washout and erosion repair is typically accomplished by filling in the eroded area with native material and sometimes grouted rock. It also includes periodic vegetation control. Channels may also be used for heavy equipment access for channel repair activities and vegetation/debris management.

Dikes

This activity entails occasional excavation and compaction of the dike material at the source of leaks, similar work to replace broken overflow culverts, and repair of washouts. Such repairs occur infrequently.

Vegetation Management

Fuel Modification

Fuel modification can be in the form of manual, mechanical, or chemical vegetation control for the purposes of wildfire management. Methods may include thinning, trimming up, and removing vegetation within buffer zones. Such activities could occur periodically throughout the year in the Planning Area.

Conveyance Maintenance

Mechanical and manual vegetation management activities—including mowing and manual pruning—remove vegetation within facilities or on or in the vicinity of water conveyance structures (e.g., weeds growing up through gabions) that prevent the proper conveyance of storm flows

downstream. Equipment used includes, but is not limited to, herbicide[6] applicators, tractor mowers, tractor and disc trailer, and boom mowers. Manual removal includes using power trimmers, weed eaters, and tools such as pruning loppers, saws, and clippers to trim and thin vegetation so it does not clog downstream facilities or reduce water quality.

Facility/Infrastructure Access

Mechanical and manual vegetation management activities are also necessary to maintain access to exposed pipelines, fence lines, and access roads. Equipment used is the same as above, and removal is intended to provide access for inspection of facilities and infrastructure integrity and to prevent damage from vegetation.

RPU may also conduct vegetation management around powerlines. Vegetation management around powerlines requires maintaining a specific clearance distance from the line to ensure that vegetation does not grow back into the electric lines before the next maintenance cycle. If the vegetation is located adjacent to the line, limbs can be pruned along one side of a tree (i.e., side pruning). Vegetation growing under the lines is often topped (i.e., its height is reduced) at the required height below the conductors. Vegetation management is only implemented for those trees and shrubs that will interfere with the electric line when at a mature height or when North American Electric Reliability Corporation (NERC) requirements specify different prescriptions. With few exceptions, such as in the case of pole clearing, any low-growing species are left untouched because they will never pose a risk to the safety or reliability of the electric line. NERC requires clearing at subject poles to remove any vegetation that could propagate a fire. Avoidance and minimization measures for this activity, including avoidance of breeding periods for birds, are addressed in Chapter 5.

Vector and Pest Control

Vector control primarily involves mosquito control to reduce the spread of disease, including West Nile virus. Vector control is conducted by the Riverside and San Bernardino County Environmental Health Department – Mosquito/Vector Control offices, and includes biopesticides and the introduction of mosquito-larvae eating fish.

Pest control includes controlling species that impair habitat quality for Covered Species or degrade water management infrastructure (e.g., ground squirrels burrowing in earthen berms). Pest control measures include the following.

- Hunting or trapping of wild pigs to reduce their population and protect native species and their habitats. Wild pigs have spread throughout California as a result of escaped domestic pigs breeding with European wild boars, which were introduced to California in the 1920s. Wild pigs were designated as a game species by the state of California in 1957 and they currently exist in 56 of the state's 58 counties on both private and public lands.

[6] Activities associated with the application of herbicide that may result in take of a Covered Species (e.g., the operation of an all-terrain vehicle in San Bernardino kangaroo rat habitat resulting in the collapse of a burrow) are covered by the HCP. Applicators must use pesticides according to the label. This includes limits on applications to avoid impacts on wildlife. Appendix B of the HCP Handbook (USFWS and NMFS 2016) provides special considerations for including use of pesticides in HCPs. This HCP does not cover take from herbicide or pesticide use.

- Controlling ground squirrels on earthen berms to prevent burrowing and maintain berm integrity. Control will be done through the use of pesticides.[7]
- Brown-headed cowbirds (*Molothrus ater*) may also be controlled on preserve lands. These birds are brood parasites; females do not build nests but instead lay their eggs in the nests of other "host" birds and transfer the responsibility of hatching and raising their young to the host bird. When parasitizing nests they often remove the eggs of the host bird. If the eggs are left, the cowbird chick often hatches before the native bird species and develop faster, resulting in more care and attention from the host parents. Least Bell's vireo (*Vireo bellii pusillus*) and southwestern willow flycatcher (*Empidonax traillii extimus*), two Covered Species in this HCP, are negatively affected by nest parasitism by brown-headed cowbirds.

2.2 Projects and Activities Not Covered by the HCP

During development of the HCP, other activities were considered but rejected for inclusion as Covered Activities. These activities are not covered by this HCP. If take authorization is needed for any activities not covered by the HCP, it would have to be obtained independently from the Wildlife Agencies by the appropriate party.

Activities not covered by the HCP and the incidental take authorizations include the following.

- Any activity conducted by a non-Permittee or entity not holding a Certificate of Inclusion (COI) is not covered under the HCP, for example:
    - Utility construction and maintenance, such as electric transmission lines, gas pipelines, petroleum pipelines, telecommunications lines, or cellular telephone stations and associated access roads, if not specifically required as part of a Covered Activity and included as part of the Covered Activity's design.
    - SBCFCD owns facilities within the HCP Planning Area upon which some Covered Activities will occur (implemented by HCP Permittee Agencies); however, SBCFCD is not a Permittee and SBCFCD's own projects, operations, and maintenance activities are not covered under this HCP.
- Projects, and operations and maintenance of the San Bernardino County Flood Control District are not covered by this HCP.
- Channel centerflow activities. Channel centerflow is the establishment and maintenance of a smaller center channel within a channel to convey low volume flows within the center of an earthen channel to keep flows away from the slopes, and is used for guiding first-storm flows. A centerflow channel is established by clearing sediment and vegetation within the center of the channel.

[7] Activities associated with the application of herbicide that may result in take of a Covered Species (e.g., the operation of an all-terrain vehicle in habitat resulting in the collapse of a burrow) are covered by the HCP. Applicators must use pesticides according to the label. This includes limits on applications to avoid impacts on wildlife. Appendix B of the HCP Handbook (USFWS and NMFS 2016) provides special considerations for including use of pesticides in HCPs. This HCP does not cover take from herbicide or pesticide use.

- Disking as a means of vegetation control or maintenance of fire breaks. Mowing is covered as needed for these purposes; disking is not covered.
- This HCP does not cover IEUA's pipeline maintenance activities.
- The Conservation District owns and operates water spreading facilities located outside of the southern edge of Mill Creek, on the dry side of the existing Mill Creek floodwall and approximately 3.5 miles south of Seven Oaks Dam. The Conservation District's Mill Creek Diversion and Debris Management Improvement Project and maintenance to the spreading facilities south of the Mill Creek flood wall will be permitted outside of this HCP, and therefore are not Covered Activities.
- Routine freeway O&M activities that occur within the Planning Area.
- The Western Riverside County Regional Wastewater Treatment Plant (WRCRWTP) Enhancement and Expansion Project was included in the HCP Hydrology Model to account for its effects on in-stream flow from a cumulative effects perspective. However, this project is not covered by the HCP. The discharge from this facility is governed by the California Regional Water Quality Control Board, Santa Ana Region's Order No. R8-2008-0005 (National Pollutant Discharge Elimination System Permit No. CA8000316). Its present design capacity is 8.0 mgd with a proposed ultimate capacity of approximately 16 mgd.

  The Final Environmental Impact Report (FEIR) for the Western Riverside County Regional Wastewater Treatment Plant Enhancement and Enlargement Project, State Clearinghouse No.2009091040 (K.S. Dunbar & Associates 2010) was certified by the WRCRWA Board of Directors' Resolution No. 10-116 on August 24, 2010. The goals and objectives of the project are as follows.

  - Remain in compliance with Order No. R8-2008-0005 adopted by the California Regional Water Quality Control Board, Santa Ana Region on July 18, 2008 and any amendments thereto.
  - Decrease the amount of recycled water that must be discharged to the Santa Ana River.
  - Increase the use of recycled water within economic distance of the Western Riverside County Regional Wastewater Treatment Plant for non-potable uses.
  - Decrease the dependence on imported water supplies within the service areas of the Western Riverside County Regional Wastewater Authority members.

  The FEIR analyzed diversion of up to approximately 24.9 cfs (13.4 mgd) and found that the proposed reduction in recycled water discharge would have no significant impacts on riparian habitat within the Santa Ana River environs nor would it have significant impacts on special-status species that occupy the subject riparian habitat. This determination was based on the fact that the proposed reduction in discharge of 24.8 cfs (13.3 mgd) accounts for only about 2.3% of the total recycled water discharged to the Prado wetlands.

  In December 2012, WRCWRA filed a request with the SWRCB seeking authorization to reduce its current discharge to zero for a reduction of 12.4 cfs (6.7 mgd) to the Santa Ana River Diversion Channel or Canal pursuant to California Water Code Section 1211, Wastewater Change Petition WW0067. The entirety of the water remaining in the Canal, following WRCRWA's discharge reduction, would be from the OCWD diversion at the Santa Ana River.

Following its request to the SWRCB for Wastewater Change Petition WW0067, in coordination with USFWS, CDFW has developed an Adaptive Management and Monitoring Program that addresses potential impacts on riparian habitat and associated special-status species within and along the Canal.

- Large-scale maintenance activities not listed as a stand-alone Covered Activity or included under the covered routine maintenance activities (Section 2.1.6). Covered routine maintenance activities are actions that occur repeatedly in one location and/or in many locations over a wide area (e.g., bank stabilization, storm-damage repair, maintenance of facilities). These maintenance activities are generally performed periodically and include actions such as minor construction, earth-moving, or vegetation clearing activities that can affect listed species.
- Collection and handling of the Covered Species unless specifically required as a component of the biological monitoring and adaptive management. Separate authorization from USFWS and CDFW as appropriate is required for unrelated collection and handling of any listed species.
- Take of a Covered Species, species proposed for federal listing, state-listed species, or state candidate species as a result of the use of herbicides or other pesticides, or other chemical agents.[8]

2.2.1 Utility Construction and Maintenance

Public and private utility infrastructure maintained by entities that are not the Permittee Agencies or HCP Participating Entities, such as electric transmission lines, gas pipelines, petroleum pipelines, telecommunications lines, or cellular telephone stations, might cross or need to cross the Planning Area. However, the construction of such new utility infrastructure, including associated permanent and temporary access roads, or the maintenance of such existing infrastructure in the Planning Area is not a Covered Activity. Additionally, routine and emergency maintenance and repairs to such existing utilities within the Planning Area are not covered by the HCP. If improvements to utilities are required as part of an HCP Covered Activity and included as part of the Covered Activity design, those improvements are covered as part of that Covered Activity.

2.2.2 Freeway Operation and Maintenance

Freeway O&M activities that occur within the I-210 ROW or any other areas within the Planning Area are not covered by the HCP.

2.2.3 General Urban Development

Any development projects such as commercial, industrial, residential development or other urban transportation infrastructure (e.g., roadways, railways, bicycle paths) are not covered unless specifically listed as a Covered Activity, above.

[8] Activities associated with the application of herbicide that may result in take of a Covered Species (e.g., the operation of an all-terrain vehicle in San Bernardino kangaroo rat habitat resulting in the collapse of a burrow) are covered by the HCP. Applicators must use pesticides according to the label. This includes limits on applications to avoid impacts on wildlife. Appendix B of the HCP Handbook (USFWS and NMFS 2016) provides special considerations for including use of pesticides in HCPs. This HCP does not cover take from herbicide or pesticide use.

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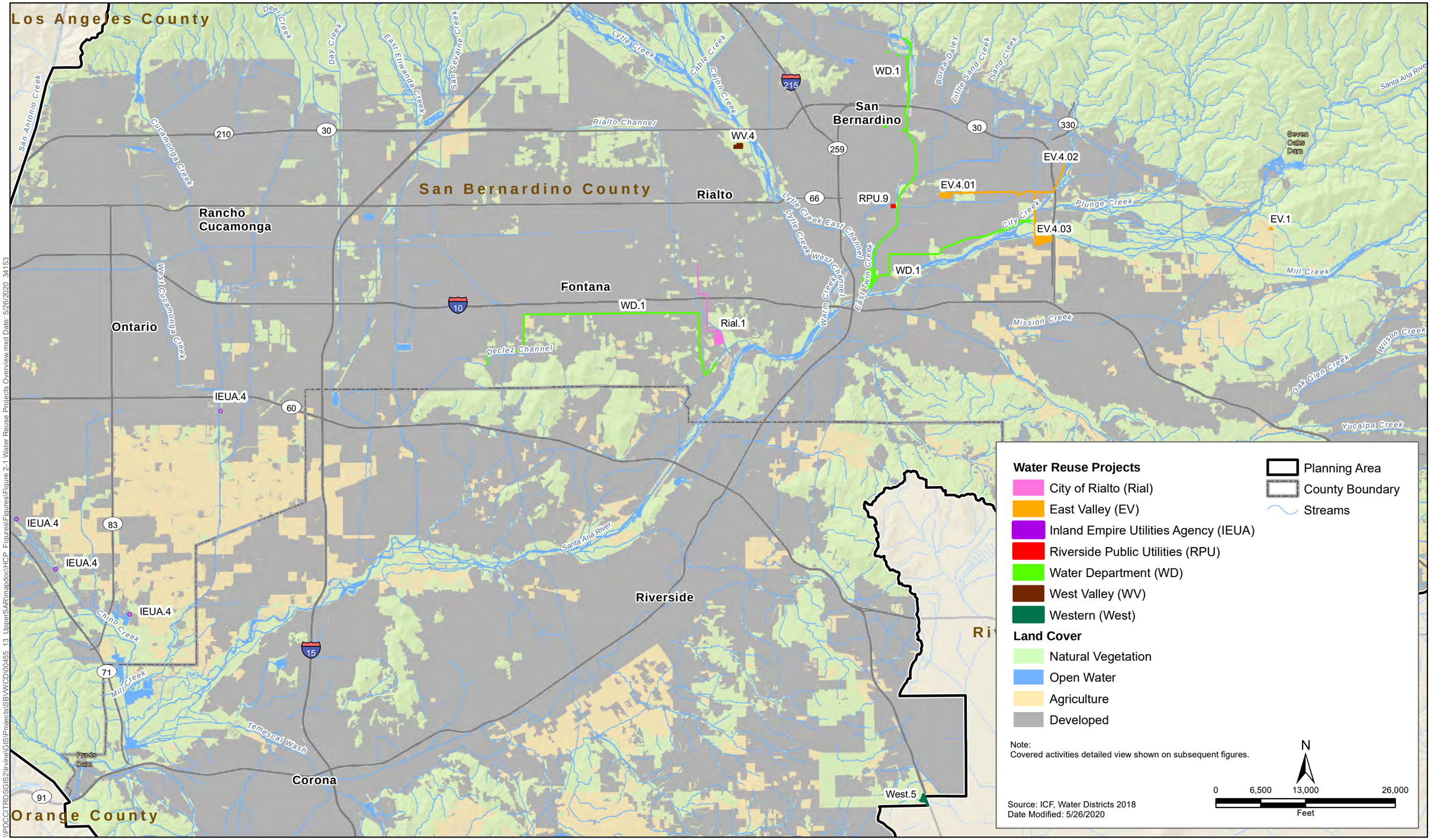

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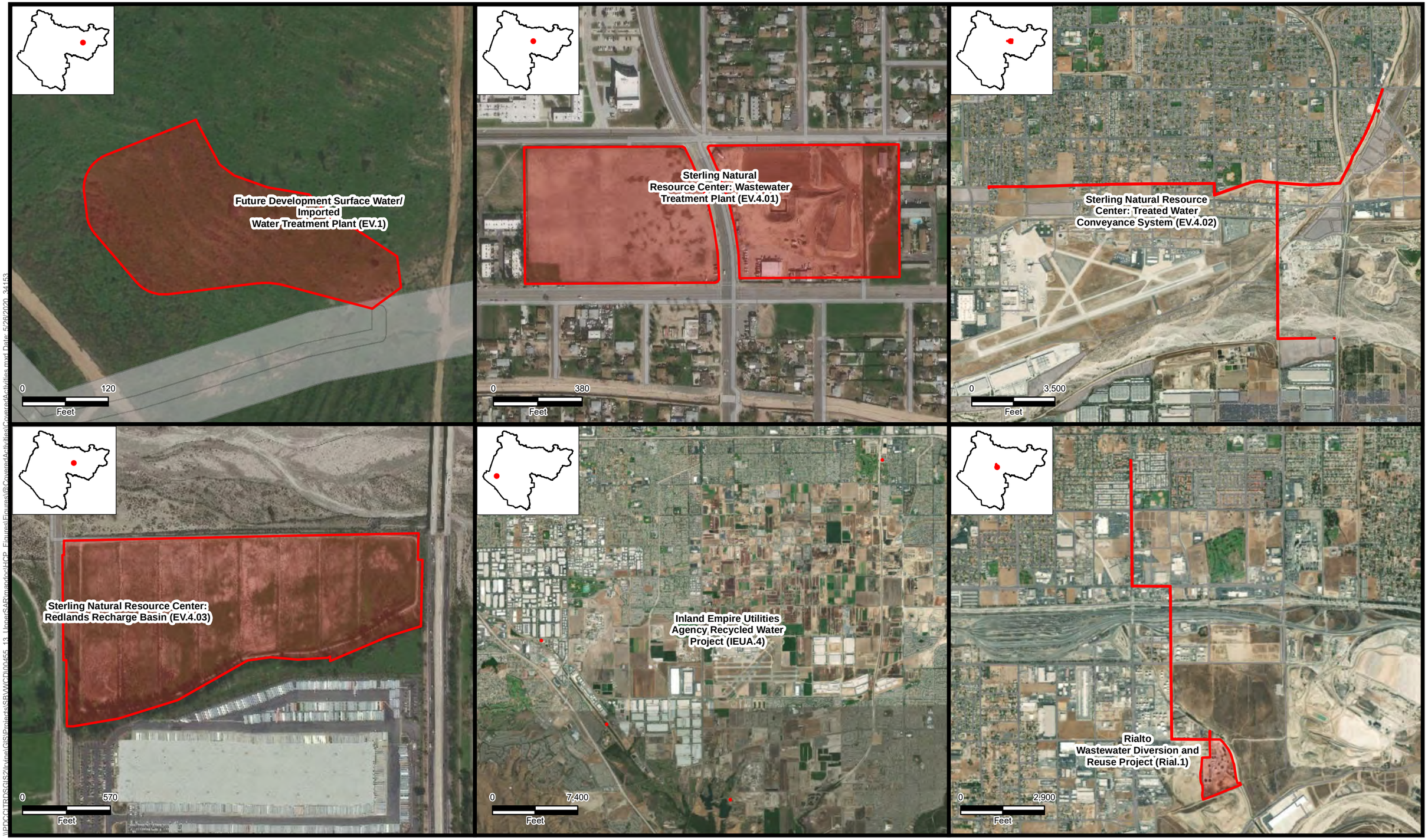
Upper Santa Ana River Habitat Conservation Plan

Figure 2-1
Covered Activities: Water Reuse Projects



Upper Santa Ana River
Habitat Conservation Plan

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Covered Activity
Adjacent Covered Activities
Planning Area

Figure 2-2
Covered Activities:
Water Reuse Projects

Upper Santa Ana River Habitat Conservation Plan

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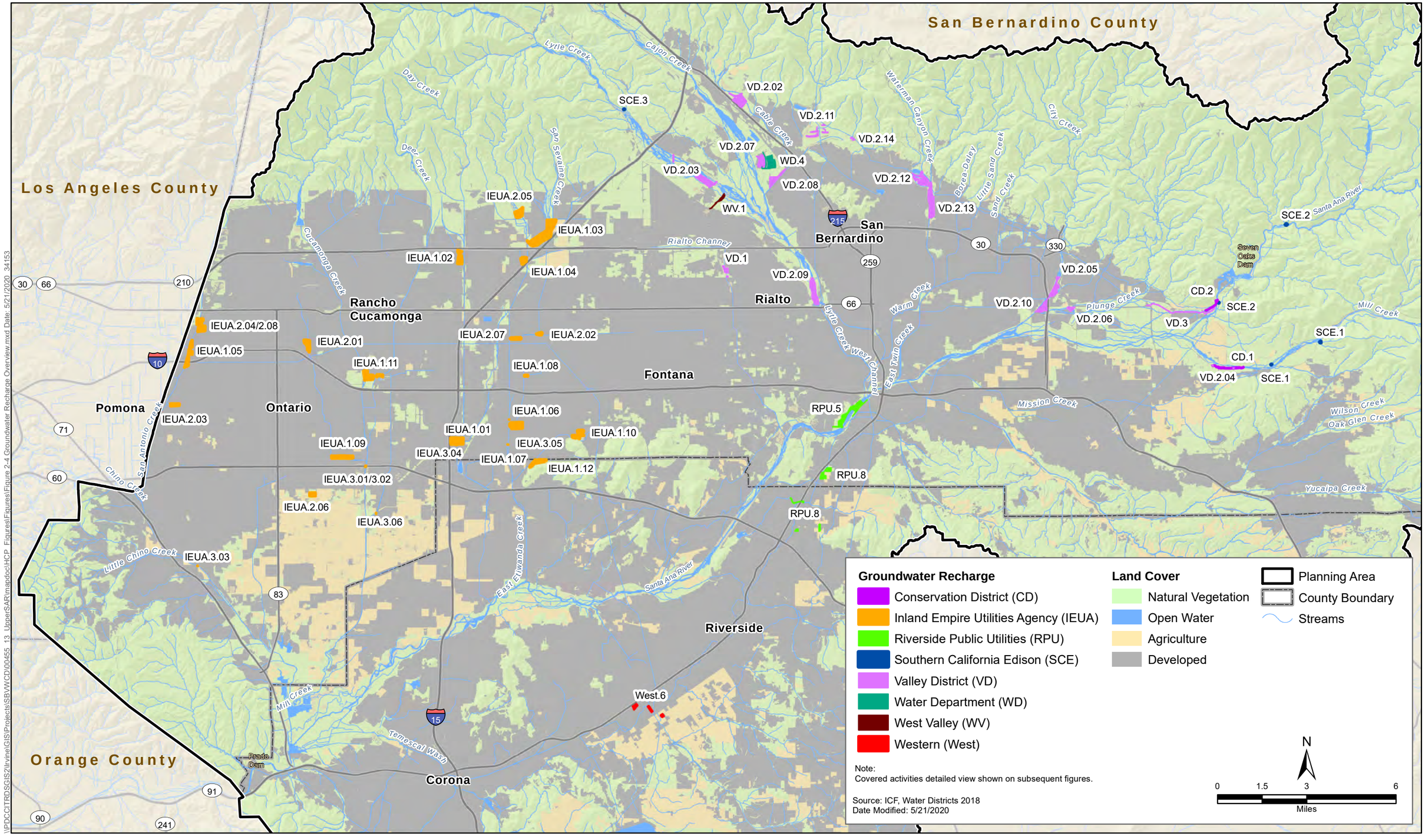
Covered Activity
Adjacent Covered Activities
Planning Area

Figure 2-3
Covered Activities:
Water Reuse Projects (continued)



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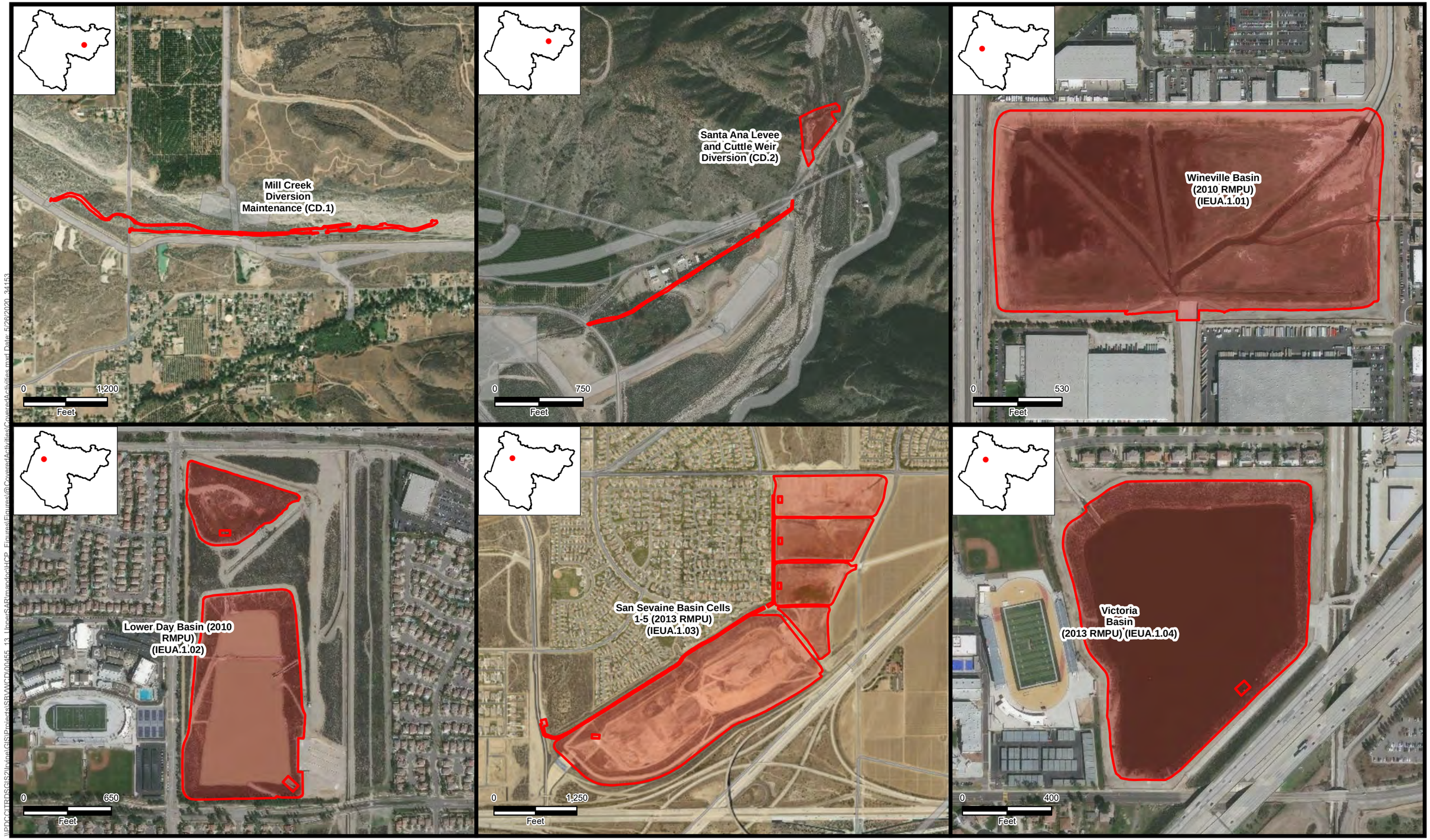
Upper Santa Ana River Habitat Conservation Plan

Figure 2-4
Covered Activities: Groundwater Recharge



Upper Santa Ana River Habitat Conservation Plan

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Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-5
Covered Activities: Groundwater Recharge

Upper Santa Ana River Habitat Conservation Plan

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Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-6
Covered Activities:
Groundwater Recharge (continued)

Upper Santa Ana River Habitat Conservation Plan

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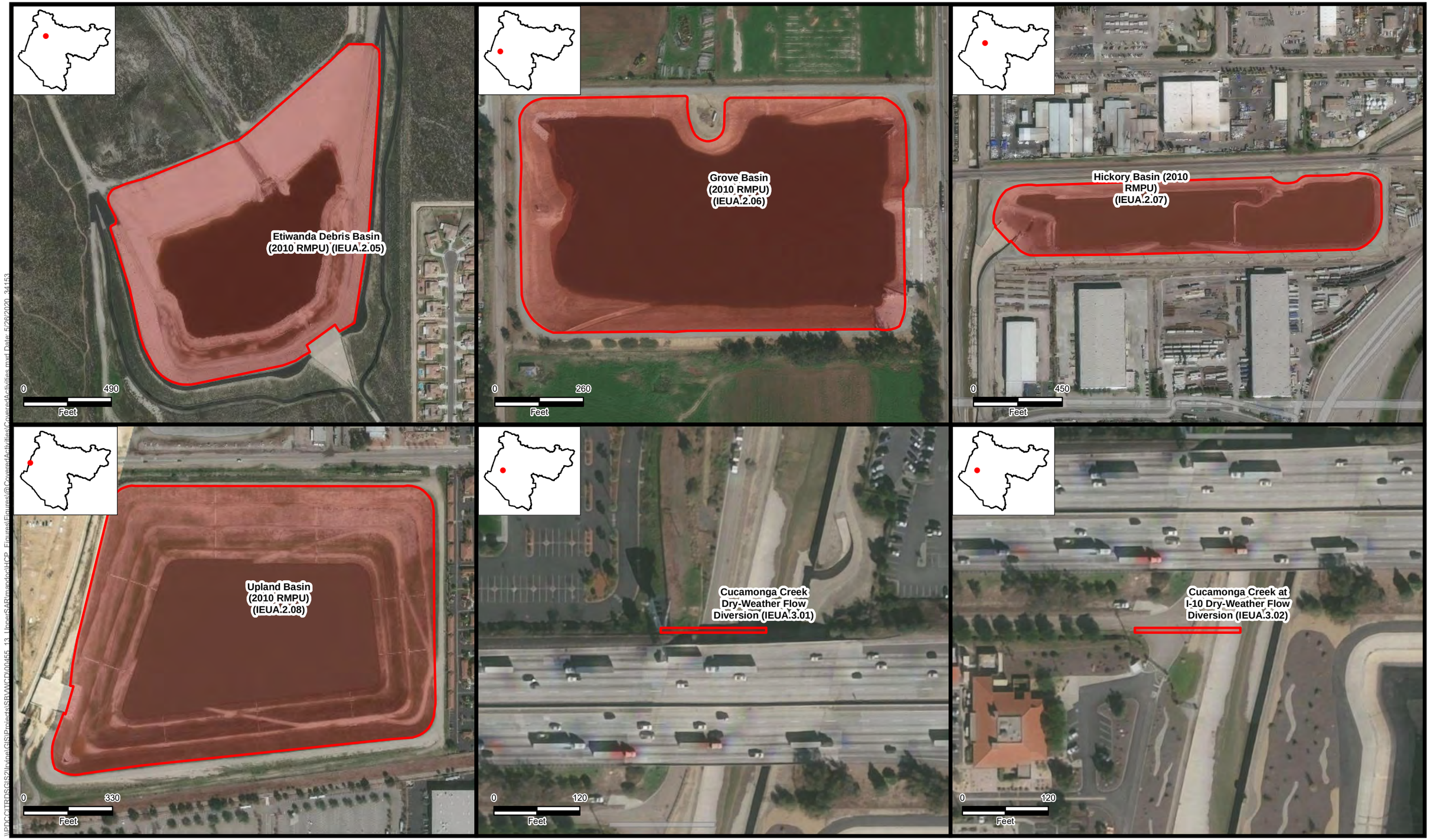
Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-7
Covered Activities:
Groundwater Recharge (continued)



Upper Santa Ana River Habitat Conservation Plan

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Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-8
Covered Activities:
Groundwater Recharge (continued)

Upper Santa Ana River Habitat Conservation Plan

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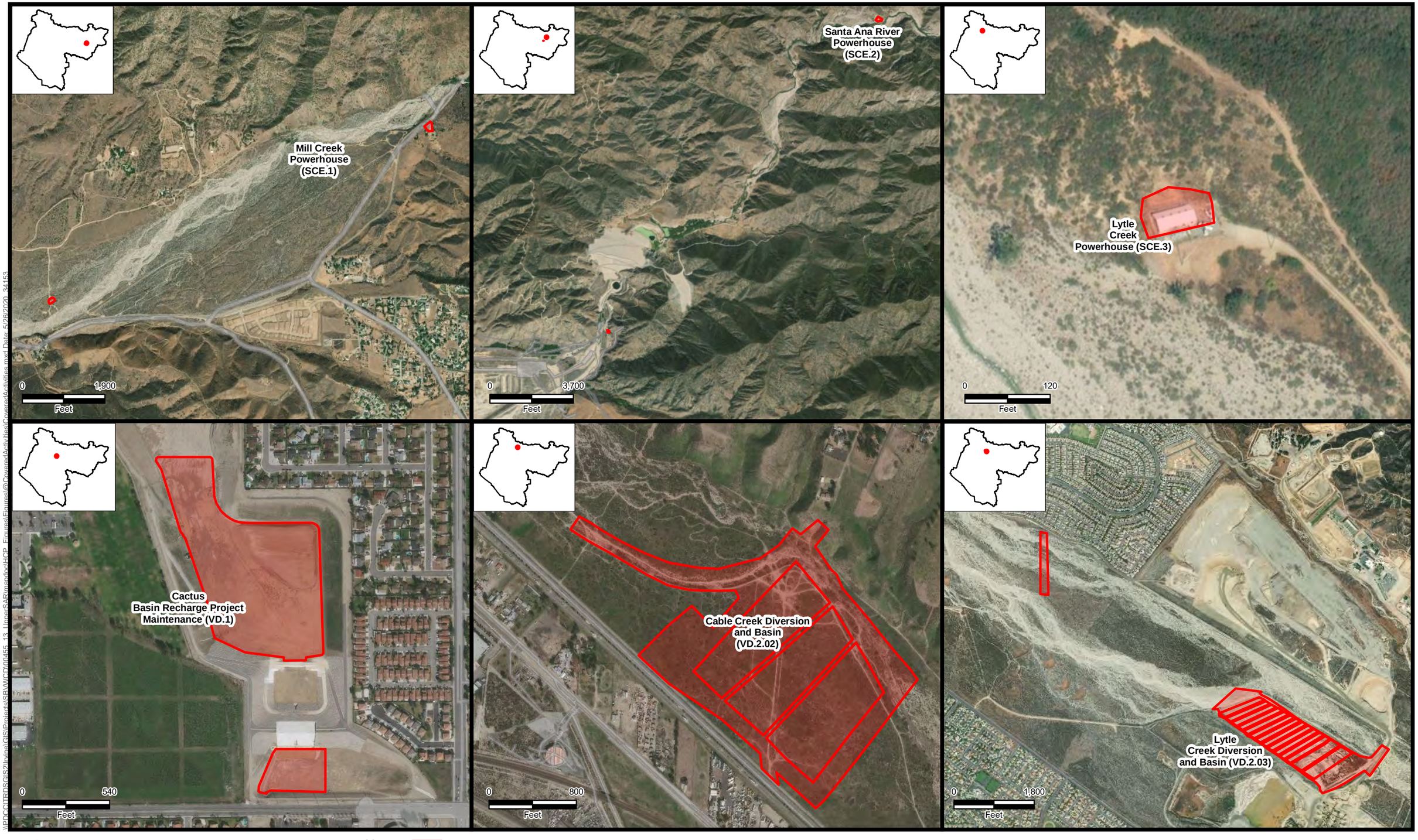
Covered Activity
Adjacent Covered Activities
Planning Area

Figure 2-9
Covered Activities:
Groundwater Recharge (continued)



Upper Santa Ana River Habitat Conservation Plan

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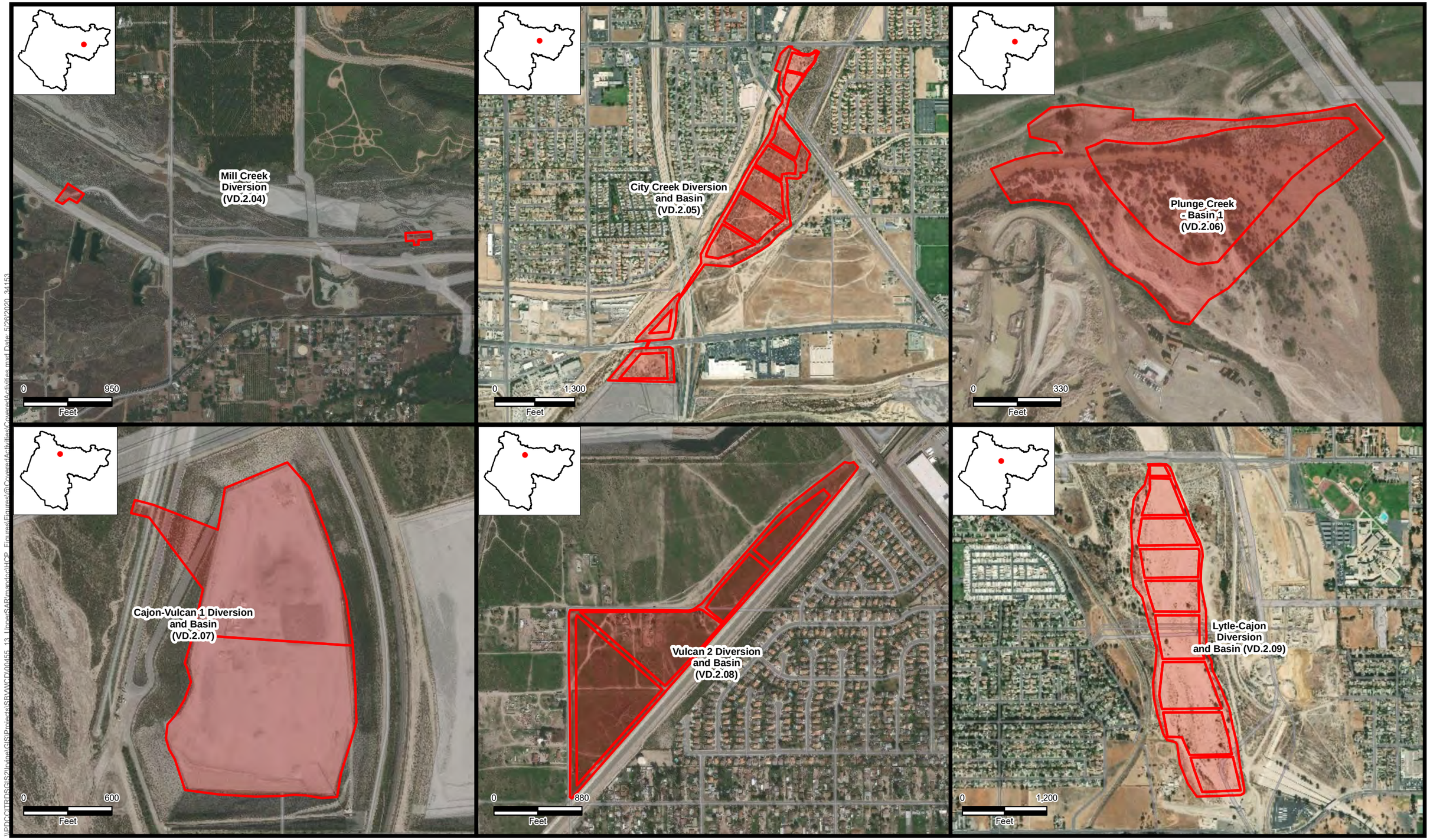
Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-10
Covered Activities:
Groundwater Recharge (continued)



Upper Santa Ana River Habitat Conservation Plan

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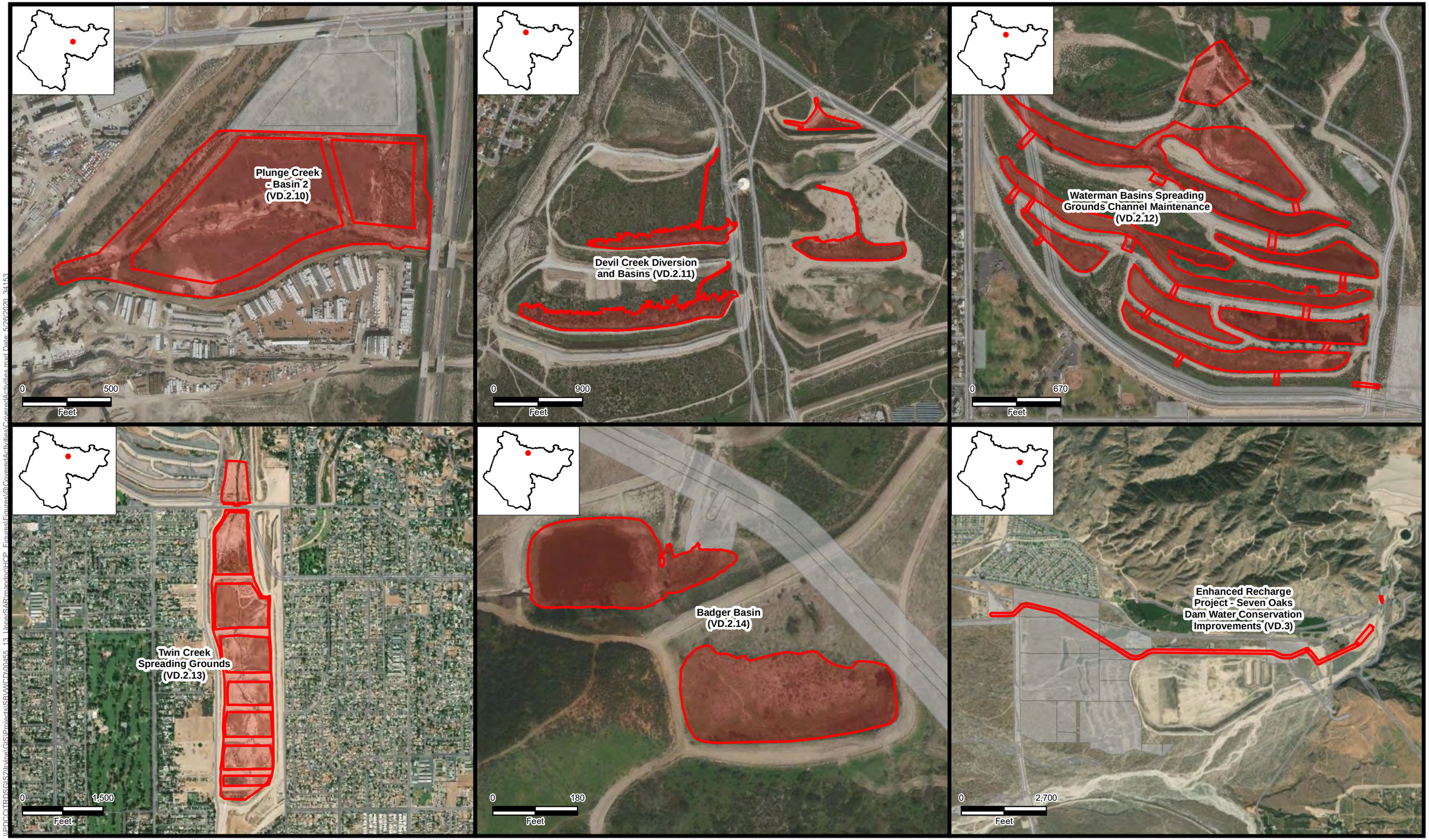
Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-11
Covered Activities:
Groundwater Recharge (continued)



Upper Santa Ana River Habitat Conservation Plan

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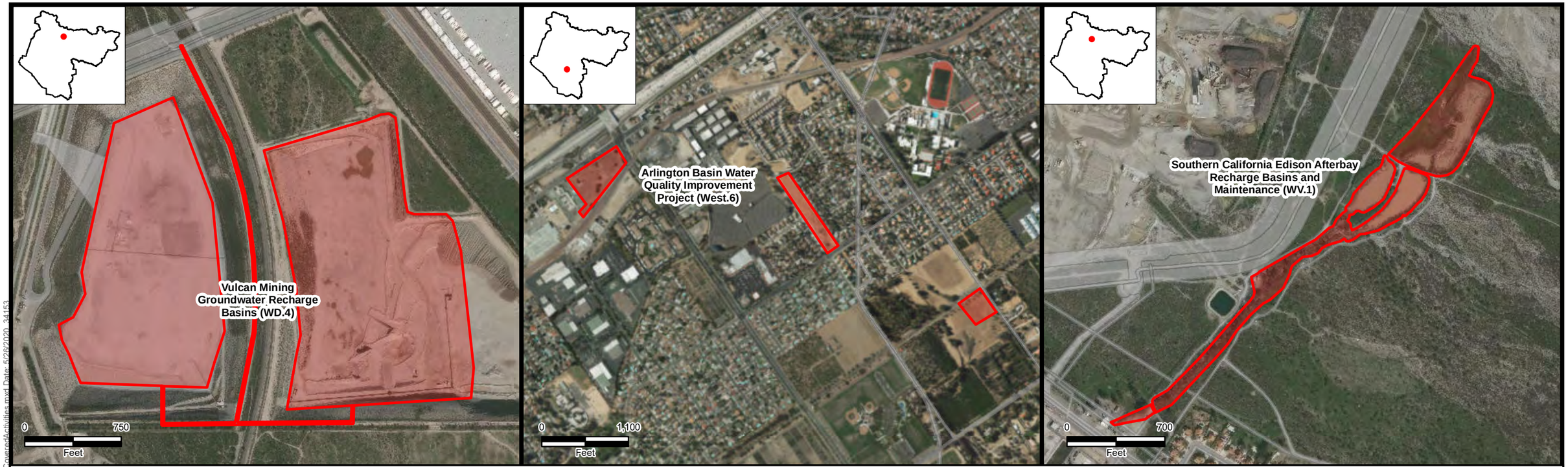
Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-12
Covered Activities:
Groundwater Recharge (continued)



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Upper Santa Ana River Habitat Conservation Plan

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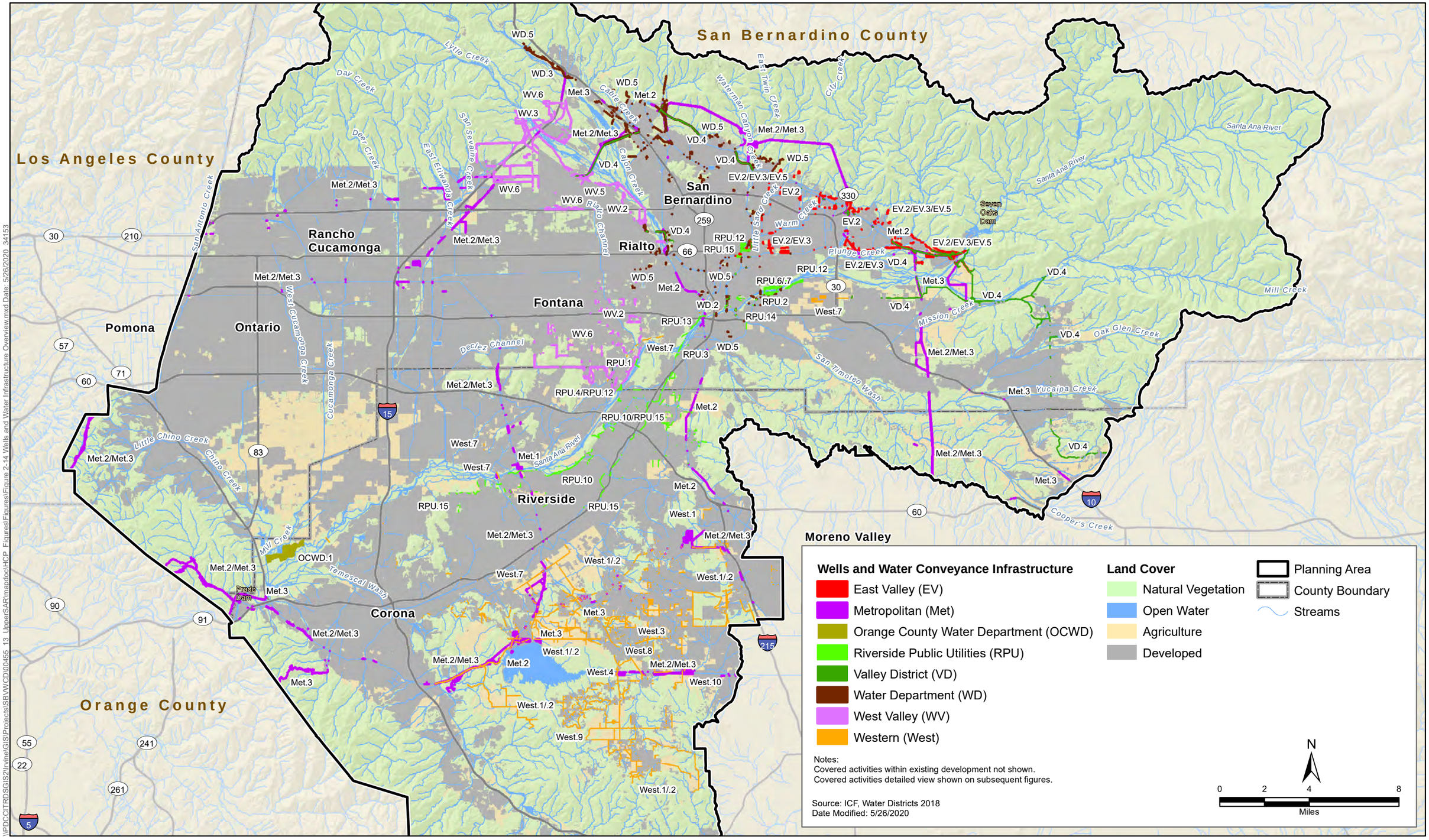
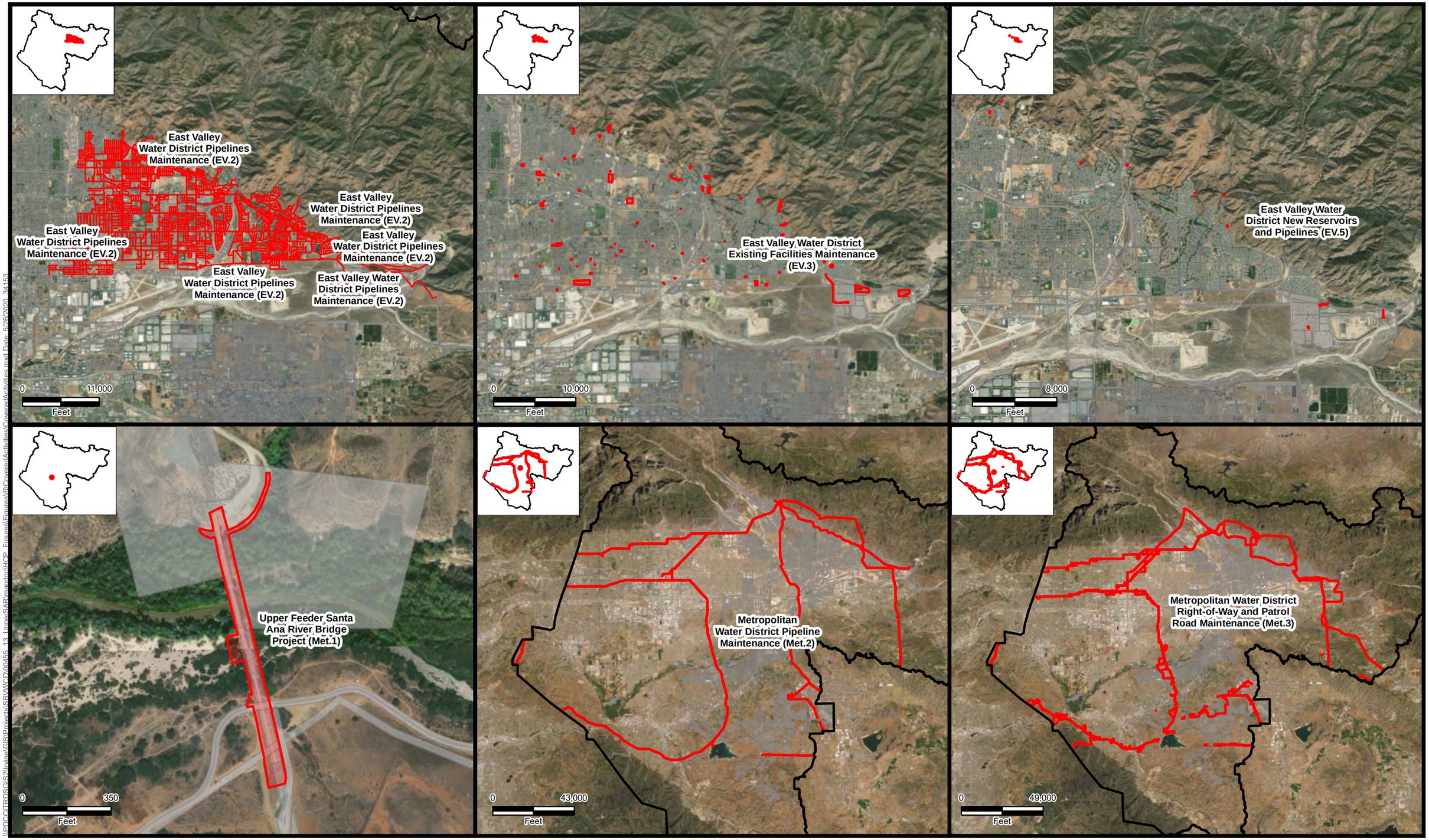
Covered Activity
Adjacent Covered Activities
Planning Area

Figure 2-13
Covered Activities:
Groundwater Recharge (continued)



Upper Santa Ana River Habitat Conservation Plan

Figure 2-14
Covered Activities:
Wells and Water Conveyance Infrastructure



Upper Santa Ana River Habitat Conservation Plan

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Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-15
Covered Activities:
Wells and Water Conveyance Infrastructure

Upper Santa Ana River Habitat Conservation Plan

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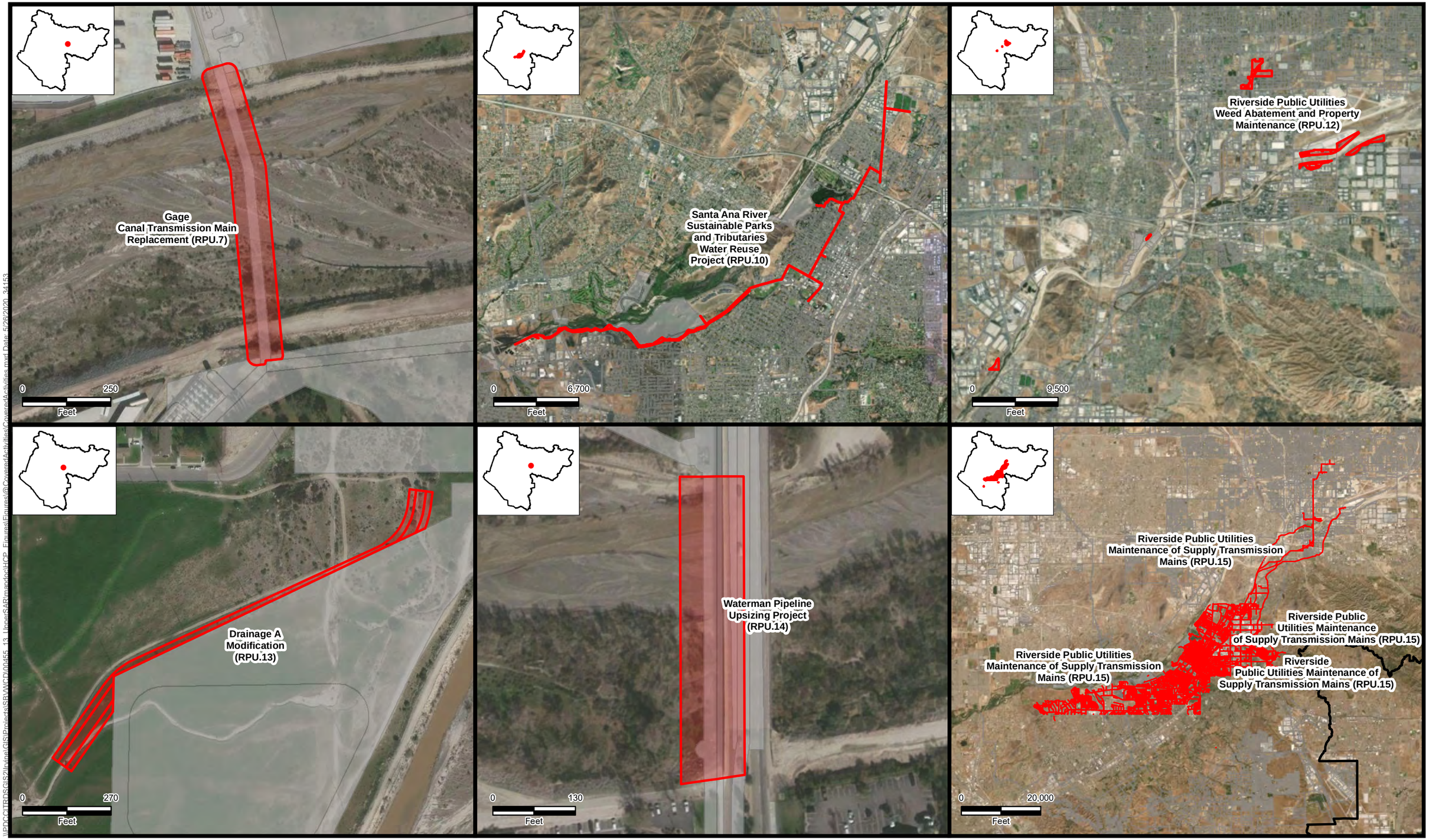
Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-16
Covered Activities:
Wells and Water Conveyance Infrastructure (continued)



Upper Santa Ana River Habitat Conservation Plan

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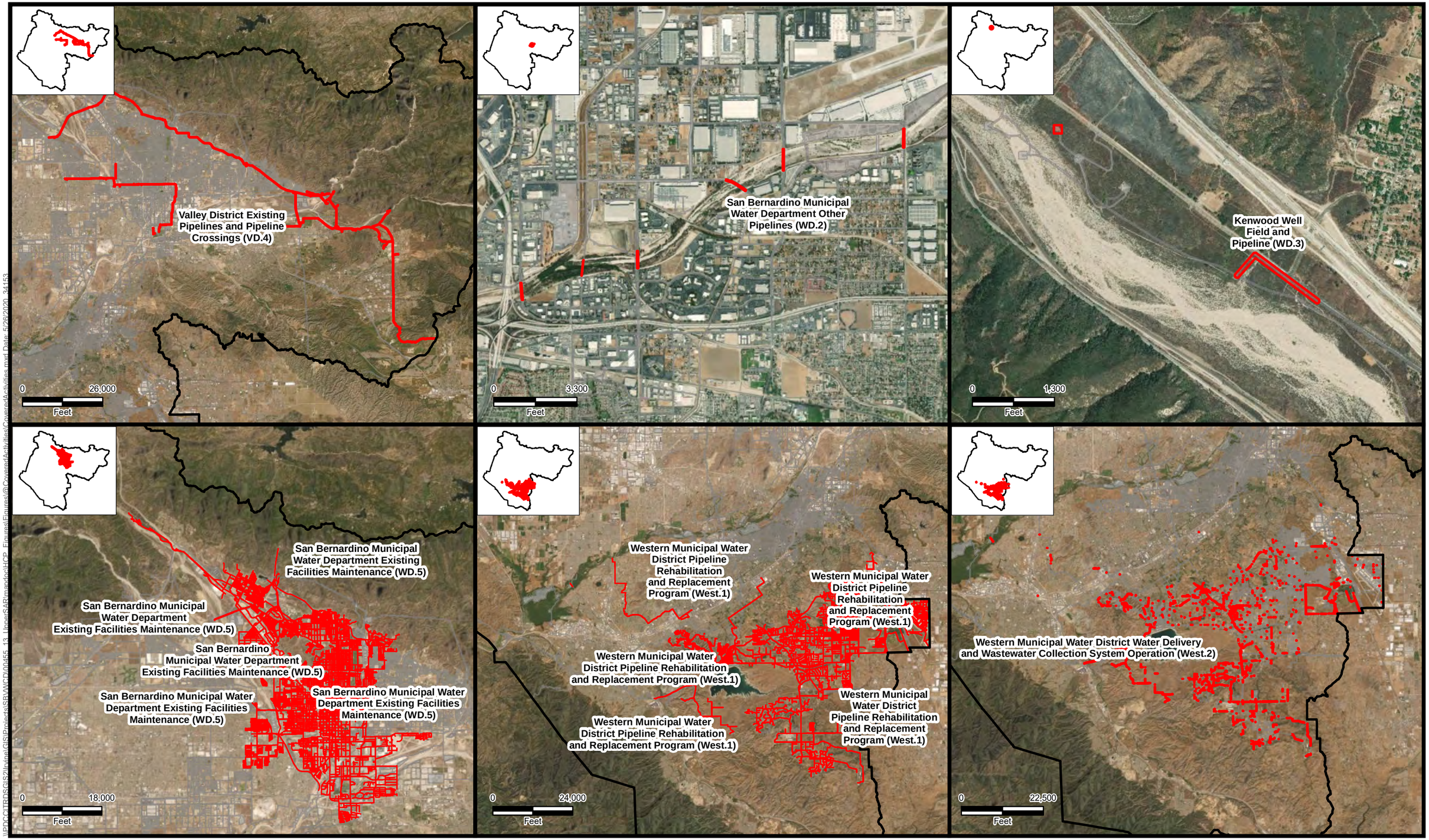
Covered Activity
Adjacent Covered Activities
Planning Area

Figure 2-17
Covered Activities:
Wells and Water Conveyance Infrastructure (continued)



Upper Santa Ana River Habitat Conservation Plan

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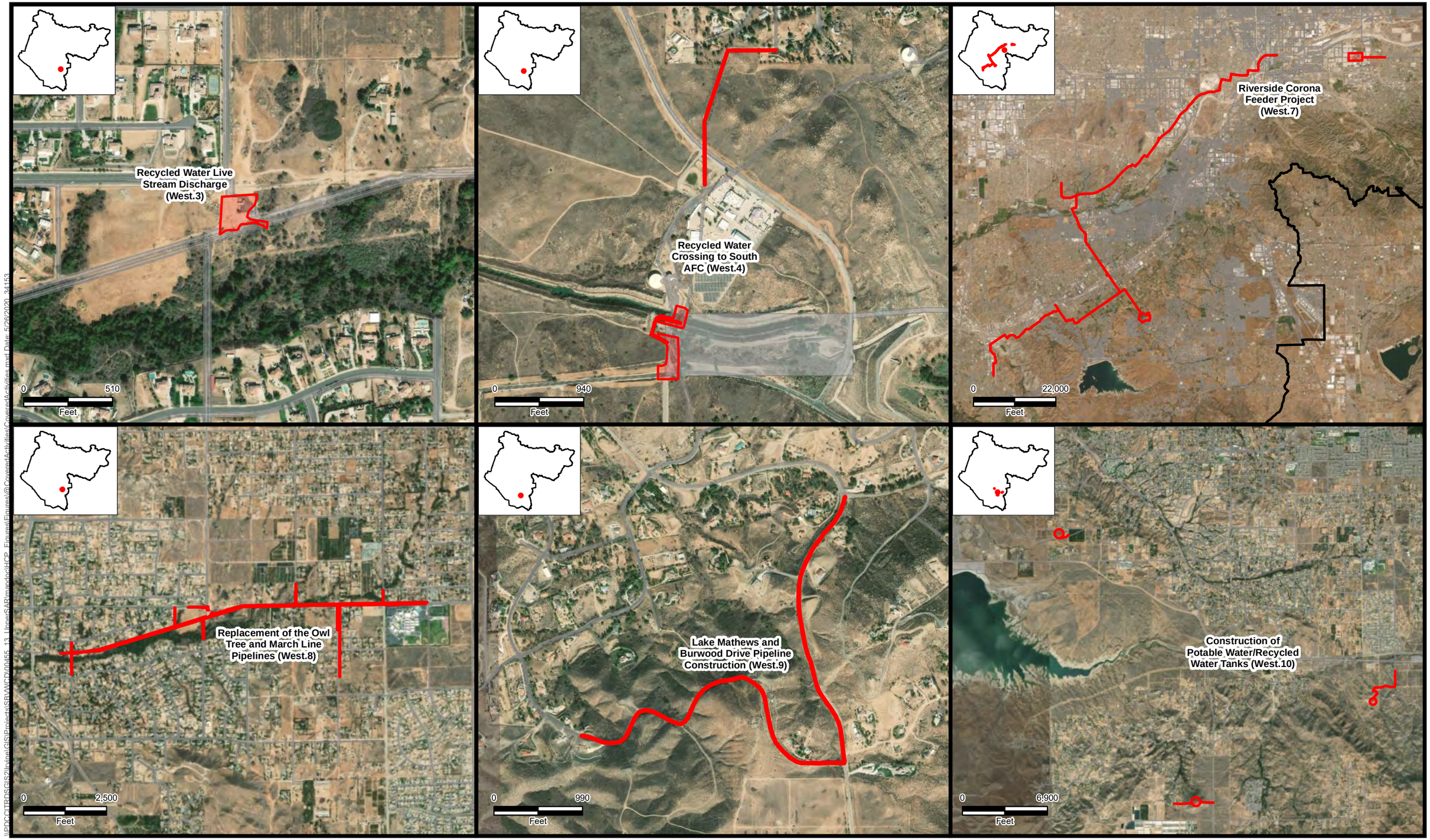
Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-18
Covered Activities:
Wells and Water Conveyance Infrastructure (continued)



Upper Santa Ana River Habitat Conservation Plan

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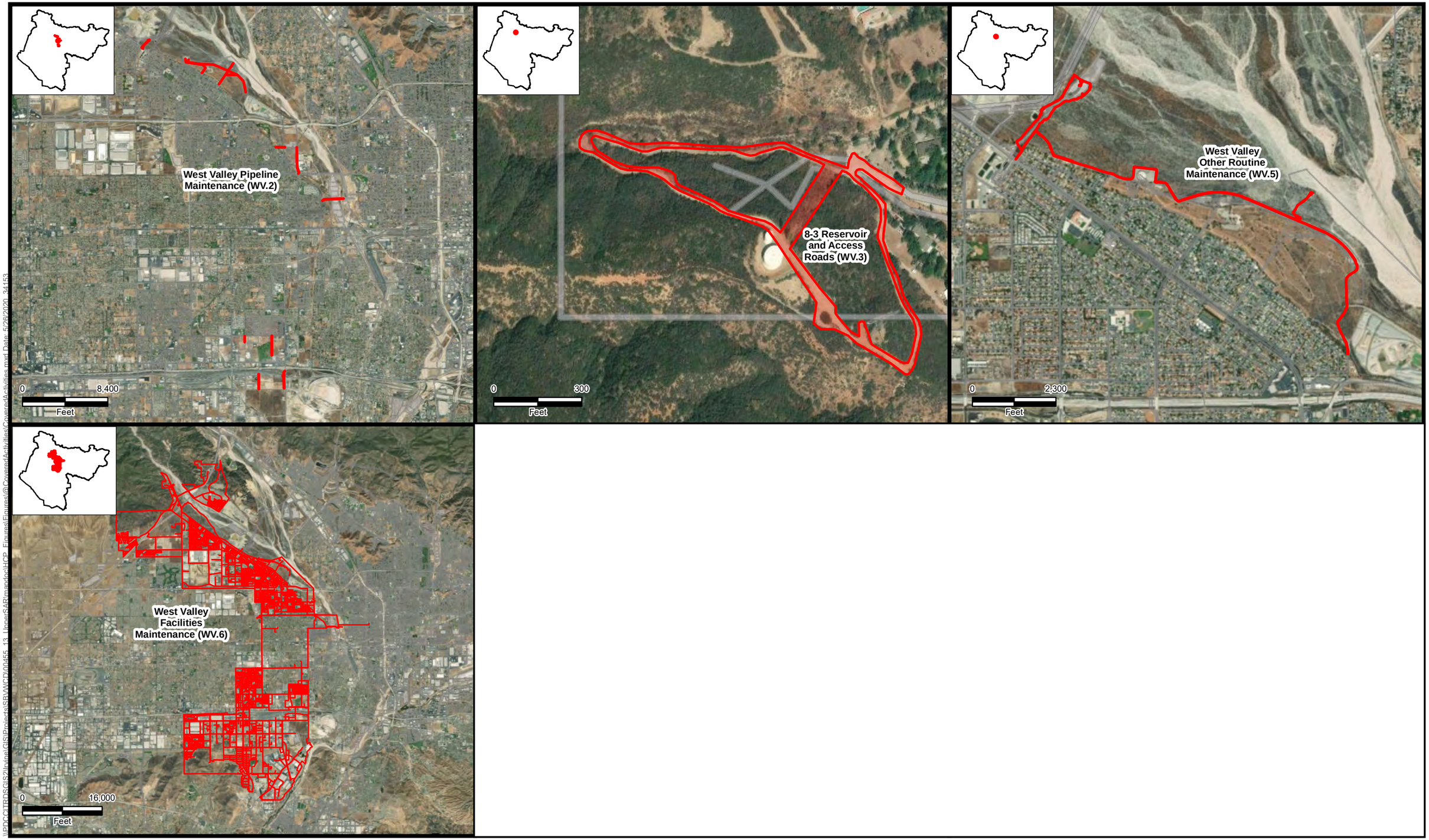
Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-19
Covered Activities:
Wells and Water Conveyance Infrastructure (continued)



Upper Santa Ana River Habitat Conservation Plan

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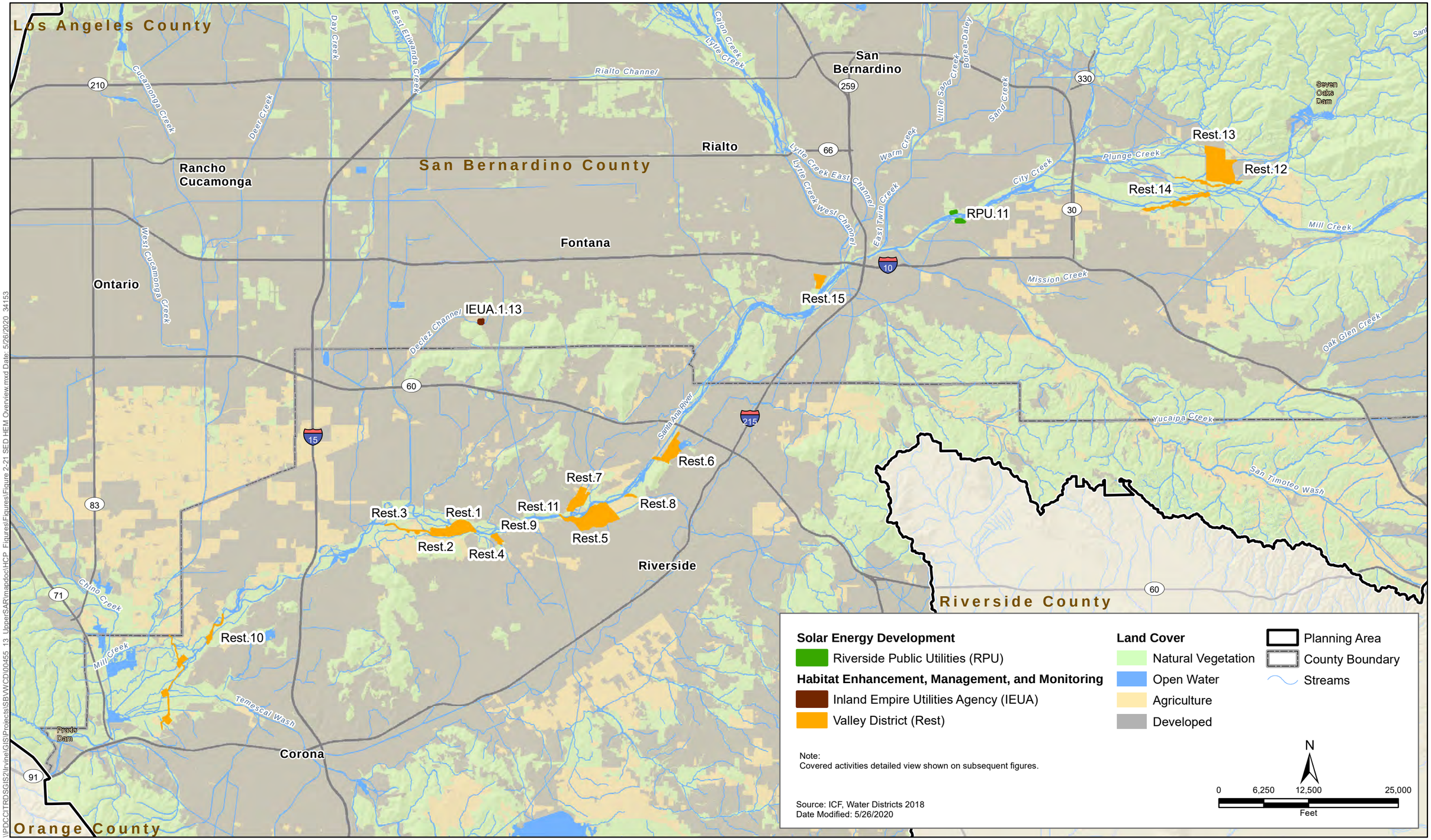
Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-20
Covered Activities:
Wells and Water Conveyance Infrastructure (continued)



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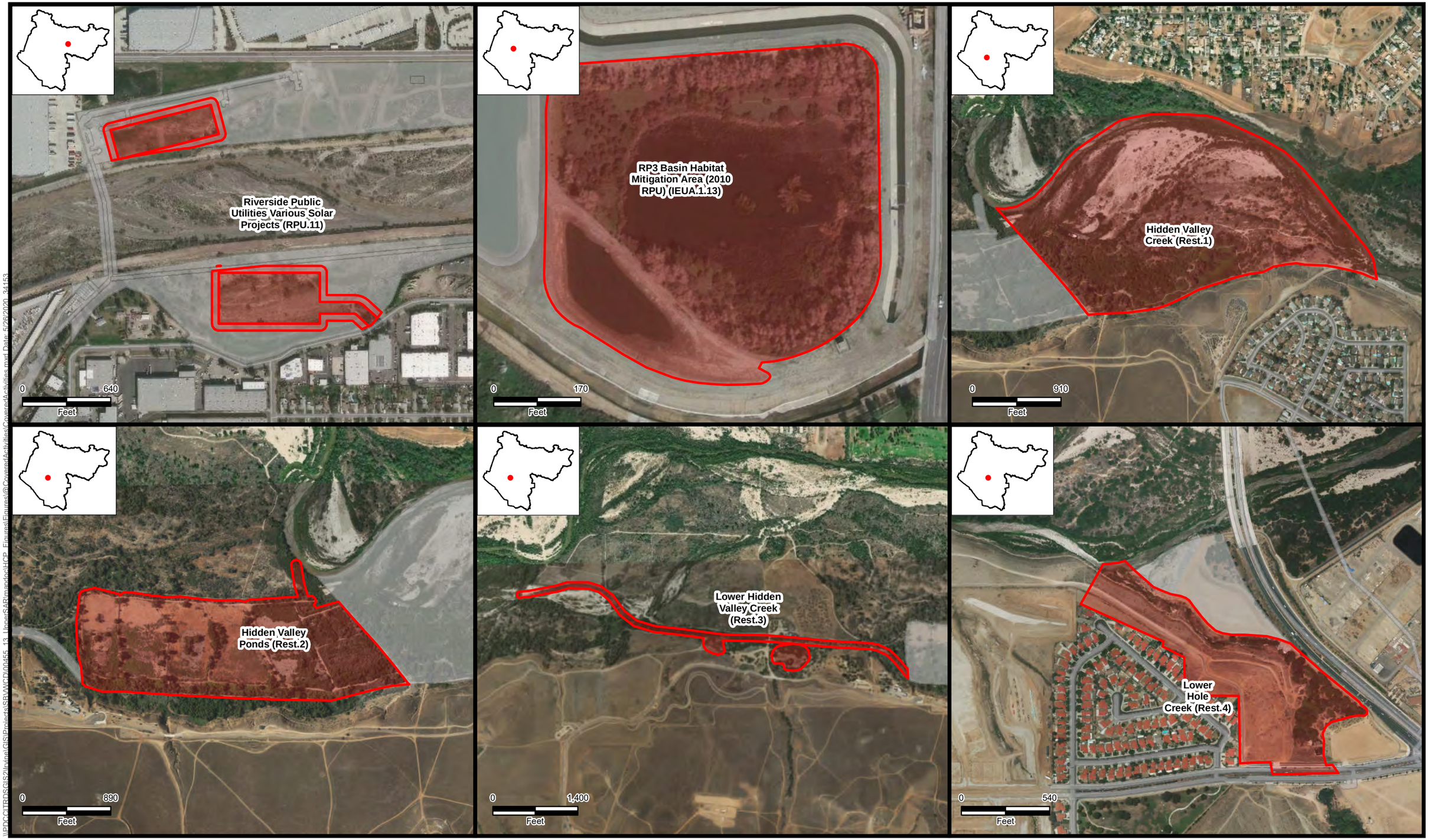
Upper Santa Ana River Habitat Conservation Plan

Figure 2-21
Covered Activities:
Solar Energy Development and Habitat Enhancement, Management, and Monitoring



Upper Santa Ana River Habitat Conservation Plan

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Covered Activity
Adjacent Covered Activities
Planning Area

Figure 2-22
Covered Activities:
Solar Energy Development and Habitat Enhancement, Management, and Monitoring

Upper Santa Ana River Habitat Conservation Plan

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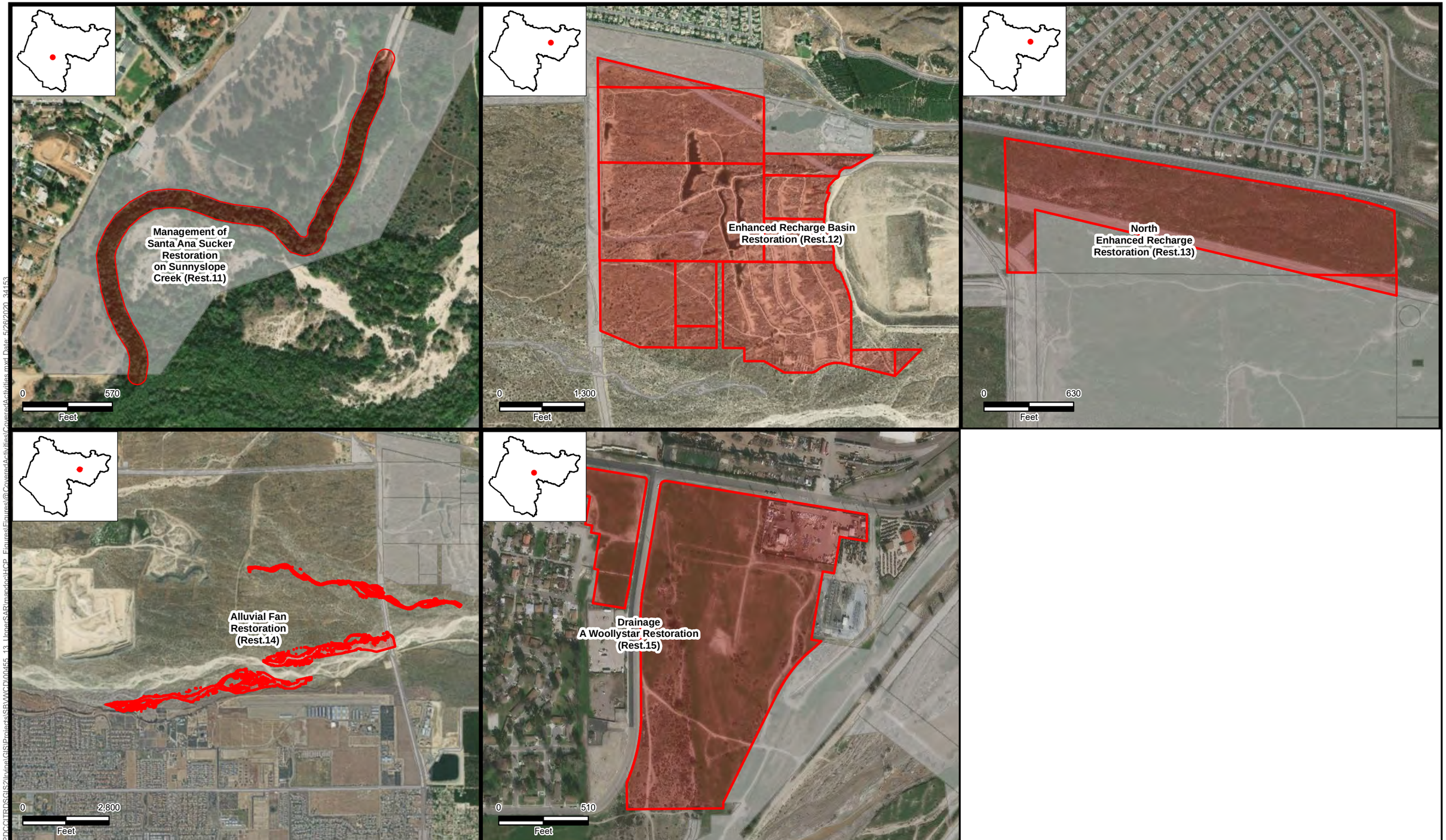
Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-23
Covered Activities:
Solar Energy Development and Habitat Enhancement, Management, and Monitoring (continued)



Upper Santa Ana River Habitat Conservation Plan

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Covered Activity

Adjacent Covered Activities

Planning Area

Figure 2-24
Covered Activities:
Solar Energy Development and Habitat Enhancement, Management, and Monitoring (continued)

Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Chapter 3
Planning Area and Existing Environment

This chapter describes existing conditions in the Planning Area. The Planning Area comprises all areas that will be used for any of the activities associated with the Upper Santa Ana River (SAR) Habitat Conservation Plan (HCP), including Covered Activities (Chapter 2) and the conservation strategy (Chapter 5). It includes all lands necessary for the HCP to be fully implemented. A Planning Area for any HCP must, at a minimum, include the permit area, but it may be larger, as is the case for this HCP.

This chapter describes the physical conditions in the Planning Area, including geographic location, topography, geology, soils, climate, and hydrology and geomorphology. It also describes the existing biological environment with an explanation of the methodology and approach used to describe the physical conditions for each Covered Species and their habitats. This description provides the foundation for estimating the potential impacts and potential for take that is presented in Chapter 4, *Take Assessment and Impact Analysis*, as well as for the conservation strategy described in Chapter 5.

3.1 Geography, Location and Topography

The Planning Area (covering approximately 862,987 acres) is in San Bernardino and Riverside Counties and includes the majority of the upper Santa Ana River watershed. The Planning Area extends from Prado Dam along the San Bernardino County and Los Angeles County line to the north, and then along the Santa Ana River watershed boundary west to east in the San Gabriel and San Bernardino Mountains, reaching elevations of approximately 2,000 to 8,000 feet in the Planning Area. The Planning Area then continues south into Riverside County to the Box Spring Mountains (elevation up to approximately 2,500 feet in the Planning Area), and then southwest through the Moreno Valley to eastern slopes of the Santa Ana Mountains (elevation up to approximately 3,500 feet in the Planning Area) where it runs north again along the border with Orange County. Elevation in the valleys ranges from approximately 500 feet at Prado Basin to approximately 2,000 feet at the eastern end of San Bernardino Valley. Most of the proposed Covered Activities would occur on the main stem of the Santa Ana River or its tributaries within the Planning Area (see Chapter 2).

3.2 Land Use, Ownership, and Jurisdictions

Existing land uses in the Planning Area include urban areas, farmland, grazing land, national forest, water conservation/water storage facilities, flood control, habitat conservation, open space, aggregate mining/mineral extraction, agriculture/orchards and vineyards, roadways, and airport operations (Table 3-1). National Forest and urban areas comprise the greatest acreage in the Planning Area. See Figure 3-1 for a map of land use types within the Planning Area. Figure 3-2 provides an overview of land ownership boundaries within the Planning Area. For a description of the jurisdictional and physical factors used to define the Planning Area, see Chapter 1, *Introduction and Background*.

Table 3-1. Generalized Land Use in the Planning Area

Existing Land Use	Area (acres)
Residential	163,920
Commercial/Office	21,085
Industrial	35,623
Mixed Uses	1,336
Rural Residential	13,312
Military Installations	7,528
Public Facilities	14,478
Transportation/Communications/Utilities	35,525
Under Construction	11,969
Agriculture	40,869
Water	3,973
Open Space and Recreation	19,612
Existing Land Use Total (does not include Vacant/Undeveloped Land)	**369,230**
Vacant Lands	
U.S. Forest Service	233,514
Private	221,929
State Parks	9,011
Owned by Counties	8,686
Owned by Cities	6,911
U.S. Bureau of Land Management	5,073
Special District	4,384
Non-Governmental Organization	2,185
Other Federal	1,213
California Department of Fish and Wildlife	681
Other State	172
Vacant Lands Total	**493,759**
Grand Total	**862,989**

Source: Southern California Association of Governments 2005

3.2.1 Cities and Counties

The majority (65%) of the Planning Area is within San Bernardino County, with most of the remaining portion (35%) in Riverside County. A number of local land use agencies have approved general plans and specific plans in the Planning Area. These local land use-planning agencies play a major role in zoning and land use decisions in the region. Cities in the Planning Area are listed in Table 3-2 and the larger cities are shown on Figure 3-1.

Table 3-2. Counties and Cities/Jurisdictions in the Planning Area

Jurisdiction	Population[5]	Area (acres)[4]
San Bernardino County		**560,440**
Chino[1]	85,595	19,042
Chino Hills[1]	78,309	28,676

Jurisdiction	Population[5]	Area (acres)[4]
Colton[1]	52,154	10,318
Fontana[1]	207,460	27,587
Grand Terrace[1]	12,040	2,245
Highland[1]	54,854	11,959
Loma Linda[1]	23,261	4,805
Montclair[1]	38,690	3,537
Ontario[1]	171,214	31,968
Rancho Cucamonga[1]	175,236	25,672
Redlands[1]	71,035	23,151
Rialto[1]	103,132	14,270
San Bernardino[1]	216,108	39,961
Upland[1]	76,443	10,025
Yucaipa[1]	53,328	18,037
Unincorporated San Bernardino County[2]	309,759	289,187
Riverside County		**302,498**
Beaumont[1]	36,877	1,536
Calimesa[1]	7,879	9,501
Corona[1]	164,226	25,135
Eastvale[2]	63,211	8,403
Jurupa Valley[2]	106,028	27,939
Lake Elsinore[1]	51,821	12,306
Moreno Valley[1]	193,365	2,069
Norco[1]	27,063	8,948
Riverside[1]	322,424	52,190
Unincorporated Riverside County[3]	364,413	154,471

[1] USCB 2010
[2] U.S. Census Bureau 2017
[3] SCAG 2017a, 2017b
[4] California State Board of Equalization 2015
[5] Population numbers are for the entire city or jurisdiction and not just the portion that occurs in the Planning Area.

3.2.2 Existing Protected Areas

A variety of local, state, federal, and private open space land exists in the Planning Area, including United States Department of Agriculture Forest Service land, and county and city parks (Table 3-3 and Figure 3-3). Roughly 60.1% (approximately 289,154 acres) of the natural habitat in the Planning Area is currently in some form of public or private habitat protection or otherwise designated open space. The California Protected Areas Database (CPAD) is maintained by GreenInfo Network (www.calands.org) to create a regional database mapping of the distribution of existing protected lands.

Table 3-3. Protected Lands in the Planning Area

Ownership	Acres
California Department of Fish and Wildlife	1,779
California Department of Parks and Recreation	9,798
City	12,029
County	7,002
Non-Governmental Organization	2,355
Other Federal	2,213
Other State	179
Special District	25,168
U.S. Bureau of Land Management	5,290
U.S. Forest Service	236,504
Total	**302,319**

Source: CPAD 2019

3.3 Geology and Fault Zones

The geology and fault zones of the Planning Area have an important influence on the distribution of landforms and soil types, which in turn influence vegetation and plant species distribution and abundance. In some cases, geology and soils also greatly influence wildlife species distribution. For example, many invertebrates are closely associated with particular plant species or vegetation types that are restricted to particular soil types and geologic substrates. On a regional scale, geologic activity has also greatly influenced the pattern of stream formation and the structure and function of local watersheds.

Southern California is a geologically active area. Major earthquake faults in the region include the San Andreas Fault and its large branch, the San Jacinto Fault; the Elsinore-Whittier Fault; and the Newport-Inglewood Fault. The San Andreas Fault divides the San Gabriel Mountains from the San Bernardino Mountains. The San Jacinto Fault, which splits off from the San Andreas Fault near San Bernardino, affects groundwater flows associated with both the Santa Ana and San Jacinto Rivers. The Elsinore-Whittier Fault passes under Prado Dam as it trends, like the others, from the southeast toward the northwest. The Newport-Inglewood Fault enters the region from the Los Angeles basin and passes offshore at Newport Beach. In addition to these major faults, there are many branching, connecting, and parallel faults in the region (Santa Ana RWQCB 2008).

Major rock types in the Planning Area include sandstone, alluvium, granodiorite, gneiss, mica schist, schist, limestone, tonalite, argillite, gabbro, and felsic volcanic rock (USGS 2007). As depicted on Figure 3-4, the majority of the Planning Area consists of alluvium. Alluvium is a general term for clay, silt, sand, gravel, or similar unconsolidated detrital material deposited during comparatively recent geologic time by streams, rivers, and major flooding events. Alluvium is deposited as a sorted or semi-sorted sediment in the bed of the stream or river, or on its flood plain or delta, or as a cone or fan at the base of a mountain slope.

3.4 Soils

Soils are the result of complex interactions between geologic parent material, climate, topography, organisms, and time. Soils are classified by the degree of development into distinct layers, or horizons, and their prevailing physical and chemical properties. Similar soil types are grouped into soil orders based on defining characteristics, such as organic matter and clay content, amount of mineral weathering, water and temperature regimes, depth, drainage, slope, particle size, or base saturation that give soil its unique properties.

Soil resources provide the foundation for vegetation and biological communities. Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. The kind and abundance of wildlife depend largely on the amount and distribution of food, water, and cover. Soil orders in the Planning Area include entisols, inceptisols, alfisols, mollisols, and vertisols (NRCS 2017). Entisols, alfisols, and mollisols comprise the majority of the Planning Area (Figure 3-5).

Entisols exhibit little to no soil development other than the presence of an identifiable topsoil horizon. These soils occur in areas of recently deposited sediments, often in places where deposition is faster than the rate of soil development (e.g., active floodplains) (Soil Science Society of America 2017).

Alfisols are moderately leached soils that have relatively high native fertility. They have mainly formed under forest and have a subsurface horizon in which clays have accumulated. Alfisols are primarily found in temperate humid and sub-humid regions of the world (University of Idaho 2017).

Mollisols are prairie or grassland soils that have a dark-colored surface horizon. They are highly fertile and rich in chemical “bases” such as calcium and magnesium. The dark surface horizon comes from the yearly addition of organic matter to the soil from the deep roots of prairie plants. Mollisols are often found in climates with pronounced dry seasons (Soil Science Society of America 2017).

Of particular interest in the Planning Area are the suborder of soils known as fluvents. Fluvents are alluvial soils that undergo repeated sediment deposition from relatively frequent periodic flooding. The repeated deposition prevents substantial development of soil horizons. Fluvent soils are most typical in the valley floor, alluvial fans, and active floodplains. Several Covered Species have a high affinity for fluvents in the Planning Area, including San Bernardino kangaroo rat, Los Angeles pocket mouse, slender-horned spineflower, and Santa Ana woolly-star.

3.5 Climate

The Planning Area is characterized by a climate of long dry summers and short wet winters, commonly referred to as a Mediterranean climate. Average daily temperatures in the winter (December through March) are about 56 degrees Fahrenheit (°F), and in the summer (June through September) are about 76°F for the Planning Area, with the highest average temperature (95°F) occurring in August and the lowest average temperature (41°F) occurring in December (U.S. Climate Data 2017a: San Bernardino, CA Station 1961–1990 climate data, 2017b: Riverside Citrus Exp. 1991–2010 climate data). Annual average daily temperatures for the Planning Area range from a low of about 51°F to an average high of about 80°F (US Climate Data 2017a, 2017b). Average annual precipitation ranges from 12 inches in the coastal plain, 10 to 24 inches in the inland alluvial valleys, and 24 to 48 inches in the San Bernardino Mountains (USGS 2016, 2009). The average total annual precipitation recorded in the City of San Bernardino from water years 1893 through 2014 is 16.0

inches; however, the average total annual precipitation will vary depending on location in the watershed. Most of the precipitation occurs between November and April, and rainless periods are common in the summer.

3.6 Hydrology and Geomorphology

The Santa Ana River Watershed is the largest watershed in coastal Southern California, covering an area of approximately 2,800 square miles composed of mountains, foothills, and valleys. The watershed contains many sub-watersheds with approximately 50 mapped tributaries and contains parts of Orange, San Bernardino, Riverside, and Los Angeles Counties (note the Planning Area does not include any of the watershed occurring in Orange and Los Angeles Counties). The flow of the Santa Ana River begins high in the San Bernardino Mountains and flows over 100 miles southwestward where it discharges into the Pacific Ocean at the City of Huntington Beach (USGS 2016). Figure 3-6 shows the main reaches of the Santa Ana River and the sub-watersheds in the Planning Area. The hydrology and geomorphologic features of the mainstem of the Santa Ana River and tributaries are described below.

3.6.1 Hydrology

Streamflow in the Santa Ana River Watershed is highly variable from year to year in response to precipitation patterns, with large floods and long periods of extremely low flow or dry channels. As reported by the Santa Ana River Watermaster (2018), the total flow at Prado is 202,808 acre-feet/year averaged over the 1972–2017 water years. The total flow over the same period at the Riverside Narrows is 94,910 acre-feet/year. Average annual discharges determined from hydrology models for select locations along the Santa Ana River and its major tributaries are listed in Table 3-4. Generally, the largest monthly discharges occur in February and March, and the lowest flows occur in August through October. Because the climate in the region is characterized by hot, dry summers and cool winters with intermittent precipitation, the Santa Ana River and most of its tributaries are intermittent with little or no flow in the summer months (USGS 2016, WRCC n.d.). All reaches of the river and tributaries have seasonal flows, including large flood flows in most winters and spring, as well as perennial flows in some stream reaches from groundwater upwelling in most years.

Table 3-4. Mean Annual Flow for the Upper Santa Ana River and Major Tributaries

Location	Mean Annual Flow (acre-feet/year)[1,2]
Santa Ana River Mainstem	
Seven Oaks Dam Inflow (Reach 6)	33,032
SAR at Mt Vernon Avenue (Reach 5)	56,815
SAR at Mission Boulevard (Reach 4)	84,961
SAR at Prado Dam[3]	291,663
Major Tributaries	
Mill Creek	14,362
City Creek (includes 3,694 acre-feet/year from Plunge Creek tributary)	9,423
Plunge Creek	3,694
Mission Creek	3,029
San Timoteo Wash	3,419

Location	Mean Annual Flow (acre-feet/year)[1,2]
East Twin Creek	6,195
Lytle Creek	9,471
Cajon Wash	1,711
Rialto Channel	12,822
San Sevaine Creek	17,934
Day Creek	13,473
Chino Creek	96,318
Temescal Wash	30,068

[1] Discharge values are from modeled hydrology described under Section 3.6.3, *Hydrologic Modelling as the Foundation for Hydrologic Analysis*.
[2] Hydrology values include flow regulation by Seven Oaks Dam.
[3] Discharge from wastewater treatment plants and groundwater upwelling contribute to the total Santa Ana River mainstem flow at Prado Dam.

Due to urbanization, flood control, inter-basin water transfers, and other water-supply projects throughout the Santa Ana River basin, the natural hydrology of watershed runoff and the streamflow for most streams have been substantially altered. By 1969, water diversions and groundwater pumping had severely diminished natural flow in the Santa Ana River (Kratzer et al. 2011) such that groundwater levels experienced large declines since the 1800s, eliminating perennial flows in much of the river (ESA 2015).

Existing alterations to natural hydrologic conditions, including diversions, constructed drainages, channels, and other impervious surfaces, are especially prevalent in the San Bernardino Mountains foothills and the Santa Ana River Valley, causing decreased groundwater infiltration and increased runoff from urban areas (SBVMWD 2004). Modification of natural flow patterns also stems from water storage and controlled releases from reservoirs, groundwater withdrawal, hydraulic structures, diversion into groundwater recharge basins, vegetation clearing, and irrigation runoff and wastewater effluent that create perennial flow in some streams that would otherwise be dry. Stormwater and flood management is an ongoing concern in the region. Flood control facilities, such as detention basins, have provided control of flood flows. The region's groundwater managers are working with flood control agencies to optimize the use of flood control facilities to increase the recharge of stormwater into the groundwater basin (RMC 2015).

Santa Ana River Mainstem

Several major dams are located on the Santa Ana River, including Big Bear Dam, Seven Oaks Dam, and Prado Dam. The surface water of Bear Creek (a tributary to the Santa Ana River) is impounded high in the mountains by Big Bear Dam beyond the northeast boundary of the Planning Area, which was constructed in 1884 as a reservoir to supply water for surrounding communities. Seven Oaks Dam and Prado Dam, shown on Figure 3-6, were constructed for flood control purposes, as described below.

A flash flood in 1938 resulted in the flooding of 68,400 acres. The recurrence of large floods such as this was the driver behind construction of the Prado Dam in 1941 at the downstream end of the Planning Area. Approximately 80% of the Santa Ana River's total watershed area (2,780 square miles) is upstream of Prado Dam (2,260 square miles). Another major flood in 1969 caused damage along several tributaries of the Santa Ana River, including San Timoteo and Santiago Creeks,

prompting additional flood control improvements. The U.S. Army Corps of Engineers (USACE) conducted an initial study for the Santa Ana River Mainstem Project (SARMP) in 1970, and in 1986 the SARMP was authorized by Congress in the Water Resources Development Act (WRDA) to improve flood control. Construction of the SARMP began in 1989 and is ongoing. Construction elements associated with SARMP include several bank and bridge protection features and associated mitigation actions along the Santa Ana River, generally between Seven Oaks Dam (6 miles east of the City of Highland) and the Pacific Ocean. Flood risk management features associated with the SARMP also occur at San Timoteo Creek and are planned for Santiago Creek. Prado Dam, in Corona, was also improved in the mid-2000s (USACE 2015).

Seven Oaks Dam was completed in 2000 as part of the SARMP. Seven Oaks Dam provides flood control protection by temporarily retaining Santa Ana River storm flows and snowmelt from the San Bernardino Mountains. The dam impounds water in Seven Oaks Reservoir, thereby reducing flow magnitudes downstream. Floodwaters are retained behind the dam during winter and early spring rain events, and released once the rain event is passed, typically in early spring, and depending on local conditions, including inputs to Prado and Seven Oaks reservoirs. Peak flows from the dam following flood events average 500 cubic feet per second (cfs) or less, and are determined by the USACE water control manual for Seven Oaks Dam. This results in reduced magnitude and variability of flows in comparison with the pre-dam condition.

Seven Oaks Dam acts as a barrier to downstream transport of sediments, trapping sediment that would otherwise be transported to downstream reaches of the Santa Ana River. Sediment trapping has resulted in winnowing of the finer sand and gravel sediment and a remaining coarse substrate in the river between the dam and the confluence with Mill Creek (Wright and Minear 2019). The result of sediment winnowing and reduced peak flows is that the bed and bank below Seven Oaks has remained relatively stable since start of operations of the Dam in comparison with the pre-dam condition.

In addition to altering flows and sediment supply/transport in the channel, the dam affects flood magnitude and erosional/depositional characteristics in overbank floodplain areas. Reduced flood magnitude results in restricted inundation limits and prevents overbank flooding. Operation of the dam under current conditions means that large portions of the floodplain immediately downstream of the dam and outside the main course of the Santa Ana River will not experience flood disturbance during the dam's operational lifetime.

The dam is also operated to meet historic water rights held by the East Valley Water District, the San Bernardino Valley Water Conservation District, and others to ensure pre-dam water supply obligations continue to be met. Southern California Edison diverts water several miles upstream of the dam for power generation and then returns flow to the river to meet downstream water rights. Just downstream of Seven Oaks Dam water is the Cuttle Weir. The Cuttle Weir is operated in tandem with flow releases from Seven Oaks Dam with a capacity to divert up to 195 cfs of the Santa Ana River flow into the Santa Ana River Spreading Grounds for groundwater recharge. Typical flow diversions are around 150 cfs.

Flow in the Santa Ana River generally increases in a downstream direction due to inflows from tributaries, rising groundwater, and inflow from wastewater treatment plants (WWTPs) (Geoscience 2014). There are 14 publicly owned WWTPs in the Upper Santa Ana River watershed, 9 of which contribute to surface flow (SBVMWD 2004). Discharge from wastewater treatment facilities provides base flow in many parts of the drainage network (USGS 2016).

The following description of the six main reaches of the Santa Ana River is adapted from the Santa Ana River Basin Water Quality Control Plan (California Regional Water Quality Control Board 1995); therefore, the reach numbers used below are consistent with the numbering in the Water Quality Control Plan. The main stem of the Santa Ana River is divided into six reaches, described below starting from upstream of the Seven Oaks Dam down to the tidal zone flowing into the ocean. Reaches 3 through 6 are within the Planning Area; reaches 1 and 2 are downstream of the Planning Area.

Reach 6 includes the river upstream of Seven Oaks Dam. Flows consist largely of snowmelt and storm runoff. Other than Big Bear Reservoir, hydrologic conditions are relatively unaltered compared to downstream reaches.

Reach 5 extends from Seven Oaks Dam to the City of San Bernardino at the San Jacinto Fault (Bunker Hill Dike), which marks the downstream edge of the Bunker Hill groundwater basin. Most of this reach tends to be dry, except as a result of storm flows. The extreme lower end of this reach historically includes rising groundwater and flows from major Santa Ana River tributaries such as Mill Creek, Lytle Creek, and San Timoteo Creek, which flows intermittently and includes effluent from the City of Beaumont and Yucaipa Valley Water District WWTPs.

Reach 4 includes the river from the Bunker Hill Dike down to Mission Boulevard Bridge in the City of Riverside. That bridge marks the upstream limit of rising water induced by the flow constriction in the Riverside Narrows downstream in Reach 3. Until about 1985, most water in the reach percolated to the local groundwater, leaving the lower part of the reach dry. However, flows in the lower end of this reach may now intermittently contain rising groundwater and are supplemented with effluent from the Rialto WWTP and San Bernardino/Colton Rapid Infiltration and Extraction (RIX) Facility.

Reach 3 includes the river from Mission Bridge to Prado Dam at the downstream end of the Planning Area. In the Riverside Narrows, rising water feeds several small tributaries (Tequesquite Arroyo, Anza Park Drain, Sunnyslope Channel, Hole Creek) which historically were breeding and nursery areas for the native fishes. Temescal, Chino, and Mill/Cucamonga Creeks in Prado Basin are also important river tributaries. Reach 3 also includes major tributaries of San Sevaine Creek, Day Creek, Cucamonga Creek, San Antonio Creek/Chino Creek, and Temescal Wash. Flow is supplemented with effluent from the City of Riverside Regional Water Quality Control Plant and Western Riverside County Regional Wastewater Authority. Many of the tributaries in this reach are channelized, flood control facilities with little resemblance to natural conditions.

Reaches 1 and 2 are downstream of the Planning Area, through Santa Ana Canyon in Orange County and flood control channels to the Pacific Ocean.

Santa Ana River Tributaries

The Santa Ana River includes over 20 significant tributaries (e.g., a stream or river that flows into a larger stream or main stem), 11 of which occur within the Planning Area. These tributaries and their mean annual flow are listed above in Table 3-4 and are described further below.

Mill Creek is a 17.8-mile long stream that originates in the San Bernardino Mountains and has a confluence with the Santa Ana River just downstream of the mouth of the upper Santa Ana Canyon. This creek is in relatively better condition than lower portions of the Santa Ana watershed because

its drainage area is less urbanized. This creek is the site of three hydroelectric plants owned by Southern California Edison.

City Creek is a 7.5-mile stream that originates in the San Bernardino National Forest and rises in two forks of similar length and size: the West Fork City Creek and East Fork City Creek. The two forks combine in a steep ravine under a bridge of California State Route 330 (City Creek Road) and flows through a deep gorge between McKinley and Harrison Mountains where it drops into the plains near the city of Highland.

Plunge Creek is a 13-mile long stream that originates in the San Bernardino Mountains as a high gradient single-thread stream and continues southwest to the Santa Ana River just east of the San Bernardino International Airport. The stream widens into braided channels for approximately 6 miles of its length from the San Andreas Rift Zone southwest of Greenspot Road to the airport. Portions of the stream are scheduled for restoration within the Wash Plan HCP Planning Area.

Mission Creek is an approximately 5-mile stream that has a confluence with Mill Creek before it continues to the west where it meets the Santa Ana River. It is located just north of the Crafton Hills in a relatively low topography area within the Planning Area east of the town of Mentone. The entirety of this creek is channelized.

San Timoteo Wash is formed by the confluence of Little San Antonio Creek and Noble Creek west of the city of Beaumont in Riverside County. This wash flows northwest through San Timoteo Canyon, north of the Badlands in the southern hills of the city of Redlands. It joins the Santa Ana River near the Interstate (I-) 10 and I-215 interchange. The creek flowed intermittently in the past; however, today it flows nearly year-round due to agricultural runoff and secondary treatment discharge from a water plant in Yucaipa.

East Twin Creek originates southwest of Strawberry Creek and is joined by West Twin Creek, which is tributary to Warm Creek, which is, in turn, tributary to the Santa Ana River.

Lytle Creek is approximately 18 miles long and originates in southwestern San Bernardino County near the city of San Bernardino. It is a tributary of Warm Creek, which feeds into the Santa Ana River 1 mile after Warm Creek joins the Santa Ana River. Southern California Edison operates a hydroelectric plant on Lytle Creek at Miller Narrows.

Cajon Wash is an approximately 20-mile-long tributary to Lytle Creek. It is a braided channel that originates in the northwestern portion of the Planning Area within Cajon Canyon and extends south to Lytle Creek at West Foothill Boulevard.

Rialto Channel is a concrete conveyance channel that flows south for approximately 9 miles before meeting the Santa Ana River. The flow in this channel is outflow from the Rialto wastewater treatment plant.

San Sevaine Creek is a concrete conveyance channel that runs south for approximately 11 miles through San Bernardino County, which is joined by Day Creek and ultimately connects with the Santa Ana River.

Day Creek or Day Canyon Wash originates in the San Gabriel Mountains as a high gradient single-thread stream and becomes a concrete conveyance channel as it continues south to its confluence with the Santa Ana River.

Chino Creek is approximately 12.7 miles long and originates in the San Gabriel Mountains from an underground stormwater channel and flows south from southern Pomona in eastern Los Angeles County. The channelized stream enters southwestern San Bernardino County and runs southeast across the Chino Valley between the Chino Hills to the south and the city of Chino to the northeast. From here, the creek flows parallel to State Route 71 through industrial and agricultural areas of Chino and joins the Santa Ana River north of Prado Dam.

Temescal Wash is approximately 29 miles long and is the largest tributary of the Santa Ana River. Temescal Wash originates in the Elsinore Spillway Channel, an overflow channel that is confined to Lake Elsinore and passes northwest into the Warm Springs Valley. The wash flows through the rain shadow zone of the Santa Ana Mountains, and where it emerges from Temescal Canyon, north of El Cerrito, it enters a second reservoir from which point it is channelized before entering into the Prado Flood Control Basin, which consists of a series of wetlands where Temescal Wash merges with the Santa Ana River. Temescal Wash is diverted heavily for human use and, as a result, is ephemeral for most of its length, except in areas where runoff from housing and agricultural development return flows.

3.6.2 Geomorphology

The geomorphology of the Upper Santa Ana River and tributaries is a product of the interaction of the underlying geology with past and current hydrologic patterns in the watershed. As described above in Section 3.3, *Geology and Fault Zones*, the majority of the Santa Ana River watershed in the Planning Area consists of unconsolidated alluvium. Winter rains result in high streamflow events that produce a variety of geomorphic processes, including moving sediment downstream in tributaries into the main stem of the Santa Ana River and scouring and renewing vegetation. Ecologically, the native plant and animal communities evolved to exist within the context of these geomorphic processes; however, they have been altered by human development. An understanding of the geomorphologic conditions in the Planning Area is necessary to assess the existing ecological conditions.

Light detection and ranging (LiDAR), air photo analysis, and geomorphic assessment techniques were used to perform a broad assessment of different geomorphic attributes of streams in the Planning Area. The channel classification specific to the HCP Planning Area was developed based on three variables: (1) channel pattern, (2) channel slope, and (3) width to depth ratio. Channel classification was performed for 431 miles of channels within the Planning Area, as described below.

Influence of Geomorphology on Aquatic and Riparian Biotic Communities

Geomorphic processes influence the channel pattern and channel type, as described in the sections below, and these in turn influence the riparian and aquatic habitats and biotic communities. Riparian habitats develop along the margins of the stream channel. The riparian vegetation structure (e.g., shrubs, woodlands, forest) and the width of the riparian zone depend on the channel pattern, slope, and type (Figure 3-7).

The aquatic or in-channel habitat is the portion of the stream channel that is wetted during any given period. Throughout most of the year this “wetted area” is defined by the low-flow channel that is sustained by upstream sources and connection to groundwater. The low-flow channel varies in width and depth throughout the year. During storm events the aquatic habitat can expand dramatically as the main channel expands onto the floodplain. The low-flow state of the stream is

important to sustain aquatic species throughout the year, while the high-flow (storm) state is important to periodically reset the in-channel habitat through sediment transport and other fluvial processes that scour vegetation. During high-flow events and the subsequent periods of higher stage flows, there are important periods of enhanced habitat connectivity, allowing movement of aquatic species between otherwise disconnected areas of suitable habitat. High flow events also mobilize gravel, cobbles, and boulders in the bed, flushing away sand and changing the sediment distribution and availability of hard substrates, which support algal growth and gravely areas for fish foraging and spawning.

Geomorphology also influences the degree to which groundwater is sustained near the surface, regulating the extent to which streams lose surface water to groundwater or gain surface water from groundwater. The interchange of water between surface flows in the stream channel and adjacent groundwater plays a major role in supporting riparian and aquatic communities during the dry season as well as extended drought periods.

Classification of Stream Channels in the Planning Area

Stream reach classification is a process of categorizing natural variation in measured characteristics among a group of streams and rivers to delineate channel types that are similar in terms of hydrologic, geomorphic, and other environmental features. Categorization of the river and streams in the Planning Area is important to be able to describe the range of channel types and to understand and analyze the potential changes in each channel type as a response to the different Covered Activities evaluated by the HCP.

By assigning stream channels or segments to a particular channel type category, relationships between ecological metrics and potential flow alteration from Covered Activities can be developed for each channel type based on data obtained from a representative set of channels of each type within the Planning Area (Arthington et al. 2006, Poff et al. 2006). For each channel type there is a range of natural hydrologic variation that regulates characteristic ecological processes and habitat characteristics (Lytle & Poff 2004, Arthington et al. 2006).

Channel Pattern

Channel pattern is commonly used to characterize the geomorphic state of streams in the watershed. A channel's pattern is often related to other important geomorphic variables, such as channel stability, the texture and volume of sediment supply, slope (stream gradient), and mode of sediment transport (bedload vs. suspended load) (Figure 3-8). Channels with different patterns will typically respond differently to changes in sediment supply, discharge, riparian vegetation removal, and other alterations, making channel pattern an effective approach to characterizing the geomorphic conditions of the watershed (Mollard 1973). Nine channel patterns were identified to capture the range of variability in the Planning Area, as described below. The distribution of these channel patterns is illustrated on Figure 3-9, and their prevalence in the Planning Area is summarized in Table 3-5.

There are nine categories of channel patterns in the Planning Area:

- **Concrete conveyance channels** are streams with concrete bed and banks that function as flood control channels designed to quickly route water off the landscape. These highly altered channels account for the largest percentage of the channel pattern, comprising 40% (171 miles) of the total channel length evaluated in the Planning Area.

- **Straight channelized reaches** comprise 4% of the total channel length in the Planning Area and are similar to concrete conveyance channels except they do not have concrete beds and thus have more ecological value than just pure flood conveyance channels. Examples in the Planning Area include reaches on Chino Creek and City Creek Channel.
- **High-gradient, single-thread channels** are channels with slopes greater than 2%. They make up 18% of the total channel length, and in the Planning Area they are typically unaltered channels located in the foothills and mountainous areas upstream of diversions or other alterations. High-gradient, single-thread channels typically have coarse bed substrate (gravel, cobble, boulder) and are often confined to valleys with little developed floodplain.
- **High-gradient, single-thread channelized** occur on 1% of the total channel length, and are similar to high-gradient, single-thread channels except that they have been channelized for flood control purposes.
- **Low-gradient, meandering channels**, defined as having slopes less than 2%, account for 17% of the total channel length in the Planning Area. Most of the low-gradient, meandering channels are located on the downstream portion of the Santa Ana River and San Timoteo Wash. They are differentiated from braided channels in the Planning Area (see below) by their lower channel slopes, increased channel stability with channel paths typically separated by vegetated bars or islands, and floodplain creation (at least in areas where the floodplain has not been developed or the stream leveed).
- **Low-gradient, meandering channelized** occur on less than 1% of the total channel length, and are similar to low-gradient, meandering channels except that they have been channelized for flood control purposes.
- **Braided channels** comprise 15% of the total channel length in the Planning Area, largely located on the upper reaches of the Santa Ana River and on Lytle Creek, Cajon Wash, and Mill Creek. The braided channels are located on alluvial washes at the transition from the mountainous regions to the lower alluvial plan reaches below. They are characterized by high sediment loads, also often with high slopes, and erodible banks in which the channel has multiple braids that routinely shift in response to flood events.
- **Braided channelized reaches** cover 4% of the total channel length, and are similar to the braided reaches, but are laterally confined by levees and often have been straightened for flood control purposes.
- **Prado Wetlands** classifies the channel pattern of the Santa Ana River as it flows through the wetlands in Prado Reservoir.

Table 3-5. Categorization of Streams by Channel Pattern in the Planning Area

Channel Pattern	Miles of Channel	Percent of Total Channel Miles
Concrete Conveyance	171	40
Straight Channelized	17	4
High-Gradient, Single-Thread	77	18
High-Gradient, Single-Thread Channelized	4	1
Low-Gradient, Meandering	74	17
Low-Gradient, Meandering Channelized	1	0

Channel Pattern	Miles of Channel	Percent of Total Channel Miles
Braided	66	15
Braided Channelized	17	4
Prado Wetlands	3	1
Total	**431**	**100**

Channel Slope

Channel slope or gradient is a primary determinant of the rate at which water and sediment flow through the system and the texture of sediment that forms the channel and is carried downstream. The slopes of the major streams in the Planning Area are derived from Montgomery & Buffington (1997). These investigators correlated channel slope with channel morphology. LiDAR was used to determine the slope of channels. Channel slopes within the Planning Area were correlated and categorized with the channel morphologies developed by Montgomery and Buffington (1997). The results of that analysis were tabulated within slope categories (Table 3-6). The channels with slopes between 0.6 and 1.6% (Pool-Riffle) were the most prevalent in the Planning Area, while channels with slopes less than 3.3 represented 71% of the reaches. It is worth noting that the mapped channels in the Planning Area did not always have the specified channel morphology described by Montgomery and Buffington (1997) (e.g., as stated above, highly altered concrete conveyance channels account for 40% of the total channel length). To this end, the channel morphology classification they derived did not include braided channels, which are prevalent in the Planning Area. Braided channels can fall within several different slope ranges depending on flow and sediment supply. Braided channels are addressed in *Channel Type Classification*, below.

Table 3-6. Channel Slope of Streams in the Planning Area

Slope (%)	Miles	Percent of Total	Channel Morphology
0.0–0.5	78	18	Low-Gradient
0.6–1.6	146	34	Pool-Riffle
1.7–3.3	84	19	Plane Bed
3.4–6.8	64	15	Step-Pool
6.9–14	36	8	Cascade
14.1–73.5	24	6	Headwaters

Width Depth Ratio

Channel width-to-depth ratio is a measurement of the ratio of a channel's wetted width to flow depth for a given flood stage. Channels with different width-to-depth ratios typically exhibit different morphologic form and behave differently in terms of how they route water and sediment, and the degree to which they are connected to floodplains and riparian areas. Because width-to-depth ratio is a dimensionless ratio, it is a useful variable in a channel classification scheme as different channel reaches may be at different positions in the watershed with different flow regimes, yet have similar form and process because of similarities in width to depth. Relative elevation mapping based on LiDAR analysis and hydraulic calculations was used to determine the width-to-depth ratio of reaches in the Planning Area. A majority (56%) of the stream channels were generally very wide and shallow channels with a width-to-depth ratio greater than 175 (Figure 3-10 and Table 3-7).

Table 3-7. Width Depth Ratios of Natural Stream Channels in the Planning Area[1]

Width-to-Depth Ratio	Miles	Percent of Total
< 50	14.9	18.7
50–175	20.0	25.1
> 175	44.9	56.2

[1] 87 miles of concrete conveyance channel was not included in this table.

Channel Type Classification

The results from the analysis of channel pattern, channel slope, and channel width-to-depth ratio were combined to create a channel type classification for the Planning Area. The reaches in the Planning Area located downstream of Covered Activities with hydrology effects were assigned to one of 12 channel type bins. Frequency distributions (miles of channel) were created for the channel classification variables from which breakpoints were created to define the channel type bins. The resultant channel type classification developed for the Planning Area is mapped on Figure 3-11. Summary statistics are listed in Table 3-8. Note that the statistics do not account for concrete conveyance channels because width-to-depth calculations were not performed for this channel type. Concrete conveyance channels comprise 87 miles (50% of total) of channel length in the Planning Area downstream of Covered Activities with hydrology effects.

Table 3-8. Channel Type Classification of Streams in the Planning Area in Reaches Downstream of Covered Activities

Channel Pattern	Braided/Braided Channelized	Braided/Braided Channelized	Braided/Braided Channelized	Braided/Braided Channelized	Braided/Braided Channelized	Low-Gradient Meandering	Low-Gradient Meandering	Low-Gradient Meandering	High-Gradient Single-Thread Channel	High-Gradient Single-Thread Channel	Straight Channelized	Straight Channelized
Slope	<2%	<2%	≥2%	≥2%	≥2%	<2%	<2%	<2%	≥2%	≥2%	<2%	≥2%
W/D Ratio	50–175	>175	<50	50–175	>175	<50	50–175	>175	<50	50–175	<50	<50
# of Reaches	16	26	1	5	13	5	8	9	4	1	15	12
Miles	8	20	0.5	4.9	8.7	4.5	6.8	16.2	1.7	0.3	6.9	1.3

Note: Concrete Conveyance Channels account for 87 miles (50% of total) of channel length in the Planning Area downstream of Covered Activities with hydrology effects.
W/D = width-to-depth

3.6.3 Hydrologic Modeling as the Foundation for Hydrologic Analysis

The development of a hydrologic database that describes flow regimes in terms linked to ecological outcomes is a key feature in establishing the hydrologic foundation for analysis of hydrologic effects of Covered Activities in the HCP. The hydrologic database is based on empirical data from stream gages throughout the Planning Area in combination with hydrologic modelling. The hydrologic

model is calibrated with flows measured at stream gage stations and is able to predict the flows throughout the Planning Area where stream gage data is not available. By using the hydrologic model it is possible to characterize existing hydrologic conditions at key points where Covered Activities could change the stream flow and then predict the effects of these changes downstream (see Chapter 4).

The hydrologic model includes two primary conditions for stream flow (described as daily, weekly, monthly, or seasonal average flow as needed for analysis): (1) existing conditions (described in this chapter), and (2) future conditions as would be expected with all Covered Activities in place (described in Chapter 4). The future conditions reflect the altered flow regimes resulting from implementation of the Covered Activities. Other than land use changes directly associated with Covered Activities, the watershed land use conditions are kept the same in both the existing and future condition (i.e., With Covered Activities) models to isolate the effect of implementing the Covered Activity.

The following sections summarize the hydrologic data and modelling conducted to establish existing hydrologic conditions analyzed in the HCP.

Stream Gage Data

Numerous U.S. Geological Survey (USGS) and San Bernardino County Flood Control stream gages are located in the Planning Area. The stream flows are typically reported at 15-minute intervals from these gages and are generally the most accurate and precise source of existing stream flow information because they are based on direct measurements and not modeling. However, many limitations prevent the exclusive use of stream gages to describe the existing hydrologic conditions:

1. Many of the gages (especially USGS gages) are located higher in the watershed, upstream of many of the Covered Activities that need to be assessed.
2. Several stream gages are no longer active, and have not been for decades.
3. The periods of record of the gages vary widely, making comparison between locations difficult.
4. Numerous streams do not have any gages.

Hydrology Modeling

Instead of using empirical gage data, the development of the existing hydrologic condition used for the HCP is primarily based on modeling of mean daily flows with the stream gage data used to calibrate the hydrology model to ensure the most accurate model predictions. The model developed for the HCP is a composite model that integrates two separate models, one for the Planning Area upstream of Rialto Channel (known as the *Geoscience Hydrology Model*), and another for the Planning Area downstream of Rialto Channel (known as the *Wildermuth Hydrology Model*). The composite model is identified as the *HCP Hydrology Model.* Each of these models is described below. The HCP Hydrology Model predicts mean daily flow values under existing conditions at 122 model nodes on the SAR and major tributaries located between the Seven Oaks Dam and Prado Basin (Figure 3-12). The nodes are generally at locations where flows change, such as wastewater treatment plant outfalls or channel confluences.

The HCP Hydrology Model is used to predict the direct effects of the Covered Activities on the surface hydrology of the river and tributaries, which are then used to estimate potential direct and indirect effects on habitat and species based on those model-predicted changes to surface flow. All

hydrology modelling developed for the HCP followed best modelling practices for hydrology models built for specific purposes (Reilly and Harbaugh 2004, Zheng et al. 2012)

Geoscience Hydrology Model

Geoscience Support Services, Inc. (Geoscience) has developed several watershed hydrology models of the upper Santa Ana River basin, including models to assess the Active Recharge Project, the Enhanced Recharge Project, and the Riverside North Aquifer Storage Recharge Project. The modeling is performed in Hydrologic Simulation Program Fortran (HSPF) software and includes calibration with USGS gage data. The Geoscience model includes the current operation parameters for Seven Oaks Dam and the operations of the groundwater recharge basins in the upper watershed. Existing conditions are based on 2012 land use and precipitation records from 1934–2008. The Geoscience model includes mean daily flows for stream nodes in the watershed area upstream of the proposed Riverside North Aquifer Storage and Recovery Project (RPU.5) (see Geoscience 2012, 2013, and 2014 for full descriptions of the Geoscience models, including calibration results with measured data). While additional development has occurred within the Planning Area since 2012, it is not expected to create an appreciable difference at the watershed level that would result in different model results for the purposes of this HCP. The Geoscience model represents use of the best available data for this type of HSPF model.

Wildermuth Hydrology Model

Wildermuth Environmental, Inc. (Wildermuth) also has developed several watershed hydrology models of the Santa Ana River watershed. Wildermuth developed the Wasteload Allocation Model (WLAM) that simulates discharge, streambed recharge, and the fate and transport processes for total dissolved solids (TDS) and total inorganic nitrogen (TIN) as part of the work of the Basin Monitoring Program Task Force to assess water quality objectives specified in the Santa Ana River Watershed Basin Plan. For the HCP, Wildermuth combined its WLAM Scenario 8 model with recent improved resolution modeling of the Chino Basin to assess the 2013 Recharge Master Plan Update. Wildermuth's model includes effluent discharges from the wastewater treatment plants and operations of groundwater recharge basins. Existing conditions are based on 2005 land use and precipitation records from 1950–2011. Wildermuth's Fortran ROUTER model uses Soil Conservation Service (SCS) curve number methods for 2001 land use conditions to estimate runoff and its ROUTER module to route the runoff through the drainage system. Wildermuth's model includes calibration with USGS gage data. The Wildermuth model includes mean daily flows for stream nodes in the watershed area upstream of Prado Dam (see Wildermuth 2009, 2015, and 2017 for full descriptions of the Wildermuth models, including calibration results with measured data).

HCP Hydrology Model

The Geoscience model and Wildermuth model were combined into one model for the HCP by taking the outflow from the Geoscience model at its most downstream location (a node on the Santa Ana River just downstream of the proposed RPU.5) and using it as the inflow into the Wildermuth model. The streambed infiltration rates used in the Wildermuth model in both the Rialto Channel and in the Santa Ana River reach downstream of RIX were modified to provide a better fit between modeled losses and the measured USGS infiltration losses in the same reach. Finally, the existing effluent discharges at RIX and Rialto were modified to better fit recent reported measured effluent discharges at these two locations.

Groundwater Flow Model

A groundwater flow model was created for the Upper Santa Ana River (SAR) Groundwater Basin (known as the Integrated SAR Model) by integrating existing groundwater and surface water models (Geoscience 2018). The Integrated SAR Model gives a more detailed understanding of the surface hydrology/groundwater interaction by taking into consideration variables such as infiltration rate, groundwater upwelling, and riparian vegetation evapotranspiration. The Integrated SAR Model is able to depict the current depth to groundwater in riparian areas used by Covered Species (see Figure 3-13). The model is used to predict the changes in groundwater associated with Covered Activities (see Section 4.3.4, *Methods for Effects of Groundwater Change on Riparian and Wetland Habitats*) and will be used as an important component of the long-term monitoring and adaptive management program.

3.6.4 HCP Existing Condition Hydrologic Period

As previously noted, both the Wildermuth and Geoscience models use precipitation records for different time periods in the rainfall-runoff calculations. The historic precipitation records dating back to 1934 include a mixture of years that were drier and wetter than the long-term average. It is important to note that the models are not predicting historic runoff and streamflow. Instead they calculate the amount of runoff and streamflow that would occur by applying historic precipitation patterns to 2005 (Geoscience 2012) and 2001 (Wildermuth 2009) land use conditions. A statistical analysis of precipitation records dating back to 1892 was performed to determine a base hydrologic period to use in the HCP Hydrology Model. The purpose of the base period is to select a period of precipitation years that is representative of the long-term average and that fits within the hydrologic periods used in both the Geoscience and Wildermuth models. The process to select the base period was conducted by the HCP Hydrology Technical Advisory Committee (HTAC), which included an interdisciplinary team of water managers, hydrologic modeling experts, biologists, and representatives of the U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW), among other regulatory agencies involved in development of the HCP. The hydrologic period for the HCP Hydrology Model was selected as a 25-year base period that begins in 1966 and ends in 1990. This period includes a dry and wet period that is representative of the long-term conditions. Selection of this hydrologic period was based on an analysis of precipitation frequency distribution curves that clearly depicted historic dry, intermediate, and wet water year types classifications. Based on historical records, dry years have less than 11 inches of annual precipitation, intermediate years have 11–19 inches, and wet years have more than 19 inches of annual precipitation.[1]

Table 3-9 compares water year type statistics for the following periods: 1892–2014 (full record), 1995–2014 (previous 20 years), and 1966–1990 (selected existing condition hydrologic period). The results show strong similarity in the percentage of years designated in each of the three water year types between the long-term period of 1892–2014 and the selected existing condition hydrologic period of 1966–1990. See Appendix B, *Selection of Baseline Period for Hydrology Analysis,* for additional details on the analysis performed to select the existing condition hydrologic period for the HCP.

[1] The City of San Bernardino gauge was used to depict the pattern of variability over time (1892–2014) in precipitation in the Planning Area. This gage provides the longest continuous precipitation record in the region and is centrally located without any notable montane rain shadow effects.

Table 3-9. Comparison of Water Year Type Characteristics among the 1892–2014, 1995–2014, and 1966–1990 Periods

Period	Water Year Type	Rainfall (inches)	Number of Years	Percent of Years	Average Rainfall (inches)
1892–2014	Dry	<11	30	24	8.7
	Intermediate	11–19	62	50	14.7
	Wet	>19	31	25	25.4
	Annual Average	--	123	--	16.0
1995–2014	Dry	<11	9	45	7.7
	Intermediate	11–19	7	35	14.4
	Wet	>19	4	20	27.6
	Annual Average	--	20	--	14.0
1966–1990	Dry	<11	6	24	9.8
	Intermediate	11–19	14	56	14.7
	Wet	>19	5	20	29.3
	Annual Average	--	25	--	16.4

Mean Daily Streamflow

Mean daily stream flow is often represented as a statistical probability of flow, known as an *exceedance flow*. An exceedance flow analysis shows the probability that a certain magnitude flow is equaled or exceeded on a given day within a given period. For example, a 0.05 probability of exceedance means the flow magnitude is equaled or exceeded only 5% of the time in a given year. As stream flows are rarely greater than the 5% exceedance, it is typically an indicator of high flows that infrequently occur. Conversely, the 0.95 probability of exceedance means the flow magnitude is equaled or exceeded 95% of the time, and thus is an indicator of low flow conditions. The 0.5 probability of exceedance is the median flow in which half the time the flow is greater and half the time it is less.

Mean daily stream flow was calculated at each model node for existing conditions under the HCP hydrologic period. Appendix C, *Monthly and Annual Flows for Exceedance Probabilities at Existing Conditions and with Covered Activities,* lists the 0.95, 0.75, 0.5, 0.25, and 0.05 exceedance probabilities on a monthly and annual basis for all model nodes shown on Figure 3-12. It also lists the mean monthly and annual flows. To spatially summarize the existing hydrology for the drainages in the Planning Area, Figures 3-14 and 3-15, show the mean September and March flows, respectively (representing the wettest and driest months of the year, on average).

Dry Weather Flows

In September, streamflow in the upper parts of the tributaries in the upper watersheds (e.g., Lytle, City, Plunge, San Timoteo) is less than 1 cfs (Figure 3-14). Some of the upper watershed tributaries have September flows in the 1.1–10 cfs range that exhibit influences of effluent flows, irrigation runoff, or groundwater upwelling. The mean September flow in the Santa Ana River is typically in the 1.1–10 cfs range from downstream of Seven Oaks Dam until the confluence with Lytle Creek, at which point the additional tributary inputs have increased the flow into the 10.1–50 cfs range. Significant effluent inputs at the Rialto and RIX WWTPs increase the Santa Ana River flow

downstream of the Rialto Channel into the 50.1–100 cfs range. However, streambed infiltration downstream of the WWTPs decrease the surface flow to the 10.1–50 cfs range until approximately the Van Buren bridge in Riverside. Due to surface water contributions from groundwater upwelling at the Riverside Narrows and discharge from the City of Riverside Regional Water Quality Control Plant, just upstream of Van Buren Boulevard and Hole Creek, the flow increases again up to the 100.1–200 cfs range. After additional streambed infiltration losses, the Santa Ana River in the reach downstream of San Sevaine Creek has September flows in the 50.1–100 cfs range until it reaches the diversion channel at Prado Wetlands (Node NSAR36). Approximately 30 cfs is lost to infiltration in the Santa Ana River between the City of Riverside Regional Water Quality Control Plant and the diversion to the Orange County Water District wetlands. Mean September streamflow in tributaries in the Chino Basin (e.g., Chino Creek, Cucamonga Creek, Day Creek, San Sevaine Creek) are typically in the 1.1–10 cfs range, with some increases due to WWTP effluent.

Wet Weather Flows

In March, streamflows are often the highest in the Planning Area, on average. Mean March streamflow is mapped on Figure 3-15. Several of the tributaries in the upper portion of the watershed have mean March streamflow in the 1.1–10 cfs range (e.g., San Timoteo, Mission Creek, Sand Creek) or 10.1–50.0 cfs range (e.g., Lytle Creek, Mill Creek, Plunge Creek). The Santa Ana River downstream of Seven Oaks Dam also has flows in the 10.1–50 cfs range until losses to streambed infiltration reduce flows down to 1.1–10 cfs upon reaching the confluence with Mission Creek. Downstream of the confluence with Lytle Creek, the flow contributions from all the tributaries upstream increase the Santa Ana River's mean March flow to 100.1–200 cfs. Streamflow in the Santa Ana River is increased again up to the 200.1–400.0 cfs range from effluent supplied to the river by the RIX and Rialto WWTPs. Mean March flows in the Santa Ana River reach remain in the 200.1–400.0 cfs range from the Rialto Channel all the way down to the Prado Wetlands diversion (Node NSAR36) upstream of Temescal Wash. Compared to September conditions, the tributary inputs from the Chino Basin are increased to flows in the 100.1–200.0 cfs range.

Hydrologic Sediment Transport

High flows in the wet season and during major storm events are responsible for most of the fluvial processes that create and maintain stream channels. Channel maintenance flows are described here as instream flows necessary to maintain the physical character of the stream channel (Schmidt and Potyondy 2004). Maintenance of the physical habitat is in turn essential for healthy aquatic and terrestrial habitat and reducing flood risk. Schmidt and Potyondy (2004) describe the following benefits of channel maintenance flows:

- Convey water and sediment from tributary areas through the stream system without aggradation (net raising) or degradation (net lowering) of the channel bed.
- Maintain the relationship between the channel and the floodplain by temporarily storing flood flows on the floodplain.
- Maintain the ability of the stream to dissipate energy on the floodplain.
- Maintain essential channel capacity to avoid increasing flood risk to adjacent and downstream facilities.
- Maintain pools, riffles, meanders, and other physical habitats necessary to sustain aquatic ecosystems.

Channel maintenance flows are also essential for maintaining healthy riparian vegetation and the numerous benefits it provides, including habitat, root cohesion to protect against excessive erosion, shading to regulate stream temperatures, and nutrient filtering. Channel maintenance flows sustain riparian vegetation by:

- Providing a source of abundant moisture.
- Transporting seed and propagules.
- Depositing sediment and scouring areas of the floodplain to create and maintain regeneration sites.
- Suppressing vegetation growth and encroachment of the main channel by several mechanisms including scour and inundation. (Schmidt and Potyondy 2004)

Loss of riparian vegetation can lead to increased erosion of sediments, forming channel banks and floodplains. Rapid transport and eventual deposition of this sediment downstream can cause flooding problems and degrade aquatic habitats. Furthermore, riparian vegetation stores flood water, at least temporarily, and slows the pace of the flood wave as it moves down the watershed, thereby reducing flooding levels downstream (Anderson 2006).

The magnitude, frequency, and duration of flood flows necessary for performing channel maintenance can vary depending on the characteristics of the channel morphology. The recurrence interval, also known as the return period, is the average interval of time in years for which the discharge magnitude of a given flood will be equaled or exceeded. Surian et al. (2014) present a conceptual framework that relates recurrence interval flows with channel maintenance fluvial processes in braided rivers, similar to much of the Santa Ana River in the Planning Area (Figure 3-16). Braided channel processes of sediment transport in channels and on low bars, in-channel bank erosion, sudden channel shifts into new channel braids, and vegetation erosion can all occur at frequently occurring flood events with recurrence intervals of less than a 1-year return period. It can require larger recurrence interval events of up to 2.5 years for the process of sediment transport on high bars. The framework model (Figure 3-16) illustrates that fluvial processes occur under a range of discharges, not a single discharge, and relatively infrequent floods (recurrence intervals in the 1- to 3-year range) are important drivers of braided channel morphology (Surian et al. 2014, Bertoldi et al. 2010). Flow regulations that affect frequent, low magnitude floods with recurrence intervals in the 1- to 3-year range can significantly change braided river vegetation dynamics and the transport of coarse sediment (Surian et al. 2014). The recurrence interval of 1.25 years was selected as one measure to characterize the existing high flow conditions of the Santa Ana River in the Planning Area as this recurrence interval includes all of the primary channel maintenance processes except sediment transport to high bars. As discussed below, characterization of bedload transport over the entire hydrograph, which includes less frequent and higher magnitude flood events than the 1.25-year flood, was also performed as another measure of high flow characterization.

Three different analyses were performed to characterize existing conditions:

1. Characterization of the Flow Magnitude for the 1.25-year Flood Event
2. Characterization of Sediment Transport for the 1.25-year Flood Event
3. Characterization of Sediment Transport Over the Entire Hydrograph

Details on this analysis are included in Appendix D, *Santa Ana River High Flow Effects Analysis*.

Characterization of Flow Magnitude for the 1.25-year Flood Event

Determination of the flow magnitude that corresponds to different recurrence intervals, including the 1.25-year flood event, is usually based on peak instantaneous flows that can be queried from USGS gage records (e.g., flow levels reported on a 15-minute interval) to find the largest value that occurred in the year. While several USGS gages exist in the Planning Area, there are too few to comprehensively characterize the 1.25-year flood event for all reaches of the upper Santa Ana River and its tributaries. Therefore, ICF used a procedure to correlate the available peak flow recurrence interval with mean daily discharge. For the first step, flood recurrence intervals (based on the approach in England et al. 2018) were calculated on the available gage records. Then a flow duration curve was created from the mean daily flow records at the USGS gages, and the exceedance probability corresponding to the 1.25-year flood was determined. Finally, the same exceedance probability determined for the USGS gage was used to determine the modeled mean daily flow that corresponds to the 1.25-year flood event (see Appendix D for a more thorough description of this approach and graphs of the flow duration curves).

While this approach does not produce an exact correlation of peak flow with mean daily flow (e.g., when the peak instantaneous flow duration is less than a day) it does provide a good approximation and results in a comprehensive characterization of the existing conditions for comparison with potential effects of the Covered Activities. As the results in Appendix D show, the peak instantaneous and modeled mean daily existing flows have similar magnitudes for most gages. The flow magnitude at the 1.25-year flood event is shown in the second column of Table 3-10.

Characterization of Sediment Transport for the 1.25-year Flood

Particle size analysis of the channel bed sediment samples shows that most of the assessment reaches are composed of fine grained, poorly sorted, sandy sediment (Appendix D). The exceptions are steeper reaches in the upper watershed on the Santa Ana River at Greenspot Road and Mill Creek (dominant small cobble size), the Rialto Channel (dominant coarse gravel), and Santa Ana River (ESA) Middle Reach downstream of Highway 60 (dominant fine gravel size). Results for the modeled sediment transport for the 11 assessment reaches are listed in Table 3-10. The table lists total sediment transport and change in fractional sediment transport. Mill Creek has the largest sediment transport rate (15,781 tons/day) and is nearly three times greater than the second largest tributary site of Lytle Creek upstream of Cajon Wash (5,295 tons/day). Mill Creek's steep bed slope (4.1%) is the highest of all reaches assessed and a primary factor for why this tributary is the largest sediment source. In terms of the fractional size components of the total sediment load, Mill Creek is the largest supplier of gravel and cobble at the 1.25-year flood under the existing hydrologic condition (Table 3-10).

Table 3-10. Sediment Transport Rate Under Existing Conditions that Corresponds to the 1.25-Year Flood Recurrence Interval

2D Hydraulic Model Assessment Reach	Stream Flow (cfs)	Total Bedload Transport (t/d)	Fractional Bedload Transport under Existing Conditions			
			Sand (t/d)	Gravel (t/d)	Cobble (t/d)	Boulder (t/d)
Mill Creek Upstream of SAR	84	15,781	6,407	8,557	815	2
Lower City Creek	176	1,100	904	196	0	0
Lytle Creek Upstream of Cajon Wash	100	5,295	4,224	1,063	8	0

2D Hydraulic Model Assessment Reach	Stream Flow (cfs)	Total Bedload Transport (t/d)	Fractional Bedload Transport under Existing Conditions			
			Sand (t/d)	Gravel (t/d)	Cobble (t/d)	Boulder (t/d)
Lytle Creek Downstream of Cajon Wash	159	1,737	1,497	240	0	0
Cajon Wash	100	2,167	1,847	319	0	0
SAR – Greenspot Rd	259	8,201	1,949	3,747	2,365	140
SAR – Downstream of Mill Creek	401	5,660	1,482	2,660	1,462	56
SAR – Upstream of East Twin Creek	473	959	877	81	0	0
SAR – USGS Reach 9 Downstream of RIX	3,178	7,626	6,862	764	0	0
SAR – ESA Middle Reach	2,971	2,490	1,641	849	0	0
SAR – Site 3A Downstream of I-15	5,948	2,157	1,179	978	0	0

t/d = tons per day

Characterization of Bedload Transport Over the Entire Hydrograph

Results of the sediment transport analysis over the entire hydrograph are presented in Table 3-11. These locations were selected for analysis because they are the tributaries that deliver the most sediment to the mainstem of the Santa Ana River that also are the site of Covered Activities. The other three tributaries on the Santa Ana River were selected to include different locations distributed throughout the Planning Area. Appendix D includes the sediment transport rating curves that were used to determine the values in Table 3-11. It also illustrates with graphical bar charts the fractional transport rates listed in Table 3-11. Mill Creek by far has the largest total sediment load under existing conditions of all sites at 1,184,365 tons/year, and is also the largest supplier of combined gravel and cobble to the Santa Ana River. The Santa Ana River at Greenspot Road is the location with the second largest existing condition total sediment load at 280,296 tons/year. The third largest location under existing conditions for total sediment load is the Santa Ana River USGS Reach 9 downstream of RIX at 177,376 tons/year. In terms of the fractional size components of the total sediment load, Mill Creek is the largest supplier of gravel and cobble under existing conditions (Table 3-11). The Santa Ana River at Greenspot Road is the second largest supplier of gravel and cobble.

Table 3-11. Sediment Transport Effects from Changes in Hydrology Calculated for Every Mean Daily Discharge over the 25-Year 1966–1990 Base Hydro Period

Hydraulic Model Assessment Reach	Stream Flow (afy)	Total Bedload Transport (t/yr)	Fractional Bedload Transport			
			Sand (t/yr)	Gravel (t/yr)	Cobble (t/yr)	Boulder (t/yr)
Mill Creek Upstream of SAR	14,362	1,184,365	466,051	641,526	75,564	967
Lower City Creek	8,275	22,964	18,838	4,126	0	0
Lytle Creek Downstream of Cajon Wash	9,471	48,938	41,864	7,052	23	0
SAR at Greenspot Rd	15,650	280,296	63,450	125,237	84,766	6,340
SAR – Upstream of East Twin Creek	36,313	39,531	35,847	3,668	15	0

Hydraulic Model Assessment Reach	Stream Flow (afy)	Total Bedload Transport (t/yr)	Fractional Bedload Transport			
			Sand (t/yr)	Gravel (t/yr)	Cobble (t/yr)	Boulder (t/yr)
SAR – USGS Reach 9 Downstream of RIX	99,675	177,376	161,323	16,053	0	0

afy = acre-feet per year; t/y = tons per year

3.7 Vegetation and Land Cover

The vegetation communities and other land cover types were compiled using the most current land cover data available from a variety of sources to create a single land cover layer encompassing the entire Planning Area. The majority of the landcover aerial coverage was derived from the California Department of Forestry and Fire Protection (CAL FIRE) land cover dataset (CAL FIRE). This layer was supplemented with more current and/or detailed data from (1) agricultural and developed lands from the Farmland Mapping and Monitoring Program (California Department of Conservation 2014), (2) USFWS National Wetlands Inventory (USFWS 2017a), (3) Southern California Wetlands Inventory (State of California 2007), (4) Western Riverside Multiple Species Conservation Program vegetation data, and (5) Upper Santa Ana River Wash Plan land cover data (see Table 3-12 for a complete list of land cover data sources). All data were reclassified to the U.S. National Vegetation Classification Standard level 5 (macrogroup) (USNVC 2016) to match the CAL FIRE base layer. Table 3-13 lists the vegetation community macrogroup types occurring in the Planning Area. See Figures 3-17 through 3-23, for a geographic overview of where these land cover types occur within the Planning Area.

Table 3-12. Land Cover Data Sources

Data Layer	Data Description
CAL FIRE	This vegetation dataset was compiled from three different vegetation classifications (U.S. Forest Service [USFS] CALVEG, *Mojave Manual of California Vegetation* [MCV], and *West Riverside MCV*) that have been crosswalked for the Santa Ana River Watershed planning project. CALVEG and the California Wildlife Habitat Relationships System were crosswalked to National Vegetation Classification System. Sources: CAL FIRE, California Native Plant Society (CNPS) MCV at http://vegetation.cnps.org/.
California Farmland Mapping and Monitoring Program	A land cover map that focuses on farmland of California. Source: California State, Department of Conservation, Division of Land Resource Protection at http://redirect.conservation.ca.gov/DLRP/fmmp/county_info_results.asp.
CALVEG, USFS	This layer provides vegetation databases in Zone 7: South Coast, which includes San Bernardino County, that meets regional and national vegetation mapping standards. Source: http://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347188.
CNPS Western Riverside vegetation mapping	An alliance-level vegetation classification and map of Western Riverside County. Source: CDFW at http://www.dfg.ca.gov/biogeodata/gis/veg.asp.
Desert Renewable Energy Conservation Plan Vegetation Map	A fine-scale vegetation map of portions of the Mojave and Colorado Deserts in California prepared for the CDFW Renewable Energy Program and the California Energy Commission. Source: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=62826.

Data Layer	Data Description
Southern California Wetlands Mapping Project	Updated mapping of wetland and associated riparian habitat maps in Southern California coastal watersheds. Source: https://www.sfei.org/projects/southern-california-wetland-mapping-project
USFWS National Wetlands Inventory	Reconnaissance level information on the location, type, and size of wetlands and deepwater habitats, which are identified based on vegetation, visible hydrology, and geography. The maps are prepared from the analysis of high altitude imagery. Source: http://www.fws.gov/wetlands/data/Data-Download.html.
Upper Santa Ana River Wash Plan	A land cover map produced for the Wash Plan. Source: https://www.sbvwcd.org/our-projects/wash-plan.html
Soils	
USDA NRCS Soil Survey Geographic Database	Soil texture and landform data produced by the National Cooperative Soil Survey. Source: U.S. Department of Agriculture National Resource Conservation Service at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.
Elevation	
National Elevation Dataset	A seamless raster product primarily derived from USGS 10- and 30-meter Digital Elevation Models, and, increasingly, from higher resolution data sources such as LiDAR, interferometric synthetic aperture radar (IFSAR), and high-resolution imagery. Source: USGS at http://nationalmap.gov/elevation.html#data.

Table 3-13. Vegetation Community and Land Cover Types in the Planning Area

Vegetation Community/Land Cover Type	Description
Riparian	**Subtotal = 14,752 acres (2% of Planning Area)**
Interior Warm and Cool Desert Riparian Forest *14,062 acres* *2% of Planning Area*	Warm and cold climate riparian and wetland forested vegetation of the southwestern deserts and western interior U.S., including the Tamaulipan area of southern Texas. Some of the dominant trees species of this highly diverse macrogroup include sweet acacia (*Acacia suaveolens*), sugar hackberry (*Celtis laevigata*), Texas ebony (*Ebenopsis ebano*), Arizona walnut (*Juglans major*), California sycamore (*Platanus racemose*), Arizona sycamore (*Platanus wrightii*), Rio Grande cottonwood (*Populus deltoides* ssp. *wislizeni*), eastern cottonwood (*Populus deltoides* ssp. *monilifera*), Fremont's cottonwood (*Populus fremontii*), honey mesquite (*Prosopis glandulosa*), red willow (*Salix laevigata*), and Goodding's black willow (*Salix gooddingii*). This macrogroup also includes oases dominated by evergreen palms such as California fan palm (*Washingtonia filifera*) or Rio Grande palmetto (*Sabal Mexicana*).
Interior West Disturbed Flooded and Swamp Forest and Woodland *4 acres* *<1% of Planning Area*	Low-elevation riparian and lacustrine areas throughout the southwestern U.S. and into Mexico that are dominated by nonnative invasive woody species such as tamarisk (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*), or date palm (*Phoenix dactylifera*).
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland *687 acres* *<1% of Planning Area*	Includes desert freshwater wetlands, such as low-statured honey mesquite (*Prosopis glandulosa*) and velvet mesquite (*Prosopis velutina*) stands and shrubby areas of Emory's baccharis (*Baccharis salicina*), mulefat (*Baccharis salicifolia*), arrowweed (*Pluchea sericea*), arroyo willow (*Salix lasiolepis*), silver buffaloberry (*Shepherdia argentea*), and desert willow (*Salix exigua*), along perennial and intermittent streams, lake or playa edges, and alkaline seeps and springs, at low elevations (>1,100 meters) in the warm desert regions of the southwestern U.S.
Wetland	**Subtotal = 2,733 acres (<1% of Planning Area)**
Western North American Disturbed Marsh, Wet Meadow, and Shrubland *79 acres* *<1% of Planning Area*	This macrogroup includes disturbed natural wetland habitats of temperate western North America that are now strongly dominated by nonnative and sometimes weedy or generalist native species. This macrogroup occupies approximately 79 acres (<1%) of the Planning Area.
Western North American Freshwater Aquatic Vegetation *205 acres* *<1% of Planning Area*	Consists of rooted and floating freshwater aquatic herbaceous vegetation dominated by western U.S. aquatic species such as Pacific mosquitofern (*Azolla filiculoides*), Mexican mosquitofern (*Azolla mexicana*), Rocky Mountain pond-lily (*Nuphar polysepala*), pygmy water-lily (*Nymphaea tetragona*), broadleaf pondweed (*Stuckenia striata*), and several other cosmopolitan species, found throughout the temperate regions of western North America.

Vegetation Community/Land Cover Type	Description
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland *22 acres* *<1% of Planning Area*	Contains montane to subalpine and alpine wet meadows, marshes, and wet shrublands throughout the Rocky Mountains of the U.S. and Canada, the Sierra Nevada, and Intermountain cordillera. Dominant species include graminoids such as bluejoint reedgrass (*Calamagrostis canadensis*), mountain sedge (*Carex scopulorum*), Northwest Territory sedge (*Carex utriculata*), fowl mannagrass (*Glyceria striata*); forbs such as white marsh-marigold (*Caltha leptosepala*), Sierra shootingstar (*Primula subalpina*), creeping-glow-wort (*Sibbaldia procumbens*); and shrub species such as, but not limited to, gray alder (*Alnus incana*), water birch (*Betula occidentalis*), resin birch (*Betula glandulosa*), and many willow (*Salix*) species.
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland *2,427 acres* *<1% of Planning Area*	Contains marshes, wet meadows, and shrublands, singly and in mosaics, along riparian corridors, around vernal pools, depressions, seeps, and springs on mineral soils or shallow organic layers over mineral substrates in temperate (and possibly southern boreal) latitudes of western North America.
Water *(includes alluvial fan sage scrub in parentheses)*	**Subtotal = 28,596 acres (3% of Planning Area)**
Permanent Water *4,575 acres* *<1% of Planning Area*	Contains open water areas of intermittent, permanent, and seasonal nature.
Water in Existing Basins *618 acres* *<1% of Planning Area*	Contains open water areas of intermittent, permanent, and seasonal nature.
Dry Channel/Shrubland *23,403 acres (5,440)* *2% of Planning Area (<1% of Planning Area)*	Contains open water areas of intermittent, permanent, and seasonal nature.
Shrubland *(includes alluvial fan sage scrub in parentheses)*	**Subtotal = 283,097 acres (33% of Planning Area)**
Californian Chaparral *170,526 acres* *20% of Planning Area*	Consists of evergreen sclerophyllous shrublands found throughout California, extreme southern Oregon, and northern Baja California, closely associated with Mediterranean climates, from fog-belt coastal settings to extremely xeric interior stands that are dominated by a wide variety of endemic shrubs, including chamise species (*Adenostoma* spp.), manzanitas species (*Arctostaphylos* spp.), ceanothus species (*Ceanothus* spp.), birch-leaf mountain-mahogany (*Cercocarpus beltuloides*), Eastern Mojave buckwheat (*Eriogonum fasciculatum*), two-petal ash (*Fraxinus dipetala*), toyon (*Heteromeles arbutifolia*), scrub oak (*Quercus berberidifolia*), and many others.

Vegetation Community/Land Cover Type	Description
Californian Coastal Scrub *89,346 acres (8,039)* *10% of Planning Area (<1% of Planning Area)*	Consists of a diverse mix of drought-deciduous shrubs and characteristic obligate-seeding or resprouting evergreen shrubs occurring in coastal and foothill communities of southwestern Oregon, along the California coast and inner foothills, and south into Baja Norte, Mexico.
Cool Interior Chaparral *7,989 acres* *1% of Planning Area*	Chaparral shrublands occur between low-elevation desert landscapes and higher subalpine woodlands of the Cascades, Sierra Nevada, and interior mountain ranges of the western U.S., generally among montane forests above 4,550 feet elevation.
Great Basin-Intermountain Dry Shrubland and Grassland *168 acres* *<1% of Planning Area*	Found throughout the Intermountain West, including mid-elevation sites in eastern and central Mojave Desert, the Great Basin, Colorado Plateau, Columbia Plateau, and lower elevation sites in the central Rocky Mountains extending east across Wyoming Basins into the western Great Plains. It can occur as open shrubland, dwarf-shrub, shrub herbaceous, or grassland communities. Characteristic species include shrubs such as yellow rabbitbrush (*Chrysothamnus viscidiflorus*), blackbrush (*Coleogyne ramosissima*), ephedra species (*Ephedra* spp.), rubber rabbitbrush (*Gutierrezia sarothrae*), and winterfat (*Krascheninnikovia lanata*), and dry grasses such as Indian ricegrass (*Achnatherum hymenoides*), Letterman's needlegrass (*Achnatherum lettermanii*), purple three-awn (*Aristida purpurea*), blue grama (*Bouteloua gracilis*), needle and thread (*Hesperostipa comata*), wildrye (*Elymus* spp.), sandhill muhly (*Muhlenbergia pungens*), James' galleta (*Pleuraphis jamesii*), mutton grass (*Poa fendleriana*), big bluegrass (*Poa secunda*), bluebunch wheatgrass (*Pseudoroegneria spicata*), sand dropseed (*Sporobolus cryptandrus*), and alkali sacaton (*Sporobolus airoides*).
Great Basin-Intermountain Tall Sagebrush Steppe and Shrubland *254 acres* *<1% of Planning Area*	Includes the big sagebrush shrubland and shrub-steppe that is a matrix and large-patch type throughout much of the intermountain western U.S. and that is dominated by big sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), and several local dominants such as silver sagebrush (*Artemisia cana*) and threetip sagebrush (*Artemisia tripartita* ssp. *tripartita*).
Great Basin-Intermountain Xeric-Riparian Scrub *5,973 acres (3,283)* *<1% of Planning Area (<1% of Planning Area)*	Shrublands along dry washes and valley floors dominated by *Atriplex canescens*, *Ericameria nauseosa*, *Artemisia tridentata* ssp. *tridentata*, and other species within the cool temperate desert of western North America.
North American Warm-Desert Xeric-Riparian Scrub *6,309 acres (4,756)* *<1% of Planning Area (<1% of Planning Area)*	Shrublands and grasslands along intermittent streams and washes dominated by shrubs such as catclaw acacia (*Senegalia greggii*), desertbroom (*Baccharis sarothroides*), sweetbush (*Bebbia juncea*), splitleaf brickelbush (*Brickellia laciniata*), desert willow (*Chilopsis linearis*), California Mormon tea (*Ephedra californica*), Mojave rabbitbrush (*Ericameria paniculata*), Apache plume (*Fallugia paradoxa*), burrowbrush (*Ambrosia salsola*), singlewhorl burrobrush (*Ambrosia monogyra*), desert lavender (*Hyptis emoryi*), desert ironwood (*Olneya tesota*), blue palo verde (*Parkinsonia florida*), Mexican bladdersage (*Salazaria mexicana*), and/or netvein goldeneye (*Viguiera reticulata*) and herbs such as bulb panicgrass (*Panicum bulbosum* var.

Vegetation Community/Land Cover Type	Description
	bulbosum), shortawn foxtail (*Alopecurus aequalis*), or wolfstail (*Lycurus Kunth*) that are found within the warm temperate deserts of western North America.
Warm Interior Chaparral *2,530 acres* *<1% of Planning Area*	Includes all the interior chaparral in the southwestern U.S. and northern Mexico and is composed of a very diverse list of diagnostic, mostly evergreen shrubs such as Mexican manzanita (*Arctostaphylos pungens*), desert ceanothus (*Ceanothus greggii*), Wright's silktassel (*Garrya wrightii*), and turbinella oak (*Quercus turbinella*), which dominate large areas on foothills, xeric mountain slopes, and canyons.
Grassland	**Subtotal = 55,475 acres (6% of Planning Area)**
Californian Annual and Perennial Grassland[1] *55,359 acres* *6% of Planning Area*	Consists of native perennial and annual forb- and grass-dominated meadows and grasslands of California from the coast to the upper foothills of the Sierra Nevada, dominated or characterized by native perennial bunchgrass tussockgrass species (*Nassella* spp. [= *Stipa* spp.]), and/or perennial forbs such as brodiaea (*Brodiaea*), mariposa lily (*Calochortus*), snakelily (*Dichelostemma*), sanicle (*Sanicula*), and triteleia (*Triteleia)* species; and annual species such as fiddlenecks (*Amsinckia* spp.), poppy (*Eschscholzia* spp.), American bird's-foot trefoil (*Acmispon americanus*), lupines (*Lupinus* spp.), rusty popcornflower (*Plagiobothrys nothofulvus*), whitetip clover (*Trifolium variegatum*), and small fescue (*Vulpia microstachys*). Occurrences often have high native species richness though they may have significant abundance of nonnative species.
Californian Disturbed Grassland, Meadow, and Scrub *115 acres* *<1% of Planning Area*	Encompasses nonnative-dominated annual grassland, forbland, and scrub found in the "Mediterranean" region of California, especially in disturbed areas. Dominant introduced species include the herbs slender oat (*Avena barbata*), wild oat (*Avena fatua*), black mustard (*Brassica nigra*), ripgut brome (*Bromus diandrus*), soft brome (*Bromus hordeaceus*), red brome (*Bromus rubens*), knapweeds (*Centaurea* spp.), finarees (*Erodium* spp.), perennial rye grass (*Lolium perenne* L.), and cultivated radish (*Raphanus sativus*). Species in nonnative shrublands include common gorse (*Ulex europaeus*), Scotch broom (*Cytisus scoparius*), and species of broom (*Genista* spp. and *Spartium* spp.), among others.
Woodland	**Subtotal = 56,019 acres (6% of Planning Area)**
Californian Disturbed Forest *703 acres* *<1% of Planning Area*	Includes groves of escaped or naturalized cultivars of tree-of-heaven (*Ailanthus altissima*), acacias (*Acacia* spp.), several species of eucalyptus (*Eucalyptus* spp.), common fig (*Ficus carica*), ngaio tree (*Myoporum laetum*), Aleppo pine (*Pinus halepensis*), black locust (*Robinia pseudoacacia*), peppertree (*Schinus molle*), and Brazilian peppertree (*Schinus terebinthifolius*), or native species that have become invasive, such as Monterey cypress (*Callitropsis macrocarpa*) or Monterey pine (*Pinus radiata*), found scattered throughout California and south into Baja California, Mexico.

Vegetation Community/Land Cover Type	Description
Californian Forest and Woodland *54,185 acres* *6% of Planning Area*	Mesic to dry upland savannas, woodlands, and forests dominated by warm-temperate endemic oak and conifer species at low elevations throughout California, on the mainland and islands of Baja California, and in the foothills of the Cascade Range of Oregon.
Intermountain Singleleaf Pinyon–Utah Juniper–Western Juniper Woodland *1,130 acres* *1<% of Planning Area*	Occurs in dry foothills in the interior western U.S. and is characterized by an open to closed tree canopy composed of western juniper (*Juniperus occidentalis*), Utah juniper (*Juniperus osteosperma*), twoneedle pinyon (*Pinus edulis*), singleleaf pinyon (*Pinus monophylla*), and/or curl-leaf mountain-mahogany *Cercocarpus ledifolius*.
Forests	**Subtotal = 33,343 acres (4% of Planning Area)**
Rocky Mountain Subalpine–High Montane Conifer Forest *4,027 acres* *<1% of Planning Area*	Occurs in dry foothills in the interior western U.S. and is characterized by an open to closed tree canopy composed of western juniper (*Juniperus occidentalis*), Utah juniper (*Juniperus osteosperma*), twoneedle pinyon (*Pinus edulis*), singleleaf pinyon (*Pinus monophylla*), and/or curl-leaf mountain-mahogany *Cercocarpus ledifolius*.
Southern Vancouverian Montane–Foothill Forest *29,316 acres* *3% of Planning Area*	Includes Jeffrey pine–ponderosa pine woodlands; mixed conifer woodlands with balsam fir (*Abies concolor*), incense cedar (*Calocedrus decurrens*), Jeffrey pine (*Pinus jeffreyi*), sugar pine (*Pinus lambertiana*), ponderosa pine (*Pinus ponderosa* [= var. *pacifica*, = var. *benthamiana*]), Washoe pine (*Pinus washoensis* [= *Pinus ponderosa* var. *washoensis*)]), Douglas fir (*Pseudotsuga menziesii* var. *menziesii*), or giant sequoia (*Sequoiadendron giganteum*); and western white pine (*Pinus monticola*) and white fir (*Abies concolor* var. *concolor*) forests that occur in dry habitats found in the foothills and montane elevations of the southern Cascade Range, Klamath Mountains, Modoc Plateau, Sierra Nevada, and Peninsula and Transverse ranges. Additionally, some stands of bristlecone fir (*Abies bracteata*), sugar pine, and ponderosa pine occur close to the coast, such as in the Santa Lucia Range of the Central Coast, which is the highest coastal range in the U.S.
Rock Outcrop	**Subtotal = 2,857 acres (<1% of Planning Area)**
North American Warm Semi-Desert Cliff, Scree, and Rock Vegetation *82 acres* *<1% of Planning Area*	Consists of a variety of near barren and sparsely vegetated substrates in the southwestern U.S. and northern Mexico (including Baja California), including coastal areas, saline plains, desert pavement, rocky slopes, cliffs, and outcrops in foothills, canyons, and desert mountain ranges.
Western North American Cliff, Scree, and Rock Vegetation *2,775 acres* *<1% of Planning Area*	This cliff, scree, and rock vegetation is scattered across California's Coast, Transverse, and Peninsular ranges, Klamath Mountains, southern Sierra Nevada, and the northern coast of Baja California.

Vegetation Community/Land Cover Type	Description
Barren	**Subtotal = 2 acres (<1% of Planning Area)**
Barren	In general, barren lands include deserts, dry salt flats, sand dunes, exposed strip mines, quarries, and gravel pits.
Agriculture	**Subtotal = 50,387 acres (6% of Planning Area)**
Herbaceous Agricultural Vegetation *48,097 acres* *6% of Planning Area*	Agricultural land is used primarily for the production of food and fiber. Agricultural land uses include forest landscapes such as orchards as well as non-forested land uses such as vineyards and field crops.
Woody Agricultural Vegetation *2,290 acres* *<1% of Planning Area*	Agricultural land is used primarily for the production of food and fiber. Agricultural land uses include forest landscapes such as orchards as well as non-forested land uses such as vineyards and field crops.
Developed	**Subtotal = 335,704 acres (39% of Planning Area)**
Developed and Urban *335,704 acres* *39% of Planning Area*	Developed and urban areas in the Planning Area include the cities of Chino, Montclair, Rancho Cucamonga, Fontana, San Bernardino, Redlands, Yucaipa, Riverside, and Corona.
Total	**862,966 acres**

[1]While this habitat type is defined by a high native species richness, this habitat is predominantly non-native grassland species within the Planning Area.

3.8 Covered Species

As described in Chapter 1, this HCP covers 22 species (Table 1-1). The following discussion provides species accounts for each of the 22 Covered Species. These accounts summarize important life history traits of the species. The accounts represent a summary of the best available scientific data for each species on which to base this HCP. The species accounts are not intended to summarize all biological information known about a species. Rather, each account summarizes scientific information that is relevant to the issues that must be considered when developing and implementing this HCP. The biological data in these profiles support the impact analysis (Chapter 4) and conservation strategy (Chapter 5) in this HCP.

3.8.1 Species Occurrence Data

Covered Species occurrence data was obtained from a variety of sources (Table 3-14) and combined to create a single species occurrence database for analysis in the HCP. The database was screened for duplicate records, which were removed when identified. The species occurrence database represents a composite of Covered Species occurrence over time. In most cases, it is incidental observational data and therefore subject to survey bias, depending upon where and when Covered Species are most likely to be observed. Therefore, it should not be interpreted as an indication of species abundance or spatial distribution. However, it can be useful to compare species occurrences to species distribution models as a way of subjectively evaluating how likely the model is at capturing species distribution.

Table 3-14. Species Occurrence Data Sources

Data Layer	Data Description
Audubon and Cornell Lab of Ornithology eBird Database	These data identify documented and reported bird species occurrences. Source: Audubon and Cornell Lab of Ornithology at http://ebird.org/ebird/map/.
USGS – Annual Fish Survey Data (2015–2018)	Wulff, M.L., Brown, L.R., May, J.T., and Gusto, E. 2019. *Native Fish Population and Habitat Study, Santa Ana River, California, 2018*: U.S. Geological Survey data release. Wulff, M.L., Brown, L.R., May, J.T., and Gusto, E. 2018. *Native Fish Population and Habitat Study, Santa Ana River, California, 2017*: U.S. Geological Survey data release. Wulff, M.L., Brown, L.R., and May, J.T. 2017. *Native Fish Population and Habitat Study, Santa Ana River, California, 2016* (ver. 2.0, August 2017): U.S. Geological Survey data release. Wulff, M.L., Brown, L.R., and May, J.T. 2017. *Native Fish Population and Habitat Study, Santa Ana River, California, 2015*: U.S. Geological Survey data release.
CDFW – Cactus Wren Occurrence Data	Western Riverside County MSHCP Biological Monitoring Program cactus wren occurrences. Source: California Department of Fish and Wildlife.
CDFW – California Natural Diversity Database (CNDDB) Species Occurrence Data	These data identify documented and reported occurrences of special-status plant communities, as well as special-status plant and animal species within the Planning Area. They are also available to view with the Biogeographic Information and Observation System.

Data Layer	Data Description
	Source: CDFW at http://www.dfg.ca.gov/biogeodata/cnddb/rf_ftpinfo.asp.
Coastal Cactus Wren Working Group	Dataset identifies coastal cactus wren occurrences and appropriate cactus wren habitat in Western Riverside and San Bernardino Counties. Source: Santa Ana Watershed Association.
Herpetological Education and Research Project	The North American Herpetological Education and Research Project database is a repository of sightings and information on North American herpetofauna contributed by amateur citizen scientists and professional herpetologists. Source: http://www.naherp.com/
San Bernardino County Museum – Species Occurrence Data	These data identify additional documented species occurrences within San Bernardino County. Source: San Bernardino Association of Governments regional database.
San Diego Zoo	San Bernardino kangaroo rat trapping data. Source: San Diego Zoo, Institute for Conservation Research.
Tricolored Blackbird Portal	Database of publicly accessible records of locations of tricolored blackbird colonies and aggregations in San Bernardino and Riverside Counties. Source: http://tricolor.ice.ucdavis.edu/locations/public/xls.
Upper Santa Ana River Wash Plan	Cactus wren occurrences and suitable nesting habitat. Source: San Bernardino Valley Water Conservation District.
USFWS – Species Occurrence Data	These data identify documented and reported occurrences of federally endangered or threatened species within the Planning Area. Source: Carlsbad USFWS office, geographic information systems (GIS), at http://www.fws.gov/carlsbad/GIS/CFWOGIS.html.
Upper Santa Ana River Wash Plan	Dataset from 2014 identifies coastal cactus wren occurrences and appropriate cactus wren habitat in the Wash Plan boundary. Source: San Bernardino Valley Water Conservation District.

3.8.2 Species Distribution Modeling

It is important to have a good understanding of the distribution of each Covered Species in the Planning Area so that the potential effects of Covered Activities can be estimated (estimation of take for wildlife and impacts for plants), and so that areas for mitigation of those effects can be identified. Species habitat distribution models are important tools to use when evaluating species effects at a landscape scale, especially when it is not feasible to conduct comprehensive species surveys across the entire Planning Area. These models tend to be conservative from an impact estimation point of view (i.e., over predict impacts), and the results generally overstate the probable actual effects on species. Not all of the predicted suitable habitat is expected to be occupied by the subject species at any one time due to the population dynamics of species that change local distribution over space and time. In addition, there are small-scale habitat features that are not mapped in the geographic information system (GIS) database that can affect the suitability of habitat. The species distribution model for each Covered Species is described within its account.

It is important to note the predicted suitable habitat distribution models are one of many tools used in developing the HCP. The models are helpful in developing the initial estimate of take that may occur so that the appropriate amount of take can be quantified for the effects analyses and ultimately authorized with the issuance the incidental take permit (ITP). The actual amount of

incidental take that does occur will be quantified and reported during implementation of the HCP. This will be accomplished through pre-activity surveys, post-activity surveys, and biological monitoring. The pre-activity surveys will accurately document current habitat condition and species presence or absence on the ground immediately prior to initiation of a Covered Activity. Post-activity monitoring of the project site will accurately quantify the direct and indirect effects that result from implementation of a Covered Activity. Biological monitoring during a Covered Activity will help avoid and minimize impacts on species and document any incidental take that may occur during the implementation.

Expert-based species distribution modeling has been used successfully in many HCPs and is the modeling approach used for the Covered Species. Expert-based species distribution modeling uses the GIS data layers expected to have meaningful correlations with the distribution of each species based on their biological or life-history traits (e.g., vegetation community type, soil type, and elevation). The decisions regarding how these data are related to the distribution of each species are made through expert knowledge. The expert-based models use Boolean "and/or" relationships to formulate the habitat distribution. For example, a species would be predicted to occur in an area if it had the right vegetation community and the right soil type, and the correct elevation range where the species is known to occur. The primary source of expert knowledge is the scientific literature. Additional consultation with species experts and review of draft model results provide further insight and refinements to the selection of the best criteria to model the distribution of each species habitat.

For this HCP, the expert-based species distribution models were developed based on the species profiles, and, when available, on other models created for the same species for other species conservation programs in or near the Planning Area. The draft predicted–species distribution model results were evaluated relative to the distribution of known occurrences in the Planning Area to assess the accuracy of the model. When known occurrences were located in areas not predicted by the draft model, the GIS data layers were examined in these areas to identify any additional species-habitat relationship supported by expert knowledge that could be included in the model to improve the accuracy. Such changes to the draft model were only made when the change was generally consistent with known species' habitat requirements as described in the species profile. Some of the species models also incorporate critical habitat as designated by USFWS.

Covered Species occurrence data are used for modeling the distribution of potential Covered Species habitat primarily to evaluate how well the modeled habitat performs at known occupied locations. A number of sources of Covered Species occurrence data were used (Table 3-14). The vegetation/land cover communities and physical properties (such as elevation and soils) data were compiled from a variety of sources. Additional GIS processing was conducted to construct a land cover layer with full coverage of the Planning Area, using the most current land cover data available as described above in Section 3.7, *Vegetation and Land Cover*.

The wetted area (area of in-channel aquatic habitat) was also calculated for habitat of aquatic species based on the wetted area modelling methods described in Section 3.6.2, *Geomorphology*. Wetted area was only modeled for reaches downstream of Covered Activities and therefore does not include the total wetted area of aquatic habitat in the Planning Area.

The model for each species is described within each species account, and the resulting species distribution models are shown in figures. Table 3-15 provides the amount of modeled habitat in the Planning Area for each Covered Species.

Table 3-15. Covered Species Habitat in Planning Area

Common Name	Scientific Name	Federal Status	State Status	Amount of Habitat in Planning Area
Slender-horned spineflower	*Dodecahema leptoceras*	E	E	Current Occupied Habitat: 18 acres Historic Occupied Habitat: 35 acres Potentially Suitable Habitat: 93,006 acres
Santa Ana River woolly-star	*Eriastrum densifolium* ssp. *Sanctorum*	E	E	Potentially Suitable Habitat: 16,434 acres
Delhi Sands flower-loving fly	*Rhaphiomida terminatus abdominalis*	E	None	Potentially Suitable Habitat: 1,362 acres Potentially Suitable Habitat (Extirpated): 1,742 acres
Santa Ana sucker	*Catostomus santaanae*	T	None	Potentially Suitable Habitat: 2.15 acres
Arroyo chub	*Gila orcuttii*	None	SSC	Potentially Suitable Habitat: 14 miles Occupied Habitat: 26 miles Wetted Area Downstream of Covered Activities: 173.7 acres
Santa Ana speckled dace	*Rhinichthys osculus*	None	SSC	Potentially Suitable Habitat: 37.5 miles Occupied Habitat: 29.4 miles Wetted Area Downstream of Covered Activities: 0 acre
Arroyo toad	*Anaxyrus californicus*	E	SSC	Suitable Breeding Habitat: 1,754 acres Non-Breeding Upland Habitat: 5,884 acres Permeable Movement Area: 1,659 acres Wetted Area Downstream of Covered Activities: 0.4 acre
Mountain yellow-legged frog	*Rana muscosa*	E	E	Potentially Suitable Aquatic Habitat: 2,189 acres Refugia/Foraging/ Dispersal Habitat: 91,854 acres Wetted Area Downstream of Covered Activities: 0.2 acre
Western spadefoot	*Spea hammondii*	None	SSC	Potentially Suitable Habitat: 38,252 acres Wetted Area Downstream of Covered Activities: 198.7 acres
California glossy snake	*Arizona elegans occidentalis*	None	SSC	Potentially Suitable Habitat: 146,338 acres
South coast garter snake	*Thamnophis sirtalis* sp.	None	None	Potentially Suitable Habitat: 7,703 acres Wetted Area Downstream of Covered Activities: 188.6 acres
Southwestern pond turtle	*Emys pallida*	None	SSC	Aquatic Habitat: 1,245 acres Potentially Suitable Upland Habitat: 14,944 acres Wetted Area Downstream of Covered Activities: 191.8 acres

Common Name	Scientific Name	Federal Status	State Status	Amount of Habitat in Planning Area
Tricolored blackbird	*Agelaius tricolor*	None	T	Occupied Colony Habitat: 10 acres Suitable Colony Habitat: 1,868 acres Breeding Season Foraging - Natural: 38,222 acres Breeding Season Foraging - Agriculture: 40,641 acres Non-Breeding Season Foraging - Natural: 1,919 acres Non-Breeding Season Foraging - Agriculture: 758 acres
Burrowing owl	*Athene cunicularia*	None	SSC	Potentially Suitable Habitat: 141,791 acres
Cactus wren	*Campylorhynchus brunneicapillus*	None	None	Known Suitable Nesting Habitat: 677 acres Potential Nesting and Foraging Habitat: 127,918 acres Recently Burned (2008–2018): 9,470 acres
Yellow-breasted chat	*Icteria virens*	None	SSC	Potentially Suitable Habitat: 15,329 acres
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	T	E	High Value Breeding Habitat: 2,773 acres Other Potentially Suitable Breeding Habitat: 1,999 acres
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	E	Core Southwestern Willow Flycatcher Habitat: 1,844 acres Very High Value Habitat: 1,564 acres High Value Habitat: 613 acres Moderate Value Habitat: 360 acres Other Potentially Suitable Habitat: 10,949 acres
Coastal California gnatcatcher	*Polioptila californica californica*	T	SSC	Very High Value Habitat: 8,298 acres High Value Habitat: 9,918 acres Moderate Value Habitat: 12,345 acres Low Value Habitat: 30,081 acres Other Suitable Habitat: 5,441 acres
Least Bell's vireo	*Vireo bellii pusillus*	E	E	Core Breeding Habitat: 5,463 acres Other Breeding Habitat: 9,867 acres
Los Angeles little pocket mouse	*Perognathus longimembris brevinasus*	None	SSC	Potentially Suitable Habitat: 67,500 acres

Common Name	Scientific Name	Federal Status	State Status	Amount of Habitat in Planning Area
San Bernardino Merriam's kangaroo rat	*Dipodomys merriami parvus*	E	Candidate	High Value Habitat: 465 acres Medium Value Habitat: 901 acres Low Value Habitat: 2,223 acres Very Low-Quality Habitat: 4,006 acres Ecological Process Area: 831 acres Suitable Habitat: 11,591 acres

Can = Candidate; E = endangered; SSC = species of special concern; T = threatened.

3.8.3 Covered Species Accounts

Slender-Horned Spineflower (*Dodecahema leptoceras*)

Current Status and Distribution

The slender-horned spineflower (*Dodecahema leptoceras*) is federally listed as endangered, California listed as endangered, and is on the California Rare Plant Rank list. This species is found in 27 known extant occurrences throughout coastal foothill drainages of Riverside, San Bernardino, and Los Angeles Counties, ranging from the Temecula area northwestwards to Santa Clarita. One historic record was collected near Palm Springs (CNPS 2020, CCH 2014).

Within the Planning Area the known occurrences are concentrated east of San Bernardino along the Santa Ana River and along the southern portion of Cajon Creek. Smaller populations are known at the south end of the Planning Area near Lake Elsinore, at the western boundary of the Planning Area near Rancho Cucamonga, and near Yucaipa (ICF 2014).

Habitat Affinities

Slender-horned spineflower occurs on stable older alluvium away from active channels in areas with little flooding disturbance and infrequent surface flows between 656 and 2,493 feet in elevation (CNPS 2020). This species occurs in slightly acidic silt soil with low salinity, organic matter, and nutrient content in silt-filled shallow depressions on relatively flat surfaces (Allen 1996). Its preferred habitat is transient in nature and a mid to late successional stage that requires disturbance to maintain over a larger scale. Some populations are known in denser woody habitats that are thought to arise from successional changes from past alluvial flow (USFWS 2010a).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of slender-horned spineflower habitat and occurrences in the Planning Area are illustrated on Figure 3-24. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Potentially Suitable Habitat:

- **Land Cover**: California Chaparral (Chamise), California Coastal Scrub, California Coastal Scrub (Black Sage), California Coastal Scrub (Brittle Bush), California Coastal Scrub (Brittlebush), California Coastal Scrub (Bush Penstemon), California Coastal Scrub (Bush Poppy), California Coastal Scrub (California buckwheat), California Coastal Scrub (California Juniper), California Coastal Scrub (California sagebrush), California Coastal Scrub (Chamise), California Coastal Scrub (Deerweed), California Coastal Scrub (Laurel Sumac), California Coastal Scrub (Prickly Pear), California Coastal Scrub (Toyon), California Coastal Scrub (White Sage), California Coastal Scrub (Yerba Santa), Great Basin-Intermountain Xeric-Riparian Scrub, and North American Warm-Desert Xeric-Riparian Scrub; **AND**
- **Elevation**: 700–2,500 feet.

Current Occupied Habitat

- Current Occupied Habitat are areas with a 100-foot buffer around known current occurrences within Potentially Suitable Habitat.

Historic Occupied Habitat

- Historic Occupied Habitat are areas with a 100-foot buffer around known historic occurrences, outside of Current Occupied Habitat, within Potentially Suitable Habitat.

Taxonomy and Genetics

This species was first described as *Centrostegia leptoceras* in 1870 and was then published as *Chorizanthe leptoceras* in 1877. The original name is the name under which the species was listed by state and federal agencies. Taxonomists changed the name to the current name *Dodecahuma leptoceras* in 1989 based on its morphological and phylogenetic distinctiveness (IPNI 2014, USFWS 2010a). Genetic diversity is high for the entire population; however, this is due to the population in Los Angeles, which is genetically distinct from populations in Riverside and San Bernardino Counties (USFWS 2010a). Despite differences in population sizes between locations, Ferguson and Ellstrand (1999) found that there was no evidence of lack of genetic diversity or homozygosity within locations. Plants are mostly outcrossing but are also self-fertile.

Life History and Demography

This spineflower is an annual herb. The involucre number per individual varies and depends on climactic and genetic factors and has been observed to range from 1 to 169 involucres (USFWS 2010a). The typical arrangement is three flowers per involucre, one fruit per flower, and one seed per fruit (Reveal 2005).

Pollination and Seed Dispersal

Information and studies about pollination are limited on this species. Spineflower is thought to be pollinated by various small insects (USFWS 2010a). The single-seeded fruits are located in involucres with hooked spines that may attach to wildlife for dispersal. Seeds are glabrous with no dispersal mechanisms of their own (Reveal 2005).

Seasonal Phenology

This species typically germinates with a 6 to 52% survival rate in February (USFWS 2010a, Ferguson and Ellstrand 1999). The blooming period generally occurs between April and June (CNPS 2020) (Table 3-16). Seed banks are known to occur with this species and are relatively long-lasting, which helps maintain demographics and genetic diversity of the species in dry years (Ferguson and Ellstrand 1999). Within each population there are often wide fluctuations in population size due to seasonal rainfall (USFWS 2010a).

Table 3-16. Phenology of Slender-Horned Spineflower

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Blooming												
Fruiting												

Sources: CNPS 2014, USFWS 2010a

Threats and Special Management Considerations

The primary threat is habitat modification or destruction from development, mining, proposed flood control measures and other hydrology alteration, off-highway vehicles, illegal dumping, and invasive nonnative species. The USFWS also cites inadequacy of state and local plans to fully protect this species, specifically attributing this to discretionary impacts that are allowed by state and local laws, and to the fact that most populations of this species do not occur on protected or otherwise conserved lands. Other general threats include climate change, sand and gravel mining, off-highway vehicles, invasive plants, herbivory, and the small population size present at each location (CNPS 2020, USFWS 2010a). The slender-horned spineflower is also affected by groundwater management and merits consideration by Groundwater Sustainability Agencies under the Sustainable Groundwater Management Act; however, specific threats to this species from groundwater changes have not been assessed (Rohde et al. 2019).

Santa Ana River Woolly-Star (*Eriastrum densifolium* ssp. *sanctorum*)

Current Status and Distribution

The Santa Ana River woolly-star (*Eriastrum densifolium* ssp. *sanctorum*) is federally listed as endangered, California listed as endangered, and on the California Rare Plant Rank list. All 27 known occurrences are highly restricted to the Santa Ana River complex, occurring along Santa Ana River, Mill Creek, Lytle Creek, Plunge Creek, and Cajon Creek. Most known occurrences are in San Bernardino County, and the remaining extant occurrences are in Riverside County (USFWS 2010b, CNPS 2014). All known occurrences are within the Planning Area.

Habitat Affinities

This species is found on the alluvial terraces of open floodplains in chaparral or coastal scrub with intermittent flooding, light surface disturbance, on south- to west- facing aspects, and relatively low cover of annuals or perennials in areas with nutrient-poor sands between 885 and 2,625 feet in elevation (CNPS 2020, DeGroot 2016). It is most competitive in early stage habitats with 97% or greater sand particles, but can also compete with other species in moderate stage habitats with 90–97% sand particles. Woolly-star is a pioneer plant that is often outcompeted in more stable shrubby ecosystems (USFWS 2010b). This habitat type is transient in nature and is an early to mid-successional stage, which requires disturbance to maintain over a large scale.

Distribution of Habitat and Occurrences in the Planning Area

Distribution of Santa Ana River woolly-star habitat and occurrences in the Planning Area are illustrated on Figure 3-25. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Potentially Suitable Habitat

- **Land Cover**: Californian Coastal Scrub, Great Basin-Intermountain Xeric-Riparian Scrub, North American Warm-Desert Xeric-Riparian Scrub, and Water – Seasonal (except within existing groundwater recharge basins); **AND**
- **Soil Texture**: sand, loamy sand, coarse sand, and loamy fine sand, **AND**

- **Elevation**: 0–2,100 feet.
- **Post-processing**: Excludes existing groundwater recharge basins and areas of the Devil's Creek, Etiwanda Fan, and Jurupa Hills that are known to be out of the species range.

Taxonomy and Genetics

This taxon was originally described as *Hugelia densiflorum* and changed to *Eriastrum* in 1945. Currently five total subspecies are described for this species (IPNI 2014). This species is also thought to hybridize with other subspecies, namely the subspecies *elongatum* around Cajon Creek and Lytle Creek, and the subspecies *austromontanum* in Lytle Creek and La Cadeña Drive (USFWS 2010b).

Life History and Demography

This species is a perennial subshrub and typically lives for 5 years, but some individuals are known to live for 10 years (USFWS 2010b). Each head typically produces 4 to 30 flowers, each flower has 1 fruit (a capsule), and each fruit has 6 to 33 seeds (De Groot 2014). Seeds germinate with the first major fall rainfall, and few seeds remain in the seed bank (USFWS 2010b).

Pollination and Seed Dispersal

Santa Ana woolly-star is self-incompatible and an obligate outcrosser. Primary pollinators vary with location and include the giant flower-loving fly (*Rhaphiomida acton* ssp. *acton*), the sphinx moth (*Hyles lineata*), two bee species (*Micranthophora flavocinata* and *Bombus californicus*) and two hummingbirds (black-chinned hummingbird [*Archilochus alexandri*] and Anna's hummingbird [*Calypte anna*]). Seeds have a smooth surface morphology with a coating that becomes mucilaginous on contact with water and attaches the seed to the soil. Most seeds drop within a foot of the plant, but some stay in the capsule, which can remain on the plant for several years. Seeds and capsules can be transported longer distances by floodwater (USFWS 2010b).

Seasonal Phenology

Blooming typically occurs between April and September but is most heavy in June (CNPS 2014) (Table 3-17). Fruiting typically occurs between mid-July and mid-October (USFWS 2010b).

Table 3-17. Phenology of Santa Ana River Woolly-Star

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Blooming												
Fruiting												

Sources: CNPS 2014, USFWS 2010b

Threats and Special Management Considerations

The primary threat to Santa Ana River woolly-star is habitat alteration resulting from development, mining, hydrologic changes (specifically those resulting from operation of the Seven Oaks Dam), grading for flood control, and off-highway vehicle activity. USFWS cites the inadequacy of state and local plans to fully protect this species, specifically in that discretionary impacts are allowed by state and local laws, and most occurrences are not on conserved lands. More broadly, climate change and

hybridization at one-third of the known locations could threaten this species (USFWS 2010b). The Santa Ana River woolly-star is also affected by groundwater management and merit consideration by Groundwater Sustainability Agencies under the Sustainable Groundwater Management Act; however, specific threats to this species from groundwater changes have not been assessed (Rohde et al. 2019).

Delhi Sands Flower-Loving Fly (Rhaphiomidas terminatus abdominalis)

Current Status and Distribution

The Delhi Sands flower-loving fly (*Rhaphiomidas terminatus abdominalis*) is federally listed as endangered. It is a subspecies endemic to the Colton Dunes Ecosystem of Southern California and is only known to occur in Riverside and San Bernardino Counties, with most of the occupied habitat located within a limited area of southwestern San Bernardino County (USFWS 2008).

Habitat Requirements

The characteristic feature of this species' occupied habitat is fine wind-blown sandy soils, often wholly or partly within sand dunes stabilized by sparse native vegetation. Plant species in the Colton Dunes include California buckwheat, California croton, deerweed, telegraph weed, and California evening primrose. Adults do not appear to use areas of dense vegetation. The fly can utilize Delhi sands in moderately disturbed areas such as abandoned vineyards or grazed lands (USFWS 1997). Larvae can be found within relatively moist soil several feet below the soil surface (Osborne and Ballmer pers. comm).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of Delhi Sands flower-loving fly habitat and occurrences in the Planning Area are illustrated on Figure 3-26. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Potentially Suitable Habitat

- **Land Cover**: All land cover types except Developed and Agriculture; **AND**
- **Soil Component Name**: Delhi Sands.

Potentially Suitable Habitat (Extirpated)

- Potentially suitable habitat that is within the USFWS Ontario Recovery Unit.

Taxonomy and Genetics

Taxonomic studies have shown that the genus Rhaphiomidas (giant flower-loving flies) belongs in the family Mydidae (no common name) (Cazier 1985), and, as a result, some researchers believe that the Delhi Sands flower-loving fly name should be changed to the Delhi Sands giant flower-loving fly (USFWS 2008).

Reproduction

Delhi sands flower-loving fly undergoes a complete metamorphosis from egg to larva to pupa to adult. Oviposition (egg-laying) occurs within loose, sandy soils in the late summer (Kingsley 1996). Eggs are placed 1 to 2 inches beneath the surface of the sand (Rogers and Mattoni 1993). Larval stages develop completely underground and emerge as adults from July through September (Mattoni and Ballmer 1998).

Dispersal, Territoriality, and Home Range

Dispersal distances, territorial behavior, and home range sizes have not been documented.

Daily and Seasonal Activity

This species is very difficult to observe because only the adult/flying stage occurs above ground between July and September (Table 3-18). Adults are most active during the warmest sunniest parts of the day (USFWS 2008). Larvae are capable of indeterminate development, molting two to three times per year for at least 3 years prior to pupation (Osborne and Ballmer pers. comm).

Table 3-18. Seasonal Activity of Delhi Sands Flower-Loving Fly

Life Stage/Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult Flight Season (breeding)												

Sources: USFWS 1997, USFWS 2008

Diet and Foraging

Both males and females extract nectar from California buckwheat and other plants. It is not clear if nectar feeding is essential for adult survival or reproduction (Kingsley 1996).

Threats and Special Management Considerations

The primary threat to the Delhi Sands flower-loving fly is loss of habitat, habitat degradation, and habitat fragmentation (USFWS 2008). Activities that result in habitat degradation include grading, plowing, disking, and off-highway vehicle use. Occupied sites have become increasingly isolated by surrounding development. Exotic invasive plants also degrade suitable habitat by increasing the vegetation cover or by altering soil conditions through dune stabilization and changes to soil moisture conditions (Western Riverside County MSHCP Biological Monitoring Program 2011).

Currently, there are only three known populations where management must be focused. The Slover/Pepper population is located east of Riverside Avenue, south of I-10, north of the Santa Ana River, and west of the cement plant. This population is partially protected through the establishment of the 7.5-acre Colton Transmission Facility Reserve and the 150-acre Vulcan Materials, Inc., Colton Dunes Conservation Bank. These conserved sites are surrounded by additional undeveloped Delhi Sands flower-loving fly habitats that are currently not protected but are needed to provide adequate protection for this population. A second population is located at Pepper Avenue adjacent to I-10 and the Pepper Avenue on- and off-ramps, which is an area partially protected with Hospital Reserve; additional habitat in this area would need to be protected to sustain a robust population (Osborne 2016a, 2106b). The third population is the Jurupa Hills population located in the City of Fontana, south of I-10, which has been adequately protected with conservation of 52 acres of Delhi Sands flower-loving fly habitat. There are no other conserved sites that are large enough and adequately

managed to support a Delhi Sands flower-loving fly population. In 2005, USFWS estimated that approximately 2,826 acres of potential Delhi Sands flower-loving fly habitat remains (USFWS 2008).

Santa Ana Sucker (Catostomus santaanae)

Current Status and Distribution

The Santa Ana sucker (*Catostomus santaanae*) is federally listed as threatened and is a California Species of Special Concern. Listed populations occur in the Santa Ana and San Gabriel Rivers and Big Tujunga Creek (USFWS 2009a). In the Santa Ana River, the species' range is officially from the Weir Canyon drop structure downstream of the Prado Dam all the way upstream to the La Cadena drop structure, and suitable habitat extends between Van Buren Boulevard in the Jurupa Valley downstream to the RIX outfall (Figure 3-27). The highest abundance of Santa Ana sucker are usually concentrated from immediately downstream of the RIX facility discharge to approximately Riverside Avenue (Palenscar 2014).

Habitat Requirements

Santa Ana sucker is most abundant in unpolluted, clear water, at temperatures that are typically less than 72°F (Moyle 2002). Optimal stream conditions include coarse substrates (e.g., gravel, cobble, boulders), a combination of shallow riffles and deeper pools with algae present, and consistent flow (USFWS 2011,; Palenscar 2014). Adults prefer deeper habitats such as pools and runs and utilize streams with gravelly substrates for spawning; juveniles occupy primarily riffle habitats (Haglund et al. 2010, Paramo et al. 2013). No sucker have been found in reaches with greater than 7% gradient (USFWS 2010c), and sucker rarely use habitat with less than 10% gravel and cobble substrate (USFWS 2010c, Thompson et al. 2010). In-stream or bank habitat with riparian vegetation providing shade is important for larvae and juveniles as are tributary habitat inflows that create refugia (USFWS 2011). Sucker tolerate reduced flows and elevated temperatures in the summer months, and turbid conditions associated with high flows that typically occur during winter months (Moyle 2002). The USFWS description of critical habitat *Physical and Biological Features* includes a functioning hydrological system that provides sources of water and coarse sediment necessary to maintain all life stages, including adults, juveniles, larvae, and eggs (Moyle 2002, USFWS 2010c).

Distribution of Habitat and Occurrences in the Planning Area

The existing distribution of sucker habitat in the Planning Area is based on habitat suitability modelling, intensive annual surveys for sucker and other fish annually on the Santa Ana River (USGS surveys described below), surveys assessing the availability of suitable gravel and cobble substrate (Riverwalk surveys described below), and the distribution of designated critical habitat. The distribution of modeled habitat and occurrences are shown on Figure 3-27 along with sucker occurrences and designated critical habitat. Occurrence data comes from the sources listed in Table 3-12 above, including the USGS Annual Fish Survey Data 2015–2019 (Wulff et al. 2020). Habitat suitability modelling for Santa Ana sucker is described later in this section.

USGS Annual Fish Surveys

The San Bernardino Valley Municipal Water District has employed the services of the USGS to conduct native fish surveys in the Santa Ana River on an annual basis since 2015. The USGS also collects physical habitat data in the same reaches where native fish surveys are carried out. Physical

habitat survey data collection includes information related to channel morphology, flow rate, substrate type, and streamside vegetation. The focus of the USGS effort is centered on the native fish census; therefore, the survey area is limited in geographic scope to areas where native fish are typically encountered. The survey area includes from the Rialto Channel, in Colton, downstream along the Santa Ana River to the vicinity of the river's confluence with the Anza Creek, in the City of Riverside.

Riverwalk Annual Channel Morphology Surveys

The Riverwalk is a volunteer based aquatic habitat survey that takes place on an annual basis along an 18-mile stretch of the Santa Ana River. The first Riverwalk occurred in 2006. Data is collected at the same point each year in October from the Rialto Channel confluence with the river, in Colton, downstream to I-15, in Norco, in an effort to inform the quantity, quality, and distribution of suitable habitat for the Santa Ana sucker. Basic channel morphology, substrate, and streamside vegetation information is collected at predetermined cross-section transects. The size and location of gravel bars is also noted wherever they are encountered within the river.

Santa Ana Sucker Critical Habitat

The upper reaches of the mainstem Santa Ana River and tributaries City Creek and Mill Creek are designated as critical habitat for the Santa Ana sucker (75 *Federal Register* 77962). The species does not currently occur in these reaches because they are dry except following significant rain events; however; they are essential sources of coarse sediment (gravel and cobble) that are transported to the occupied lower reaches of the Santa Ana River. Channel maintenance flows are necessary to maintain the balance of sediment transport and deposition in the stream system, and this includes continued transport of coarse sediment from the tributaries containing a supply of coarse sediment to reaches lower in the system.

Habitat Suitability Criteria for Habitat Distribution Modeling

The amount of suitable habitat for the Santa Ana sucker in occupied reaches of the Santa Ana River was predicted using an approach that incorporated components of the USFWS Instream Flow Incremental Methodology (IFIM) (Bovee et al. 1998) and Physical Habitat Simulation System (PHABSIM) (Milhous & Waddle 2012) methodologies. The Santa Ana sucker habitat suitability model predicts the amount of suitable habitat available at various flows using water velocity and water depth to map the distribution of suitable depth and velocity conditions. A detailed description of this approach and the results are included in Appendix E, *Santa Ana Sucker Habitat Suitability Analysis*.

The area is considered suitable habitat if it meets these depth and velocity conditions and has an average of 10% or greater cobble and gravel substrate as indicated by previous research on Santa Ana sucker habitat preference (Thompson et al. 2010). The channel bottom substrate data was derived from the Riverwalk surveys described above (including 12 years of data from 2006 to 2018). The methodology was developed in coordination with a technical advisory committee that consisted of representatives from resource agencies, nongovernmental organizations, and academic institutions.

While there are other elements of the sucker habitat that could have been included to predict the distribution of suitable habitat (e.g., riparian cover type and amount), the depth and flow velocity are the habitat features most easily measured and integrated into a hydrology model in the context

of the IFIM/PHABSIM approach, and amount of coarse substrate has been annually surveyed since 2006. Furthermore, many of the Covered Activities evaluated by this HCP are directly affecting the flow velocity and depth such that these effects can be included in the model to analyze the effects of these Covered Activities (see Chapter 4).

The habitat suitability data come from intensive surveys conducted by USGS on the Upper Santa Ana River (Wulff et al. 2018). Wulff et al. (2018) provided raw suitability scores for depth and water velocity. These suitability scores were based on direct observations of Santa Ana sucker habitat use over two field seasons in the Santa Ana River in the Planning Area. For this habitat distribution model the suitability scores for Santa Ana sucker habitat preferences (depth and velocity) from 2 years of data collection were combined and the higher of the values for each year was used. When calculating depth suitability, maximum values presented an appropriate use curve (Figure 3-28). However, the data on velocity values was noisy and varied between field seasons. For the purposes of estimating an appropriate velocity suitability curve, maximum values were selected for peaks and median values were inferred for valleys. This resulted in a smoother curve that is more likely to approximate the true velocity preference of the species (Figure 3-29).

A habitat suitability matrix for water depth and velocity was created by multiplying the velocity suitability scores by the depth suitability scores derived from Wulff et al. (2018). Combined suitability scores greater than 0.50 were considered to represent habitat with suitable velocity and depth, while scores less than 0.50 represent unsuitable habitat, as is consistent with the IFIM/PHABSIM approach (Table 3-19). An assumption supporting this criteria is that flow velocities greater than 1.2 feet per second result in decreased sand deposition and the maintenance of coarser substrates on which the Santa Ana sucker is dependent (based on field observations of reaches of the Santa Ana River occupied by Santa Ana sucker; ESA 2015).

Table 3-19. Santa Ana Sucker Depth by Velocity Habitat Suitability Matrix

	Velocity (feet/second)	**0.66**	**1.31**	**1.97**	**2.62**	**3.28**	**3.94**	**4.59**	**5.25**	**5.91**
Depth (feet)	Habitat Suitability Index	0.09	0.62	0.81	1.00	0.96	0.93	0.90	0.03	0.00
0.33	0.08	0.01	0.05	0.06	0.08	0.08	0.07	0.07	0.00	0.00
0.66	0.09	0.01	0.06	0.07	0.09	0.09	0.08	0.08	0.00	0.00
0.98	0.26	0.02	0.16	0.21	0.26	0.25	0.24	0.23	0.01	0.00
1.31	0.74	0.07	0.46	**0.60**	**0.74**	**0.71**	**0.69**	**0.67**	0.02	0.00
1.64	1.00	0.09	**0.62**	**0.81**	**1.00**	**0.96**	**0.93**	**0.90**	0.03	0.00
1.97	1.00	0.09	**0.62**	**0.81**	**1.00**	**0.96**	**0.93**	**0.90**	0.03	0.00
2.30	1.00	0.09	**0.62**	**0.81**	**1.00**	**0.96**	**0.93**	**0.90**	0.03	0.00
2.62	1.00	0.09	**0.62**	**0.81**	**1.00**	**0.96**	**0.93**	**0.90**	0.03	0.00
2.95	1.00	0.09	**0.62**	**0.81**	**1.00**	**0.96**	**0.93**	**0.90**	0.03	0.00
3.28	1.00	0.09	**0.62**	**0.81**	**1.00**	**0.96**	**0.93**	**0.90**	0.03	0.00
3.61	1.00	0.09	**0.62**	**0.81**	**1.00**	**0.96**	**0.93**	**0.90**	0.03	0.00
3.94	1.00	0.09	**0.62**	**0.81**	**1.00**	**0.96**	**0.93**	**0.90**	0.03	0.00

Combined Suitability Index Range	Combined Depth and Velocity
0–.49	Not Suitable
0.50–1.00	**Suitable**

ft/s = feet per second

Modelling the Distribution of Suitable Habitat

The modeling of suitable depth and velocity conditions was performed at seven different assessment sites by applying the Santa Ana sucker habitat suitability criteria to the flow depths and flow velocities modeled in a Two-Dimensional Sedimentation and River Hydraulics model (2D hydraulic model) that was developed for the HCP. Six of the sites are located on the Santa Ana River, from just downstream of the RIX discharge outfall (ESA Upper Reach) to the downstream site (3A) located near Prado Basin Park downstream of I-15. One site is located on the Rialto Channel downstream of the Rialto discharge outfall (see mapped locations on Figure 3-30). The total assessed channel length from the Rialto Channel to the downstream end of the Santa Ana River near Prado is 21.1 miles.

The 2D hydraulic model requires an elevation surface of channel and floodplain elevations. Elevations outside of the low-flow channel were obtained from 2015 LiDAR. All of the assessment sites have perennial flow and thus require bathymetric data of the low-flow channel to supplement the 2015 LiDAR data because LiDAR does not capture underwater elevations. Bathymetry data was available for four of the sites from studies conducted in 2015 (ESA Upper Reach, ESA Middle Reach, ESA Lower Reach, and USGS Reach 9) (ESA 2015, Wright and Minear 2019). New bathymetry surveys were conducted at Reach 3, Reach 3A, and Rialto Reach in 2017. Model elevation surfaces made from the combined bathymetry and LiDAR sources have nodes spaced typically around 3 feet from each other.

A series of flows were modeled for each site that span the range of low flows that typically occur at the sites. The model output for each model node along the continuous 2D modeling surface was queried to assess the combination of depth and velocity at each node. For each modeled flow, calculations were performed to determine the percentage of wetted area in which the combination of depth and velocity values are within the sucker habitat "suitable" range shown in the combined habitat suitability matrix in Table 3-19.

Table 3-20 summarizes the amount of suitable depth and velocity determined for all seven of the 2D hydraulic model assessment sites. The table lists the August through October 95% exceedance flow (i.e., base flow conditions, or statistically the flow in the channel is equal to or greater than this magnitude 95% of the time from August through October) for the existing hydrology condition (also shown on Figure 3-31). The months of August through October were selected because these are typically the 3 months of the year with the lowest flows and thus allow for habitat assessment under limiting flow conditions when habitat suitability is likely the lowest it will be for the year. Figures 3-32 through 3-38, show the resulting mapping of suitable depth and velocity for each of the seven assessment sites.

Table 3-20. Summary of Hydrologic Model Characteristics by Santa Ana Sucker Habitat Modeling Site (Upstream to Downstream)

Hydrologic Model Characteristic	Rialto Channel	ESA Upper	USGS Reach 9	ESA Middle	ESA Lower	SAR Site 3	SAR Site 3a
Low Flow Channel Length (feet)	507	1,132	975	1,195	1,048	1,032	1,099
Reach Average Bed Slope (percent)	0.77	0.32	0.39	0.36	0.38	0.25	0.24
Existing Condition Aug–Oct 95% Exceedance Flow (cfs)	9.2	49.0	49.0	31.1	31.1	87.4	63.6
Average Modeled Wetted Channel Width under Existing Condition Aug–Oct 95% Exceedance Flow (feet)	14	26	35	24	40	84	81
Area of Suitable Depth and Velocity under Existing Condition Aug–Oct 95% Exceedance Flow (acres)	0.006	0.202	0.110	0.071	0.012	0.107	0.045
Unit Area of Suitable Depth and Velocity under Existing Condition Aug–Oct 95% Exceedance Flow (acres/1,000 feet of channel length)	0.011	0.179	0.112	0.059	0.011	0.103	0.041
Suitable Depth and Velocity as percent of Total Channel Wetted Area under Existing Condition Aug–Oct 95% Exceedance Flow (percent)	3.3	30.3	14.2	11.0	1.2	5.3	2.2

cfs = cubic feet per second

The process for using the results from the individual assessment sites to interpolate suitability for the entire 21.1-mile long study reach (starting at the Rialto Outfall and extending down the Rialto Channel and then down the Santa Ana River to Prado) is described in Appendix E. The acreage of habitat with suitable depth and velocity, in acres per 1,000 feet of channel length, over the 21.1-mile long study reach is illustrated on Figure 3-39.

There are 110 transects along this 21.1-mile portion of the river that have been surveyed annually from 2006 to 2018 to quantify the amount of coarse substrate (gravel and cobble) along with several other habitat features. The mean percent of gravel and cobble over this 12-year period was calculated. When multiple transects occurred between model nodes the average of the means was taken. Areas were determined to be suitable habitat when the depth and velocity was suitable and the proportion of cobble and gravel substrate was greater than 10% (USFWS 2010c). Table 3-21 shows the acres in each reach meeting all three criteria (depth, velocity, and substrate). The sum of all the predicted suitable habitat meeting these criteria over the 21.1-mile long study reach is 2.15 acres.

Table 3-21. Acres of Existing Santa Ana Sucker Modeled Habitat in the Planning Area

Reach Description[1]	Hydro Model Node[1]	Reach Length (feet)	Acres of Area with Suitable Depth and Velocity per 1,000 feet	Acres of Area with Suitable Depth and Velocity	Suitable Habitat (>10% Gravel/Cobble Substrate per Riverwalk Surveys[2])
Reaches with Suitable Substrate (>10% Gravel/Cobble)					
Rialto Channel DS of Rialto outfall	NFRC-06	1,705	0.01	0.019	Suitable (55.2%)
SAR DS Rialto Channel & US RIX outfall	NSAR19	1,141	0.00	0.000	Suitable (51.1%)
SAR DS RIX outfall & US Riverside Ave (@ ESA Upper model site)	NSAR20	6,865	0.13	0.910	Suitable (67.6%)
SAR DS Riverside Ave & US node NSAR 22	NSAR21	3,242	0.09	0.279	Suitable (59.2%)
SAR DS node NSAR 22 & US Market St	NSAR22	5,624	0.08	0.425	Suitable (44.2%)
SAR DS Market St & US Hwy 60	NSAR23	1,576	0.06	0.093	Suitable (34.1%)
SAR DS Hwy 60 and US node NSAR 232	NSAR231	1,804	0.06	0.106	Suitable (27.8%)
SAR DS Hwy 60 & US Mission Blvd (@ ESA Middle model site)	NSAR232	4,000	0.06	0.236	Suitable (24.7%)
SAR DS Mission Blvd & US node NSAR 241 (@ ESA Lower model site)	NSAR24	5,679	0.01	0.064	Suitable (20.7%)
SAR DS node NSAR 241 & US node NSAR 242 (Tequesquite Arroyo reach)	NSAR241	7,883	0.00	0.016	Suitable (10.8%)
Total Suitable Habitat				**2.15**	
Reaches without Suitable Substrate (>90% Sand/Silt)					
SAR DS node NSAR 242 & US node NSAR 243	NSAR242	1,842	0.00	0.004	Not Suitable (7.0%)
SAR Anza Creek reach	NSAR243	1,826	0.00	0.004	Not Suitable (8.9%)
SAR DS of Anza Creek/railroad bridge & US pipeline crossing	NSAR244	3,703	0.00	0.008	Not Suitable (6.9%)
SAR DS of pipeline crossing & US RWQCP	NSAR25	4,700	0.02	0.114	Not Suitable (4.6%)
SAR DS of RWQCP & US of Van Buren Blvd	NSAR26	1,305	0.02	0.022	Not Suitable (5.3%)
SAR DS Van Buren Blvd (Hole Creek reach)	NSAR27	1,647	0.12	0.190	Not Suitable (9.2%)
SAR DS node NSAR 28 & US node NSAR 29	NSAR28	1,777	0.11	0.197	Not Suitable (6.6%)

Reach Description[1]	Hydro Model Node[1]	Reach Length (feet)	Acres of Area with Suitable Depth and Velocity per 1,000 feet	Acres of Area with Suitable Depth and Velocity	Suitable Habitat (>10% Gravel/Cobble Substrate per Riverwalk Surveys[2])
SAR DS node NSAR 29 & US node NSAR 30	NSAR29	1,010	0.11	0.107	Not Suitable (4.3%)
SAR DS node NSAR 30 & US node NSAR 301	NSAR30	2,990	0.10	0.306	Not Suitable (3.8%)
SAR DS node NSAR 301 & US node NSAR 31	NSAR301	7,793	0.10	0.741	Not Suitable (5.1%)
SAR DS node NSAR 31 & US node NSAR 311 (San Antonio Creek reach)	NSAR31	1,493	0.08	0.119	Not Suitable (3.9%)
SAR DS node NSAR 311 & US node NSAR 32	NSAR311	1,900	0.07	0.140	Not Suitable (4.3%)
SAR DS node NSAR 32 & US node NSAR 321	NSAR32	4,855	0.07	0.342	Not Suitable (2.4%)
SAR DS node NSAR 321 & US node NSAR 33 (Day Creek reach)	NSAR321	2,968	0.07	0.195	Not Suitable (1.1%)
SAR DS node NSAR 33 & US node NSAR 331	NSAR33	4,953	0.05	0.261	Not Suitable (1.6%)
SAR DS node NSAR 331 & US node NSAR 332	NSAR331	3,354	0.05	0.154	Not Suitable (0.9%)
SAR DS node NSAR 332 & US node NSAR 34 (I-15)	NSAR332	1,724	0.04	0.074	Not Suitable (0.1%)
SAR DS node NSAR 34 (I-15) & US node NSAR 35	NSAR34	1,388	0.04	0.058	Not Suitable (0.8%
SAR DS node NSAR 35 & US node NSAR 351	NSAR35	2,064	0.04	0.086	Not Suitable (0.8%)
SAR DS node NSAR 351 & US node NSAR 352	NSAR351	11,399	0.04	0.474	Not Suitable (0.7%)
SAR DS node NSAR 352 & US node NSAR 36 (entrance into Prado)	NSAR352	7,293	0.04	0.303	Not Suitable (0.0%)

[1] Defines upstream boundary of reach: DS=downstream, US=upstream; NSAR = node Santa Ana River, an identifier from the Wildermuth hydrology model ; RWQCP = Regional Water Quality Control Plant.
[2] Average percent gravel/cobble substrate within reach.

Taxonomy and Genetics

Santa Ana sucker is closely related to mountain suckers. The species was originally described as *Pantosteus santaanae*. Subsequently, the genus was reduced to subgenus *Catostomus*. Santa Ana sucker exhibits higher variability in anatomical characteristics than other members of the subgenus *Pantosteus*. Santa Ana suckers hybridize with introduced Owens sucker (*Catostomus fumeiventris*) in Santa Clara River (Moyle 2002). Richmond et al. (2017) studied the metapopulation structure in Santa Ana sucker using microsatellites and mitochondrial DNA sequence data, finding that only the

population on the Santa Clara River upstream of Piru Gap is free of genetic input from *C. fumeiventris*.

Reproduction

Santa Ana sucker become reproductively mature by the first year and spawn during the first and second years (Moyle et al. 1995). Spawning takes place over gravelly riffles (Moyle 2002). Eggs are demersal and adhesive and hatch in 3 days at 55°F (Moyle 2002). Fecundity is high for a small sucker species and increases with size (Greenfield et al. 1970, Moyle 2002). Sucker are able to recolonize suitable habitat rapidly due to high reproductive rates from short generation time, high fecundity, and long spawning period (Moyle 2002, Moyle et al. 1995).

Dispersal, Territoriality, and Home Range

Santa Ana sucker is limited by dams or other impassable structures that preclude further upstream dispersal or migration (i.e., Prado Dam and La Cadena drop structure) in the Santa Ana River (USFWS 2011). The species is highly adaptable to periodic flooding that occurs in Southern California; high reproductive rates allow for recolonization of suitable habitat (Moyle 2002). Territoriality and home range are undocumented.

Daily and Seasonal Activity

Santa Ana sucker spawning occurs mid-March to early July, with peak activity in April (Moyle 2002) (Table 3-22). In the Riverside-Corona Resource Conservation District captive populations, spawning has occurred in February, with larval fish present in early March.

Table 3-22. Seasonal Activity of Santa Ana Sucker

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spawning												

Source: Moyle 2002

Diet and Foraging

Algae, diatoms, and detritus make up 98% of the diet of young Santa Ana sucker, scraped from coarse substrate with a subterminal mouth. Aquatic insects are also prey as size increases (Greenfield et al. 1970). The Riverside-Corona Resource Conservation District has observed large adults taking insects from the surface on occasion.

Threats and Special Management Considerations

The primary threat to Santa Ana sucker is modification, fragmentation, and loss of habitat through hydrologic modifications (USFWS 2017b). Additional threats include ongoing negative trends in water quantity and quality through reduced availability of surface water; modification to stream processes through reduced flows inhibiting downstream transport of coarse sediments needed for habitat; spread of nonnative *Arundo donax* and other invasive plant species resulting in negative modification of habitat; and predation by nonnative fishes (bass, sunfish, carp, catfish, tilapia) (USFWS 2017b). Groundwater conditions that alter instream flows can also threaten habitat conditions for Santa Ana sucker, because such flows can result in cool water inflows and elevated

water temperatures that are less suitable for the species (Rohde et al. 2019). Ongoing drought conditions in the Santa Ana basin are exacerbating these threats. In addition, habitat degradation through the spread of the invasive exotic algae *Compsopogon coeruleus* is a recent threat because it forms dense mats, reducing foraging opportunities for the fish (Palenscar 2014). Re-appropriation of treated water that currently provides much of the available water supply for the species is a future threat (USFWS 2011).

Habitat availability has been greatly reduced in the Santa Ana River over the last 200 years because of ongoing (1) channelization, urban runoff, and other undocumented non-point source discharges negatively affecting water quality; and (2) water abstraction for human use reducing or eliminating in-stream flows (USFWS 2011). Habitat suitability in the Santa Ana River within currently occupied reaches is declining because of modified hydrologic processes that may have reduced coarse sediment transport to downstream occupied areas (Moyle 2002). Suitable habitat upstream of Seven Oaks Dam in the upper Santa Ana River, Plunge Creek, and City Creek are being assessed as potential reintroduction sites.

Other Relevant Information

In the Planning Area, suckers concentrate in tributaries or in sections of river that are fed by high-quality effluent from sewage treatment plants (Moyle 2002). Discharged treated effluent makes up the majority of the water present in the mainstem of the Santa Ana River during the dry summer months (USFWS 2011). Santa Ana sucker abundance is predominantly concentrated around the Regional Tertiary Treatment RIX discharge location to approximately Riverside Avenue. Concentrations of all age classes are at times present in the Rialto Drain, although habitat conditions are degraded due to multiple variables such as high summer water temperatures and high abundance of aquatic predator species. Critical habitat in the Planning Area is designated in the Santa Ana River from the Orange-San Bernardino County line to Greenspot Road, City Creek from its confluence with the Santa Ana River to the East-West City Creek fork, and Mill Creek from its confluence with the Santa Ana River to Valley of the Falls Drive.

Changes in flood flows below Seven Oaks Dam result in changes to sediment transport within the Santa Ana River Wash and reaches farther downstream. The operation of Seven Oaks Dam modifies the historic flow regime of the upper Santa Ana River. The reduction in peak flows has reduced both the amount and size of sediment that is transported downstream (USACE 2000), affecting the prevalence of course sediment as Santa Ana sucker habitat. Furthermore, the dam creates a discontinuity in sediment transport because it traps the bedload that is transported into Seven Oaks Reservoir, resulting in a reduction in sediment supply downstream.

Arroyo Chub (*Gila orcutti*)

Current Status and Distribution

The arroyo chub (*Gila orcutti*) is a California Species of Special Concern that is native to the streams and rivers of the Los Angeles basin, including the Los Angeles, San Gabriel, San Luis Rey, Santa Ana, and Santa Margarita Rivers (Moyle 2002). Distribution in the Santa Ana River is from Prado Dam upstream past Riverside Avenue, to the RIX and Rialto outflows, where surveys for Santa Ana sucker have documented incidental occurrences (Western Riverside County MSHCP 2012a). A number of tributary streams to the Santa Ana River are also occupied at times, dependent upon flow conditions and water quality, primarily in the Riverside area. This species is scarce in its native range because it

does best in lower gradient streams that have largely disappeared due to the degradation of urbanized streams near the Los Angeles metropolitan area (Swift et al. 1993).

Habitat Requirements

Arroyo chub is most common in slow-flowing or backwater area within warm to cool (50–75°F) streams with sand or mud substrates and a depth greater than 15 inches (Moyle et al. 1995, Swift et al. 1993). This species also occurs in fairly fast-moving streams with velocities over 31 inches per second or more, and in streams with coarse bottoms (CDFG 2010, Moyle 2002, Greenfield and Deckert 1973). The species can also tolerate intermittency and is adapted to survive in fluctuating streams and shift between fast-moving muddy streams in winter and clear intermittent brooks in summer. Arroyo chub can also survive in hypoxic (low oxygen) conditions and in fluctuating temperatures (Western Riverside County MSHCP 2012a).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of arroyo chub habitat and occurrences in the Planning Area are illustrated on Figure 3-40. The known occupied habitat and potentially suitable habitat was mapped directly by species experts based upon habitat preference criteria, documented occurrences, and existing conditions in the Planning Area. There are 181.4 acres of aquatic habitat downstream of Covered Activities, which was estimated based on the acreage of wetted area calculated by the HCP Hydrology Model within occupied or suitable reaches. The low flow dry season (August to October) is when this habitat is most limited and when arroyo chub are most vulnerable to habitat loss. During the dry season there are approximately 3.7 acres of habitat with depths greater than 15 inches where arroyo chub would be most commonly found within the Planning Area.

Taxonomy and Genetics

Arroyo chub readily hybridize with California roach and Mojave tui chubs (Moyle 2002). This species is closely related to other Gila chub from the Southwest, including those found in the Colorado River (Simons and Mayden 1998). Arroyo chub shares the subgenus Temeculina with *Gila purpurea* from Mexico and southeastern Arizona (Western Riverside County MSHCP 2012a).

Reproduction

Females can reproduce at 1 year of age. Most spawning occurs in pools or in quiet wedge water at temperatures of 57–72°F (Moyle et al. 1995). Spawning takes place in pools and edge habitat from February to August, with a peak in June and July (Moyle 2002). Eggs are adhesive and are preferentially deposited on available submerged vegetation (Western Riverside County MSHCP 2003). Eggs typically hatch in 4 days, and the fry stay on the substrate for a few days before rising to the surface to stay among plants or other cover for approximately 3 to 4 months (Moyle et al. 1995, Moyle 2002).

Dispersal, Territoriality, and Home Range

Dispersal of arroyo chub is typically up- or down-river and depends on habitat availability and connectivity. The species will invade or re-invade downstream habitat from upstream or tributary spawning areas as it becomes available. On a broad scale, dispersal in the Santa Ana River is limited by Prado Dam and La Cadena drop structure. On a fine scale, upstream dispersal can often be limited

by natural and human-made barriers and drop structures (Western Riverside County MSHCP 2003). There is no documented information on this species' territorial behaviors or on home range size.

Daily and Seasonal Activity

Daily activity patterns are not documented widely for arroyo chub. Some behavior patterns have been documented in the Riverside-Corona Resource Conservation District captive population. Seasonally, spawning occurs from February through August (Table 3-23).

Table 3-23. Seasonal Activity of Arroyo Chub

Life Stage/Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spawning												

Source: Moyle 2002

Diet and Foraging

Arroyo chub feed on plants such as algae and water fern (*Azolla* spp.), and on invertebrates including insects and mollusks, depending on the availability (Moyle 2002). Arroyo chub are typically benthic feeders; however, individuals may also forage on drifting invertebrates when they are prevalent in the water column (Krug et al. 2012).

Threats and Special Management Considerations

Arroyo chub are threatened by habitat degradation from channelization, hardbank stabilization, and flood control projects that alter hydrologic conditions (i.e., decrease flow rate or remove backwater areas). These activities may also block movement by introducing impassable barriers to upstream movement. The species is threatened by habitat degradation through the spread of invasive plant species including giant reed (*Arundo donax*) and tamarisk (*Tamarix* spp.) (Moyle 2002, Western Riverside County MSHCP 2003). Arroyo chub can be displaced through competition with introduced exotic species such as red shiners (*Cyprinella lutrensis*) (Moyle 2002). Water quality degradation from urban runoff and in-stream discharges also negatively affects habitat quality (Western Riverside County MSHCP 2003).

Conservation management should include maintenance of connectivity through intermediate creek stretches to facilitate exchange between populations. Population exchange and subsequent gene flow is important for long-term persistence of the species. Perennial stream refugia should be protected from exotic plant and animal species known to negatively impact chub populations. Drop structures isolating populations from each other should be identified and assessed for possible removal. The species responds favorably to captive rearing, and can easily be re-introduced to create new populations. Because of this, unoccupied habitat that is suitable for the species, especially above impassable drop structures, but currently unoccupied should be considered for reintroduction opportunities (Moyle 2002, Western Riverside County MSHCP 2012a).

Santa Ana Speckled Dace (*Rhinichthys osculus*)

Current Status and Distribution

Santa Ana speckled dace (*Rhinichthys osculus*) is a California Species of Special Concern and historically occurred throughout the upland portions of the Los Angeles, Santa Ana, and San Gabriel

River systems, but currently only occurs in the headwaters of the Santa Ana and San Gabriel Rivers (Moyle et al. 1995). In the Planning Area this species is considered present in Lytle Creek, Cajon Creek, City Creek, and Plunge Creek (Pisces 2014). There are also occurrence records for Mill Creek and Strawberry Creek; however, Santa Ana speckled dace is now assumed to be extirpated from these streams (ICF International 2014, Pisces 2014). After significant winter flows, this species has been found in the mainstem Santa Ana River at the confluence of Warm Springs Creek and below the drop structure at La Cadena Drive; however, these sites are not perennially wetted (ICF International 2014, Russell pers. comm).

Habitat Requirements

Santa Ana speckled dace is found primarily in small perennial streams fed by cool springs that maintain summer water temperature below 68°F (Moyle 2002). This species can thrive in shallow (less than 24 inches), rocky riffles and runs with gravel and cobble substrates, which is optimal foraging habitat (Moyle 2002, Moyle et al. 1995). Numbers of dace may actually increase in streams that have been channelized or reduced in flow, providing more preferred riffle habitat (Moyle 2002). Overhanging vegetation is important for cover (Moyle et al. 1995). This species is often most abundant in streams where sculpins are absent, which compete for habitat and prey (Moyle 2002).

Distribution of Habitat and Occurrences in the Planning Area

The distribution of the Santa Ana speckled dace in the Planning Area is defined via miles of occupied reaches, documented occurrences, and wetted area in occupied reaches downstream of Covered Activities, and are illustrated on Figure 3-41. The known occupied habitat and potentially suitable habitat was mapped directly by species experts based upon habitat preference criteria, documented occurrences, and existing conditions in the Planning Area. This species is expected to be present in Fredabla Creek, downstream of the Plunge Creek confluence, Hemlock Creek, the North Fork of Lytle Creek, and Waterman Creek. Potential habitat exists in Strawberry Creek, East Twin Creek, and possibly Horsethief Creek (Pisces 2014, Russell pers. comm.). Only 0.01 acre of this aquatic habitat occurs downstream of Covered Activities based on the acreage of wetted area calculated by the HCP Hydrology Model within occupied or suitable reaches.

Taxonomy and Genetics

The genus *Rhinicthys* is distributed throughout North America and has eight recognized species. Species are highly variable and may encompass complexes of unrecognized species or subspecies. This species has not been formally described as a subspecies, but studies indicate that it is genetically distinct (Moyle 2002).

Reproduction

Santa Ana speckled dace spawn throughout the summer with peaks in activity in June and July, likely induced by rising water temperatures. Reproduction rates have not been measured, but are probably high due to the species' ability to recolonize or repopulate areas over a few seasons, when suitable habitat exists (Moyle 2002).

Dispersal, Territoriality, and Home Range

Santa Ana speckled dace has the ability to recolonize or repopulate areas if conditions become too extreme and local populations are greatly depressed by floods, droughts, or winter freezing.

Dispersal in the Planning Area is limited by available suitable habitat and by barriers to movement. Santa Ana speckled dace typically occurs in small groups while foraging and are seldom found singly; however, they avoid forming conspicuous shoals except during the breeding season (Moyle 2002).

Daily and Seasonal Activity

Santa Ana speckled dace may be active during the day or night, and activity may depend on vulnerability to avian predators. The species can be active year-round if the temperatures do not drop below 39°F, and spawning occurs March through July (Moyle 2002) (Table 3-24).

Table 3-24. Seasonal Activity of Santa Ana Speckled Dace

Life Stage/Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spawning												

Source: Moyle 2002

Diet and Foraging

In general, Santa Ana speckled dace forage as bottom-browsers on small invertebrates, especially those taxa found in riffles, such as insect larvae or nymphs (Moyle 2002, Pisces 2014). This species will also feed on filamentous algae (Pisces 2014). The species' diet varies with season and associated prey availability (Moyle 2002).

Threats and Special Management Considerations

Predominant threats to Santa Ana speckled dace include water diversion, urbanization of watersheds, introduction of nonnative species, habitat loss from wildfire, and habitat fragmentation. Where small populations do exist, this species is separated by dry washes most of the year and/or barriers that isolate them and make repopulation impossible. Other threats include recreational use that alters habitat or disturbs behavior, water quality degradation, and drought (Moyle et al. 1995).

Conservation management should include maintenance of connectivity through intermediate creek stretches to facilitate exchange between populations. Population exchange and subsequent gene flow is important for long-term persistence of the species. Perennial stream refugia should be protected from exotic plant and animal species known to negatively impact dace populations. Drop structures isolating populations from each other should be identified and assessed for possible removal. The species responds favorably to captive rearing and can easily be re-introduced to create new populations. Because of this, unoccupied habitat that is suitable for the species, especially above impassable drop structures, but currently unoccupied should be considered for reintroduction opportunities. Surveys are needed to better understand population abundance and trends in the Santa Ana River in the Planning Area. Water diversions that reduce in-stream flows and barriers to movement remain pervasive threats that isolate populations and threaten the species' existence (Moyle et al. 1995).

Arroyo Toad (Anaxyrus californicus)

Current Status and Distribution

The arroyo toad (*Anaxyrus* [*Bufo*] *californicus*) is federally listed as endangered and is a California Species of Special Concern. The known range for the arroyo toad in the Planning Area only occurs in San Bernardino County, where it occurs in the Upper Santa Ana River and Cajon Wash basins. It is also known to occur from the mouth of Cucamonga Canyon within and south of the San Bernardino National Forest (USFWS 2009b).

Habitat Requirements

Arroyo toad habitat includes shallow, slow-moving stream and riparian habitats that are naturally disturbed on a regular basis, primarily by flooding, including streams and washes with sandy banks free of dense vegetation with mature willow (*Salix* spp.) stands, cottonwoods (*Populus* spp.), western sycamore (*Platanus racemosa*), riparian habitats of semi-arid areas, and small cobble streambeds (USFWS 2009b). Areas of sandy or friable (readily crumbled) soils are the most important upland habitat for the species, and these soils can be interspersed with gravel or cobble deposits (USFWS 2005). USFWS description of critical habitat physical and biological features (PBFs) includes primary hydrologic regimes that supply water for space, food, and cover to maintain eggs, tadpoles, juveniles, and breeding adults, including low-gradient stream segments and alluvial streamside terraces. Groundwater conditions must support intermittent flows and persisting shallow pools into mid-summer; areas of open, sandy, and dynamic stream channels; and adjacent upland habitat (USFWS 2005, Rohde et al. 2019).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of arroyo toad habitat and occurrences in the Planning Area are illustrated on Figure 3-42. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Suitable Breeding Habitat

- An average width of 20 feet around specific selected streams mapped as breeding areas or within final critical habitat; **AND**
- **Land Cover**: Water – Intermittent (except within existing groundwater recharge basins); Water – Permanent (except within existing groundwater recharge basins); Water – Seasonal (except within existing groundwater recharge basins); Western North American Freshwater Aquatic Vegetation; Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland; Western North American Disturbed Marsh, Wet Meadow, and Shrubland; Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland; Great Basin-Intermountain Xeric-Riparian Scrub; North American Warm-Desert Xeric-Riparian Scrub; Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland; and Warm Southwest Riparian Forest.

Non-Breeding Upland Habitat

- Upland areas within a half-mile of Suitable Breeding Habitat (excluding developed, agriculture, disturbed).

Permeable Movement Area (Developed, Agriculture, Disturbed)

- Developed, agriculture, disturbed within a half-mile of Suitable Breeding Habitat.

Aquatic Habitat Downstream of Covered Activities

- There is 0.4 acre of habitat downstream of Covered Activities, which was estimated based on the acreage of wetted area calculated by the HCP Hydrology Model within reaches with suitable modeled habitat.

Taxonomy and Genetics

Arroyo toad was originally identified as part of the southwestern toad complex (*Bufo microscaphus*), and was considered a subspecies at original listing (*B. m. californicus*) (USFWS 1994). Recent genetic studies now place it in the genus *Anaxyrus* (Crother 2008).

Reproduction

Arroyo toad breeding occurs from late January or February to early July, although it can be extended in some years depending on weather conditions (USFWS 1999). Breeding in mountainous habitats characteristic of the Planning Area populations may commence later (May–June) and last longer (to August) than in the coastal portion of the range. Breeding sites are typically adjacent to sandy terraces (USFWS 1994); at or near the edge of shallow pools, low-flow stream channels, and ox-bows; and along in-stream sand bars with minimal current (0–2 kilometers [1.24 miles] per hour) and have little or no emergent vegetation.

Dispersal, Territoriality, and Home Range

The arroyo toad is capable of moving 0.3 to 1.3 miles into suitable adjacent habitats and may not be constrained by topography (USFWS 1999). In a study using pitfall traps, this species was captured in upland habitats averaging more than 980 to 1,640 feet from two coastal streams; one was captured 3,940 feet beyond the edge of the riparian habitat bordering the stream (Holland and Sisk 2001). Four separate studies of inland populations (Ramirez 2002a, 2002b, 2002c, 2003) showed that this species burrowed no farther than 1,062 feet from the edge of a stream, with an overall average of 52 feet between burrow locations and the edge of the stream. These larger movements may be associated with dispersal, as additional work has shown arroyo toads to have high site fidelity, moving less than 300 feet during the breeding season (Mitrovich et al. 2011).

Home range is influenced by rainfall amounts, availability of surface water, width of streamside terraces and floodplains, vegetative cover, and topography (Griffin et al. 1999, Ramirez 2000a). Females have been documented to use riparian and upland habitats an average maximum distance of 443 feet with a maximum of more than 984 feet perpendicular to streams, while males move an average maximum distance of 240 feet from streams. Within-stream movement was documented up to 492 feet. Juvenile dispersal is shown to be 0.5 to 0.6 mile (Sweet 1993).

Daily and Seasonal Activity

Arroyo toad is primarily nocturnal, though activity of neonates often extends throughout the day. Adult activity begins after the onset of fall rains and continues through the typical breeding period (January–August) (Table 3-25). The species enters aestivation during the non-breeding season (August–January) (USFWS 1999).

Table 3-25. Seasonal Activity of Arroyo Toad

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Breeding												

Source: USFWS 1999

Diet and Foraging

Tadpoles are highly specialized feeders on loose organic material such as detritus, interstitial algae, bacteria, and diatoms (Sweet 1992). Subadults and adults are opportunistic feeders, foraging on immediately available prey throughout both their breeding and upland habitats. Adults feed on a variety of invertebrates, including snails, Jerusalem crickets, beetles, ants, caterpillars, and moths.

Threats and Special Management Considerations

Historically, because habitats are favored sites for dams and reservoirs, roads, mining, agriculture, livestock grazing, urbanization, and recreational facilities (such as campgrounds and off-highway vehicle parks), many arroyo toad populations were reduced in size or extirpated due to extensive habitat loss that occurred from about 1920 to 1980 (USFWS 1999).

Introduced plants and predators (bullfrog, African clawed frog, crayfish, and green sunfish) have had substantial impacts on existing populations, and may have contributed to regional extirpation. Exotic plant species (e.g., tamarisk, giant reed, iceplant, pampas grass) degrade habitat by contributing to altered hydrology, eliminating sandbars and breeding pools, and restricting the quality and access to upland habitats. Active management of weeds may benefit arroyo toad populations by reducing weed cover of sandy soils that are essential refugia habitat for the species. Arroyo toads are highly vulnerable to habitat degradation resulting from changes in groundwater levels because they are so dependent on riparian vegetation for foraging and on perennial still pools for development and metamorphosis that span a minimum of two summer months (Rohde et al. 2019). Because native ants are a major food source for juveniles during the rapid growth stage in the weeks following metamorphosis, the spread of the nonnative Argentine ant into arroyo toad habitat may displace native ants and other macro invertebrates and thus negatively affect arroyo toad (Mitrovich et al. 2010, Stephenson and Calcarone 1999).

Other Relevant Information

The Upper Santa Ana River Basin/Cajon Wash Critical Habitat Unit (Unit 20) is the only critical habitat unit in the Planning Area, and supports a population that may represent some of the last vestiges of a much greater population that historically existed along the upper Santa Ana River Basin. Improved conservation of this location is important to maintain the current geographic extent of the species. Unit 20 contains the PBFs that are essential to the conservation of the species, including aquatic habitat for breeding and non-breeding activities (PBFs 1, 2, and 3) and upland habitat for foraging and dispersal activities (PBF 4). This habitat has been disturbed and fragmented over time; therefore, the PBFs essential to the conservation of the species in this unit may require special management considerations or protection to address threats from recreational activities (USFWS 2005).

Mountain Yellow-Legged Frog (*Rana muscosa*)

Current Status and Distribution

The mountain yellow-legged frog (*Rana muscosa*) is federally and state listed as endangered and occurs in the San Gabriel, San Bernardino, and San Jacinto Mountain Ranges, in Los Angeles, Riverside, and San Bernardino Counties. In the San Gabriel Mountain Range, known populations occur in Devil's Canyon, Little Rock Creek, South Fork Big Rock Creek, Vincent Gulch, and Bear Gulch. In the San Jacinto Range, known populations occur in Fuller Mill Creek, Dark Canyon, and Tahquitz-Willow Creek (ICF 2014). The status of individuals that were previously salvaged, maintained in captivity, and then released in Indian Creek and Hall Canyon are unknown as of 2012. In the San Bernardino Mountain Range, the only known population occurs in East Fork City Creek. Populations occur from 370 to 2,290 meters (1,200 to 7,500 feet) in elevation (USFWS 2012).

Habitat Requirements

In Southern California, habitat typically consists of rocky and shaded streams with boulders or vegetation growing along the water's edge (USFWS 2012, Jennings and Hayes 1994) 3 feet away from water (Stebbins 2003). This species is found in creeks and streams with at least some portion with permanent water. Perennial flows are needed for reproduction, larval growth and survival, and hydration of juveniles and adults. The species is absent from the smallest creeks because these habitats lack the depth for aquatic refuge and overwintering (USFWS 2012, Jennings and Hayes 1994). Occupied habitat at City Creek consists of pools, rapids, and small waterfalls, with some structure that could function as refugia (cover from predators) such as bank overhangs, rocks, and downed logs, although aquatic vegetation is minimal (USFWS 2012). The USFWS description of critical habitat PBFs includes aquatic habitat with characteristics suitable for breeding, rearing, and non-breeding (over-wintering) as well adjacent upland areas providing feeding and movement habitat (USFWS 2006).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of mountain yellow-legged frog habitat and occurrences in the Planning Area are illustrated on Figure 3-43, and quantified in Table 3-15. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Potentially Suitable Aquatic Habitat

- Within 100 feet of: National Hydrography Dataset perennial streams/waterbodies or National Wetlands Inventory (NWI) permanently flooded ponds or all streams within final critical habitat or all streams with documented or possibly extirpated occurrences – removed open water to retain perimeter of larger water bodies.

Refugia/Foraging/Dispersal Habitat

- **Landcover:** All landcover except Developed and Agriculture within 4,920 feet of Potentially Suitable Aquatic Habitat.

Aquatic Habitat Downstream of Covered Activities

- There is 0.2 acre of habitat downstream of Covered Activities, which was estimated based on the acreage of wetted area calculated by the HCP Hydrology Model within reaches with suitable modeled habitat.

Taxonomy and Genetics

Mountain yellow-legged frogs were once considered one species, *Rana muscosa* throughout its range. Vrendenburg et al. (2007) clarified the taxonomy of mountain yellow-legged frog by analyzing the mitochondrial DNA, acoustic data, and morphological characteristics. His study showed two distinct species of mountain yellow-legged frogs: *R. sierra* in the northern and central Sierra Nevada and R. muscosa in the southern Sierra Nevada and Southern California. Within *R. muscosa*, three clades were identified (two in the southern Sierra Nevada and one in Southern California). The Southern California clade is disjunct from the clades in the Sierra Nevada and occurs in Los Angeles, Riverside, and San Bernardino Counties (USFWS 2012).

Reproduction

In Southern California, breeding occurs from March through August. Breeding commences as soon as aquatic habitat is free of snow and ice and when high waters subside (Stebbins 2003). Oviposition occurs in shallow water and egg masses are often clustered and are generally unattached in ponds and lakes, but may be attached to underwater structures in streams (Jennings and Hayes 1994). Metamorphosis (i.e., the time it takes for this species to transform from a tadpole to frog) is variable and dependent upon temperature (USFWS 2012), and can occur as quickly as one season at low elevations and up to three seasons at high elevation (Jennings and Hayes 1994). For southern populations, metamorphosis likely occurs at the end of the second summer when second year tadpoles are 1.5 years old. Hibernation and aestivation occurs between November and January and between July and September, respectively (USFWS 2012). Breeding typically occurs between March and August (Jennings and Hayes 1994).

Dispersal, Territoriality, and Home Range

Dispersal often takes place along available aquatic habitat, but may occur through upland habitats as well. Dispersing individuals can travel long distances (up to 1,500 meters) in search of new territories or for breeding purposes (USFWS 2012). Longer dispersals generally occur soon after emerging from hibernation in the spring or before returning to hibernacula in the winter. Longer movements may occur due to drying of habitat (Matthews 2003).

Daily and Seasonal Activity

Larvae select warmer microclimates to keep relatively high body temperatures and often congregate in shallow waters during the day to increase body temperature. Adults are generally diurnal, and hibernate during winter months beneath ice-covered streams, lakes, and ponds. Adults emerge from hibernation immediately following snowmelt. During the active season, adults maximize their body temperatures at all times of the day by basking in the sun by moving between the warmer shallows along the shoreline and rocks on the shoreline (Jennings and Hayes 1994). Adults in Southern California will aestivate during the drier periods of late summer (Matthews 2003) (Table 3-26).

Table 3-26. Seasonal Activity of Mountain Yellow-Legged Frog

Life Stage/Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hibernation												
Aestivation (in dry conditions)												
Breeding												

Sources: USFWS 201, Jennings and Hayes 1994

Diet and Foraging

Adults feed opportunistically on other amphibians, beetles, flies, ants, bees, wasps, and true bugs (Jennings and Hayes 1994). Larvae feed on algae and diatoms located along the rocky bottoms of streams (Matthews 2003).

Threats and Special Management Considerations

The decline of mountain yellow-legged frog in Southern California is severe, with loss at approximately 99% of historical sites thought to be due to chytrid fungus, predation by introduced trout, habitat degradation due to mining, public dumping, and off-road vehicles, stream channelization, fire and post-fire debris flows, and pollution (CaliforniaHerps 2014, Morey 1988). Additionally, physical isolation has caused inbreeding, resulting in genetic isolation. Catastrophic natural events such as fires or flooding increase the likelihood of extirpation of small, isolated populations (USFWS 2012). Drought can also result in large mortality events if larval habitat evaporates. Mountain yellow-legged frogs depend on perennial water sources that do not fully freeze in winter. Changes in groundwater levels that reduce the necessary depth for overwintering tadpoles or increase oxygen depletion for overwintering adults may negatively affect this species (Rohde et al. 2019).

Translocation is often discussed as a possible management tool to reestablish threatened and endangered animals to areas where they have been extirpated. However, in the case of mountain yellow-legged frogs, one study found that because they are highly philopatric, translocated adult frogs can return to their capture site following short distance translocations and possibly from longer distance translocations. Additionally, translocating adult frogs can cause stress on the animals resulting in the loss of body mass. Matthews suggests that translocation of egg masses or tadpoles may have greater success and less stress as the homing would presumably not be as developed (Matthews 2003). More information on the viability of re-introducing the species via egg masses or tadpoles is needed to assess this as a potential management tool (USFWS 2012). Trout removal in the headwaters of some systems appears to be a potential tool for expanding available habitat for the species. Additional information regarding potentially suitable reintroduction sites is needed, including the presence and distribution of perennial waters, chytrid fungus, and exotic fish species at any proposed sites (CDFG 2011).

The Southern California population is critically endangered. To increase this population, San Diego Zoo Global has a southern mountain yellow-legged frog recovery project that began approximately 13 years ago. The Los Angeles Zoo, Henry Doorly Zoo, CDFW, USFWS, USGS, and the U.S. Forest Service are also part of this collaborative effort to re-introduce captive-bred frogs in Southern California. This program has released froglets and tadpoles into the frog's historic range in Southern California. In June of 2018, San Diego Zoo Global released 250 froglets in the San Bernardino National Forest (U.S. Forest Service 2018).

Western Spadefoot (*Spea hammondii*)

Current Status and Distribution

The western spadefoot (*Spea hammondii*) is a California Species of Special Concern and is endemic to California and northern Baja California (Jennings and Hayes 1994). This species occurs in the Central Valley, Coast Ranges, and Southern California south of the Transverse Range and west of Peninsular Mountains from near sea level to around 4,500 feet above sea level (CaliforniaHerps 2014). Western spadefoot has been extirpated from much of Southern California but persists in coastal Orange, western Riverside, cismontane San Bernardino, and inland San Diego Counties (Stebbins 2003). In the Planning Area this species occurs in the central and southern portions, along I-15 south of Corona, just east of I-215 near March Air Force Base, and in the Santa Ana River basin just downstream from and at scattered locations along the base of the San Bernardino Mountains (ICF 2014, Braden pers. comm).

Habitat Requirements

Western spadefoot occurs primarily in lowland areas including river floodplains, alluvial plains, playas, and alkali flats (Stebbins 2003). This species prefers habitats with sandy or gravely soils and requires slow-moving edges of rivers and streams or temporary rain pools with temperatures >48°F to <86°F in which to breed. Pools need to last at least 3 weeks in order to allow successful metamorphosis (CaliforniaHerps 2014, Jennings and Hayes 1994). Breeding habitat includes vernal pools and artificial impoundments such as stock ponds and pools that form at the bases of road and railroad grades, and pooled areas of ephemeral streams (Jennings and Hayes 1994). Suitable breeding habitat must be free of bullfrogs, crayfish, or fish (AmphibiaWeb 2014, CaliforniaHerps 2014). Upland habitats include grasslands, oak woodlands, coastal sage scrub, and chaparral in the vicinity of breeding pools, and the species prefers open areas with short grasses (AmphibiaWeb 2014, Stebbins 2003).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of western spadefoot habitat and occurrences in the Planning Area are illustrated on Figure 3-44. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Potentially Suitable Habitat

- **Land Cover**: Californian Annual and Perennial Grassland, Warm Southwest Riparian Forest, North American Warm-Desert Xeric-Riparian Scrub, Californian Chaparral, and Californian Coastal Scrub; Barren; **AND**
- **NWI and SoCal Wetlands hydrology attribute modifier**: Seasonally Flooded, Temporarily Flooded, Artificially Flooded; Upper Santa Ana River Wash Plan recharge basin; NWI freshwater pond; and SoCal Wetlands pond, detention basin; **AND**
- **Soil Texture**: sand, sandy loam, coarse sand, coarse sandy loam, fine sand, fine sandy loam, loamy sand, loamy coarse sand, loamy fine sand, river wash, very fine sandy loam, clay, and loam; **AND**

- **Landform**: alluvial flats; alluvial fans; alluvial plains; channels; floodplains, foothills, terraces, and uplands; also drainageways regardless of land cover type; **AND**
- **Elevation**: 0–2,953 feet; **AND**
- **Slope**: 0–3%; **AND**
- Must be a 536-acre block of natural contiguous open space grouped using a minimum separation tolerance of 25 feet.
- **Post-processing:** Removed fragmented and isolated patches surrounded by development.

Aquatic Habitat Downstream of Covered Activities

- There are 198.7 acres of habitat downstream of Covered Activities, which was estimated based on the acreage of wetted area calculated by the HCP Hydrology Model within reaches with suitable modeled habitat.

Taxonomy and Genetics

Western spadefoot was once considered widespread through the southwestern U.S. and northern Mexico with the population in California being a subspecies, *S. hammondii hammondii* (CaliforniaHerps 2014). Past studies have proposed that populations east of California be recognized as Mexican spadefoot (*Spea multiplicata*) citing morphological differences and differences in mating calls and ecology. Since this work, *S. hammondii* has been applied to western spadefoot populations in California exclusively (Jennings and Hayes 1994, AmphibiaWeb 2014)

Reproduction

Breeding for western spadefoot is dependent on temperature and rainfall. Mating and egg laying generally occurs from late February to late May (Jennings and Hayes 1994). Females lay 300–500 eggs in small clusters of 10–42 eggs (CaliforniaHerps 2014). Egg masses are attached to submerged plant material or detritus (Jennings and Hayes 1994, CaliforniaHerps 2014). Eggs usually hatch in 3–4 days, and larval development lasts approximately 58 days, although development of larvae is flexible and positively correlated to pool duration. Larvae will delay transformation in long-lasting pools with large food supply. Breeding may not occur during dry years because breeding pools may not fill (CaliforniaHerps 2014).

Dispersal, Territoriality, and Home Range

Little is known about how far individuals move to reach breeding sites (AmphibiaWeb 2014), but adults are known to travel a few meters on rainy nights. Following metamorphosis, juveniles migrate from the breeding pools. Little is known about how far the species disperses (Morey 1988). They are not territorial during most of the year; however, males keep individual space during chorusing (AmphibiaWeb 2014). Calling males do exhibit aggressive behaviors at breeding sites, suggesting some territoriality (Morey 1988).

Daily and Seasonal Activity

Western spadefoot is predominantly terrestrial, only enters the water to breed, and is rarely seen on the surface; it remains dormant for most of the year in subterranean refugia that it constructs or in mud cracks, under boards or other surface cover objects (Morey 1988). Toads can dig their own

burrows using the hardened spades on their hind feet. The species emerges from underground during periods of relatively warm rains from fall to early spring months, migrates to breeding pools, and emigrates from pools following breeding (Jennings and Hayes 1994, CaliforniaHerps 2014) (Table 3-27). Emergence and migration is generally synchronous (CaliforniaHerps 2014).

Table 3-27. Seasonal Activity of Western Spadefoot

Life Stage/Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Emergence and Migration												
Breeding												

Sources: Jennings and Hayes 1994, CaliforniaHerps 2014

Diet and Foraging

Larvae primarily consume plankton and algae, but may also be carnivorous and feed on other tadpoles. Adults feed on invertebrates including worms and insects (Morey 1988). Adults require annual foraging opportunities to acquire enough food to survive through seasonal dormancy (Jennings and Hayes 1994).

Threats and Special Management Considerations

The primary threat to western spadefoot is loss of habitat. In Southern California, more than 80% of habitat once known to sustain the species has been lost due to development or incompatible conversion (Jennings and Hayes 1994, CaliforniaHerps 2014, Stebbins 2003). Introduction of bullfrogs into breeding pools has had a negative impact on some populations, as has the introduction of mosquito fish (Jennings and Hayes 1994, CaliforniaHerps 2014).

Efforts should be undertaken to protect areas with temporary rain pools and surrounding habitat. The species will readily use human-made water sources to breed, and could be subsidized through the maintenance of temporary waters sources in areas where adults are known to occur. Weed management, including removal or grazing control of exotic grasses, may also provide some benefit to the species (Marty 2005). In addition to conservation of existing habitat, creation of new vernal pool habitat and subsequent translocation of western spadefoot egg masses and larvae has shown success as a conservation mitigation strategy in Orange County, California, where persistence of the species and successful reproduction was observed at mitigation sites 10 years after establishment (Baumberger et al. 2020).

Other Relevant Information

There are over 66 San Bernardino County Museum records of western spadefoot in the Planning Area between June 1999 and March 2002. Forty-four were from intermediate alluvial fan sage scrub, 16 from mature alluvial fan sage scrub, and the remainder in pioneer alluvial fan sage scrub. These records were from alluvial fan sage-scrub habitats despite other major habitats being simultaneously sampled for the same period. There were no discernable breeding water sources (creeks, artificial impoundments, stock ponds, accumulated road runoff, etc.) for the Etiwanda Fan records other than naturally occurring shallow ephemeral pools following heavy rains (ICF 2014).

California Glossy Snake (Arizona elegans occidentalis)

Current Status and Distribution

California glossy snake (*Arizona elegans occidentalis*) is a California Species of Special Concern and is found from California's central San Joaquin Valley south to the U.S. Mexico border and east into the Mojave and Sonoran desert region. The Planning Area encompasses the area of intergrade between the unrecognized California and desert subspecies (Stebbins 2003, Thompson et al. 2016). Occurrences are known around the Santa Ana River from the San Bernardino Airport east toward the Seven Oaks reservoir and to the north associated with Cajon Wash and Lytle Creek.

Habitat Requirements

California glossy snake prefers open areas in a variety of habitats including light shrubby to barren desert, grassland, chaparral, and coastal sage scrub (Stebbins 2003, Thompson et al. 2016). California glossy snake is found in cismontane habitat (Braden pers. comm.).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of California glossy snake habitat and occurrences in the Planning Area are illustrated on Figure 3-45. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Potentially Suitable Habitat

- **Land Cover**: Californian Annual and Perennial Grassland; California Chaparral; Cool Interior Chaparral; Warm Interior Chaparral; Californian Coastal Scrub; Californian Forest and Woodland; Great Basin-Intermountain Xeric-Riparian Scrub; Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland; North American Warm-Desert Xeric-Riparian Scrub; North American Warm Semi-Desert Cliff, Scree, and Rock Vegetation; Western North American Cliff, Scree, and Rock Vegetation; **AND**
- **Soil Texture**: sand, sandy loam, coarse sand, coarse sandy loam, fine sand, fine sandy loam, loam sand, loamy coarse sand, loamy fine sand, river wash, and very fine sandy loam; **AND**
- **Landform**: alluvial fans, alluvial flats, alluvial plains, channels, floodplains, foothills, terraces, uplands, and also drainageways regardless of land cover type; **AND**
- **Elevation**: 0–6,000 feet.
- **Post-processing**: Excludes very small isolated habitat fragments that would not be considered viable habitat and agricultural lands near the Prado Basin, Chino, and Ontario because the disturbance regime in these areas would not be compatible with this species occurrence.

Taxonomy and Genetics

Nine subspecies have been described within this monotypic genus (Aldridge 2001). The subspecies *occidentalis* was proposed as a western subspecies but has not been accepted (Hammerson et al. 2007).

Reproduction

California glossy snake is oviparous; mating season is restricted to the spring (Aldridge 2001); ovulation begins in June and eggs are laid in July with clutch size of 3–23 with an average of 8.5 (Stebbins 2003, Thompson et al. 2016). Hatchlings emerge in September (Thompson et al. 2016).

Dispersal, Territoriality, and Home Range

The sexual and seasonal distribution observed based on a mortality study found that the mating system is consistent with Prolonged Mate Searching Polygyny (Aldridge 2001). In this mating system, males search competitively for widely distributed, spatially unpredictable females. Territoriality and home range behaviors are not documented for this species.

Daily and Seasonal Activity

California glossy snake is active primarily at night and remains underground during the day (Stebbins 2003). Seasonal activity is depicted in Table 3-28.

Table 3-28. Seasonal Activity of California Glossy Snake

Life Stage/Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Egg Laying												
Hatchling Emergence												

Source: CaliforniaHerps 2014

Diet and Foraging

California glossy snake feeds primarily on diurnal lizards, which it captures while they sleep, and nocturnal mammals, such as kangaroo rats, which it ambushes (Klauber 1946, Rodriguez-Robles et al. 1999). Larger specimens are also known to take small birds and other snakes (Rodriguez-Robles et al. 1999, Stebbins 2003, Thomson et al. 2016).

Threats and Special Management Considerations

Major threats to California glossy snake include primarily anthropogenic threats caused by direct mortality from development (agricultural, commercial, and residential) and road kill, as well as pressure from collectors (NatureServe 2014). Additional threats may include light pollution and increasing frequency and intensity of fires (Thomson et al. 2016).

This species has a moderately small range and a moderate degree of ecological specialization and endemism, which make management difficult, coupled with documented declines in the range and projected impacts from ongoing development. Habitat management is the primary management priority. This is a poorly studied species, and two research priorities will help inform habitat management objectives: (1) ecological studies to enhance the understanding of life history and existing population sizes, and (2) a species-wide phylogenetic study to determine whether there is intraspecific variation and to identify appropriate conservation needs (Thomson et al. 2016).

Other Relevant Information

The California glossy snake is the only snake that occurs in cismontane habitat. The distribution of this snake has been reduced by 90% with only a handful of extant cismontane occurrences remaining (Braden pers. comm.).

South Coast Garter Snake (*Thamnophis sirtalis* ssp.)

Current Status and Distribution

The south coast garter snake (*Thamnophis sirtalis* ssp.) is a Priority 1 California Species of Special Concern (Thomson et al. 2016) that is wide-ranging throughout the United States and Canada from the Pacific to the Atlantic (Stebbins 2003). Along the Southern California coast, this species has a restricted distribution from the Santa Clara River Valley (Ventura County) south coastally to the vicinity of San Pasqual (San Diego County). South coast garter snake occurs from near sea level to 2,730 feet and has been observed in the Lake Prado Basin in the Planning Area (Jennings and Hayes 1994, ICF 2014, Thomson et al. 2016).

Habitat Requirements

Essential habitat factors for south coast garter snake includes a permanent water source, low gradient topography, and dense multi-storied riparian vegetation (Ervin 2011). South coast garter snake is restricted to shallow freshwater aquatic habitats such as wetlands and marshes and upland riparian habitat near permanent waters (Jennings and Hayes 1994). This species is highly aquatic and needs open water for foraging; however, it generally avoids fast-flowing water (Morey 1988b, Rohde et al. 2019).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of south coast garter snake habitat and occurrences in the Planning Area are illustrated on Figure 3-46. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Potentially Suitable Habitat

- **Land Cover:** Western North American Freshwater Aquatic Vegetation; Warm Southwest Riparian Forest; Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland; **AND**
- Elevation: 0–833 feet; **AND**
- Slope: 0–3%; **AND**
- Within 500 feet of selected land cover, elevation, and slope *except for* Developed and Agriculture.

Aquatic Habitat Downstream of Covered Activities

- There are 188.6 acres of habitat downstream of Covered Activities, which was estimated based on the acreage of wetted area calculated by the HCP Hydrology Model within reaches with suitable modeled habitat.

Taxonomy and Genetics

Although south coast populations of *Thamnophis sirtalis* have not been formally described as a distinct taxon (Thomson et al. 2016), consistent with earlier findings (Jennings and Hayes 1994) garter snakes in this part of the range are considered Species of Special Concern (Thomson et al. 2016). Populations from Southern California were first described as California red-sided garter snake (*Thamnophis sirtalis infernalis*) by Henri Marie Ducrotay de Blainville in 1835 (CaliforniaHerps 2014). Barry (1998) and Stebbins (2003) support description of snakes from Southern California as *Thamnophis sirtalis infernalis*, while others (Boundy and Rossman 1995, Janzen at al. 2002) refer to them as red-spotted garter snakes (*Thamnophis sirtalis concinnus*). Morphological and genetic studies that will help to clarify the status of this taxon (*Thamnophis sirtalis* ssp.) are still pending (Thomson et al. 2016).

Reproduction

South coast garter snakes mate in the spring. Several males may often attempt to mate with a single female (Morey 1988b). This species is a live-bearing snake and generally gives birth to 12 to 18 young (Stebbins 2003). Young are generally born in August but may extend into late summer and early fall (Jennings and Hayes 1994).

Dispersal, Territoriality, and Home Range

South coast garter snake is not thought to migrate (Morey 1988b). Data on movement ecology for this species are limited and the nature of its home range is not well known (Jennings and Hayes 1994, Morey 1988b). Individual home ranges probably overlap with others during the summer period. Individuals can be found close together in areas of favorable habitat. Many populations of common garter snakes aggregate in large numbers during the winter, especially in cold northern climates, though it is unknown if south coast garter snakes exhibit this behavior (Morey 1988b).

Daily and Seasonal Activity

South coast garter snake is an excellent swimmer and is often found near water (Jennings and Hayes 1994, Morey 1988a). The species is most active during the daytime, mainly during the morning and late afternoon most summer days and mainly during the afternoon in spring and fall. It may retreat to hibernacula during the winter months but may emerge to bask during warmer winter days (Morey 1988a). Seasonal activity is depicted in Table 3-29.

Table 3-29. Seasonal Activity of South Coast Garter Snake

Life Stage/Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hibernation												
Breeding												

Sources: Morey 1988, Stebbins 2003, Jennings and Hayes 1994

Diet and Foraging

South coast garter snake is known to primarily feed on amphibians; however, fish and invertebrates are also targeted as prey (Jennings and Hayes 1994). This species is also known to prey on adult Pacific newts (*Taricha* sp.) without suffering the effects of poison secreted from the newt's body (Stebbins 2003).

Threats and Special Management Considerations

The loss of habitat is the principal threat to south coast garter snake. Urbanization and flood control projects have greatly affected suitable habitat. Of the 24 known historic localities, 18 sites (75%) no longer supported the species. The introduction of nonnative aquatic predators also threatens existing populations. Destruction of suitable aquatic habitat is the biggest threat to populations, and the species is vulnerable to habitat degradation caused by reduced water levels and quality, which affects the availability of suitable vegetation and burrows (Jennings and Hayes 1994, Rohde et al. 2019). Wetland drying in the summer months and decreased irrigation due to water transfers or drought can also reduce suitable habitat. Substitution of groundwater for surface water can degrade habitat because groundwater has lower temperatures and higher concentrations of contaminants (Rohde et al. 2019). As of 1994, 75% of known localities of this taxon no longer supported snakes. Wide-spread surveys need to be undertaken in Southern California to determine where the species still exists and to evaluate the quality of the habitat where it does exist. Studies are also necessary to identify the importance of prey resources on recruitment and reproduction. Because seasonal movement patterns and recolonization abilities are not well understood, studies to identify these attributes should also be undertaken (Jennings and Hayes 1994).

Southwestern Pond Turtle (*Emys pallida*)

Current Status and Distribution

The southwestern pond turtle (*Emys pallida*) is a California Species of Special Concern and is currently under review by USFWS. This species was formerly considered western pond turtle (*Actinemys marmorota*) until a recent taxonomic split into two distinct, geographically non-overlapping species: *E. pallida* and *E. marmorota* (Nicholson et al. 2020). The range for the southwestern pond turtle includes the southern and coastal portions of the overall range from northwestern Baja California del Sur to approximately San Francisco Bay. In the Planning Area, this species is known from Chino Hills State Park in Aliso Creek from Banie Canyon to the confluence with the Santa Ana River and in Soquel Canyon; Arnold Reservoir in Tonner Canyon; and in a detention basin at the southern end of Walker Canyon north of Lake Elsinore (ICF 2014).

Habitat Requirements

The southwestern pond turtle is an aquatic turtle that occurs in ponds, lakes, marshes, rivers, streams, and irrigation ditches. This species prefers habitats with emergent basking sites such as logs, rocks, and shorelines, and with underwater refugia (Stebbins 2003, Bury and Germano 2008). Southwestern pond turtle is most abundant in slow-moving portions of streams and rivers such as plunge pools because they lack swift currents and are deep enough to allow the turtle to retreat when threatened. Densities of this species in standing or slow-moving waters are often several times higher than in swifter-moving sections of streams and rivers. Southwestern pond turtle also utilizes upland habitats near aquatic habitat to reproduce, aestivate, and overwinter (Bury and Germano 2008). Hatchlings require shallow aquatic habitat with submerged vegetation on which to feed (Jennings and Hayes 1994).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of southwestern pond turtle habitat and occurrences in the Planning Area are illustrated on Figure 3-47. The following modeled habitat types are used to represent the species'

habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Aquatic Habitat

- **Land Cover**: Water-Permanent (except within existing groundwater recharge basins) and Western North American Freshwater Aquatic Vegetation; **AND**
- **Elevation**: 0–1,800 feet.

Potentially Suitable Upland Habitat

- Areas that are within 1,640 feet of Aquatic Habitat (Reese and Welsh 1997); **AND**
- **Elevation:** 0–1,800 feet; **AND**
- Contiguous with Aquatic Habitat *except for* Developed; Agriculture; California Chaparral; and Cool Interior Chaparral, Western North American Cliff, Scree, and Rock Vegetation.
- **Post-processing**: Removed fragmented and isolated patches surrounded by development and upstream of RIX Discharge.

Aquatic Habitat Downstream of Covered Activities

- There are 191.8 acres of habitat downstream of Covered Activities, which was estimated based on the acreage of wetted area calculated by the HCP Hydrology Model within reaches with suitable modeled habitat.

Taxonomy and Genetics

Since 2011, CDFW has identified one species throughout its range (*Actinemys marmorata*) (CDFG 2011). However, four distinct mitochondrial clades have been identified: Northern, San Joaquin Valley, Santa Barbara, and Southern California (Spinks and Shaffer 2005, Spinks et al. 2010). Additionally some studies recommend, based on genetic differences, that populations north of San Francisco and in the Central valley be identified as *E. marmorata,* and populations in the central Coast Range south of San Francisco be identified as *E. pallida* (Spinks et al. 2014). This implies that the Tehachapi Mountains/Transverse Range are major barriers to movement in Southern California northward (Spinks et al. 2010). The pond turtle species found within the Planning Area is *Emys pallida*.

Reproduction

Southwestern pond turtle nest in terrestrial habitat in sites that can be as far as 1,312 feet from aquatic habitat; however, most are within 656 feet of aquatic habitat (Reese and Welsh 1997, Jennings and Hayes 1994). Mating typically occurs in April and May. Females emigrate from the water to upland nest sites and deposit 3–14 eggs from April through August, with timing dependent on location (Stebbins 2003). Females are highly terrestrial while they are gravid and make multiple trips onto land and burrow themselves beneath leaf litter (Reese and Welsh 1997). Incubation time ranges from 94 to 122 or more days (Bury and Germano 2008). Hatchlings in the northern portion of the species' range generally overwinter in the nest and emerge in the spring (Reese and Welsh 1997). In Southern California, hatchlings may emerge from the nest in the fall (Jennings and Hayes 1994).

Dispersal, Territoriality, and Home Range

Dispersal distances are highly variable among individuals. Some individuals may only travel a few feet from aquatic habitat to nest, aestivate, or overwinter, while others may travel 1,312 feet or more to overwinter. Southwestern pond turtle has been known to disperse farther than 1.2 miles if local aquatic habitat disappears or becomes inhospitable, and adults can tolerate at least 7 days without water. The dispersal habits of juveniles are unknown (Jennings and Hayes 1994).

Males have average home ranges of 2.4 acres, while females have average home ranges of 0.6 acre. Populations can reach densities of 215 per hectare in undisturbed stream habitats and even higher in undisturbed ponds (Buskirk 2002). As water levels drop in the summer months and during droughts, the species tends to aggregate in higher densities (Bury and Germano 2008). Basking pond turtles will engage in aggressive behaviors such as biting and ramming to ensure adequate spacing for basking (DOI 1999).

Daily and Seasonal Activity

The level of activity is greatly affected by temperature, especially when surface water temperature is above 59°F (Bury and Germano 2008). Along the southern coastal areas of California, southwestern pond turtles may be active year-round. At higher elevations and higher latitudes, pond turtles will overwinter in upland areas or in the water (Jennings and Hayes 1994). Overwintering turtles may travel up to 1,640 feet from aquatic habitat to terrestrial refuges. Some have been known to occur in terrestrial habitats up to 7 months out of the year (Reese and Welsh 1997). Seasonal activity is depicted in Table 3-30.

Table 3-30. Seasonal Activity of Southwestern Pond Turtle

Life Stage/Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hibernation												
Breeding												
Hatchling Emergence												

Sources: Stebbins 2003, Jennings and Hayes 1994

Diet and Foraging

Southwestern pond turtles are omnivorous and dietary generalists (Bury and Germano 2008). Hatchlings and young juveniles feed primarily on zooplankton (Jennings and Hayes 1994). Adults feed on insect larvae, other aquatic invertebrates, fish, amphibian eggs and tadpoles, small fish, carrion, and aquatic plants (Stebbins 2003; DOI 1999).

Threats and Special Management Considerations

Overexploitation for food in the nineteenth and early twentieth centuries caused initial population declines throughout much of the southwestern pond turtle's range. Habitat destruction and alteration are now the primary threats (Bury and Germano 2008, Nicholson et al. 2020). Raccoons (*Procyon lotor*) and other native and introduced mammals may destroy nests and consume neonates. The introduction of largemouth bass (*Micropterus salmoides*) and bullfrogs (*Lithobates catesbeiana*) into aquatic habitats has been damaging to neonates and yearlings (Buskirk 2002, Nicholson et al. 2020).

Population declines may also be a result of female-biased mortality on roads, caused when gravid females leave aquatic habitats to nest in upland habitats (Nicholson et al. 2020). A recent study showed a strong correlational relationship between road proximity and density and increasing male population bias in this species (Nicholson et al. 2020).

Tricolored Blackbird (*Agelaius tricolor*)

Current Status and Distribution

Tricolored blackbird (*Agelaius tricolor*) is state listed as threatened. It is nearly endemic to California, with 95% of historic breeding range within the state (Western Riverside County MSHCP 2012a). Recent data shows breeding colonies occur sporadically within the Planning Area at the following locations (the most recent date and breeding colony size are given in parentheses)—San Bernardino County: pond adjacent to the Santa Ana River in Colton (2009; 100) (Feenstra 2009), wheat field near Euclid and Eucalyptus Avenues in Chino (2014; 100) (UC Davis 2014), a created wetland south of the Chino Airport (2014; 500) (UC Davis 2014), and the recently created Mill Creek Wetlands (2014; 1,000) (Pike pers. comm, eBird 2014).

Habitat Requirements

Habitat requirements for a tricolored blackbird breeding colony include open water; appropriate nesting substrate with cattails, bulrushes, willows, and forbs; and nearby foraging habitat (Beedy and Hamilton 1999). Foraging areas include grasslands, open fields, irrigated pasture, and agricultural areas (Beedy and Hamilton 1997, Shuford and Gardali 2008, Rohde et al. 2019). Alfalfa fields are the primary foraging area for the Mill Creek Wetlands colony (Pike pers. comm.) and is reported as the primary forage for several colonies in Riverside County (Western Riverside MSHCP 2012b). Sunflower is the only other crop known to support good foraging opportunities for this species (Meese pers. comm.). In addition to cattail/bulrush habitat, nest sites in the Planning Area have been documented in weedy areas, dominated by species such as bull thistle, mustard, nettle, and cheeseweed mallow (Western Riverside MSHCP 2012b).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of tricolored blackbird habitat and occurrences in the Planning Area are illustrated on Figure 3-48. Statewide mapping and monitoring of tricolored blackbird colony locations is coordinated through the UC Davis Tricolored Blackbird Portal. Colony locations are attributed with the habitat where the colony is located. Colonies were classified into categories based on the surrounding habitat.

- **Typical colony**: Colony located in naturally occurring emergent wetland habitats.
- **Atypical colony**: Colony located in nonnative or atypical natural habitats including: thistle or nettle colony, willow colony, agriculture colony, and urban park colony.

The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area, and include a listing of the data and/or parameters used to create each modeled habitat type.

Occupied Colony Habitat (suitable breeding habitat that allows colony establishment around known colony locations)

- Typical Colony Locations; **AND**
- **Land Cover:** Wetlands; **OR**
- Other natural habitats within 500 feet of atypical thistle, nettle, or willow colony locations (natural is defined as all landcover types except, agriculture, open water, and developed); **OR**
- Agricultural habitats within 500 feet of atypical agriculture colony locations (agriculture colonies are in a limited number of crop types, but all agriculture types are selected because crops are regularly rotated); **OR**
- Urban park colonies represented by the colony occurrence data alone.

Suitable Colony Habitat

- Wetlands within 500 feet of Occupied Colony Habitat.

Breeding Season Foraging – Natural

- Grasslands within 5 kilometers of Occupied Colony Habitat or Suitable Colony Habitat with a minimum patch size of 20 acres.

Breeding Season Foraging – Agriculture

- Agriculture within 5 kilometers of Occupied Colony Habitat or Suitable Colony Habitat with a minimum patch size of 20 acres.

Non-Breeding Season Foraging – Natural

- Grasslands with a minimum patch size of 20 acres.

Non-Breeding Season Foraging – Agriculture

- Agriculture with a minimum patch size of 20 acres.

Taxonomy and Genetics

There are two populations of tricolored blackbird within California: (1) Southern California population and (2) Central Valley population. Banding studies have not shown evidence of individuals mixing between the two populations (UC Davis 2014, Shuford and Gardali 2008).

Reproduction

Tricolored blackbirds are synchronized, colonial nesters (Beedy and Hamilton 1997). Reproduction starts in mid-March (UC Davis 2014, Hamilton 1998) and concludes in early August (Beedy and Hamilton 1997, Shuford and Gardali 2008). Females build deep cup nests composed of leaves and grasses in which they lay 3–4 eggs. Eggs are incubated solely by the female for 12–14 days, and chicks typically fledge 10–14 days after hatching (UC Davis 2014). Young within the colony fledge no more than a few days from each other (Western Riverside County MSHCP 2012b). Both male and female feed the young (Beedy and Hamilton 1997). Once the young have fledged, they will remain with the colony (either inside or along the perimeter of the colony) for a few days while still being fed by both parents (UC Davis 2014).

Dispersal, Territoriality, and Home Range

Tricolored blackbirds are regionally philopatric, so this species tends to remain within the region where it hatched, but studies show no strong evidence of site fidelity. This species will move in both winter and breeding months within the region (Shuford and Gardali 2008, Hamilton 1998). Young will disperse from the breeding colony, sometimes being led away by the parents carrying food items (UC Davis 2014).

During the breeding season, territories are relatively small, averaging 2–6 meters between nesting sites (UC Davis 2014, Beedy and Hamilton 1999). Foraging areas generally occur up to 5 kilometers from the nest site (Beedy and Hamilton 1999) but have been documented up to 13 kilometers from the nest site (Beedy and Hamilton 1997). Itinerant breeders, capable of breeding twice a year in different locations within the same region (UC Davis 2014, Hamilton 1998).

Daily and Seasonal Activity

In the non-breeding season, tricolored blackbirds form large flocks, often with other species, such as red-winged blackbirds, for foraging and roosting (Shuford and Gardali 2008). Seasonal activity is depicted in Table 3-31.

Table 3-31. Seasonal Activity of Tricolored Blackbird

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wintering												
Breeding												

Sources: University of California-Davis 2014, Shuford and Gardali 2008

Diet and Foraging

Tricolored blackbirds are opportunistic feeders. This species is mainly granivorous, but will consume invertebrates, such as grasshoppers, beetles, and insect larvae, during the breeding season (UC Davis 2014, Shuford and Gardali 2008, Beedy and Hamilton 1997). Young are fed exclusive insect prey (Western Riverside County MSHCP 2012b).

Threats and Special Management Considerations

Loss of habitat and fragmentation of this species' habitat is largely attributed to human development, and land alteration is considered the most significant threat (Beedy and Hamilton 1999). These anthropogenic factors include water diversion and draining of wetlands, land conversion to agricultural uses, and development of land (UC Davis 2014). Conversion of productive foraging habitat to perennial, woody crops including nut trees and vines also threaten this species (Rohde et al. 2019). Severe weather conditions, such as drought, can also contribute to population decline, as it can reduce insect prey populations and cause abandonment of colonies, low reproductive success, and failure to reproduce (Beedy and Hamilton 1999, Rohde et al. 2019).

Nesting habitat within the Planning Area for tricolored blackbird consists primarily of wetland- and marsh-type habitats, but also includes weedy habitats that may be found within or adjacent to crops such as wheat. The Mill Creek Wetlands Recreation and Restoration Demonstration Project provides a management example and shows how quickly this species can occupy newly created suitable

nesting habitat (with adjacent suitable foraging habitat), as construction was initiated in early 2013 and occupied in spring 2014 (UC Davis 2014). Activities that alter potential nesting habitat, including vegetation removal and changes in water flow, will be important to consider for conservation of this species in the Planning Area. The conservation and management of suitable foraging habitat within 3 miles of a breeding colony may be an equally important consideration; in the Planning Area, the primary forage appears to be alfalfa fields. There are few areas within the Planning Area that have suitable nesting and foraging habitat and are being used by breeding tricolored blackbirds, and recently occupied sites and surroundings should be the primary consideration.

Other Relevant Information

The Planning Area is within the current range of this species, and, therefore, it is dependent on patchy and somewhat unpredictable breeding and foraging habitat. As a result, it is possible that additional tricolored blackbird colonies will be documented within the Planning Area in the future.

Burrowing Owl (Athene cunicularia)

Current Status and Distribution

Burrowing owl (*Athene cunicularia*) is a California Species of Special Concern that is widely distributed throughout California. Riverside and San Bernardino Counties have the largest remaining numbers in the Central and South Coast region (Gervais et al. 2008). Burrowing owl have generally been documented in the lower elevations and flat portions of the Planning Area. This species is known to occur in the Santa Ana River Basin at the San Bernardino International Airport, along City Creek, along the perimeter of several flood control basins, and scattered throughout the Prado Basin. Burrowing owls are also known to occur east of the Jurupa Mountains, at Lake Mathews, at Ayala Park in Chino, scattered throughout the dairy farms in east Chino, and in the business parks along I-15 and I-10 (ICF 2014).

Habitat Requirements

Burrowing owl occurs primarily in grassland habitats with few shrubs on level to gently sloping topography and well-drained soils (Poulin et al. 2011). This species may also occur in scrub habitats with low, sparse shrubs. While low vegetation is favored, burrowing owl can be found among taller shrubs where the shrubs are rather sparse. This species can also be found in habitats that are highly altered by human activity, such as agricultural fields, golf courses, parks, airports, and vacant urban lots (Gervais et al. 2008, Klute et al. 2003). The most important habitat component is the presence of small mammal burrows for roosting and nesting, and relatively short vegetation (Gervais et al. 2008, Klute et al. 2003, Poulin et al. 2011). Fossorial species whose burrows are often used by burrowing owls include: California ground squirrels (*Spermophilus beecheyi*), American badger (*Taxidea taxus*), coyote (*Canis latrans*), and kit fox (*Vulpes macrotis*). The owl will also utilize non-natural burrows such as pipes and culverts as well as rock outcrops that offer suitable holes (Gervais et al. 2008).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of burrowing owl habitat and occurrences in the Planning Area are illustrated on Figure 3-49. The following modeled habitat types are used to represent the species' habitat distribution in

the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Potentially Suitable Habitat

- **Land Cover**: Herbaceous Agricultural Vegetation; Californian Coastal Scrub; Californian Annual and Perennial Grassland; Californian Disturbed Grassland, Meadow, and Scrub; North American Warm-Desert Xeric-Riparian Scrub; and Great Basin-Intermountain Xeric-Riparian Scrub; **AND**
- **Elevation**: 0–2,000 feet; **AND**
- **Slope**: 0–20%.
- **Post-processing**: Removed patch sizes less than 100 acres.

Taxonomy and Genetics

In North America, burrowing owl is divided into two recognized subspecies; *Athene cunicularia hypugaea* in the west and *A. c. floridana* in Florida and the Bahamas (Poulin et al. 2011).

Reproduction

The breeding season for burrowing owl in California is generally March to August, but can begin in February and extend into December (Gervais et al. 2008), The peak of the breeding season occurs between April 15 and July 15, which is when most burrowing owls have active nests (eggs or young). Incubation lasts 29 days and young fledge 44 days after hatching. Burrowing owl may change burrows several times during the breeding season, starting when the nestlings are about 3 weeks old (CDFG 2012). This species may attempt to re-nest if the first nest is destroyed early in the nesting season (Klute et al. 2003).

Dispersal, Territoriality, and Home Range

Dispersal distances for both juveniles (post fledging) and adults (post nesting) may be considerable, between 33 and 93 miles (Gervais et al. 2008). One study found that populations in California were indistinguishable, suggesting a high degree of dispersal and interconnectivity of populations (Klute et al. 2003).

Home range size is linked to the availability of food. Burrowing owl generally forage near a nest burrow during breeding, but have been recorded foraging up to 1.7 miles away from a burrow during the breeding season. In California, burrowing owl had a nest-site fidelity from year to year of 32–50% in areas with large expanses of grasslands and 57% in agricultural areas (Gervais et al. 2008). Wintering owls, unlike breeding owls, are not as dedicated to single burrows or a group of burrows. However, there is roost fidelity within and between winter seasons (Poulin et al. 2011).

Daily and Seasonal Activity

Many burrowing owls in California are year-round residents, often retreating from higher elevations in the winter. Migrants from other states may augment lowland populations in the winter throughout the state (Gervais et al. 2008). The species is primarily diurnal, with the greatest period of activity occurring during crepuscular hours. Seasonal activity is depicted in Table 3-32.

Table 3-32. Seasonal Activity of Burrowing Owl

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wintering												
Breeding												
Migration												
Molt												

Source: Poulin et al. 2011

Diet and Foraging

Burrowing owls are opportunistic foragers that will feed on a wide variety of prey depending on availability. This species readily preys upon insects such as crickets, beetles, and dragonflies. Other prey include small rodents such as voles, deer mice, harvest mice, pocket mice, and kangaroo mice. Less frequently, this species is known to consume birds such as horned larks (*Eremophila alpestris*), western meadowlarks (*Sturnella neglecta*), and shorebirds, as well as bat species (Hoetker and Gobalet 1999). Burrowing owl are generally crepuscular hunters and hunt either on the wing or by walking or hopping on the ground, and will often use elevated perches to spot prey (Poulin et al. 2011).

Threats and Special Management Considerations

Loss of habitat, degradation and fragmentation of remaining habitat, ongoing urbanization, and continuing eradication of ground squirrels are the main threats to burrowing owl in California (Gervais et al. 2008). The elimination of burrowing rodents through the use of rodenticides and other means has contributed to the decline of populations nationwide (Klute et al. 2003). The control of ground squirrels in California may affect local populations by reducing or eliminating ground squirrel burrows. Road and ditch maintenance and discing to control weeds in fallow fields may destroy burrows. Exposure to pesticides may also cause mortality to individuals (CDFG 2012).

Declines in Southern California have continued to occur. One study determined that the number of burrowing owl pairs in the inland portion of Southern California declined by 34% between 1993 and 2007 (Wilkerson and Siegel 2010). Retaining colonies of burrowing mammals is of upmost importance, as burrowing owls require their burrows for nesting and roosting. While burrowing owls appear to adapt fairly well to human disturbances in some cases (i.e., airport runways and other human modified open spaces), the continued presence of active mammal-created burrows is essential to its survival. Rodent eradication programs may reduce the consistent availability of high and moderate function habitat. Additionally, suitable foraging habitat near burrows is required to sustain viable populations (Gervais et al. 2008, Klute et al. 2003, Poulin et al. 2011, CDFG 2012). Because of high nest site fidelity, the disturbance of nest sites could have a dramatic impact on populations. Before artificial burrows are constructed and burrowing owls are relocated, it is important to consider the characteristics of the burrow sites previously used for nesting and mimic them as closely as possible (Botelho and Arrowood 1998). Additionally, because of high nest site fidelity, relocated nests should be installed close to the original nest burrow, ideally within 100 meters (Smith and Belthoff 2001).

Cactus Wren (Campylorhynchus brunneicapillus)

Current Status and Distribution

The cactus wren (*Campylorhynchus brunneicapillus*) is a California Species of Special Concern. It is found in California east to Texas, extending south through Baja California and mainland Mexico (Hamilton et al. 2011).

In the Planning Area, it occurs in southwestern San Bernardino County in washes and lower slopes flanking the urbanized area from Fontana east to Yucaipa, including the Santa Ana River, Lytle Creek, Cajon Creek, and Mill Creek. In western Riverside County occurrences are concentrated near Lake Mathews and the Santa Ana River, with small populations scattered in washes and lower hills south to the Temecula area; apparently a disjunct population persists in the Aguanga area (ICF 2014).

Habitat Requirements

Cactus wren typically occupies native scrub with cholla (*Cylindropuntia*) or prickly-pear (*Opuntia*) (Hamilton et al. 2011). Suitable nest sites in and near the Planning Area in addition to cholla and prickly-pear include California buckwheat (*Eriogonum fasciculatum*) and California sagebrush (*Artemisia californica*), yucca (*Yucca* spp.), chamise (*Adenostoma fasciculatum*), mountain mahogany (*Cercocarpus* spp.), and juniper (*Juniperus* spp.) (Hamilton et al. 2011, San Bernardino County Museum 2014).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of cactus wren habitat and occurrences in the Planning Area are illustrated on Figure 3-50. The following modeled habitat types are used to represent cactus wren habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Known Suitable Nesting

- **Existing data**: Historical breeding habitat dataset from Cactus Wren Working Group, as well as cactus mapping conducted as part of the Wash Plan HCP buffered by 213 feet (approximate coastal average nesting territory size); **AND**
- **Land Cover** (only within Known Suitable Nesting buffer): Californian Coastal Scrub; Californian Annual and Perennial Grassland; Californian Disturbed Grassland, Meadow, and Scrub; North American Warm-Desert Xeric-Riparian Scrub; Great Basin-Intermountain Xeric-Riparian Scrub; Californian Coastal Scrub (prickly pear).

Potential Nesting and Foraging Habitat:

- **Land Cover**: Californian Coastal Scrub; Californian Annual and Perennial Grassland; Californian Disturbed Grassland, Meadow, and Scrub; North American Warm-Desert Xeric-Riparian Scrub; Great Basin-Intermountain Xeric-Riparian Scrub; Californian Coastal Scrub (prickly pear); **AND**
- **Elevation**: 0–2,500 feet; **AND**
- **Slope**: 0–40%.

Recently Burned (2008–2018):

- All Known Suitable Nesting and Potential Nesting and Foraging Habitat that has been burned within the last 10 years (CALFIRE 2018).

Taxonomy and Genetics

Of the eight subspecies of *Campylorhynchus brunneicapillus* (Hamilton et al. 2011), two occur within Southern California. *C. b. sandiegensis* is found in San Diego County and southern Orange County, whereas populations elsewhere on the coastal slope are classified as *C. b. anthonyi* (Solek and Sziji 2004). Current molecular evidence does not support historical separation of gene lineages between *C. b. sandiegensis* and *C. b. anthonyi* populations (Teutimez 2012), but does indicate recent genetic differentiation of subpopulations, presumably due to habitat fragmentation (Barr et al. 2013).

Reproduction

Cactus wrens nest almost entirely in prickly pear or cholla between 3 and 6 feet tall (Hamilton et al. 2011), and averaging 4 to 5 feet tall within Southern California (Solek and Sziji 2004). Both male and female build the nest (Hamilton et al. 2011, ebird 2014). The female lays 3–5 eggs per clutch (Solek and Sziji 2004). Only the female incubates, which lasts for 16–17 days, and eggs hatch asynchronously (Hamilton et al. 2011, Solek and Sziji 2004). Nestlings fledge 17–23 days after hatching (Hamilton et al. 2011).

Dispersal, Territoriality, and Home Range

Adults show site fidelity to breeding areas, returning to the same area each year (Solek and Sziji 2004). Adults will lead juveniles to old breeding nests for use as roost nests, and eventually stop responding to begging calls to break dependency (Hamilton et al. 2011). Juveniles will disperse to nearby areas, the average distance approximately 1 mile, but the majority will stay within the site where they were hatched and establish territories (Preston and Kamada 2012). Juveniles typically complete only short-distance dispersal that can be negatively affected by fragmented habitat and non-cactus supporting lands (Teutimez 2012).

Adult may disperse short distances to foraging areas during the non-breeding season. Adults have been documented moving between 0.19 and 0.31 mile from breeding areas (Hamilton et al. 2011). Within Southern California, territories typically range from 1.2 to 4.9 acres (Solek and Sziji 2004). Larger territories have been recorded in drought conditions, when prey populations are depressed (Hamilton et al. 2011). Territories have been recorded as large as 16.6 acres (Hamilton et al. 2011).

Daily and Seasonal Activity

Cactus wren is a year-round, non-migratory resident of the Planning Area. Individuals typically do not make long distance seasonal movements (Hamilton et al. 2011, Solek and Sziji 2004). The breeding period is February to September (Table 3-33) (Hamilton et al. 2011, Simons and Martin 1990). However, adults build nests throughout the year for roosting (Solek and Sziji 2004).

Table 3-33. Seasonal Activity of Cactus Wren

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Breeding												

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Molt												

Sources: Hamilton et al. 2011, Solek and Sziji 2004

Diet and Foraging

Cactus wren forage on the ground or in low shrubs (Hamilton et al. 2011, Solek and Sziji 2004). Their diet consists mainly of insects, such as grasshoppers, ants, beetles, and wasps (Hamilton et al. 2011). As summarized in Solek and Sziji (2004), a stomach contents analysis concluded that vegetation may be important in the diet during months when insect prey is low.

Threats and Special Management Considerations

Habitat loss and fragmentation of habitat seem to have the largest impact on cactus wren (Solek and Sziji 2004, Preston and Kamada 2012). Development has removed large tracts of cactus and has fragmented what is left, which limits dispersal between patches of suitable habitat, creating isolated populations. Decreased gene flow could weaken a population's ability to adapt to changing environmental conditions and potentially lead to localized extinction (Hamilton et al. 2011, Preston and Kamada 2012). The species appears to be affected by edge-related habitat degradation, rather than aversion to the edge per se, which suggests that restoration of cactus scrub habitat along urban edges could be beneficial (Hamilton et al. 2011). Long recovery times for cactus after fire limit the species' ability to recolonize suitable habitat for long periods after fire; use of nest boxes may speed the process (Hamilton et al. 2011). Anthropogenic increase in cover of exotic grasses and forbs in scrub understory may decrease foraging efficiency (Hamilton et al. 2011).

Habitat throughout the Planning Area consists as a patchy distribution of coastal sage scrub habitat with extensive stands of cactus. Vegetation removal activities will reduce the amount of suitable habitat for this resident species, and it will be important to consider avoidance/restoration of cactus patches for conservation of this species in the Planning Area.

Yellow-Breasted Chat (*Icteria virens*)

Current Status and Distribution

Yellow-breasted chat (*Icteria virens*) is a California Species of Special Concern. It breeds in western North America (from the Great Plains and western Texas toward the west) (Shuford and Gardali 2008, ICF International 2014) and winters in Baja California and southern Texas south through western Mexico to Guatemala (Eckerle and Thompson 2001). In Southern California, the species is known to occur during migration and summer months from the coast east to the Colorado River (Shuford and Gardali 2008). Within the Planning Area, the species occurs sporadically within Riverside and San Bernardino Counties where suitable riparian habitat is present. The largest population is present in the Santa Ana River riparian corridor.

Habitat Requirements

Yellow-breasted chat is found in early successional riparian habitats that have developed shrub layer and an open canopy (Shuford and Gardali 2008). These habitats include riparian woodland and forest, and scrub dominated by cottonwoods, mulefat, and willows (Myers n.d.). Dense thickets are required for nest placement. These often consist of shrubby willows, wild grape (Myers n.d.),

and blackberry, tamarisk, and other species that form dense thickets (Shuford and Gardali 2008). Nests are usually built near waterways (Zeiner et al. 1990) along the borders of rivers, streams, and creeks (Shuford and Gardali 2008).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of yellow-breasted chat habitat and occurrences in the Planning Area are illustrated on Figure 3-51. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Potentially Suitable Habitat

- **Land Cover**: Western North American Disturbed Marsh, Wet Meadow, and Shrubland; Warm Southwest Riparian Forest; Warm Southwest Riparian Forest (Arroyo Willow); Warm Southwest Riparian Forest (Black Willow); Warm Southwest Riparian Forest (Elderberry); Warm Southwest Riparian Forest (Fremont Cottonwood); Warm Southwest Riparian Forest (Red Willow); Warm Southwest Riparian Forest (Sandbar Willow); Warm Southwest Riparian Forest (Shining Willow); Warm Southwest Riparian Forest (Sycamore); Warm Southwest Riparian Forest (White Alder); and Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland; **AND**
- **NWI and SoCal Wetlands hydrology attribute modifier**: Semi-permanently flooded (regardless of Land Cover type).

Taxonomy and Genetics

Two subspecies exists for *Icteria virens: I. v. virens* in eastern North America and *I. v. auricollis* in western North America.

Reproduction

Adults begin building nests in early to mid-May and chicks usually fledge by early August (Eckerle and Thompson 2001, Dudek and Associates 2003a). Females construct a cup nest between 3 and 6 feet from the ground (Myers n.d.). Females incubate a single clutch of 3–6 eggs (Myers n.d.) for 11–15 days (Zeiner et al. 1990). Young are altricial, hatching without down feathers and unable to nourish themselves, and are fed by both parents until they fledge at 8–11 days (Zeiner et al. 1990, McKibbin and Bishop 2012a).

Dispersal, Territoriality, and Home Range

Literature on juvenile dispersal, territoriality, and home range is limited. As summarized in Eckerle and Thompson. (2001), studies indicate a lack of strong fidelity to return to hatch site to breed. A study found that approximately half of banded nestlings returned to their natal site to breed (McKibbin and Bishop 2012a). For those that did not return to natal site, dispersal ranged from 2.5–15.6 kilometers for males and 2.3–2.6 kilometers for females (McKibbin and Bishop 2012a). The dispersal distance for adult males that did not return to their previous territory ranged from 6.4–42.9 kilometers (McKibbin and Bishop 2012a).

Territorial responses appear to decrease as pairs tend to congregate in an area as population densities increase (Eckerle and Thompson 2001). Studies in the eastern U.S., including Indiana,

report the average territory size to be 0.3–3.1 acres (Eckerle and Thompson 2001). In British Columbia, breeding territories were on average 1.5 acres based on singing male locations, but averaged 2.9 acres based on radio telemetry (McKibbin and Bishop 2012b).

Daily and Seasonal Activity

During spring migration, yellow breasted chat arrives in Southern California early to mid-April and departs for fall migration back to wintering areas in late August into early September (Eckerle and Thompson 2001). Table 3-34 summarizes seasonal activity.

Table 3-34. Seasonal Activity of Yellow-Breasted Chat

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wintering												
Breeding												
Migration												
Molt												

Source: Eckerle and Thompson 2001.

Diet and Foraging

Yellow-breasted chat forages by gleaning (Zeiner et al. 1990), taking invertebrates from the surface of foliage or the ground. Diet consists primarily of insects and spiders. Fruits and berries, such as elderberries, blackberries, and wild grape, may also be eaten (Shuford and Gardali 2008, Eckerle and Thompson 2001, Myers n.d.). Invertebrate prey includes beetles, ants, weevils, bees, wasps, mayflies, and caterpillars (Eckerle and Thompson 2001, Myers n.d.). Young are fed soft-bodied invertebrates, including adult and larval insects (Eckerle and Thompson 2001, Myers n.d.).

Threats and Special Management Considerations

Habitat loss and habitat degradation are the primary threats to the species. Removal of vegetation for development, agriculture, or flood control maintenance are the driving forces behind habitat removal (Myers n.d.). Nest parasitism by brown-headed cowbirds is also a contributing factor to the decline of the species (Myers n.d., Zeiner et al. 1990).

Suitable habitat for the species is found throughout the Planning Area within riparian vegetation in and along rivers, creeks, and flood control basins. The most important limiting factor of populations appears to be habitat. Consequently, the maintenance of early successional shrub-scrub habitat is essential. Mature forests with a closed canopy preclude breeding by this species due to the lack of understory. It requires thick vegetation for nesting, and this should be considered when performing activities that alter habitat. Human activity in the vicinity of a nest can cause abandonment of the egg and nestlings by the adults.

Western Yellow-Billed Cuckoo (*Coccyzus americanus*)

Current Status and Distribution

Western yellow-billed cuckoo (*Coccyzus americanus*) is federally listed as threatened and state-listed as endangered. In California, only three core areas support breeding yellow-billed cuckoo: the

Sacramento River between Colusa and Red Bluff, the South Fork of the Kern River, and the lower Colorado River (McNeil and Tracy 2013). The most recent breeding record from the Planning Area is Prado Basin in 1989 (ICF 2014). There are historical occurrences documented within the Santa Ana River (1930 and 1977) and San Timoteo Creek, with sporadic migrants recorded in San Bernardino and Riverside County (USFWS 2014, ICF 2014, Dudek & Associates. 2003a). In August 2014, USFWS proposed designating critical habitat within the Prado Flood Control Basin (Unit 6) in the Planning Area and revised this designation in 2020 (85 *Federal Register* 11458).

Habitat Requirements

For breeding, especially along the Lower Colorado River, the species is often found in structurally complex mature riparian habitats with tall trees and a dense woody vegetative understory, typically near waterways and dominated by willows and cottonwoods (Laymon 1998, Hughes 1999). In contrast, at the Palos Verde Ecological Reserve restoration site on the Lower Colorado River, cuckoos appear to favor the young, 2- to 3-year-old cottonwood-willow habitat (McNeil et al. 2011). Other studies have shown habitats ranging from monotypic salt cedar with no differentiated understory, linear strips of open and mixed native and nonnative habitat, small isolated patches of mature cottonwood/willow riparian, and very open habitat without understory and small clusters of mature cottonwoods. Canopy height typically ranges from 15 to 100 feet, and the understory ranges from 3 to 20 feet (Dudek & Associates 2003). USFWS description of critical habitat PBFs includes riparian woodlands, prey base consisting of large insect fauna and tree frogs, and dynamic riverine processes that encourage sediment movement and deposits to facilitate plant growth (USFWS 2014).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of western yellow-billed cuckoo habitat and occurrences in the Planning Area are illustrated on Figure 3-52. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

High Value Breeding Habitat

- **Land Cover**: Interior Warm and Cool Desert Riparian Forest; **AND**
- Patches of the above selected vegetation must be at least 328 feet in width and *at least* 200 acres in size.

Other Potentially Suitable Breeding Habitat

- **Land Cover**: Interior Warm and Cool Desert Riparian Forest; **AND**
- Patches of the above selected vegetation must be at least 328 feet in width and *less than* 200 acres in size.

Taxonomy and Genetics

Recent research on yellow-billed cuckoo genetics did not indicate sufficient genetic differences between eastern and western yellow-billed cuckoos to support two separate subspecies (USFWS 2014). However, existing DNA studies show sufficient divergence to determine that cuckoos that nest in the western North America are a biologically distinct population segment (USFWS 2014).

Reproduction

Western yellow-billed cuckoo breeding occurs from June through August but may begin as early as May. Both male and female adults construct a flat, loose platform stick nest (Hughes 1999). Nests are built on horizontal branches. Nest height varies from 2–88 feet (Hughes 1999, Dudek & Associates 2003), and on the Santa Ana River varies from 4–30 feet (14-foot average) (Laymon 1998). Incubation is shared by both adults, which lasts 9–12 days. Nestlings are fed by both parents and fledge 5–9 days after hatching (Laymon 1998, Hughes 1999). Cuckoos are an occasional nest parasite, and there is documentation of their laying eggs in other *C. americanus* nests (Hughes 1999).

Dispersal, Territoriality, and Home Range

Cuckoo adults show high breeding site fidelity and have been documented returning to the same to breed for at least three consecutive seasons (McNeil et al. 2011, USFWS 2014). Two females dispersed 21 and 24 miles to other sites along the same reach of the Colorado River (USFWS 2014).

Home ranges are large, variable in size depending on seasonal food abundance, and overlap between neighboring pairs (McNeil and Tracy 2013). Recent radio telemetry has documented home ranges between 95 and 204 acres (McNeil and Tracy 2013).

Daily and Seasonal Activity

Western yellow-billed cuckoo migrates in the spring and arrives in California as early as mid to late May (Hughes 1999), but typically arrives in June (Laymon 1998). The species' non-breeding range is believed to be the western side of the Andes in South America (Hughes 1999). Departure for fall migration begins in August, but peaks in September (Laymon 1998). Seasonal activity is depicted in Table 3-35.

Table 3-35. Seasonal Activity of Western Yellow-Billed Cuckoo

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wintering												
Breeding												
Migration												
Molt												

Source: Hughes 1999

Diet and Foraging

Cuckoos are insectivorous and forage by gleaning, usually while perched (Dudek & Associates 2003, Laymon 1998), taking invertebrates from the surface of foliage. Their diet consists primarily of cicadas, katydids, grasshoppers, crickets, and caterpillars (Hughes 1999, Laymon 1998). Adults feed nestlings whole prey items, which consist primarily of caterpillars (Hughes 1999).

Threats and Special Management Considerations

Habitat loss and fragmentation due to flooding behind dams, clearing, water table lowering, and invasion by exotic vegetation are the primary threats to the species (Laymon 1998). Groundwater

depletion that results in reduction of groundwater-depending riparian vegetation (e.g., cottonwood, willow, and valley oak) can further fragment and reduce this species' available suitable habitat (Rohde et al. 2019).

Suitable nesting habitat with the appropriate acreage is limited within the Planning Area. Large-scale restoration activities have been shown to be an effective management technique for this species, where their use has been documented within 2 years. Areas with the most recent documentation of occurrences, such as Prado Basin, could be considered for such restoration efforts.

Other Relevant Information

Little is known about the migration route of the western yellow-billed cuckoo. Conservation of riparian corridors within the Planning Area may be considered for this species as migration between summer and wintering areas. The most recent statewide survey (1999 to 2000) indicates a population decline with a contraction of the range to the core areas of occurrence along the Sacramento, Kern, and Colorado Rivers (McNeil and Tracy 2013). When compared to earlier statewide surveys (1977 and 1987), there was an absence of yellow-billed cuckoos at isolated sites in the Prado Flood Control Basin, the Mojave and Armargosa Rivers, and the Owens Valley in Inyo County where it had previously bred (McNeil and Tracy 2013). The lower Eel River in Humboldt County may prove to be a newly documented breeding site.

Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

Current Status and Distribution

The southwestern willow flycatcher (*Empidonax traillii extimus*) is federally and state listed as endangered and has a breeding range that includes Southern California; southern Nevada; southern Utah, Arizona, and New Mexico; and southwestern Colorado (Sogge et la. 2010). Occurrences recorded in the Planning Area since 2004 are in Cajon Wash, Waterman Creek, Day Canyon, Santa Ana River (north of Crafton Hills), San Timoteo Canyon, Santa Ana River Prado Basin, English Creek, Little Sand Canyon, and southwest of McKinley Mountain (northeast of San Bernardino) (ICF 2014, USFWS 2013).

Habitat Requirements

In Southern California, the southwestern willow flycatcher is restricted to riparian habitat along rivers, streams, or other wetlands where an adequate prey base is present (USFWS 1995). Suitable habitat typically consists of dense tree or shrub cover (≥ 10 feet) with dense twig structure and foliage, and may include interspersed patches of open habitat (USFWS 1995, Sogge et al. 2010). Vegetative composition can range from all native species to a mix of native and nonnative species or monotypic stands of nonnative species, but almost always includes willow (*Salix* spp.) and/or tamarisk (*Tamarix* sp.) (Sogge et al. 2010, USFWS 2013). Nests are located near surface water or saturated soils; water availability at a site may range from inundated to dry from year to year or within the breeding season (Sogge et al. 2010). Riparian habitats lacking suitable conditions and adjacent to territories may function as secondary habitat used for foraging.

Distribution of Habitat and Occurrences in the Planning Area

Distribution of southwestern willow flycatcher habitat and occurrences in the Planning Area are illustrated on Figure 3-53. The habitat distribution model combines an existing regional model

developed by USGS (Hatten 2016) that identifies and ranks core habitat and adds other areas of potentially suitable habitat based on wildlife habitat relationships.[2] The Hatten (2016) model was limited to the extent of potentially suitable land cover types as identified below.

Potentially Suitable Habitat

Land Cover: Western North American Disturbed Marsh, Wet Meadow, and Shrubland; Warm Southwest Riparian Forest; Warm Southwest Riparian Forest (Arroyo Willow); Warm Southwest Riparian Forest (Black Willow); Warm Southwest Riparian Forest (Elderberry); Warm Southwest Riparian Forest (Fremont Cottonwood); Warm Southwest Riparian Forest (Red Willow); Warm Southwest Riparian Forest (Sandbar Willow); Warm Southwest Riparian Forest (Shining Willow); Warm Southwest Riparian Forest (Sycamore); Warm Southwest Riparian Forest (White Alder); Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland.

The Hatten model output is displayed within the riparian habitat as defined above.

The potentially suitable habitat was then classified into the following habitat suitability categories by ranking highest value to lowest value based on the Hatten (2016) model scores and critical habitat delineations:

- **Core Southwestern Willow Flycatcher Habitat**: Potentially suitable habitat within southwestern willow flycatcher final critical habitat
- **Very High Value Habitat**: Hatten model highest score
- **High Value Habitat**: Hatten model next highest score
- **Moderate Value Habitat**: Hatten model next highest score
- **Other Potentially Suitable Habitat**: Potentially suitable habitat not mapped in the very high, high, and moderate value habitat classes of the Hatten model.

Taxonomy and Genetics

The southwestern willow flycatcher is one of four currently accepted subspecies of the willow flycatcher (*Extimus traillii*) in North America (USFWS 2002). Genetic research has determined that southwestern willow flycatcher (*E. t. extimus*) is a distinct subspecies (Paxton 2000).

Reproduction

The southwestern willow flycatcher is predominantly monogamous, although some populations have high rates of polygyny (Paxton et al. 2007). Breeding typically begins in early June (few in early May). The female builds the nest with little to no assistance from the male. Up to two clutches are produced each season; re-nesting rates are higher for pairs following an unsuccessful breeding attempt (Ellis et al. 2008). Clutch size is typically 3–4 eggs and decreases with each re-nesting attempt (Sogge et al. 2010, Ellis et al. 2008). The female incubates eggs for 12–13 days after the last egg is laid. Chicks leave the nest within 12–15 days of hatching. Initially the female provides the

[2] The Hatten (2016) Southwestern Willow Flycatcher Model is a statistical model that integrates GIS, Landsat TM data, and logistic regression. Input variables include floodplain size, vegetation density, and variation in vegetation density and amount of dense vegetation. Output of the Hatten model is categorized and ranked into classes of habitat value. See Hatten (2016) for further information.

majority of care for the young; the male's role increases with the age of the nestlings. Both parents will feed fledglings for about 2 weeks (Sogge et al. 2010).

Dispersal, Territoriality, and Home Range

Most adult flycatchers return to the same drainage from one year to the next, often near their previous breeding site; however, movement to different breeding sites from year to year is not uncommon. Dispersal can range from 0.1–450 kilometers. First year birds tend to disperse farther distances than adults, on average 11 kilometers farther (Sogge et al. 2010, Paxton et al. 2007).

Males establish and defend territories aggressively. Females usually arrive 1 or 2 weeks after males and settle on established territories; the territory is likely chosen based on the characteristics of the site rather than those of the male (Sogge et al. 2010). Territories tend to be larger early in the season and become smaller after pairing occurs (Sogge et al. 2010, Finch and Stoleson 2000). Territory sizes vary depending on the habitat quality, food availability, population density, and pairing/nesting stage. Typically territories range from 0.2 to 5.7 acres (Sogge et al. 2010).

Daily and Seasonal Activity

Individuals typically arrive on breeding grounds by early May (very few in late April); males typically arrive a few weeks before females (USFWS 2002, Sogge et al. 2010). Pairs with fledglings may stay as late as late-August to early-September. Unpaired males may leave the breeding grounds as early as mid-July (USFWS 2002). Seasonal activity is depicted in Table 3-36.

Table 3-36. Seasonal Activity of Southwestern Willow Flycatcher

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wintering												
Breeding												
Migration												

Source: USFWS 2002

Diet and Foraging

The southwestern willow flycatcher is an insectivore generalist and forages on external edges or internal opening of its territory (sometime in neighboring territories), above the canopy or over open water (Finch and Stoleson 2000). Adult diets consist mainly of arthropods: bees, wasps, flies, leaf hoppers, and beetles (Durst et al. 2008), which it catches in the air, gleams from vegetation, or picks from the ground. Variations in diet can occur based on the quality of its territory or weather conditions (Durst 2004).

Threats and Special Management Considerations

The primary threat to southwestern willow flycatcher is the loss, modification, and fragmentation of suitable riparian habitat, caused primarily by dams and reservoirs, water diversion and ground water pumping, channelization, flood control, agriculture, recreation, and urbanization (Durst et al. 2008). Changes in groundwater levels can result in overall reduction in water availability during breeding and nesting seasons, which can particularly affect this species (Rohde et al. 2019). Tamarisk (*Tamarix* spp.), which has invaded riparian habitats in part due to anthropogenic

disturbances, is highly flammable and poses a threat to riparian habitat. The reduction of flow of water through riparian habitat, due to the dams and flood control, allows for the buildup of fuel in the understory, which increases the risk of fire (USFWS 2002) and reduces the natural processes of recruitment and fluvial disturbance.

Major stressors on the species, such as destruction of riparian habitat, manipulation of groundwater and surface water, livestock and other agricultural practices, and floodplain and watershed alterations, must be managed and/or minimized in areas of suitable habitat (USFWS 2002). Monitoring and surveying efforts in the Planning Area should continue in order to maintain current information regarding the population size, breeding status, and distribution of this species. Important considerations when managing and creating riparian habitat are inundation timing, plant species proportions, and plant genotypes, which can influence the arthropod prey base.

Other Relevant Information

Brown-headed cowbirds (*Molothrus ater*), which are obligate brood parasites, also contribute to overall nest failure for southwestern willow flycatcher; however, they are not considered a primary threat (Durst et al. 2008). Nonetheless, short-term cowbird control practices, such as trapping, as well as long-term management practices, with an emphasis on reducing conditions known to attract cowbirds, including horse stables, agricultural fields, and golf courses, should be implemented (USFWS 2002, Finch and Stoleson 2000).

Coastal California Gnatcatcher (Polioptila californica californica)

Current Status and Distribution

The coastal California gnatcatcher (*Polioptila californica californica*) is federally listed as threatened and is a California Species of Special Concern. This species occurs in the following locations within the Planning Area: (1) San Bernardino County: Etiwanda Fan, Lytle Creek Wash, Cajon Wash, Cable Creek Wash, Santa Ana River Wash, Mill Creek, Reche Canyon (Jurupa Hills, Blue Mountain), and Chino Hills; and (2) Riverside County: Reche Canyon, Lake Matthews, Gavilan Hills, Norco Hills, Arroyo Del Torro-Temescal Wash (Lake Elsinore, Wasson Canyon), Alberhill/Lake Elsinore (Walker Canyon, Lake Elsinore Clay Mines), and Temescal Valley (ICF 2014, USFWS 2014, eBird 2012).

Habitat Requirements

Coastal California gnatcatcher occurs in Venturan, Riversidian, and Diegan coastal sage scrub (Atwood 1993). Suitable coastal sage scrub typically includes *Artemisia californica*, *Eriogonum fasciculatum*, *Encelia californica*, *E. farinosa*, and various species of *Salvia* (Beyers and Wirtz 1997). Nest success, fledgling survival, and adult survival are positively correlated with robust vertical and horizontal perennial structure, and suitable nest patches can be significantly different among pairs (Braden 1999). USFWS description of critical habitat PCEs includes dynamic and successional sage scrub habitats and nearby non-sage scrub habitats such as chaparral, grassland, and riparian areas to provide space for dispersal, foraging, and nesting (USFWS 2007).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of coastal California gnatcatcher habitat and occurrences in the Planning Area are illustrated on Figure 3-54. As part of the San Diego Multi-Species Management Plan (SDMMP) to conduct long-term coordinated monitoring of the gnatcatcher across the species' range, a statistical

habitat distribution model was developed (Preston and Kus 2015). The results of the SDMMP model were applied to areas mapped as Californian Coastal Scrub and North American Warm-Desert Xeric-Riparian Scrub land cover types within the Planning Area, and habitat value was categorized based on the scores of the SDMMP model as follows:

- Very High Value Habitat = 0.75–1.00
- High Value Habitat = 0.50–0.74
- Moderate Value Habitat = 0.25–0.49
- Low Value Habitat = 0–0.24
- **Other Suitable Habitat**: Includes the above vegetation types within the species range but *not* captured by the SDMMP model.
- **Post-processing**: Areas mapped as developed or agriculture in the Upper SAR HCP land cover data were removed from the model results.

Taxonomy and Genetics

One of three species of California gnatcatcher, the Coastal California gnatcatcher (*P. c. californica*) is the northernmost subspecies of California gnatcatcher. Other subspecies (*P. c. pontilis* and *P. c. margaritae*) are located in Baja California (Atwood 1993).

Reproduction

The Coastal California gnatcatcher is monogamous. The breeding season occurs from mid-February to August. Both males and females nest build, incubate, and care for altricial young. Egg laying is highest April through May. Incubation is 14–15 days, clutch size ranges from 2–5 eggs, and chicks fledge 16 days after hatching (USFWS 2010d). Reproductive success is dependent on habitat condition, predator populations, and food availability.

Dispersal, Territoriality, and Home Range

The Coastal California gnatcatcher is a permanent resident and does not migrate. This species tends to remain in the same home range from year to year and disperses only as far as necessary to find unoccupied areas within suitable habitat patches (Atwood 1993, Braden 1999). This species' natal dispersal is largely connected with corridors of native vegetation. Juveniles generally disperse approximately 1.4 miles from their natal site depending on habitat availability and condition (Bailey and Mock 1998). The pair of gnatcatchers defends their home range. Density of shrub cover, composition of plants, habitat quality, surrounding disturbances, and adjacent gnatcatcher territories dictate the size of a territory (Kucera 1997). The size of a territory ranges between 2 and 14 acres (USFWS 2010d), typically on lower elevations along coast ranges or on gentle slopes.

Daily and Seasonal Activity

The Coastal California gnatcatcher is diurnal and is active yearlong. The species' highest activity is in the morning. Daily activity is dependent on the condition of occupied coastal sage scrub. Poor quality coastal sage scrub results in an expansive home range. Foraging can occur in adjacent vegetation communities (e.g., riparian and chaparral), especially in the non-breeding season. During

the breeding season, home range becomes smaller (Atwood 1993). Seasonal activity is depicted in Table 3-37.

Table 3-37. Seasonal Activity of Coastal California Gnatcatcher

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Breeding												
Dispersal												
Molt												

Sources: Atwood 1993, Atwood and Bontrager 2001

Diet and Foraging

Coastal California gnatcatcher typically gleans insects from vegetation, primarily *Artemisia* and *Eriogonum* (Atwood 1993) and may also eat some seeds (Kucera 1997). The species' foraging range is dependent on condition of coastal sage scrub (variation of plant species and shrub cover), food availability, and time of year (breeding season vs. non-breeding season) (Atwood 1993).

Threats and Special Management Considerations

The primary threat to coastal California gnatcatcher is loss of habitat due to urban and agricultural development. Wildfires, nest predators, and brood parasitism by brown-headed cowbirds have potential to debilitate population viability (Atwood 1993). Successful conservation of the species is dependent on restoring or enhancing areas of fragmented coastal sage scrub throughout the Planning Area so that increased shrub cover and improved habitat quality supports dispersing individuals. Expansion of corridors connecting good quality coastal sage scrub allows for a greater exchange of genetic material. Expanding/connecting areas of coastal sage scrub between Lytle Creek and the Etiwanda Fan, Lake Matthews, and other areas that are currently fragmented would promote the overall viability of the species within the Planning Area. Coastal sage scrub restoration areas should include higher density of *Artemisia californica* and *Eriogonum fasciculatum*, as there seems to be a strong correlation between these species and occupied habitat (likeliness to use as nest substrate and greater food supply). Additionally, wildfires are fueled by drought-tolerant coastal sage scrub. Fire management along the foothills of the San Bernardino and San Gabriel Mountains and areas of critical habitat throughout the Planning Area should be carefully considered.

Other Relevant Information

The highest densities of coastal California gnatcatcher are known to occur in the upper Santa Ana River, Lake Matthews Watershed, the foothills of the San Bernardino mountains (Etiwanda Fan, Lytle Creek, Cable Creek), and Temescal Wash. Riversidian coastal sage scrub with greater than 50% shrub cover has the highest potential to support successful nesting and high quality foraging grounds. Home ranges or territory sizes are dependent on density of shrub cover, composition of plants, habitat quality, surrounding disturbances, and adjacent gnatcatcher territories. Poor quality coastal sage scrub increases dispersal and overall home range size.

Least Bell's Vireo (*Vireo bellii pusillus*)

Current Status and Distribution

Least Bell's vireo (*Vireo bellii pusillus*) is listed as federally and state endangered. The species is found throughout Southern California during the breeding season, from Santa Barbara County southward, with the largest populations in San Diego and Riverside Counties (USFWS 2006). The species is distributed throughout the Planning Area where suitable riparian habitat is present, with large core populations in the Prado Basin portion of the Santa Ana River (ICF 2014).

Habitat Requirements

Suitable habitat is largely associated with early successional (5- to 10-year-old) riparian scrub and woodlands that have developed canopy layer and dense shrubs at 3–6 feet (Franzreb 1989). Habitat is typically dominated by species such as mulefat, willows, cottonwood, and Mexican elderberry (Kus 2002). Nesting habitat in California is characterized by a dense shrub layer 2–10 feet aboveground, and the species can use any age riparian habitat if such an understory is present (Franzreb 1989, Kus 2002). Breeding birds are also found in isolated riparian patches (>0.20 acre) with no discernable over-story canopy and limited understory structure (Braden 2015). USFWS description of critical habitat PBFs includes riparian woodland vegetation that generally contains both canopy and shrub layers, and some associated upland habitats (USFWS 1994).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of least Bell's vireo habitat and occurrences in the Planning Area are illustrated on Figure 3-55. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Core Breeding Habitat

- **Land Cover**: Western North American Disturbed Marsh, Wet Meadow, and Shrubland; Warm Southwest Riparian Forest; Warm Southwest Riparian Forest (Arroyo Willow); Warm Southwest Riparian Forest (Black Willow); Warm Southwest Riparian Forest (Elderberry); Warm Southwest Riparian Forest (Fremont Cottonwood); Warm Southwest Riparian Forest (Red Willow); Warm Southwest Riparian Forest (Sandbar Willow); Warm Southwest Riparian Forest (Shining Willow); Warm Southwest Riparian Forest (Sycamore); Warm Southwest Riparian Forest (White Alder); Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland; **AND**
- **NWI and SoCal Wetlands hydrology attribute modifier:** Semi-permanently flooded (regardless of Land Cover type); **AND**
- Within final critical habitat.

Other Breeding Habitat

- **Land Cover**: Western North American Disturbed Marsh, Wet Meadow, and Shrubland; Warm Southwest Riparian Forest; Warm Southwest Riparian Forest (Arroyo Willow); Warm Southwest Riparian Forest (Black Willow); Warm Southwest Riparian Forest (Elderberry); Warm Southwest Riparian Forest (Fremont Cottonwood); Warm Southwest Riparian Forest

(Red Willow); Warm Southwest Riparian Forest (Sandbar Willow); Warm Southwest Riparian Forest (Shining Willow); Warm Southwest Riparian Forest (Sycamore); Warm Southwest Riparian Forest (White Alder); Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland; **AND**

- **NWI and SoCal Wetlands hydrology attribute modifier**: Semi-permanently flooded (regardless of Land Cover type).

Taxonomy and Genetics

Least Bell's vireo is one of four subspecies of Bell's vireo (*Vireo belli*). All subspecies breed in different areas of the U.S. and winter in Mexico (Franzreb 1989).

Reproduction

Least Bell's vireo breeds monogamously. Males arrive mid-March to establish and defend breeding territories. Nests are built in dense shrubs along the edge of riparian habitat (USFWS 1998). Nests are typically placed below approximately 6.5 feet from the ground. In the Planning Area, nests were most common in willow species (48%) and mulefat (29%) (SAWA 2019). Courtship, pair-bonds, and full nesting occurs while the male actively defends the breeding territory. Both adults incubate for 14 days and feed chicks. Clutch size is 3–5 eggs, and pairs often produce two broods (Franzreb 1989). Young fledge in 10–12 days, but are tended by adults for up to 40 days. Fledglings disperse gradually from the natal site.

Dispersal, Territoriality, and Home Range

Birds have a high breeding site fidelity in that an individual will return to breed in the same area from year to year (Franzreb 1989). Juveniles disperse from their natal site gradually: 10–100 meters between the first 14 days after fledging and approximately 1.6 kilometer from the natal site by the time of the second brood (Kus et al. 2010). Individuals are capable of long-distance dispersal, perhaps over 350 kilometers (217 miles) (Howell et al. 2010).

Males aggressively defend breeding territories through all reproductive stages. Breeding territories expand and contract based on the nest cycle stage, with wider territories while a male is unpaired and as fledglings begin to forage. Territories contract when a male is mated and the pair is incubating (Kus et al. 2010). Breeding territories vary from 0.37 to 4.1 acres depending on location (Franzreb 1989). Along the Santa Ana River, breeding territories range from 0.75–3.2 acres (Kus et al. 2010).

Daily and Seasonal Activity

Least Bell's vireo are mostly active during the day (diurnal). Daily activity includes foraging by hopping amongst vegetation between branches while foraging (Kus 2002). Seasonal activity includes defense of breeding territory by males during nesting season. Migration occurs in April–May and August–November from Southern California to overwintering areas in Baja California and along the Pacific slope of Central America to north-central Nicaragua (Table 3-38) (Franzreb 1989, Kus et al. 2010).

Table 3-38. Seasonal Activity of Least Bell's Vireo

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wintering												
Breeding												
Migration												
Molt												

Source: Franzreb 1989

Diet and Foraging

Least Bell's vireo is an insectivore. Foraging behavior includes gleaning, hovering, and hawking (fly-catching behavior) insects from all riparian vegetation levels, up to 20 meters (65 feet) above the ground, with activity concentrated in lower to mid-canopies during breeding (Kus 2002). During the nesting season, foraging is typically restricted to the breeding territory. Non-riparian habitat adjacent to the breeding territory is utilized as foraging habitat toward the end of the nesting season (Franzreb 1989).

Threats and Special Management Considerations

Predominant threats to the species include loss of riparian habitat, degradation of riparian habitat, and brood parasitism by brown-headed cowbird (Franzreb 1989). Changes in groundwater levels can result in overall reduction in water availability during breeding and nesting seasons, which can particularly affect this species (Rohde et al. 2019). Successful conservation of the species is dependent on restoring or enhancing areas of fragmented and degraded riparian habitat so that successional habitat can support dispersing and returning individuals. In the Planning Area, areas such as the Prado Basin and Santa Ana River should continue annual brown-headed cowbird trapping to decrease brood parasitism. Establishment and recruitment of riparian habitat is dependent on natural hydrological processes, and changes to those processes can alter the distribution and species composition of riparian habitat, which in turn could affect breeding suitability and reproductive output.

Los Angeles Little Pocket Mouse (Perognathus longimembris brevinasus)

Current Status and Distribution

Los Angeles little pocket mouse (*Perognathus longimembris brevinasus*) is a California Species of Special Concern. Its distribution is restricted to Southern California. Historically, it was found from San Fernando east through San Bernardino and Riverside to Cabazon, south through Temecula to Aguanga (Williams 1986, Bolster 1998). It has been documented in the northern portion of the Planning Area, almost entirely within San Bernardino County, with some occurrences in Riverside County (ICF 2014).

Habitat Requirements

Generally, habitat consists of alluvial, aeolian, or well-drained upland deposits of sandy soil in sparsely vegetated habitats (Dudek & Associates 2003). These habitats are generally lower elevation sparse grassland, alluvial sage scrub, and coastal sage scrub (Bolster 1998). Foraging occurs under

shrub cover or near rock crevices (Dudek & Associates 2003). In Riverside County, trapping data suggests that habitat dominated by bare ground is more frequently occupied than habitat dominated by litter and grass thatch (WRMSHCP 2011).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of Los Angeles little pocket mouse habitat and occurrences in the Planning Area are illustrated on Figure 3-56. The following modeled habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type.

Potentially Suitable Habitat

- **Land Cover**: Californian Coastal Scrub; Californian Annual and Perennial Grassland; Californian Disturbed Grassland, Meadow, and Scrub; North American Warm-Desert Xeric-Riparian Scrub; Great Basin-Intermountain Xeric-Riparian Scrub; **AND**
- **Soil Texture**: Sand; sandy loam; coarse sand; coarse sandy loam; fine sand; fine sandy loam; loamy sand; loamy coarse sand; loamy fine sand; river wash; very fine sandy loam; **AND**
- **Landform**: alluvial fans; alluvial flats; floodplains; foothills, terraces, and uplands; also drainageways regardless of land cover type; **AND**
- **Elevation**: 0–3,000 feet; **AND**
- **Slope**: 0–10%.

Taxonomy and Genetics

Los Angeles little pocket mouse is one of eight subspecies of *P. longimembris* found in California. Subspecies *P. l. pacificus,* is federally endangered. *P. l. brevinasus* is physically distinguished from other *P. longimembris* subspecies by a short rostrum (Bolster 1998).

Reproduction

Individuals breed once, typically April–June, but can extend breeding season and have more litters. Reproduction appears correlated with rainfall and seed availability, which can result in substantial population fluctuations (USFWS 2010e). Reproductive males and females have been observed as early as February and continue through September, with the peak of breeding occurring May–July (Dudek & Associates 2003). Litters consist of 3 to 4 pups.

Dispersal, Territoriality, and Home Range

The data on Los Angeles little pocket mouse is limited. Studies done on *P. longimembris* show high site fidelity, with individuals trapped from year to year as close as 50 feet from previous detections. Studies from similar subspecies, *P. l. pacificus,* showed first year individuals dispersing a mean distance of 62 feet (Dudek & Associates 2003).

Individuals are solitary, with home ranges typically overlapping during the breeding season. A study of *P. longimembris* demonstrated that home ranges averaged 0.25–1.2 acres, with an average of 0.74 acre. Average home ranges are 1.2–7.6 acres for females and 0.7–4.7 acres for males (Dudek & Associates 2003).

Though dispersal and home ranges are relatively small (generally no more than 8 acres per individual), corridors for dispersal between populations are important for the health and survival of the species. Disconnection between populations limits gene flow, which may prevent populations from adapting to changing environmental conditions.

Daily and Seasonal Activity

Los Angles little pocket mouse is primarily nocturnal, being active and emerging at night (Dudek & Associates 2003, WRMSHCP 2011). The species uses torpor to decrease body temperature and metabolic rate to conserve energy. It remains belowground in burrows from September to March (USFWS 2010e). However, timing and duration of activity cycles can vary across seasons and appear to be a function of soil temperature, food availability, and ambient air temperature; aestivation (dormancy) has been recorded in June (USFWS 2010e). May and June are peak months for surface activity (WRMSHCP 2011). Seasonal activity is depicted in Table 3-39.

Table 3-39. Seasonal Activity of Los Angeles Little Pocket Mouse

Life Stage/Activity Period[1]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hibernation												
Peak Surface Activity												
Breeding												

Sources: Dudek & Associates 2003, WRMSHCP 2011, USFWS 2010e
[1]Timing and duration of seasonal activity can vary depending upon site conditions (e.g., soil temperature, food availability, ambient air temperature)

Diet and Foraging

Los Angeles little pocket mouse is primarily a granivore (seed eater), and may prefer to feed on grass and forb seeds (Dudek & Associates 2003). Although a strong seed specialist, it may seasonally eat forbs and rarely insect larva and arthropods (Bolster 1998). Los Angeles little pocket mouse forages on the ground under the low canopy of shrubs and trees, using fur–lined cheek pouches to gather food. It stores seeds in underground caches (Dudek & Associates 2003).

Threats and Special Management Considerations

The main threat to the species is habitat loss due to urban and suburban development, agriculture, sand and gravel mining, and flood control projects (Bolster 1998, Dudek & Associates 2003, WRMSHCP 2011). Fragmentation of habitat caused by this habitat loss creates isolated populations that limit dispersal, causing a decrease in gene flow that could lead to localized extinction (Dudek & Associates 2003). Plant species that are food sources for Los Angeles little pocket mouse may be adversely affected by changes in groundwater management regimes. Changes in groundwater levels may also affect soil substrates, which would affect the availability of forage (Rohde et al. 2019).

Suitable habitat for this species is found throughout the Planning Area. Based on occurrence information, habitat suitability appears linked to the presence of sandy terraces associated with rivers and creeks. These areas experience infrequent flood events that remove excess vegetation, grass thatch, and litter to maintain the open sandy soils preferred by this species. Any activities that might change the flood event frequency could have a negative effect on the species. The allocation and conservation of large areas of habitat should be considered to prevent continued decline in

distribution and abundance. This species responds well to management activities, such as fire (WRMSHCP 2011) and presumably mechanical removal that takes out excess shrub vegetation and groundcover to expose open sandy substrates. This species has limited periods when it is active at the surface, which must be considered for any monitoring program that is established. As for the established trapping technique, at 20 locations with both trapping grids (standard 10x10, 100 trap grids) and standard herp arrays, San Bernardino County Museum captured nine individuals in herp arrays but not in the associated grids. Conversely, in only one case did arrays paired with grids fail to capture individuals when grid results were positive. The results strongly suggest arrays, versus Sherman traps, may be the better sampling technique for this species (Braden pers. comm.).

San Bernardino Merriam's Kangaroo Rat (*Dipodomys merriami parvus*)

Current Status and Distribution

San Bernardino Merriam's kangaroo rat (*Dipodomys merriami parvus*) is federally listed as endangered and is proposed for listing under the California Endangered Species Act. Prior to emergency listing, the San Bernardino County Museum estimated the historic range at 28,000 acres. At the time of the final listing, USFWS determined that only about 9,797 acres appeared to be suitable in three primary locations: (1) Santa Ana River (3,861 acres), (2) Lytle Creek and Cajon Wash (5,161 acres), and (3) San Jacinto River (775 acres), with smaller amounts of habitat at City Creek, Reche Canyon, Etiwanda alluvial fan, and South Bloomington (USFWS 2009c). During the 2009, 5-year review, USFWS determined that San Bernardino Merriam's kangaroo rat (SBKR) populations persisted only within the three main locations; however, these habitats were highly fragmented and included a mosaic with varying qualities of habitat that were isolated from other high-quality habitats occupied by the species (USFWS 2009c). As of 2018, it was estimated that over 85% of remaining functional SBKR occupied habitat was associated with Lytle Creek and Cajon Wash and the Santa Ana River, with the other important occupied habitat occurring along the San Jacinto River (USFWS 2009c). This species is likely extirpated from the Etiwanda Fan and Bautista Creek (USFWS 2018).

Current (post-2005) occurrences of this species are known from the northern portion of the Planning Area in San Bernardino County, Day Canyon Wash, Etiwanda Canyon, Lytle Creek, Cajon Canyon, Devil Canyon, and City Creek, and habitat along the Upper Santa Ana River from southwest of the San Bernardino International Airport east to the Crafton Hills. There is also critical habitat designated in the Planning Area.

Habitat Requirements

Primary habitat for San Bernardino Merriam's kangaroo rat is Riversidian alluvial fan sage scrub (RAFSS) within alluvial floodplains (USFWS 2009c). Each successional stage of this habitat (pioneer, intermediate, and mature) is used, but highest densities are often found in pioneer-intermediate RAFSS. Mature habitat occurs within the greatest elevation from the low flow channel and provides the most protection from inundation during storm events (USFWS 2002). Sandy substrate is the best predictor of species abundance (Shier et al. 2019), while a high density of nonnative grass is most strongly correlated with negative occupancy (USFWS 2009c). USFWS description of critical habitat PBFs includes alluvial fans, washes and associated floodplains with sandy soils suitable for burrowing, and adjacent upland areas, including alluvial fan sage scrub and associated vegetation with a moderately open canopy (USFWS 2002).

Distribution of Habitat and Occurrences in the Planning Area

Distribution of SBKR habitat and occurrences in the Planning Area are illustrated on Figure 3-57 and Figure 3-58. The following modeled and mapped habitat types are used to represent the species' habitat distribution in the Planning Area; this includes a listing of the data and/or parameters used to create each modeled habitat type

The distribution of SBKR habitat in the Planning Area is based on two sources of mapping information: (1) a habitat assessment and existing SBKR habitat mapping by USFWS for the Wash Plan HCP area and Lytle-Cajon Creek area; and (2) a habitat suitability model developed by ICF with review and input from SBKR researchers at the San Diego Zoo Institute for Conservation Research.

San Bernardino Merriam's Kangaroo Rat Habitat Assessment and Mapping (Wash Plan HCP and Lytle-Cajon Creeks)

Survey points were selected using stratified random sampling across the survey areas. Sampling was stratified by proposed land use type. Various indicators of habitat quality were recorded. These included substrate (i.e., the percent aboveground cover of cobble and rocks versus sand and gravel), vegetation type, presence of nonnative vegetation, vegetative cover, and cryptogamic soil crusts. These data were subsequently used to assist in ranking habitat quality within the Planning Area.

Each distinct polygon in the survey areas was mapped (digitized on screen) in ArcGIS using aerial imagery. Within each polygon, the percent cover of shrubs, grass, and bare ground was estimated. A habitat quality ranking of high, medium, low, or very low (trace) was assigned to each polygon. SBKR densities are expected to generally correspond to the assessed quality of the habitat. A fifth category, ecological process area, was created for areas in the active channels the Santa Ana River and Mill, Plunge, Lytle, and Cajon Creeks. These areas, while important to the maintenance and renewal of SBKR habitat, contain little or no vegetation and typically are not used by SBKR for most of their life history needs, but are very important for maintaining hydrology and connectivity throughout the areas of suitable habitat.

Annual grass cover, soils, and presence of RAFSS habitat were the important metrics used to assign habitat quality rankings. Secondary considerations were the canopy cover of shrubs and the surficial coverage of large rocks (boulders and cobble) versus sand, and gravel. These were secondary considerations because in most instances shrub cover was low, 40% or less, and areas with significant coverage of large rocks were uncommon, except in the east end of the Wash Plan HCP area and in the active channel of the Santa Ana River. If the estimated cover of annual grasses was between 51 and 70% the polygon was of low quality, and if the percent cover of annual grasses was greater than 70%, the polygon was considered trace.

The best habitat occurred where earlier seral stages of RAFSS (pioneer and intermediate) overlapped with clean sand and gravel substrates. This was correlated with available trapping data, the areas with the highest capture densities typically containing these above features.

The strongest negative correlations for SBKR are a boulder and cobble substrate, and areas with heavy cover of nonnative grass. Heavy shrub cover and well developed, consolidated soils were negatively correlated, but not as strongly.

It should be emphasized that the habitat assessment was qualitative. SBKR can be found in all types of habitat within the species' historic distribution (Braden and McKernan 2000); however, it was assumed that differences in habitat quality would affect the relative abundance of SBKR at different

sites such that that there would generally be higher densities of animals in areas assessed as high quality than in areas assessed as medium or low quality.

The following identifies the Habitat Assessment and Mapping general guidelines for classification:

- **High:** Estimated percent cover of annual grasses was 30% or less, pioneer and intermediate RAFSS seral stages, and clean sand and gravel substrates.
- **Medium:** Estimated percent cover of annual grasses was 31–50%, pioneer and intermediate RAFSS seral stages, and clean sand and gravel substrates.
- **Low:** Estimated percent cover of annual grasses was 51 - 70%, pioneer and intermediate RAFSS seral stages, and clean sand and gravel substrates. Or high density shrub cover (mature RAFSS). Or heavy boulder or cobble substrates.
- **Very Low Quality:** Estimated percent cover of annual grasses was greater than 70% and boulder or cobble substrates.
- **Ecological Process Area:** Habitat areas with little or no habitat but that support hydrogeomorphic processes necessary to the maintenance and reestablishment of SBKR habitat, and provide for SBKR movement and connectivity between more highly suitable habitat areas.

ICF Habitat Suitability Model

Suitable Habitat: (areas outside of USFWS SBKR mapping described above)

- **Land Cover**: Californian Coastal Scrub, North American Warm-Desert Xeric-Riparian Scrub, Great Basin-Intermountain Xeric-Riparian Scrub, and Water – Seasonal; **AND**
- **Slope**: 0–3%; **AND**
- **Elevation**: 0–2,670 feet.
- **Post-processing**: Removed fragmented and isolated patches surrounded by development.
- Identified areas outside of the 100-year floodplain boundary as Potential Refugia Habitat (Figure 3-58)

Combined Distribution Data and Resulting Distribution Map

All USFWS mapping data and ICF habitat suitability modelling data were combined into a single layer in the GIS and were further processed to identify areas with more suitable soils and to remove fragmented and disturbed areas, as described below.

SBKR researchers at the San Diego Zoo Institute for Conservation Research have found that SBKR often have a high association with fluvent soils (alluvial soils where repeated deposition of sediments from periodic flooding prevents the development of more mature soil characteristics) (Shier, pers. comm.). The fluvent soils data were used to select all mapping and model results in the combined GIS layer, which were retained in the final results. Areas with non-fluvent soils were removed.

Areas that were small, fragmented, highly disturbed, and isolated by development were identified using aerial photos and removed from the model output or downgraded in habitat assessment classification, where appropriate.

Taxonomy and Genetics

The subspecies is one of three Merriam's kangaroo rat (*Dipodomys merriami*) in California (USFWS 2009c). The species is the most highly differentiated subspecies of *Dipodomys merriami* morphologically (Lidicker 1960). A range-wide genetic study found that the three primary remaining populations (Santa Ana, Lytle-Cajon, and San Jacinto) are genetically distinct from one another with further sub-structuring among sites within the populations and little to no gene flow between sites (Hendricks et al. 2020). Sub-structuring indicates isolation or limited gene flow is occurring among sites within populations. All three remaining populations exhibit a low level of genetic diversity with low effective population sizes (Hendricks et al. 2020). Diversity within the three populations is similar to other species with fragmented distributions. Genetic evidence suggests that these three populations have been recently separated, likely within the last 100 years, which also corresponds with reduction in habitat since the 1930s (Hendricks et al. 2020). This indicates a lack of ability to adapt to environmental change, which in turn makes the populations more vulnerable to extinction as a result of stochastic (random) environmental events, such as wildfire or flooding.

Reproduction

Reproductive activities peak in June and July (USFWS 2009c), but pregnant or lactating females can be present January–November (USFWS 1998) (Table 3-40). Females are capable of more than one litter per year and typical size is 2–3 individuals (Jones 1993). Breeding varies in relation to ecological conditions, with individuals not breeding when plant productivity is poor (Heske et al. 1993).

Dispersal, Territoriality, and Home Range

The species is philopatric so tends to establish home ranges close to their natal range (French 1993). Movements of 40–60 meters are common (USFWS 1998), and long-distance events can be over 240 meters (Zeng and Brown 1987) and documented up to 1.2 kilometers (Braden 2015). However, more than 85% of individuals disperse less than 125 meters (Jones 1989). Dispersal is slightly male-biased (Jones 1989). Reproductive males travel farther than females or males with regressed testes (Behrends et al. 1986). A study in the Chihuahua Desert determined that 75% of adult males and 59% of adult females dispersed between 197 and 787 feet from initial capture sites (Zeng and Brown 1987).

Individuals are primarily solitary but have overlapping home ranges (Randall 1993). They tend to tolerate familiar neighbors more than strangers and may have long-term associations with the same individuals (Randall 1993). Rats actively defend small core areas near burrows (Jones 1993). Sand baths may be important to establish familiarity between individuals (Randall 1991). Average male home ranges may be slightly larger than those of females (0.74 versus 0.26 hectare) (Jones 1989).

Daily and Seasonal Activity

The San Bernardino Merriam's kangaroo rat is unable to enter a state of torpor (Brown and Harney 1993), and therefore can be active at the surface year-round. They are nocturnal, emerging from their burrows at dusk to forage and returning before dawn, and occupying their burrows during daylight hours for shelter and to avoid high temperatures. Surface activity is reduced during full moon periods (Daly et al. 1992a).

Table 3-40. Seasonal Activity of San Bernardino Merriam's Kangaroo Rat

Life Stage/ Activity Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Breeding												

Sources: USFWS 1998, USFWS 2009c

Diet and Foraging

San Bernardino kangaroo rats are primarily granivores (seed eaters), but consume herbaceous material and insects when available (Reichman and Price 1993). They collect seeds in cheek pouches and store them in surface caches (Daly et al. 1992b). Water requirements are satisfied by seeds and herbaceous material consumed (French 1993).

Threats and Special Management Considerations

Major threats to the San Bernardino kangaroo rat include the loss of habitat, including upland refugia habitat (Figure 3-58), and habitat fragmentation due to development and the alteration of waterways. Flood control, dams, and water conservation projects that change the hydrology of a system are indirect long-term threats to fluvial process required for habitat. Changing groundwater conditions for groundwater-dependent vegetation can result in reduced flooding, which is essential to maintain the pioneer and intermediate phases of alluvial fan sage scrub that comprises the majority of suitable habitat for this species (Rohde et al. 2019).

Because existing flood control structures, roads, and dams have altered fluvial processes, long-term maintenance of high-quality habitat through vegetation management and fluvial processes will be important for conservation in the Planning Area. Pioneer- and intermediate-stage alluvial fan sage scrub, which tends to occur on the terraces above the low flow channel, provides the highest quality habitat because it is sandy and fairly open, and has low vegetation cover. The density of vegetation is particularly important as it affects the species' burrowing, locomotion, and foraging ability. Experimental thinning of vegetation in the Santa Ana River resulted in an increase in use of the more open habitat (Price 1978). Mature-stage alluvial fan sage scrub is less suitable as primary habitat because of the typical dense vegetation cover, but is important as refugia in high flow events. Consequently, natural fluvial processes, whereby cycles of flooding and dry periods result in dynamic fluctuations of terraces and habitat, are crucial.

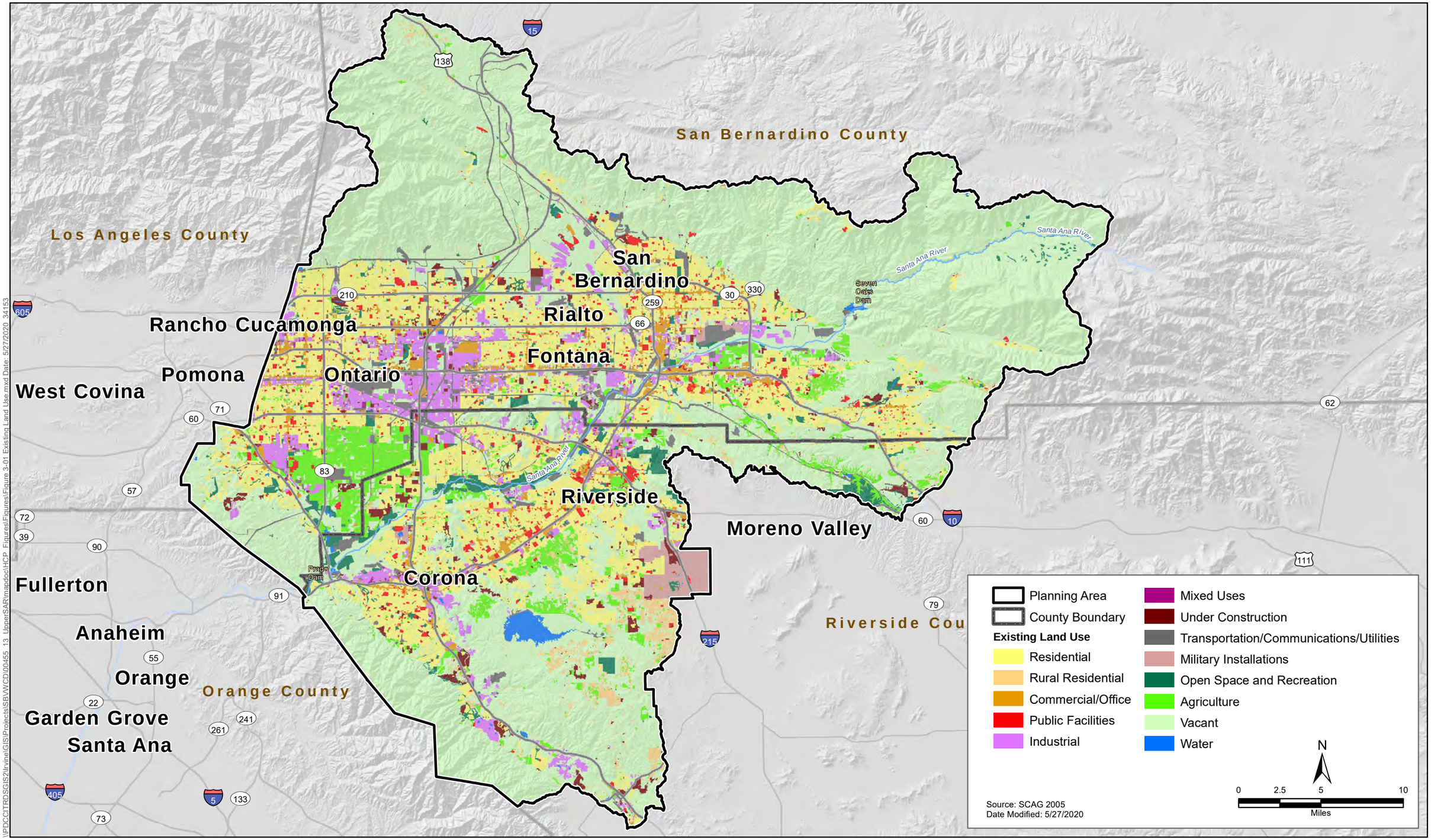
Reduction in overall genetic diversity and lack of gene flow between populations make this species more vulnerable to stochastic events. While fluctuations in population numbers are natural for this species due to local extirpation and recolonization following flood events, increasing precipitation volatility in the form of extreme drought years followed by extreme precipitation years and flooding may have more serious consequences for this species (Hendricks et al 2020). Natural recolonization following extreme events may be impossible due to habitat fragmentation as evidenced by no gene flow between sub-populations in the Planning Area aside from translocation (Hendricks et al. 2020). Successful translocation may help offset effects of habitat fragmentation, restore some level of geneflow between sub-populations, and increase genetic diversity within sub-populations (Hendricks et al. 2020).

Edge effects are also threats to remaining San Bernardino Merriam's kangaroo rat populations, which are increasingly fragmented. These effects include increased nighttime illumination, habitat degradation due to weed invasions, disturbances from off-highway vehicles, and effects associated

with trash dumping. The effects of nighttime lighting are of particular concern for nocturnal animals, including this species, because rodents alter foraging behaviors in response to the full moon, and artificial lights can result in the same responses (Wang and Shier 2017). Increased nighttime lighting can also result in increased predation (Beier 2006).

Other Relevant Information

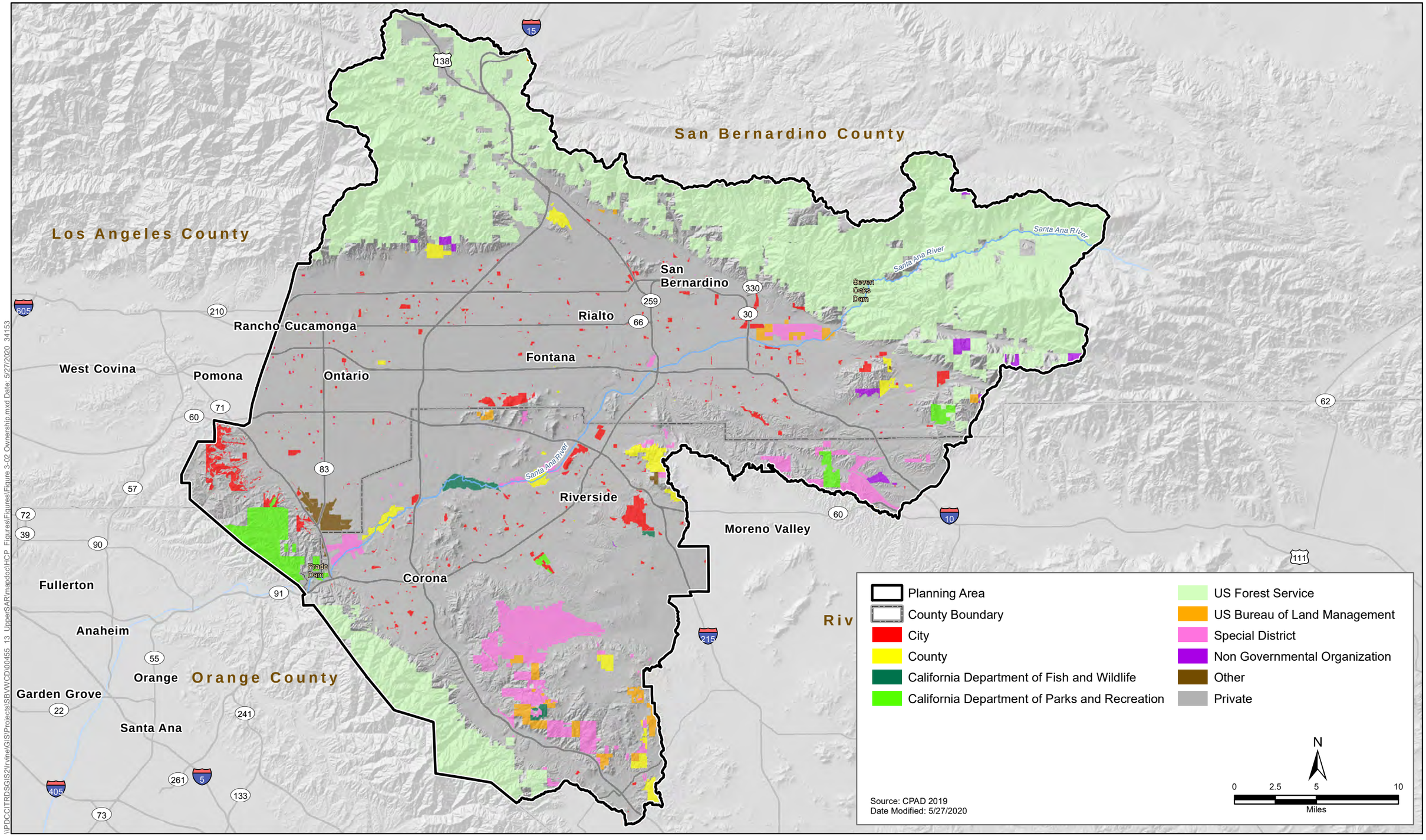
The Planning Area supports the majority of the current known range. The most stable populations remaining are present in Lytle Creek, Cajon Wash, and the Santa Ana River. Plunge Creek and City Creek also support moderate populations, although the long-term viability of these areas is probably dependent on the connectedness of suitable habitat to the more robust Santa Ana River populations. Currently, the suitable habitat connection between City Creek and the Santa Ana River is constrained at Alabama Street with a very narrow swath of habitat. Further constraints to movement may occur between 5th Street and I-210, where currently no terraced habitat is available and vegetation is lacking due to frequent scouring events. The suitable habitat connection between City Creek and Plunge Creek is constrained at I-210 and Plunge Creek where only a very narrow swath of habitat is present. The suitable habitat connection between Plunge Creek and the Santa Ana River is likely only slightly constrained by maturing vegetation characteristics and the presence of nonnative grasses.



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Figures\Figure 3-01 Existing Land Use.mxd Date: 5/27/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

Figure 3-1
Existing Land Use in the Planning Area



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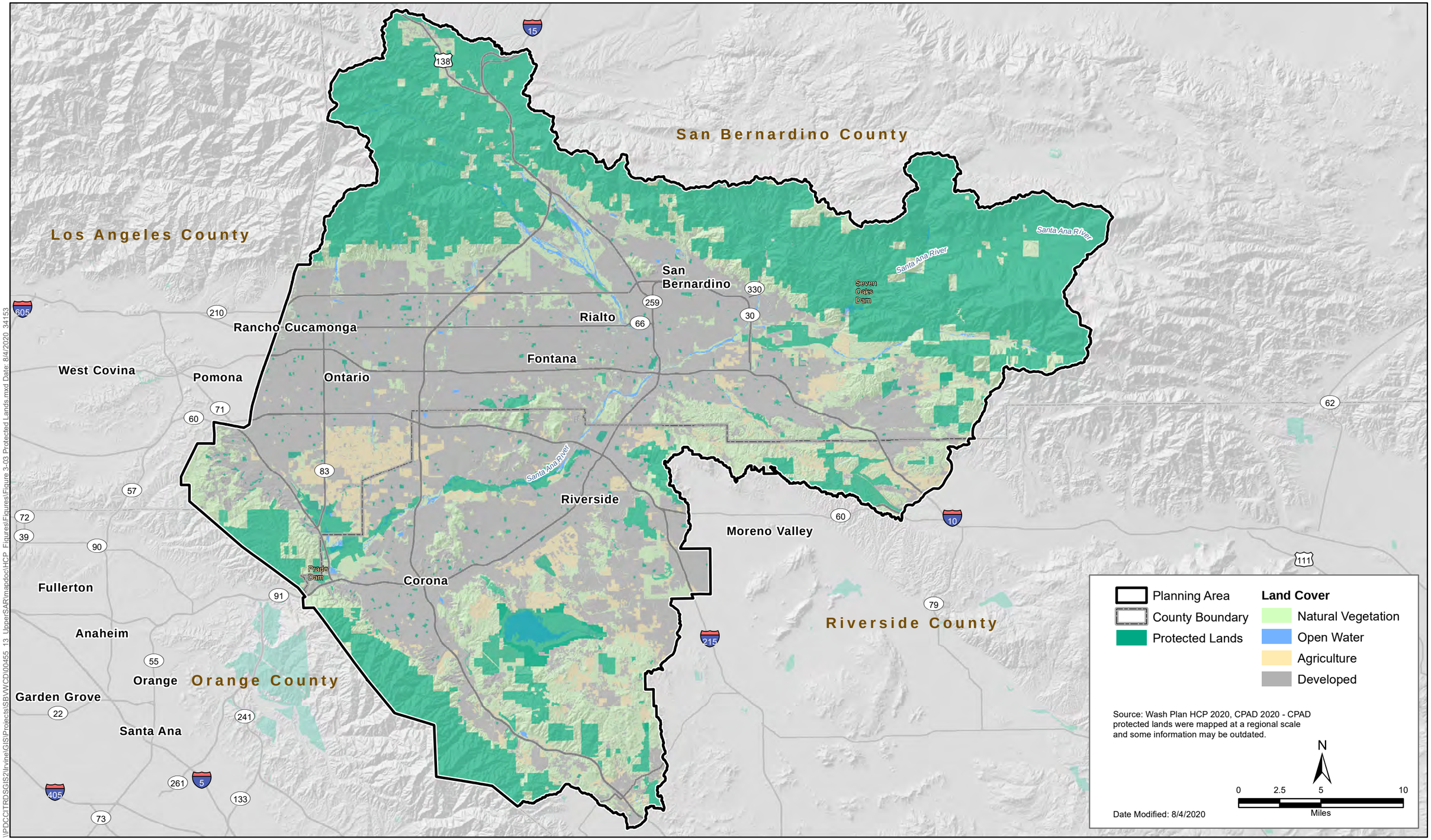
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-2
Generalized Land Ownership in the Planning Area



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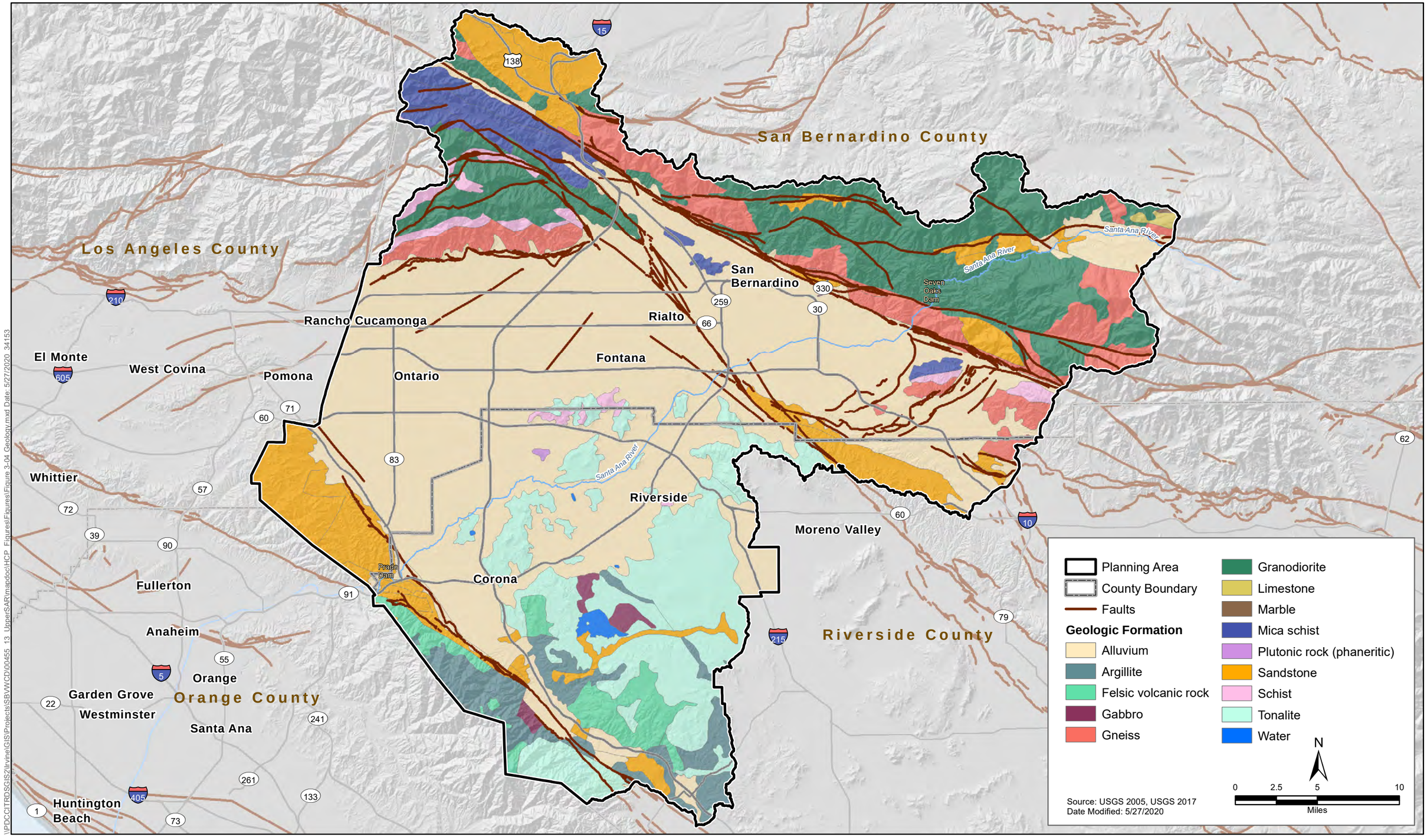
ICF

Upper Santa Ana River Habitat Conservation Plan

Figure 3-3
Protected Lands in the Planning Area



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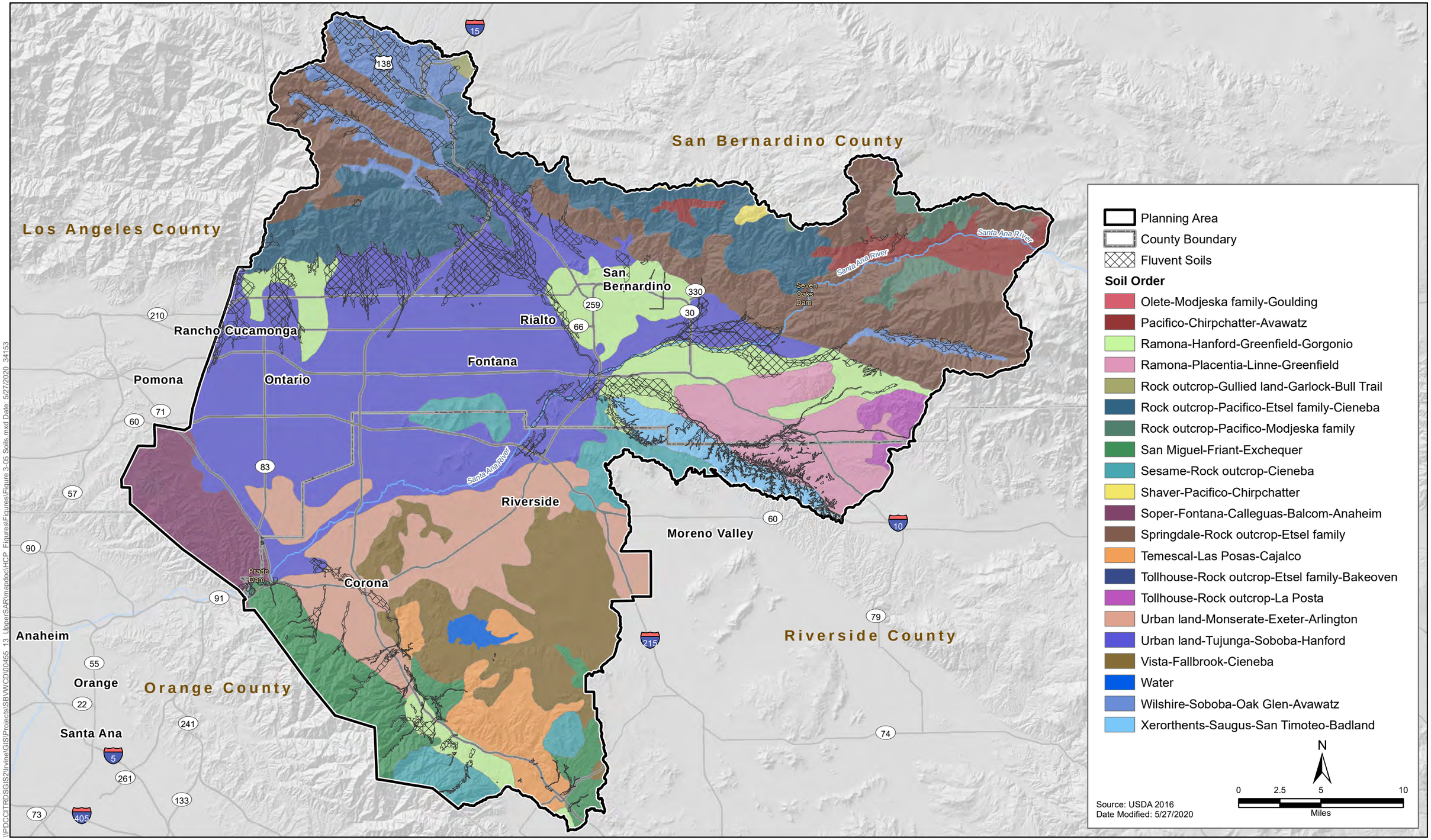
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-4
Geology and Fault Zones of the Planning Area



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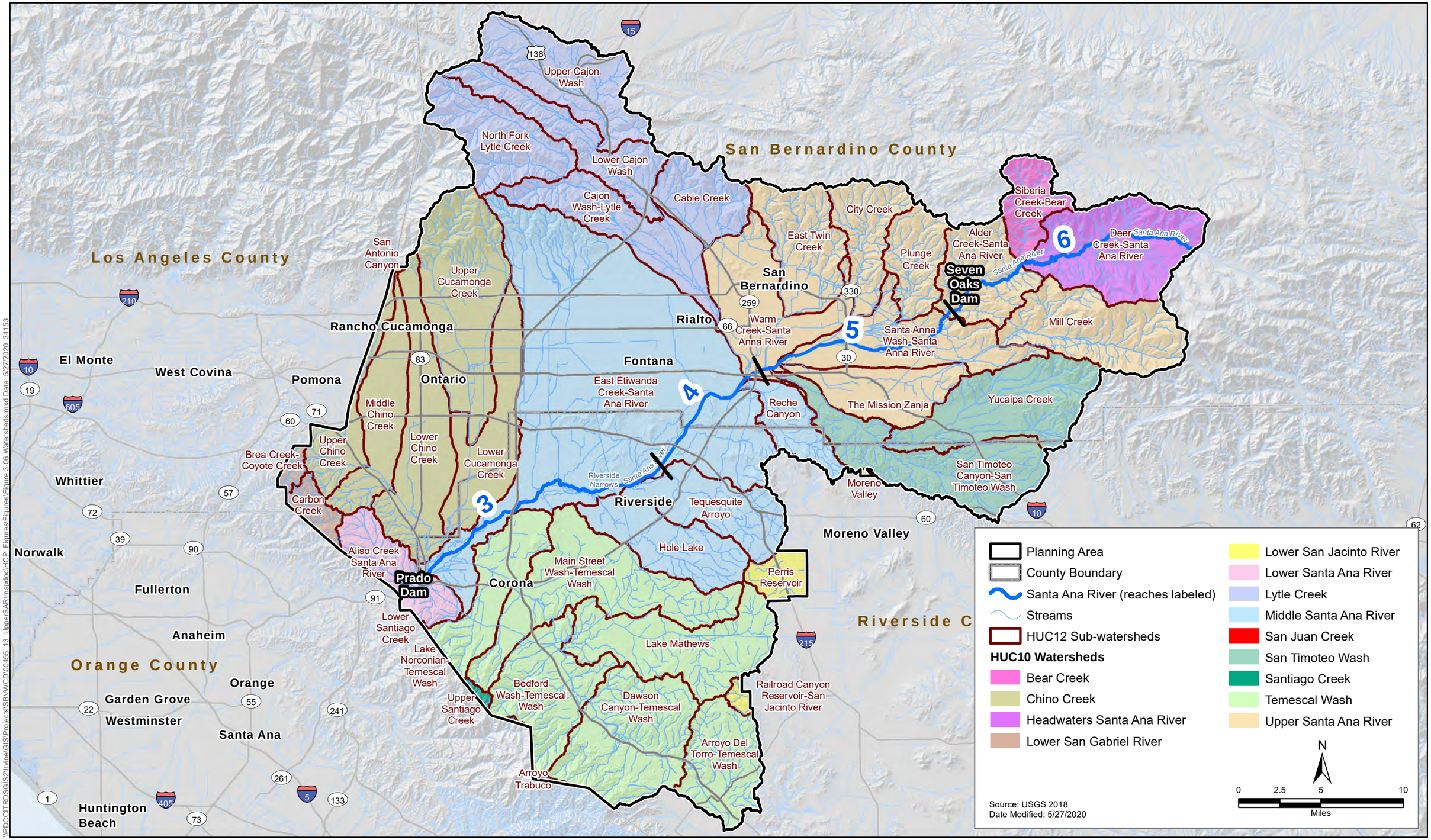
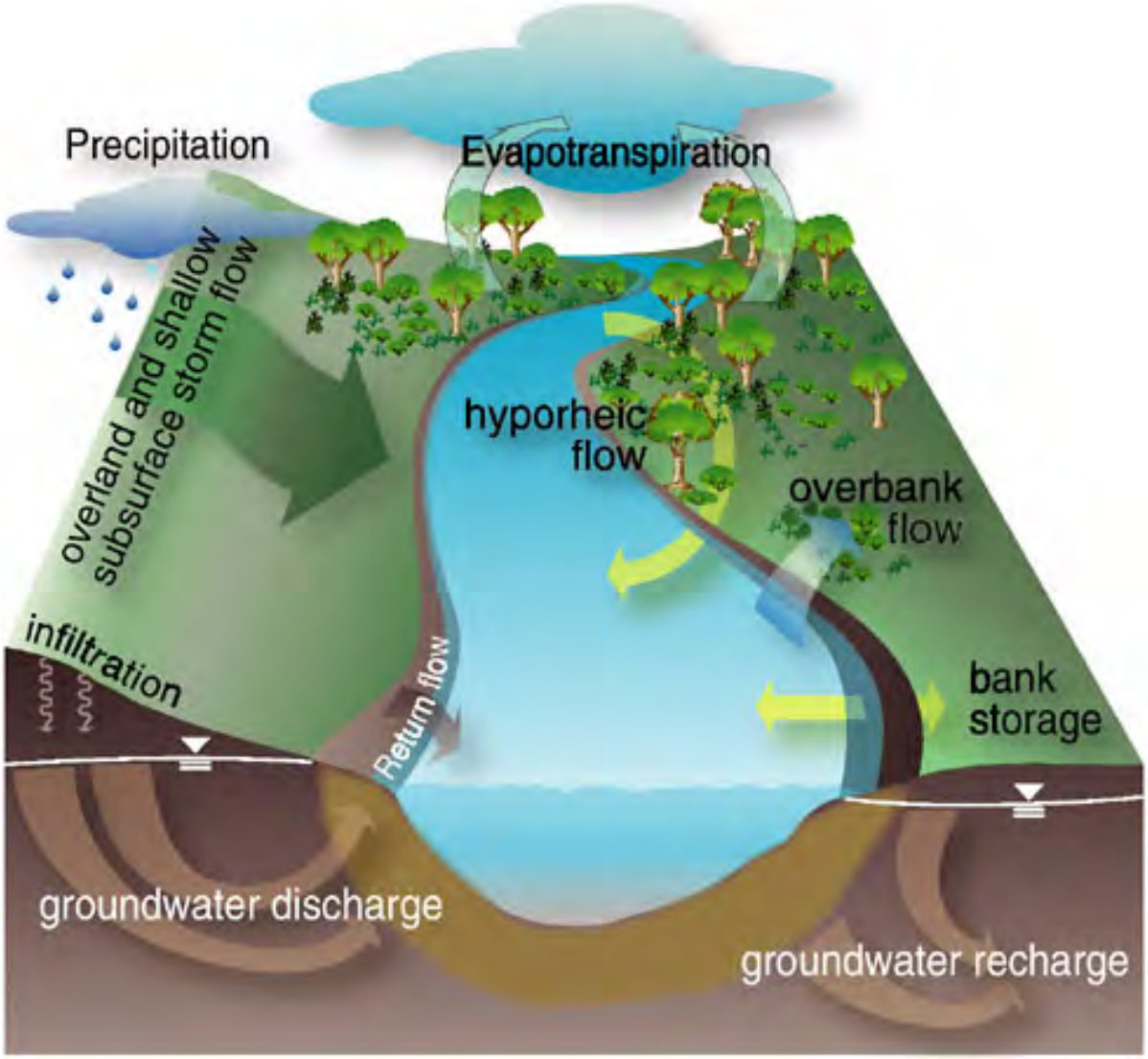
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-5
Soil Orders in the Planning Area



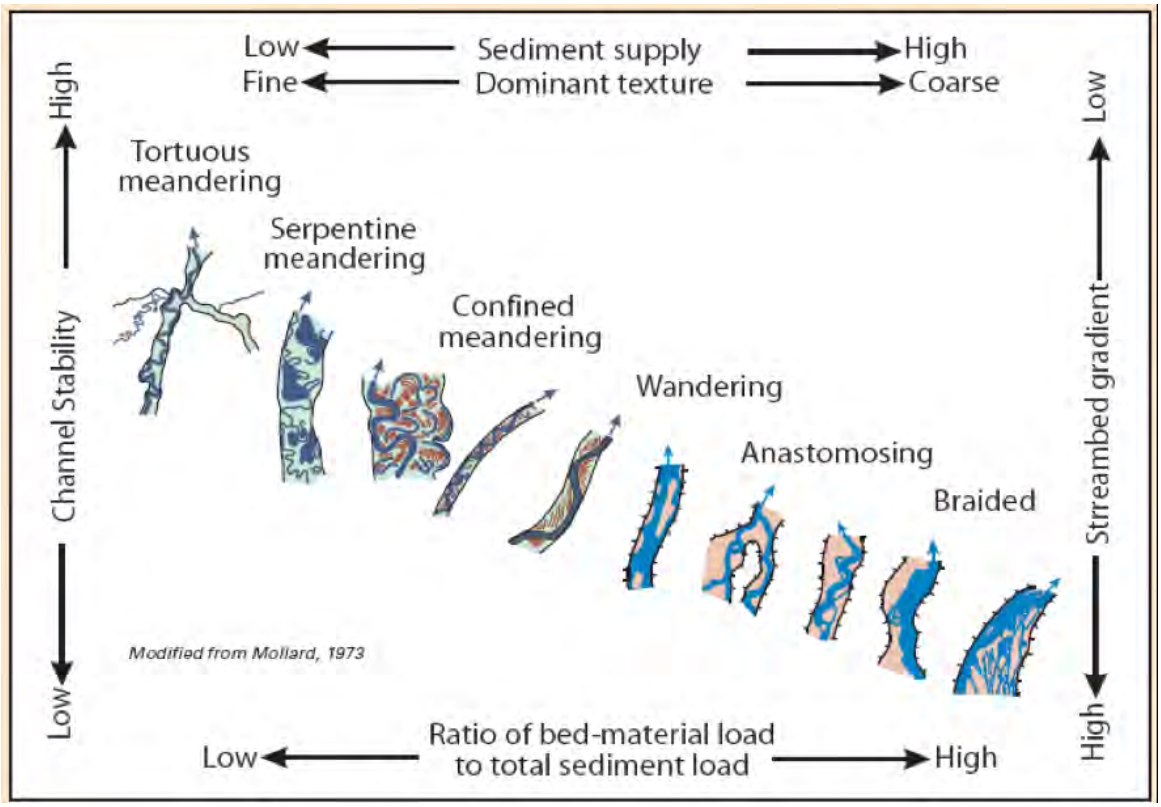
Upper Santa Ana River Habitat Conservation Plan

Figure 3-6
Watersheds and Sub-watersheds in the Planning Area



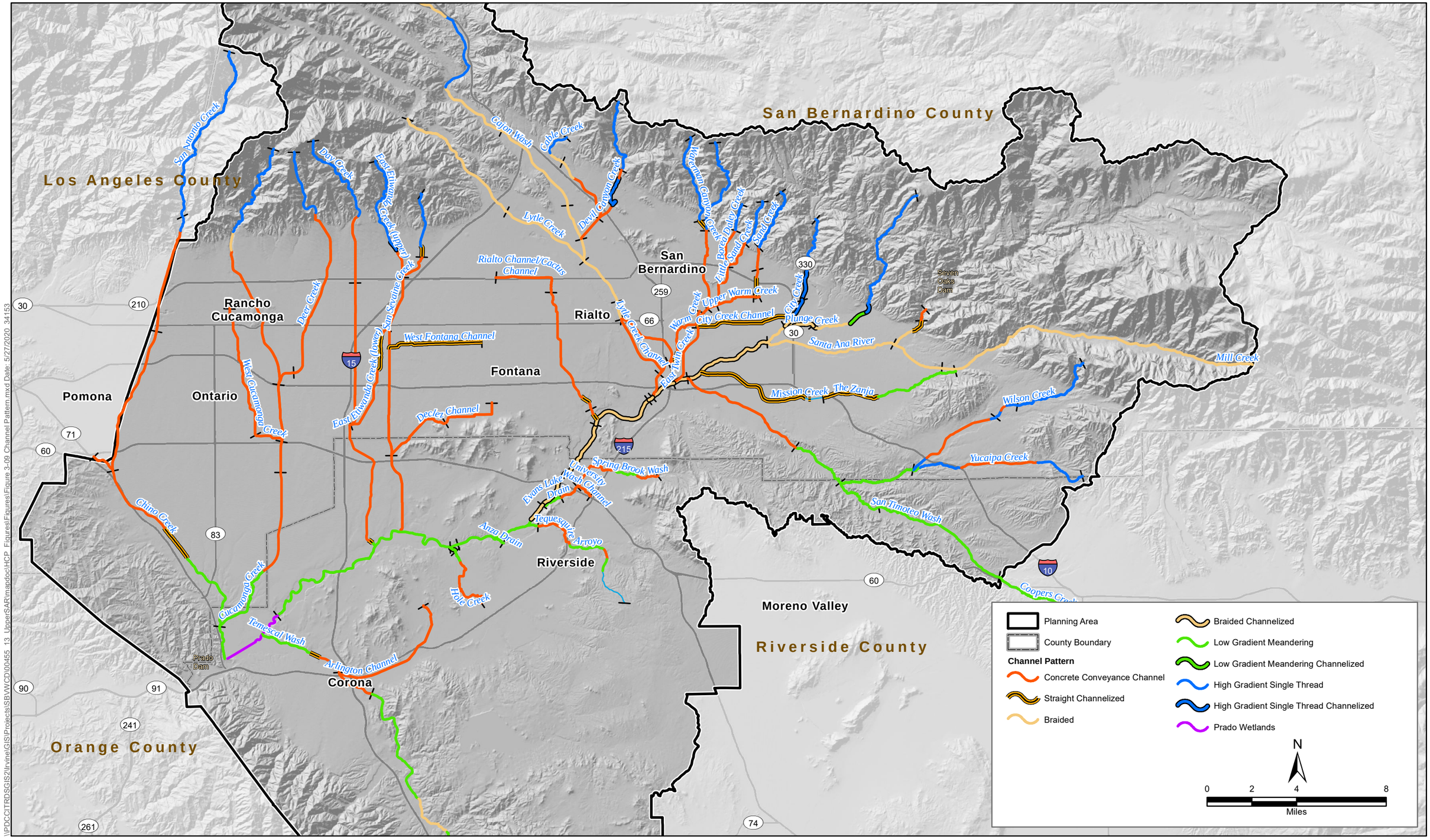
Source: National Research Council. 2002.

Figure 3-7
Water Movement Pathways through Riparian Areas
Upper Santa Ana River Habitat Conservation Plan



Source: William H. Langer, USGS Open-File Report, 2002, modified from Mollard, 1973.

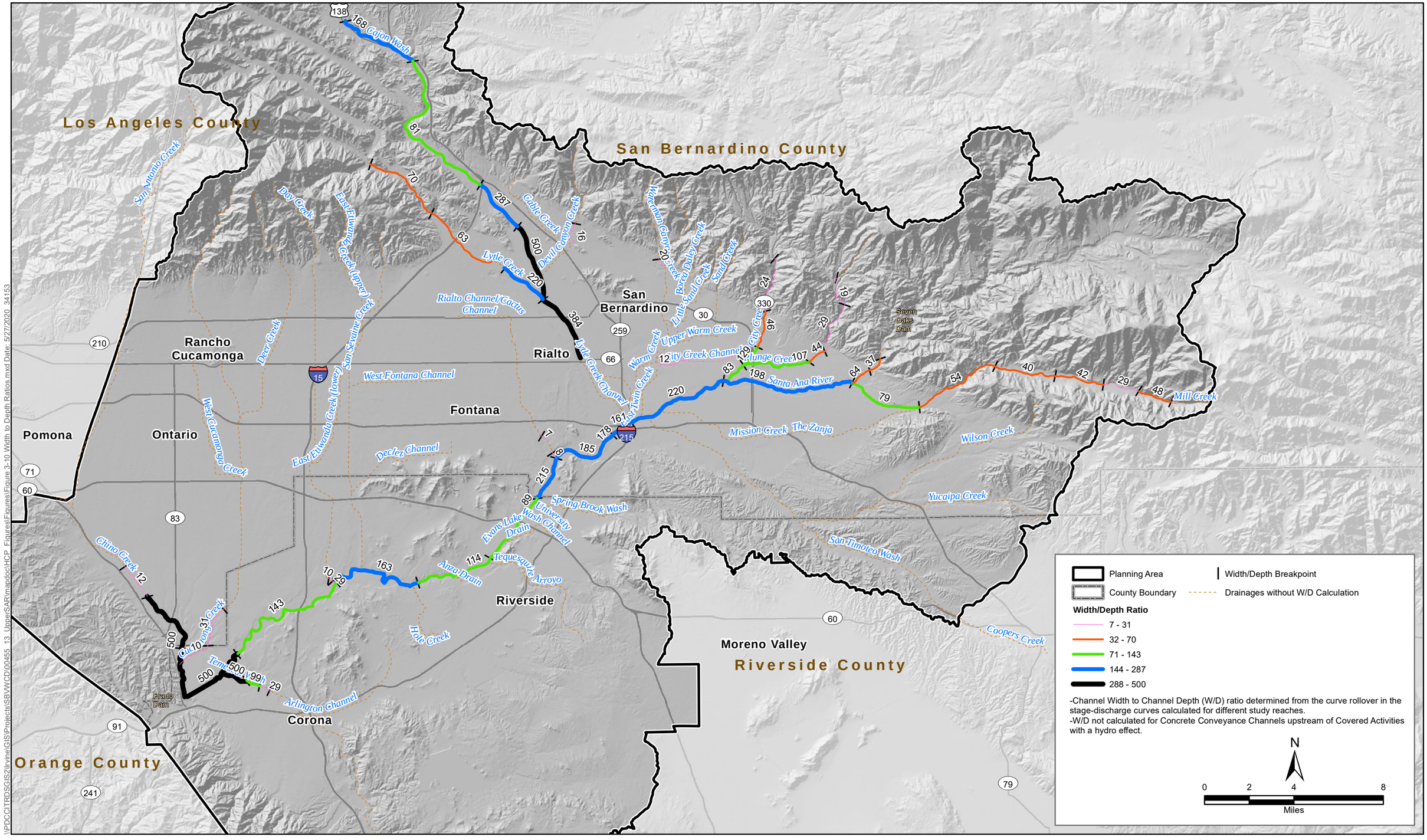
Figure 3-8
Geomorphic Behavior of Different Channel Patterns
Upper Santa Ana River Habitat Conservation Plan



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSARImapdoc\HCP_Figures\Figures\Figure 3-09 Channel Pattern.mxd Date: 5/27/2020, 34153

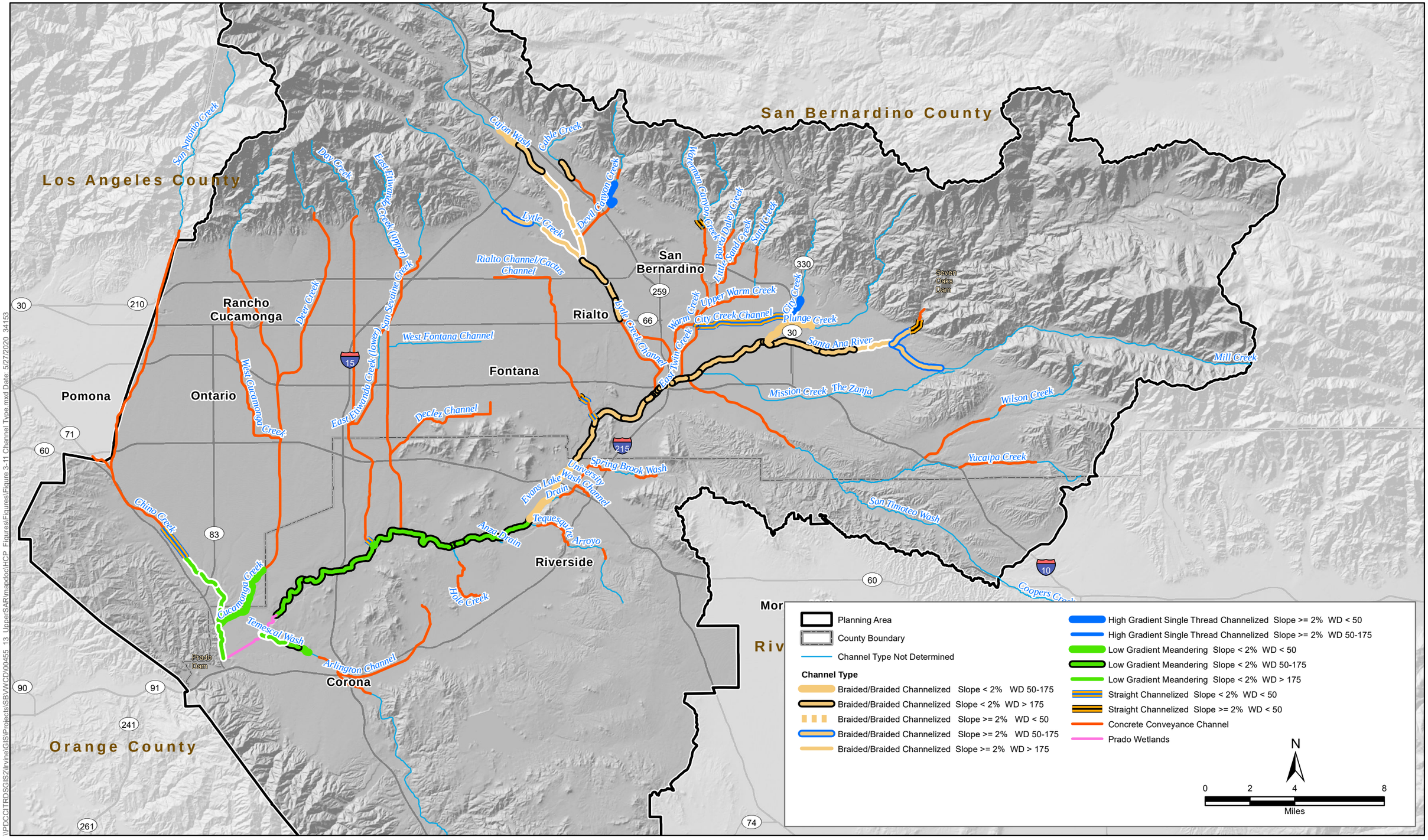
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-9
Channel Patterns in the Planning Area



Upper Santa Ana River
Habitat Conservation Plan

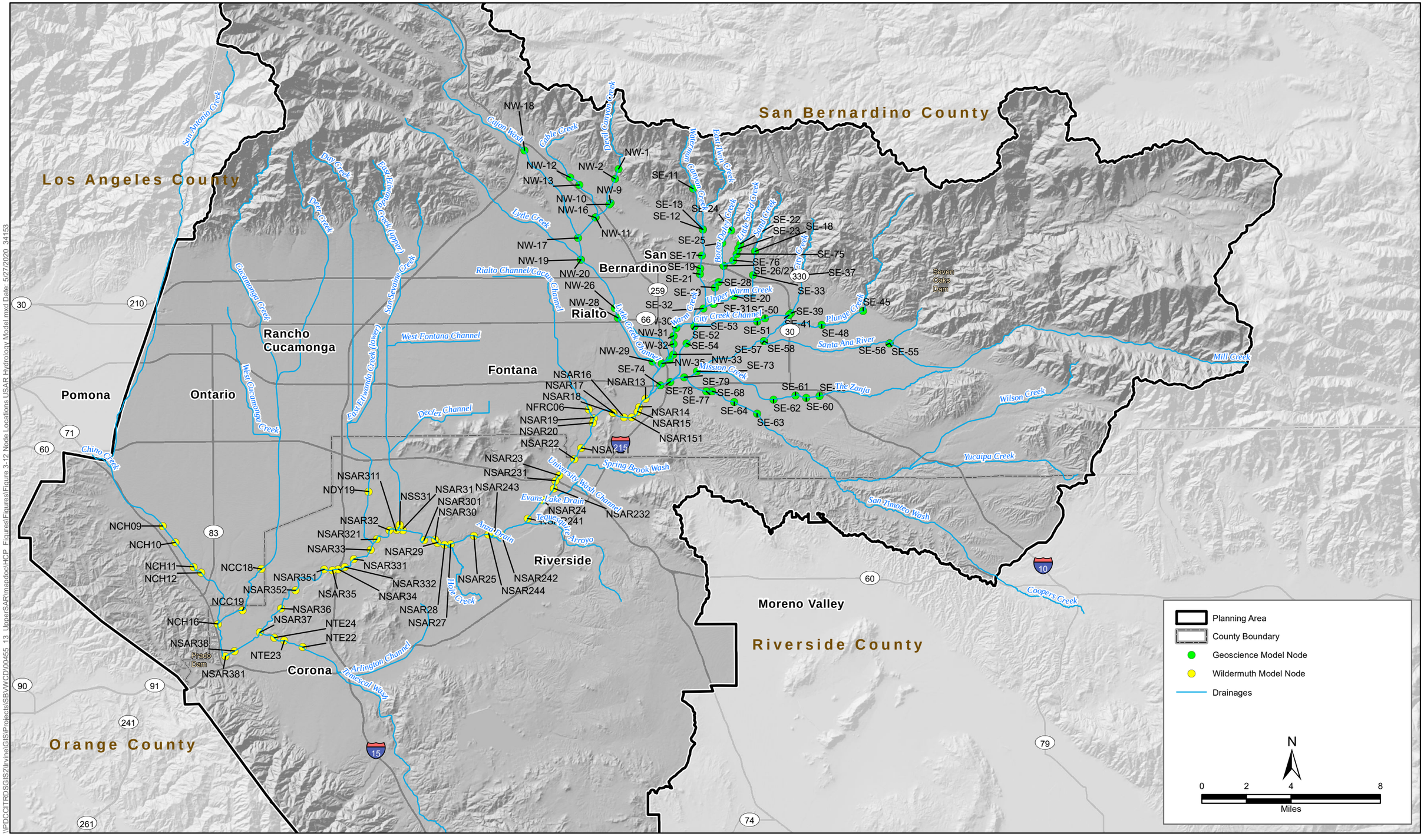
Figure 3-10
Width to Depth Ratios of Stream Channels in the Planning Area



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Figures\Figure 3-11 Channel Type.mxd Date: 5/27/2020, 34153

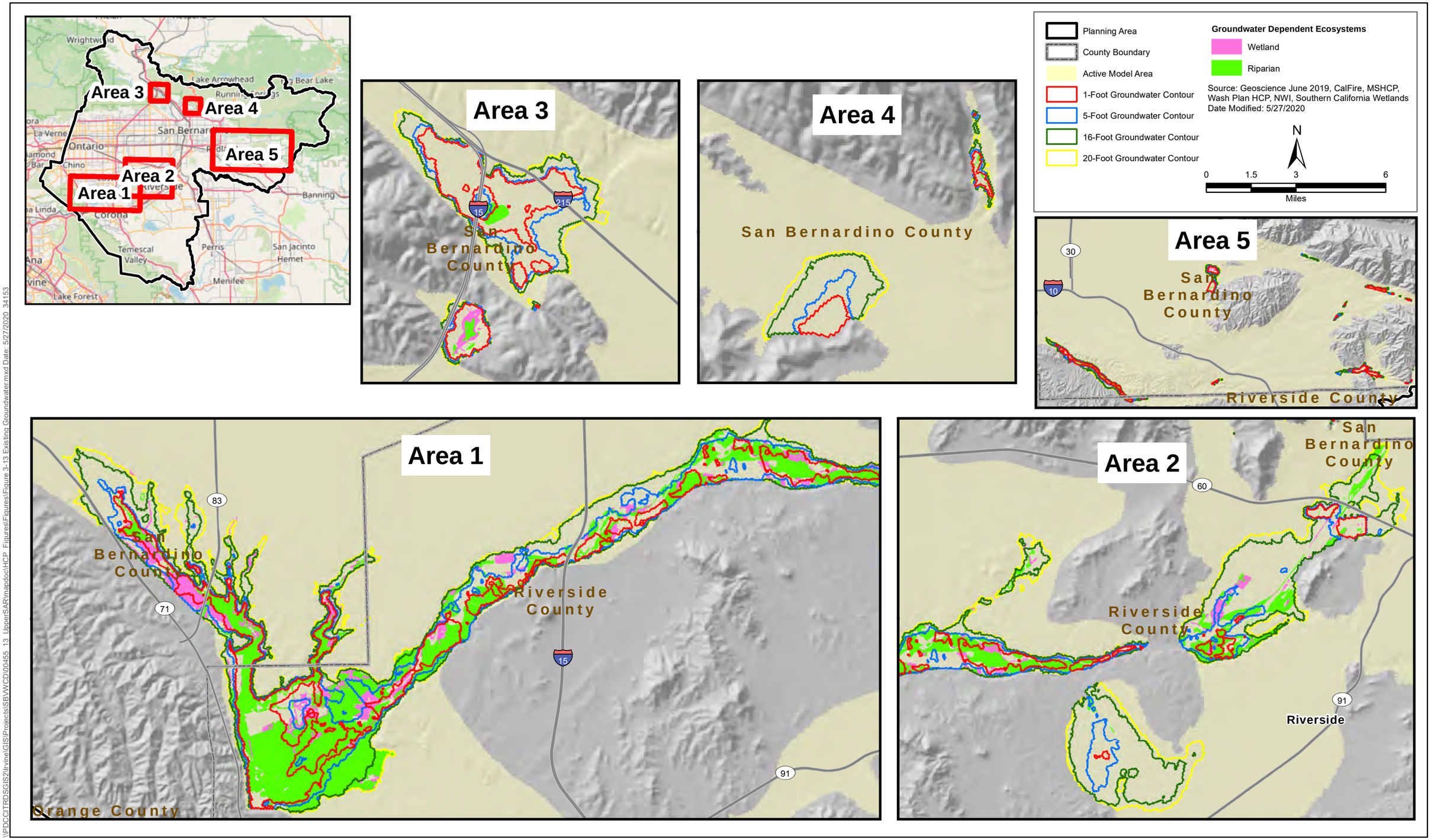
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-11
Channel Types in the Planning Area



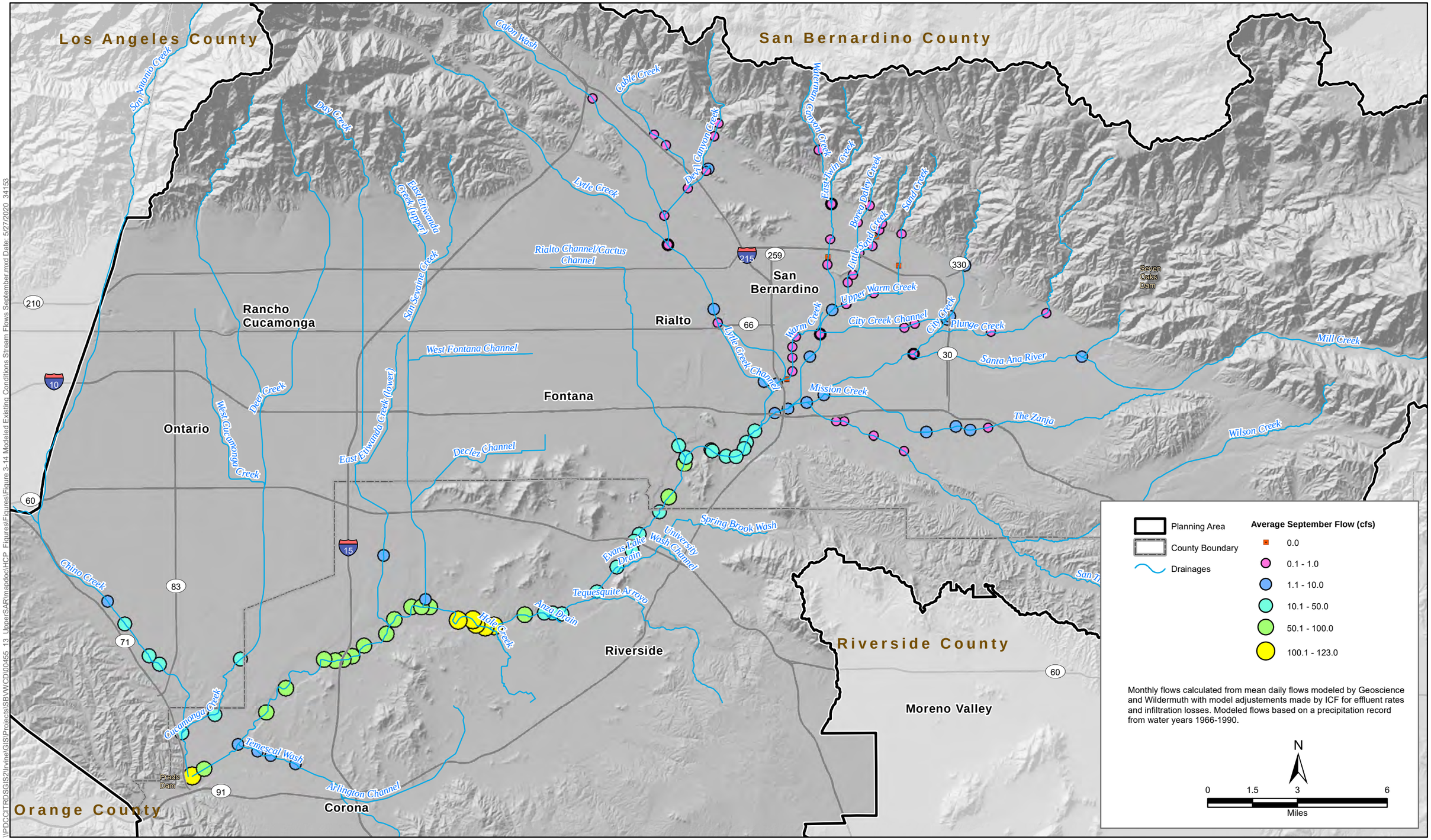
Upper Santa Ana River Habitat Conservation Plan

Figure 3-12
Node Locations of Upper Santa Ana River HCP Hydrology Models



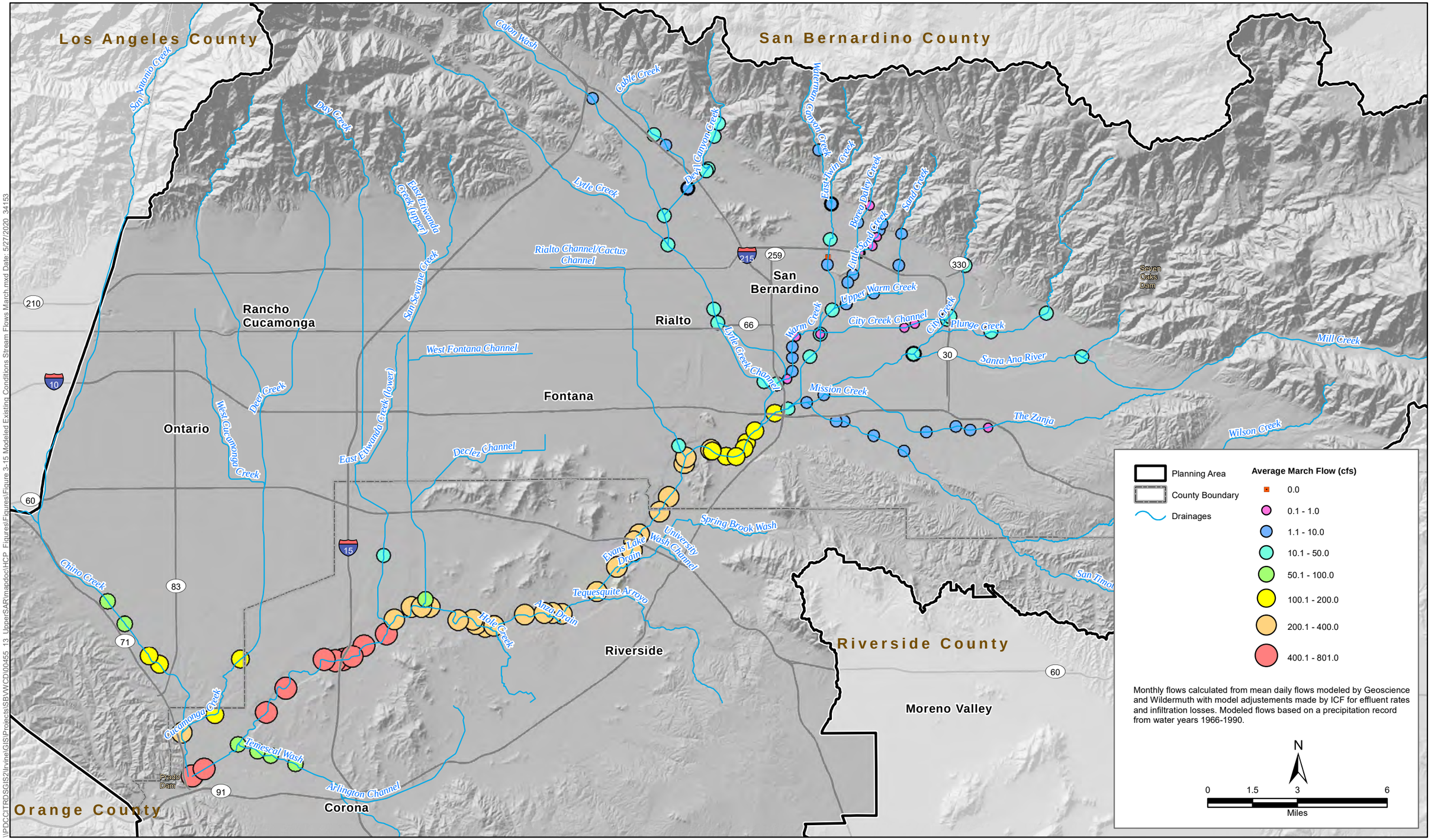
Upper Santa Ana River Habitat Conservation Plan

Figure 3-13
Depth to Groundwater (Existing Conditions)



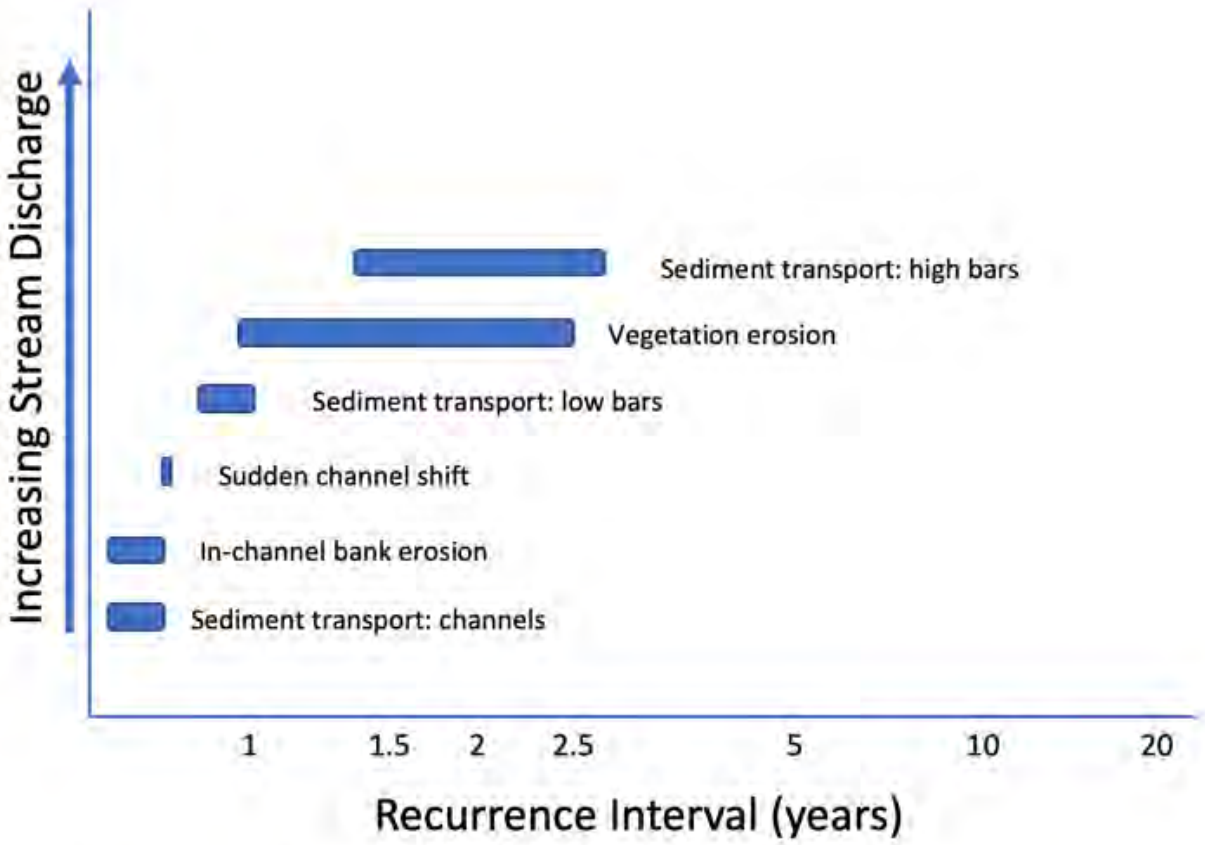
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-14
September Monthly Average Daily Flow for Existing Conditions (modeled)



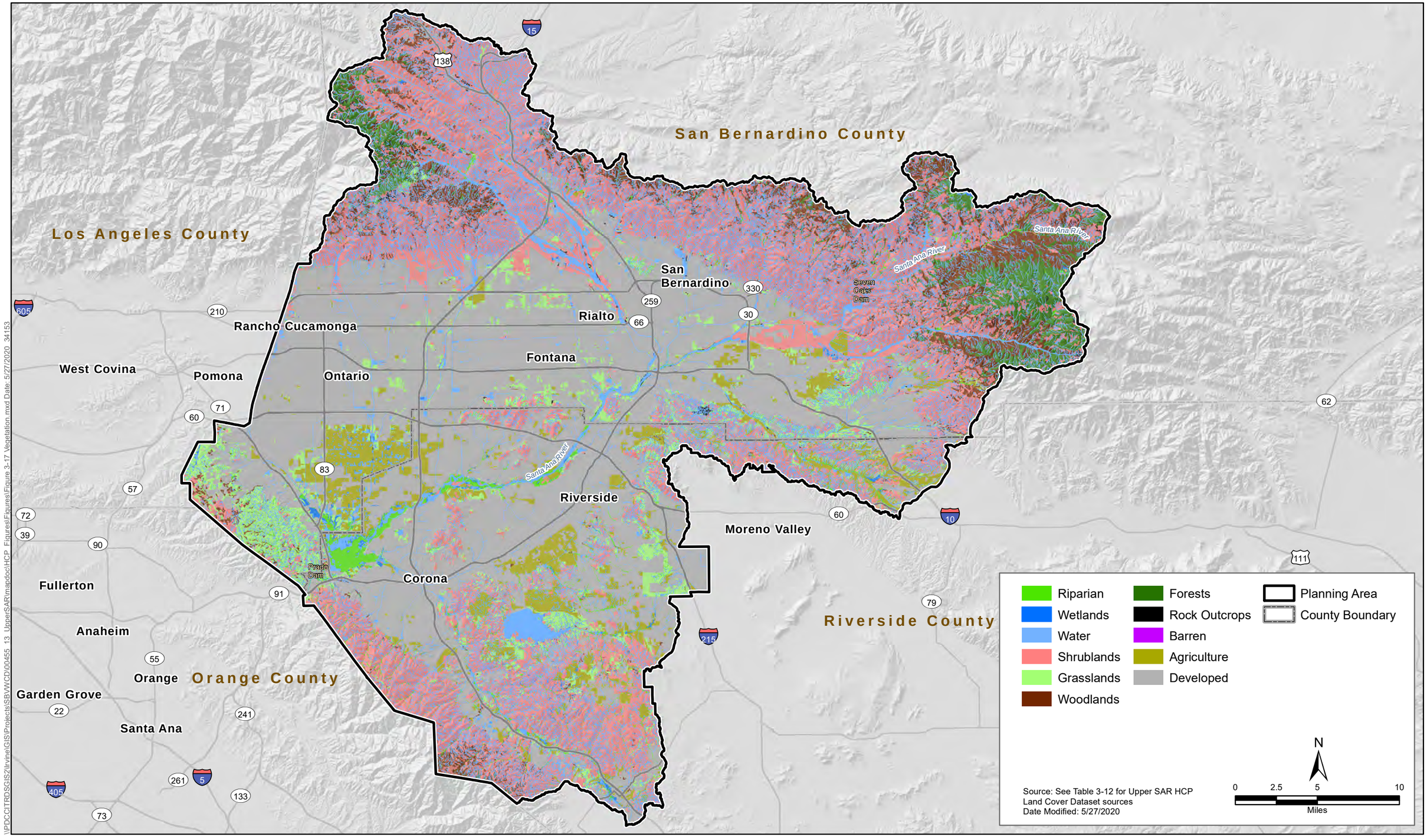
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-15
March Monthly Average Daily Flow for Existing Conditions (modeled)



After Surian et al. 2014

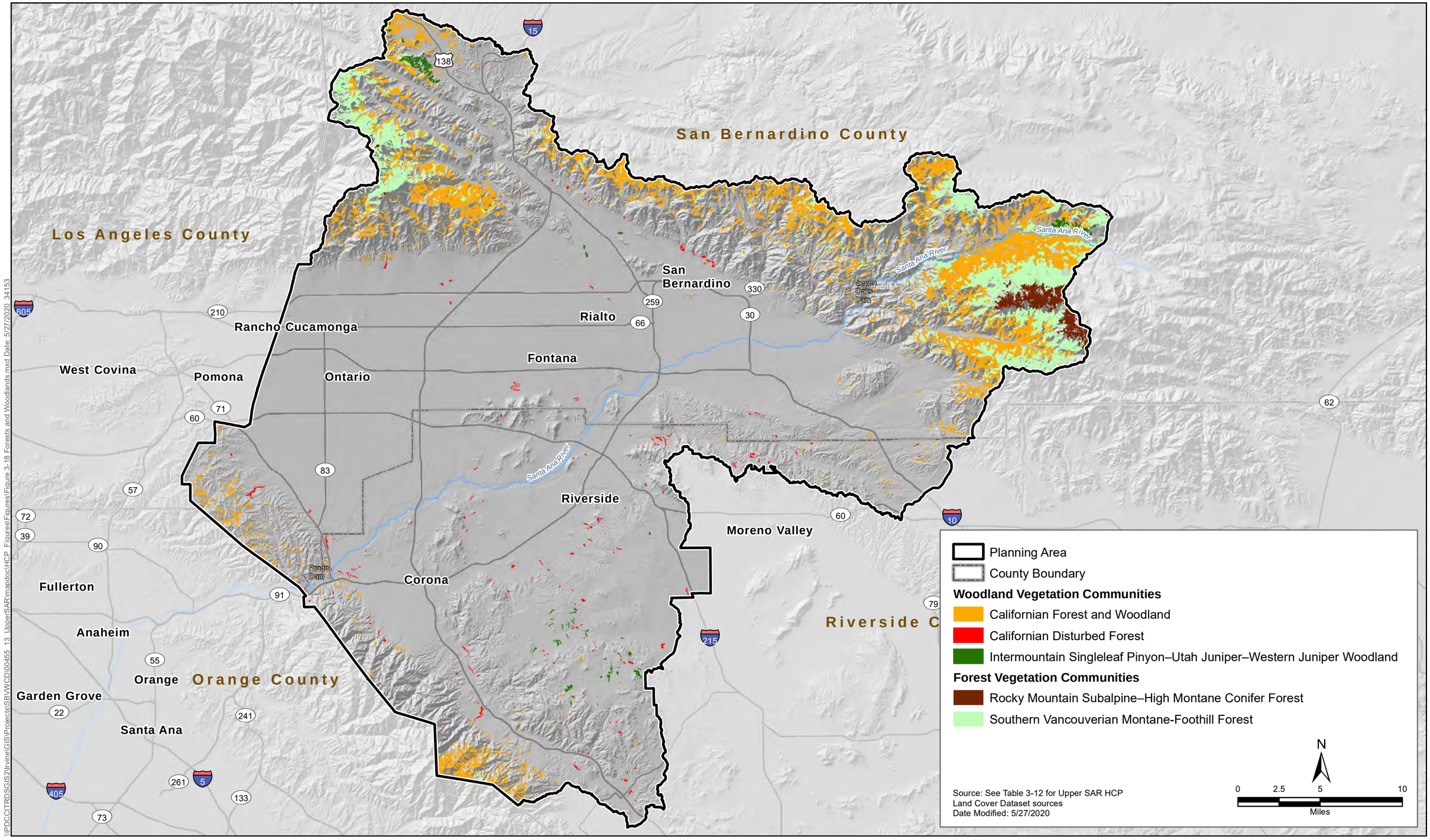
Figure 3-16
Relationship of recurrence interval and high flow channel maintenance processes
Upper Santa Ana River Habitat Conservation Plan



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Figures\Figure 3-17 Vegetation.mxd Date: 5/27/2020_34153

Upper Santa Ana River
Habitat Conservation Plan

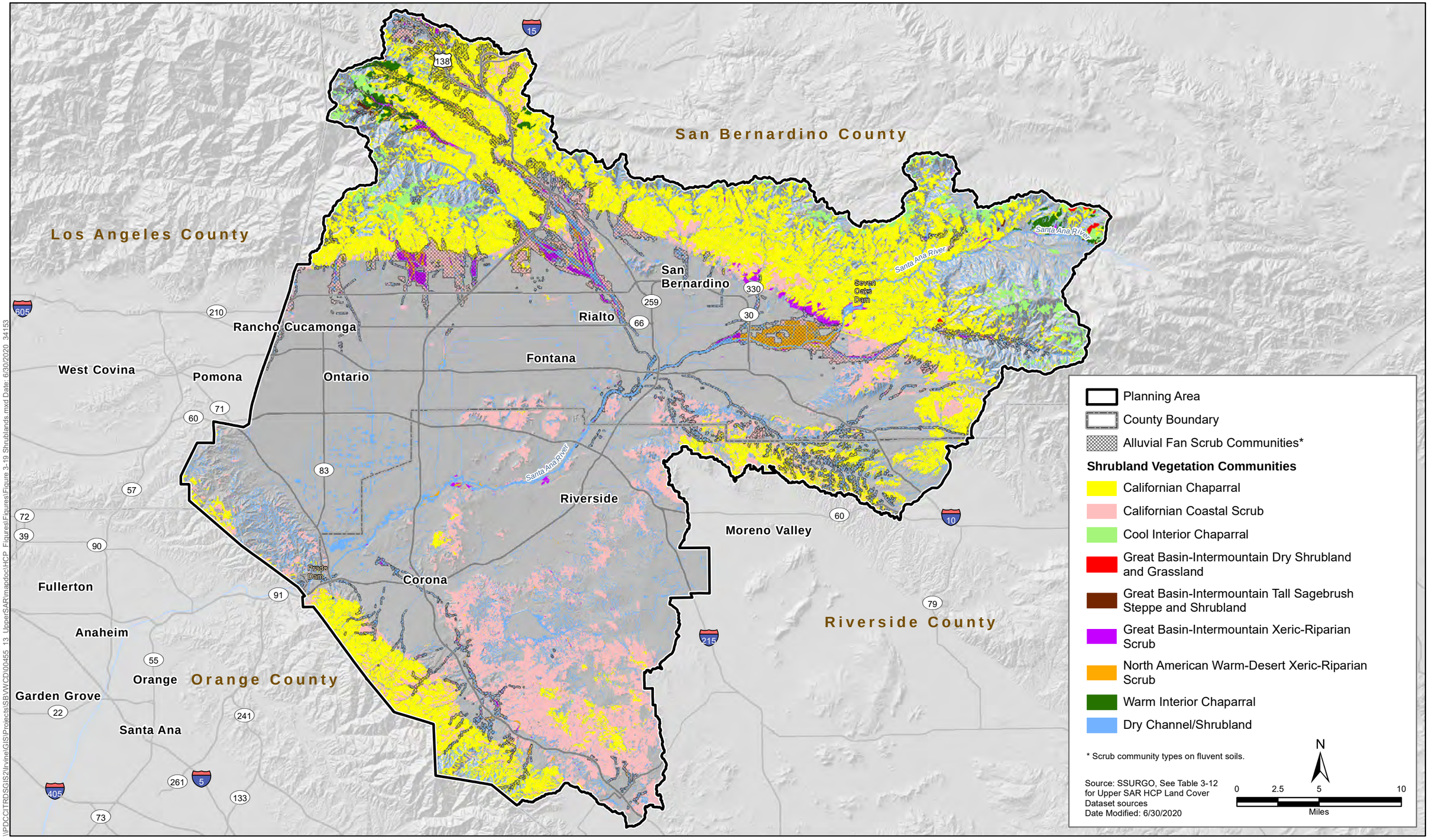
Figure 3-17
General Vegetation Communities and Land Cover Types in the Planning Area



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SB\WCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Figures\Figure 3-18 Forests and Woodlands.mxd Date: 5/27/2020, 34153

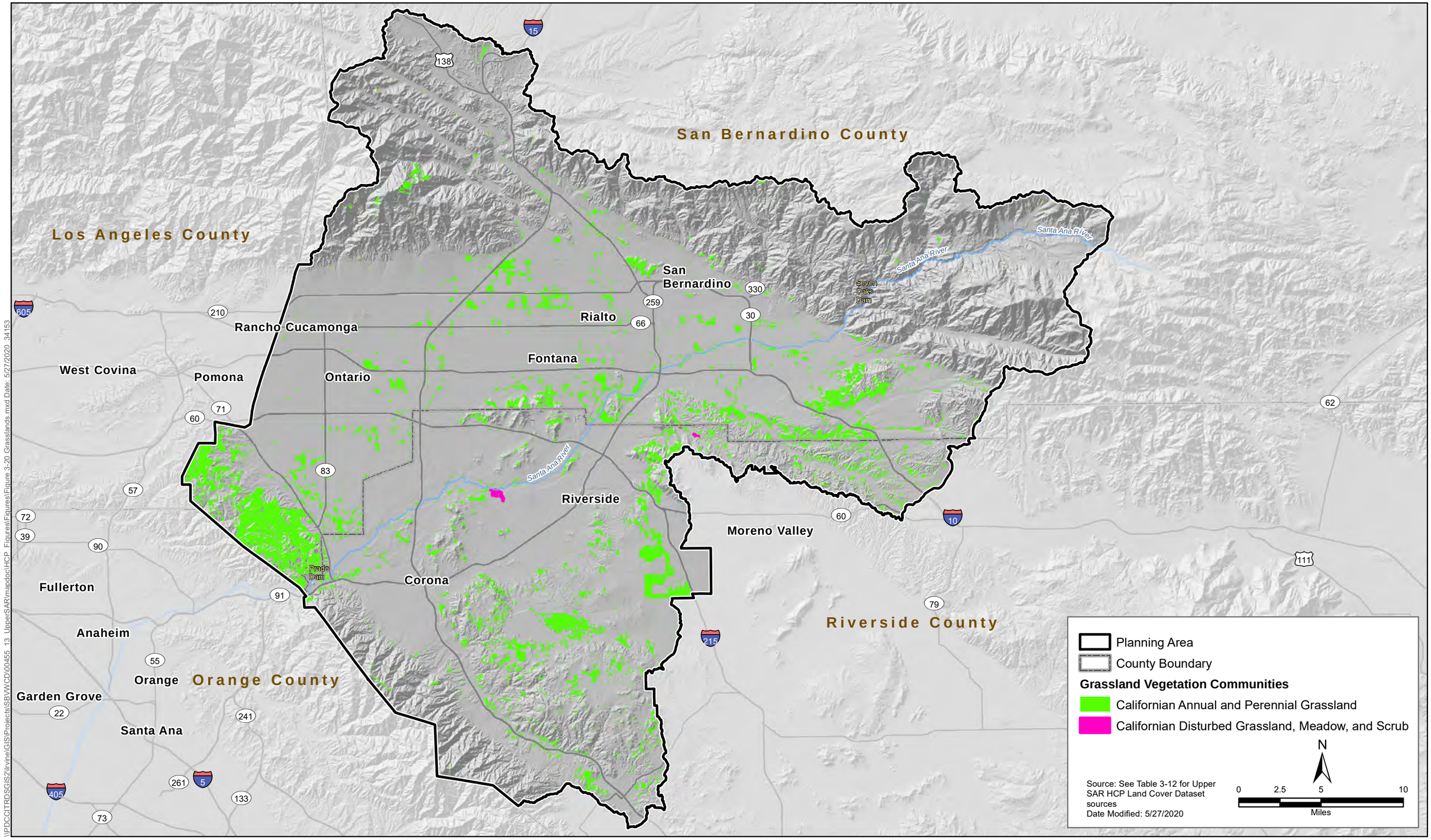
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-18
Forest and Woodland Communities in the Planning Area



Upper Santa Ana River
Habitat Conservation Plan

Figure 3-19
Shrubland Vegetation Communities in the Planning Area



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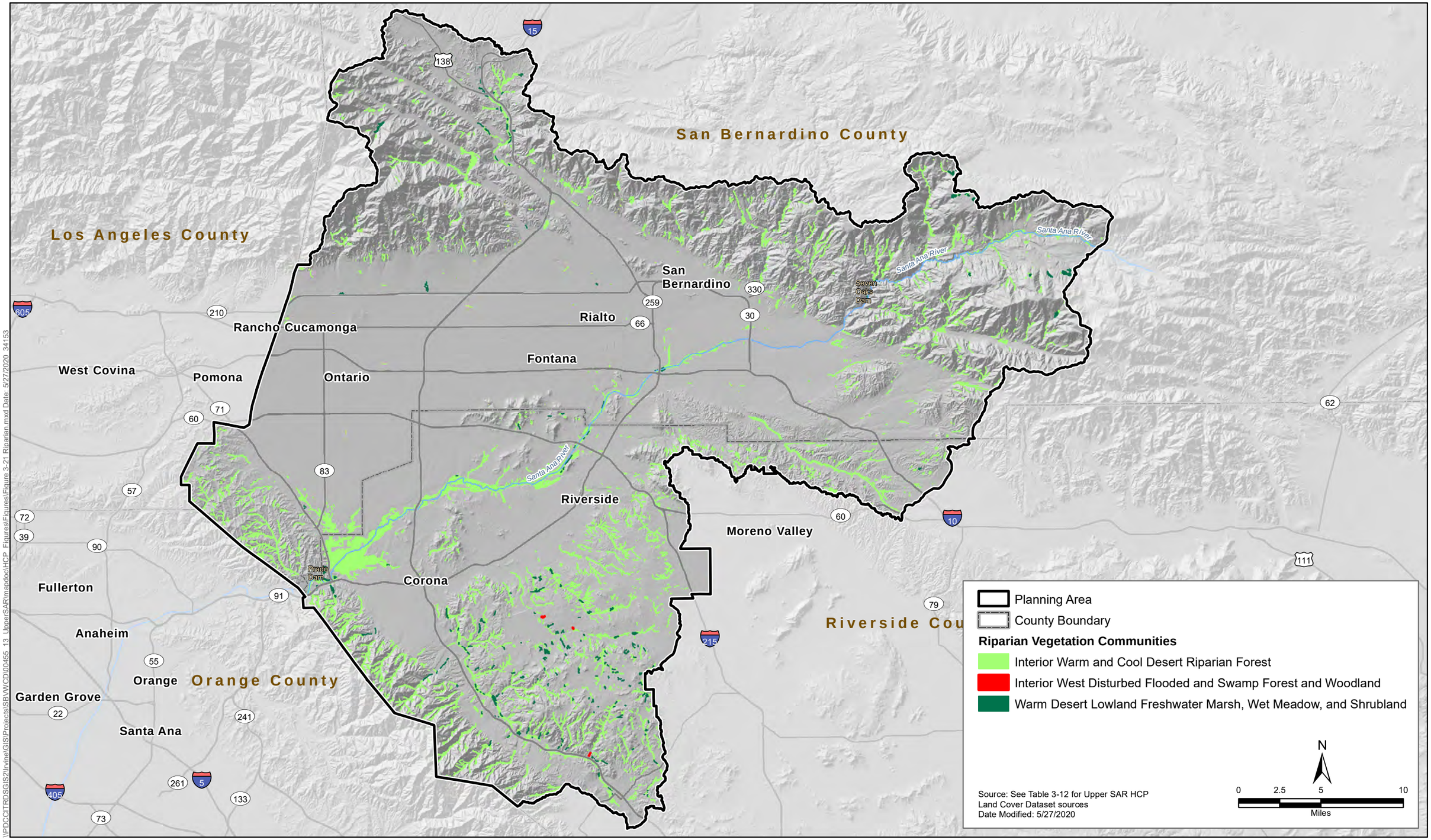
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-20
Grassland Vegetation Communities in the Planning Area



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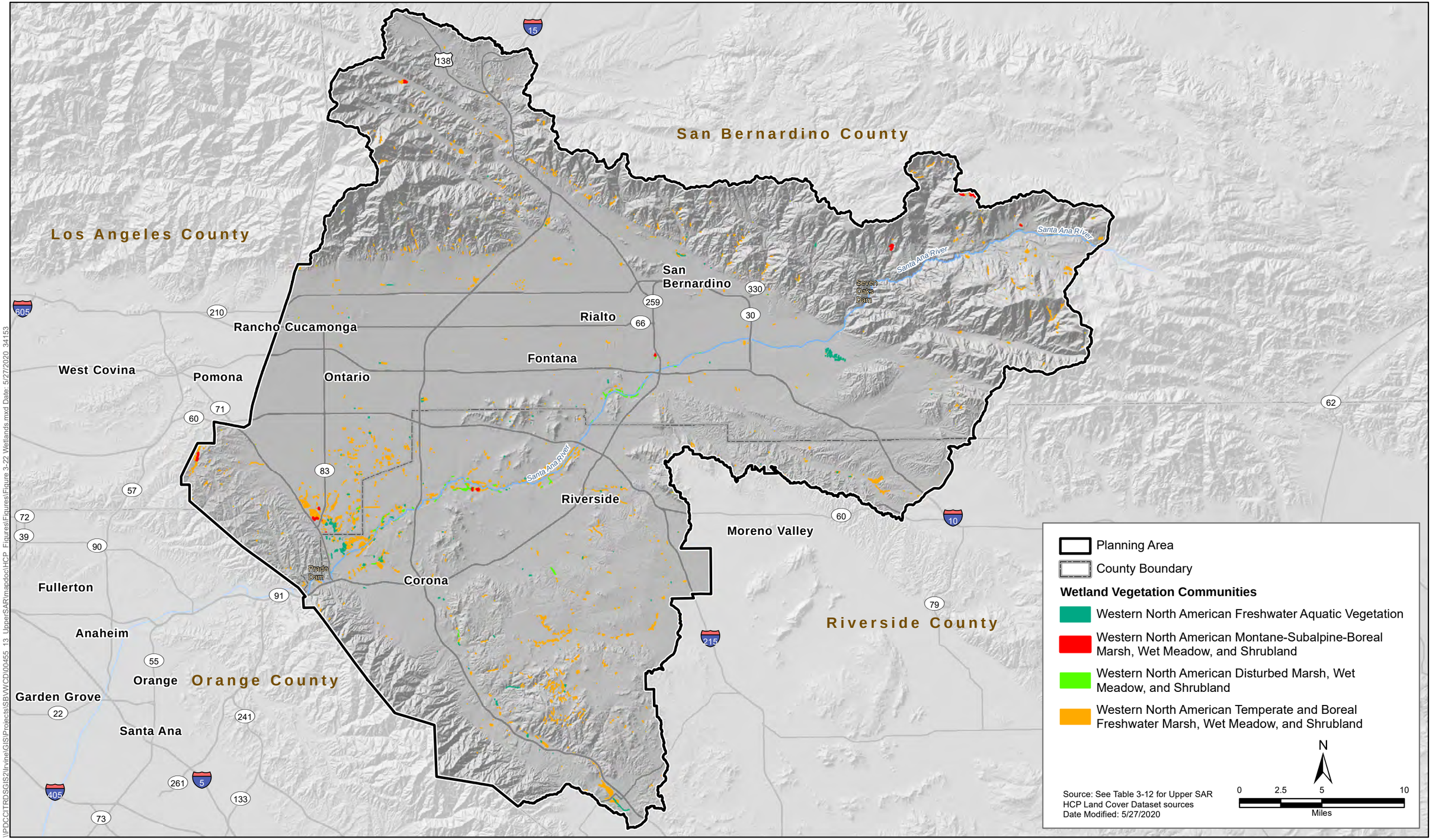
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-21
Riparian Vegetation Communities in the Planning Area



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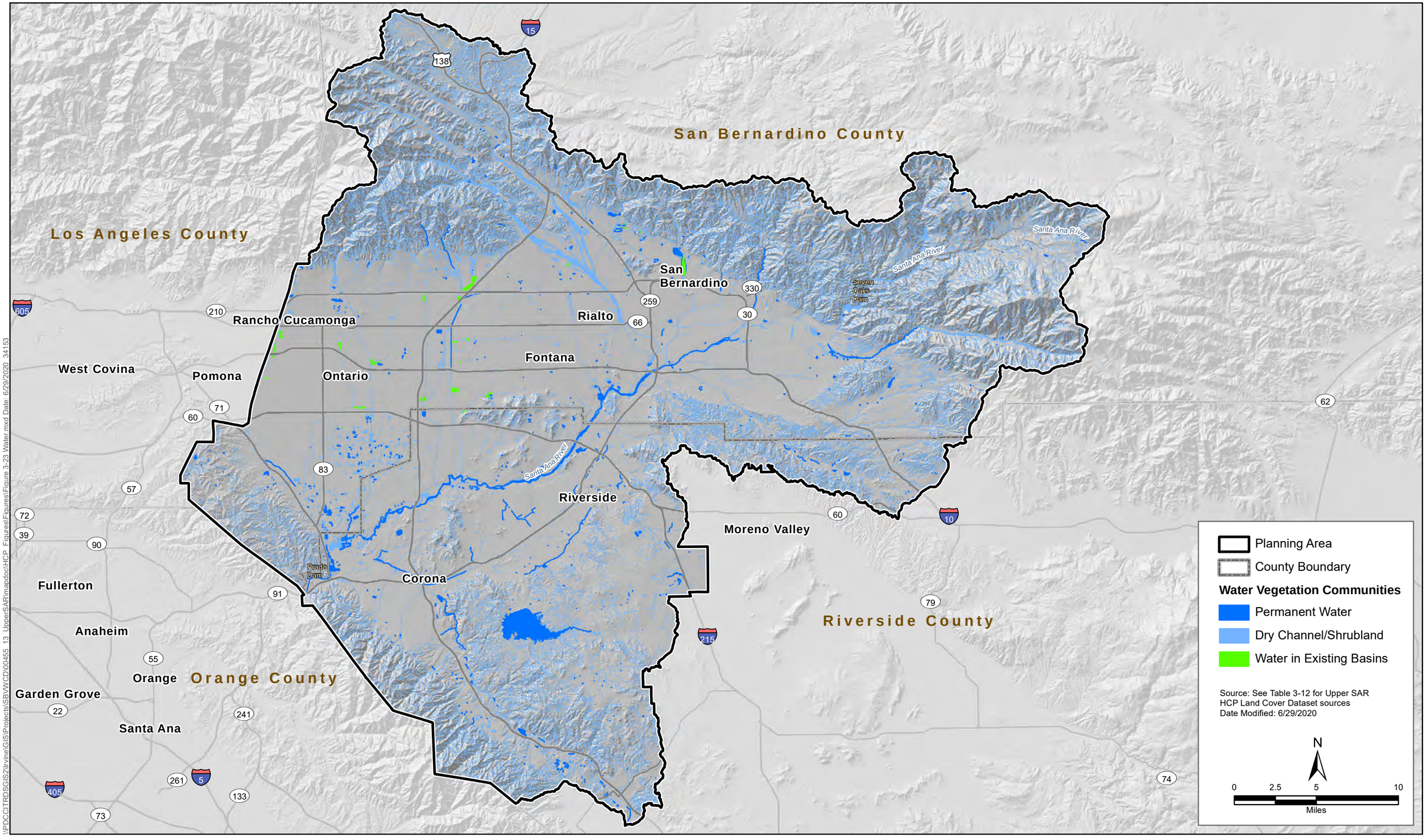
Upper Santa Ana River Habitat Conservation Plan

Figure 3-22
Wetland Vegetation Communities in the Planning Area



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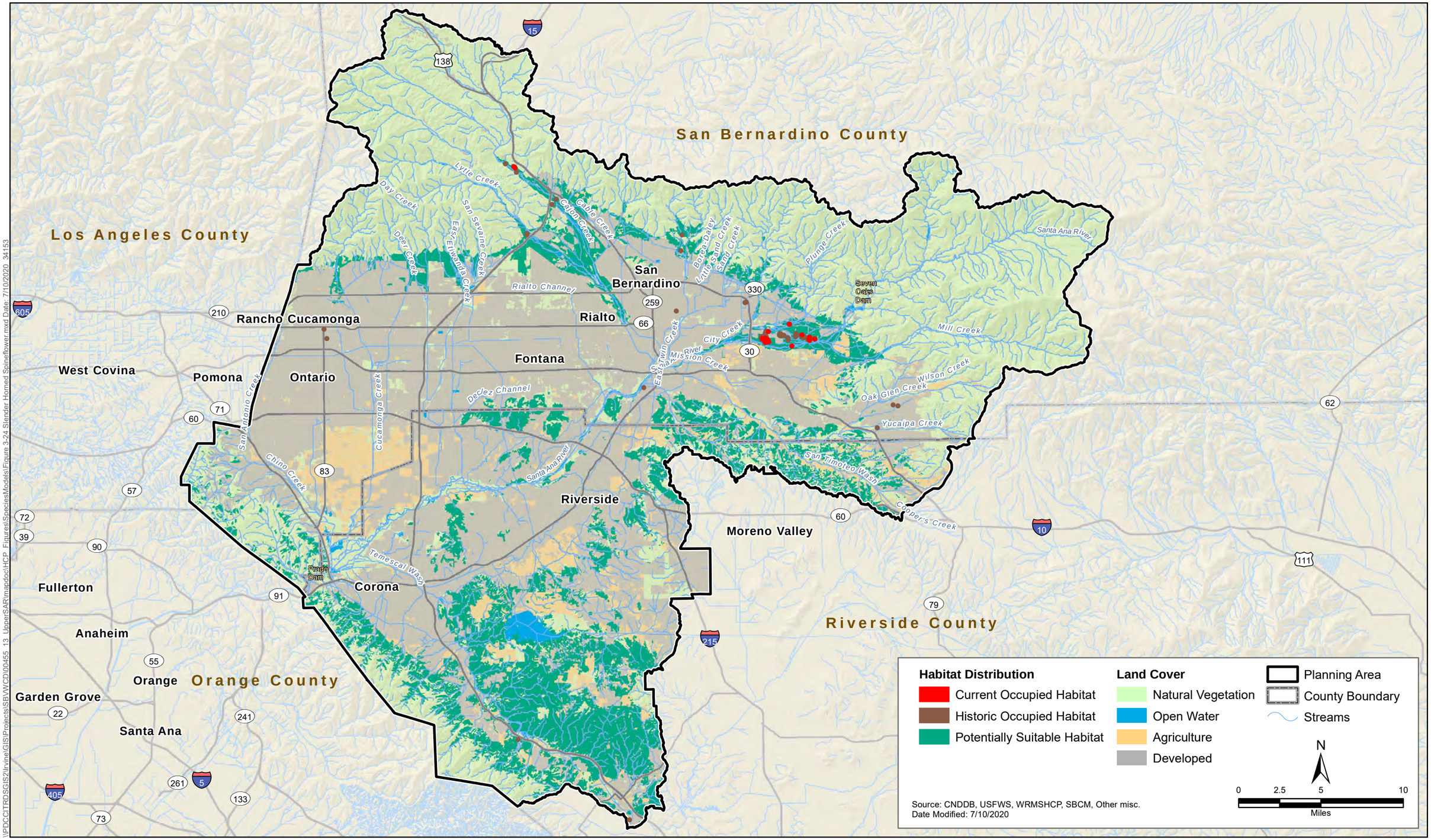
Upper Santa Ana River
Habitat Conservation Plan

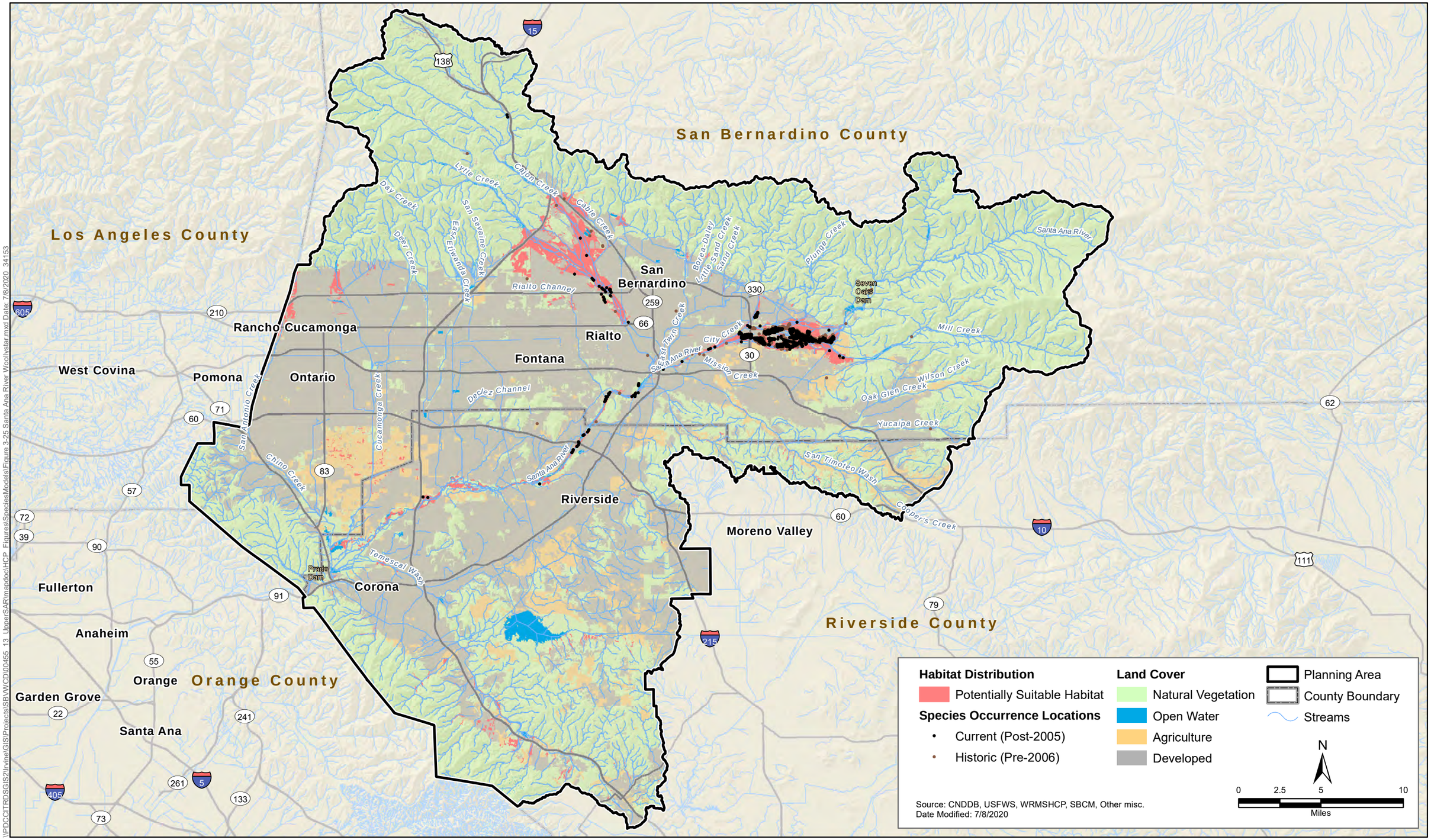
Figure 3-23
Water Vegetation Communities in the Planning Area



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-24 Slender Horned Spineflower.mxd Date: 7/10/2020_34153

Upper Santa Ana River
Habitat Conservation Plan

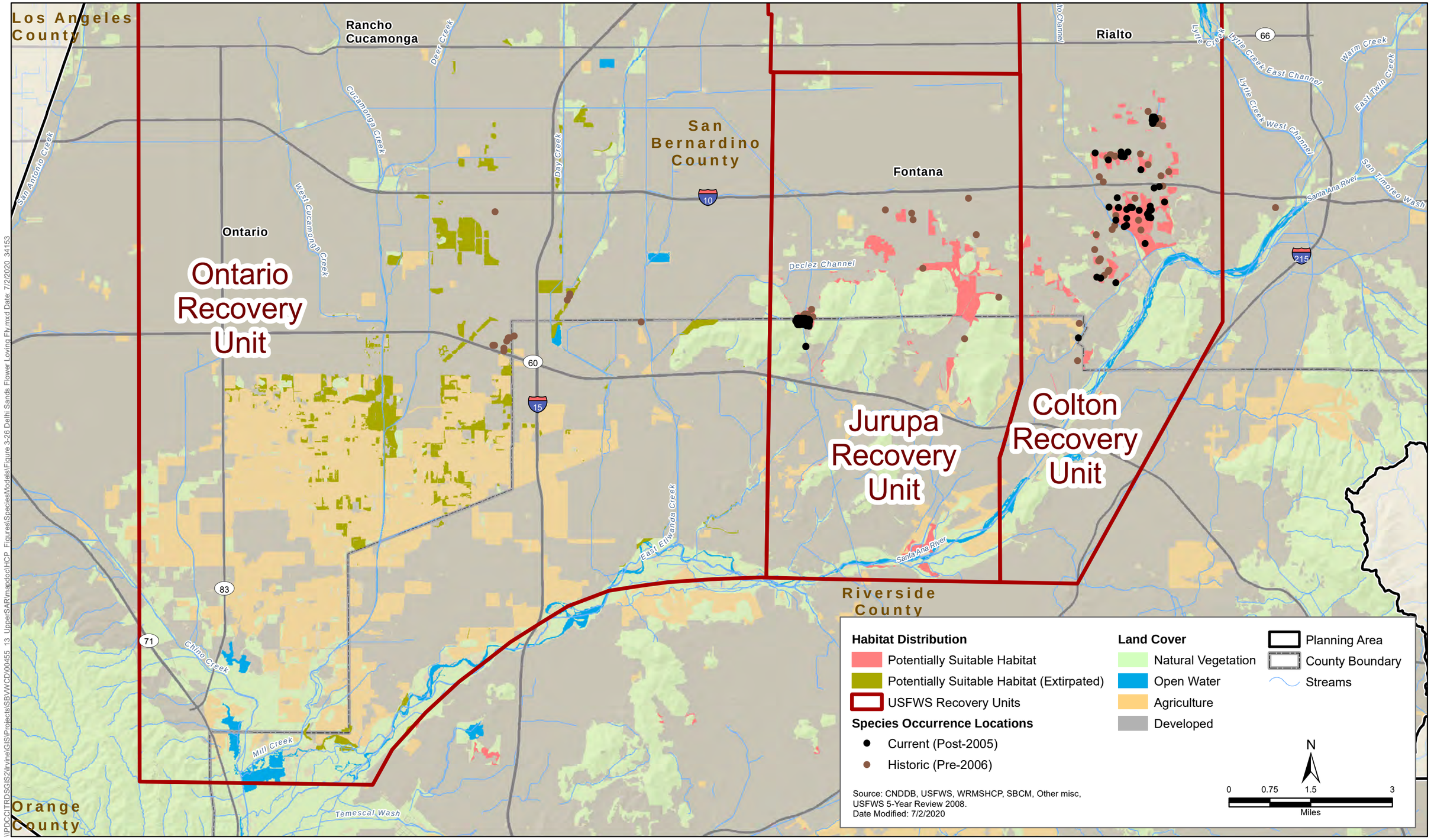
Figure 3-24
Slender-horned spineflower, *Dodecahema leptoceras*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-25 Santa Ana River Woollystar.mxd Date: 7/8/2020, 34153

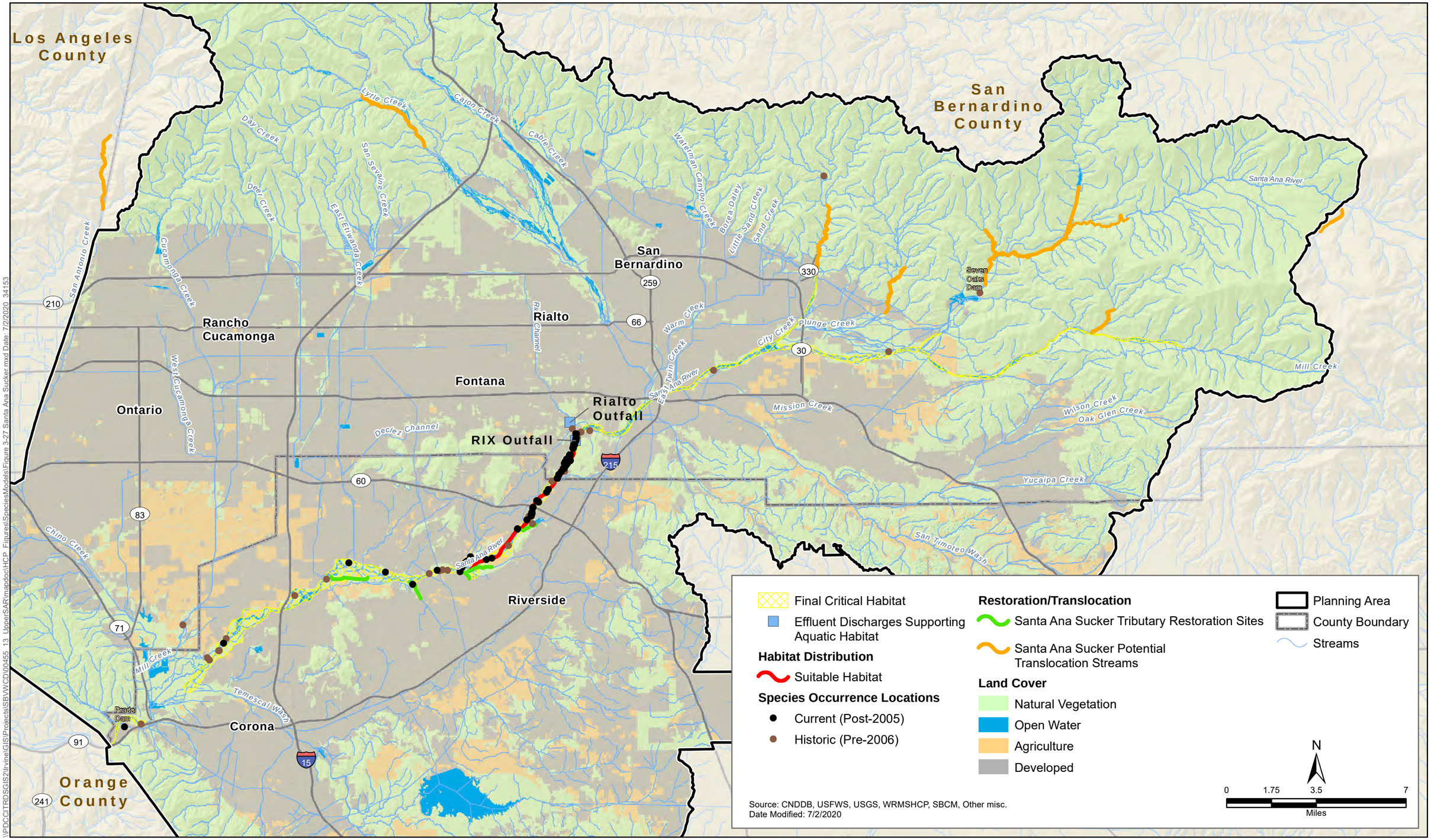
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-25
Santa Ana River woolly-star, *Eriastrum densifolium ssp. sanctorum*
Potential Habitat Distribution and Known Occurrence Records



Upper Santa Ana River
Habitat Conservation Plan

Figure 3-26
Delhi sands flower-loving fly, *Rhaphiomidas terminatus abdominalis*
Potential Habitat Distribution and Known Occurrence Records



Upper Santa Ana River Habitat Conservation Plan

Figure 3-27
Santa Ana sucker, *Catostomus santaanae*
Potential Habitat Distribution and Known Occurrence Records

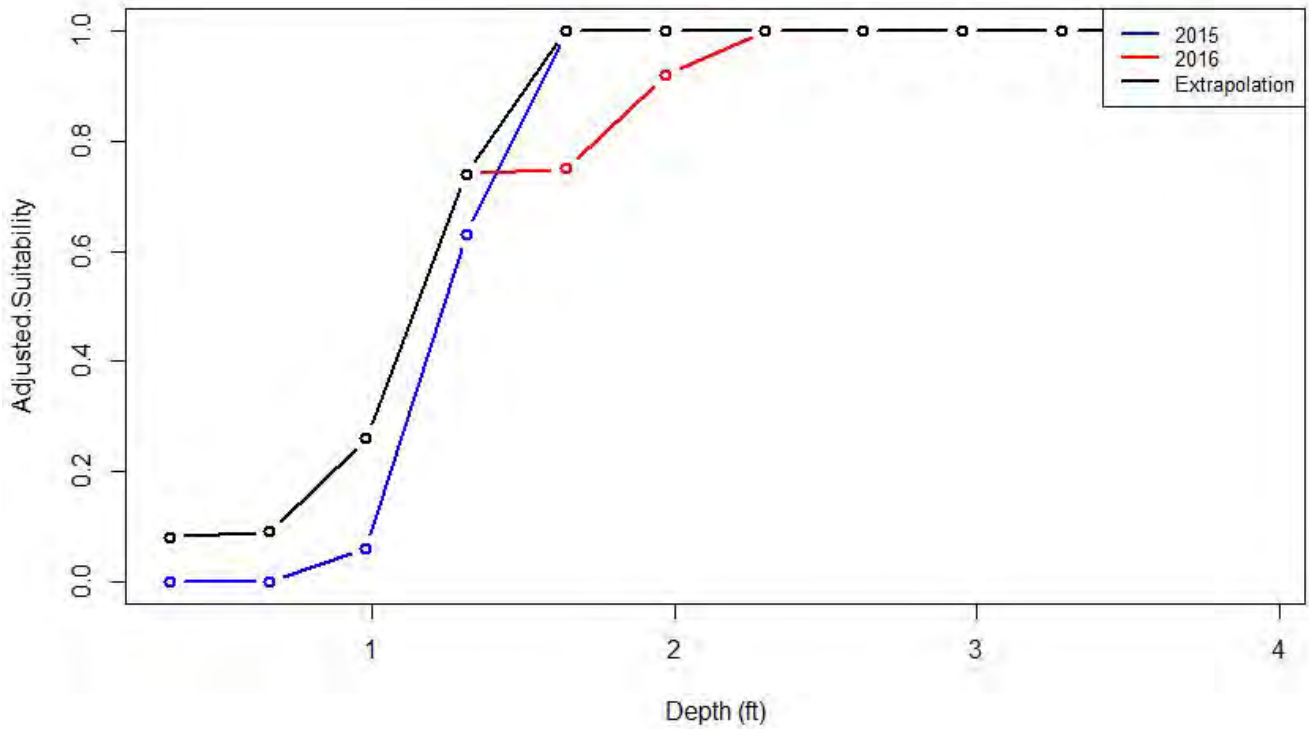


Figure 3-28
Sucker Habitat Flow Depth Suitability Curve
Upper Santa Ana River Habitat Conservation Plan

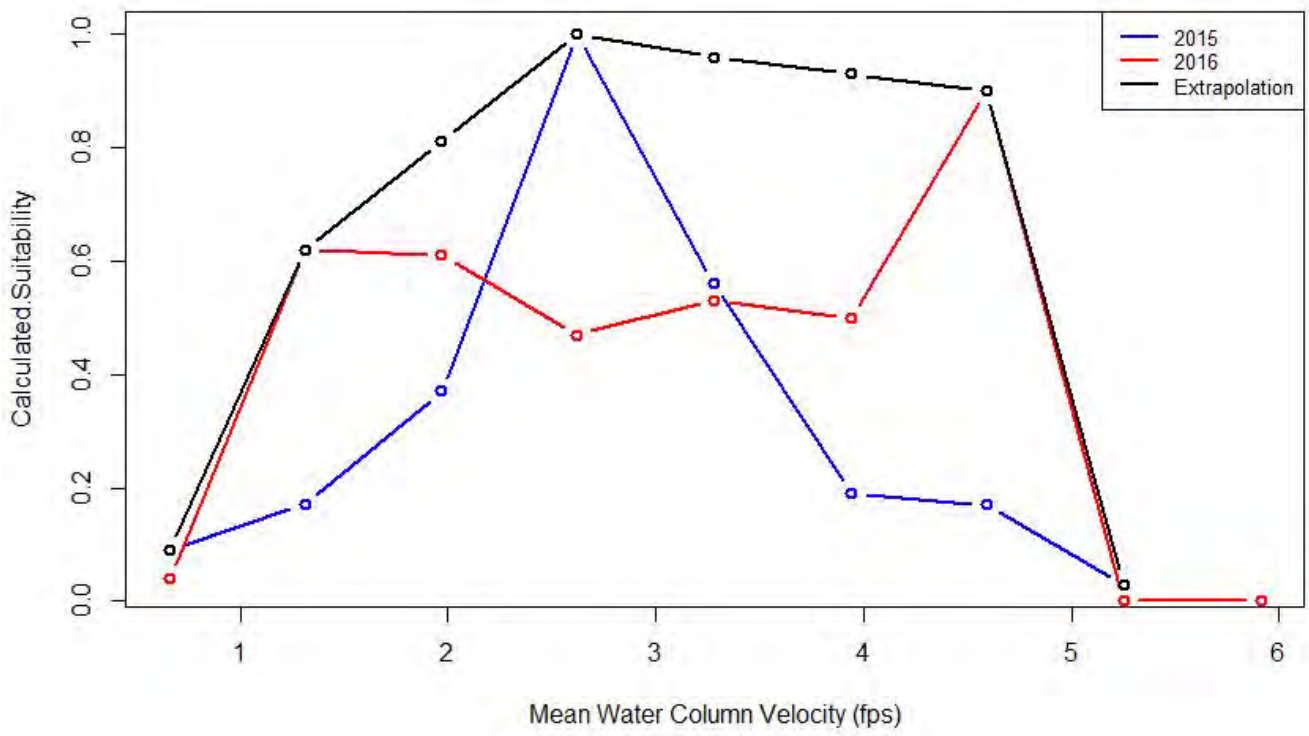
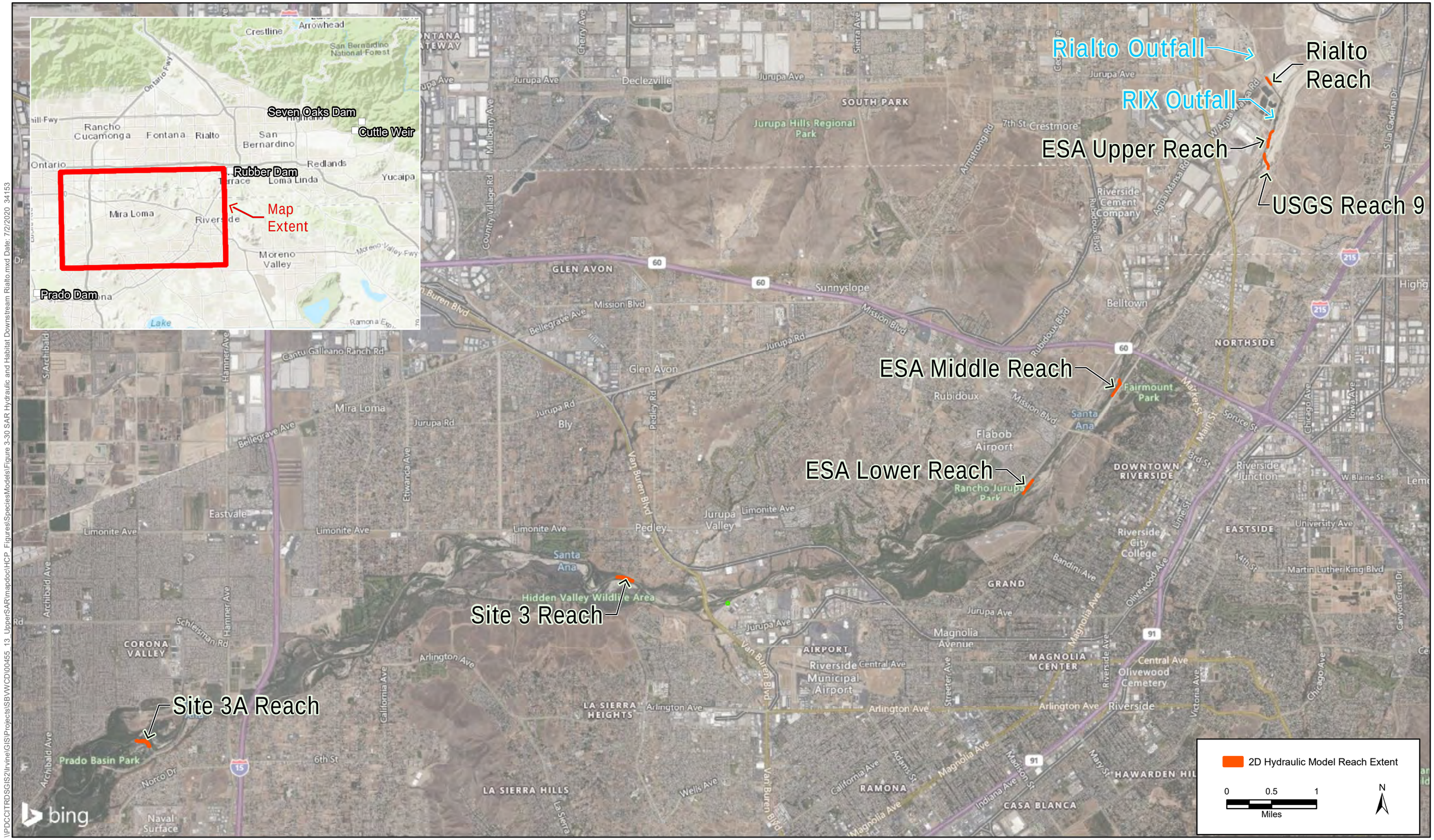


Figure 3-29
Sucker Habitat Flow Velocity Suitability Curve
Upper Santa Ana River Habitat Conservation Plan



Upper Santa Ana River
Habitat Conservation Plan

Figure3-30
Santa Ana River Hydraulic & Habitat Modeling Reaches Downstream of Rialto

\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSARImapdoc\HCP_Figures\SpeciesModels\Figure 3-30 SAR Hydraulic and Habitat Downstream Rialto.mxd Date: 7/2/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

Figure 3-31
Average August-October 95% Exceedance Flow (cfs) for the Existing Condition

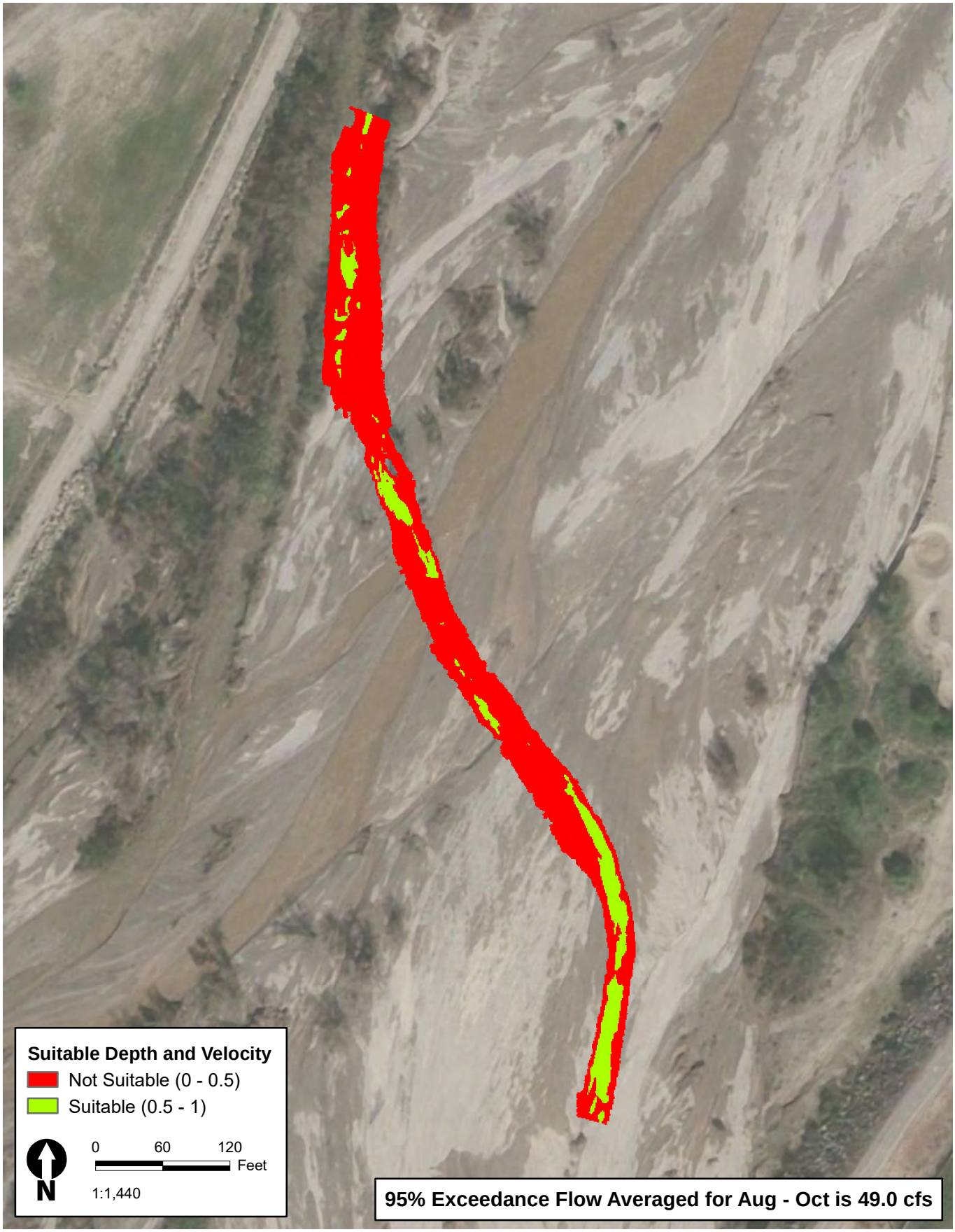
\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBWVCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-31 SAR Average Aug-Oct 95 Exceedance Existing Conditions.mxd Date: 7/2/2020 34153

\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Species\Models\Figure 3-32 Santa Ana Sucker Rialto Reach.mxd; User: 34153; Date: 7/2/2020

Figure 3-32
Santa Ana Sucker Suitable Depth and Velocity
Rialto Reach - Modeled Flow of 9.0 cfs
Upper Santa Ana River Habitat Conservation Plan

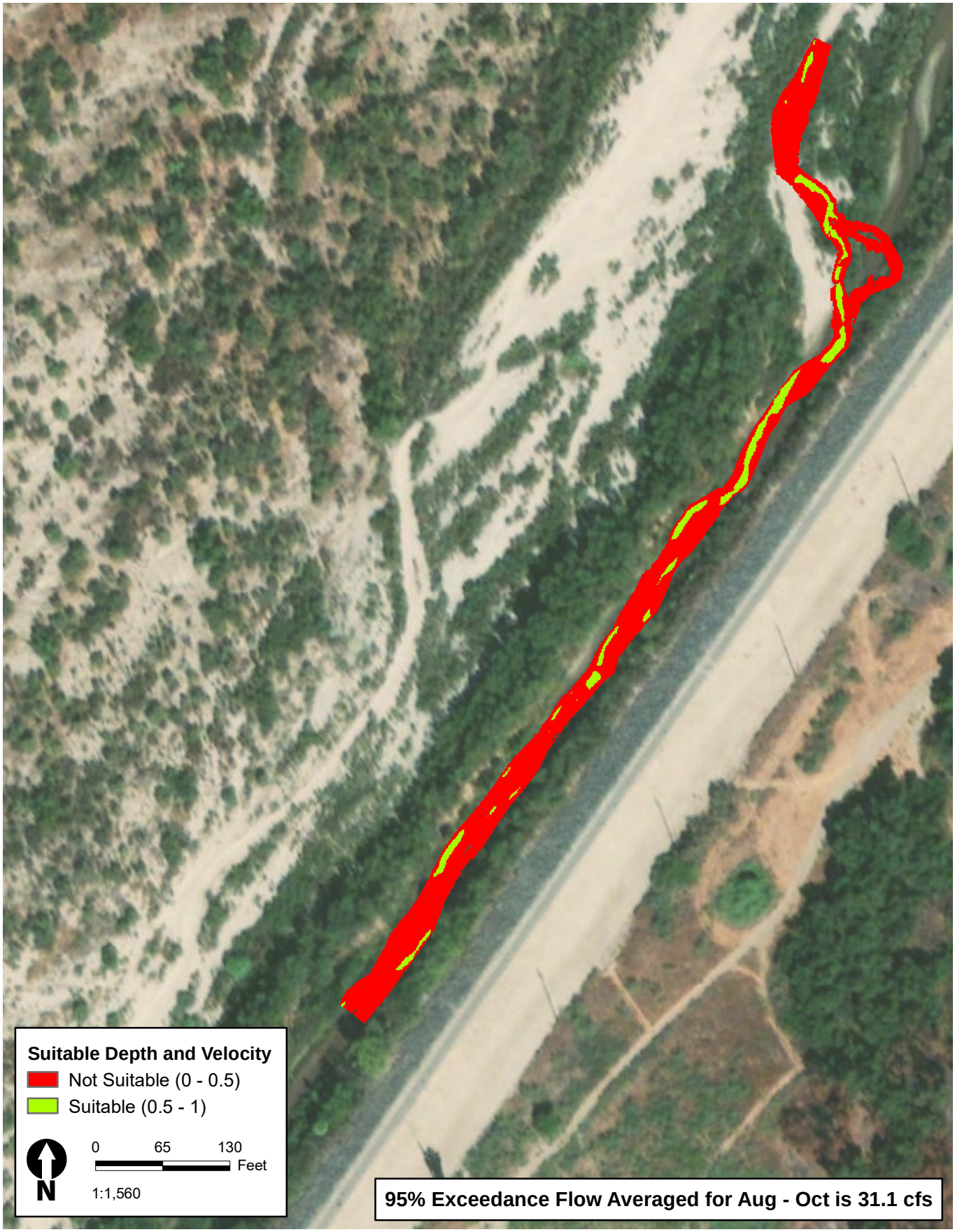
\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Species\Models\Figure 3-33 Santa Ana Sucker ESA Upper Reach.mxd; User: 34153; Date: 7/2/2020

Figure 3-33
Santa Ana Sucker Suitable Depth and Velocity
ESA Upper Reach - Downstream of RIX - Modeled Flow of 51.5 cfs
Upper Santa Ana River Habitat Conservation Plan



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Species\Models\Figure 3-34 Santa Ana Sucker USGS9 Reach.mxd; User: 34153; Date: 7/2/2020

Figure 3-34
Santa Ana Sucker Suitable Depth and Velocity
USGS Reach 9 - Downstream of RIX - Modeled Flow of 51.5 cfs
Upper Santa Ana River Habitat Conservation Plan



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSARmapdoc\HCP_Figures\SpeciesModels\Figure 3-35 Santa Ana Sucker ESA Middle Reach.mxd; User: 34153; Date: 7/2/2020

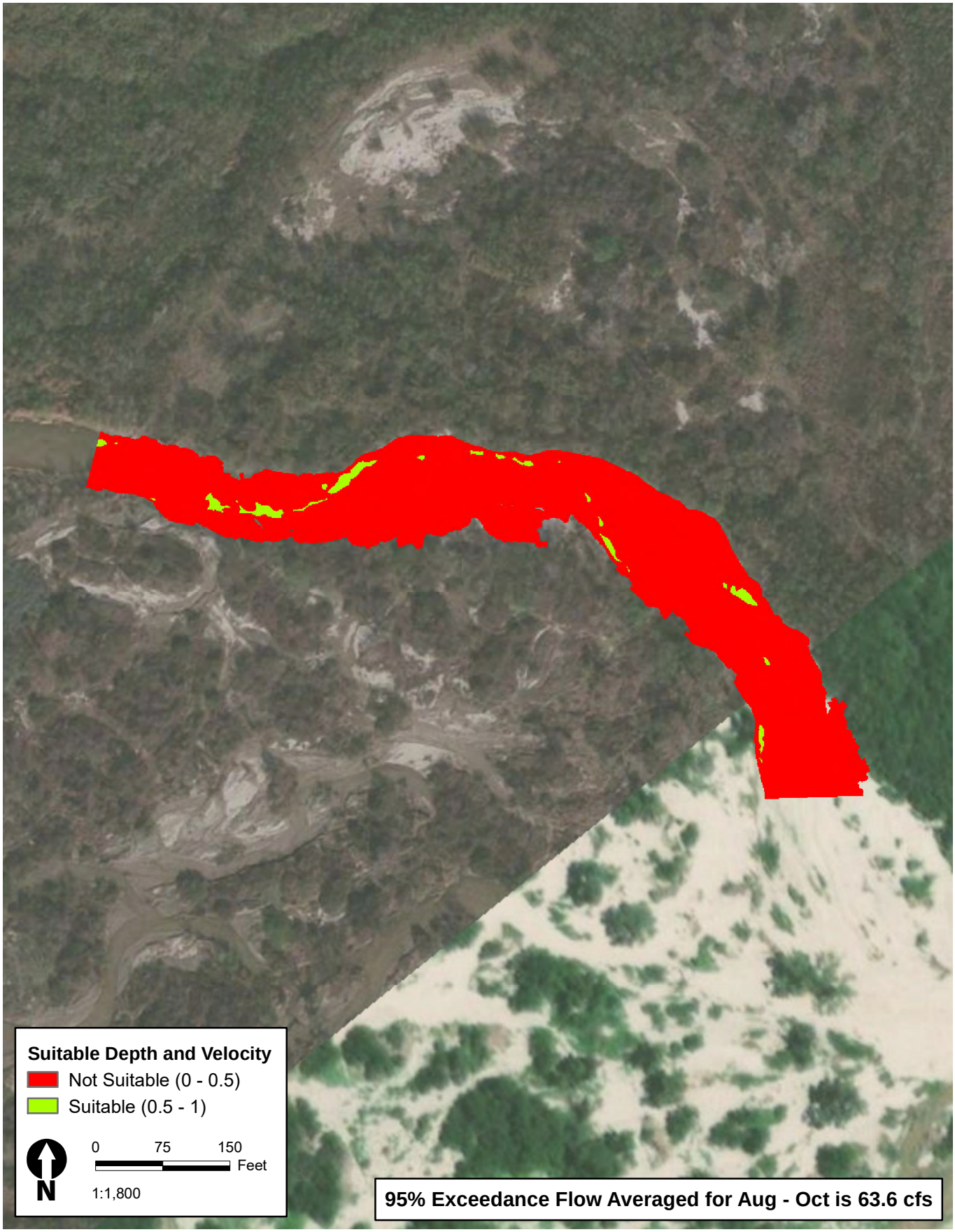
Figure 3-35
Santa Ana Sucker Suitable Depth and Velocity
ESA Middle Reach - Downstream of RIX - Modeled Flow of 32.4 cfs
Upper Santa Ana River Habitat Conservation Plan

\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSARmapdoc\HCP_Figures\SpeciesModels\Figure 3-36 Santa Ana Sucker ESA Lower Reach.mxd; User: 34153; Date: 7/2/2020

Figure 3-36
Santa Ana Sucker Suitable Depth and Velocity
ESA Lower Reach - Downstream of RIX - Modeled Flow of 32.4 cfs
Upper Santa Ana River Habitat Conservation Plan

\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-37 Santa Ana Sucker SAR3 Reach.mxd; User: 34153; Date: 7/2/2020

Figure 3-37
Santa Ana Sucker Suitable Depth and Velocity
Site 3 Reach - Downstream of RIX - Modeled Flow of 67.0 cfs
Upper Santa Ana River Habitat Conservation Plan

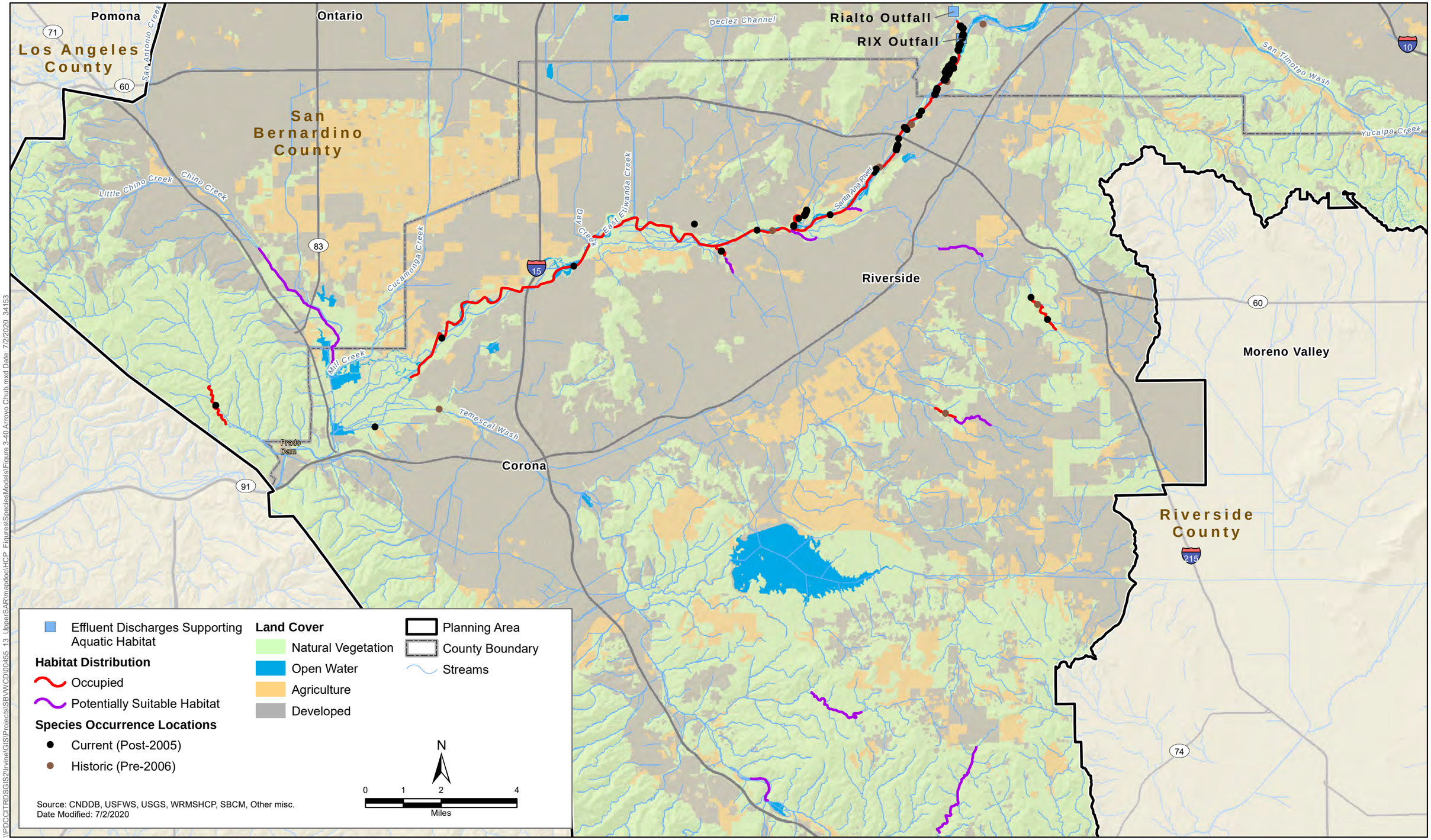


\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSARmapdoc\HCP_Figures\SpeciesModels\Figure 3-38 Santa Ana Sucker SAR3a Reach.mxd; User: 34153; Date: 7/2/2020

Figure 3-38
Santa Ana Sucker Suitable Depth and Velocity
Site 3a Reach - Downstream of RIX - Modeled Flow of 67.0 cfs
Upper Santa Ana River Habitat Conservation Plan

Upper Santa Ana River Habitat Conservation Plan

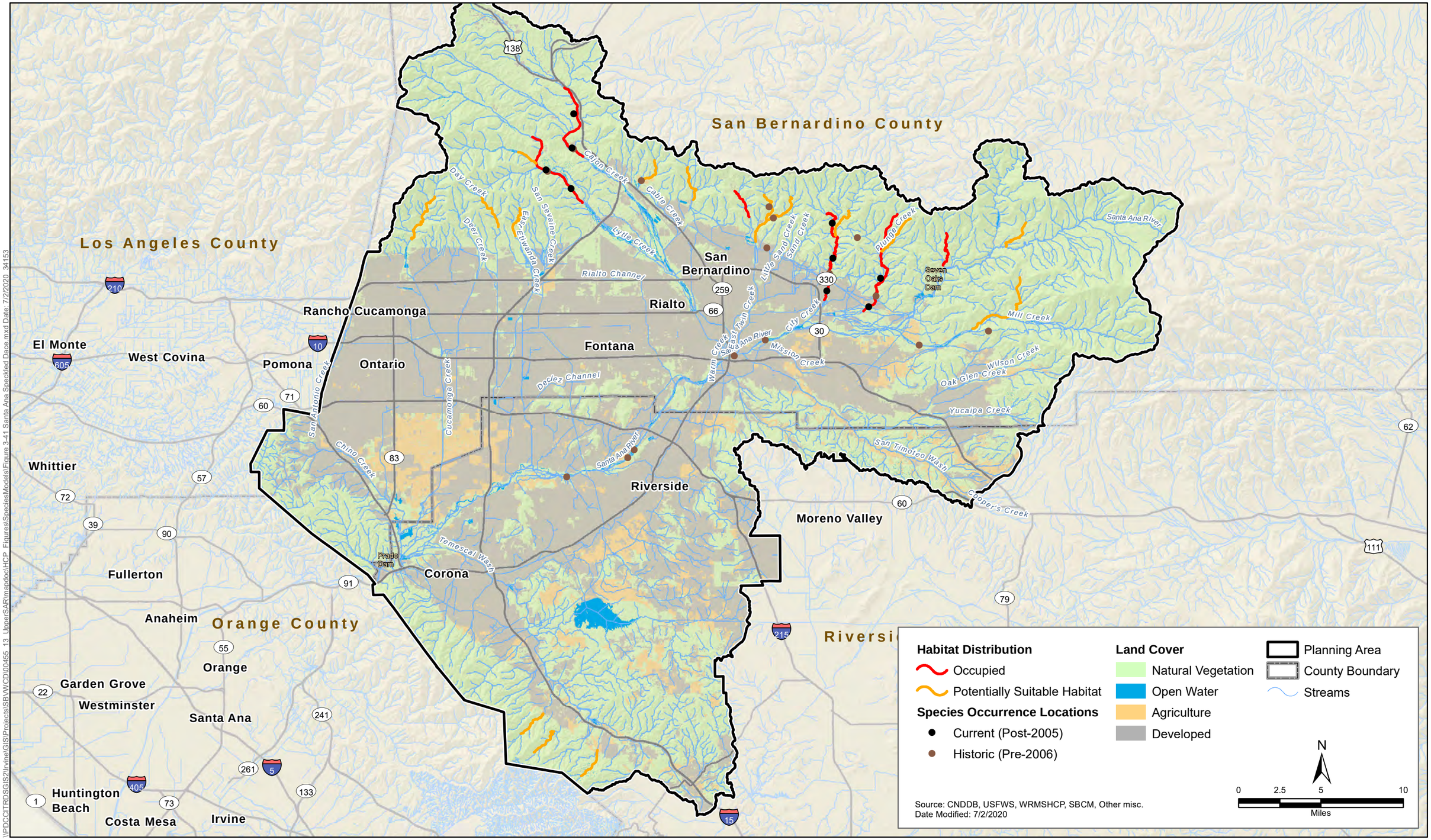
Figure 3-39
Acres of Santa Ana Sucker Suitable Depth and Velocity per 1,000 ft of Channel Length under Existing Condition Average Aug-Oct 95% Exceedance Flow



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBWVCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-40 Arroyo Chub.mxd Date: 7/2/2020 34153

Upper Santa Ana River Habitat Conservation Plan

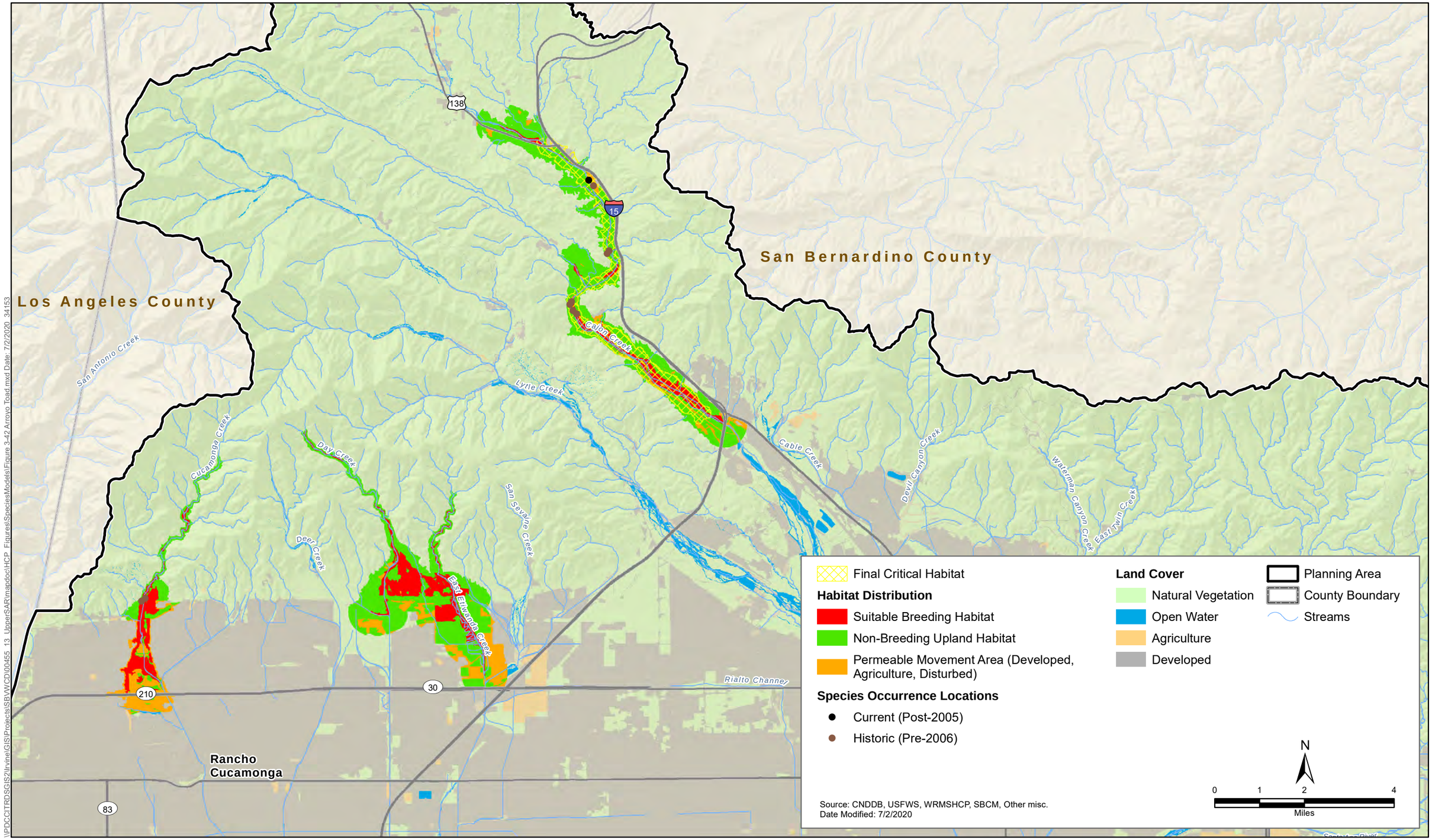
Figure 3-40
Arroyo chub, *Gila orcuttii*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-41 Santa Ana Speckled Dace.mxd Date: 7/2/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

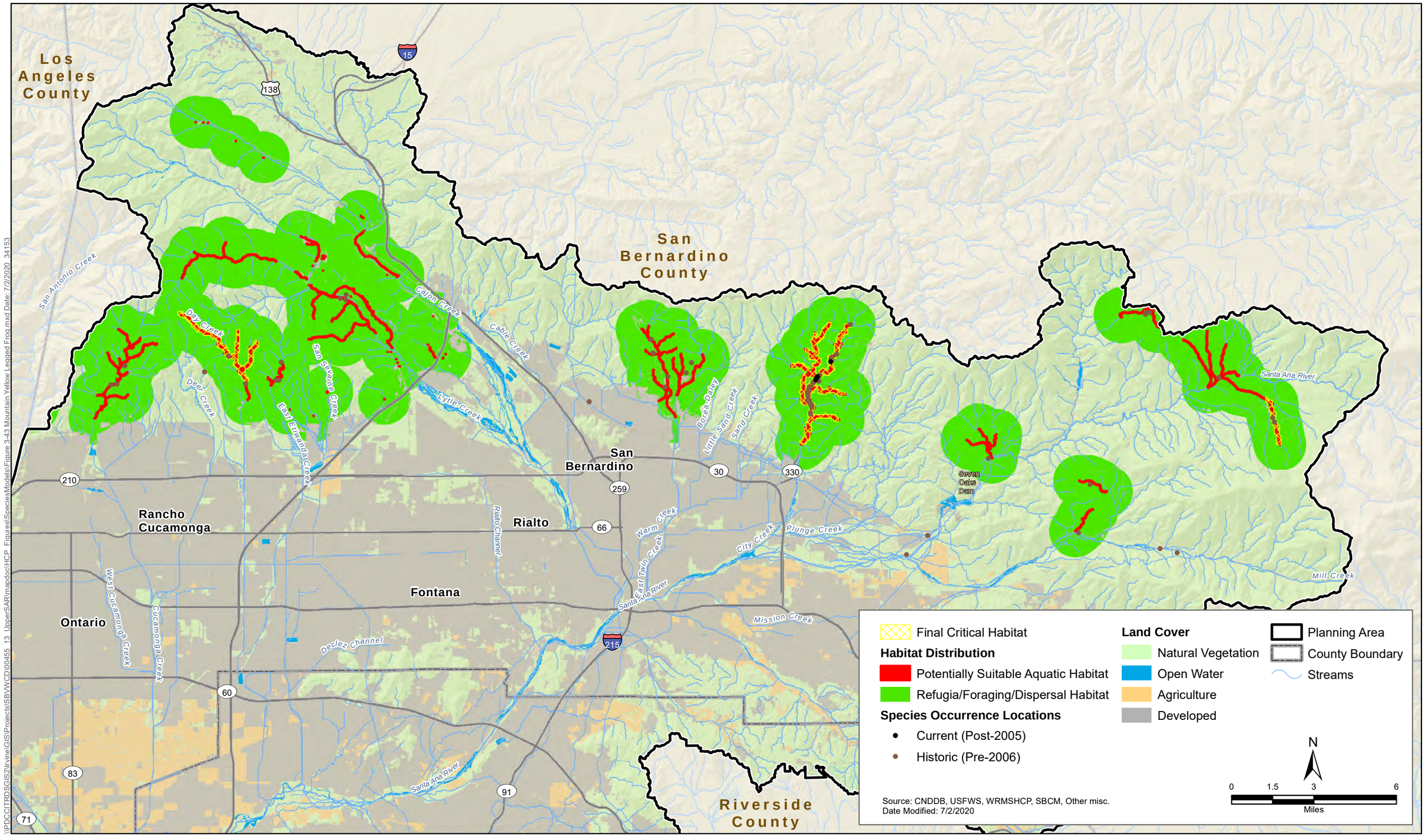
Figure 3-41
Santa Ana speckleld dace, *Rhinichthys osculus ssp.*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-42 Arroyo Toad.mxd Date: 7/2/2020_34153

Upper Santa Ana River
Habitat Conservation Plan

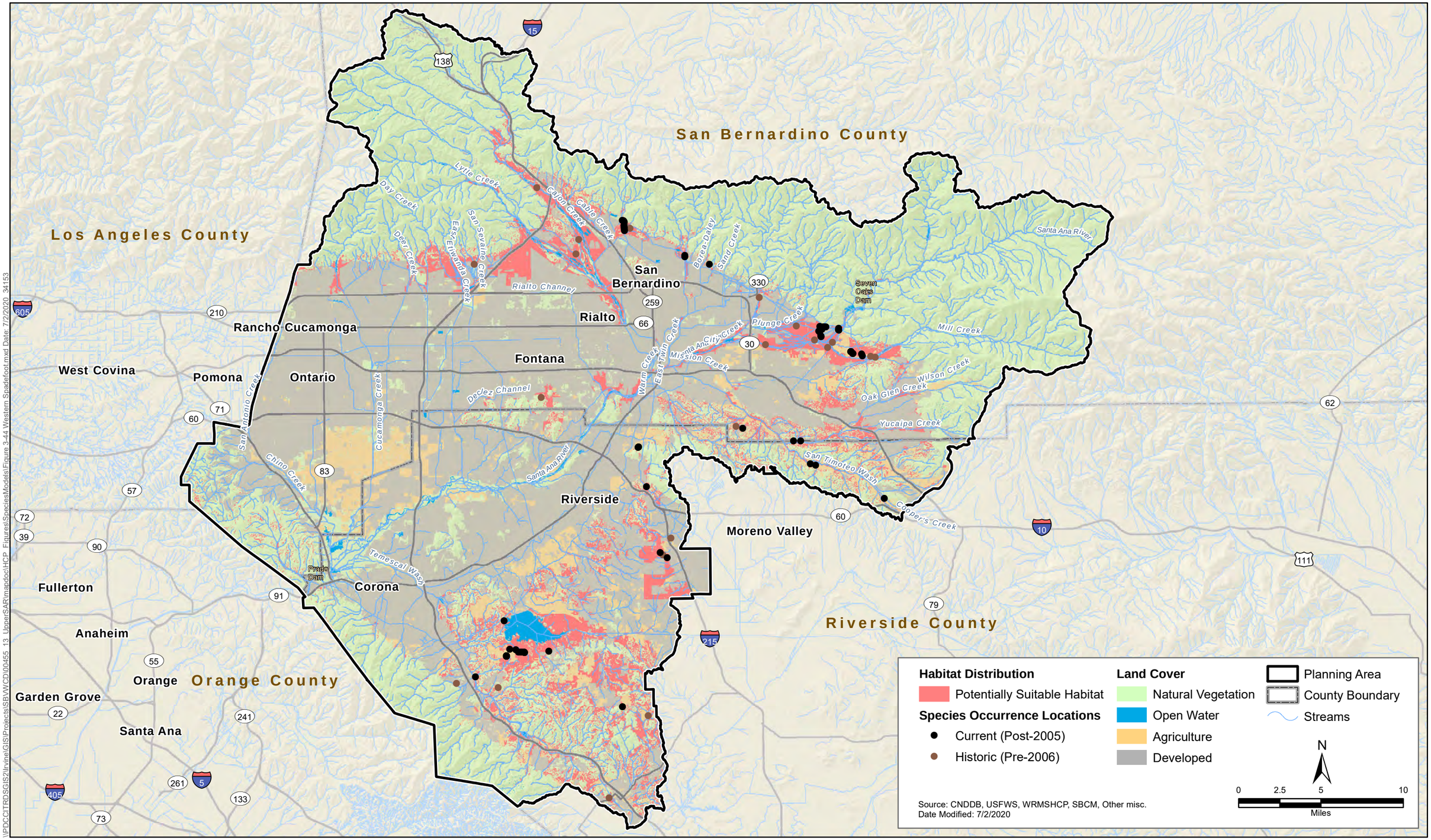
Figure 3-42
Arroyo toad, *Anaxyrus californicus*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-43 Mountain Yellow Legged Frog.mxd Date: 7/2/2020_34153

Upper Santa Ana River
Habitat Conservation Plan

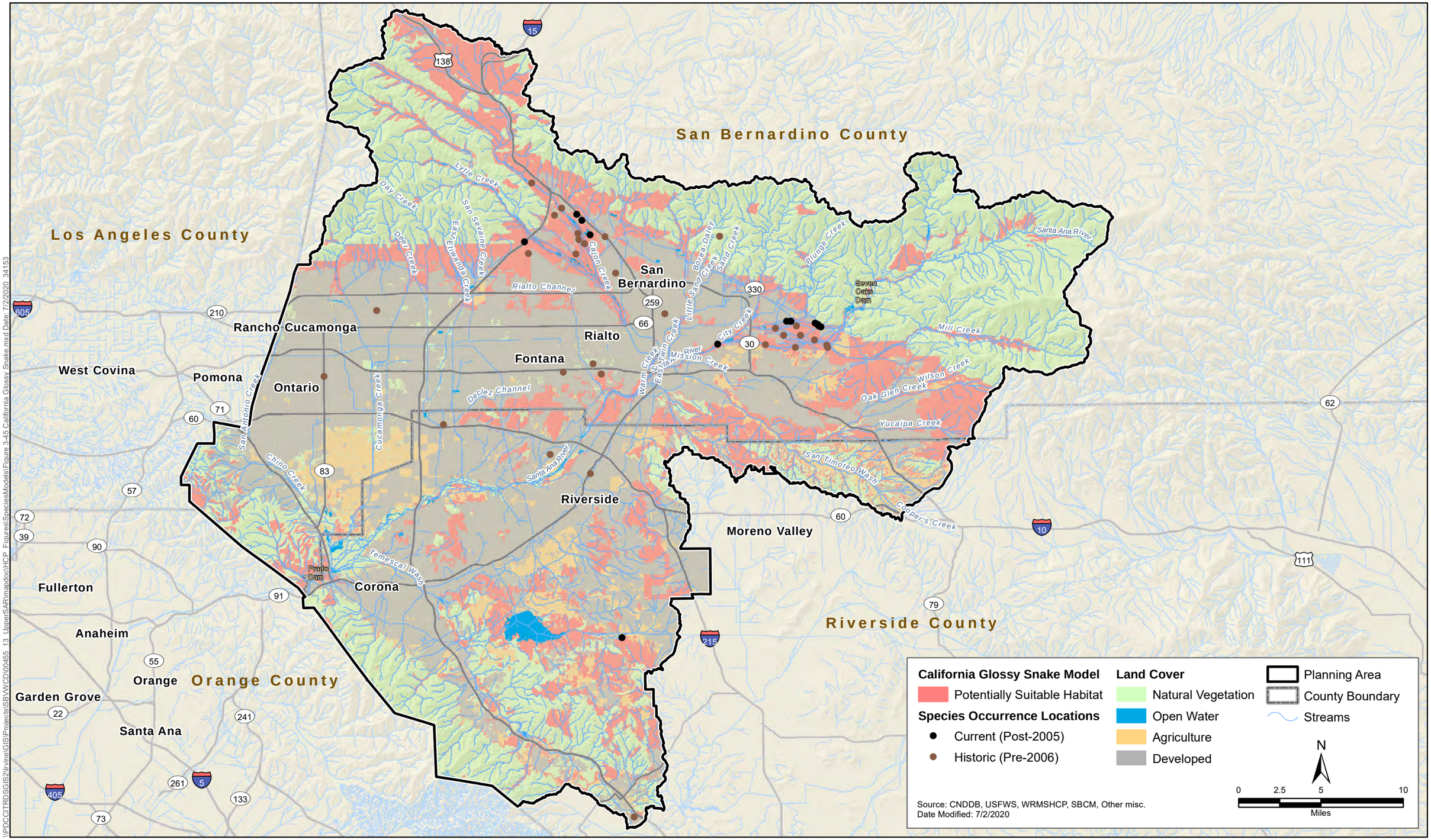
Figure 3-43
Mountain yellow-legged frog, *Rana muscosa*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-44 Western Spadefoot.mxd Date: 7/2/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

Figure 3-44
Western spadefoot, *Spea hammondii*
Potential Habitat Distribution and Known Occurrence Records



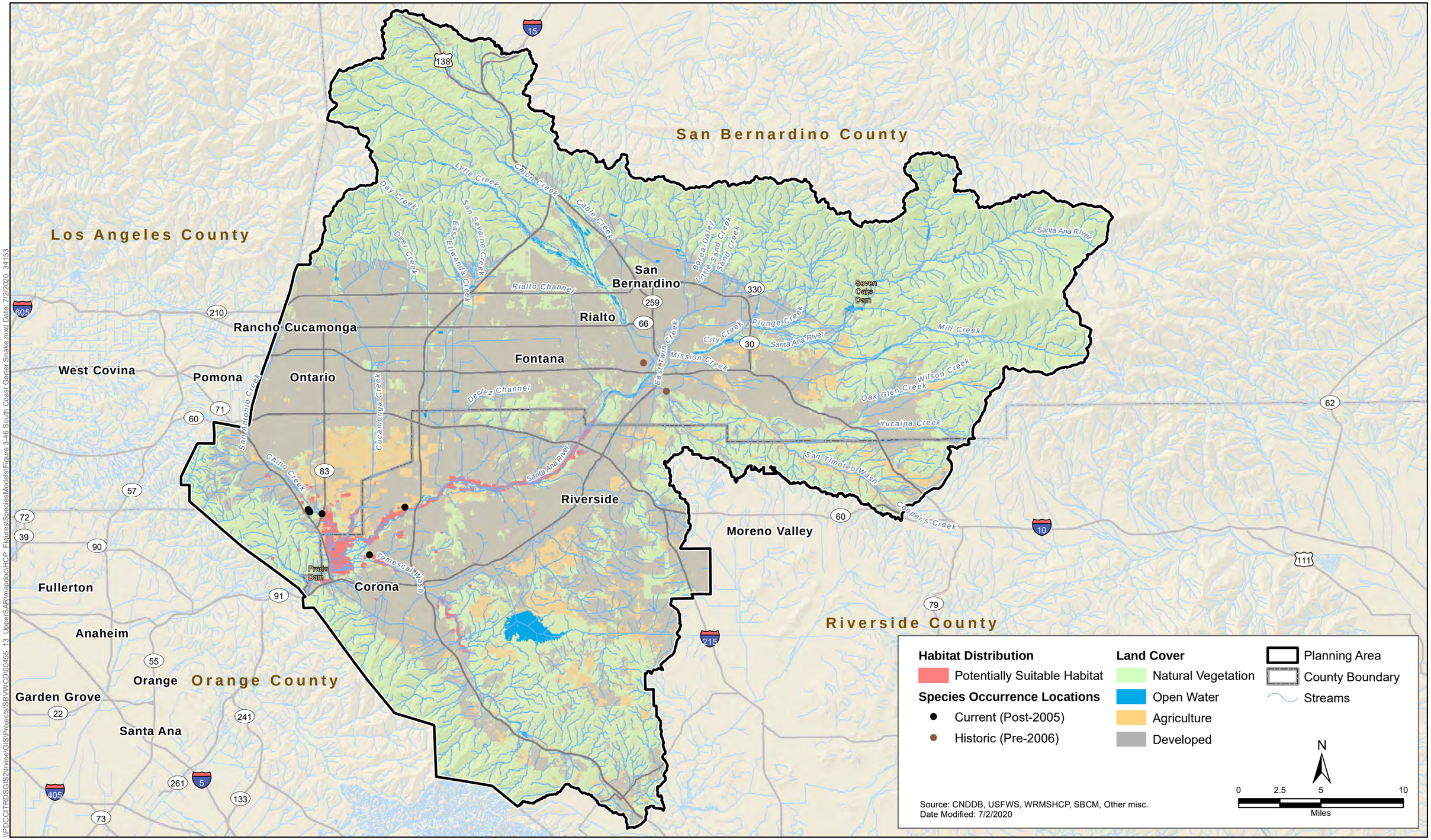
California Glossy Snake Model
Potentially Suitable Habitat
Species Occurrence Locations
Current (Post-2005)
Historic (Pre-2006)
Land Cover
Natural Vegetation
Open Water
Agriculture
Developed
Planning Area
County Boundary
Streams
N
0 2.5 5 10
Miles

Source: CNDDB, USFWS, WRMSHCP, SBCM, Other misc.
Date Modified: 7/2/2020

\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-45 California Glossy Snake.mxd Date: 7/2/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

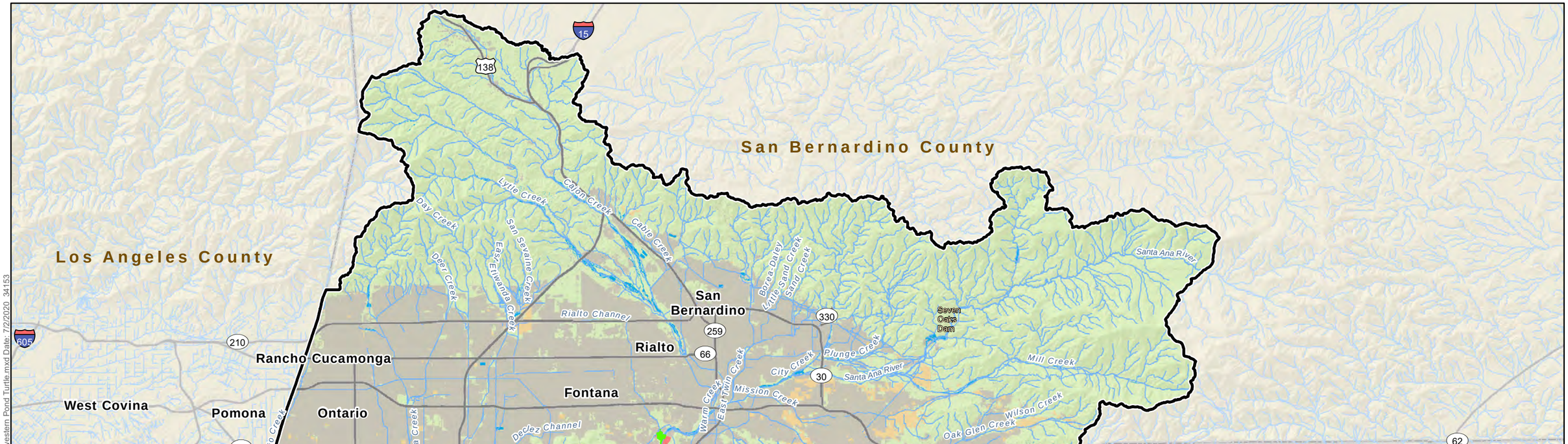
Figure 3-45
California glossy snake, *Arizona elegans occidentalis*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-46 South Coast Garter Snake.mxd Date: 7/2/2020 34153

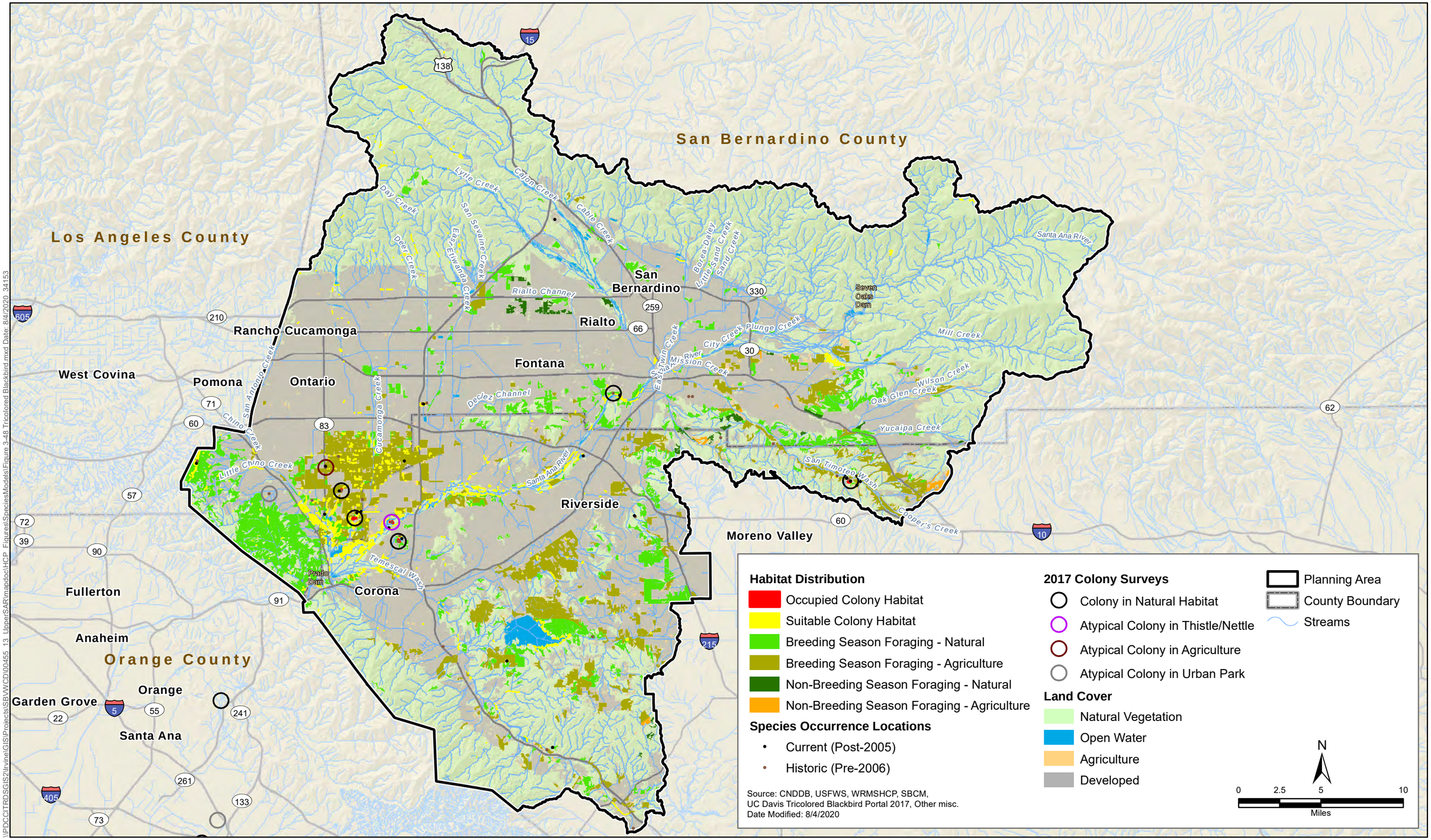
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-46
South coast garter snake, *Thamnophis sirtalis ssp.*
Potential Habitat Distribution and Known Occurrence Records



Upper Santa Ana River
Habitat Conservation Plan

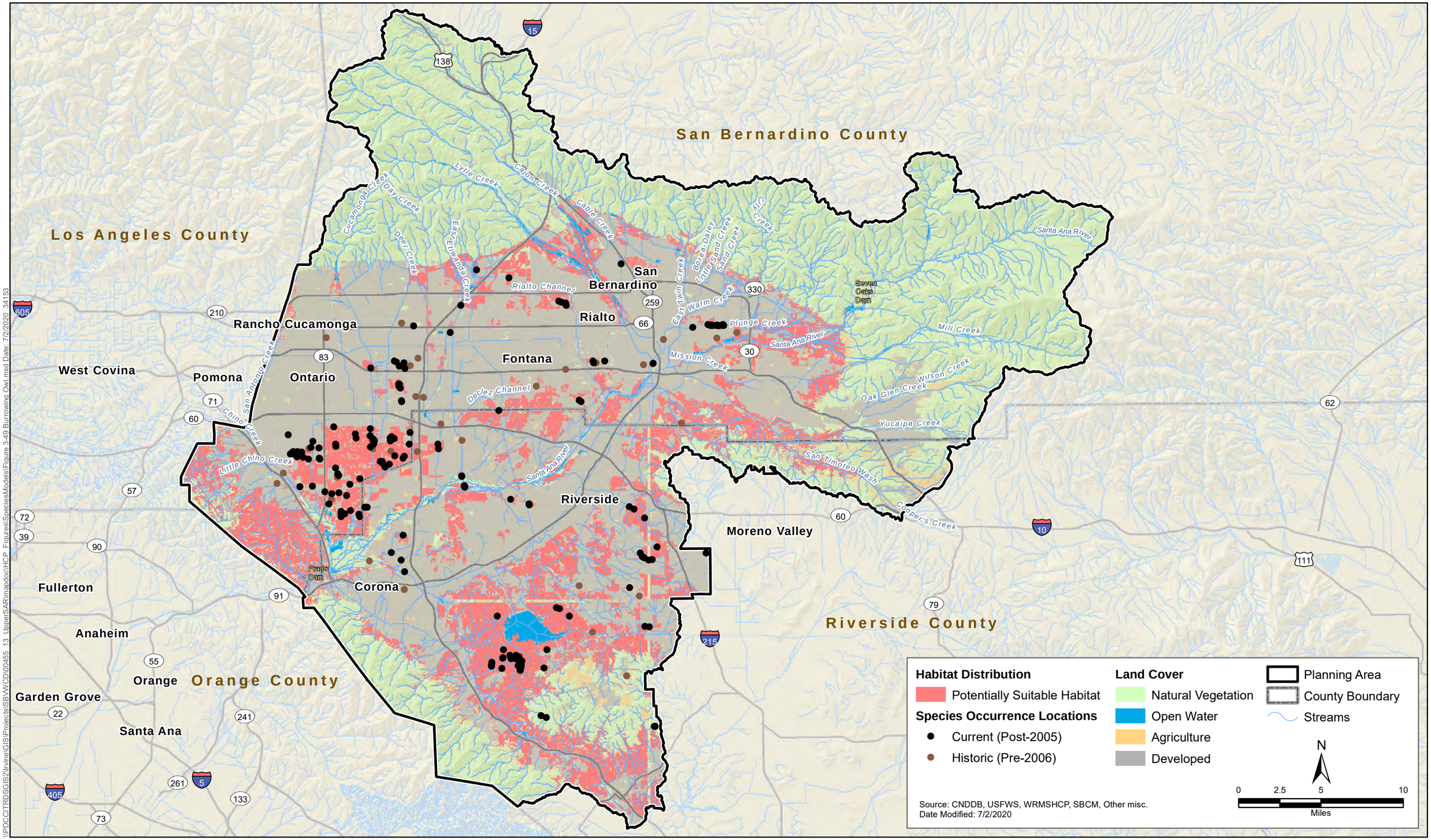
Figure 3-47
Southwestern pond turtle, *Emys pallida*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-48 Tricolored Blackbird.mxd Date: 8/4/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

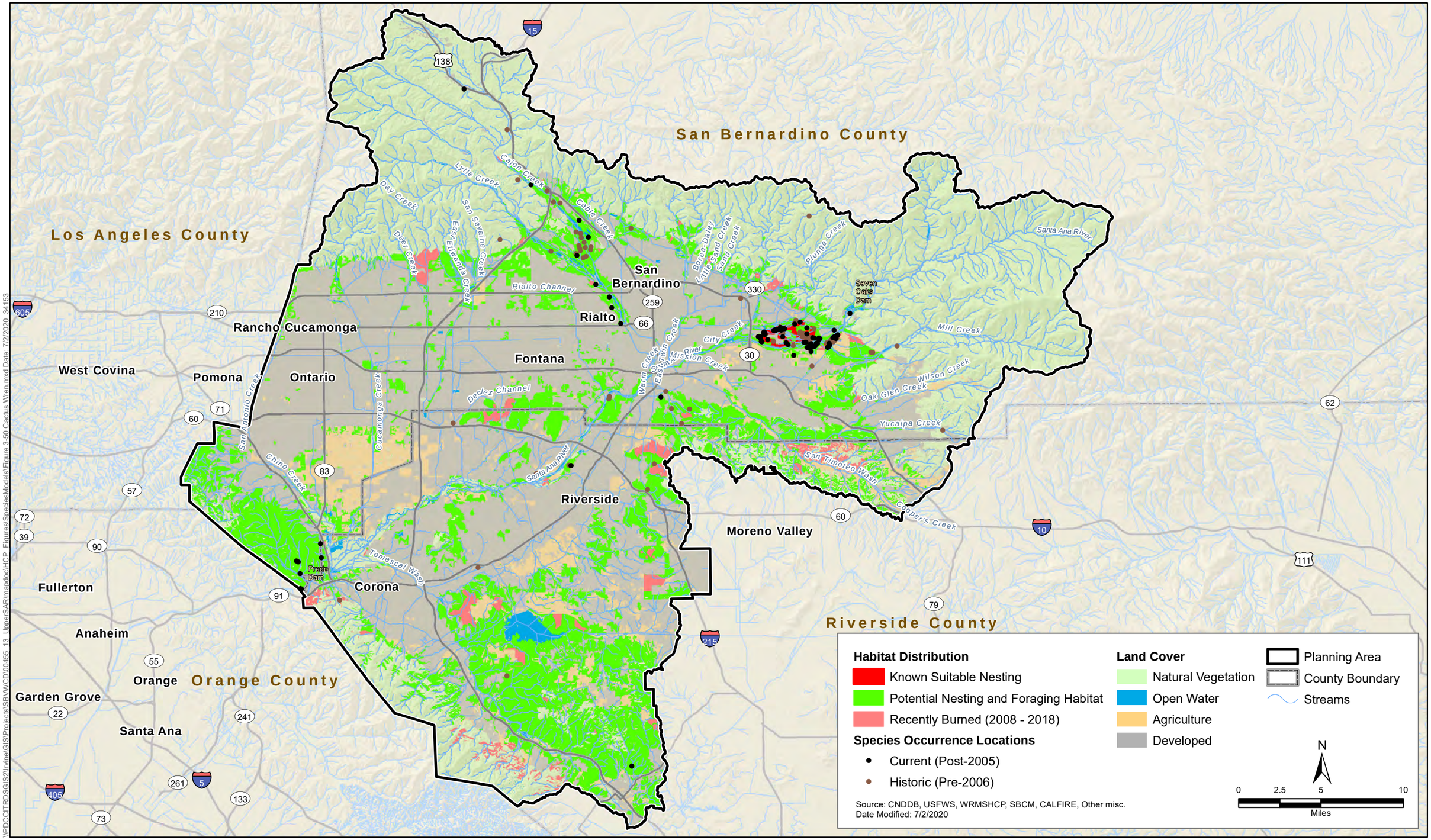
Figure 3-48
Tricolored blackbird, *Agelaius tricolor*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-49 Burrowing Owl.mxd Date: 7/2/2020, 34153

Upper Santa Ana River
Habitat Conservation Plan

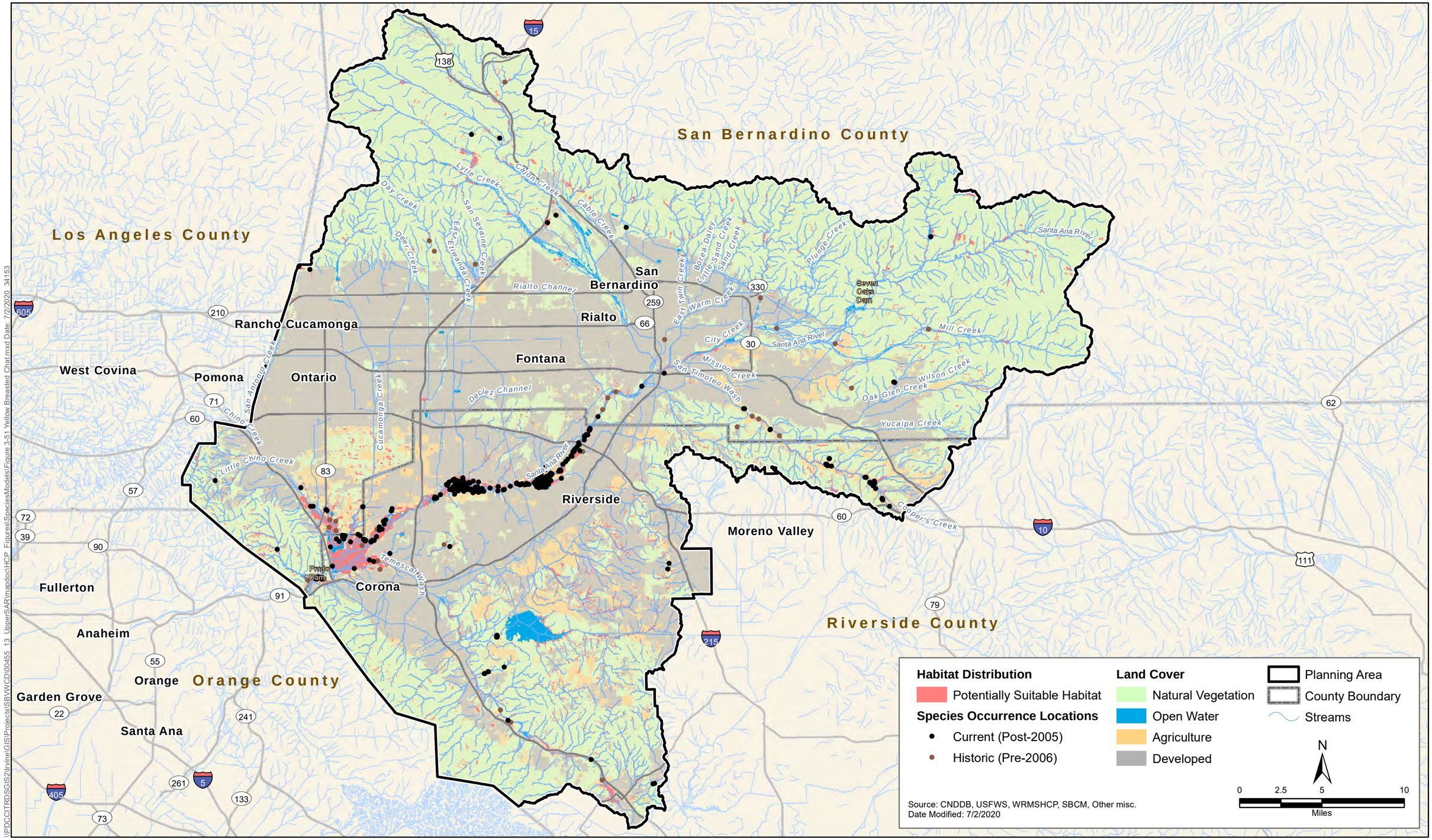
Figure 3-49
Burrowing owl, *Athene cunicularia*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-50 Cactus Wren.mxd Date: 7/2/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

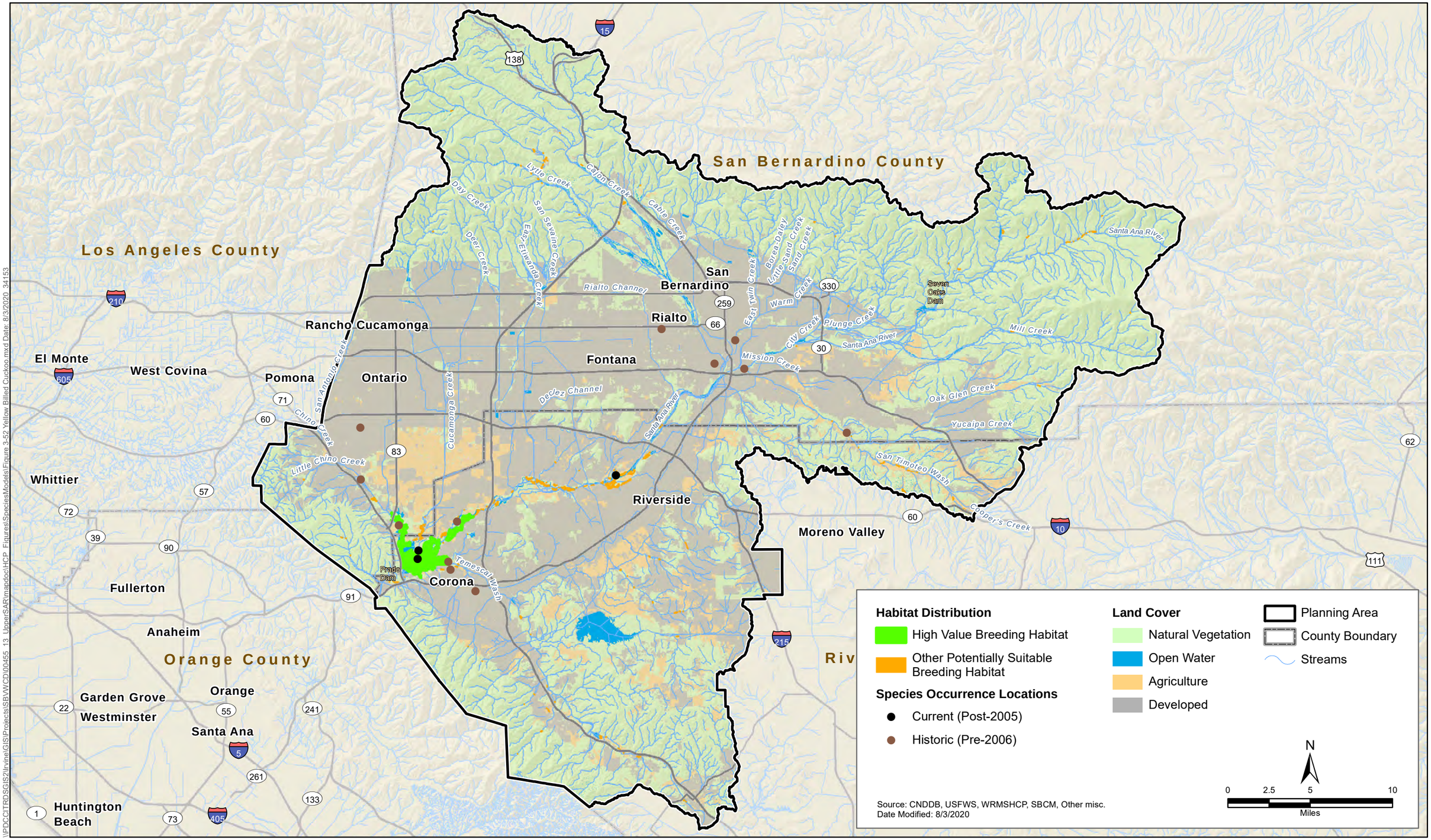
Figure 3-50
Cactus wren, *Campylorhynchus brunneicapillus*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-51 Yellow Breasted Chat.mxd Date: 7/2/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

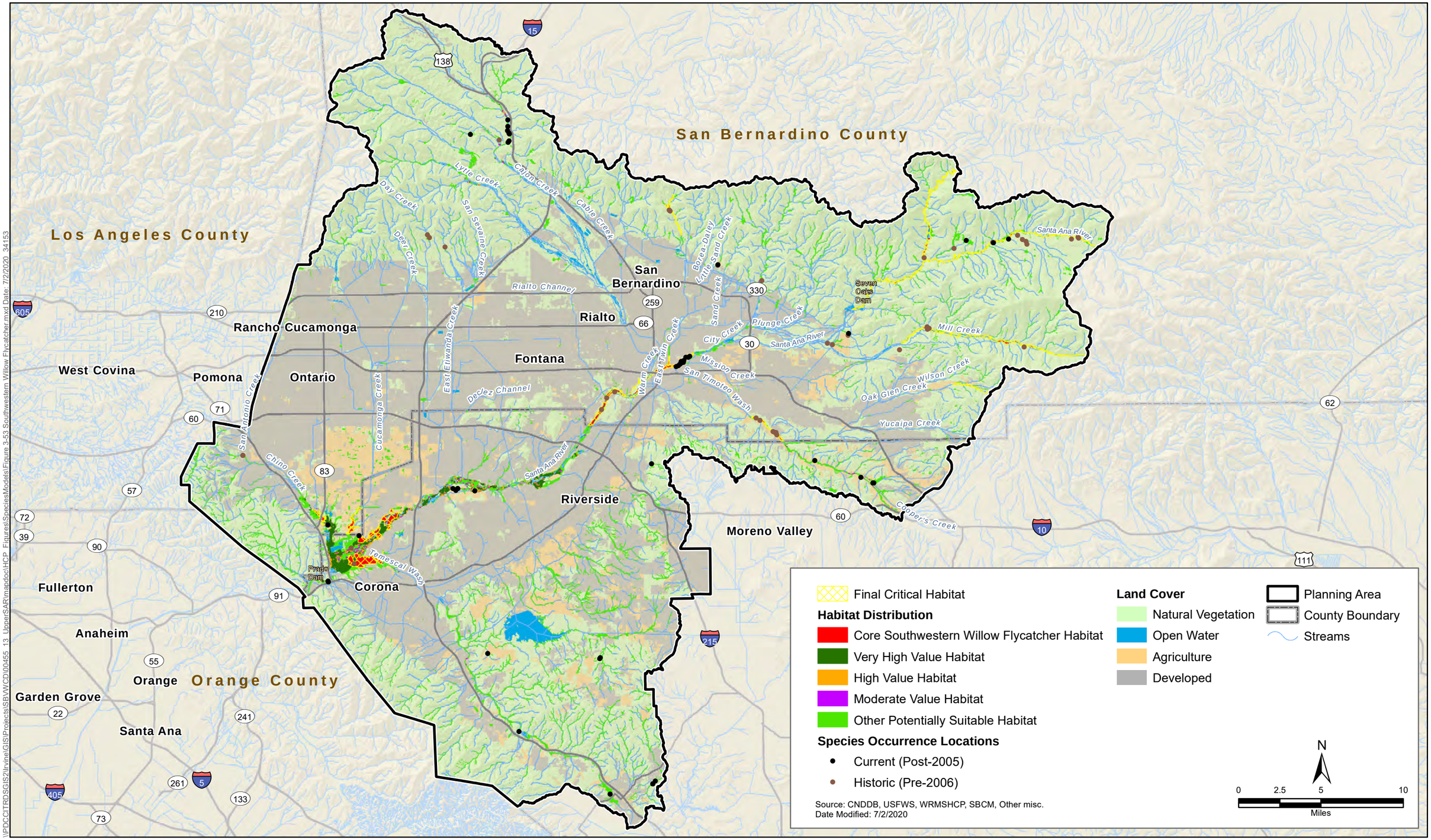
Figure 3-51
Yellow-breasted chat, *Icteria virens*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-52 Yellow Billed Cuckoo.mxd Date: 8/3/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

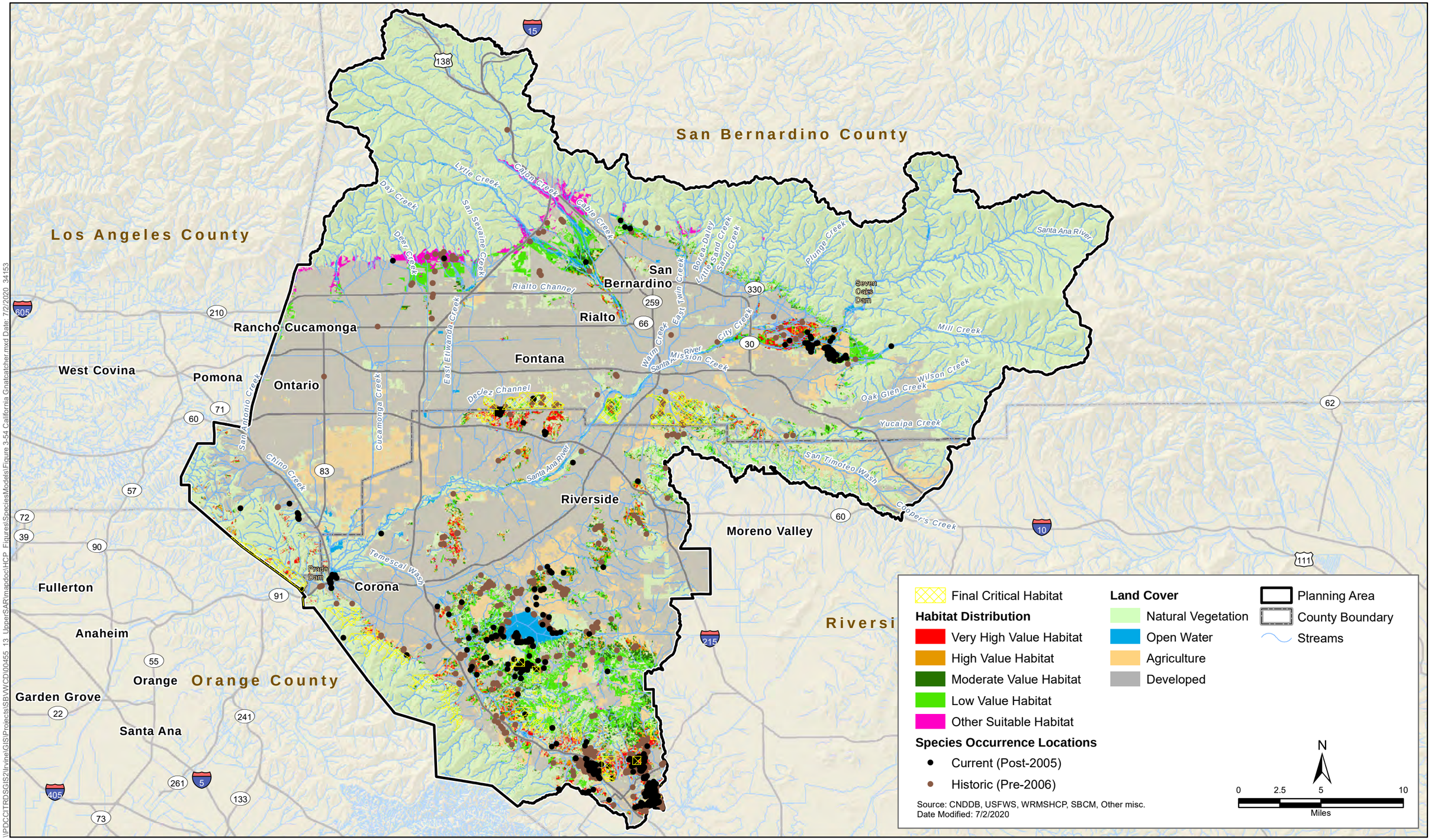
Figure 3-52
Yellow-billed cuckoo, *Coccyzus americanus*
Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-53 Southwestern Willow Flycatcher.mxd Date: 7/2/2020_34153

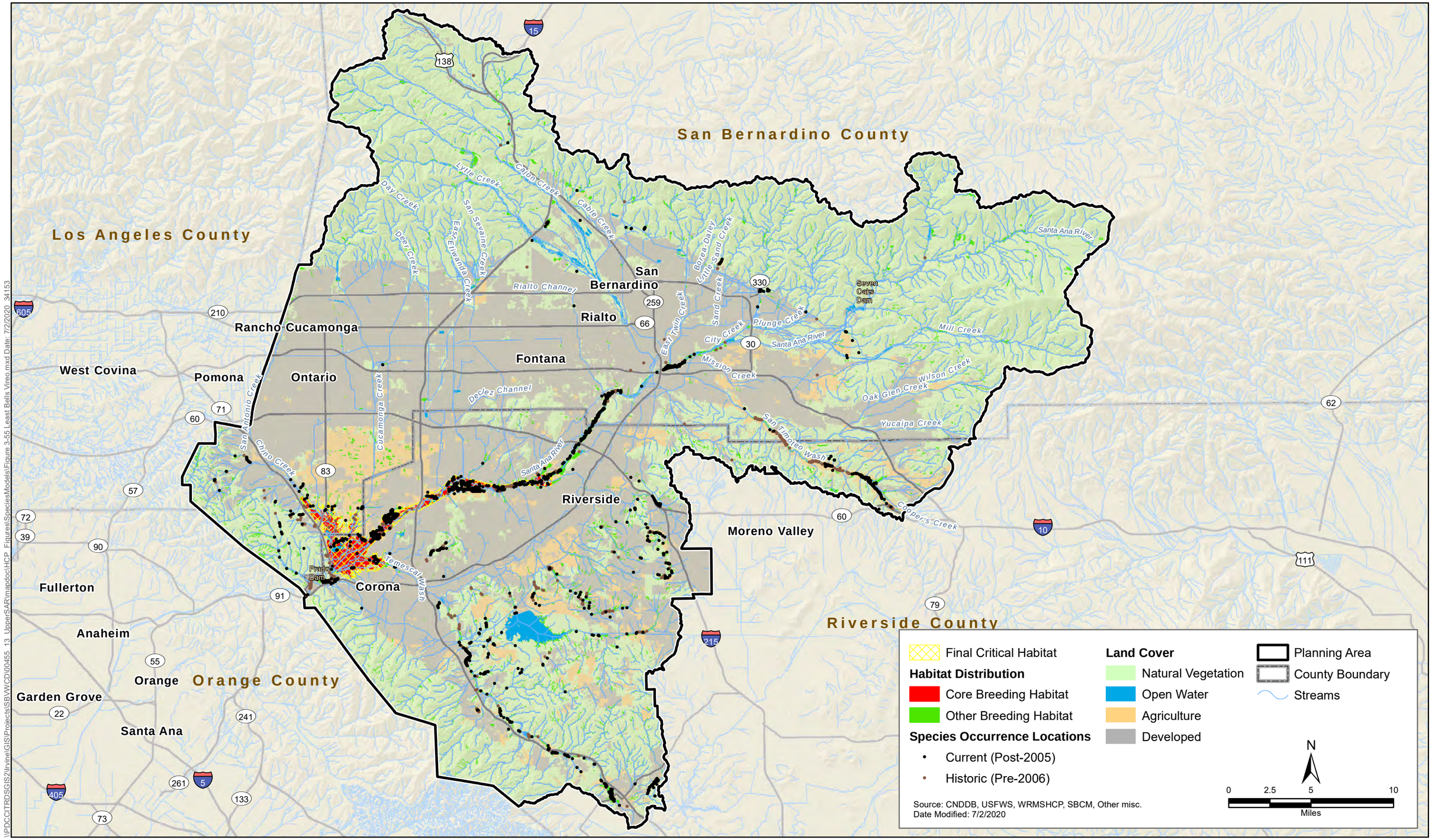
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-53
Southwestern willow flycatcher, *Empidonax traillii extimus*
Potential Habitat Distribution and Known Occurrence Records



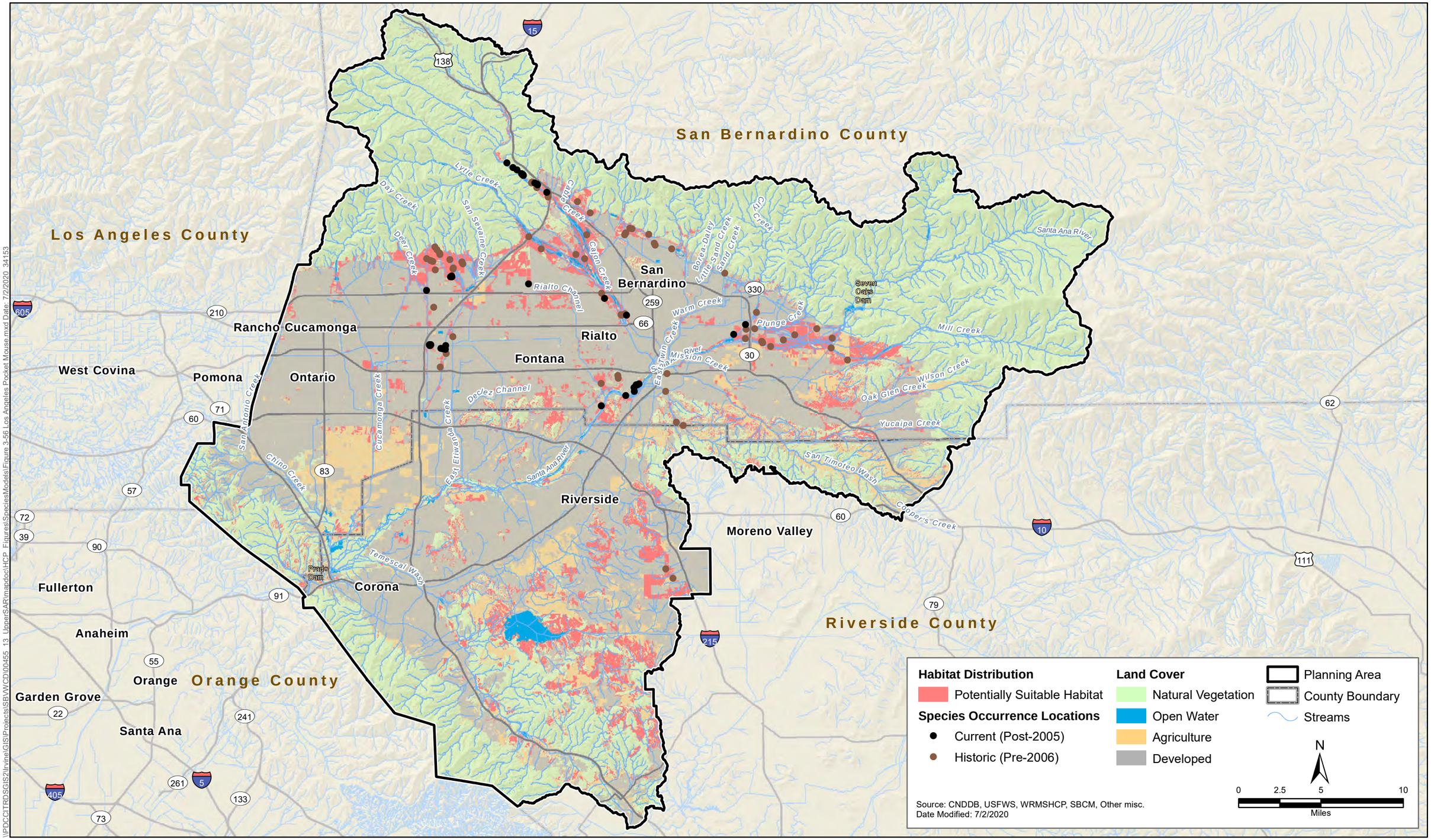
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-54
Coastal California gnatcatcher, *Polioptila californica californica*
Potential Habitat Distribution and Known Occurrence Records



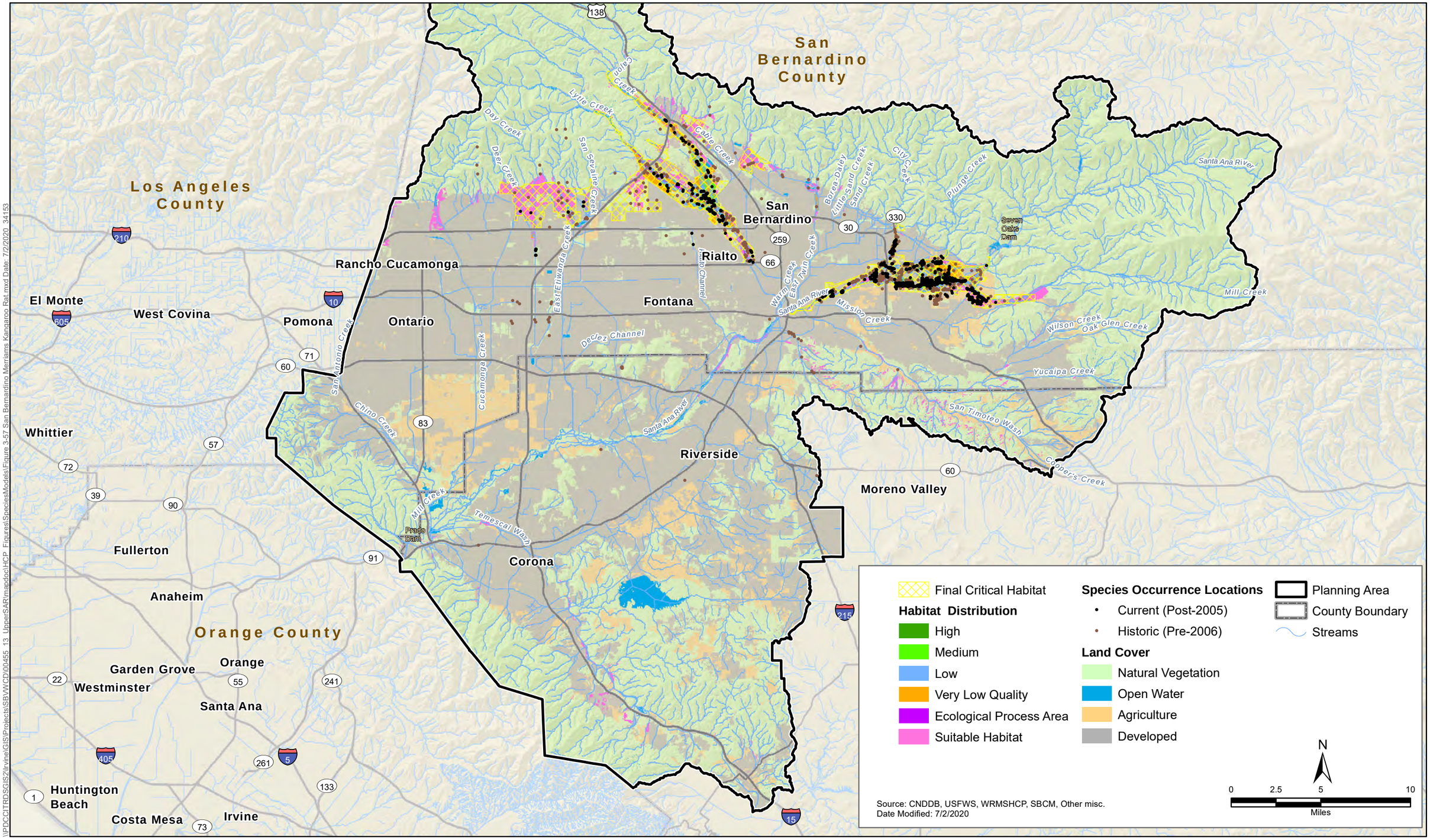
Upper Santa Ana River Habitat Conservation Plan

Figure 3-55
Least Bell's vireo, *Vireo bellii pusillus*
Potential Habitat Distribution and Known Occurrence Records



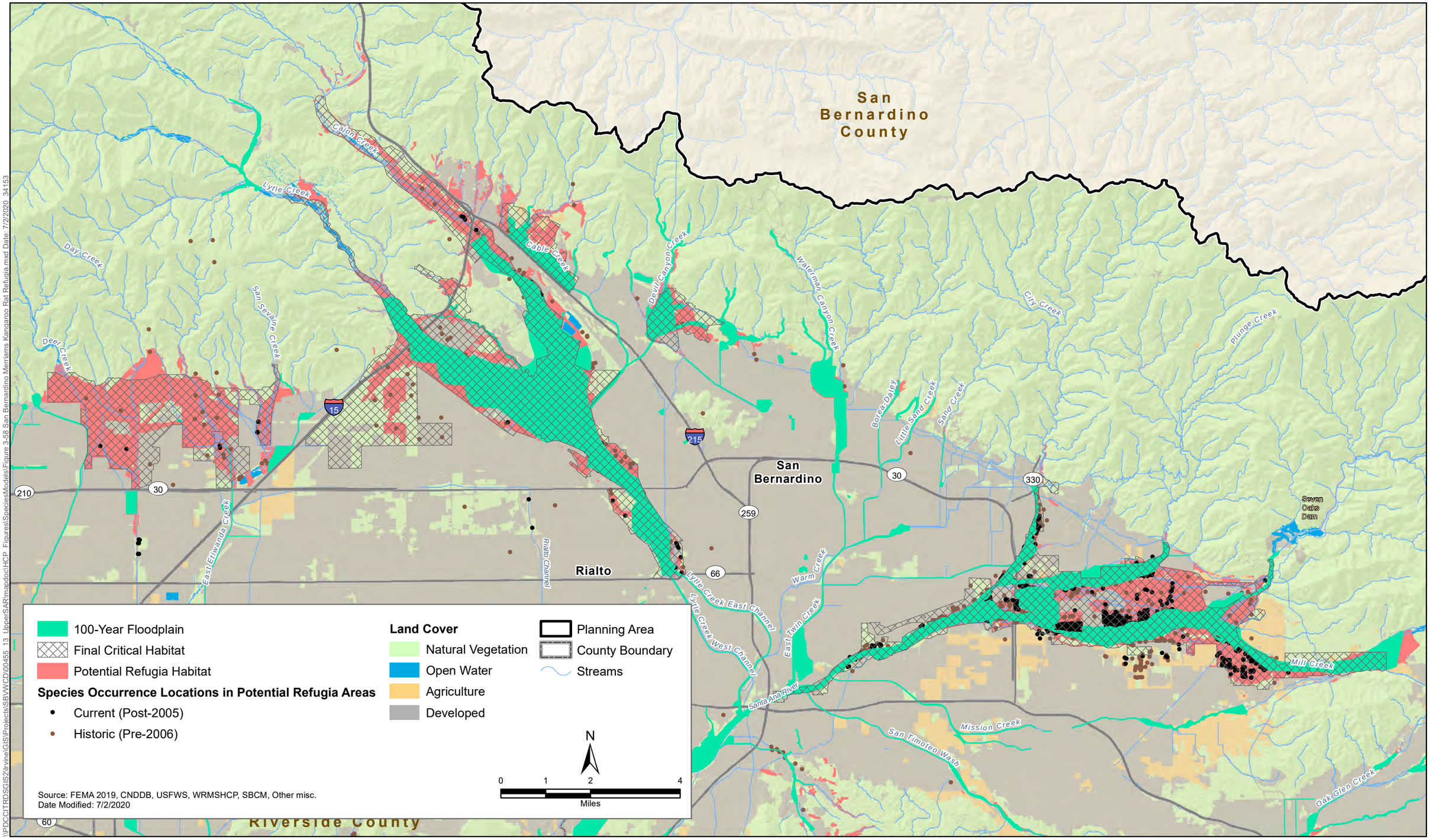
Upper Santa Ana River
Habitat Conservation Plan

Figure 3-56
Los Angeles pocket mouse, *Perognathus longimembris brevinasus*
Potential Habitat Distribution and Known Occurrence Records



Upper Santa Ana River Habitat Conservation Plan

Figure 3-57
San Bernardino Merriam's kangaroo rat, *Dipodomys merriami parvus* Potential Habitat Distribution and Known Occurrence Records



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\SpeciesModels\Figure 3-58 San Bernardino Merriams Kangaroo Rat Refugia.mxd Date: 7/2/2020 34153

Upper Santa Ana River Habitat Conservation Plan

Figure 3-58
Refugia Habitat and Occurrence Records for San Bernardino Merriam's kangaroo rat

Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Chapter 4

Take Assessment and Impact Analysis

4.1 Introduction and Approach

This chapter addresses the effects of the Covered Activities described in Chapter 2, *Covered Activities,* on Covered Species and examines the potential for the Covered Activities to result in take of Covered Species and loss or degradation of their habitat. To meet regulatory requirements and properly mitigate effects, the amount of take must be discussed and quantified to the extent possible. Under the Federal Endangered Species Act (FESA), *take* is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." *Harm* is defined as "an act which actually kills or injures wildlife [and] may include significant habitat modification."

This chapter estimates direct impacts on Covered Species quantitatively and assesses indirect impacts qualitatively. Impacts on critical habitat are also analyzed. Impacts are analyzed in terms of hydrologic effects on aquatic habitat, groundwater, and riparian habitat, and ground-disturbing effects on all habitat types in the Planning Area. Each species will vary regarding if or how each impact type may affect it and have the potential for take. For example, the primary effects on Santa Ana sucker and other aquatic and riparian species are changes to hydrologic conditions that reduce the amount and quality of the aquatic habitats or affect access to groundwater (e.g., changes in flow velocity, water depth, overall reduction in wetted area, or access to groundwater), while the primary effects anticipated on other terrestrial species would result from the direct removal of habitat due to ground-disturbing activities.

The approach to analyzing impacts is programmatic due to the geographic scope, range of Covered Activities, and duration of the permit term. Therefore, the acres of impacts presented in this chapter represent the maximum impact that will be allowable under the Plan and associated incidental take permit. All impact estimates are conservative and will function as a maximum amount of take not to be exceeded by Covered Activities without a Habitat Conservation Plan (HCP) amendment. Actual impacts will be monitored, tracked, and reported throughout HCP implementation to ensure that impacts do not exceed the maximum established by this analysis and in the incidental take permits. As further described in Chapter 6, *Plan Implementation*, take is calculated as a sum total, by species, for all the HCP Covered Activities but may be re-allocated among participating entities provided all take remains within the stated limits.

The approach to the take assessment and impact analysis for Covered Species is to (1) quantify the amount of habitat for each species in the Planning Area (Chapter 3, *Planning Area and Existing Environment*), (2) determine the reduction in quantity and/or quality of that habitat to result from Covered Activities (i.e., take), and then (3) assess the potential impact of that take on the species. This analysis forms the basis for determining appropriate mitigation actions needed to offset these impacts. The net effect of the estimated impacts and mitigation actions to offset the impacts on Covered Species are described in Chapter 5, *Conservation Strategy*.

The locations of the Covered Activities relative to the natural habitats where Covered Species are expected to occur are shown in Chapter 2, Figures 2-1 through 2-6. The potential distribution of habitat for each of the Covered Species is shown in Chapter 3, Figures 3-23 through 3-56.

The methods and results for estimating the impacts from Covered Activities and the potential associated take of Covered Species to be permitted under the HCP are included in the sections that follow. These take estimates are as accurate as possible using the methods described below and given the available details of the Covered Activities at the time of HCP preparation. These take estimates represent a maximum potential take estimate for each species. With the implementation of avoidance and minimization measures and more precise project-specific design, the take is expected to be lower than estimated in most cases. In no case will the take of any species be allowed to exceed the take estimate established by this HCP. Furthermore, these methods to estimate take are based on habitat suitability models and the potential impacts on *modeled habitat*, not occupied habitat. The area of potentially suitable habitat predicted by the models is much larger than the area of occupied habitat at any given moment in time, such that the actual impacts on occupied habitat will be substantially less. Actual impacts will be further minimized through the implementation of general and species-specific avoidance and minimization measures (Section 5.11, *Measures to Avoid and Minimize Take*).

4.2 Summary of Effects on Species

The actual impacts on Covered Species and their habitats are expected to be substantially less than the estimates provided in this effects analysis for the reasons stated above. The mitigation provided by the conservation actions (Chapter 5) will provide significant net benefits to Covered Species through the addition of permanent protections, restoration and enhancement, monitoring, and management. The focus of this chapter is to document the potential impacts of Covered Activities on species. Those potential impacts should be considered in the context of the net benefit to species resulting from the implementation of the conservation strategy. Therefore, the effects analysis will cross-reference those net benefits described in detail in Chapter 5 regularly throughout the analysis.

Table 4-1. Summary of Estimated Impacts and Expected Outcome of Actual Take

Common Name	Estimated Total Impacts on Modeled Habitat (acres)	Mitigation (acres of Modeled Habitat in the HCP Preserve System)	Expected Outcome of Actual Take of Species
Covered Species			
Slender-horned spineflower	400[1] (no impacts on extant occurrences)	**877**	Strict avoidance and minimization measures will ensure direct take of individual plants is near zero. Suitable habitat will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Santa Ana River woolly-star	446	**728**	Strict avoidance and minimization measures will ensure direct take of individual plants is near zero. Suitable habitat will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Santa Ana sucker	1.25	**5.1** (including 1.5 acres of enhancement in mainstem Santa Ana River and 3.6 acres of tributary restoration) Santa Ana sucker will also be translocated to a minimum of three montane streams and actively managed	A majority of actions in the U.S. Fish and Wildlife Service (USFWS) Recovery Plan for this species will be initiated within the HCP Preserve System through implementation of the HCP Conservation Strategy. Habitat enhancement and restoration will occur ahead of any impacts on suitable habitat. Population stability and distribution will be substantially improved through tributary restoration and translocation before any direct impacts on the species can occur. Suitable habitat will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. While the suitable habitat in the mainstem of the Santa Ana River will be reduced as a result of implementation of Covered Activities, the restoration, enhancements and translocation actions within the HCP Preserve System will offset these impacts and make major contributions to the recovery of the Santa Ana Sucker.

Common Name	Estimated Total Impacts on Modeled Habitat (acres)	Mitigation (acres of Modeled Habitat in the HCP Preserve System)	Expected Outcome of Actual Take of Species
Arroyo chub	2.4	**5.1** (1.5 acres of enhancement in mainstem Santa Ana River and 3.6 acres of tributary restoration)	Population stability and distribution will be substantially improved through tributary restoration before any direct impacts on the species can occur. Suitable habitat in all occupied reaches of the Santa Ana River and tributaries will be monitored and managed to enhance habitat conditions for this species. All areas of suitable habitat within the HCP Preserve System will be protected in perpetuity.
Santa Ana speckled dace	0.01	**0.0**	Strict avoidance and minimization measures will ensure direct take of this species is near zero. Population stability and distribution will be substantially improved through translocation. Direct impacts on habitat are very limited.
Mountain yellow-legged frog	128 (including 4 acres of aquatic habitat)	**264** (including 16 acres of aquatic habitat)	Less than 2% of the impacted habitat is aquatic habitat. The remaining 124 acres are refugia, foraging, and dispersal upland habitats. Strict avoidance and minimization measures will ensure direct take of this species is near zero. Population stability and distribution will be improved through HCP contributions to the mountain yellow-legged frog translocation program. Suitable habitat will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Western spadefoot	723	**987**	Avoidance and minimization measures will ensure direct take of this species is substantially lower than the estimated impact on modeled habitat. Suitable habitat within the HCP Preserve System, including ephemeral pools and groundwater recharge basins used for breeding, will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
California glossy snake	897	**1,209**	Avoidance and minimization measures will ensure direct take of this species is substantially lower than the estimated impact on modeled habitat. Suitable habitat within the HCP Preserve System will be monitored and

Common Name	Estimated Total Impacts on Modeled Habitat (acres)	Mitigation (acres of Modeled Habitat in the HCP Preserve System)	Expected Outcome of Actual Take of Species
			managed to enhance habitat conditions for this species and will be protected in perpetuity.
South coast garter snake	21	**193** (including restoration of 129 acres of riparian and 3.5 miles of aquatic stream habitat)	Avoidance and minimization measures will ensure direct take of this species is substantially lower than the estimated impact on modeled habitat. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Southwestern pond turtle	34 (including 2 acres of aquatic habitat)	**344** (29 acres aquatic habitat and 315 upland habitat, including restoration of 193 acres riparian habitat and 3.5 miles of aquatic stream habitat)	Avoidance and minimization measures will ensure direct take of this species is substantially lower than the estimated impact on modeled habitat. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Tricolored blackbird	425 (including 54 acres of unoccupied but suitable colony habitat and 370 acres of foraging habitat)	**387** (including 86 acres of modeled colony habitat, 131 acres of created colony habitat, 157 acres of modeled foraging habitat, and 14 acres of created foraging habitat)	Avoidance and minimization measures will ensure no occupied colonies are disturbed. An additional 30 acres of suitable colony habitat will be restored. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Burrowing owl	876	**1,031**	Avoidance and minimization measures will reduce the potential for occupied burrows to be disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Cactus wren	821	**1,069**	Avoidance and minimization measures will ensure active nests are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Yellow-breasted chat	150	**257** (including restoration of 221 acres of riparian habitat)	Avoidance and minimization measures will ensure active nests are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species

Common Name	Estimated Total Impacts on Modeled Habitat (acres)	Mitigation (acres of Modeled Habitat in the HCP Preserve System)	Expected Outcome of Actual Take of Species
			and will be protected in perpetuity. A total of 221 acres of habitat will be restored, including restoration of 51 acres that are not currently identified as modeled habitat.
Western yellow-billed cuckoo	17	**143**	Avoidance and minimization measures will ensure active nests and occupied habitat are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity.
Southwestern willow flycatcher	150	**257** (including restoration of 221 acres of riparian habitat)	Avoidance and minimization measures will ensure active nests and occupied habitat are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total of 221 acres of habitat will be restored, including restoration of 51 acres that are not currently identified as modeled habitat.
Coastal California gnatcatcher	444	**843** (including 222 acres of alluvial fan sage scrub restoration)	Avoidance and minimization measures will ensure active nests are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total of 222 acres of alluvial fan sage scrub habitat will be enhanced and restored.
Least Bell's vireo	150	**257** (including restoration of 221 acres of riparian habitat)	Avoidance and minimization measures will ensure active nests are not disturbed. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total of 221 acres of habitat will be restored, including restoration of 51 acres that are not currently identified as modeled habitat.

Common Name	Estimated Total Impacts on Modeled Habitat (acres)	Mitigation (acres of Modeled Habitat in the HCP Preserve System)	Expected Outcome of Actual Take of Species
Los Angeles little pocket mouse	739	**1,007** (including 220 acres of alluvial fan sage scrub restoration)	Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total of 220 acres of alluvial fan sage scrub habitat will be enhanced and restored.
San Bernardino Merriam's kangaroo rat	552	**894** (including 220 acres of alluvial fan sage scrub restoration)	Avoidance and minimization measures will ensure that will ensure that take of individuals and occupied habitat is reduced to the greatest extent practicable. These measures include habitat assessments, exclusionary fencing, trapping surveys, relocation, topsoil sequestration, and timing and night-lighting limitations. Suitable habitat within the HCP Preserve System will be monitored and managed to enhance habitat conditions for this species and will be protected in perpetuity. A total of 220 acres of alluvial fan sage scrub habitat will be enhanced and restored to be suitable for this species.
Fully Avoided Species [1]			
Delhi Sands flower-loving fly	101[1] (No impact on occupied habitat)		Strict avoidance measures will ensure full avoidance of this species.
Arroyo toad	82[1] (No impact on occupied habitat)		Strict avoidance measures will ensure full avoidance of this species.

[1] Implementation of avoidance measures as described in Chapter 5 would prevent the direct take of these species.

4.3 Effects Analysis Methods

Several methods were used to estimate the effects on species and their habitats from Covered Activities. Effects from ground-disturbing actions of Covered Activities were evaluated in terms of impacts on species habitat based on species habitat suitability models (including temporary and permanent impacts). The hydrologic effects from Covered Activities that modify hydrology were evaluated in terms of the effect on daily instream flow during wet and dry seasons, the ability to transport sediment, the amount of aquatic habitat (measured as wetted area), and the depth to groundwater that could affect the ability of an area to continue to support wetland and riparian vegetation.

Effects on the aquatic habitat for Santa Ana sucker were evaluated in terms of reduction of suitable habitat, based on a detailed hydrologic model that integrated water depth, velocity, and effects of reduced flow on the availability of suitable riverbed substrate needed for foraging and breeding. Effects on other aquatic species were evaluated in terms of the total amount of aquatic habitat as measured by wetted surface area. The hydrologic effects were evaluated for all Covered Activities together, which represents the maximum potential effect if and when all Covered Activities with hydrologic changes are implemented. Each of these methods is described below.

4.3.1 Methods for Effects on Mean Daily Streamflow Hydrology

As described in Section 3.6.4, *HCP Existing Condition Hydrologic Period*, mean daily stream flow was calculated as a statistical probability of flow known as an exceedance flow. The mean daily stream flow was calculated at each model node by modeling the modified hydrologic effect of all Covered Activities together. The HCP hydrology model used the same hydrologic period as was used for the existing conditions hydrology model results in order to quantify the net hydrologic effect of the Covered Activities. Appendix C, *Monthly and Annual Flows for Exceedance Probabilities at Existing Conditions and with Covered Activities,* lists the 0.95 (i.e., low flow conditions), 0.75, 0.5, 0.25, and 0.05 (i.e., high flow conditions) exceedance probabilities on a monthly and annual basis for all model nodes shown on Figure 3-12 in Chapter 3. It also lists the mean monthly and annual flows. To spatially summarize the existing hydrology for the drainages in the Planning Area, Figures 3-14 and 3-15 show the mean September and March flows, respectively (representing the driest and wettest months of the year, on average).

Actual effects on streamflow hydrology will be monitored and adaptively managed to ensure the potential effects estimated in the HCP Effects Analysis are not exceeded.

Results of the mean daily streamflow effects analysis are provided in Section 4.4.1, *Effects on Monthly Average Daily Streamflow Hydrology,* below.

4.3.2 Methods for Effects on Hydrologic Sediment Transport

The focus of the hydrologic sediment transport effects analysis was on the mainstem Santa Ana River, extending from near Seven Oaks Dam downstream to near Prado Wetlands, and major tributaries from Lytle Creek and farther upstream. Sediment transport analysis was not performed on tributaries downstream of the Lytle Creek confluence with the Santa Ana River because they are (1) not significant sources of sediment compared to the upper tributaries, (2) mostly concrete

conveyance channels devoid of natural geomorphic processes, and (3) not designated as Santa Ana sucker critical habitat for sediment sources (Wright and Minear 2019). Sediment transport analysis in the lower watershed downstream of Lytle Creek is focused on evaluation of the sediment transport capacity of the Santa Ana River, which includes potential changes in its ability to transport sediment supplied by the lower tributaries.

Bedload transport analysis was performed at 11 stream reaches on the Santa Ana River and tributaries using 2D hydraulic modeling and field-measured bed sediment particle size analysis. The average 2D model reach over which sediment transport was evaluated is 2,280 feet in stream length and several acres in flow area. Sediment transport capacity was calculated using a sediment transport capacity equation (see Appendix D, *Santa Ana River High Flow Effects Analysis,* for more details). It is important to note that the sediment transport analysis conducted for the HCP is based on transport capacity, which is the maximum rate that a stream can move sediment based on the energy available for a given flow. The two key inputs in the transport capacity analysis are: (1) the modeled shear stress available at the bed to mobilize sediment and (2) the bed sediment particle sizes based on actual field measurements.

A fractional, or size class, sediment transport analysis was performed in which the individual transport capacity rates of different sediment size classes (e.g., sand, gravel, cobble) are calculated and then summed to obtain the total transport capacity. The transport equation will only predict movement of a size class if the size class is represented in the field sediment sample used in the analysis. For example, the modeled shear stress may be great enough to transport cobble size sediment, but if there is no cobble in the sediment sample, then the equation will not predict transport of cobble material. Because it is a transport capacity analysis, the equation inherently assumes that the supply of sediment coming into the assessment reach is in equilibrium with the calculated rate of movement. The transport capacity analysis does not predict how the bed elevations may change if the transport capacity is greater than the sediment supply (*erosion*) or less than the sediment supply (*deposition*). Likewise, the capacity analysis does not predict changes in bed sediment texture, such as potential winnowing of fine-grained sediment that can lead to armoring of the substrate if the transport capacity is greater than the sediment supply.

The Covered Activities have the potential to decrease the magnitude, frequency, and duration of high-flow flood events in the Santa Ana River and several tributaries, primarily through diversion of a portion of the storm flow into groundwater recharge basins, which can affect hydrologic sediment transport, dependent upon operation of the diversion. Changes in over-bank flooding and sediment transport were characterized to assess the potential for Covered Activities to alter high flows and channel maintenance processes. As described in Section 3.6.4, three different analyses were performed to characterize existing conditions as a point of comparison with the effects of Covered Activities. Each of these analyses were run with the hydrologic changes due to Covered Activities to determine the net effect on the following metrics.

1. **Flow Magnitude for the 1.25-Year Flood Event.** The change in the flow magnitude between the existing conditions and with Covered Activities conditions corresponding to the 1.25-year recurrence was evaluated. As described in Chapter 3, the 1.25-year flood is in the range of events that have been shown to be a key driver of geomorphic processes and vegetation dynamics in braided channel systems. Characterizing the existing conditions and understanding how the Covered Activities would alter the 1.25-year flood event provides insight into the extent to which channel maintenance processes may be altered.

2. **Sediment Transport for the 1.25-Year Flood Event.** Based on the change in the flow magnitude of the 1.25-year flood, sediment transport calculations were performed to assess if the Covered Activity condition would alter existing flow events that translate into altered sediment transport, which is a primary channel maintenance function.
3. **Sediment Transport Over the Entire Hydrograph.** Because fluvial processes occur under a range of discharges, not just the 1.25-year flood, analysis was performed at select locations to understand how changes between existing conditions and Covered Activity hydrologic conditions could cumulatively affect sediment transport for all flows in the hydrograph. Sediment transport rating curves were developed to analyze any potential changes in sediment transport to downstream reaches for every flow under existing conditions and Covered Activity conditions—from the lowest to highest flow over the 25-year hydroperiod.

Actual effects on sediment transport will be monitored and adaptively managed to ensure the potential effects estimated in the HCP Effects Analysis are not exceeded.

Details on this analysis are included in Appendix D. Results of the hydrologic sediment transport effects analysis are provided in Section 4.4.2, *Effects on Hydrologic Sediment Transport*.

4.3.3 Methods for Effects on Aquatic Species Habitat

Santa Ana Sucker Effects Methods

The effects analysis for Santa Ana sucker focused on quantifying the amount of available suitable habitat during the driest time of year when available wetted habitat is most limited due to increased infiltration and evapotranspiration. As described in Section 3.8.3, *Covered Species Accounts*, the habitat suitability model for Santa Ana sucker identifies the areas with suitable water depth and velocity, and suitable gravel and cobble substrate. The effects of the Covered Activities were quantified with this model by taking the hydrology output from the HCP Hydrology Model run with all Covered Activities and modelling the water depth and velocity under this condition. The amount of suitable habitat where the velocity, depth, and substrate are suitable can then be compared with the amount of habitat modeled under existing conditions to determine the effects of the Covered Activities.

Actual effects on Santa Ana sucker habitat will be monitored and adaptively managed to ensure the potential effects estimated in the HCP Effects Analysis are not exceeded.

The methods are described in detail in the Santa Ana sucker species account in Chapter 3 and in Appendix E, *Santa Ana Sucker Habitat Suitability Analysis*, and the results and effects of the Covered Activities are quantified in Section 4.6, *Effects on Covered Species*.

Other Aquatic Species Effects Methods

In addition to the Santa Ana sucker there are seven other Covered Species (two fish species, three amphibians, and two reptiles, listed below) that use aquatic habitats for all, or a portion of their habitat needs.

Fish: arroyo chub, Santa Ana speckled dace

Amphibians: western spadefoot, arroyo toad, mountain yellow-legged frog

Reptiles: southwestern pond turtle, south coast garter snake

The amount of aquatic habitat for each of these species was determined by modeling the "wetted area" (water surface area) of the stream channel where it occurs within the species habitat. The wetted area analysis focused on the driest part of the year, August through October, because this is the time when stream flows are typically at their lowest and temperatures are greatest in Southern California. This dry season represents the time period where a decrease in wetted surface area has the greatest potential to affect Covered Species and their habitat, and therefore provides the most conservative evaluation of potential species effects. The analysis was based on output from the HCP Hydrology Model, which calculated the wetted area in the Santa Ana River and tributaries under existing conditions and with all Covered Activities. The net change in wetted area was calculated to quantify the effect of Covered Activities on these species. Note that for each species the wetted area was considered habitat only when it was within the area known to be occupied by the species or modeled as potentially suitable habitat. For the two fish species the wetted area is the only area quantified for their habitat distribution. The other five species also may have habitat in the riparian or adjacent upland habitat areas based on the habitat relationships in their species distribution models (described in Chapter 3).

Actual effects on aquatic species habitat will be monitored and adaptively managed to ensure the potential effects estimated in the HCP Effects Analysis are not exceeded.

The methods for determining wetted area from the HCP Hydrology Model are described in Section 3.6.2, *Geomorphology.* The results and effects of the Covered Activities are quantified in Section 4.6.

4.3.4 Methods for Effects of Groundwater Change on Riparian and Wetland Habitats

The methods to assess potential effects on riparian and wetland habitat from changes in groundwater level due to Covered Activities in the areas supporting riparian and wetland habitats are described below. These methods are based on the assumption that once the wetland and riparian plant species are no longer able to access the groundwater, they will no longer be able to persist. The point at which an increasing depth to groundwater becomes too deep for a groundwater-dependent ecosystem (GDE) to reliably access the groundwater is called the *extinction depth.* More precisely, extinction depth is the elevation relative to the surface where evapotranspiration ceases. For this analysis, extinction depth is used to determine the depth to groundwater threshold where GDEs can no longer persist, i.e., plants no longer transpire. GDEs are defined for the purpose of this assessment as wetland and riparian land covers mapped within the groundwater basin underlying the Santa Ana River. Additionally, wetland and riparian habitats are discussed as mutually exclusive habitats in this analysis even though the wetlands being discussed are within the overall riparian area. This is done to distinguish aquatic and non-aquatic habitat types and to clarify the potential effect of shifting groundwater on GDE habitat types. Landcover types included in the wetland and riparian habitats are defined in Table 3-13.

The extinction depth was estimated for wetland and riparian habitats in the Planning Area (Aspen 2017) based on evapotranspiration flux curves identified for similar plant functional groups (Maddock et al. 2012). Figure 4-1 indicates the depths to groundwater of evapotranspiration flux curves for wetlands and riparian (shallow-rooted and deep-rooted) GDEs and the associated GDE extinction depths. The extinction depths for wetlands and riparian habitats are shown in Table 4-2. Note that the herbaceous and scrub vegetation of the riparian understory is more shallow-rooted than the deep-rooted larger shrubs and trees of the riparian overstory and therefore has a shallower corresponding extinction depth.

Table 4-2. Expected Groundwater-Dependent Ecosystem Extinction Depths for Wetland and Riparian Habitats in the Planning Area

GDE Plant Functional Group	Extinction Depths (feet) Lower	Extinction Depths (feet) Upper
Wetland	-0.7	2.6[1]
Riparian Understory (shallow-rooted)	-4.92	0[1]
Riparian Overstory (deep-rooted)	-16.4	0[1]

Source: Maddock et al. 2012
[1] surface water

Based on these extinction depths, groundwater contours were created for the existing conditions and the future conditions with Covered Activities for the groundwater depths of 1, 5, and 16 feet (rounded to the nearest 1-foot interval from GDE extinction depths). The groundwater contours were created by Geoscience Support Services, Inc. (Geoscience) using the groundwater flow model created for the Upper Santa Ana River Groundwater Basin (known as the Integrated SAR Model; Geoscience 2019). The Integrated SAR Model integrates existing groundwater and surface water models and is used to identify the potential effects from proposed Covered Activities on streamflow and groundwater levels across the basin. The model assessed the hydrologic response of the Upper Santa Ana River (SAR) to the Covered Activities with hydrologic effects, including streamflow diversions, recharge basins (new basins and modifications), effluent reductions, and new discharge locations to determine the effects on wetland and riparian habitat, groundwater levels, and streamflow.

The acres of wetland and riparian habitats were determined in each groundwater depth range (between each extinction depth, i.e., 0–1, 1–5, 5–16, and >16 feet) for existing conditions and with Covered Activities, and then number of acres was determined that crossed from each groundwater depth range for each GDE community type. Potential impacts from Covered Activities on GDE communities are assumed when the groundwater depth shifts into a groundwater depth range that is below the extinction depth for a given GDE community.

Actual effects on GDE community types will be monitored and adaptively managed to ensure the potential effects estimated in the HCP Effects Analysis are not exceeded.

4.3.5 Methods for Effects of Ground-Disturbing Activities

Many of the Covered Activities will result in the direct removal of habitat through ground-disturbing activities (e.g., project construction). The method to calculate ground-disturbing impacts is through an overlay of the project footprint on a map of the biological resources (vegetation map and individual species distribution model maps) so that the acreages of impacts can be calculated for each project and summarized for all Covered Activities. Calculations of impacts from specific projects are included in Appendix F, *Covered Activity Impacts*.

As noted previously, these methods to estimate take are based on habitat suitability models and the potential impacts on *modeled habitat*, not occupied habitat. The distribution of potentially suitable habitat predicted by the models is much larger than the distribution of occupied habitat at any given moment in time, such that the actual impacts on occupied habitat will be substantially less. Actual impacts will be further minimized through the implementation of general and species-specific avoidance and minimization measures (Section 5.11).

This impact analysis quantifies both permanent and temporary impacts on species and habitats.

Permanent impacts are impacts that occur when existing habitat is permanently replaced by the construction or implementation of a Covered Activity. Permanent impacts can result from installation of a new facility, new road or pipeline, or operations and maintenance (O&M) activities in areas occurring frequently enough so that habitat is not allowed to reestablish (assumed to be occurring at least annually).

Temporary impacts occur when habitat is removed but then allowed to regrow and recover habitat value for Covered Species. Temporary impacts may be one-time impacts, such as impacts associated with a construction staging area, or may be recurring impacts, such as those associated with periodic or infrequent O&M activities like vegetation management for facility maintenance (e.g., access road or basin maintenance). Permanent and temporary impacts are generally estimated by determining the area of overlap between the footprint for these activities and Covered Species habitat (i.e., the estimated area where activities would occur that would disturb soil or vegetation or otherwise affect environmental conditions so as to destroy or degrade Covered Species habitat).

Additional assumptions are used to estimate the amount and duration (permanent or temporary) of habitat loss based on the project footprint and the type of Covered Activity. Table 4-3 summarizes these assumptions. For example, construction of a new water treatment facility is assumed to result in habitat loss over the entire project footprint (i.e., footprint multiplier of 1.0). For O&M activities multipliers are used to estimate the amount of impacts to occur relative to the entire activity footprint. For example, the impact from access road maintenance is assumed to induce permanent habitat loss at a 0.1 multiplier of the entire road footprint, assuming that habitat would only be impacted on the outer margins of the road where vegetation would be trimmed back, and that road maintenance would occur at least annually so that impacted habitat would not be allowed to recover. Impacts from recharge basin maintenance are assumed to result across the entire footprint of the basin (footprint multiplier of 1.0) and in permanent loss of habitat because basins would be maintained frequently enough to prevent habitat recovery. Existing pipeline maintenance would result in temporary impacts, with the amount of impact assumed to be a 25-foot-wide area for maintenance activities by 10% of the entire pipeline length (or 0.1% of the entire pipeline length per year over the 50-year permit duration).

Table 4-3 summarizes the methods for estimating temporary and permanent impacts for each type of Covered Activity.

Table 4-3. Impact Estimation Methods and Key Assumptions

Covered Activity Type	New or O&M	Impact Type	Footprint Multiplier
Construction of new facilities, roads, or basins	New	Permanent	1.0
Construction of new pipelines	New	Temporary	1.0
Maintenance of existing pipelines	O&M	Temporary	0.1
Maintenance of existing recharge basins	O&M	Permanent	1.0
Maintenance of existing access roads	O&M	Permanent	0.1
Property and facility maintenance	O&M	Permanent	0.1
Habitat enhancement and monitoring[1]	O&M	N/A	N/A

[1] Certain habitat enhancement activities covered under the HCP may result in temporary ground disturbance, but the disturbance footprint from these activities is not estimated because it would typically be relatively small in

area, temporary in duration, and ultimately result in improved habitat conditions for Covered Species (i.e., self-mitigating).

4.4 Effects on Hydrology and Sediment Transport

The effects of Covered Activities were analyzed in terms of average daily streamflow and hydrologic sediment transport. The average daily streamflows are summarized as monthly averages for the driest (September) and wettest (March) months. Sediment transport was analyzed in terms of movement of sand, gravel, cobble, and boulder for the 1.25-year flood event and over the entire hydrograph. Wet season (March) high flows are primarily responsible for sediment transport of the coarse substrates (gravel, cobble, and boulder), especially during peak flows. Availability of coarse substrate is important because it provides important breeding and foraging habitat for the Santa Ana sucker. Non-peak flows during the wet season continue to move fine sediments to maintain exposure of these coarse sediments. Wet season flows can also provide important aquatic habitat connectivity to facilitate movement and dispersal of covered aquatic species among areas that are otherwise isolated when ephemeral reaches are dry. Dry season (September) flows represent the period when aquatic habitat is most limited and when further reductions in flow can have the strongest effects on aquatic species.

4.4.1 Effects on Monthly Average Daily Streamflow Hydrology

Monthly average daily stream flow was calculated at each model node for the Covered Activities based on the results of the modeled hydrology. Figures 4-2 and 4-3 show the average September and March flows, respectively (representing the driest and wettest months of the year, on average) to spatially summarize the Covered Activities effects on hydrology for the drainages in the Planning Area. Appendix C lists the 95% (i.e. low flow conditions), 75%, 50%, 25%, and 5% (i.e. storm flow conditions) exceedance probabilities on a monthly and annual basis listed for all model nodes under the Covered Activities modeled hydrology and also lists the average monthly and annual flows. The dry weather (September) and wet weather (March) flows with the effects of the Covered Activities are described below as they are shown on Figures 4-2 and 4-3. Figures 4-4 and 4-5 show the net different (Existing Conditions flows minus Covered Activities flows) for the September dry weather and March wet weather flows, respectively.

The primary potential effects on covered aquatic species are reduced total area of aquatic habitat (as measured by wetted area) during the dry weather months and potential reduced sediment transport and connectivity of habitat during wet weather months. The effects of reduced average daily stream flows on Covered Species are described in Section 4.6.

Dry Weather Flows

Changes in dry weather flows (average September flow) are shown on Figure 4-4. Upper tributaries show decreases of 3.4 cubic feet per second (cfs) on Mill Creek, 1.1 cfs on City Creek, and 1.1 cfs on Lytle Creek. Modeled decreases of less than 1.0 cfs are predicted on other upper watershed tributaries with Covered Activities, including Plunge Creek, East Twin Creek, Waterman Canyon Creek, Devil Canyon Creek, Cable Creek, and Cajon Wash. The Santa Ana River just upstream of the Riverside North Aquifer Storage and Recovery Project (RPU.5) would have a flow reduction of 9% (decreasing from 12.6 cfs down to 11.5 cfs). Downstream of the Riverside North Aquifer Storage and

Recovery Project the average September flow in the Santa Ana River would decrease by 63% (from 12.6 cfs down to 4.7 cfs).

Reductions in City of Rialto Public Works (Rialto) outflow cause the flow in the Rialto Channel to decrease by 20%, from 10.9 cfs down to 8.7 cfs. When the Rialto outfall reduction is added with the San Bernardino/Colton Rapid Infiltration and Extraction Facility (RIX) outfall reduction, the flow in the Santa Ana River downstream of RIX is reduced by 34%, from 62.1 cfs down to 41.1 cfs. Santa Ana River average September flows are consistently reduced by over 20 cfs from RIX to downstream of the Interstate (I-) 215 crossing. At the Riverside Water Quality Control Plant upstream of Van Buren Boulevard, Covered Activity reductions in effluent from the plant outfall, when combined with the other reductions upstream, contribute to a total reduction in Santa Ana River flow of 36% (from 106.5 cfs down to 68.6 cfs). However, as part of the Santa Ana River Sustainable Parks and Tributaries Water Reuse Project, much of the flow reduction at the plant would be redirected to benefit species and habitat at Santa Ana River tributary restoration sites upstream (Lake Evans, Tequesquite Arroyo, Old Ranch Creek, Anza Creek) and downstream (Hole Creek, Hidden Valley Creek). Inland Empire Utilities Agency (IEUA) Covered Activities reduce San Sevaine Creek's flow by 2.8 cfs and Day Creek by 1.3 cfs, which contributes to a 1.4 cfs flow reduction in the Santa Ana River at the confluence with East Etiwanda Creek. The Santa Ana River downstream of the confluence with Temescal Wash in the Prado Basin has a dry weather flow reduction of 38%, decreasing from 86.7 cfs down to 53.9 cfs. Other IEUA Covered Activities result in dry weather flow reductions of 52% on Cucamonga Creek (from 15.3 cfs down to 7.4 cfs), and 24% on Chino Creek upstream of Cucamonga Creek (from 13.5 cfs down to 10.3 cfs). Where Chino Creek enters the Prado Basin, the Covered Activities result in a 37% flow reduction (from 31.4 cfs down to 19.7 cfs).

Wet Weather Flows

In March, streamflows are typically the highest on average in the Planning Area. Figure 4-5 shows the net decrease in March monthly average daily flows, due to the effects of Covered Activities. All of the following decreases in flow in the upper watershed are the result of stormwater capture projects that divert a portion of the stormflow (usually beginning or end of a storm event) into groundwater recharge basins. An example of how the recharge basins would typically operate is illustrated in the Upper Cable Creek (VD.2.02) hydrograph example shown on Figure 4-6. The example shows the modeled mean daily flows for the baseline condition and with Covered Activity condition for three consecutive years that span intermediate, wet, and dry water-year types. For Intermediate and Dry water year types. Cable Creek flows are low and little flow diversion into the recharge basin is occurring. Nearly all of the flow diversion is occurring in wet water years in which the diversion into the groundwater recharge basin reduces Cable Creek's peak flow. The magnitude of the diversion is related to the basin's storage capacity, its percolation rate, and the amount of time that has transpired between peak flows.

The Enhanced Recharge Project (VD.3) would decrease average March Santa Ana River flow upstream of Mill Creek by 43% (from 41.2 cfs down to 23.5 cfs). Upper tributaries show decreases of 6.1 cfs on Mill Creek, 16.5 cfs on City Creek, and 16.2 cfs on Lytle Creek. Modeled decreases on other upper watershed tributaries with Covered Activities, include 6.8 cfs on East Twin Creek, 4.6 cfs on Waterman Canyon Creek, 5.9 cfs on Devil Canyon Creek, 10 cfs on Cable Creek, and 6.3 cfs on Cajon Wash. Downstream of the Riverside North Aquifer Storage and Recovery Project the average march flow in the Santa Ana River would decrease by 45% (from 192.4 cfs down to 105.0 cfs), although due to operations of the facility the peak flow of storm events would likely be allowed to flow past the structure and continue downstream in order to protect infrastructure.

Covered Activity reductions in Rialto and RIX effluent from the plant outfall, when combined with the other reductions upstream, contribute to a total reduction in Santa Ana River flow of 36% (from 266.25 cfs down to 169.6 cfs). IEUA Covered Activities reduce San Sevaine Creek's average March flow by 17.5 cfs and on Day Creek by 6.2 cfs, which, when combined with other Covered Activities upstream on the Santa Ana River and its tributaries, results in a 28% flow reduction in the Santa Ana River at the confluence with East Etiwanda Creek (from 413.6 cfs down to 296.5 cfs). The Santa Ana River downstream of the confluence with Temescal Wash in the Prado Basin has a wet weather flow reduction of 23%, decreasing from 500.7 cfs to 385.0 cfs. Other IEUA Covered Activities result in wet weather flow reductions of 7% on Cucamonga Creek (from 138.3 cfs down to 129.0 cfs), and 8% reduction on Chino Creek upstream of Cucamonga Creek (from 119.3 cfs down to 110.1 cfs). Where Chino Creek enters the Prado Basin, the Covered Activities result in 7% flow reduction (from 265.9 cfs down to 247.1 cfs).

Effects on Covered Species from Changes in Hydrology

The effects of these hydrologic changes on aquatic Covered Species and their habitat are estimated based on change in wetted area representing the aquatic habitat (and using the depth and velocity flow model for Santa Ana sucker). These effects are quantified in Section 4.6. Actual effects on streamflow hydrology will be monitored and adaptively managed to ensure the potential effects on Covered Species estimated in the HCP Effects Analysis are not exceeded.

4.4.2 Effects on Hydrologic Sediment Transport

The effects discussion related to changes in sediment transport is focused on how altered transport rates may affect channel maintenance processes and how the supply of coarse sediment to the reaches occupied by native fish in the Santa Ana River downstream of the Rialto Channel may change. The changes in flushing of fine sediment (sand and silt) to expose the coarser gravel and cobble substrate needed for native fishes are discussed in the Santa Ana sucker effects analysis in Section 4.6.

Change in the Flow Magnitude of the 1.25-Year Flood

The 1.25-year flood has been shown to be a key driver of geomorphic processes and vegetation dynamics in braided channel systems (Bertoldi et al. 2010; see Appendix D for more discussion). Evaluating how the Covered Activities would alter the 1.25-year flood event provides insight into the extent to which channel maintenance processes may be altered, including the effect on sediment transport. The Covered Activities would decrease the mean daily discharge exceedance flow that corresponds to the 1.25-year flood for all locations (Table 4-4). The decrease is the smallest on Mill Creek (4%) and largest on Lytle Creek upstream of Cajon Wash (77%). For the Santa Ana River locations, the magnitude of the reductions progressively decreases downstream: 34% at Greenspot Road, 18% downstream of Mill Creek, and reaching a low of 7% at the E Street gage location (Node SE-74 upstream of Lytle Creek). Downstream of Lytle Creek, the Santa Ana River 1.25-year flood reductions increase to 19%. This is attributed to the substantial flow reductions created by Covered Activities on the Lytle Creek and Cajon Wash tributaries that affect Santa Ana River flows. At the most downstream Santa Ana River location evaluated (Site 3A, downstream of I-15), the reduction is 15%. Lower City Creek (just upstream of the confluence with Plunge Creek) has a 42% decrease in the 1.25-year flood reduction.

These estimated potential changes in the 1.25-year flood event do not equate to similar proportional changes in suitable habitat. The effects on species habitat are quantified in Section 4.6. Overall, a decrease in flow magnitude for the 1.25-year flood event means that the channel maintenance processes may occur over a smaller area and could result in possible narrowing of the channel and riparian zone. The channel characteristics and distribution of riparian habitat will be monitored and adaptively managed to ensure that any effects on Covered Species are within the limits identified in the HCP and incidental take permit.

Table 4-4. Flow Magnitudes with Covered Activities for Model Assessment Reaches for the 1.25-Year Flood Event

2D Hydraulic Model Assessment Reach	Existing Conditions (cfs)	With Covered Activities (cfs)	Relative Decrease in Flow Magnitude (cfs)	Percent Change
Mill Creek Upstream of SAR	84	81	3	4%
Lower City Creek	176	102	74	42%
Lytle Creek Upstream of Cajon Wash	100	23	77	77%
Lytle Creek Downstream of Cajon Wash	159	72	87	55%
Cajon Wash	100	54	46	46%
SAR – Greenspot Road	259	170	89	34%
SAR – Downstream of Mill Creek	401	328	73	18%
SAR – Upstream of East Twin Creek	473	429	44	9%
SAR – USGS Reach 9 Downstream of RIX	3,178	2,580	599	19%
SAR – ESA Middle Reach	2,971	2,421	550	19%
SAR – Site 3A Downstream of I-15	5,948	5,053	896	15%

ESA = Environmentally Sensitive Area; USGS = U.S. Geological Survey

Change in Sediment Transport for the 1.25-Year Flood

Results for the modeled sediment transport for the 11 assessment reaches are given in Table 4-5. The table lists the change between the existing conditions and with Covered Activities for streamflow of the 1.25-year flood, change in total sediment transport, and change in sediment transport size classes. Graphs showing comparisons for transport of all the sediment size classes analyzed are presented in Appendix D.

Under the existing conditions, Mill Creek has the largest sediment transport capacity rate (15,781 tons/day) and is nearly three times greater than the second-largest tributary site of Lytle Creek, upstream of Cajon Wash (5,295 tons/day). Mill Creek's steep bed slope (4.1%) is the highest of all reaches assessed and a primary factor for why this tributary is the largest sediment source. A 4% reduction in Mill Creek's 1.25-year flood under the Covered Activities condition also results in a 4% reduction in sediment transport capacity. Lytle Creek upstream of Cajon Wash has a 75% reduction in the 1.25-year flood that results in a 72% reduction in a sediment transport capacity. This is the largest reduction of all sites assessed. Other tributary reductions in sediment transport capacity include 59% at Lytle Creek downstream of Cajon Wash, 48% at Cajon Wash, and 49% at lower City Creek. For the Santa Ana River assessment sites, the location at Greenspot Road has the largest reduction (41%). The other Santa Ana River locations have reductions ranging from 12% (Environmentally Sensitive Area [ESA] Middle Reach and upstream of East Twin Creek) up to 24%

(SAR U.S. Geological Survey [USGS] Reach 9 Downstream of RIX). The fractional sediment transport changes for sand, gravel, cobble, and boulder are also shown in Table 4-5.

These estimated potential changes in sediment transport for the 1.25-year flood event do not equate to similar proportional changes in suitable habitat. The effects on species habitat are quantified in Section 4.6. Overall, reductions in sediment transport and associated channel maintenance processes are expected based on the analysis of the 1.25-year flood because flow diversions are reducing the amount of flow in the channel, and thus reducing the potential to transport sediment. However, the effect on Covered Species can be minimized by the operation procedures implemented at the recharge basins as described in the *Basin Sediment Management Plan*. Sediment that deposits in basins can be excavated and placed back in the channel and made available as sediment supply to be transported downstream during the next flood event. This is described further below under *Net Effect on Channel Morphology and Sediment Composition*. In addition, because the amount of water that can be diverted into the recharge basins is limited, the differences in peak flows between the baseline and under the Covered Activities condition decreases with increasing flow magnitude. At the 25-year event, for example, the amount of water diverted is a small percentage of the total flow volume, and thus the reductions in sediment transport will be substantially less than compared to the 1.25-year event. Sediment that may no longer be transported at relatively frequent flood events (e.g., 1.25-year flood) will still be available for transport and supporting habitat at less frequent flood events.

Table 4-5. Sediment Transport Rate Effects of Covered Activities that Correspond to the 1.25-Year Flood Recurrence Interval (tons per day)

2D Hydraulic Model Assessment Reach	Existing Conditions	With Covered Activities	Relative Change in Sediment Transport Rate	Percent Change
Total Bedload Transport				
Mill Creek Upstream of SAR	15,781	15,139	-643	-4%
Lower City Creek	1,100	556	-544	-49%
Lytle Creek Upstream of Cajon Wash	5,295	1,472	-3,823	-72%
Lytle Creek Downstream of Cajon Wash	1,737	721	-1,017	-59%
Cajon Wash	2,167	1,117	-1,049	-48%
SAR – Greenspot Road	8,201	4,872	-3,328	-41%
SAR – Downstream of Mill Creek	5,660	4,136	-1,524	-27%
SAR – Upstream of East Twin Creek	959	846	-113	-12%
SAR – USGS Reach 9 Downstream of RIX	7,626	5,790	-1,836	-24%
SAR – ESA Middle Reach	2,490	2,197	-293	-12%
SAR – Site 3A Downstream of I-15	2,157	1,806	-352	-16%
Sand				
Mill Creek Upstream of SAR	6,407	6,171	-236	-4%
Lower City Creek	904	465	-439	-49%
Lytle Creek Upstream of Cajon Wash	4,224	1,201	-3,023	-72%
Lytle Creek Downstream of Cajon Wash	1,497	633	-864	-58%
Cajon Wash	1,847	966	-881	-48%
SAR – Greenspot Road	1,949	1,196	-753	-39%

2D Hydraulic Model Assessment Reach	Existing Conditions	With Covered Activities	Relative Change in Sediment Transport Rate	Percent Change
SAR – Downstream of Mill Creek	1,482	1,120	-362	-24%
SAR – Upstream of East Twin Creek	877	776	-102	-12%
SAR – USGS Reach 9 Downstream of RIX	6,862	5,226	-1,636	-24%
SAR – ESA Middle Reach	1,641	1,443	-199	-12%
SAR – Site 3A Downstream of I-15	1,179	990	-190	-16%
Gravel				
Mill Creek Upstream of SAR	8,557	8,199	-358	-4%
Lower City Creek	196	92	-105	-53%
Lytle Creek Upstream of Cajon Wash	1,063	269	-794	-75%
Lytle Creek Downstream of Cajon Wash	240	88	-152	-63%
Cajon Wash	319	151	-168	-53%
SAR – Greenspot Road	3,747	2,240	-1,508	-40%
SAR – Downstream of Mill Creek	2,660	1,958	-702	-26%
SAR – Upstream of East Twin Creek	81	70	-11	-14%
SAR – USGS Reach 9 Downstream of RIX	764	564	-200	-26%
SAR – ESA Middle Reach	849	754	-94	-11%
SAR – Site 3A Downstream of I-15	978	816	-162	-17%
Cobble				
Mill Creek Upstream of SAR	815	766	-49	-6.0%
Lower City Creek	0.0	0.0	0.0	0.0%
Lytle Creek Upstream of Cajon Wash	8.1	1.7	-6.4	-79.0%
Lytle Creek Downstream of Cajon Wash	0.4	0.1	0.2	-65.6%
Cajon Wash	0.3	0.1	0.1	-52.2%
SAR – Greenspot Road	2,365	1,361	-1,004	-42.5%
SAR – Downstream of Mill Creek	1,462	1,026	-436	-29.8%
SAR – Upstream of East Twin Creek	0.0	0.0	0.0	0.0%
SAR – USGS Reach 9 Downstream of RIX	0.0	0.0	0.0	0.0%
SAR – ESA Middle Reach	0.0	0.0	0.0	0.0%
SAR – Site 3A Downstream of I-15	0.0	0.0	0.0	0.0%
Boulder				
Mill Creek Upstream of SAR	2.5	2.4	-0.1	-4.1%
Lower City Creek	0.0	0.0	0.0	0.0%
Lytle Creek Upstream of Cajon Wash	0.0	0.0	0.0	0.0%
Lytle Creek Downstream of Cajon Wash	0.0	0.0	0.0	0.0%
Cajon Wash	0.0	0.0	0.0	0.0%
SAR – Greenspot Road	140	76	-64	-45.6%
SAR – Downstream of Mill Creek	56	32	-24	-42.5%
SAR – Upstream of East Twin Creek	0.0	0.0	0.0	0.0%
SAR – USGS Reach 9 Downstream of RIX	0.0	0.0	0.0	0.0%

2D Hydraulic Model Assessment Reach	Existing Conditions	With Covered Activities	Relative Change in Sediment Transport Rate	Percent Change
SAR – ESA Middle Reach	0.0	0.0	0.0	0.0%
SAR – Site 3A Downstream of I-15	0.0	0.0	0.0	0.0%

Change in the Sediment Transport Over the Entire Hydrograph

The changes in hydrology over the entire 25-year hydrograph (1966–1990 base hydro period) are shown in Table 4-6 as an annual average of the mean daily discharges in terms of acre-feet per year.

Results of the sediment transport analysis over the entire hydrograph are listed in Table 4-7. The sediment transport rating curves that were used to determine the values in Table 4-7 are presented in Appendix D.

Mill Creek has the largest total sediment transport capacity of all sites under existing conditions, at 1,184,365 tons/year, and is also the largest supplier of combined gravel and cobble to the Santa Ana River. With Covered Activities, Mill Creek's streamflow would be reduced by 3,105 acre-feet/year (22%), resulting in a sediment transport capacity reduction of 215,357 tons/year (18%). The Santa Ana River at Greenspot Road is the location with the second-largest existing conditions total sediment transport capacity at 280,296 tons/year. With Covered Activities, this location's streamflow would be reduced by 3,357 acre-feet/year (21%), resulting in a sediment transport capacity reduction of 57,404 tons/year (20%).

The distinction that the sediment transport analysis is based on sediment transport capacity (as defined above) is particularly important for the Santa Ana River upstream of Mill Creek. Seven Oaks Dam has effectively cut off sediment supply to the Santa Ana River upstream of Mill Creek, which includes the Greenspot Road location. Over time, the channel bed will coarsen as more of the relatively mobile finer-grained sediment in the channel bed is transported downstream (i.e., sand and gravel size classes) and not replenished with sediment from upstream. This winnowing of the finer-grained sediment will create an increasingly immobile substrate composed of greater percentages of cobble and boulder sediment. Therefore, it is expected that the Santa Ana River sediment transport capacity will continue to decrease beyond the 20% reduction reported herein.

The third-largest existing condition total sediment transport capacity is the SAR USGS Reach 9 Downstream of RIX at 177,376 tons/year. With Covered Activities, this location's streamflow would be reduced by 34,698 acre-feet/year (35%), resulting in a total sediment transport capacity reduction of 63,486 tons/year (36%). Total sediment transport capacity would be reduced by 45% at lower City Creek, 49% at Lytle Creek downstream of Cajon Wash (which is the largest percent reduction of all sites), and 18% at the Santa Ana River upstream of East Twin Creek.

In terms of the fractional size-class components of the total sediment transport capacity, Mill Creek has the largest potential to transport gravel and cobble under existing conditions (Table 4-6). With Covered Activities, gravel transport capacity would be reduced by 17% and cobble by 10%. The Santa Ana River at Greenspot Road has the second largest transport capacity of gravel and cobble, and it would experience reductions of gravel transport capacity by 26% and cobble by 18%. On a percentage basis, Lytle Creek downstream of Cajon Wash would have the largest reduction in gravel transport capacity (48%) and cobble transport capacity (35%).

These estimated potential changes in sediment transport over the entire hydrograph do not equate to similar proportional changes in suitable habitat. The effects on species habitat are quantified in Section 4.6.

Table 4-6. Changes in Hydrology Calculated as an Annual Average AFY of Every Mean Daily Discharge over the 25-year 1966–1990 Base Hydro Period

2D Hydraulic Model Assessment Reach	Existing Conditions (AFY)	With Covered Activities (AFY)	Relative Change in Annual Average (AFY)	Percent Change
Mill Creek Upstream of SAR	14,362	11,257	-3,105	-22%
Lower City Creek	8,275	3,585	-4,689	-57%
Lytle Creek Downstream of Cajon Wash	9,471	4,989	-4,482	-47%
SAR – Greenspot Road	15,650	12,292	-3,357	-21%
SAR – Upstream of East Twin Creek	36,313	29,072	-7,241	-20%
SAR – USGS Reach 9 Downstream of RIX	99,675	64,977	-34,698	-35%

Table 4-7. Sediment Transport Rate Effects from Changes in Hydrology Calculated for every Mean Daily Discharge over the 25-year 1966–1990 Base Hydro Period (tons/year)

2D Hydraulic Model Assessment Reach	Existing Conditions	With Covered Activities	Relative Change in Sediment Transport Rate	Percent Change
Total Bedload Transport				
Mill Creek Upstream of SAR	1,184,365	968,978	-215,387	-18%
Lower City Creek	22,964	12,683	-10,280	-45%
Lytle Creek Downstream of Cajon Wash	48,938	24,846	-24,092	-49%
SAR – Greenspot Road	280,296	222,892	-57,404	-20%
SAR – Upstream of East Twin Creek	39,531	32,267	-7,264	-18%
SAR – USGS Reach 9 Downstream of RIX	177,376	113,891	-63,486	-36%
Sand				
Mill Creek Upstream of SAR	466,051	370,450	-95,601	-21%
Lower City Creek	18,838	10,124	-8,713	-46%
Lytle Creek Downstream of Cajon Wash	41,864	21,154	-20,711	-49%
SAR – Greenspot Road	63,450	44,720	-18,729	-30%
SAR – Upstream of East Twin Creek	35,847	29,020	-6,827	-19%
SAR – USGS Reach 9 Downstream of RIX	161,323	103,717	-57,606	-36%
Gravel				
Mill Creek Upstream of SAR	641,526	529,443	-112,083	-17%
Lower City Creek	4,126	2,559	-1,567	-38%
Lytle Creek Downstream of Cajon Wash	7,052	3,678	-3,374	-48%

2D Hydraulic Model Assessment Reach	Existing Conditions	With Covered Activities	Relative Change in Sediment Transport Rate	Percent Change
SAR – Greenspot Road	125,237	93,156	-32,081	-26%
SAR – Upstream of East Twin Creek	3,668	3,131	-537	-15%
SAR – USGS Reach 9 Downstream of RIX	16,053	10,174	-5,879	-37%
Cobble				
Mill Creek Upstream of SAR	75,564	67,955	-7,609	-10%
Lower City Creek	0.0	0.0	0.0	0.0%
Lytle Creek Downstream of Cajon Wash	23	15	-8	-35%
SAR – Greenspot Road	84,766	69,372	-15,394	-18%
SAR – Upstream of East Twin Creek	15	16	1	7%
SAR – USGS Reach 9 Downstream of RIX	0.0	0.0	0.0	0.0%
Boulder				
Mill Creek Upstream of SAR	967	912	-55	-6%
Lower City Creek	0.0	0.0	0.0	0.0%
Lytle Creek Downstream of Cajon Wash	0.0	0.0	0.0	0.0%
SAR – Greenspot Road	6,340	5,153	-1,187	-19%
SAR – Upstream of East Twin Creek	0.0	0.0	0.0	0.0%
SAR – USGS Reach 9 Downstream of RIX	0.0	0.0	0.0	0.0%

Net Effect on Channel Morphology and Sediment Composition

The sediment transport analysis above shows Mill Creek and the Santa Ana River upstream of the confluence with Mill Creek have the largest transport capacity for total sediment and coarse sediment to the upper Santa Ana River; however, without the continual supply of total and coarse sediment that is now blocked by Seven Oaks Dam, the available sediment and sediment transport capacity of this reach of the Santa Ana River will diminish over time. Coarse sediment is defined here as gravel (2 to 64 millimeters) and cobble (64 to 256 millimeters). This conclusion is consistent with analysis reported by Wright and Minear (2019) in their work to assess the effects of Seven Oaks Dam on sediment transport, and as reported in a recent study of the effects of Seven Oaks Dam on geomorphic process downstream of the dam (ICF 2019a, 2019b). Mill Creek will continue to have the largest sediment transport capacity with the Covered Activities but at a reduced rate.

Appreciable reductions ranging from 18 to 49% in total sediment transport capacity are predicted from the major sediment source tributaries. This will likely result in reduced channel maintenance processes compared to the existing conditions as less sediment scour and deposition will result in less vegetation uprooting, less sediment bar burial of vegetation from bar migration, and less bank undercutting. The width of the active channel belt will likely narrow compared to existing conditions. A similar response has occurred in the Santa Ana River downstream of Seven Oaks Dam, in which the zone of sparse to unvegetated bars has narrowed, and formerly active areas of the channel belt have become inactive or abandoned with increased vegetation density (ICF 2019a, 2019b). Unlike in the Santa Ana River immediately downstream of Seven Oaks Dam, however, the Covered Activities are not expected to trap all sediment and therefore will not result in clear water (sediment-free water) flows downstream. The Covered Activities responsible for most of the effects

on sediment transport are storm flow diversions and recharge basins. A portion of the flow during a flood event (typically just following the peak flow or the tail of a storm event) would be diverted into recharge basins. The peak flow with the highest shear stress capable of transporting sediment would still continue downstream past the diversion due to operational parameters of the facilities. Furthermore, the basins would not permanently trap sediment because sediment will be actively removed from the basins and placed back into the main channel as described below.

To mitigate for reductions in sediment transport potential and the temporary capture of sediment in basins, the basins will be managed as a part of a *Basin Sediment Management Plan*, which will require that when sediment is periodically excavated from basins to maintain basin capacity it will be deposited downstream of each basin to allow continued transport along the tributary and into the Santa Ana River. The sediment will be transported downstream by the rising curve and peaks of storm events that would be allowed to pass by the groundwater recharge basins and facilities in order to protect the infrastructure.

A large portion of the Santa Ana sucker's designated critical habitat is in areas that have intermittent water and are not occupied habitat. Critical habitat in these areas was designated because the reaches are a source of coarse sediment to be supplied to downstream-occupied reaches, where the fish depend on coarse substrate for feeding and spawning. Wright and Minear (2019) concluded that Seven Oaks Dam decreases coarse sediment supply and deposition rates in the occupied reach downstream of the Rialto Channel. The Covered Activities will reduce the rate of transport and slow the replenishment of coarse substrate within occupied reaches. Regardless, the availability of coarse substrate in the occupied reaches of the Santa Ana River will be monitored and adaptively managed to maintain sufficient availability to support the sucker population in this area.

The Covered Activities are predicted to reduce coarse sediment transport capacity from Mill Creek by 17%, from the Santa Ana River upstream of Mill Creek by 23%, and from Lytle Creek by 48% (Table 4-7). The slope of the Santa Ana River becomes more gradual below the confluence with Mill Creek, notably near the San Bernardino Airport and the confluence with East Twin Creek. This gentler slope results in reduced shear stress levels for a given flow and a reduction in the stream's potential to transport sediment, particularly coarse sediment, as is evident by the increasing proportion of fine sediment textures in the channel bed from upstream to downstream. The slope reduction effect applies for both the baseline condition and the Covered Activities condition. Coarse gravel and cobble sediment delivered from mountain tributary streams tends to deposit in the Santa Ana River alluvial fan upstream of the confluence with East Twin Creek (Wright and Minear 2019). This process is evident in the sediment transport results presented here for the Santa Ana River upstream of the East Twin Creek confluence where the predicted 15% reduction in transport capacity of coarse sediment due to the Covered Activities is considerably lower than for reaches farther upstream with higher slopes (i.e., the reach is depositional for both the existing conditions and with Covered Activities conditions). Only during large-magnitude, infrequently occurring events does the river have enough energy to transport appreciable volumes of coarse sediment farther downstream into reaches occupied by Santa Ana sucker. The SAR USGS Reach 9 Downstream of RIX location (Table 4-7), at the upper end of the occupied reach, is a good site for evaluating how the Covered Activities would affect sediment conditions in a reach of the river occupied with Santa Ana sucker. The sediment transport calculation applied for this sediment transport analysis uses the field-measured bed-sediment particle size gradation. In this reach, the Santa Ana River is a sand bed channel, with only 15% gravel and no cobble in the field sample used for the sediment transport calculations (Appendix D, Table 2). If no material is available on the bed, then the transport equation will not predict transport of these particle sizes. Thus, gravel transport is only 9% of the total

sediment transport of all particle sizes for both the existing conditions and with Covered Activities conditions, and no cobble transport is predicted because the field sample shows no cobble is available to transport (Table 4-7). The Covered Activities are predicted to reduce gravel transport by 37% and cobble transport by <1%. The actual amount of available suitable substrate in the occupied reaches will continue to be monitored and adaptively managed to maintain habitat suitability.

Small patches of coarse sediment are present in SAR USGS Reach 9, which is the primary reason fish occupy this reach. But the patches, particularly coarse sediment (gravel and cobble), compose a small portion of the channel and are only exposed where the flow velocities are high enough to flush away sand that otherwise buries the gravel and cobble. There is concern that, with a reduction in coarse sediment supply to the native fish reach, eventually the coarse material currently in the reach will be transported downstream and not replenished. Because of the previously discussed sensitivity of the transport equation to the field-measured particle sizes, an additional analysis was performed to examine how the shear stresses levels would change in SAR USGS Reach 9 with the Covered Activities. This assessment examines the extent to which coarse sediment could be transported if it were available. At the 0.4% mean daily discharge exceedance probability, which corresponds to the 1.25-year recurrence interval flood, reduction in flow from 3,178 to 2,580 cfs reduces shear stress levels capable of transporting gravel by 17%. At higher flows, the differences between the baseline and under the Covered Activities becomes less. Shear stresses high enough to transport cobble are not obtained in appreciable quantities until an exceedance flow of approximately 0.03% (22,551 cfs baseline and 22,129 cfs with Covered Activities), and the area over which cobble transport would occur is a small fraction of the total wetted channel area (Figure 4-7).

In summary, this analysis further demonstrates that the reach of the Santa Ana River occupied by Santa Ana sucker (SAR USGS Reach 9) is largely depositional with respect to coarse gravel and cobble sediment. Large floods are required to transport coarse gravel and cobble sediment into and out of this reach. Because the Covered Activities do not substantially reduce the flow magnitude of these large flood events, it is feasible that the coarse sediment already in the reach could eventually be transported downstream at a higher rate than it is replaced if the coarse sediment supply from upstream was substantially decreased, which would result in decreased availability of coarse substrate for fish population in this reach. However, because the Santa Ana River upstream of this reach is also depositional under existing conditions, reductions in coarse sediment transport predicted in several of the tributaries and the Santa Ana River upstream of Mill Creek will not translate directly into imminent reductions in availability of coarse sediment in the occupied reach. Over a long period of time it is possible that the reduction of transport upstream will result in less coarse sediment in this reach. The timeframe for this largely depends on the frequency of large flood events that occur in the future with the potential to transport coarse sediment. Long-term monitoring of sediment conditions in the Santa Ana River will be implemented as a part of this HCP to assess if the availability of coarse sediment in the native fish reach is diminishing, and, if so, management tools such as sediment replenishment may be necessary at the upper end of SAR USGS Reach 9. Adaptive management and monitoring in coordination with the implementation of the *Basin Sediment Management Plan* will work together to provide suitable substrate and a means to make it available in the occupied reaches of the river.

4.4.3 Effects on Groundwater-Dependent Ecosystems

The effects of Covered Activities on GDEs are divided into three categories: decreasing groundwater level effects, increasing groundwater level effects, and no expected effect from changes in depth to groundwater. As described in Section 4.3.4, *Methods for Effects of Groundwater Change on Riparian and Wetland Habitats*, areas with decreasing groundwater levels have the potential for conversion of GDE community types to drier, non-GDE communities when the groundwater decreases below the lower extinction depth (i.e., depth below the reach of plants in the community above). Similarly, with increasing groundwater levels there is the potential for changes in community type when the groundwater increases above the upper extinction depth (e.g., conversion of a riparian area to a wetland). Areas of decreasing and increasing groundwater levels expected to occur as a result of the effects of the Covered Activities are shown on Figure 4-8. Table 4-3 identifies the projects that are anticipated to result in an appreciable effect on groundwater.

The two main areas of decreasing groundwater levels on the Santa Ana River occur in the reach from the Main Street crossing to the railroad crossing at the confluence with Sunnyslope Channel, and the reach from I-15 downstream to Prado Dam. The main area of increasing groundwater on the Santa Ana River occurs between the railroad crossing and I-15. Other areas of increasing groundwater are in the vicinity of the lower tributaries of Chino and Cucamonga Creeks and the upper tributaries of Cajon, Cable, Devil Canyon, Waterman, and San Timoteo Creeks.

Table 4-8 shows the acres of wetlands, riparian understory, and riparian overstory that are predicted to have groundwater decrease past their respective extinction depths. Extinction depths are based on estimates in Maddock et al. (2012) for wetlands and riparian habitats of the arid west.

Falling groundwater depths from Covered Activity implementation could result in conversion of wetland and riparian habitats to drier habitat types, and could also affect the habitat for wetland and riparian-dependent Covered Species (i.e., mountain yellow-legged frog, western spadefoot, south coast garter snake, southwestern pond turtle, tricolored blackbird, yellow-breasted chat, western yellow-billed cuckoo, southwestern willow flycatcher, and least Bell's vireo). Potential species effects are also discussed in Section 4.6. It is important to note that conversion of habitat from one type to another is not necessarily indicative of reduced function of habitat, rather a likely transition of habitat for one cohort of species to another cohort more suited for the new vegetative conditions.

The acreages in this analysis are based on an overlay of predicted (modeled) groundwater depths on the existing vegetation maps. Therefore, the inference of potential biological responses to groundwater changes based on this large-scale hydrologic modelling and vegetation mapping is speculative. It will be important to conduct regular groundwater monitoring in conjunction with wetland and riparian habitat condition monitoring to adaptively manage the effects of Covered Activities on groundwater and GDEs. Figures 4-9 and 4-10 show the areas of groundwater increase and decrease for riparian and wetland areas, respectively.

Table 4-8. Acres of Wetland and Riparian Habitats with Falling Groundwater Depths

Falling Groundwater Depth Transition (feet)		Acres of Groundwater-Dependent Community Type (Lower Extinction Depth[1])		
From Existing Depth[1]	To Covered Activities Depth[1]	Wetlands (-1 foot)	Riparian Understory (-5 feet)	Riparian Overstory (-16 feet)
<1	1–5	29.5	--	--
<1	5–16	4.9	--	--
1–5	5–16	--	211.2	--
5–16	>16	--	--	106.6

[1] Extinction depths from Maddock et al. 2012, rounded to nearest foot for modelling analysis. The extinction depths defined in Maddock et al. 2012 are -0.7 feet for wetlands, -4.92 feet for riparian understory, and -16.4 feet for riparian overstory habitats. Acreages are not indicated for habitats in areas where the existing groundwater depth is either above or below the identified extinction depths.

Table 4-9 shows the acres of wetland and riparian habitats with rising groundwater. It is less clear what effect rising groundwater would have on wetland and riparian communities. Rising groundwater could benefit these communities by creating more persistent availability of groundwater, which will particularly benefit any areas that have experienced previous groundwater drawdown as well as provide some level of protection against drought. Increased groundwater could also result in conversion to a wetter community type (e.g., from riparian to wetland habitat, or from a non-GDE to riparian or wetland habitat, or wetland or riparian to open water) if the groundwater depth rises above the upper extinction depth shown on Figure 4-1. Riparian habitats can tolerate higher groundwater levels, but reach the point of converting to a wetland once the soil is fully saturated or surface water is present (i.e., groundwater at or above the surface elevation). Wetlands may lose their emergent wetland vegetation at surface water depths in excess of 2.6 feet (Figure 4-1), causing conversion to open water. Because this groundwater analysis does not include surface water levels, there is not a clear indication if the upper extinction depth would be reached for riparian communities (0 foot) or wetland communities (>2.6 feet). Again, the actual depths to groundwater and the condition of wetland and riparian habitats will be monitored and adaptively managed as a part of HCP implementation.

Table 4-9. Acres of Wetland and Riparian Habitats with Rising Groundwater Depths

Rising Groundwater Depth Transition		Acres of Groundwater-Dependent Community Type (Upper Extinction Depth[1])	
From Existing Depth[1] (feet)	To Covered Activities Depth[1] (feet)	Riparian Understory (0 feet)	Riparian Overstory (0 feet)
1–5	<1	33.8	33.8
5–16	<1	0.0	0.0
5–16	1–5	16.3	16.3
>16	5–16	2.9	2.9

[1] Extinction depths from Maddock et al. 2012, rounded to nearest foot for modelling analysis. Upper extinction depth for wetlands is +2.6 feet; however, wetlands are not included in this table because surface water contours were not included in this analysis.

Finally, the acres of wetland and riparian habitat indicated in Table 4-10 are not expected to be affected from changes in depth to groundwater because any groundwater depth changes under these acres stay within the extinction depth ranges that occur under existing conditions.

Table 4-10. Acres of Wetland and Riparian Habitats with No Meaningful Change in Groundwater Depths

Falling Groundwater Depth Transition		Acres of Groundwater-Dependent Community Type		
From Existing Depth (feet)	To Covered Activities Depth (feet)	Wetlands	Riparian Understory	Riparian Overstory
<1	<1	263.9	1,773.5	1,773.5
1–5	1–5	--	1,113.4	1,113.4
5–16	5–16	--	--	1,101.0

4.5 Ground-Disturbance Effects on Vegetation Communities

Although impacts on vegetation communities in the Planning Area do not directly determine the take estimate for Covered Species, this information serves as a point of reference for the overall ground-disturbing impacts on habitat in the Planning Area from the Covered Activities. Table 4-11 summarizes the amount of temporary and permanent ground disturbance estimated for each water resource agency by the type of Covered Activity. Permanent and temporary impacts from Covered Activities attributed to each natural vegetation community are summarized in Table 4-12and Table 4-13.

Table 4-11. Temporary and Permanent Ground Disturbance by Water Resource Agency (Permittees) and Covered Activity Type

	Acres of Impact by Covered Activity Type – Permanent (Temporary)					
Water Agency	Water Reuse Projects	Groundwater Recharge	Wells and Water Conveyance Infrastructure	Solar Energy Development	Habitat Enhancement, Management, and Monitoring	Total
Rialto	15 (--)	-- (--)	-- (--)	-- (--)	-- (--)	15 (0)
Conservation District	-- (--)	1 (--)	-- (--)	-- (--)	-- (--)	1 (0)
East Valley	19 (4)	-- (--)	9 (4)	-- (--)	-- (--)	27 (8)
IEUA	-- (--)	677 (--)	-- (--)	-- (--)	-- (--)	677 (0)
Metropolitan	-- (--)	-- (--)	96 (38)	-- (--)	-- (--)	96 (38)
OCWD	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0 (0)
RPU	3 (--)	125 (--)	166 (37)	16 (--)	-- (--)	309 (37)
Valley District	-- (--)	530 (15)	-- (32)	-- (--)	-- (--)	528 (48)
Water Department	2 (7)	-- (1)	1 (12)	-- (--)	-- (--)	3 (21)
West Valley	1 (--)	15 (--)	-- (15)	-- (--)	-- (--)	16 (15)

	Acres of Impact by Covered Activity Type – Permanent (Temporary)					
Water Agency	**Water Reuse Projects**	**Groundwater Recharge**	**Wells and Water Conveyance Infrastructure**	**Solar Energy Development**	**Habitat Enhancement, Management, and Monitoring**	**Total**
Western	2 (--)	3 (--)	96 (233)	-- (--)	-- (--)	101 (233)
Total	**40 (12)**	**1,351 (16)**	**368 (372)**	**16 (0)**	**0 (0)**	**1,775 (400)**

Rialto = City of Rialto Public Works; Conservation District = San Bernardino Valley Water Conservation District; East Valley = East Valley Water District; IEUA = Inland Empire Utilities Agency; Metropolitan = Metropolitan Water District of Southern California; OCWD = Orange County Water District; RPU = Riverside Public Utilities; Valley District = San Bernardino Valley Municipal Water District; Water Department = San Bernardino Municipal Water Department; West Valley = West Valley Water District; Western = Western Municipal Water District of Riverside County

The land cover and vegetation communities with the greatest impacts are water, shrubland, and grassland communities (Table 4-12). Groundwater recharge activities confer the greatest permanent impacts within these vegetation communities. The water land cover type would experience the most permanent impacts (890 acres); however, 75% of this area is already in existing groundwater recharge basins that would be expanded such that the actual land cover type would not change in these areas. The land cover with the second largest permanent impacts is the shrubland community (386 acres), followed by the grassland community (273 acres). Temporary impacts would be highest in the shrubland communities (137 acres), followed by agricultural and grassland communities (119 acres and 72 acres, respectively). Woodland communities would experience the least amount of impacts of any type.

Table 4-12. Impacts on Natural Vegetation Communities and Land Cover Types

	Acres of Impact		
Vegetation Community and Land Cover Type	**Permanent**	**Temporary**	**Total**
Riparian			
Interior Warm and Cool Desert Riparian Forest	48	28	77
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	1	4	5
Riparian Subtotal	*49*	*32*	*82*
Wetlands			
Western North American Freshwater Aquatic Vegetation	4	<1	4
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	<1	<1	<1
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	3	<1	3
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	67	1	68
Wetlands Subtotal	*74*	*2*	*76*
Water (includes alluvial fan scrub in parentheses)			
Permanent Water	34	5	39
Water in Existing Basins	618	<1	619

Vegetation Community and Land Cover Type	Acres of Impact Permanent	Temporary	Total
Dry Channel/Shrubland	237 (193)	26 (15)	263 (208)
Water Subtotal	*890*	*31*	*921*
Shrublands (includes alluvial fan scrub in parentheses)			
Californian Chaparral	25	14	38
Californian Coastal Scrub	316 (112)	99 (21)	414 (133)
Great Basin and Intermountain Xeric-Riparian Scrub	19 (17)	6 (4)	25 (21)
North American Warm-Desert Xeric-Riparian Scrub	26 (24)	18 (17)	44 (41)
Shrublands Subtotal	*386 (153)*	*137 (42)*	*523 (195)*
Grasslands			
Californian Annual and Perennial Grassland	273	72	344
Californian Disturbed Grassland, Meadow, and Scrub	0	<1	<1
Grasslands Subtotal	*273*	*72*	*345*
Woodlands			
Californian Forest and Woodland	1	1	2
Californian Disturbed Forest	1	1	2
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	0	1	1
Woodlands Subtotal	*2*	*1*	*5*
Rock Outcrops			
Rock Outcrops Subtotal	13	4	17
Agriculture			
Herbaceous Agricultural Vegetation	90	116	206
Woody Agricultural Vegetation	2	3	5
Agriculture Subtotal	*92*	*119*	*211*
TOTAL	**1,779**	**400**	**2,179**

Table 4-13. Impacts on Vegetation Communities by Covered Activity Type

	Acres of Impact by Covered Activity Type – Permanent (Temporary)				
Vegetation Community	**Water Reuse**	**Groundwater Recharge**	**Wells & Water Infrastructure**	**Solar Energy**	**Habitat Enhancement**
Riparian					
Interior Warm and Cool Desert Riparian Forest	1 (1)	20 (0)	27 (28)	0 (0)	0 (0)
Warm Desert Freshwater Shrubland, Meadow and Marsh	0 (0)	0 (0)	1 (4)	0 (0)	0 (0)
Riparian Subtotal	*1 (1)*	*20 (0)*	*28 (32)*	*0 (0)*	*0 (0)*
Wetlands					
Western North American Freshwater Aquatic Vegetation	0 (0)	4 (0)	0 (<1)	0 (0)	0 (0)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	0 (0)	0 (0)	<1 (<1)	0 (0)	0 (0)
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	0 (0)	0 (0)	3 (<1)	0 (0)	0 (0)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	0 (0)	66 (0)	<1 (1)	0 (0)	0 (0)
Wetlands Subtotal	*0 (0)*	*70 (0)*	*3 (2)*	*0 (0)*	*0 (0)*
Water [includes alluvial fan scrub in brackets]					
Permanent Water	3 (<1)	26 (0)	5 (5)	0 (0)	0 (0)
Water in Existing Basins	0 (<1)	618 (0)	0 (<1)	0 (0)	0 (0)
Dry Channel/Shrubland	5 (4) [0 (3)]	223 (<1) [189 (<1)]	9 (21) [3 (12)]	0 (0)	0 (0)
Water Subtotal	*8 (5)*	*867 (<1)*	*14 (26)*	*0 (0)*	*0 (0)*
Shrublands [includes alluvial fan scrub in brackets]					
Californian Chaparral	0 (0)	10 (0)	15 (14)	0 (0)	0 (0)
Californian Coastal Scrub	<1 (1) [<1 (1)]	220 (2) [94 (1)]	89 (95) [15 (19)]	6 (0) [3 (0)]	0 (0)
Great Basin and Intermountain Xero-Riparian Scrub	0 (1) [0 (1)]	16 (0) [16 (0)]	3 (5) [1 (3)]	0 (0) [0 (0)]	0 (0)
North American Warm-Desert Xero-Riparian Scrub	0 (<1) [0 (<1)]	21 (13) [20 (13)]	4 (5) [4 (4)]	0 (0) [0 (0)]	0 (0)
Shrublands Subtotal	*<1 (2) [<1 (2)]*	*267 (15) [130 (14)]*	*111 (119) [20 (25)]*	*6 (0) [3 (0)]*	*0 (0)*
Grasslands					
Californian Annual and Perennial Grassland	27 (2)	110 (<1)	125 (69)	10 (0)	0 (0)
Californian Disturbed Grassland, Meadow, and Scrub	0 (0)	0 (0)	0 (<1)	0 (0)	0 (0)

	Acres of Impact by Covered Activity Type – Permanent (Temporary)				
Vegetation Community	**Water Reuse**	**Groundwater Recharge**	**Wells & Water Infrastructure**	**Solar Energy**	**Habitat Enhancement**
Grasslands Subtotal	*27 (2)*	*110 (<1)*	*125 (69)*	*10 (0)*	*0 (0)*
Woodlands					
Californian Forest and Woodland	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)
Californian Disturbed Forest	<1 (<1)	0 (0)	<1 (2)	0 (0)	0 (0)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	0 (0)	0 (0)	<1 (<1)	0 (0)	0 (0)
Woodlands Subtotal	*<1 (<1)*	*0 (0)*	*2 (3)*	*0 (0)*	*0 (0)*
Rock Outcrops					
Western North American Cliff, Scree, and Rock Vegetation	0 (1)	12 (1)	1 (3)	0 (0)	0 (0)
Rock Outcrops Subtotal	*0 (1)*	*12 (1)*	*1 (3)*	*0 (0)*	*0 (0)*
Agriculture					
Herbaceous Agricultural Vegetation	0 (1)	7 (0)	83 (116)	0 (0)	0 (0)
Woody Agricultural Vegetation	<1 (0)	0 (<1)	1 (2)	0 (0)	0 (0)
Agriculture Subtotal	*<1 (1)*	*7 (<1)*	*84 (118)*	*0 (0)*	*0 (0)*
Total	**40 (12)**	**1,354 (16)**	**368 (372)**	**16 (0)**	**0 (0)**

4.6 Effects on Covered Species

Table 4-14 summarizes the overall permanent and temporary impacts expected from all the Covered Activities on Covered Species habitat as a surrogate for the take estimated to occur. Note that impacts on species occurrence records are only calculated for ground-disturbing impacts where the impact footprint overlays the species occurrence. Impacts on aquatic species from changes in hydrology are calculated in terms of changes in acreage of aquatic habitat.

Table 4-15 summarizes the permanent and temporary impacts under each activity type for each Covered Species that is affected. The following sections address each Covered Species separately to provide additional context for the take assessment and the impact of the taking on species' habitat and populations, including impacts from ground-disturbing activities and from the hydrologic effects described above in Section 4.4, *Effects on Hydrology and Sediment Transport*.

The mitigation to fully offset the impacts on each species is briefly discussed in the species-specific effects analysis, below. Chapter 5 includes the complete description of all conservation actions for each species and long-term management and monitoring of the HCP Preserve System.

Note that the effects analysis for ground-disturbing effects is based on habitat suitability models and the potential impacts on *modeled habitat*, not occupied habitat. The area of potentially suitable habitat predicted by the models is much larger than the area of occupied habitat at any given moment in time, such that the actual impacts on occupied habitat will be substantially less. Actual impacts will be further minimized through the implementation of general and species-specific avoidance and minimization measures (Section 5.11). Therefore, these take estimates represent a maximum potential take estimate for each species. With the implementation of avoidance and minimization measures and more precise project-specific design, the take is expected to be lower than estimated in most cases. In no case will the take of any species be allowed to exceed the take estimate established by this HCP.

Table 4-14. Estimated Impacts on Modeled Habitat, Occurrences, and Critical Habitat

	Acres of Impact (Amount of Take)	
Covered Species	**Permanent**	**Temporary**
Slender-Horned Spineflower		
Current Occupied Habitat	--	--
Historic Occupied Habitat	<0.1	--
Potentially Suitable Habitat	283.2	116.3
Occurrences[1]	--	--
Santa Ana River Woolly-Star		
Potentially Suitable Habitat	392.6	53.1
Occurrences	31.0	4.0
Santa Ana Sucker		
Suitable Habitat[2]	1.3	--
Final Critical Habitat[3]	83.3	20.2
Occurrences	N/A	N/A

Covered Species	Acres of Impact (Amount of Take) Permanent	Temporary
Arroyo Chub		
Potentially Suitable Habitat (Wetted Area[2,4])	2.4	--
Occurrences	N/A	N/A
Santa Ana Speckled Dace		
Potentially Suitable Habitat (Wetted Area[2,4])	0.1	--
Occurrences	N/A	N/A
Mountain Yellow-Legged Frog		
Reduction in Wetted Area[2,4]	0.2	N/A
Potentially Suitable Aquatic[2,4]	3.9	0.3
Refugia/Foraging/Dispersal Habitat	108.8	15.3
Final Critical Habitat	--	--
Occurrences	--	--
Western Spadefoot		
Reduction in Wetted[2,4]	6.5	--
Potentially Suitable Habitat	612.1	110.7
Occurrences	1.0	1.0
California Glossy Snake		
Potentially Suitable Habitat	718.4	178.6
Occurrences	1.0	1.0
South Coast Garter Snake		
Reduction in Wetted Area[2,4]	19.5	--
Potentially Suitable Habitat	14.7	6.7
Southwestern Pond Turtle		
Reduction in Wetted Area[2,4]	17.8	--
Aquatic Habitat[2,4]	0.9	0.8
Potentially Suitable Upland Habitat	18.5	14.1
Occurrences	--	--
Tricolored Blackbird		
Occupied Colony Habitat	--	--
Suitable Colony Habitat	52.3	1.4
Breeding Season Foraging – Natural	158.2	43.7
Breeding Season Foraging – Agriculture	67.0	101.1
Non-Breeding Season Foraging – Natural	0.4	0.4
Non-Breeding Season Foraging – Agriculture	0.1	0.9
Occurrences	1.0	--
Burrowing Owl		
Potentially Suitable Habitat	632.8	243.7
Occurrences	--	1.0
Cactus Wren		
Known Suitable Nesting	0.4	0.4

Covered Species	Acres of Impact (Amount of Take) Permanent	Temporary
Potential Nesting and Foraging Habitat	630.0	181.4
Recently Burned (2008–2018)	1.6	6.4
Occurrences	1.0	1.0
Yellow-Breasted Chat		
Potentially Suitable Habitat	120.3	29.4
Occurrences	1.0	2.0
Western Yellow-Billed Cuckoo		
High Value Breeding Habitat	<0.1	0.1
Other Potentially Suitable Breeding Habitat	8.7	8.2
Occurrences	--	--
Southwestern Willow Flycatcher		
Core Southwestern Willow Flycatcher Habitat	15.5	3.0
Very High Value Habitat	<0.1	0.2
High Value Habitat	<0.1	0.1
Moderate Value Habitat	<0.1	<0.1
Other Potentially Suitable Habitat	104.7	26.1
Final Critical Habitat	95.9	12.1
Occurrences	--	--
Coastal California Gnatcatcher		
Very High Value Habitat	18.3	6.5
High Value Habitat	48.3	17.5
Moderate Value Habitat	43.0	21.1
Low Value Habitat	149.5	64.5
Other Suitable Habitat	70.3	4.6
Final Critical Habitat	2.9	3.0
Occurrences	2.0	1.0
Least Bell's Vireo		
Core Breeding Habitat	0.2	1.8
Other Breeding Habitat	120.0	27.6
Final Critical Habitat	1.9	11.7
Occurrences	1.0	3.0
Los Angeles Little Pocket Mouse		
Potentially Suitable Habitat	593.4	145.4
Occurrences	1.0	1.0
San Bernardino Merriam's Kangaroo Rat		
High	0.7	<0.1
Medium	1.4	0.3
Low	93.9	2.4
Very Low-Quality Habitat	154.1	18.5
Ecological Process Area	86.4	0.5

Covered Species	Acres of Impact (Amount of Take)	
	Permanent	Temporary
Suitable Habitat	160.0	33.7
Final Critical Habitat	616.3	107.5
Occurrences	67.0	3.0
Refugia[5]	83.2	30.4

[1] Post-2005 occurrence data is defined as total number of occurrences in the Planning Area, not as acres.

[2] Impacts from changes to hydrology, not from ground-disturbance.

[3] Unoccupied intermittently flowing portions of the Santa Ana River designated as Critical Habitat as a source of coarse sediment to be supplied to downstream-occupied reaches, where the fish depend on coarse substrate for feeding and spawning.

[4] The difference between wetted area impact estimates and aquatic habitat impact estimates are due to two separate analytical methods. Wetted area is calculated based on three-dimensional hydrology models, while aquatic habitat is calculated based on regional land cover mapping.

[5] San Bernardino kangaroo refugia habitat is composed of modeled habitat that occurs outside of the 100-year floodplain.

Table 4-15. Impacts of Ground-Disturbing Covered Activities on Covered Species by Covered Activity Type

	Acres of Impact by Covered Activity Type – Permanent (Temporary)				
Covered Species Habitat[1]	**Water Reuse**	**Groundwater Recharge**	**Wells and Water Infrastructure**	**Solar Energy**	**Habitat Enhancement**
Slender-Horned Spineflower					
Current Occupied Habitat	0.0 (0.0)	0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Historic Occupied Habitat	0.0 (0.0)	<0.1 (0.0)	0.0 (0.0)	0.0 (0.0	0.0 (0.0)
Potentially Suitable Habitat	0.5 (2.5)	179.3 (12.0)	98.0 (101.9)	5.5 (0.0)	0.0 (0.0)
Santa Ana River Woolly-Star					
Potentially Suitable Habitat	0.6 (5.3)	332.2 (11.9)	54.4 (35.9)	6.0 (0.0)	0.0 (0.0)
Mountain Yellow-Legged Frog					
Potentially Suitable Aquatic Habitat	0.0 (0.2)	3.4 (0.0)	0.5 (0.1)	0.0 (0.0)	0.0 (0.0)
Refugia/Foraging/Dispersal Habitat	0.7 (1.5)	95.1 (0.0)	13.0 (13.8)	0.0 (0.0)	0.0 (0.0)
Western Spadefoot					
Potentially Suitable Habitat	3.2 (3.0)	446.8 (12.6)	146.8 (95.1)	15.3 (0.0)	0.0 (0.0)
California Glossy Snake					
Potentially Suitable Habitat	20.3 (7.3)	471.6 (13.6)	210.9 (157.7)	15.7 (0.0)	0.0 (0.0)
South Coast Garter Snake					
Potentially Suitable Habitat	0.0 (0.0)	0.0 (0.0)	14.7 (6.7)	0.0 (0.0)	0.0 (0.0)
Southwestern Pond Turtle					
Aquatic Habitat	0.0 (0.0)	0.0 (0.0)	0.9 (0.8)	0.0 (0.0)	0.0 (0.0)
Potentially Suitable Upland Habitat	0.0 (0.0)	0.0 (0.0)	18.5 (14.1)	0.0 (0.0)	0.0 (0.0)
Tricolored Blackbird					
Occupied Colony Habitat	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Suitable Colony Habitat	0.0 (0.0)	49.0 (0.0)	3.3 (1.4)	0.0 (0.0)	0.0 (0.0)
Breeding Season Foraging – Natural	24.8 (1.5)	66.8 (0.0)	61.0 (42.2)	5.6 (0.0)	0.0 (0.0)
Breeding Season Foraging – Agriculture	0.0 (0.6)	6.8 (0.0)	60.1 (100.6)	0.0 (0.0)	0.0 (0.0)
Non-Breeding Season Foraging – Natural	0.1 (0.0)	0.0 (0.0)	0.3 (0.4)	0.0 (0.0)	0.0 (0.0)
Non-Breeding Season Foraging – Agriculture	0.0 (0.0)	0.0 (0.0)	0.1 (0.9)	0.0 (0.0)	0.0 (0.0)

Covered Species Habitat[1]	Acres of Impact by Covered Activity Type – Permanent (Temporary)				
	Water Reuse	Groundwater Recharge	Wells and Water Infrastructure	Solar Energy	Habitat Enhancement
Burrowing Owl					
Potentially Suitable Habitat	27.8 (4.9)	313.5 (12.6)	275.9 (226.2)	15.7 (0.0)	0.0 (0.0)
Cactus Wren					
Known Suitable Nesting	0.0 (0.0)	0.2 (0.0)	0.2 (0.4)	0.0 (0.0)	0.0 (0.0)
Potential Nesting and Foraging Habitat	27.9 (4.9)	369.1 (12.6)	217.3 (164.4)	15.7 (0.0)	0.0 (0.0)
Recently Burned (2008–2018)	0.1 (0.0)	0.0 (0.0)	1.5 (6.4)	0.0 (0.0)	0.0 (0.0)
Yellow-Breasted Chat					
Potentially Suitable Habitat	2.1 (0.7)	85.6 (0.0)	32.6 (28.8)	<0.1 (0.0)	0.0 (0.0)
Western Yellow-Billed Cuckoo					
High Value Breeding Habitat	0.0 (0.0)	0.0 (0.0)	<0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
Other Potentially Suitable Breeding Habitat	0.0 (0.0)	0.0 (0.0)	8.7 (8.2)	0.0 (0.0)	0.0 (0.0)
Southwestern Willow Flycatcher					
Core Southwestern Willow Flycatcher Habitat	0.0 (0.2)	6.0 (0.0)	9.5 (2.8)	0.0 (0.0)	0.0 (0.0)
Very High Value Habitat	0.0 (0.0)	0.0 (0.0)	<0.1 (0.2)	0.0 (0.0)	0.0 (0.0)
High Value Habitat	0.0 (0.0)	0.0 (0.0)	<0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
Moderate Value Habitat	0.0 (0.0)	0.0 (0.0)	<0.1 (<0.1)	0.0 (0.0)	0.0 (0.0)
Other Potentially Suitable Habitat	2.1 (0.5)	79.6 (0.0)	23.0 (25.7)	<0.1 (0.0)	0.0 (0.0)
Coastal California Gnatcatcher					
Very High Value Habitat	<0.1 (0.5)	8.1 (1.6)	9.5 (4.5)	0.7 (0.0)	0.0 (0.0)
High Value Habitat	0.0 (0.3)	36.8 (8.6)	11.5 (8.6)	0.0 (0.0)	0.0 (0.0)
Moderate Value Habitat	0.1 (0.6)	29.1 (1.4)	13.8 (19.2)	0.0 (0.0)	0.0 (0.0)
Low Value Habitat	0.4 (1.1)	88.4 (0.8)	55.9 (62.5)	5.0 (0.0)	0.0 (0.0)
Other Suitable Habitat	0.0 (0.0)	69.4 (0.0)	0.9 (4.6)	0.0 (0.0)	0.0 (0.0)
Least Bell's Vireo					
Core Breeding Habitat	0.0 (0.0)	0.0 (0.0)	0.2 (1.8)	0.0 (0.0)	0.0 (0.0)
Other Breeding Habitat	2.1 (0.7)	85.6 (0.0)	32.3 (27.0)	<0.1 (0.0)	0.0 (0.0)

Covered Species Habitat[1]	Acres of Impact by Covered Activity Type – Permanent (Temporary)				
	Water Reuse	Groundwater Recharge	Wells and Water Infrastructure	Solar Energy	Habitat Enhancement
Los Angeles Little Pocket Mouse					
Potentially Suitable Habitat	20.2 (4.9)	366.8 (12.3)	190.7 (128.3)	15.7 (0.0)	0.0 (0.0)
San Bernardino Merriam's Kangaroo Rat					
High	0.0 (0.0)	0.7 (0.0)	0 (<0.1)	0.0 (0.0)	0.0 (0.0)
Medium	0.0 (0.0)	1.3 (0.0)	0.1 (0.3)	0.0 (0.0)	0.0 (0.0)
Low	0.0 (0.0)	91.5 (0.1)	2.3 (2.3)	0.0 (0.0)	0.0 (0.0)
Very Low-Quality Habitat	0.0 (0.2)	146.8 (12.0)	7.3 (6.3)	0.0 (0.0)	0.0 (0.0)
Ecological Process Area	0.0 (0.0)	86.2 (0.0)	0.2 (0.5)	0.0 (0.0)	0.0 (0.0)
Suitable Habitat	0.4 (3.5)	143.0 (0.7)	13.5 (29.4)	3.0 (0.0)	0.0 (0.0)

[1] Ground-disturbing impacts are not applicable to the three fish species that only occur in aquatic habitat.

4.6.1 Fully Avoided Species

The Delhi Sands flower-loving fly and arroyo toad were analyzed during the development of this HCP, and avoidance measures for these species eliminate the potential for adverse effects; therefore, Covered Activities are not anticipated to result in take of these species. The avoidance measures for these species are described in Sections 5.6.1. and 5.6.2., respectively. Because it is anticipated that covered activities will fully avoid these species, they are not listed in Table 4-14 or Table 4-15. The rationale for determining that these species will be fully avoided would occur is discussed briefly below.

Delhi Sands Flower-Loving Fly

The distribution of the Delhi Sands flower-loving fly in the Planning Area is defined by modeled potentially suitable habitat and potentially suitable habitat (extirpated) and documented occurrences. Extirpated lands are those identified in the U.S. Fish and Wildlife Service (USFWS) 5-year review (USFWS 2008). It is only known from Riverside and San Bernardino Counties, with most occupied habitat located within a limited area of southwestern San Bernardino County, west of Colton. Modeled potentially suitable habitat (1,362 acres) and potentially suitable habitat (extirpated) (1,742 acres) also occur in this area on undeveloped patches within Delhi Sand soil types; the greatest density of modeled habitat occurs north and northwest of Eastvale, west of Colton, northwest of the Jurupa Hills, and east of the Ontario International Airport (Figure 3-26). Refer to the Delhi Sands flower-loving fly species account in Section 3.8.3 for a list of the parameters for this species' modeled habitat in the Planning Area.

Projects occurring in potentially suitable habitat (extirpated) would not result in take. There are an estimated 0.2 acre of permanent disturbance and 1.5 acres of temporary disturbance from Covered Activities occurring in potentially suitable habitat for the fly (Table 4-16). These activities, and any other covered projects proposed that would disturb Delhi Sands flower-loving fly habitat in the Planning Area, would adhere to the avoidance measures outline in Chapter 5 to fully avoid take of the species.

Table 4-16. Projects with Estimated Disturbance in Delhi Sands Flower-Loving Fly Habitat that Would Implement Measures to Fully Avoid Take of the Species

		Potential Impacts to Be Fully Avoided	
Covered Activity ID[1]	**Covered Activity Type**	**Permanent Disturbance**	**Temporary Disturbance**
Met.2	Wells and Water Conveyance Infrastructure	0.0	0.1
Met.3	Wells and Water Conveyance Infrastructure	0.2	0.0
Rial.1	Water Reuse Project	0.0	0.1
RPU.10	Wells and Water Conveyance Infrastructure	0.0	0.1
WD.5	Wells and Water Conveyance Infrastructure	0.0	0.1
West.7	Wells and Water Conveyance Infrastructure	0.0	0.1
WV.2	Wells and Water Conveyance Infrastructure	0.0	0.3
WV.6	Wells and Water Conveyance Infrastructure	0.0	1.1

[1] See Table 2-1 for a summary list of these Covered Activities.

Met = Metropolitan Water District of Southern California; Rial = City of Rialto Public Works; RPU = Riverside Public Utilities; WD = San Bernardino Municipal Water Department; West = Western Municipal Water District of Riverside County; WV = West Valley Water District.

Arroyo Toad

The distribution of the arroyo toad in the Planning Area is defined by modeled suitable breeding habitat, non-breeding upland habitat, permeable movement areas, documented occurrences, and wetted area in reaches with suitable habitat downstream of Covered Activities. Within the Planning Area, the arroyo toad is known from Cajon Wash and the mouth of Cucamonga Canyon within and outside of San Bernardino National Forest. Modeled habitat includes these two regions as well as lands within Day and Etiwanda Canyon washes (Figure 3-42). There are three modeled habitat types in the Planning Area: suitable breeding habitat (1,754 acres), non-breeding upland habitat (5,884 acres) and permeable movement area (1,659 acres). Within the Planning Area, Final Critical Habitat (1,777 acres) has been designated in the upper regions of Cajon Wash. The only known current (post-2005) occurrence of arroyo toad also occurs in the upper reaches of Cajon Wash (Figure 3-42). Refer to the arroyo toad species account in Section 3.8.3 for a list of the parameters for this species' modelled habitat in the Planning Area.

Table 4-17 lists projects with estimated disturbance in arroyo toad habitat types. These activities, and any other covered projects proposed that would disturb Arroyo toad modeled habitat in the Planning Area, would adhere to the avoidance measures outline in Chapter 5 to fully avoid take of the species.

Table 4-17. Projects with Estimated Disturbance in Arroyo Toad Habitat that Would Implement Measures to Fully Avoid Take of the Species

		Potential Impacts to Be Fully Avoided	
Covered Activity ID[1]	**Covered Activity Type**	**Permanent Disturbance**	**Temporary Disturbance**
Suitable Breeding Habitat			
IEUA.2.05[1]	Groundwater Recharge	0.0	0.0
Met.2	Wells and Water Conveyance Infrastructure	0.0	0.1
Met.3	Wells and Water Conveyance Infrastructure	0.3	0.00
WD.3	Wells and Water Conveyance Infrastructure	0.0	0.6
WD.5	Wells and Water Conveyance Infrastructure	0.1	0.2
Total		**0.4**	**1.0**
Non-Breeding Upland Habitat			
IEUA.1.03	Groundwater Recharge	5.8	0.3
IEUA.1.05[1]	Groundwater Recharge	0.0	0.0
Met.2	Wells and Water Conveyance Infrastructure	0.0	1.0
Met.3	Wells and Water Conveyance Infrastructure	0.9	0.0

Covered Activity ID[1]	Covered Activity Type	Potential Impacts to Be Fully Avoided	
		Permanent Disturbance	Temporary Disturbance
WD.3	Wells and Water Conveyance Infrastructure	0.4	0.9
WD.5	Wells and Water Conveyance Infrastructure	0.1	0.6
Total		**7.1**	**2.8**
Permeable Movement Area (developed, agriculture, disturbed)[3]			
IEUA.1.03	Groundwater Recharge	61.9	1.9
IEUA.2.05[2]	Groundwater Recharge	0.0	0.0
Met.2	Wells and Water Conveyance Infrastructure	0.0	2.2
Met.3	Wells and Water Conveyance Infrastructure	3.4	0.0
WD.3	Wells and Water Conveyance Infrastructure	0.1	1.1
WD.5	Wells and Water Conveyance Infrastructure	0.1	0.4
Total		**65.6**	**5.6**

[1] See Table 2-1 for a summary list of these Covered Activities.

[2] This project is included as a Covered Activity under the HCP, but has previously been permitted so is not considered to have an effect on Covered Species.

[3] If field inspection of Covered Activity project area indicates it is clearly not suitable for arroyo toad movement, then avoidance is not necessary.

IEUA = Inland Empire Utilities Agency; Met = Metropolitan Water District of Southern California; WD = San Bernardino Municipal Water Department.

4.6.2 Plant Species

Slender-Horned Spineflower

The distribution of slender-horned spineflower in the Planning Area is defined by current occupied habitat, historic occupied habitat, and potentially suitable habitat and documented occurrences. Refer to the slender-horned spineflower species account in Section 3.8.3 for a list of the parameters for this species' modelled habitat in the Planning Area. Most documented occurrences for the species occur east of the San Bernardino Airport in the vicinity of the mainstem of the Santa Ana River. Potentially suitable habitat (93,006 acres) is widely distributed into the foothills of the San Bernardino and San Gabriel Mountains in the northern portion of the Planning Area and across the Gavilan Plateau and the foothills of the Santa Ana Mountains in the southern portion of the Planning Area (Figure 3-24). Current occupied habitat (18 acres) is present in the Santa Ana River floodplain downstream of Seven Oaks Dam, and along Cajon Creek. Historic occupied habitat (35 acres) is located along the mainstem of the Santa Ana River downstream of Seven Oaks Dam, Cajon Creek, Lytle Creek, and along other minor foothill creeks.

Potential Direct and Indirect Effects

Direct effects on spineflower would result from direct removal or harm of individual plants or their existing seed bank. Grading, excavating, stockpiling, or other earth-disturbing activities associated with new construction of facilities and infrastructure (e.g., water treatment plants, water pipelines, discharge facilities, diversion structures) can directly remove spineflower plants and seeds, and the species' habitat. Compacted soil conditions caused by heavy equipment movement during construction could inhibit seed germination and root penetration in the soil surface, resulting in potential loss of spineflower habitat. The increased human presence during new construction activities and ongoing maintenance activities could also increase the potential for trampling of individual plants. Conversely, temporary surface disturbance may enhance germination in the years following disturbance if permanent structures are not constructed (USFWS 2010a).

Indirect effects on spineflower from Covered Activities include the introduction of nonnative plant species and altered hydrology. Vegetation clearing, road and pipeline construction and maintenance, and new basin construction can increase the spread of nonnative species, especially in areas adjacent to surface-disturbing activities. Invasive species such as annual grasses could outcompete the spineflower and prevent seeds sprouting, especially in areas adjacent to roads or other disturbed areas. A mid- to late-successional species, the spineflower requires flood (or other ground) disturbance; activities that eliminate, degrade, or curtail natural fluvial processes such as the creation of new diversion structures or recharge basins efforts could modify spineflower habitat and/or eliminate hydrologic processes that maintain spineflower habitat (USFWS 2010a). Most of the documented occurrences on the Santa Ana River are currently adversely affected by altered hydrology resulting from the Seven Oaks Dam; therefore, additional changes to hydrology from the Covered Activities could further exacerbate these impacts in the Planning Area. Section 4.4.2 summarizes the potential effects on sediment transport from Covered Activities.

Impact Assessment

The impact assessment of slender-horned spineflower estimates the permanent loss of 283.2 acres of potentially suitable habitat within the Planning Area (Table 4-14). As shown Table 4-15, areas of permanent habitat loss would result predominantly from the construction of groundwater recharge facilities (179.3 acres) in the vicinity of Cajon Wash, Dry Canyon Wash, and Mill Creek.

Temporary habitat loss of 116.3 acres of potentially suitable habitat would occur, primarily as a result of short-term disturbance associated with wells and water conveyance infrastructure (101.9 acres of potentially suitable habitat) (Table 4-15). These activities would result in temporary reduction of habitat quality or temporary loss of habitat. Impacts from individual Covered Activities are shown in Appendix F. There are no anticipated impacts on current occupied slender-horned spineflower habitat.

No Covered Activities coincide with documented occurrences of spineflower; however, Covered Activities occurring within potentially suitable habitat, even if they do not remove plants, could reduce the spineflower seedbank. The spineflower has a relatively long-lasting seedbank, which helps maintain the species in dry years. Destruction of this seedbank could affect the reproductive success of spineflower populations. However, given that there are no impacts on occupied habitat and impacts from Covered Activities on potentially suitable habitat are small when compared to the total habitat in the region, population-level impacts would be limited. In addition, the species is widely distributed outside the Planning Area with extant occurrences in numerous locations

throughout the coastal foothill drainages of Riverside, San Bernardino, and Los Angeles Counties ranging from the Temecula area northwestwards to Santa Clarita (CNPS 2014, CCH 2014).

Avoidance and minimization measures will ensure that direct take of individual plants is near zero and that take of modeled potential habitat is reduced to the greatest extent practicable. These measures include project siting, pre-Covered Activity surveys, seed collecting and storage, fencing, and topsoil sequestration and are discussed in more detail in Chapter 5. Approximately 877.2 acres of modeled habitat will be included in the HCP Preserve System and will be protected in perpetuity (Table 4-18). Conserved habitat will be monitored and managed to enhance habitat conditions for this species.

Table 4-18. Acres of Modeled Habitat Estimated to Be Impacted for Slender-Horned Spineflower

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Current Occupied Habitat			
Phase 1	0.0	0.0	0.2
Phase 2	0.0	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.0*	*0.0*	*0.2*
Historic Occupied Habitat			
Phase 1	0.05	0.0	--
Phase 2	0.0	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.05*	*0.0*	--
Potentially Suitable Habitat			
Phase 1	97.2	64.2	792.8
Phase 2	22.4	50.3	84.2
Phase 3	79.6	0.2	--
Phase 4	84.0	1.6	--
Total	*283.2*	*116.3*	*877.0*
Total Modeled Habitat	**283.3**	**116.3**	**877.2**

Santa Ana River Woolly-Star

The distribution of the Santa Ana River woolly-star in the Planning Area is defined by modeled potentially suitable habitat and documented occurrences. Refer to the Santa Ana River woolly-star species account in Section 3.8.3 for a list of the parameters for this species' modeled habitat in the Planning Area. The highest density of current documented occurrences in the Planning Area is

associated with the Santa Ana River valley between Greenspot Road near Redlands and I-215 north of Riverside and the Cajon Wash north and south of Foothill Highway (I-210). Modeled potentially suitable habitat (16,434 acres) occurs primarily in the floodplain of the Santa Ana River (including the Prado Flood Control Basin), Mill Creek, Cajon Wash, Lytle Creek, Temescal Wash, Lake Matthews, Mill Creek, and San Timoteo Canyon (Figure 3-25).

Potential Direct and Indirect Effects

Direct effects on the Santa Ana River woolly-star would result from direct removal or harm of individual plants or their existing seed bank. Grading, excavating, soil stockpiling, or other earth-disturbing activities associated with construction would directly remove the Santa Ana River woolly-star and its habitat. Compacted soil conditions caused by heavy equipment movement during construction could inhibit seed germination and root penetration in the soil surface, resulting in potential loss of woolly-star habitat. The increased human presence during new construction activities and ongoing maintenance activities could also increase the potential for trampling of individual plants. Woolly-star is often found in areas with slight surface disturbance; therefore, temporary surface disturbance may benefit this species (USFWS 2010b).

Indirect effects on Santa Ana River woolly-star from Covered Activities include the introduction of nonnative plant species and altered hydrology. Vegetation clearing, road and pipeline construction and maintenance, and new basin construction can increase the spread of nonnative species, especially in areas adjacent to surface-disturbing activities. Invasive species such as annual grasses could outcompete woolly-star and prevent seeds sprouting, especially in areas adjacent to roads or other disturbed areas. Facilities that remove natural land cover could also displace the plant's pollinators that could result in decreased productivity. Dams, water diversion, and recharge basin activities that reduce flow volumes and sediment loads would reduce the frequency of scouring and depositional events in the floodplain and allow alluvial fan sage scrub communities on the Santa Ana River to achieve early to mid-succession, reducing seedling establishment of woolly-star. All occurrences on the Santa Ana River are currently adversely affected by altered hydrology resulting from the Seven Oaks Dam; therefore, additional changes to hydrology from the Covered Activities could further exacerbate these impacts in the Planning Area. Section 4.4.2 summarizes the potential effects on sediment transport from Covered Activities.

Impact Assessment

The impact assessment of the Santa Ana River woolly-star estimates the permanent loss of 392.6 acres of potentially suitable habitat within the Planning Area (Table 4-14). The majority of permanent habitat loss would occur where the Permittees construct groundwater recharge facilities (332.3 acres) (Table 4-15).

Temporary habitat loss of 53.1 acres of potentially suitable habitat (Table 4-14) would occur as a result of short-term disturbance associated primarily with the construction of wells and water conveyance infrastructure (35.9 acres) (Table 4-15). These activities would result in the temporary reduction in habitat quality.

Covered Activities are estimated to impact 35 out of 1,580 of the documented current (post-2005) occurrences in the Planning Area. Covered Activities occurring near documented occurrences and/or within Santa Ana River woolly-star potentially suitable habitat could remove plants not detected in pre-activity surveys or those that could not be avoided, and could also adversely impact the woolly-star reproduction by destroying seeds or displacing pollinators. Documented pollinators

include giant flower-loving fly (*Rhaphiomida acton* ssp. *acton*), the sphinx moth (*Hyles lineata*), two bee species (*Micranthophora flavocinata* and *Bombus californicus*), and two hummingbirds: black-chinned hummingbird (*Archilochus alexandri*) and Anna's hummingbird (*Calypte anna*) (USFWS 2010b). However, given that the impacts on potentially suitable habitat and documented occurrences in the Planning Area due to Covered Activities are limited when compared to the total habitat and occurrences in the region, population-level impacts would be small.

Avoidance and minimization measures will ensure that direct take of individual plants is near zero and that take of modeled potential habitat is reduced to the greatest extent practicable. These measures include project siting, pre-Covered Activity surveys, fencing, and topsoil sequestration and are discussed in more detail in Chapter 5. Approximately 728.2 acres of habitat will be added to the HCP Preserve System and will be protected in perpetuity (Table 4-19). Conserved habitat will be monitored and managed to enhance and restore habitat conditions for this species.

Table 4-19. Acres of Modeled Habitat Estimated to Be Impacted for Santa Ana River Woolly-Star

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	63.4	49.8	656.7
Phase 2	16.6	1.2	71.5
Phase 3	175.0	0.2	--
Phase 4	137.0	2.0	--
Total Modeled Habitat	**392.6**	**53.1**	**728.2**

4.6.3 Wildlife Species

Santa Ana Sucker

The distribution of the Santa Ana sucker in the Planning Area is defined via habitat suitability modelling, intensive annual surveys for sucker and other fish annually on the Santa Ana River (USGS surveys, described in Section 3.8.3), surveys assessing the availability of suitable gravel and cobble substrate (Riverwalk surveys, described in Section 3.8.3), and the distribution of designated critical habitat. Refer to the Santa Ana sucker species account in Section 3.8.3 for a description of the methodology for determining the sucker's potentially suitable and occupied habitat in the Planning Area. The mainstem of the Santa Ana River from the Rialto Channel downstream near Prado Dam was assessed for suitable sucker habitat, totaling 21.1 miles of total assessed channel length. Over the length of this 21.1 miles, the sum of all the predicted suitable habitat meeting suitable flow depth and velocity and coarse substrate suitability criteria is 2.2 acres (Figure 3-39). The highest abundance of Santa Ana sucker are usually concentrated from immediately downstream of the RIX facility discharge to approximately Riverside Avenue (Brown and May 2016).

Potential Direct and Indirect Effects

The primary impact from Covered Activities on Santa Ana sucker is from hydrological modifications. Covered Activities that alter the depth and velocity of surface flows and change sediment transport conditions that alter the prevalence of coarse substrate can change the amount of available sucker habitat. These activities include reduced discharge from water treatment plants, new dams and water diversions, and the construction of new roads and other impervious surfaces.

The primary anticipated direct impact on occupied Santa Ana sucker habitat will result from the SBMWD Recycled Water Project (WD.1), which will permanently reduce the amount of treated effluent discharged from the RIX facility into the Santa Ana River. This effluent discharge currently sustains the majority of habitat supporting the population of the sucker in the Planning Area, so reducing it would result in adverse effects on the population. Secondary effects include the potential long-term reduction in the rate of coarse sediment transport from upper reaches of the Santa Ana River into the occupied reaches of the river (see Section 4.4.2).

Indirect effects on Santa Ana sucker from Covered Activities could include the introduction of nonnative plant species and nonnative predators, habitat fragmentation, and chemical spills. Vegetation clearing for construction and maintenance could introduce nonnative plant species, such as tamarisk (*Tamarix ramosissima*) and giant reed (*Arundo donax*). Covered Activities that introduce impassible in-stream barriers to upstream movement could increase habitat fragmentation. Adverse effects may result from road and facility maintenance with equipment such as trucks, mowers, or other mechanical equipment that can spill toxic substances (e.g., oil or gasoline) into sucker habitat; however, Best Management Practices (BMPs) would be implemented to reduce the potential for spills associated with maintenance activities. A stormwater pollution prevention plan (SWPPP) would be implemented during activities that would further reduce the potential for impacts on sucker from ground disturbance near occupied reaches.

Impact Assessment

The impact assessment of the Santa Ana sucker estimates the permanent loss of 1.3 acres of predicted suitable habitat (suitable depth and water velocity and coarse substrate present) within the 21.1-mile assessment area of the Santa Ana River (Table 4-20 and Table 4-21).

Table 4-20. Impacts on Santa Ana Sucker Habitat from Hydrologic Effects of Covered Activities

Reach Description[1]	Hydro Model Node[1]	Reach Length (feet)	Acres with Suitable Depth and Velocity per 1,000 Feet	Existing Acres of Suitable Habitat	Acres of Suitable Habitat with Covered Activities	Percent Reduction
Rialto Channel DS of Rialto outfall	NFRC-06	1,705	0.01	0.019	0.007	63.2%
SAR DS Rialto Channel and US RIX outfall	NSAR19	1,141	0.00	0.000	0.000	0.0%
SAR DS RIX outfall and US Riverside Ave (@ ESA Upper model site)	NSAR20	6,865	0.13	0.910	0.501	44.9%
SAR DS Riverside Ave and US node NSAR 22	NSAR21	3,242	0.09	0.279	0.112	59.9%
SAR DS node NSAR 22 and US Market St	NSAR22	5,624	0.08	0.425	0.122	71.3%
SAR DS Market St and US Hwy 60	NSAR23	1,576	0.06	0.093	0.021	77.4%
SAR DS Hwy 60 and US node NSAR 232	NSAR231	1,804	0.06	0.106	0.025	76.4%
SAR DS Hwy 60 and US Mission Blvd (@ ESA Middle model site)	NSAR232	4,000	0.06	0.236	0.055	76.7%
SAR DS Mission Blvd and US node NSAR 241 (@ ESA Lower model site)	NSAR24	5,679	0.01	0.064	0.010	84.4%
SAR DS node NSAR 241 and US node NSAR 242 (Tequesquite Arroyo reach)	NSAR241	7,883	0.00	0.016	0.000	100.0%
Total Suitable Habitat				**2.148**	**0.853**	**60.3%**

[1]Refer to Table 3-20 for a listing of all reaches within the 21.1-mile assessment reach over which Santa Ana sucker habitat was modelled. Only reaches with suitable substrate proportion (>10% gravel/cobble) are included in this table.

DS = downstream; NSAR = north Santa Ana River; US = upstream.

Given the limited amount of existing habitat within the Planning Area, this reduction in predicted suitable habitat is likely to have an adverse impact on the population of Santa Ana sucker in the mainstem of the Santa Ana River. Santa Ana sucker inhabits GDEs and has a direct reliance on the groundwater/surface flow interaction; therefore, these adverse impacts could be exacerbated by altered groundwater conditions (Rohde et al. 2019), as described in Section 3.8.3.

The upper reaches of the mainstem Santa Ana River and tributaries City Creek and Mill Creek are designated as critical habitat for the Santa Ana sucker (75 *Federal Register* [FR] 77962); however, sucker currently do not occupy these reaches because they are dry, except following significant rain events. These areas are essential sources of coarse sediment (gravel and cobble) that are transported to lower reaches of the Santa Ana River where sucker do occur. There are approximately 83.3 acres of critical habitat that would be affected by permanent impacts, and 20.2 acres that would be affected by temporary impacts, from Covered Activities. More importantly, however, are the effects of hydrologic change on sediment transport, as described below.

The effects of Covered Activities on sediment transport was evaluated in Section 4.4.2, which found that the total sediment transport would be reduced, but reductions in coarse sediment availability in the occupied reaches was not an imminent outcome of the effects of Covered Activities. However, over the long term (decades—but dependent on the frequency of large flood events capable of transporting coarse sediment) the reduced coarse sediment supply into occupied reaches would eventually result in a net reduction in coarse sediment availability. Therefore, long-term monitoring of sediment conditions in the occupied reaches should be implemented to assess if the availability of coarse sediment is diminishing and if sediment replenishment is necessary at the upper end of the occupied reach. The timeframe for this largely depends on the frequency of large flood events that occur in the future with the potential to transport coarse sediment. Long-term monitoring of sediment conditions in the Santa Ana River will be implemented as a part of this HCP to assess if the availability of coarse sediment available for Santa Ana sucker is diminishing. If so, management tools such as sediment replenishment may be necessary at the upper end of SAR USGS Reach 9. Adaptive management and monitoring in coordination with the implementation of the *Basin Sediment Management Plan* will work together to provide suitable substrate and a means to make it available in the occupied reaches of the river.

Avoidance and minimization measures will ensure that direct take of individual suckers and modeled habitat will be reduced to the greatest extent practicable. These measures include avoiding impacts on spawning suckers through seasonal limitations, a biological monitor during construction activities, and preliminary surveys for and relocation of suckers prior to water diversion or dewatering and are discussed in more detail in Chapter 5.

Approximately 1.5 acres of the mainstem Santa Ana River and 3.6 acres in tributary restoration sites would be restored and protected in the HCP Preserve System in perpetuity (Table 4-21). Conserved habitat will be monitored and managed to enhance habitat conditions for this species. While the suitable habitat in the mainstem of the Santa Ana River will be reduced as a result of implementation of Covered Activities, the restoration, enhancements, and translocation actions within the HCP Preserve System will offset these impacts and make major contributions to the recovery of the Santa Ana Sucker.

Table 4-21. Acres of Modeled Habitat Estimated to Be Impacted for Santa Ana Sucker

	Impacts		Mitigation		
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**Preservation (Acquisitions and Easements)**	**SAR Mainstem Enhancement (acres)**	**Tributary Restoration (acres of wetted area)**
Foraging Habitat					
Phase 1	1.3	--	--	1.5	1.7
Phase 2			--	--	1.9
Phase 3			--	--	--
Phase 4			--	--	--
Total			**--**	**--**	**3.6**

Arroyo Chub

The distribution of the arroyo chub in the Planning Area is defined via miles of occupied reaches, documented occurrences, and wetted area in reaches with suitable habitat downstream of Covered Activities. Refer to the arroyo chub species account in Section 3.8.3 for a description of mapped habitat in the Planning Area. The species' distribution in the Santa Ana River is from Prado Dam upstream past Riverside Avenue, to the RIX and Rialto outflows, where surveys for Santa Ana sucker have documented incidental occurrences (Western Riverside County MSHCP 2012). A number of tributary streams to the Santa Ana River are also occupied at times, dependent upon flow conditions and water quality, primarily in the Riverside area. There is also potential habitat in several reaches in the Planning Area, including Chino Creek, Anza Creek, and below Corona Lake in Temescal Canyon, downstream of the Terramor development (Russell pers. comm.) (Figure 3-40).

Potential Direct and Indirect Effects

This Arroyo chub is scarce in its native range because it does best in lower gradient streams, many of which have been channelized with urban expansion for water conveyance and supply purposes. Covered Activities that increase channelization or the prevalence of hardbank stabilization, or that divert flows from occupied or suitable reaches for the arroyo chub, could result in direct adverse effects on the species.

Indirect effects on arroyo chub from Covered Activities could include the introduction of nonnative plant species and nonnative predators, habitat fragmentation, and chemical spills. Vegetation clearing for construction and maintenance could introduce nonnative plant species such as tamarisk and giant reed. Covered Activities that introduce impassible in-stream barriers to upstream movement could increase habitat fragmentation. Adverse effects may result from road and facility maintenance with equipment such as trucks, mowers, or other mechanical equipment that can spill toxic substances (e.g., oil or gasoline) into arroyo chub habitat; however, BMPs would be implemented to reduce the potential for spills associated with maintenance activities. A SWPPP would be implemented during activities that would further reduce the potential for impacts on arroyo chub from ground disturbance near occupied reaches.

Impact Assessment

The impact assessment for the arroyo chub assumes a reduction in wetted area with a depth greater than 15 inches as a proxy for habitat where chub are most frequently found. The low flow dry season (August to October) is when this habitat is most limited; therefore, this impact assessment focuses on the effect during this period. During the dry season, these areas downstream of Covered Activities exist on the mainstem of the Santa Ana River and on Chino Creek. Existing habitat with depths greater than 15 inches cover approximately 3.7 acres, which would decrease to 1.3 acres with the full development of all Covered Activities. Given that the species has already experienced such extensive habitat loss throughout the Planning Area and region, any additional habitat loss could be assumed to have proportional impacts on the arroyo chub population in the Planning Area.

Avoidance and minimization measures will ensure that direct take of individual Arroyo chubs and modeled habitat will be reduced to the greatest extent practicable. These measures include seasonal limitations, a biological monitor during construction activities, and preliminary surveys for and relocation of chubs prior to water diversion or dewatering. Approximately 3.6 acres of arroyo chub habitat will be restored in tributary restoration sites (Table 4-22). Conserved habitat will be monitored and managed to enhance habitat conditions for this species and will be protected in the HCP Preserve System in perpetuity.

Table 4-22. Acres of Modeled Habitat Estimated to Be Impacted for Arroyo Chub

	Impacts		Mitigation	
Modeled Habitat Type	**Permanent Impact**	**Temporary Impacts**	**Preservation (Acquisitions and Easements)**	**Tributary Restoration (acres of wetted area)**
Habitat (wetted area, depths >15 inches)			**Restored Stream Habitat**	
Phase 1	2.4	--	--	1.7
Phase 2	--	--	--	1.9
Phase 3	--	--	--	--
Phase 4	--	--	--	--
Total	**2.4**		**--**	**3.6**

Santa Ana Speckled Dace

The distribution of the Santa Ana speckled dace in the Planning Area is defined via miles of occupied reaches, documented occurrences, and wetted area in occupied reaches downstream of Covered Activities. Refer to the Santa Ana speckled dace species account in Section 3.8.3 for a description of mapped habitat in the Planning Area. This species is expected to be present in Fredabla Creek, downstream of the Plunge Creek confluence, Hemlock Creek, the North Fork of Lytle Creek, and Waterman Creek. Potential habitat exists in Strawberry Creek, East Twin Creek, and possibly Horsethief Creek (Pisces 2014, Russell pers. comm.) (Figure 3-41).

Potential Direct and Indirect Effects

Most of the reaches occupied by Santa Ana speckled dace are upstream of where Covered Activities would occur. However, a limited amount of potential habitat occurs downstream of Covered Activities (East Twin Creek). The lower reaches of City and Plunge Creeks are occupied by dace and are downstream of existing pipelines. Direct effects on Santa Ana speckled dace could include the

potential for short-term habitat degradation during construction activities such as excavation and grading associated with pipeline maintenance and bank stabilization.

Indirect effects on Santa Ana speckled dace from Covered Activities could include the introduction of nonnative plant species and nonnative predators, habitat fragmentation, and chemical spills. Diversions that reduce in-stream flows available to the fish could further fragment populations, which are already isolated by dry washes throughout much of the year. Vegetation clearing for construction and maintenance could introduce nonnative plant species such as tamarisk and giant reed, which could further alter hydrology by eliminating breeding pools and crowding out native plants.

Adverse effects may result from road and facility maintenance with equipment such as trucks, mowers, or other mechanical equipment that can spill toxic substances (e.g., oil or gasoline) into Santa Ana speckled dace habitat; however, BMPs would be implemented to reduce the potential for spills associated with maintenance activities. A SWPPP would be implemented during vegetation and access road maintenance, which would further reduce the potential for impacts on Santa Ana speckled dace.

Impact Assessment

The majority of occupied and potentially suitable habitat for Santa Ana speckled dace in the Planning Area occurs upstream of Covered Activities. There is <0.1 acre of potentially suitable aquatic habitat (wetted area) downstream of Covered Activities (i.e., City Creek). The impact assessment for the Santa Ana speckled dace estimates that all of the wetted area downstream of Covered Activities would be lost (Table 4-23). Given the limited amount of estimated existing wetted area in this reach, the impacts on the dace population in the Planning Area would be very small; however, some potential habitat would be lost given that there is likely to be less surface flows available for the fish in this <0.1-acre area of the reach downstream of Covered Activities.

Avoidance and minimization measures will ensure that direct take of individual Santa Ana speckled dace is near zero. These measures include preliminary surveys for and relocation of individuals prior to water diversion or dewatering and are discussed in more detail in Chapter 5. Direct impacts on habitat are extremely limited. Additional conservation actions for Santa Ana speckled dace include an HCP funding contribution to the Santa Ana Speckled Dace Population Survey and Threats Analysis, which is designed to increase the understanding of the distribution of and threats to this species.

Table 4-23. Acres of Modeled Habitat Estimated to Be Impacted for Santa Ana Speckled Dace

	Impacts		
Modeled Habitat Type	**Permanent Impacts[1]**	**Temporary Impacts**	**Mitigation**
Suitable Habitat (wetted area)			**Funding and Relocation Actions**
Phase 1	--	--	There is no stream restoration specific to speckled dace habitat, however, contribution to the Santa Ana Speckled Dace Population Survey and Threats Analysis and the proposed relocation program will mitigate for impacts on this species.
Phase 2	--	--	
Phase 3	--	--	
Phase 4	0.1	--	
Total	**0.1**		

Mountain Yellow-Legged Frog

The distribution of the mountain yellow-legged frog in the Planning Area is defined by modeled potentially suitable aquatic habitat and refugia/foraging/dispersal habitat and documented occurrences. Refer to the mountain yellow-legged frog species account in Section 3.8.3 for a list of the parameters for this species' modelled habitat in the Planning Area. The species occurs in the San Gabriel and San Bernardino Mountains in the northern part of the Planning Area in the mountainous portions of Cucamonga Wash, Day Canyon Wash, Lytle Creek, City Creek, and East Fork Barton Creek (Figure 3-43) between 370 and 2,290 meters in elevation. Modeled habitat includes rocky and shaded streams as potentially suitable aquatic habitat (2,189 acres) and adjacent riparian vegetation as refugia/foraging/dispersal habitat (91,854 acres). Within the Planning Area, 2,216 acres of Final Critical Habitat have been designated in Day Canyon Wash, Lytle Creek, and East Fork Barton Creek. The only known current (post-2005) occurrences of mountain yellow-legged frog in the Planning Area are in the East Fork and mainstem of City Creek (Figure 3-43).

Potential Direct and Indirect Effects

Direct effects on mountain yellow-legged frog would include increased mortality due to vehicular traffic collisions during construction activities, such as excavation and grading associated with annual access road and pipeline alignment and bank stabilization and/or storm damage repair associated with road maintenance. Mortality of mountain yellow-legged frog would be unlikely because Covered Activities that include construction would primarily occur within modelled upland refugia/foraging/dispersal habitat and would not occur in potentially suitable aquatic habitat. Furthermore, the impacts on Refugia/Foraging/Dispersal Habitat are on Waterman and East Twin Creeks, primarily from existing groundwater recharge basins, and mountain yellow-legged frog have been extirpated from these creeks.

Indirect effects on mountain yellow-legged frog from Covered Activities include altered hydrology, the introduction of nonnative plant species and nonnative predators, habitat fragmentation, and chemical spills. Vegetation clearing for construction and maintenance could introduce nonnative plant species, such as tamarisk and giant reed, which could affect the natural hydrology of stream drainages by eliminating sandbars, breeding pools, and upland habitats, and would crowd out native plants and degrade habitat for riparian species, including mountain yellow-legged frog. These plant species are often spread by development, and any construction associated with Covered Activities could lead to their establishment in mountain yellow-legged frog habitat.

Habitat fragmentation resulting from road and pipeline maintenance that clears riparian vegetation could present barriers to movement and reduced connectivity of existing habitat patches, which would contribute to limiting dispersal potential and isolating populations. Changes in groundwater level could indirectly affect the species if falling groundwater reduced the amount of aquatic habitat or riparian habitat. Rising groundwater would not be expected to adversely affect mountain yellow-legged frogs.

Adverse effects may result from road maintenance. Equipment used to maintain vegetation along access roads and grading activities such as trucks, mowers, or other mechanical equipment could lead to spills of toxic substances (e.g., oil or gasoline) into mountain yellow-legged frog habitat; however, BMPs would be implemented to reduce the potential for spills associated with road maintenance activities, and to minimize potential for mountain yellow-legged frog to enter and be harmed in construction sites. A SWPPP would be implemented during vegetation and access road maintenance, which would further reduce the potential for impacts on mountain yellow-legged frog.

Impact Assessment

The impact assessment of the mountain yellow-legged frog estimates the permanent loss of 3.9 acres of potentially suitable aquatic habitat and 108.1 acres of refugia/foraging/dispersal habitat loss within the Planning Area (Table 4-14). Areas of permanent habitat loss would occur primarily where the Permittees construct groundwater recharge facilities (3.4 and 95.1 acres of potentially suitable aquatic and refugia/foraging/dispersal habitat, respectively [Table 4-15]). These impacts are on Waterman and East Twin Creeks, primarily from existing groundwater recharge basins, and mountain yellow-legged frog are extirpated from these creeks.

Temporary loss of 15.3 acres of refugia/foraging/dispersal habitat (Table 4-14) would occur as a result of short-term disturbance associated primarily with wells and water conveyance infrastructure (13.8 acres) (Table 4-15). The majority of the temporary impacts are also in drainages where the species no longer occurs.

The amount of mountain yellow-legged frog habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. Covered Activities would not impact designated critical habitat or occur in areas with documented current (post-2005) occurrences in the Planning Area.

Mountain yellow-legged frog inhabits GDEs and has a direct reliance on surface water that may be supported by groundwater; therefore, any adverse impacts could be exacerbated by altered groundwater conditions, as described in Section 3.8.3 (Rohde et al. 2019). Only 0.2 acre of modeled wetted area in Cajon and Waterman Creeks would be lost within reaches downstream of Covered Activities with modeled mountain yellow-legged frog habitat. Neither creek has recent occurrences or designated critical habitat. Some of the modeled habitat for mountain yellow-legged frog on Cajon Wash and Waterman Creek occurs in areas of rising groundwater (see Figure 4-7); however, this is not expected to adversely impact the species. Therefore, it is unlikely any hydrologic change resulting from Covered Activities would impact the mountain yellow-legged frog habitat. For these reasons, Covered Activities are not anticipated to result in any adverse effects on mountain yellow-legged frog populations or the species' designated critical habitat within the Planning Area.

Avoidance and minimization measures will ensure that direct take of individual mountain yellow-legged frogs is near zero. These measures include minimization of project footprints in areas of suitable habitat to the greatest extent practical, ensuring that construction activities do not extend beyond the limits of construction, and implementation of disease prevention protocols developed by USFWS. The majority of impacts on modeled habitat would occur in refugia, foraging, and dispersal habitat, with limited impacts occurring in aquatic habitat. Approximately 263.6 acres, including 15.7 acres of aquatic habitat, will be conserved in the HCP Preserve System in perpetuity (Table 4-24). Conserved habitat will be monitored and managed to enhance habitat conditions for this species. Population stability and distribution will be improved through HCP contributions to the mountain yellow-legged frog translocation program.

Table 4-24. Acres of Modeled Habitat Estimated to Be Impacted for Mountain Yellow-Legged Frog

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Aquatic Habitat			
Phase 1	2.2	0.1	--
Phase 2	1.7	0.0	15.7
Phase 3	0.0	0.0	--
Phase 4	0.0	0.2	--
Total	*3.9*	*0.3*	*15.7*
Refugia/Foraging/Dispersal Habitat			
Phase 1	16.4	13.8	3.2
Phase 2	92.1	0.0	244.7
Phase 3	0.3	0.0	--
Phase 4	0.0	1.5	--
Total[1]	*108.8*[1]	*15.3*[1]	*247.9*
Total Modeled Habitat	**112.7**	**15.7**	**263.6**

[1] Impacts on Refugia/Foraging/Dispersal Habitat are on Waterman and East Twin Creeks, primarily from existing groundwater recharge basins. Mountain yellow-legged frog have been extirpated from these creeks.

Western Spadefoot

The distribution of the western spadefoot in the Planning Area is defined by potentially suitable habitat and documented occurrences. Refer to the western spadefoot species account in Section 3.8.3 for a list of the parameters for this species' modelled habitat in the Planning Area. Within the Planning Area, the western spadefoot is known from flood and playa plains and human-made basins within the drainages of Cajon Wash, Lytle Creek, Santa Ana River, Mill Creek, and Temescal Creek (Figure 3-44). While the species can breed in slow-moving waters of rivers and streams, there are no known occurrences in the modeled habitat on the mainstem of the Santa Ana River west of Highland Avenue. There are 38,252 acres of potentially suitable habitat in the Planning Area. However, because the spadefoot can use temporary rain pools in which to breed, predicting where its breeding habitat occurs is difficult, and subject to very site-specific and ephemeral conditions. Current (post-2005) occurrences of western spadefoot are scattered throughout the Planning Area along with modeled habitat; the highest densities of current occurrences are on the upper reaches of the Santa Ana River and Mill Creek (a tributary to the Santa Ana River) north and east of Mentone (Figure 3-44).

Potential Direct and Indirect Effects

Direct effects on western spadefoot would include mortality due to vehicular traffic collisions and earth-moving activities during construction that disturb subterranean refugia. Direct effects on western spadefoot would also result from habitat destruction and degradation associated with

construction. The loss of vernal pools and the alteration of existing artificial impoundments and pooled areas of ephemeral streams would adversely affect suitable breeding habitat.

Indirect effects on western spadefoot from Covered Activities include the introduction of nonnative plant species and nonnative predators, altered surface water flows, habitat fragmentation, and chemical spills. Vegetation clearing for construction and maintenance could introduce nonnative plant species, such as tamarisk and giant reed, which could reduce the persistence of sandbars and breeding pools, crowd out native plants, and degrade native habitat for western spadefoot.

Changes in groundwater level could indirectly affect the western spadefoots if falling groundwater reduced the amount of aquatic habitat or riparian habitat. Rising groundwater would not be expected to adversely affect the species.

Edge effects could lead to the introduction of predators such as bullfrogs and mosquitofish that prey on western spadefoot tadpoles. Recharge projects could result in the creation of deeper, persistent ponds, which could provide suitable habitat for these predatory species; if these ponds are created or enlarged adjacent to potentially suitable habitat, western spadefoot could experience adverse effects. Habitat fragmentation resulting from Covered Activities could present barriers to movement and reduce connectivity between aquatic and upland areas with subterranean refugia.

Adverse effects may result from road maintenance. Equipment used to maintain vegetation along access roads and grading activities such as trucks, mowers, or other mechanical equipment could lead to spills of toxic substances (e.g., oil or gasoline) into western spadefoot habitat; however, BMPs would be implemented to reduce the potential for spills associated with the proposed project. A SWPPP would be implemented during vegetation and access road maintenance, which would further reduce the potential for impacts on western spadefoot.

Impact Assessment

The impact assessment of the western spadefoot estimates the permanent loss of 612.1 acres of potentially suitable habitat within the Planning Area (Table 4-14). Areas of permanent habitat loss would occur primarily where the Permittees construct permanent structures, such as groundwater recharge facilities (446.8 acres) and wells and water conveyance infrastructure (146.8 acres) (Table 4-15). Temporary habitat loss of 110.7 acres (Table 4-14) of potentially suitable habitat would occur primarily as a result of short-term disturbance associated with the construction of water conveyance infrastructure (95.1 acres) (Table 4-15).

Western spadefoot habitat on Cajon Wash and Waterman Creek occurs in areas of rising groundwater (see Figure 4-7); however, this is not expected to adversely impact the species. There are very little to no expected changes in groundwater in the occupied habitat east of Highland Avenue. There are large areas of rising and falling groundwater on the middle to lower reaches of the Santa Ana River in the Planning Area, where a substantial amount of western spadefoot habitat is predicted; however, there are no known occurrences in these sections of the river. According to the analysis, 6.5 acres of modeled wetted area in western spadefoot habitat would be lost with reaches downstream of Covered Activities.

Western spadefoot is a widely distributed species outside the Planning Area; its range includes the Central Valley (Redding south through the Great Valley and its foothills) through the South Coast Ranges into Southern California south of the Transverse Range and west of the Peninsular Mountains into northwest Baja California (California Herps 2014). The amount of western spadefoot

habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. Covered Activities are estimated to coincide with 2 out of 63 of the documented current (post-2005) occurrences in the Planning Area. Impacts on these occurrences would result from wells and water conveyance infrastructure maintenance, specifically periodic maintenance such as weed control, road and pipeline maintenance, and facility repairs. These activities are more intermittent in nature than construction of a new recharge basin or diversion structure; therefore, the potential for population-level impacts is lower than if permanent structures were being constructed over documented occurrences. Implementation of avoidance and minimization measures to limit direct and indirect adverse effects will be important to minimize the potential for population-level adverse impacts on the species in the Planning Area.

Avoidance and minimization measures will ensure that direct take of individual western spadefoots is substantially lower than the estimated impact on modeled habitat. These measures include implementation of disease prevention protocols developed by USFWS, reduced speeds to prevent mortality from construction traffic, limited construction or maintenance activities within or adjacent to breeding pools to dry periods, and implementation of construction site BMPs to minimize potential for spadefoots to enter and be harmed in construction sites. Approximately 986.6 acres of modeled habitat for this species will be conserved in the HCP Preserve System in perpetuity (Table 4-25). Conserved habitat will be monitored and managed to enhance habitat conditions for this species.

Table 4-25. Acres of Modeled Habitat Estimated to Be Impacted for Western Spadefoot

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	198.7	61.5	921.6
Phase 2	241.6	46.4	65.0
Phase 3	74.0	0.2	--
Phase 4	97.8	2.6	--
Total Modeled Habitat	**612.1**	**110.7**	**986.6**

California Glossy Snake

The distribution of the California glossy snake in the Planning Area is defined by potentially suitable habitat and documented occurrences. Refer to the California glossy snake species account in Section 3.8.3 for a list of the parameters for this species' modelled habitat in the Planning Area. The California glossy snake is known from grassland, chaparral, and coastal sage scrub communities in cismontane locales throughout the Planning Area (Figure 3-45). There are 146,338 acres of potentially suitable habitat in the Planning Area. Current (post-2005) occurrences of California glossy snake are scattered throughout the Planning Area, along with modeled habitat; the highest density of current occurrences are in the Santa Ana River and Cajon Wash (Figure 3-45).

Potential Direct and Indirect Effects

Direct effects on California glossy snake would include increased mortality due to vehicular traffic collisions and habitat destruction, and degradation associated with construction, especially in shrub and grassland communities where the snake is known to occur.

Indirect effects on California glossy snake from Covered Activities include the introduction of nonnative plant species that degrade habitat quality. The increase in nonnative annual grasses can increase fire frequency and intensity, degrading and removing California glossy snake habitat (Thompson et al. 2016).

Impact Assessment

The impact assessment of the California glossy snake estimates the permanent loss of 718.4 acres of potentially suitable habitat within the Planning Area (Table 4-14). Areas of permanent habitat loss would primarily occur where the Permittees construct permanent structures such as groundwater recharge facilities (471.6 acres) and wells and water conveyance infrastructure (210.9 acres) (Table 4-15). Temporary habitat loss of 178.6 acres (Table 4-14) of potentially suitable habitat would occur primarily as a result of short-term disturbance associated with the construction of well and water conveyance infrastructure (157.7 acres) (Table 4-15).

The amount of California glossy snake modeled habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. Covered Activities are estimated to coincide with 2 out of 14 of the documented current (post-2005) occurrences in the Planning Area. Impacts on these occurrences would result from general property and facilities maintenance, specifically periodic maintenance, such as weed control, road and pipeline maintenance, and facility repairs. These activities are more intermittent in nature than construction of a new recharge basin or diversion structure; therefore, the potential for population-level impacts is lower than if permanent structures were being constructed over documented occurrences.

California glossy snake is a widely distributed species outside the Planning Area; its range includes the eastern portion of the San Francisco Bay Area south through the Central Valley to northwestern Baja California and east into the Mojave and Sonoran Deserts (California Herps 2014). Implementation of avoidance and minimization measures to limit direct and indirect adverse effects will be important to minimize the potential for population-level adverse impacts on the species in the Planning Area.

Approximately 1,208.8 acres of modeled habitat will be conserved in the HCP Preserve System in perpetuity (Table 4-26). Suitable habitat will be monitored and managed to enhance habitat conditions for the California glossy snake. Avoidance and minimization measures will ensure that direct take of individual California glossy snake is substantially lower than the estimated impact on modeled habitat. These measures include minimizing project footprints in areas of suitable habitat to the greatest extent practical, ensuring that construction activities do not extend beyond the limits of construction, avoiding use of pesticides and rodenticides, and implementing construction site BMPs to minimize potential for glossy snake to enter and be harmed in construction sites.

Table 4-26. Acres of Modeled Habitat Estimated to Be Impacted for California Glossy Snake

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	246.2	116.4	1,030.7
Phase 2	169.3	59.5	178.1
Phase 3	159.3	0.5	--
Phase 4	143.6	2.1	--
Total Modeled Habitat	**718.4**	**178.6**	**1,208.8**

South Coast Garter Snake

The distribution of the south coast garter snake in the Planning Area is defined by potentially suitable habitat and documented occurrences. Refer to the south coast garter snake species account in Section 3.8.3 for a list of the parameters for this species' modelled habitat in the Planning Area. The south coast garter snake is known from permanent stream sections in central and southwestern parts of the Planning Area including the Santa Ana River, Prado Reservoir, San Timoteo Creek, and Temescal Wash (Figure 3-46). There are 7,703 acres of potentially suitable habitat and five known current (post-2005) documented occurrences of south coast garter snake in the Planning Area. The documented occurrences are near the mainstem of the Santa Ana River and in the vicinity of the Prado Wetlands (Figure 3-46).

Potential Direct and Indirect Effects

Direct effects on south coast garter snake would include increased mortality due to vehicular traffic collisions and habitat destruction and degradation associated with construction, especially in stream and riparian vegetation communities where the snake is known to occur.

Indirect effects on the south coast garter snake from Covered Activities include altered hydrology, the introduction of nonnative plant species and nonnative predators, habitat fragmentation, and chemical spills. Covered Activities such as the construction of diversion and recharge basins could lead to altered hydrology, which could result in changes in the timing, amount, and duration of channel flows; a temporal or spatial extent reduction in wetted acres could reduce prey abundance and foraging opportunities for the south coast garter snake.

Vegetation clearing for construction and maintenance could introduce nonnative plant species, such as tamarisk and giant reed, which could also contribute to the degradation of natural hydrology by eliminating sandbars, pools, and upland habitats. These invasive species can also crowd out and replace native plant species, degrading the native habitat for stream and riparian species, including the south coast garter snake. These plant species are often spread by development, and any construction associated with Covered Activities could lead to their establishment in south coast garter snake habitat. Any Covered Activities that result in the creation of ponds can also lead to the introduction of habitat that is more suitable for nonnative aquatic predators (e.g., bullfrogs and African clawed frogs) which prey on young south coast garter snakes. Habitat fragmentation resulting from Covered Activities could further reduce habitat quality by presenting barriers to

movement and reduced connectivity of existing habitat patches, which would limit dispersal potential and genetically isolate populations.

Impact Assessment

The impact assessment of the south coast garter snake estimates the permanent loss of 14.6 acres of potentially suitable habitat within the Planning Area (Table 4-14), all of which would occur where the activities involve wells and water conveyance infrastructure (Table 4-15). Temporary habitat loss of 6.7 acres would also occur where well and water conveyance infrastructure is involved. Covered Activities are estimated to affect potentially suitable habitat but none of the documented current (post-2005) occurrences in the Planning Area. The amount of south coast garter snake potentially suitable habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. There are 189.9 acres of wetted area downstream of Covered Activities in reaches with modeled potentially suitable south coast garter snake habitat. The effect of hydrologic changes resulting from Covered Activities is estimated to reduce this wetted area by 19.5 acres.

The two main areas of falling groundwater within south coast garter snake habitat are on the riparian and wetland communities of the Santa Ana River in the reach from the Main Street crossing to the railroad crossing at the confluence with Sunnyslope Channel, and the reach from I-15 downstream to Prado Dam. South coast garter snake habitat with rising groundwater occurs on the Santa Ana River between the railroad crossing and I-15, and in the vicinity of the lower tributaries of Chino and Cucamonga (see Figure 4-7). Rising groundwater is not expected to have a detrimental effect on south coast garter snake. However, falling groundwater can cause a reduction in the amount of wetland and riparian habitat suitable for the snake. South coast garter snake inhabits GDEs and has a direct reliance on groundwater-supported wetlands; therefore, any adverse impacts could be exacerbated by altered groundwater conditions, as described in Section 3.8.3 (Rohde et al. 2019). The majority of garter snake habitat is in areas of falling groundwater. Table 4-27 quantifies the acreages of wetland and riparian habitat potentially impacted by falling groundwater and that would indirectly impact garter snake habitat quality.

Overall, impacts on the south coast garter snake population from ground-disturbing effects and hydrologic changes would be limited. However, the areas of falling groundwater may have a more substantial effect on the population. It will be important to conduct regular groundwater monitoring in conjunction with garter snake habitat condition monitoring to adaptively manage the effects of Covered Activities on this species.

Approximately 193.1 acres of modeled South Coast garter snake habitat (including restoration of 3.5 miles of aquatic stream habitat) will be conserved within the HCP Preserve System in perpetuity (Table 4-27). Conserved habitat will be monitored and managed to enhance habitat conditions for this species. Avoidance and minimization measures will ensure that direct take of individual south coast garter snake is substantially lower than the estimated impact on modeled habitat. These measures include minimizing project footprints in areas of suitable habitat to the greatest extent practical, ensuring that construction activities do not extend beyond the limits of construction, avoiding use of pesticides and rodenticides, and implementing construction site BMPs to minimize potential for garter snakes to enter and be harmed in construction sites.

Table 4-27. Acres of Modeled Habitat Estimated to Be Impacted for South Coast Garter Snake

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	14.5	5.6	93.5
Phase 2	0.1	1.1	99.4
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total Modeled Habitat	**14.6**	**6.7**	**193.1**

Southwestern Pond Turtle

The distribution of southwestern pond turtle in the Planning Area is defined by modeled aquatic habitat and potentially suitable upland habitat, and documented occurrences. Refer to the southwestern pond turtle species account in Section 3.8.3 for a list of the parameters for this species' modeled habitat in the Planning Area. The southwestern pond turtle is known from pond, lake, marsh, and river habitat in the Jurupa and Chino Valley portions of the Santa Ana River, San Timoteo Creek near El Casco, Walker Creek in Warm Springs Valley, Temescal Wash in Temescal Valley, and Aliso Creek upstream from the Green River Golf Club (Figure 3-47). There are 1,245 acres of aquatic habitat, 14,944 acres of potentially suitable upland habitat, and 98 known, current (post-2005) occurrences of southwestern pond turtle in the Planning Area (Figure 3-47).

Potential Direct and Indirect Effects

Direct effects on southwestern pond turtle would include increased mortality due to vehicular traffic collisions during construction activities especially when turtles migrate through uplands to nest, aestivate, or overwinter. Direct effects would also result from habitat destruction and alteration. Covered Activities involving the construction of new facilities and the maintenance and enhancement of existing structures have the potential to alter slow moving water features and adjacent upland habitat on which southwestern pond turtle depend.

Indirect effects on southwestern pond turtle from Covered Activities include the introduction of native and nonnative predators, altered hydrology, barriers to movement, and chemical spills. Edge effects associated with construction activities could result in the introduction of native predators such as raccoons and other mammals that destroy turtle nests and eat neonates, and bullfrogs and largemouth bass that prey on neonates and yearling turtles.

The construction of dams and artificial structures could lead to altered hydrology, which could result in changes in the timing, amount, and duration of channel flows. The loss of coarse sediments in channels could result in an increase in vegetation density due to the decrease or elimination of scouring flows. The increased sedimentation and scour may reduce sandy terraces and potential basking habitat preferred by southwestern pond turtle. Increased sedimentation may also alter riparian vegetation, which could make it more difficult for turtles to find suitable nesting habitat outside of the riparian corridor. Bank erosion could also make it difficult to exit the stream habitat

for nesting or make them more susceptible to traffic collisions if they have to exit farther from suitable nesting habitat.

The construction of new roads could present barriers to movement between aquatic and upland habitats. Adverse effects may also result from road maintenance. Equipment used to maintain vegetation along access roads and grading activities such as trucks, mowers, or other mechanical equipment could lead to spills of toxic substances (e.g., oil or gasoline) into southwestern pond turtle habitat; however, BMPs would be implemented to reduce the potential for spills associated with road maintenance, and construction site BMPs would minimize potential for pond turtles to enter and be harmed in construction sites. A SWPPP would be implemented during vegetation and access road maintenance, which would further reduce the potential for impacts on southwestern pond turtle.

Impact Assessment

The impact assessment of the southwestern pond turtle estimates the permanent loss of 0.9 acre of aquatic habitat and 18.4 acres of potentially suitable upland habitat within the Planning Area (Table 4-14). Areas of permanent habitat loss would primarily occur where the Permittees construct permanent structures to implement wells and water conveyance infrastructure (18.4 acres) (Table 4-15). Temporary habitat loss of 0.8 acre of aquatic habitat and 14.1 acres of potentially suitable upland habitat would occur primarily as a result of short-term disturbance associated with construction of wells and water conveyance infrastructure (14.1 acres) (Table 4-15). These activities would result in reduction of habitat quality and loss of available potential habitat for southwestern pond turtle.

Covered Activities are not estimated to affect any of the documented current (post-2005) occurrences in the Planning Area. The amount of southwestern pond turtle habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. There are 188.7 acres of wetted area downstream of Covered Activities in reaches with modeled southwestern pond turtle habitat. The effect of hydrologic changes resulting from Covered Activities is estimated to reduce this wetted area by 17.8 acres.

The two main areas of falling groundwater within southwestern pond turtle habitat are on the riparian and wetland communities of the Santa Ana River in the reach from the Main Street crossing to the railroad crossing at the confluence with Sunnyslope Channel and the reach from I-15 downstream to Prado Dam. Southwestern pond turtle habitat with rising groundwater occurs on the Santa Ana River between the railroad crossing and I-15, and in the vicinity of the lower tributaries of Chino and Cucamonga (see Figure 4-7). Rising groundwater is not expected to have a detrimental effect on southwestern pond turtle. However, falling groundwater can cause a reduction in the amount of wetland and riparian habitat suitable for southwestern pond turtle. The majority of southwestern pond turtle habitat is in areas of falling groundwater. Table 4-8 quantifies the acreages of wetland and riparian habitat potentially impacted by falling groundwater and that would indirectly impact southwestern pond turtle habitat quality. Southwestern pond turtle inhabits GDEs and has a direct reliance on groundwater; therefore, these adverse impacts could be exacerbated by altered groundwater conditions as described in Section 3.8.3 (Rohde et al. 2019).

Overall, impacts on the southwestern pond turtle population from ground-disturbing effects and hydrologic changes would be limited. However, the areas of falling groundwater may have a more substantial effect on the population. It will be important to conduct regular groundwater monitoring

in conjunction with southwestern pond turtle habitat condition monitoring to adaptively manage the effects of Covered Activities on this species.

Approximately 28.8 acres of modeled aquatic habitat (including restoration of 3.5 miles of aquatic stream habitat) and 315.3 acres of modeled upland habitat will be conserved within the HCP Preserve System in perpetuity (Table 4-28). Conserved habitat will be monitored and managed to enhance habitat conditions for this species. Avoidance and minimization measures will ensure that direct take of individual southwestern pond turtle is substantially lower than the estimated impact on modeled habitat. These measures include minimizing project footprints in areas of suitable habitat to the greatest extent practical, ensuring that construction activities do not extend beyond the limits of construction, enforcing reduced speeds within construction areas, and implementing construction site BMPs to minimize potential for pond turtle to enter and be harmed in construction sites.

Table 4-28. Acres of Modeled Habitat Estimated to Be Impacted for Southwestern Pond Turtle

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Aquatic Habitat			
Phase 1	0.9	0.8	11.3
Phase 2	0.0	0.0	17.5
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.9*	*0.8*	*28.8*
Potentially Suitable Upland Habitat			
Phase 1	18.1	11.0	175.7
Phase 2	0.3	3.1	139.6
Phase 3	0.0	0.0	--
Phase 4	0.0	0.1	--
Total	*18.4*	*14.1*	*315.3*
Total Modeled Habitat	**19.3**	**14.9**	**344.1**

Tricolored Blackbird

The distribution of tricolored blackbird in the Planning Area is defined by modeled occupied colony habitat, suitable colony habitat, breeding season foraging—natural, breeding season foraging – agriculture, non-breeding season foraging – natural, non-breeding season foraging – agriculture, and documented occurrences. See the tricolored blackbird species account in Section 3.8.3 for a list of the parameters for this species' modelled habitat in the Planning Area. Most documented occurrences for the species occur in Chino Valley near the Chino Airport and along the San Timoteo Canyon. Occupied colony habitat (10 acres) occurs along San Timoteo Canyon and Chino Valley. Suitable colony habitat (1,868 acres) primarily occurs at the southern end of Chino Valley, a basin near Jurupa Street in Ontario, and along the Santa Ana River (Figure 3-48).

Potential Direct and Indirect Effects

Direct effects on tricolored blackbird resulting from Covered Activities include habitat loss and disturbance from human activity. Construction activities that include grading, excavating, soil stockpiling, or other earth-disturbing activities could alter tricolored blackbird habitat by permanently removing foraging areas in grassland and open fields (Beedy and Hamilton 1997, 1999; Shuford and Gardali 2008). Water diversions and recharge basins could result in draining of wetlands or removal of wetland vegetation that support appropriate nesting substrate, including cattails, bulrushes, willows, and forbs, which would remove potential breeding and nesting habitat for tricolored blackbird (Beedy and Hamilton 1999, UC Davis 2014).

Indirect effects on tricolored blackbird from Covered Activities include the introduction of nonnative plant species and habitat fragmentation. Vegetation clearing for road and pipeline construction and maintenance can increase the spread of nonnative species. The establishment of nonnative species alters wetland vegetation communities and could reduce the suitability of blackbird habitat by outcompeting more suitable native plants that are used as nesting substrate. Nests that are located on the edges of the vegetation clearings could be more susceptible to brood parasitism from brown-headed cowbirds as well as nest predation by herons, common ravens, and coyotes. Covered Activities could also further fragment already isolated patches of suitable breeding habitat for blackbird that have been adversely affected throughout their range by anthropogenic disturbance.

The routine maintenance of basins supporting tricolored blackbird nesting habitat can, however, also create optimal nesting habitat for the tricolored blackbirds, who prefer young, dense stands of cattail and bulrush (Meese and Beedy 2015). Avoidance and minimization measures in Section 5.11 identify vegetation management methods that will improve nesting habitat for tricolored blackbirds.

Impact Assessment

The impact assessment of the tricolored blackbird estimates the permanent loss 52.3 acres of suitable colony habitat, 158.2 acres of breeding season foraging – natural, 67.0 acres of breeding season foraging – agricultural, 0.4 acre of non-breeding season foraging – natural, and 0.1 acre of non-breeding season foraging – agriculture within the Planning Area (Table 4-14). There are no permanent or temporary impacts on occupied colony habitat. Areas of permanent habitat loss would occur where the Permittees construct permanent structures such as groundwater recharge facilities, water reuse projects, and wells and water conveyance infrastructure, and where Permittees conduct regular and frequent weed abatement. Temporary impacts will occur on 1.4 acres of suitable colony habitat, and 43.7 acres of breeding season foraging – natural, 101.1 acres of breeding season foraging – agriculture, 0.4 acre of non-breeding season foraging – natural, and 0.9 acre of non-breeding season foraging – agriculture as a result of short-term disturbance associated primarily with wells and water conveyance infrastructure (Table 4-14). These activities would result in reduction of habitat quality and temporary loss of available potential habitat for tricolored blackbird.

The amount of tricolored blackbird habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. The Wineville Basin project (IEUA.1.01) coincides with a previously active colony. Table 4-29 summarizes observations of tricolored blackbird colonies at this location. The last occupancy record for the site is in 2014; however, it was not occupied during the 2017 statewide survey. This basin is called the Jurupa

Street colony by the Tricolored Blackbird Portal. The tricolored blackbird is the most highly colonial of all North American passerine birds; these birds nest in large densely populated colonies with nests very close together. This nesting behavior makes the species more vulnerable if there are impacts at an active colony. Any impacts on tricolored blackbird colonies from Covered Activities could result in reduced reproductive success and contribute to population declines (CDFW 2015). However, given the lack of recent occupancy at the Jurupa Street location, it is presumed extirpated due to conversion of all nearby foraging habitat to urban and industrial uses (Meese pers. comm.) and no impact is expected from the Covered Activities. Basin maintenance will be scheduled outside of the breeding season to avoid direct impacts on the species.

Table 4-29. Jurupa Street Tricolored Blackbird Colony Location: Observation Records

Date	Number of Birds	Observation Source
April 7, 2017	0	Statewide Survey, 2017 (unpublished)
April 9, 2016	0	Personal Observation
April 26, 2014	10	Statewide Survey, 2014 (unpublished)
April 16, 2011	0	Statewide Survey, 2011 (unpublished)
June 8, 1999	50	Personal Observation
April 25, 1999	1,000	Statewide Survey, 1999 (unpublished)
April 26, 1997	300	Statewide Survey, 1997 (unpublished)
May 20 1995	500	Personal Observation

Source: UC-Davis 2019. Tricolored Blackbird Portal (https://tricolor.ice.ucdavis.edu/)

There are two areas of falling groundwater within tricolored blackbird suitable colony habitat on the riparian and wetland communities of the Santa Ana River, in the reach from the Main Street crossing to the railroad crossing at the confluence with Sunnyslope Channel and the reach from I-15 downstream to Prado Dam. Blackbird habitat with rising groundwater occurs on the Santa Ana River between the railroad crossing and I-15 and in the vicinity of the lower tributaries of Chino and Cucamonga (see Figure 4-7). Rising groundwater is not expected to have a detrimental effect on blackbird colony habitat suitability, as long as the water is not so deep that it precludes the establishment of emergent vegetation such as cattails (see Table 4-9). However, falling groundwater can cause a reduction in the amount of wetland and riparian habitat suitable for tricolor blackbird colonies. Table 4-30 quantifies the acreages of wetland and riparian habitat potentially impacted by falling groundwater and that could indirectly impact tricolored blackbird colony habitat quality.

Avoidance and minimization measures will ensure that direct take of individual tricolored blackbirds is substantially lower than the estimated impact on modeled habitat, and is near zero. Avoidance and minimization measures will also ensure that no occupied tri-colored blackbird colonies are disturbed. These measures include seasonal limitations within suitable habitat where feasible, pre-Covered Activity surveys within suitable colony habitat, and disturbance buffers of occupied colony habitat. Approximately 85.6 acres of suitable colony habitat and 157.0 of foraging habitat will be conserved in the HCP Preserve System in perpetuity. Additionally, approximately 137.4 acres of breeding habitat and 14.7 acres of natural foraging habitat will be restored within the HCP Preserve System. The Restoration Areas will include the restoration of approximately 130.8 acres of breeding habitat and 13.9 acres of natural foraging habitat that is not currently included in the modeled habitat for the species (Table 4-30). Conserved and restored habitats will be monitored and managed to enhance habitat conditions for this species.

Table 4-30. Acres of Modeled Habitat Estimated to Be Impacted for Tricolored Blackbird

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Suitable Colony Habitat			
Phase 1	24.0	0.8	63.6
Phase 2	28.3	0.5	22.0
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*52.3*	*1.4*	*85.6*
Breeding Season Foraging – Natural			
Phase 1	87.9	18.7	78.7
Phase 2	69.8	24.6	23.0
Phase 3	0.1	0.2	--
Phase 4	0.5	0.3	--
Total	*158.2*	*43.7*	*101.7*
Breeding Season Foraging – Agriculture			
Phase 1	43.5	15.5	55.3
Phase 2	23.5	75.1	--
Phase 3	0.0	0.6	--
Phase 4	0.0	0.0	--
Total	*67.0*	*101.1*	*55.3*
Non-Breeding Season Foraging – Natural			
Phase 1	0.4	0.4	--
Phase 2	0.0	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.4*	*0.4*	--
Non-Breeding Season Foraging – Agriculture			
Phase 1	0.0	0.2	--
Phase 2	0.1	0.6	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.1*	*0.9*	--
Total Modeled Habitat	**278.0**	**147.6**	**242.6**
New Colony Habitat Created through Restoration			**130.8**

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
New Foraging Habitat Created through Restoration			**13.9**
Total Habitat in the HCP Preserve System			**387.3**

Burrowing Owl

The distribution of burrowing owl in the Planning Area is defined by modeled potentially suitable habitat and documented occurrences. Refer to the burrowing owl species account in Section 3.8.3 for a list of the parameters for this species' modeled habitat in the Planning Area. Most documented occurrences for the species occur in the Chino Valley area scattered throughout the dairy farms in east Chino and in the business parks along I-15 and I-10. Potentially suitable habitat (141,791 acres) occurs throughout the Planning Area south of the San Bernardino Mountain foothills, clustered around areas in the Temescal Valley north and east of Lake Matthews, the Santa Ana River Basin east of the San Bernardino International Airport, along the Cajon and Lytle Creek washes, north of Los Osos High School, and in the low elevation area east of Highgrove in the valley between the Box Spring Mountains (Figure 3-49).

Potential Direct and Indirect Effects

Direct effects on burrowing owl resulting from Covered Activities include habitat loss and disturbance from human activity. Construction activities that include grading, excavating, soil stockpiling, or other earth-disturbing activities could alter burrowing owl habitat by permanently removing unoccupied burrows and grassland and shrubland habitat preferred by burrowing owl (Gervais et al. 2008, Klute et al. 2003). However, burrowing owl shows tolerance towards human disturbances, and Covered Activities that temporarily disturb soils may indirectly benefit burrowing owls by making soils more friable and easier for burrowing mammals to construct burrows, which can then be used by burrowing owls. Covered Activities that result in more compacted soils would have adverse effects on burrowing owl (SDSU 2013).

Indirect effects on burrowing owls from Covered Activities include the introduction of nonnative plant species and the eradication of burrowing rodents, such as California ground squirrels, that would result in loss of burrows. Edge effects may result from nearby human activities such as noise, motion, and night lighting; the introduction of nonnative species; and increased predation. These activities could lead to increased disruption of life-history requirements, decreased reproductive success, and increased avoidance by individuals or groups of burrowing owls (Gervais et al. 2008). Vegetation clearing for road and pipeline construction and maintenance can increase the spread of nonnative species, including nonnative annual grasses. The establishment of nonnative species alters vegetation composition and structure and can affect burrowing owl prey base and foraging ability (Gervais et al. 2008).

Impact Assessment

The impact assessment of the burrowing owl estimates the permanent loss of 632.8 acres of potentially suitable habitat within the Planning Area (Table 4-14). Areas of permanent habitat loss would occur where Permittees implement wells and water conveyance infrastructure (275.9 acres) and where the Permittees construct permanent structures such as groundwater recharge facilities

(313.5 acres) (Table 4-15). Temporary habitat loss of 243.7 acres of potentially suitable habitat (Table 4-14) would occur as a result of short-term disturbance associated primarily with wells and water conveyance infrastructure (226.2 acres) (Table 4-15). These activities would result in reduction of habitat quality and temporary loss of available potential habitat for burrowing owl. Covered Activities are estimated to affect 1 out of 182 of the documented current (post-2005) occurrences in the Planning Area. The amount of burrowing owl habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. Avoidance and minimization measures would be implemented to avoid destruction of occupied burrowing owl nests. Given the limited amount of potential habitat estimated to be impacted and avoidance of direct mortality, impacts on the population of burrowing owls in the Planning Area would be small.

Avoidance and mitigation measures will reduce take of individual burrowing owls and modeled habitat, including limiting disturbance at occupied burrows, to the greatest extent practicable and avoiding use of rodenticides during both construction and operations and maintenance of Covered Activities. These measures include seasonal limitations, pre-Covered Activity surveys, and translocation of burrowing owls in areas where impacts cannot be avoided. Implementation of construction site BMPs to minimize potential for burrowing owl to enter and be harmed in construction sites will also be included in the avoidance and minimization measures. Approximately 1,031.2 acres of modeled habitat will be conserved within the HCP Preserve System in perpetuity (Table 4-31). Conserved habitat will be monitored and managed to enhance habitat conditions for this species.

Table 4-31. Acres of Modeled Habitat Estimated to Be Impacted for Burrowing Owl

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	333.7	115.4	922.5
Phase 2	152.8	125.4	90.7
Phase 3	83.6	1.4	--
Phase 4	62.2	1.6	--
Total Modeled Habitat	**632.8**	**243.7**	**1,031.2**

Cactus Wren

The distribution of cactus wren in the Planning Area is defined by modeled known suitable nesting habitat, potential nesting and foraging habitat, recently burned (2008–2018) habitat, and documented occurrences. Refer to the cactus wren species account in Section 3.8.3 for a list of the parameters for this species' modeled habitat in the Planning Area. Most documented occurrences and potential nesting and foraging habitat (127,918 acres) and recently burned (2008–2018) habitat (9,470 acres) for the species occur in washes and slopes adjacent to urban areas north of Fontana east to Yucaipa, including the Santa Ana River and Lytle, Cajon, and Mill Creeks. Known suitable nesting habitat (677 acres), potential nesting and foraging habitat, and recently burned

(2008–2018) habitat also occur around Lake Matthews and in scattered washes and lower hills south to the Temecula area (Figure 3-50).

Potential Direct and Indirect Effects

Direct effects on cactus wren from Covered Activities include habitat loss from construction activities including grading, excavating, soil stockpiling, or other earth-disturbing activities. These activities could alter cactus wren habitat by permanently removing native scrub and suitable nesting sites in prickly pear or cholla (Hamilton et al. 2011, San Bernardino County Museum 2014). Adults show site fidelity to breeding areas, returning to the same area each year; therefore, removal of these suitable cactuses used for nesting substrate could result in displacement of cactus wren in these areas (Solek and Szijj 2004).

Indirect effects on cactus wren from Covered Activities include the introduction of nonnative plant species, increased potential for wildfire, and habitat fragmentation. Vegetation clearing for road and pipeline construction and maintenance can increase the spread of nonnative species. The introduction of nonnative plant species could also contribute to the degradation of suitable habitat by increasing the cover of exotic grasses and forbs in scrub understory, which may decrease foraging efficiency. The establishment of nonnative species alters scrub vegetation communities and could reduce the suitability of cactus wren habitat. The increase in nonnative annual grasses can increase fire frequency, intensity, and extent, further degrading and removing cactus wren habitat (Hamilton et al. 2011). Construction of new facilities that fragment contiguous habitat could limit dispersal between patches of suitable cactus wren habitat, creating isolated populations and resulting in reduced gene flow and weakened populations (Hamilton et al. 2011, Preston and Kamada 2012).

Impact Assessment

The impact assessment of the cactus wren assumes 0.1 acre of permanent loss and 0.4 acre of temporary loss of known suitable nesting habitat within the Planning Area (Table 4-14). The permanent loss of 630.0 acres of potential nesting and foraging habitat and 1.6 acres of recently burned (2008–2018) habitat would result primarily from the construction of groundwater recharge facilities (369.1 acres), and wells and water conveyance infrastructure (217.3 acres), while the 188.7 acres of estimated temporary impacts would result primarily from new construction and maintenance of wells and water conveyance infrastructure (164.4 acres) (Table 4-15). These activities would result in reduction of habitat quality and loss of available potential habitat for cactus wren.

The footprints of Covered Activities correspond with 2 out of 95 documented current (post-2005) occurrences in the Planning Area, indicating the potential for impacts on occupied cactus wren habitat and the importance of measures to minimize effects on breeding activity. The estimated habitat loss to occur as a result of Covered Activities is a small fraction of the available habitat within and in the vicinity of the Planning Area. Fragmentation resulting in small, isolated populations and limited dispersal is one of the major threats to cactus wren (Preston and Kamada 2012). The location of Covered Activities and their proximity to current documented occurrences is not expected to further isolate habitat or populations and would not result in substantial loss of suitable nesting habitat. As such, impacts on the cactus wren population in the Planning Area would be limited.

Avoidance and mitigation measures will ensure that active cactus wren nests are not disturbed and that take of modeled habitat is reduced to the greatest extent practicable. These measures include pre-Covered Activity surveys, application of nest buffers for active nests, and noise monitoring. Approximately 1,069.4 acres of modeled habitat will be conserved within the HCP Preserve System in perpetuity (Table 4-32). Conserved habitat will be monitored and managed to enhance habitat conditions for this species.

Table 4-32. Acres of Modeled Habitat Estimated to Be Impacted for Cactus Wren

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Known Suitable Nesting			
Phase 1	0.1	0.4	48.0
Phase 2	0.0	0.0	--
Phase 3	0.3	0.0	--
Phase 4	0.0	0.0	--
Total	0.4	0.4	48.0
Potential Nesting and Foraging Habitat			
Phase 1	281.6	98.0	897.1
Phase 2	172.0	81.0	120.8
Phase 3	83.5	0.9	--
Phase 4	92.9	2.0	--
Total	*630.0*	*181.8*	*1,017.9*
Recently Burned (2008–2018)			
Phase 1	1.3	2.4	3.5
Phase 2	0.4	4.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*1.6*	*6.4*	*3.5*
Total Modeled Habitat	**632.0**	**188.7**	**1,069.4**

Yellow-Breasted Chat

The distribution of yellow-breasted chat in the Planning Area is defined by modeled potentially suitable habitat and documented occurrences. Refer to the yellow-breasted chat species account in Section 3.8.3 for a list of the parameters for this species' modeled habitat in the Planning Area. Most documented occurrences for the species occur in riparian habitat along the Santa Ana River. Potentially suitable habitat (15,329 acres) also occurs primarily along the Santa Ana River with a large area concentrated in the Prado Basin (Figure 3-51).

Potential Direct and Indirect Effects

Direct effects on yellow-breasted chat from Covered Activities include habitat loss and disturbance from human activity. Construction activities that include grading, excavating, soil stockpiling, or other activities that remove riparian vegetation or disturb the soil could alter yellow-breasted chat habitat by permanently removing early successional riparian woodland vegetation and dense thickets that are required nest substrate for this species (Shuford and Gardali 2008, Myers n.d.).

Indirect effects on yellow-breasted chat from Covered Activities include the introduction of nonnative plant species and hydrologic effects, including alteration of surface water flows and groundwater levels that can affect riparian habitat for the chat.

Vegetation clearing for road and pipeline construction and maintenance can increase the spread of nonnative species. The establishment of nonnative species alters riparian vegetation communities and could reduce the suitability of potential yellow-breasted chat habitat by outcompeting more suitable native plants that are used as nesting substrate. Nests that are located on the edges of the vegetation clearings could be more susceptible to brood parasitism from brown-headed cowbirds as well as nest predation. Recharge projects that divert streamflow from the Santa Ana River, pump groundwater, or decrease groundwater infiltration rates could alter the distribution and species composition of riparian habitat, which, in turn, could affect breeding habitat. Refer to Section 4.4.1, for a description of the predicted effects of Covered Activities on average daily streamflows. Refer to Section 4.4.3, *Effects on Groundwater-Dependent Ecosystems*, for a description of the predicted effects of Covered Activities on GDEs, including riparian habitat.

Human activity during construction, operations, and maintenance activities that involve noise and motion could result in nest abandonment and/or nest failure when conducted near yellow-breasted chat nesting habitat if these activities occur between mid-May and early August during the nesting season (Eckerle and Thompson 2001, Dudek and Associates 2003a).

Impact Assessment

The impact assessment of the yellow-breasted chat estimates the permanent loss of 120.3 acres of potentially suitable habitat within the Planning Area (Table 4-14). Areas of permanent habitat loss would result predominantly from groundwater recharge facilities (85.6 acres) and wells and water conveyance infrastructure (32.6 acres), while temporary impacts on 29.4 acres of potentially suitable habitat would result in short-term disturbance associated primarily with wells and water conveyance infrastructure (Table 4-15).

Ground-disturbing effects of Covered Activities are estimated to affect 3 of 563 of documented current (post-2005) occurrences in the Planning Area. Clearing of dense riparian thickets and brush tangles has caused a noticeable decline in the number of breeding pairs of yellow-breasted chat within the region (Dudek and Associates 2003a); however, the location and proximity of Covered Activities to current documented occurrences and potentially suitable habitat would not result in substantial loss of potentially suitable habitat. The largest tract of intact modeled potentially suitable habitat and many of the documented occurrences within the Planning Area are northwest of the city of Corona in the Chino Valley in the Prado Basin. This portion of potentially suitable habitat would not be affected or fragmented by the ground-disturbing effects of Covered Activities. Avoidance and minimization measures would also be implemented to avoid destruction of occupied yellow-breasted chat nests. Therefore, impacts on nesting yellow-breasted chat in the Planning Area from ground-disturbing effects would be limited.

There are two areas of falling groundwater within yellow-breasted chat habitat on the riparian communities of the Santa Ana River, in the reach from the Main Street crossing to the railroad crossing at the confluence with Sunnyslope Channel and the reach from I-15 downstream to Prado Dam. Yellow-breasted chat habitat with rising groundwater occurs on the Santa Ana River between the railroad crossing and I-15, and in the vicinity of the lower tributaries of Chino and Cucamonga (see Figure 4-7). Rising groundwater is not expected to have a detrimental effect on yellow-breasted chat habitat as long as it does not become permanent surface water where riparian under- and overstory species will not grow (see Table 4-9). However, falling groundwater in areas identified as riparian habitat can cause a reduction in the amount of riparian habitat suitable for yellow-breasted chat. Conversely, there is potential for falling groundwater to increase riparian habitat in areas currently identified as open water or wetlands. Table 4-33 quantifies the acreages of riparian habitat potentially impacted by falling groundwater and that could indirectly impact some yellow-breasted chat habitat.

Avoidance and mitigation measures will ensure that active yellow-breasted chat nests are not disturbed and that take of modeled habitat is reduced to the greatest extent practicable. These measures include pre-Covered Activity surveys, application of nest buffers for active nests, and noise monitoring. Approximately 257.2 acres of modeled habitat will be conserved within the HCP Preserve System in perpetuity. Conserved habitat will be monitored and managed to enhance habitat conditions for this species.

Table 4-33. Acres of Modeled Habitat Estimated to Be Impacted for Yellow-Breasted Chat

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	56.3	16.7	143.4
Phase 2	49.2	12.1	113.8
Phase 3	14.7	0.0	--
Phase 4	0.0	0.6	--
Total Modeled Habitat	**120.3**	**29.4**	**257.2**

Western Yellow-Billed Cuckoo

The distribution of western yellow-billed cuckoo in the Planning Area is defined by modeled high value breeding habitat, other potentially suitable breeding habitat, and documented occurrences. Refer to the western yellow-billed cuckoo species account in Section 3.8.3 for a list of the parameters for this species' modeled habitat in the Planning Area. Most documented occurrences for the species occur in riparian habitat scattered throughout the Planning Area. High value breeding habitat (2,773 acres) occurs primarily in the Prado Basin. Other potentially suitable breeding habitat (1,999 acres) occurs primarily in riparian areas and parks along the Santa Ana River (Figure 3-52).

Potential Direct and Indirect Effects

Direct effects on western yellow-billed cuckoo from Covered Activities include habitat loss; however, these effects would be limited because very few Covered Activities that result in

permanent impacts intersect with western yellow-billed cuckoo high value breeding, or other potentially suitable breeding, habitat. Temporary ground disturbance associated with pipeline replacement could adversely affect western yellow-billed cuckoo where these activities occur within or adjacent to structurally complex, mature riparian habitats with tall trees and a dense woody understory near waterways dominated by willows and cottonwoods (Laymon 1998, Hughes 1999).

Indirect effects on western yellow-billed cuckoo from Covered Activities include the introduction of nonnative plant species, hydrologic effects such as alteration of surface water flows and groundwater levels that can affect riparian habitat for the cuckoo, and habitat fragmentation. Refer to Section 4.4.1 for a description of the predicted effects of Covered Activities on average daily streamflows. Refer to Section 4.4.3 for a description of the predicted effects of Covered Activities on GDEs, including riparian habitat.

Vegetation clearing for road and pipeline construction and maintenance can increase the spread of nonnative species. The establishment of nonnative species alters dense woody riparian vegetation communities and could reduce the suitability of western yellow-billed cuckoo breeding habitat. Nests that are located on the edges of the vegetation clearings could be more susceptible to brood parasitism from brown-headed cowbirds as well as nest predation. Human activity during construction, operations, and maintenance activities that involve noise and motion could result in nest abandonment and/or nest failure when conducted near western yellow-billed cuckoo nesting habitat if these activities occur between May and August during the nesting and breeding season (Hughes 1999). Recharge projects that divert streamflow from the Santa Ana River, pump groundwater, or decrease groundwater infiltration rates could alter the distribution and species composition of riparian habitat, which, in turn, could affect breeding habitat. Covered Activities could also further fragment already isolated patches of suitable breeding habitat for western yellow-billed cuckoo, which have been adversely affected throughout their range by gravel mining, agricultural development, and wildfire (79 FR 59992).

Impact Assessment

The impact assessment of western yellow-billed cuckoo assumes the permanent loss of 8.8 acres of potentially suitable breeding habitat, which would result from wells and water conveyance infrastructure (Table 4-14 and Table 4-15). Temporary habitat loss of 0.1 acre of high value breeding habitat (Table 4-14) would occur as a result of short-term disturbance associated with wells and water conveyance infrastructure (Table 4-15). Wells and water conveyance infrastructure would result in 8.2 acres of temporary impacts on potentially suitable breeding habitat. No permanent impacts from Covered Activities would occur in high value breeding habitat.

The amount of western yellow-billed cuckoo habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. None of the documented current (post-2005) occurrences in the Planning Area will be affected. The largest tract of intact modeled high value breeding habitat is within the Prado Basin and would not be affected or fragmented by ground-disturbing effects of Covered Activities. Given the limited amount of potential habitat estimated to be impacted, impacts on the population of western yellow-billed cuckoo in the Planning Area would be small.

The USFWS' description of western yellow-billed cuckoo proposed critical habitat physical and biological features includes riparian woodlands with a prey base consisting of large insect fauna and tree frogs, and dynamic riverine processes that encourage sediment movement and deposits to facilitate plant growth (USFWS 2014); however, the revised critical habitat proposed for western

yellow billed cuckoo (USFWS 2020) does not include any mapped portions within the Planning Area. Changes in groundwater level could affect riparian habitat for the species. There are two areas of falling groundwater within western yellow-billed cuckoo habitat on the riparian communities of the Santa Ana River, in the reach from the Main Street crossing to the railroad crossing at the confluence with Sunnyslope Channel and the reach from I-15 downstream to Prado Dam (the area supporting the majority of western yellow-billed cuckoo habitat). Cuckoo habitat with rising groundwater occurs on the Santa Ana River between the railroad crossing and I-15 and in the vicinity of the lower tributaries of Chino and Cucamonga (see Figure 4-7). Rising groundwater is not expected to have a detrimental effect on cuckoo habitat as long as it does not become permanent surface water where riparian under- and overstory species will not grow (see Table 4-9). However, falling groundwater can cause a reduction in the amount of riparian habitat suitable for western yellow-billed cuckoo, especially because this species favors interior riparian habitats with higher humidity (Laymon 1998, Hughes 1999). There is also potential for falling groundwater to increase riparian habitat in areas currently identified as open water or wetlands. Table 4-34 quantifies the acreages of riparian habitat potentially impacted by falling groundwater and that could indirectly impact some cuckoo habitat.

Avoidance and mitigation measures will ensure that active western yellow-billed cuckoo nests are not disturbed should they occur near Covered Activities in the future and that take of modeled habitat is reduced to the greatest extent practicable. These measures include pre-Covered Activity surveys, and application of nest buffers and noise monitoring near active nests. Approximately 142.8 acres of modeled habitat will be conserved within the HCP Preserve System in perpetuity. Conserved habitat will be monitored and managed to enhance habitat conditions for this species.

Table 4-34. Acres of Modeled Habitat Estimated to Be Impacted for Western Yellow-Billed Cuckoo

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
High Value Breeding Habitat			
Phase 1	0.0	0.0	22.1
Phase 2	0.0	0.1	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.0*	*0.1*	*22.1*
Potentially Suitable Breeding Habitat			
Phase 1	8.7	6.6	80.3
Phase 2	0.1	1.7	40.5
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*8.7*	*8.2*	*120.8*
Total Modeled Habitat	**8.8**	**8.4**	**142.8**

Southwestern Willow Flycatcher

The distribution of southwestern willow flycatcher in the Planning Area is defined by modeled core southwestern flycatcher habitat, very high value habitat, high value habitat, moderate value habitat, other potentially suitable habitat, and documented occurrences. Refer to the southwestern willow flycatcher species account in Section 3.8.3 for a list of the parameters for this species' modeled habitat in the Planning Area. Most documented occurrences for the species occur in riparian habitat in Chino Hills and Chino Valley, along the Santa Ana River in the La Loma Hills and east of the San Bernardino Golf Course, and in riparian areas scattered throughout the San Bernardino National Forest. Core southwestern willow flycatcher habitat (1,844 acres), critical habitat (4,431 acres), very high value habitat (1,564 acres), high value habitat (613 acres), moderate value habitat (360 acres), and other potentially suitable habitat (10,949 acres) are spread throughout Cajon Wash, Waterman Creek, Day Canyon, the Santa Ana River, the Prado Basin, and San Timoteo Canyon (Figure 3-53).

Potential Direct and Indirect Effects

Direct effects on southwestern willow flycatcher from Covered Activities include habitat loss and disturbance from human activity. Habitat loss and modification is currently widespread throughout the southwestern willow flycatcher range, and additional loss due to Covered Activities could further modify, reduce, and destroy riparian nesting habitat (USFWS 2014). Construction activities that include grading, excavating, soil stockpiling, or other earth-disturbing activities could alter southwestern willow flycatcher habitat by permanently removing riparian habitat along streams, rivers, or other wetlands with dense tree or shrub cover (USFWS 1995, Sogge et al. 2010).

Indirect effects on southwestern willow flycatcher from Covered Activities include the introduction of nonnative plant species, increased potential for wildfire, and alteration of surface water flows and groundwater conditions that affect riparian habitat. Vegetation clearing for road and pipeline construction and maintenance can increase the spread of nonnative species. The establishment of nonnative species alters riparian vegetation communities and could reduce the suitability of southwestern willow flycatcher habitat. While flycatchers will nest in some riparian habitats dominated by introduced nonnative species, primarily tamarisk and Russian olive (*Elaeagnus angustifolia*), this species will rarely use giant reed for nesting, which is common within the Santa Ana River Watershed (SAWA 2019). Giant reed can form dense monotypic stands, reducing habitat quality for breeding flycatchers (USFWS 2014, SAWA 2019). In addition, giant reed is highly flammable, and the combination of increased establishment of dense stands of giant reed along with other flammable introduced nonnative species and ongoing drought increases the probability of fires that pose a threat to the continued persistence of southwestern willow flycatcher habitat (Sogge et al. 2010, USFWS 2014, SAWA 2019). In addition, nests that are located on the edges of vegetation clearings could be more susceptible to brood parasitism from brown-headed cowbirds as well as nest predation.

Recharge projects that divert streamflow from the Santa Ana River, pump groundwater, or decrease groundwater infiltration rates could alter the distribution and species composition of riparian habitat, which, in turn, could affect breeding habitat. Refer to Section 4.4.1 for a description of the predicted effects of Covered Activities on average daily streamflows. Refer to Section 4.4.3 for a description of the predicted effects of Covered Activities on GDEs, including riparian habitat.

Human activity during construction, operations, and maintenance activities that involve noise and motion could result in nest abandonment and/or nest failure when conducted near southwestern willow flycatcher nesting habitat if these activities occur between May and June (Ellis et al. 2008).

Impact Assessment

The impact assessment of southwestern willow flycatcher estimates the permanent loss of 15.5 acres of core southwestern willow flycatcher habitat and 104.7 acres of other potentially suitable habitat (Table 4-14). Permanent core southwestern willow flycatcher habitat loss would result primarily from groundwater recharge facilities (6.0 acres) and wells and water conveyance infrastructure (9.5 acres), while permanent habitat loss of other potentially suitable habitat would result primarily from groundwater recharge facilities (79.6 acres) and wells and water conveyance infrastructure (23.0 acres) (Table 4-15). Temporary impacts on 3.1 acres of core southwestern willow flycatcher habitat and 26.1 acres of other potentially suitable habitat would occur as a result of short-term disturbance associated with wells and water conveyance infrastructure (Table 4-14). These activities would result in reduction in habitat quality and temporary loss of available potential habitat for southwestern willow flycatcher. Impacts from Covered Activities are estimated to result in the permanent loss of 95.9 acres of final Critical Habitat and temporary impacts on 12.1 acres of final Critical Habitat. Impacts may result in the loss or alteration of physical and biological features for southwestern willow flycatcher within Critical Habitat.

The amount of southwestern willow flycatcher habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. None of the documented current (post-2005) occurrences in the Planning Area will be affected.

Habitat loss estimated to occur as a result of ground-disturbing effects of Covered Activities is a small percentage of the modeled habitat within and in the vicinity of the Planning Area. In addition, the species breeding range extends beyond the Planning Area in riparian areas along coastal Southern California and interior Southern California, and along the lower Colorado River, which traverses the Southern California and Arizona border (Sogge et al. 2010).

The known distribution and abundance of nesting southwestern willow flycatchers has improved since the 1980s through increased survey effort. Improved information about flycatcher distribution and abundance, information from genetic studies, and improved knowledge about habitat and natural history has indicated that the flycatcher's breeding range has remained stable (USFWS 2017). Ground-disturbing effects of Covered Activities would not isolate habitat or populations or result in substantial loss of core habitat areas or critical habitat, and impacts on the population of southwestern willow flycatcher would be small.

There are two areas of falling groundwater within southwestern willow flycatcher habitat on the riparian communities of the Santa Ana River, in the reach from the Main Street crossing to the railroad crossing at the confluence with Sunnyslope Channel and the reach from I-15 downstream to Prado Dam. Flycatcher habitat with rising groundwater occurs on the Santa Ana River between the railroad crossing and I-15 and in the vicinity of the lower tributaries of Chino and Cucamonga (see Figure 4-7). Rising groundwater is not expected to have a detrimental effect on flycatcher habitat as long as it does not become permanent surface water where riparian under- and overstory species will not grow (see Table 4-9). However, falling groundwater can cause a reduction in the amount of riparian habitat suitable for southwestern willow flycatchers. Table 4-35 quantifies the acreages of riparian habitat potentially impacted by falling groundwater and that could indirectly impact some flycatcher habitat.

Avoidance and mitigation measures will ensure that active southwestern willow flycatcher nests are not disturbed should they occur near Covered Activities in the future, and that take of modeled habitat and Critical Habitat is reduced to the greatest extent practicable. These measures include seasonal limitations in suitable modeled habitat, pre-Covered Activity USFWS-protocol presence/absence or nest searching surveys, and application of nest buffers and noise monitoring for active nests. Approximately 257.2 acres of modeled habitat will be conserved within the HCP Preserve System in perpetuity. Conserved habitat will be monitored and managed to enhance habitat conditions for this species. Approximately 50.7 acres of new habitat would be created in restoration sites, 10.1 acres of which are in final Critical Habitat.

Table 4-35. Acres of Modeled Habitat Estimated to Be Impacted for Southwestern Willow Flycatcher

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Core Southwestern Willow Flycatcher Habitat			
Phase 1	9.5	2.9	--
Phase 2	6.0	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.1	--
Total	*15.5*	*3.1*	--
Very High Value Habitat			
Phase 1	0.0	0.1	28.8
Phase 2	0.0	0.1	14.6
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	0.0	0.2	43.4
High Value Habitat			
Phase 1	0.0	0.1	18.1
Phase 2	0.0	0.0	25.6
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.0*	*0.1*	*43.6*
Moderate Value Habitat			
Phase 1	0.0	0.0	5.7
Phase 2	0.0	0.0	18.5
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Total	*0.0*	*0.0*	*24.2*
Other Potentially Suitable Habitat			
Phase 1	46.8	13.6	90.8
Phase 2	43.3	12.1	55.3
Phase 3	14.7	0.0	--
Phase 4	0.0	0.5	--
Total	*104.7*	*26.1*	*146.1*
Total Modeled Habitat	**120.3**	**29.4**	**257.2**

Coastal California Gnatcatcher

The distribution of coastal California gnatcatcher in the Planning Area is defined by modeled very high value habitat, high value habitat, moderate value habitat, low value habitat, other suitable habitat, and documented occurrences. Refer to the coastal California gnatcatcher species account in Section 3.8.3 for a list of the parameters for this species' modelled habitat in the Planning Area. Most documented occurrences for the species occur in the Temescal Valley around Lake Matthews and Lake Elsinore and along the Santa Ana River north of Mentone. Very high value habitat (8,298 acres), high value habitat (9,918 acres), and critical habitat (13,589 acres) occur in the fans, washes, creeks, and canyons of the Jurupa Hills and Blue Mountain; and the hills and washes around Lake Elsinore, Wasson Canyon, Walker Canyon, and the Lake Elsinore Clay Mines (Figure 3-54). Moderate value habitat (12,345 acres) and low value habitat (30,081 acres) occur predominantly along the border of the foothills of the San Gabriel Mountains, in Cajon Wash, and south and west of Lake Matthews in the Temescal Valley, while other suitable habitat (5,441 acres) is clustered around the foothills of the San Gabriel Mountains and farther north into the Cajon Wash (Figure 3-54).

Potential Direct and Indirect Effects

Direct effects on gnatcatcher from Covered Activities include habitat loss and disturbance from human activity. Habitat loss and modification is currently widespread throughout the gnatcatcher's range due to urban and agricultural development, and additional loss due to Covered Activities could further modify, reduce, and destroy existing and potentially suitable habitat (USFWS 2010c). Construction activities that include grading, excavating, soil stockpiling, or other earth-disturbing activities could alter gnatcatcher habitat by permanently removing coastal sage scrub habitat (Atwood 1993).

Indirect effects on gnatcatcher from Covered Activities include the introduction of nonnative plant species, destruction, and modification of existing and suitable habitat due to increased wildfire, and habitat fragmentation and genetic isolation.

The establishment of nonnative species alters native vegetation communities and could reduce the suitability of gnatcatcher habitat. The conversion of native coastal scrub to nonnative annual grasses as a result of livestock grazing, and wildland fire are of particular concern to the gnatcatcher.

Frequent fire can also result in the conversion of coastal sage scrub habitat to grassland dominated by grasses and forbs (USFWS 2010c).

Human activity during construction, operations, and maintenance activities that involve noise and motion could result in nest abandonment and/or nest failure when conducted near gnatcatcher nesting habitat if these activities occur between mid-February and August (USFWS 2010c). Construction and maintenance activities could limit dispersal between patches of suitable coastal California gnatcatcher habitat, creating isolated populations and resulting in reduced gene flow and weakened populations (Atwood 1993).

Impact Assessment

The impact assessment for the gnatcatcher estimates the permanent loss of 18.3 acres of very high value habitat, 48.3 acres of high value habitat, 43.0 acres of moderate value habitat, 149.5 acres of low value habitat, and 70.3 acres of other suitable habitat within the Planning Area (Table 4-14). Covered Activities would also result in the permanent loss of 2.9 acres of gnatcatcher critical habitat. Areas of permanent impacts would result predominantly from construction of groundwater recharge facilities and wells and water conveyance infrastructure. The small amount of permanent impacts in very high value habitat would result from groundwater recharge facilities (8.1 acres) and wells and water conveyance infrastructure (9.5 acres). Temporary impacts on 6.5 acres of very high value habitat, 17.5 acres of high value habitat, 21.1 acres of moderate value habitat, 64.5 acres of low value habitat, 4.6 acres of other suitable habitat, and 3.0 acres of critical habitat would occur primarily as a result of wells and water conveyance infrastructure (Table 4-14 and Table 4-15).

The amount of coastal California gnatcatcher habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. The footprints of Covered Activities correspond with 3 out of 1,194 of documented current (post-2005) occurrences in the Planning Area, indicating the potential for impacts on occupied gnatcatcher habitat and the importance of measures to minimize effects on breeding activity. Avoidance and minimization measures would be implemented to avoid destruction of occupied gnatcatcher nests. The estimated habitat loss to occur as a result of Covered Activities is a small fraction of the modeled habitat within and in the vicinity of the Planning Area. Given the limited amount of potential habitat estimated to be impacted and the avoidance of direct mortality, impacts on the population of gnatcatchers in the Planning Area would be small.

Avoidance and mitigation measures will ensure that active coastal California gnatcatcher nests are not disturbed and that take of modeled habitat is reduced to the greatest extent practicable. These measures include seasonal limitations in suitable modeled habitat, pre-Covered Activity USFWS-protocol presence/absence or nest searching surveys, and application of nest buffers for active nests. Approximately 843.1 acres of modeled habitat will be conserved within the HCP Preserve System in perpetuity (Table 4-36). Conserved habitat will be monitored and managed to enhance habitat conditions for this species.

Table 4-36. Acres of Modeled Habitat Estimated to Be Impacted for Coastal California Gnatcatcher

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System[1]**
Very High Value Habitat			
Phase 1	10.2	5.8	97.3
Phase 2	1.0	0.5	21.4
Phase 3	1.2	0.1	--
Phase 4	5.9	0.1	--
Total	*18.3*	*6.5*	*118.6*
High Value Habitat			
Phase 1	10.5	13.9	184.1
Phase 2	4.2	3.6	7.6
Phase 3	5.0	0.0	--
Phase 4	28.6	0.0	--
Total	*48.3*	*17.5*	*191.7*
Moderate Value Habitat			
Phase 1	15.6	9.8	159.0
Phase 2	12.7	10.8	6.7
Phase 3	0.8	0.2	--
Phase 4	14.0	0.3	--
Total	*43.0*	*21.1*	*165.7*
Low Value Habitat			
Phase 1	83.2	30.0	335.3
Phase 2	37.5	33.3	10.7
Phase 3	3.5	0.0	--
Phase 4	25.3	1.2	--
Total	*149.5*	*64.5*	*346.0*
Other Suitable Habitat			
Phase 1	0.8	3.1	20.0
Phase 2	0.1	1.5	1.1
Phase 3	68.6	0.0	--
Phase 4	0.8	0.0	--
Total	*70.3*	*4.6*	*21.1*
Total Modeled Habitat	**329.4**	**114.2**	**843.1**

Least Bell's Vireo

The distribution of least Bell's vireo in the Planning Area is defined by modeled core breeding habitat, other breeding habitat, and documented occurrences. Refer to the least Bell's vireo species account in Section 3.8.3 for a list of the parameters for this species' modeled habitat in the Planning Area. Most documented occurrences for the species occur in riparian habitat in the Prado Basin and along the Santa Ana River and Temescal Wash, and in San Timoteo, Mockingbird, and Little Sand Canyons. Core breeding habitat (5,463 acres) and critical habitat (9,900 acres) occur in Prado Basin and along the lower Santa Ana River, while other breeding habitat (9,867 acres) is dispersed throughout the canyons and washes in the study area, including those mentioned above (Figure 3-55).

Potential Direct and Indirect Effects

Direct effects on least Bell's vireo from Covered Activities include habitat loss and disturbance from human activity. Construction activities that include grading, excavating, soil stockpiling, or other earth-disturbing activities could alter vireo habitat by permanently removing early successional riparian scrub and woodlands with developed canopy layer and dense shrubs required for this species (Franzreb 1989, Kus 1998, USFWS 1998a). Human activity during construction, operations, and maintenance activities that involve noise and motion could result in nest abandonment and/or nest failure when conducted near vireo nesting habitat if these activities occur between mid-March and late April (USFWS 1998a, 2006).

Indirect effects on least Bell's vireo from Covered Activities include the introduction of nonnative plant species and exotic predators, and alteration of surface water flows and groundwater conditions that affect riparian habitat. Vegetation clearing for road and pipeline construction and maintenance can increase the spread of nonnative species. Nests that are located on the edges of the vegetation clearings could be more susceptible to brood parasitism from brown-headed cowbirds as well as nest predation. The establishment of nonnative species alters the riparian vegetation communities and could reduce the suitability of core and other breeding habitat for the species by outcompeting more suitable native plants that are used as nesting substrate. The spread of giant reed in particular, as well as tamarisk and perennial pepperweed, constitute a threat to least Bell's vireo. Where Covered Activity disturbance occurs in highly urbanized areas adjacent to vireo habitat, edge effects could result in an increase in nest and adult predation due to mesopredator release and/or the addition of nonnative predators (i.e., domestic cats) (USFWS 2006). Recharge projects that divert streamflow from the Santa Ana River, pump groundwater, or decrease groundwater infiltration rates could alter the distribution and species composition of riparian habitat, which, in turn, could affect breeding habitat. Refer to Section 4.4.1 for a description of the predicted effects of Covered Activities on average daily streamflows. Refer to Section 4.4.3 for a description of the predicted effects of Covered Activities on GDEs, including riparian habitat.

Impact Assessment

The impact assessment for least Bell's vireo estimates the permanent loss of 0.3 acre of core breeding habitat and 120.0 acres of other breeding habitat within the Planning Area (Table 4-14). Areas of permanent habitat loss in other breeding habitat would result predominantly from groundwater recharge facilities (85.6 acres) and wells and water conveyance infrastructure (32.4 acres). Temporary impacts on 1.8 acres of core breeding habitat, and 27.6 acres of other breeding habitat would occur as a result of short-term disturbance associated predominantly with wells and

water conveyance infrastructure (Table 4-15). Impacts from Covered Activities are estimated to result in the permanent loss of 1.9 acres of final Critical Habitat and temporary impacts to 11.7 acres of final Critical Habitat. Impacts may result in the loss or alteration of physical and biological features for least Bell's vireo within Critical Habitat.

The amount of least Bell's vireo habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. The footprints of Covered Activities correspond with less than 4 out of 1,694 documented current (post-2005) occurrences in the Planning Area, indicating the potential for some impact on occupied habitat. Avoidance and minimization measures would reduce potential adverse effects on breeding activity.

When the least Bell's vireo was listed in 1986, there were 19 known pairs in the Prado Basin (USFWS 2006). That population has since increased to a high of 665 territorial males in 2018, and the total Santa Ana Watershed population totaled 1,967 territorial males in 2019 (SAWA 2019). The Prado Basin is a large core population within the Planning Area that will not be fragmented by Covered Activities. Impacts from ground-disturbing effects of Covered Activities would not isolate habitat, territories, or populations or result in substantial loss of core habitat areas, critical habitat, or other potential breeding habitat in the Planning Area, and avoidance and minimization measures would be implemented to avoid destruction of least Bell's vireo nests. As such, impacts from ground-disturbing activities on the least Bell's vireo population in the Planning Area would be small.

There are two areas of falling groundwater within least Bell's vireo habitat on the riparian communities of the Santa Ana River, in the reach from the Main Street crossing to the railroad crossing at the confluence with Sunnyslope Channel and the reach from I-15 downstream to Prado Dam. Vireo habitat with rising groundwater occurs on the Santa Ana River between the railroad crossing and I-15, and in the vicinity of the lower tributaries of Chino and Cucamonga (see Figure 4-7). Rising groundwater is not expected to have a detrimental effect on vireo habitat as long as it does not become permanent surface water where riparian under- and overstory species will not grow (see Table 4-9). However, falling groundwater can cause a reduction in the amount of riparian habitat suitable for least Bell's vireo. Table 4-37 quantifies the acreages of riparian habitat potentially impacted by falling groundwater and that could indirectly impact some vireo habitat.

Avoidance and mitigation measures will ensure that active least Bell's vireo nests are not disturbed and that take of modeled habitat and final Critical Habitat is reduced to the greatest extent practicable. These measures include seasonal limitations in suitable modeled habitat, pre-Covered Activity USFWS-protocol presence/absence or nest searching surveys, and application of nest buffers for active nests. Approximately 257.2 acres of modeled habitat will be conserved within the HCP Preserve System in perpetuity. Additionally, approximately 220.6 acres of habitat will be restored within the HCP Preserve System, which includes 144.4 acres of final Critical Habitat. The Restoration Areas will include the restoration of approximately 50.7 acres of habitat that is not currently included in the modeled habitat for the species. Conserved and restored habitat will be monitored and managed to enhance habitat conditions for this species.

Table 4-37. Acres of Modeled Habitat Estimated to Be Impacted for Least Bell's Vireo

Modeled Habitat Type	Impacts: Permanent Impacts	Impacts: Temporary Impacts	Mitigation: HCP Preserve System
Core Breeding Habitat			
Phase 1	0.3	1.6	29.1
Phase 2	0.0	0.2	61.5
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.3*	*1.8*	*90.6*
Other Breeding Habitat			
Phase 1	56.1	15.1	114.3
Phase 2	49.2	12.0	52.4
Phase 3	14.7	0.0	--
Phase 4	0.0	0.6	--
Total	*120.0*	*27.6*	*166.6*
Total Modeled Habitat	**120.3**	**29.4**	**257.2**
New Habitat Created through Restoration			**50.7**
Total Habitat in the HCP Preserve System			**307.9**

Los Angeles Little Pocket Mouse

The distribution of Los Angeles little pocket mouse in the Planning Area is defined by modeled potentially suitable habitat and documented occurrences. Refer to the Los Angeles little pocket mouse species account in Section 3.8.3 for a list of the parameters for this species' modeled habitat in the Planning Area. Most documented occurrences for the species occur in the northern portion of the Planning Area in San Bernardino County, in Day Canyon Wash, East Etiwanda Creek, Cajon Wash, and northern reaches of the Santa Ana River. Potentially suitable habitat (67,500 acres) occurs throughout the Planning Area and is dispersed throughout canyons and washes, including those mentioned above (Figure 3-56).

Potential Direct and Indirect Effects

Direct effects on pocket mouse from Covered Activities include habitat loss and disturbance from human activity. Construction activities that include grading, excavating, soil stockpiling, or other earth-disturbing activities could alter pocket mouse habitat by permanently removing low-elevation sparse grassland, alluvial sage scrub, and coastal sage scrub habitats (Bolster 1998). Vegetation clearing for road and pipeline construction and regular maintenance and construction of infrastructure for new diversions and recharge basins can increase the spread of nonnative species. The establishment of nonnative species alters native vegetation communities and could reduce the suitability of pocket mouse habitat.

Indirect effects on pocket mouse from Covered Activities include the introduction of nonnative plant species and habitat fragmentation and genetic isolation. Covered Activities could also further fragment already isolated patches of suitable habitat for pocket mouse, which have been adversely affected throughout the region by conversion of habitat to agricultural, suburban, and urban uses (Dudek and Associates 2003b).

Impact Assessment

The impact assessment of Los Angeles little pocket mouse estimates the permanent loss of 593.4 acres of potentially suitable habitat (Table 4-14). Areas of permanent habitat loss to potentially suitable habitat in the Planning Area, would result predominantly from groundwater recharge facilities (366.8 acres) and wells and water conveyance infrastructure (190.7 acres) (Table 4-15). Temporary impacts on 145.4 acres of potentially suitable habitat would occur as a result of short-term disturbance associated primarily with wells and water conveyance infrastructure (128.3 acres) (Table 4-15).

The amount of Los Angeles pocket mouse habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. Covered Activities will affect 2 out of 38 documented current (post-2005) occurrences in the Planning Area. While this species has experienced reductions in population due to conversion of its habitat, the species has been documented in the northern portion of the Planning Area within San Bernardino County. Fragmentation of some of this species' habitat will occur as a result of Covered Activities, which could reduce dispersal opportunities for this species and cause a decrease in gene flow; however, given the limited amount of potential habitat estimated to be impacted, impacts on the population of Los Angeles little pocket mouse in the Planning Area would be small.

Avoidance and minimization measures will ensure that take of individuals and modeled habitat is reduced to the greatest extent practicable. These measures include habitat assessments, exclusionary fencing, trapping surveys, relocation, topsoil sequestration, and timing and night-lighting limitations. Approximately 1,007.2 acres of modeled habitat will be conserved within the HCP Preserve System in perpetuity (Table 4-38). Conserved habitat will be monitored and managed to enhance habitat conditions for this species.

Table 4-38. Acres of Modeled Habitat Estimated to Be Impacted for Los Angeles Little Pocket Mouse

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	262.8	86.7	935.1
Phase 2	154.6	55.9	72.1
Phase 3	83.1	0.9	--
Phase 4	92.9	2.0	--
Total Modeled Habitat	**593.4**	**145.4**	**1,007.2**

San Bernardino Merriam's Kangaroo Rat

The distribution of San Bernardino Merriam's kangaroo rat in the Planning Area is defined by modeled high, medium, low, and very low quality habitat; ecological process area; suitable habitat; mapped critical habitat; and documented occurrences. Refer to the San Bernardino Merriam's kangaroo rat species account in Section 3.8.3 for a list of the parameters for this species' modelled habitat in the Planning Area. Most documented occurrences and suitable habitat (11,591 acres) for the species occur in the northern portion of the Planning Area in San Bernardino County, in Day Canyon Wash, Etiwanda Canyon, Lytle Creek, Cajon Canyon, Devil Canyon, City Creek, and habitat along the Upper Santa Ana River, from southwest of the San Bernardino International Airport east to the Crafton Hills. High (465 acres), medium (901 acres), low (2,223 acres), and very low (4,006 acres) quality habitat, as well as ecological process areas (831 acres) are mapped and occur predominantly in one of two areas within the Planning Area: (1) along Lytle-Cajon Wash in the area north of I-210 between I-15 and I-215, and (2) along the Santa Ana River in the area north of the town of Mentone and east of I-215. Within the Planning Area, critical habitat (27,745 acres) has been designated for the majority of the areas mentioned above that are modeled habitat (Figure 3-57).

Potential Direct and Indirect Effects

Direct effects on San Bernardino Merriam's kangaroo rat from Covered Activities include mortality and habitat loss. Construction activities could result in the death or injury of San Bernardino Merriam's kangaroo rat. Grading, excavating, soil stockpiling, or other construction-related earth-disturbing activities could crush or bury kangaroo rats in their burrows. Habitat loss and modification is currently widespread throughout the species' range due to mining, agricultural, urban, and industrial development (USFWS 2009b). Additional habitat removal resulting from Covered Activities could further exacerbate adverse effects on kangaroo rat.

Indirect effects on kangaroo rat from Covered Activities include the introduction of nonnative plant species (especially nonnative grasses), alteration of surface water flows, and habitat fragmentation. The establishment of nonnative species alters native vegetation communities and could reduce the suitability of kangaroo rat habitat. The introduction of nonnative annual grasses alters the alluvial floodplain habitat preferred by this species (USFWS 1998b). Groundwater recharge projects that divert streamflow from the Santa Ana River could alter the distribution and species composition of the alluvial fan sage scrub, which, in turn, could result in changes to the fluvial processes required for maintaining and establishing kangaroo rat habitat (USFWS 2009b). Habitat fragmentation resulting from Covered Activities could present barriers to movement and reduced connectivity of existing habitat patches, which would limit dispersal and genetically isolate populations (Jones 1989). In addition, the Covered Activities may reduce sediment transport (see Section 4.4.2), which can indirectly affect kangaroo rat by potentially reducing disturbance within channels. This species depends upon pioneer vegetation, which is maintained by frequent flood disturbance; therefore, if sediment transport is reduced within the Planning Area these channels could undergo habitat succession, resulting in lower suitability for kangaroo rat (USFWS 2009b). It will be important to conduct regular monitoring of kangaroo rat habitat suitability to adaptively manage the effects of Covered Activities that result in reduction in sediment transport.

Impact Assessment

There are limited estimated impacts (less than 3 acres of permanent or temporary impacts) associated with permanent or temporary effects on high or medium modeled habitat (Table 4-14). The impact assessment of San Bernardino Merriam's kangaroo rat estimates the permanent loss of 159.9 acres of suitable habitat, 93.9 acres of low quality habitat, 154.1 acres of very low quality habitat, and 86.4 acres of ecological process area, as well as 616.3 acres of mapped critical habitat (Table 4-14). Areas of permanent habitat loss would result predominantly from groundwater recharge facilities (Table 4-15). Temporary impacts on 33.6 acres of suitable habitat, 2.4 acres of low quality habitat, 18.5 acres of very low quality habitat, as well as 107.5 acres of mapped critical habitat would also affect San Bernardino Merriam's kangaroo rat. These impacts would occur as a result of short-term disturbance associated primarily with wells and water conveyance infrastructure (Table 4-15). Ground-disturbing impacts occurring within San Bernardino kangaroo rat habitat, even short-term disturbance from pipeline construction or staging areas, could result in long-term or permanent impacts if they alter the soil condition to make them unsuitable for San Bernardino Merriam's kangaroo rat burrows.

The amount of kangaroo rat habitat that will be permanently removed due to Covered Activities is a small proportion of the available habitat in the Planning Area. The footprints of Covered Activities correspond with 70 out of 1,202 documented current (post-2005) occurrences in the Planning Area, indicating the potential for impacts on occupied habitat and the importance of measures to minimize effects on burrow sites. In addition to populations in the Planning Area along the Santa Ana River and Lytle, Cajon, and Cable Creeks in San Bernardino County, there are also populations along the San Jacinto River and Bautista Creek (likely extirpated) in Riverside County, which will not be affected by the Covered Activities (USFWS 2009b). The majority of impacts from Covered Activities would occur within low quality, very low quality, and suitable habitat. These modeled habitat types all had much lower amounts of early seral stages of Riversidean Alluvial Fan Sage Scrub habitat that is preferred by the kangaroo rat and higher percent covers (51% and above) of annual grasses; therefore, direct impacts on these modeled habitats would be less likely to result in population-level effects on kangaroo rat.

Habitat connectivity, especially maintaining connectivity within the Santa Ana River Wash-City Creek and Cajon Wash-Lytle creek core population areas, is also an important factor when considering potential effects for Covered Activities on the species. Maintenance of existing pipelines, resulting in temporary ground disturbance, has limited fragmentation effects that are addressed by avoidance and minimization measures.

Critical Habitat Units 1, Santa Ana River Wash; 2, Lytle/Cajon Creek Wash; and 3, Cable Creek, occur within the Planning Area. The Santa Ana River Wash unit in particular and, to a lesser extent, the Lytle/Cajon Creek Wash unit, exist within an environment that is already fragmented and largely isolated (USFWS 2009b). Given that this species has already experienced such extensive habitat loss throughout its range and within the Planning Area, any additional habitat loss could be assumed to have proportional impacts on the San Bernardino Merriam's kangaroo rat.

Approximately 894.0 acres of modeled habitat will be conserved within the HCP Preserve System in perpetuity (Table 4-39). Conserved habitat will be monitored and managed to enhance habitat conditions for this species. Avoidance and minimization measures will ensure that take of individuals and occupied habitat is reduced to the greatest extent practicable. These measures include habitat assessments, exclusionary fencing, trapping surveys, relocation, topsoil

sequestration, timing and night-lighting limitations, and implementation of construction site BMPs to minimize potential for San Bernardino Merriam's kangaroo rat to enter and be harmed in construction sites.

Table 4-39. Acres of Modeled Habitat Estimated to Be Impacted for San Bernardino Merriam's Kangaroo Rat

	Impacts		Mitigation
Modeled Suitable Habitat Type[1]	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Suitable			
Phase 1	18.0	31.8	614.8
Phase 2	22.4	0.2	39.8
Phase 3	68.1	0.0	--
Phase 4	51.4	1.5	--
Total	*159.9*	*33.6*	*654.7*
High			
Phase 1	0.1	0.0	--
Phase 2	0.6	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.7*	*0.0*	--
Medium			
Phase 1	0.1	0.3	0.8
Phase 2	1.3	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*1.4*	*0.3*	*0.8*
Low			
Phase 1	3.1	2.3	0.3
Phase 2	71.6	0.1	--
Phase 3	0.0	0.0	--
Phase 4	19.2	0.0	--
Total	*93.9*	*2.4*	*0.3*
Very Low			
Phase 1	17.6	18.0	238.2
Phase 2	133.2	0.0	--
Phase 3	0.7	0.6	--
Phase 4	2.6	0.3	--

Modeled Suitable Habitat Type[1]	Impacts		Mitigation
	Permanent Impacts	Temporary Impacts	HCP Preserve System
Total	*154.1*	*18.5*	*238.2*
Ecological Process Area			
Phase 1	0.2	0.5	--
Phase 2	3.3	0.0	--
Phase 3	35.6	0.0	--
Phase 4	47.3	0.0	--
Total	*86.4*	*0.5*	--
Total Modeled Habitat	**496.4**	**55.4**	**894.0**

[1] Note that habitat suitability categories of High, Medium, Low, Very Low, and Ecological Process Area were only mapped by USFWS within the boundaries of the Upper Santa Ana River Wash HCP and the area of the Lytle-Cajon confluence (see Figure 3-57). Outside of these areas the San Bernardino Merriam's kangaroo rat model identifies San Bernardino Merriam's kangaroo rat habitat as Suitable.

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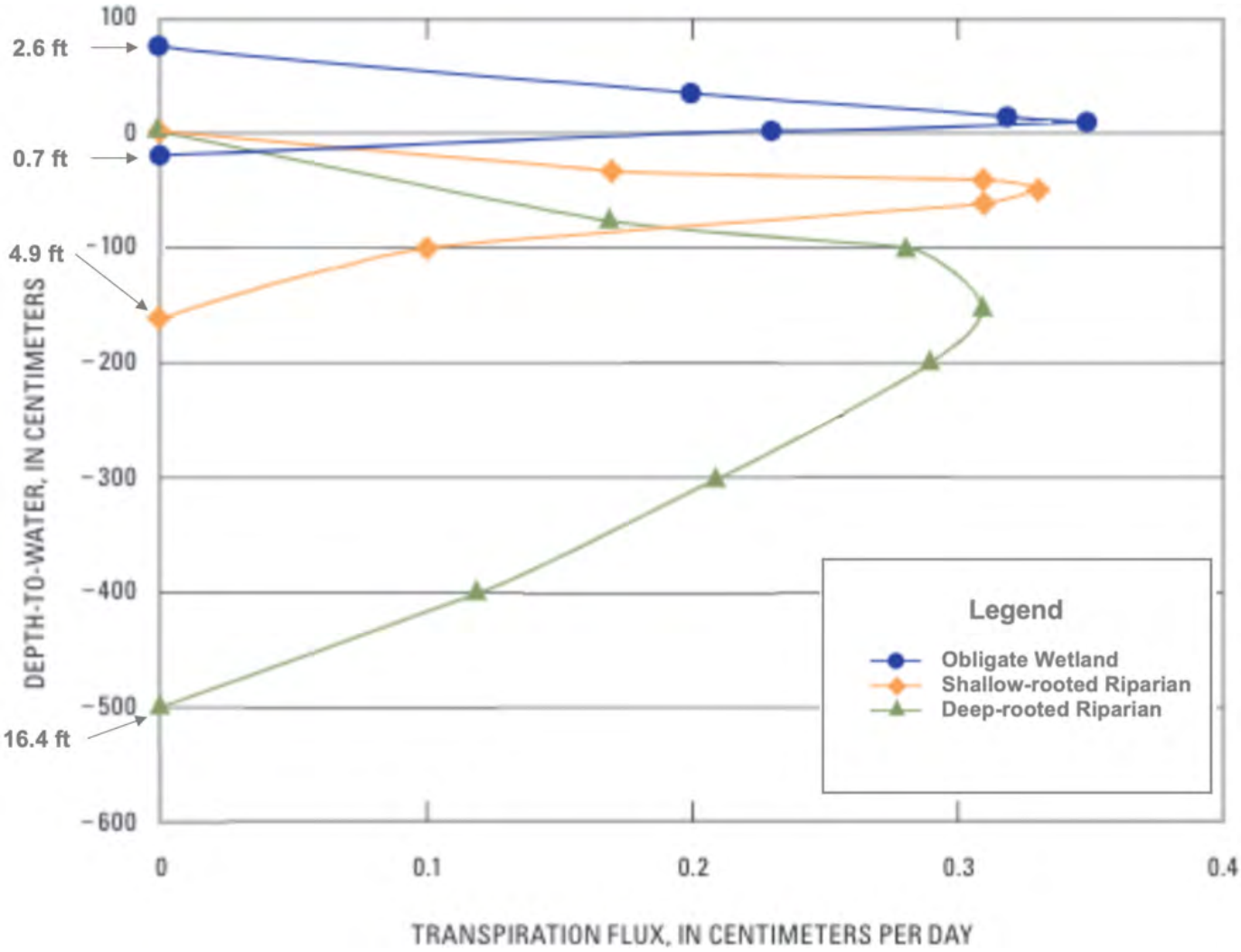
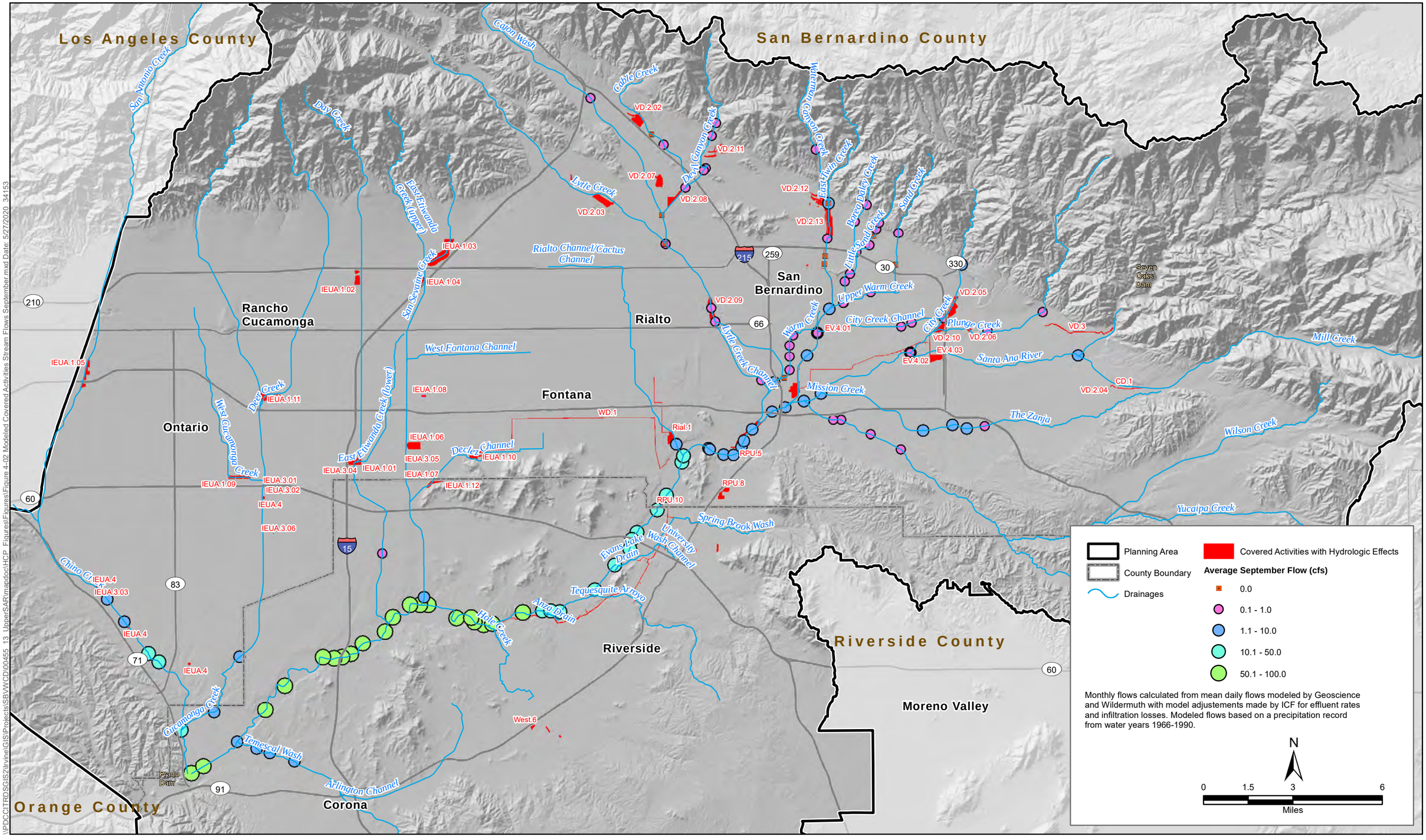


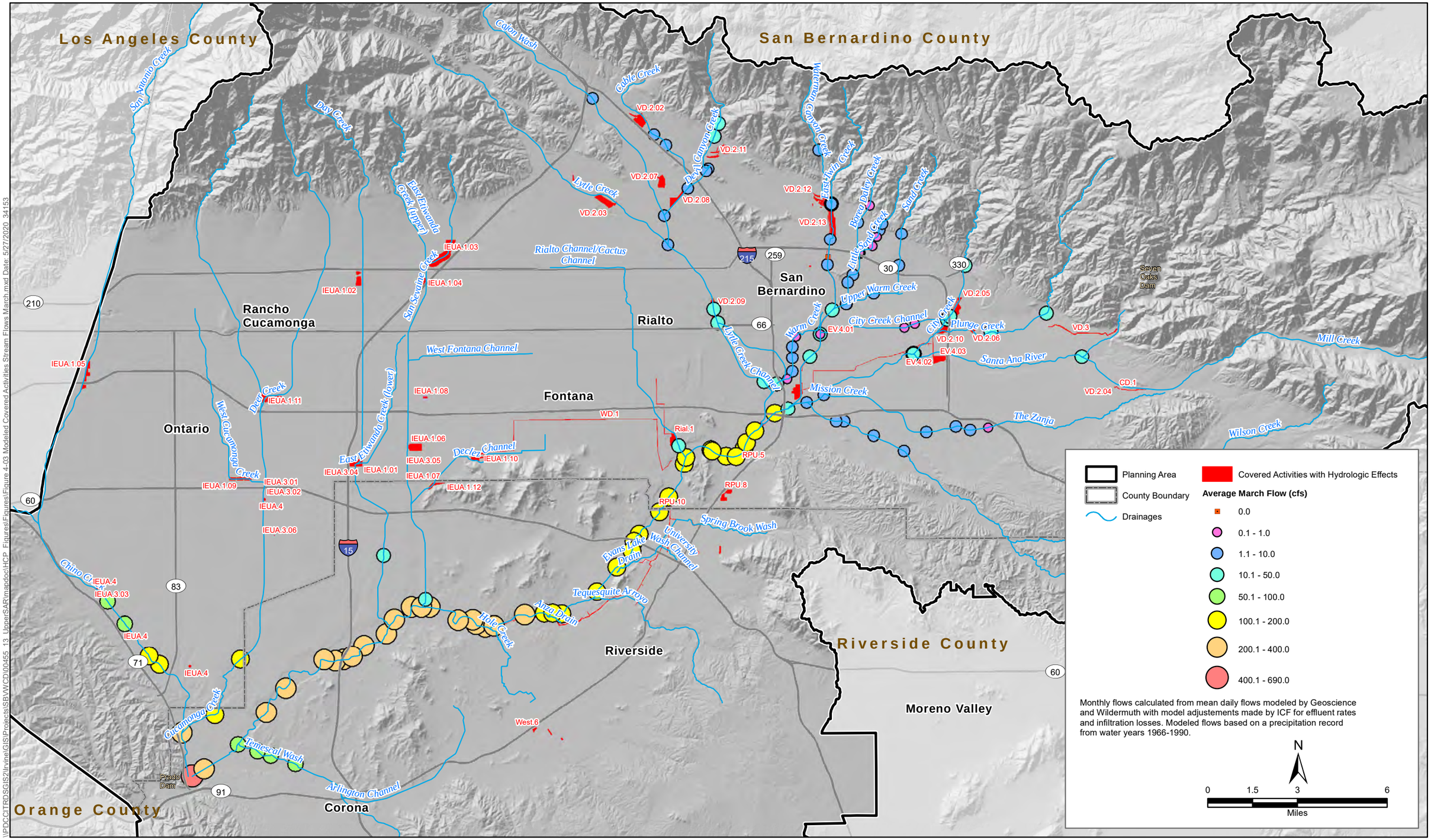
Modified from Maddock et al., 2012

Figure 4-1
GDE Extinction Thresholds as Determined by Evapotranspiration Flux
Upper Santa Ana River Habitat Conservation Plan



Upper Santa Ana River Habitat Conservation Plan

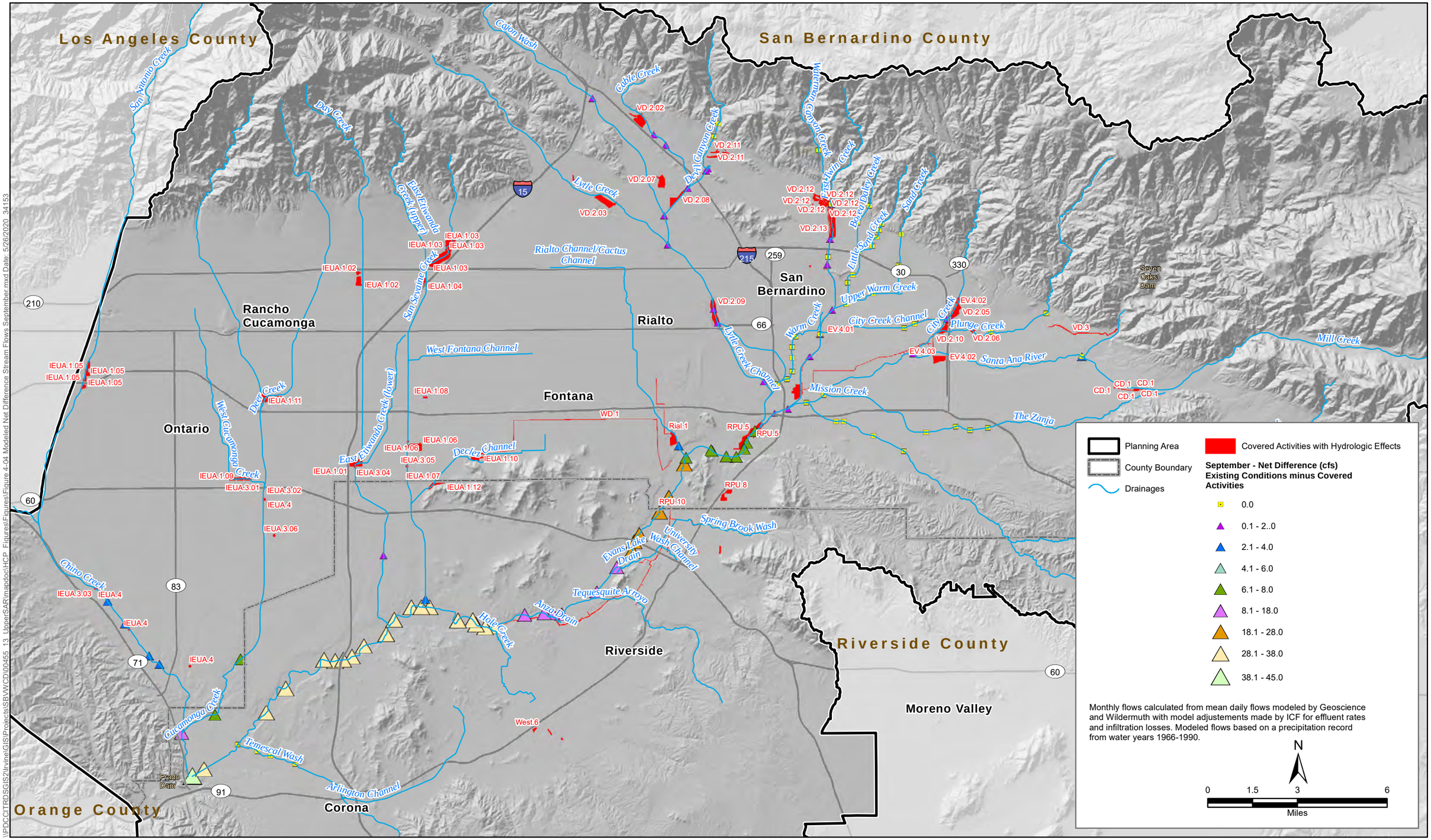
Figure 4-2
September Monthly Average Daily Flow with Covered Activities (modeled)



\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Figures\Figure 4-03 Modeled Covered Activities Stream Flows March.mxd Date: 5/27/2020, 34153

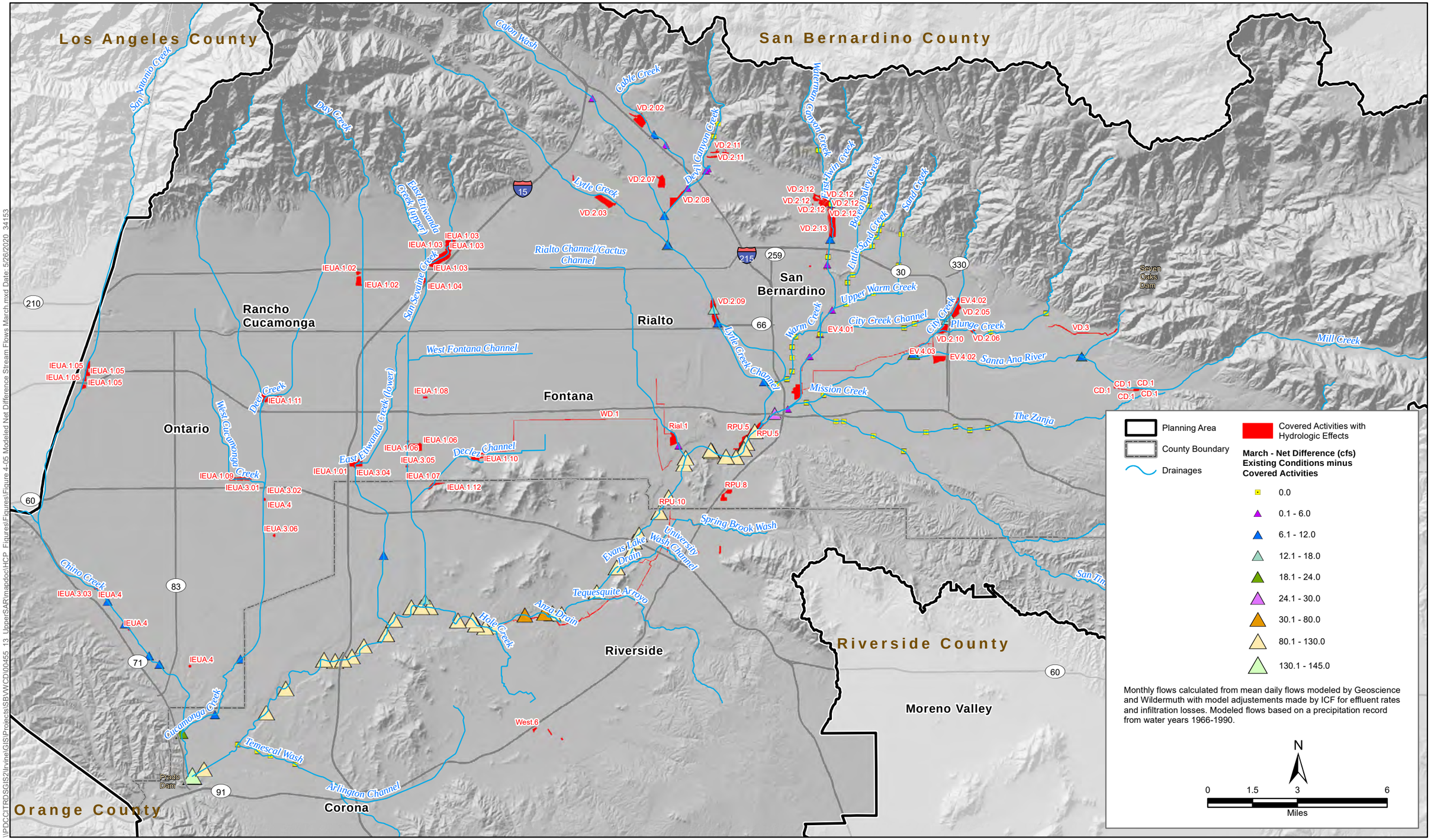
Upper Santa Ana River
Habitat Conservation Plan

Figure 4-3
March Monthly Average Daily Flow with Covered Activities (modeled)



Upper Santa Ana River Habitat Conservation Plan

Figure 4-4
Net Difference in Reduction of September Monthly Average Daily Flow with Covered Activities (modeled)



Upper Santa Ana River Habitat Conservation Plan

Figure 4-5

Net Difference in Reduction of March Monthly Average Daily Flow with Covered Activities (modeled)

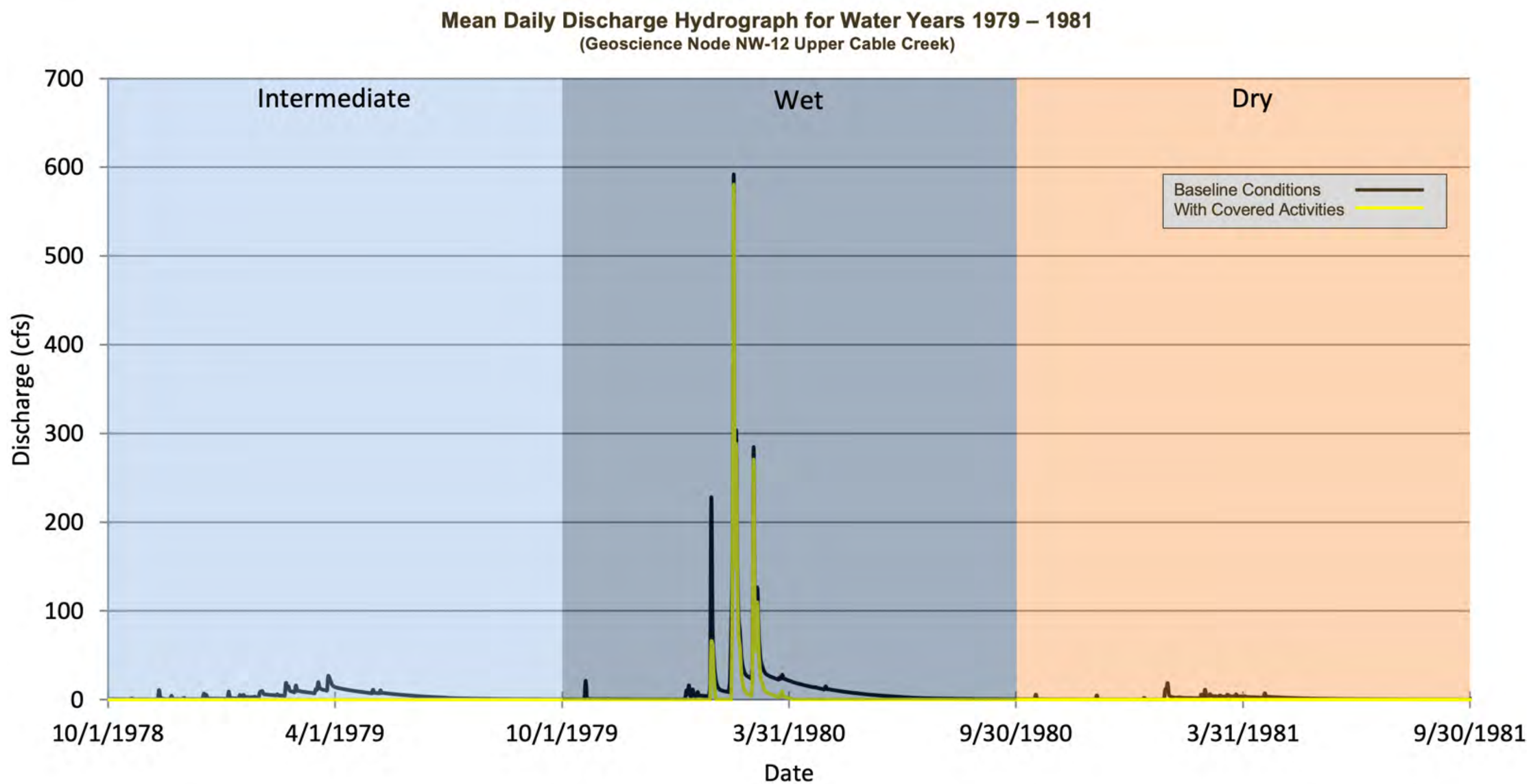
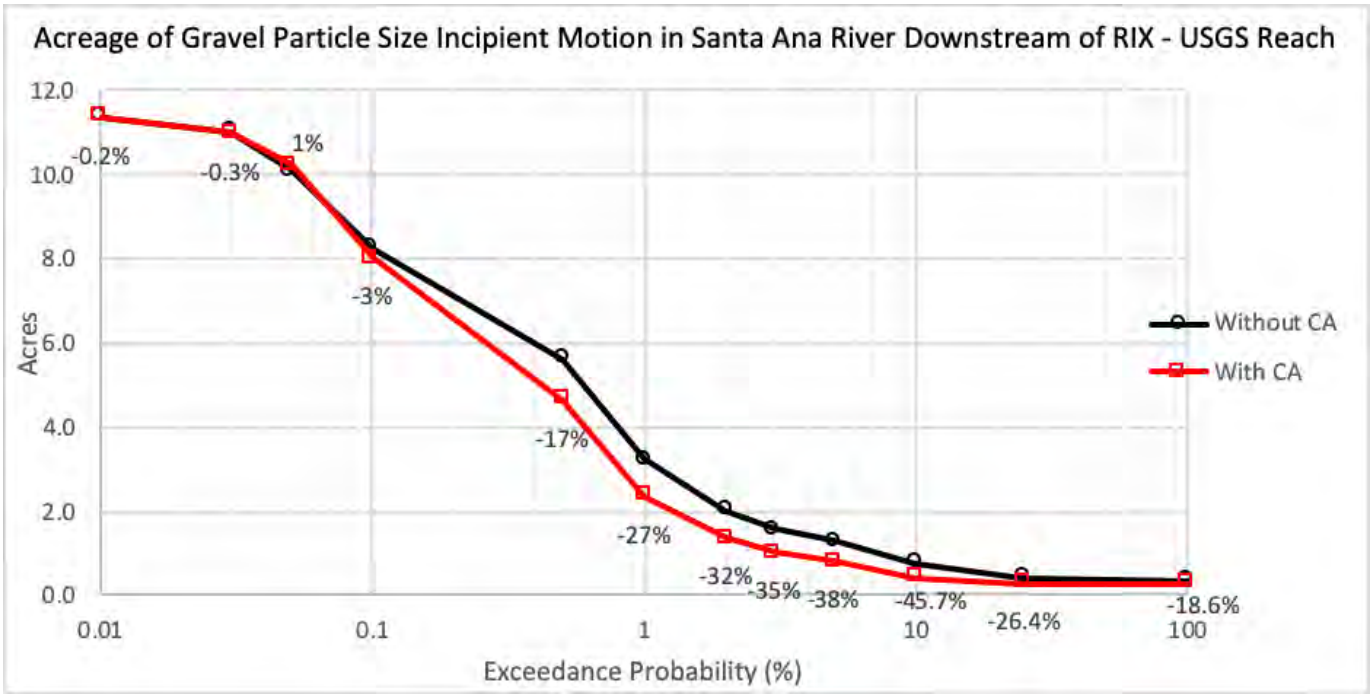


Figure 4-6

Consecutive Intermediate, Wet & Dry Water Year Hydrographs (Example: Upper Cable Creek)



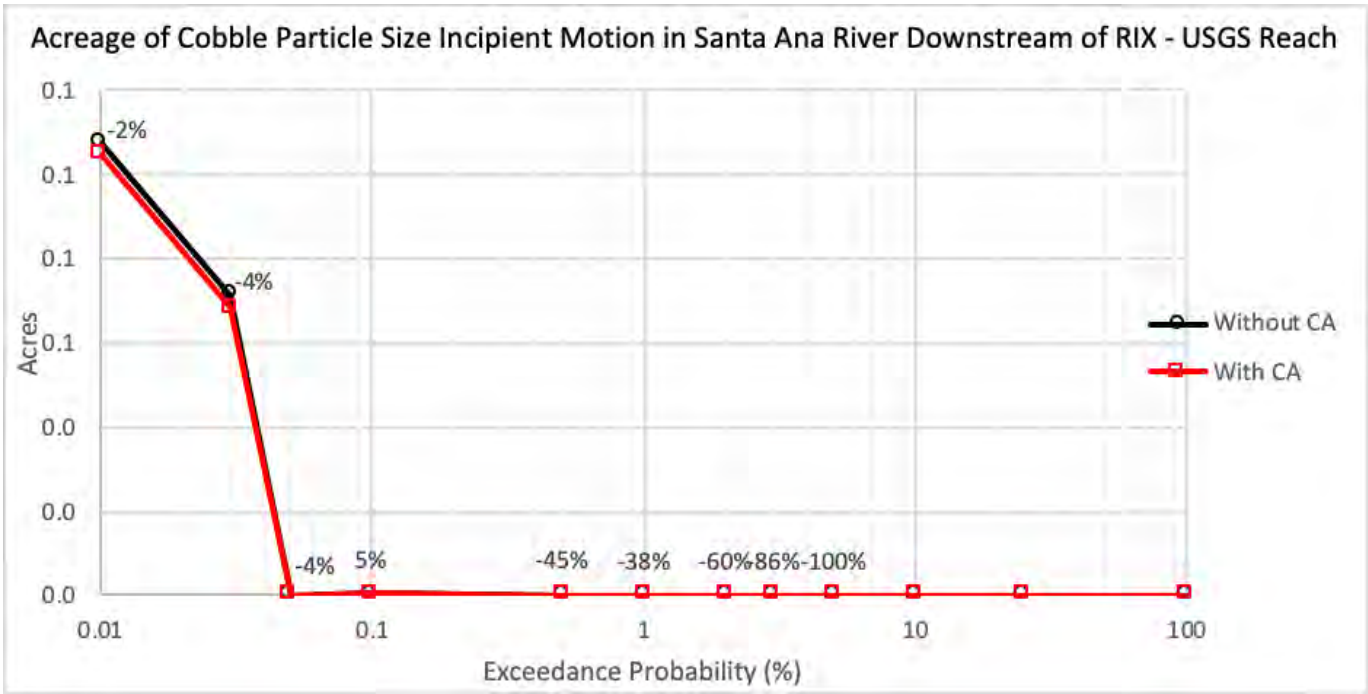
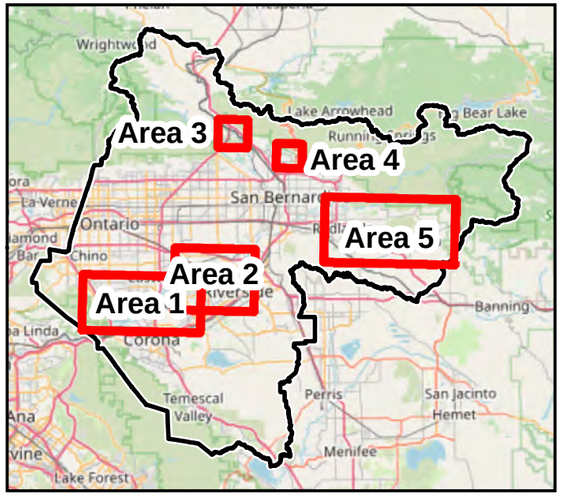
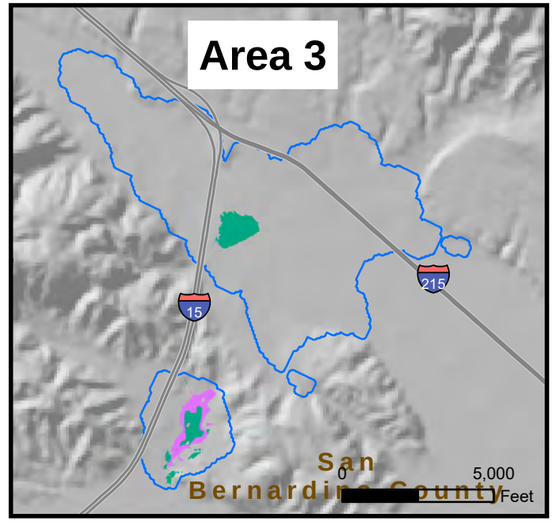
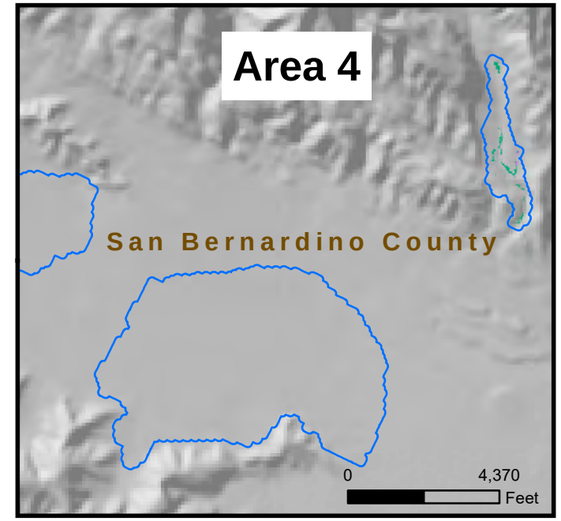


Figure 4-7
Coarse Substrate Incipient Motion in Santa Ana River
Upper Santa Ana River Habitat Conservation Plan







Planning Area
County Boundary
Increasing Groundwater Level
Decreasing Groundwater Level

Groundwater Dependent Ecosystems (GDE)

Wetland - Increasing
Wetland - Decreasing
Riparian - Increasing
Riparian - Decreasing

Source: Geoscience June 2019, CalFire, MSHCP, Wash Plan HCP, NWI, Southern California Wetlands
Date Modified: 5/27/2020

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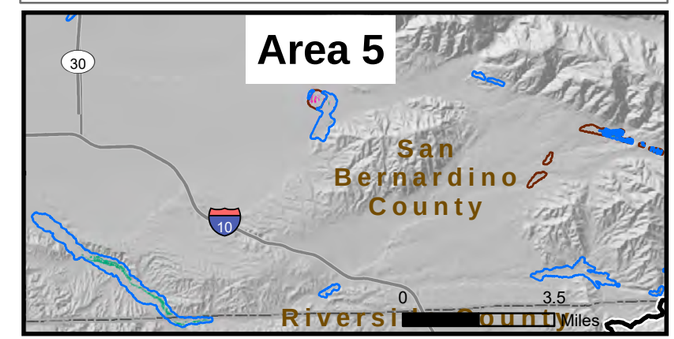
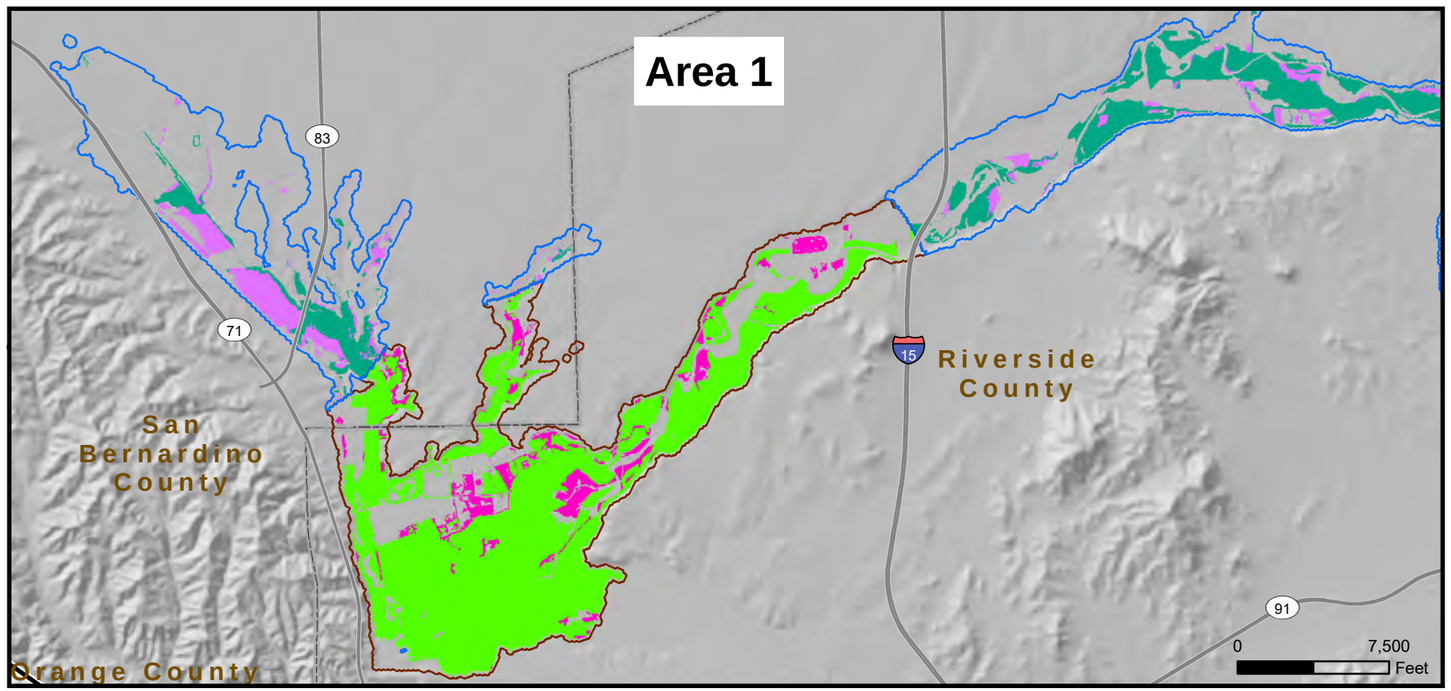
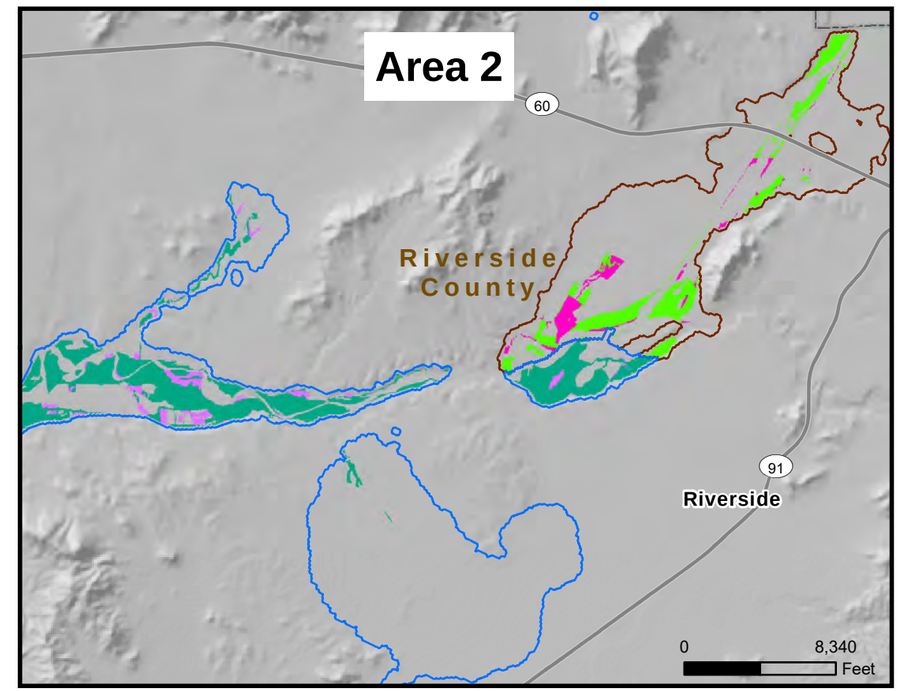


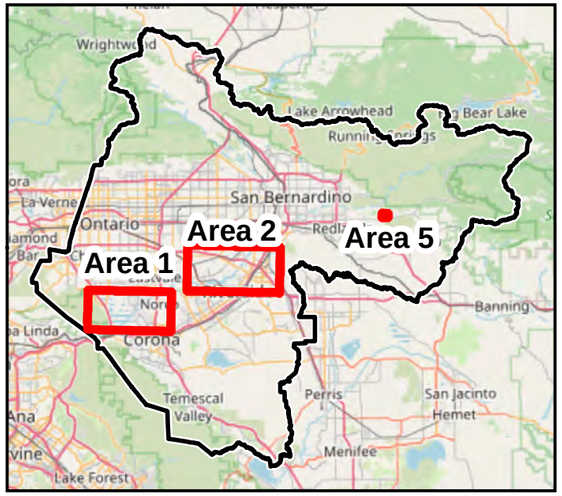


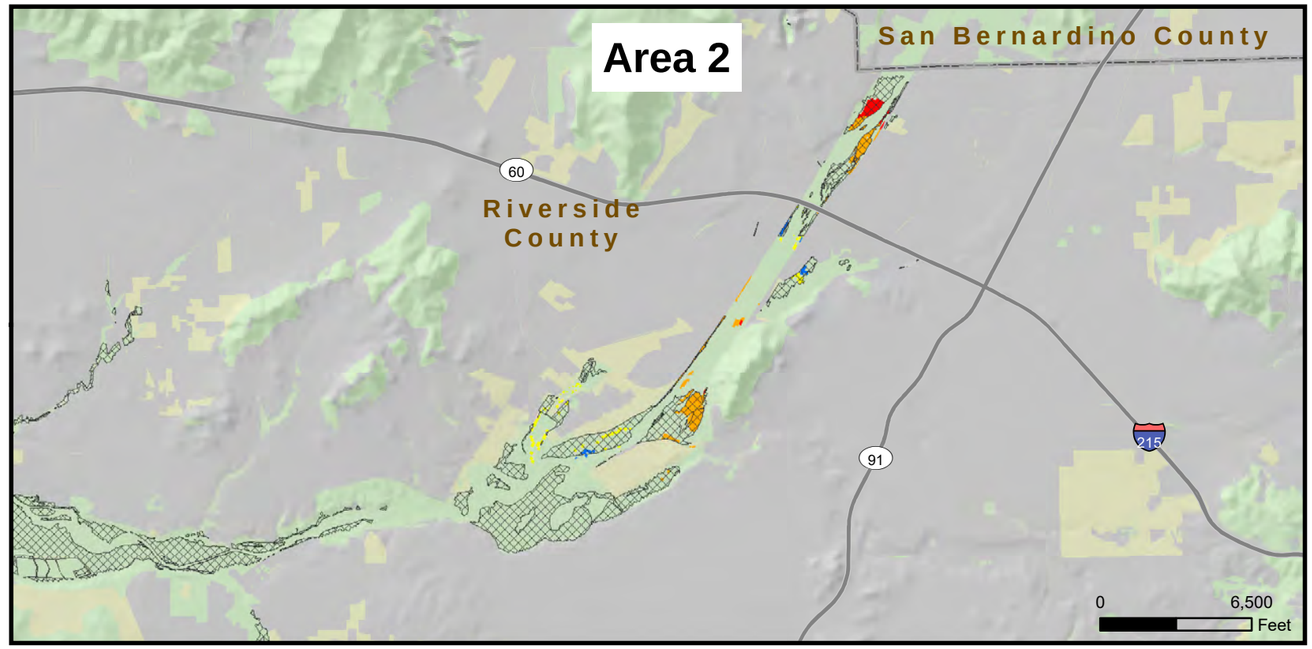


\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBVWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Figures\Figure 4-08 Falling Rising Groundwater with Covered Activities.mxd Date: 5/27/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

Figure 4-8
Modeled Areas of Rising or Falling Groundwater with Covered Activities





Planning Area
County Boundary
Natural Vegetation/Water
Agriculture
Developed

Groundwater Dependent Ecosystems

Riparian

Groundwater Transitions

Existing < 1 ft to Covered Activities 1-5 ft
Existing < 1 ft to Covered Activities 5-16 ft
Existing 1-5 ft to Covered Activities 5-16 ft
Existing 5-16 ft to Covered Activities 16-20 ft
Existing 5-16 ft to Covered Activities > 20 ft

Source: Geoscience June 2019, CalFire, MSHCP, Wash Plan HCP, NWI, Southern California Wetlands
Date Modified: 5/27/2020

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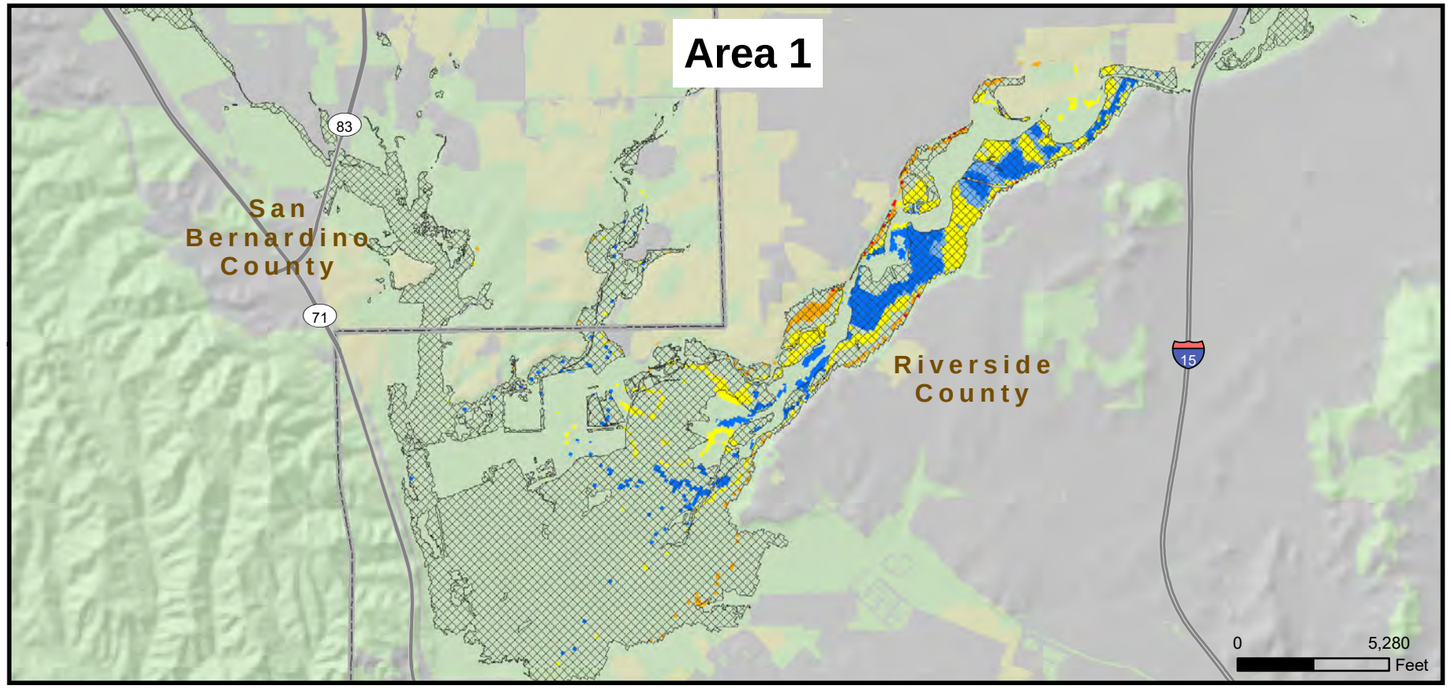
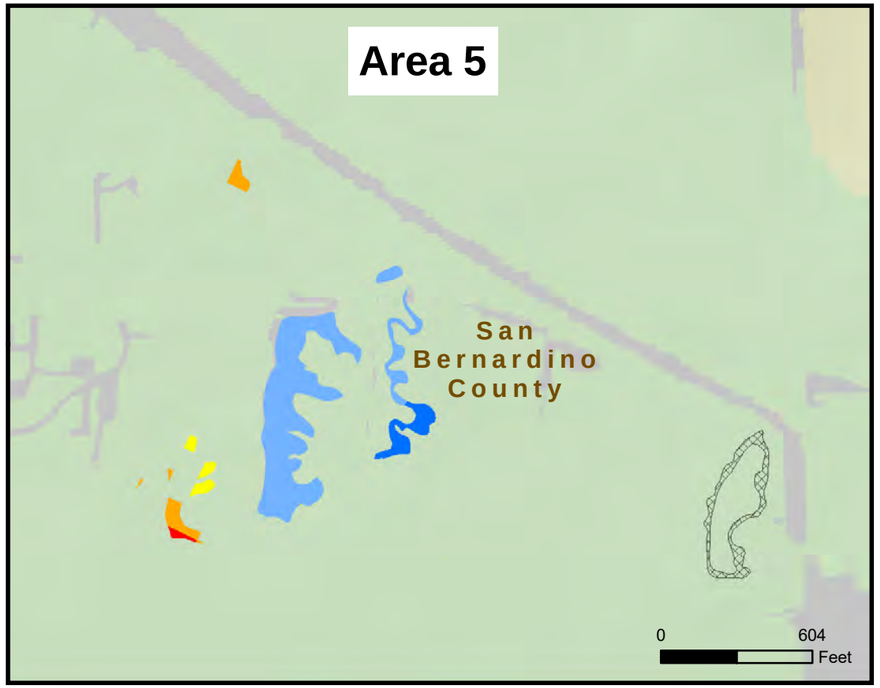
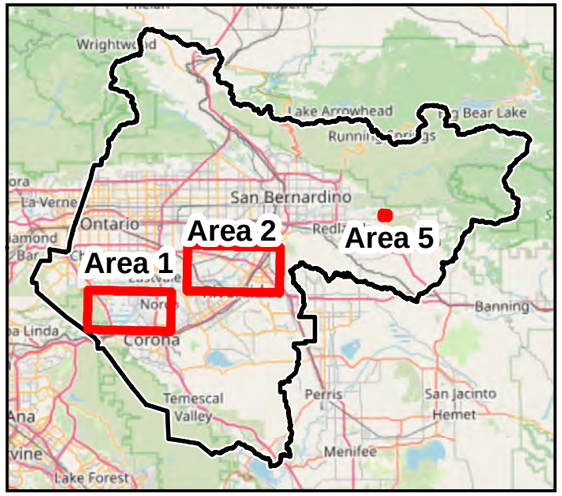


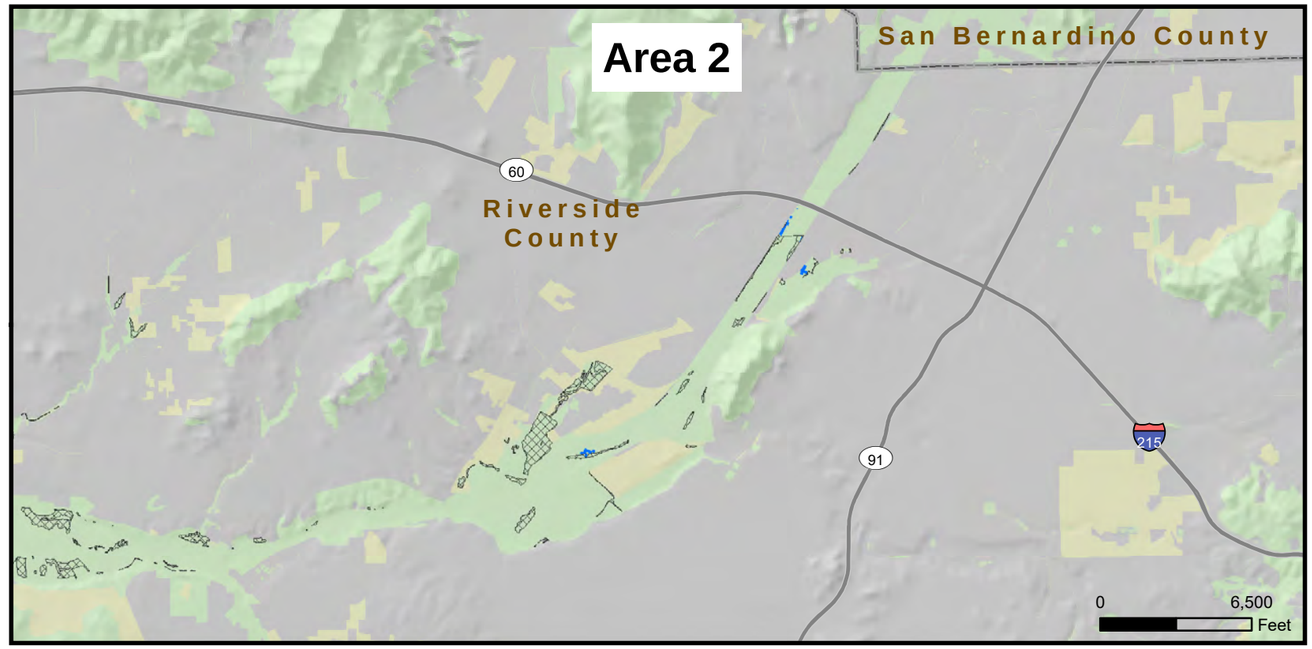


\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Figures\Figure 4-09 Goundwater Transitions Riparian.mxd Date: 5/27/2020 34153

Upper Santa Ana River
Habitat Conservation Plan

Figure 4-9
Groundwater Transitions in Riparian





Planning Area
County Boundary
Natural Vegetation/Water
Agriculture
Developed

Groundwater Dependent Ecosystems

Wetlands

Groundwater Transitions

Existing < 1 ft to Covered Activities 1-5 ft
Existing < 1 ft to Covered Activities 5-16 ft

Source: Geoscience June 2019, CalFire, MSHCP, Wash Plan HCP, NWI, Southern California Wetlands
Date Modified: 5/27/2020

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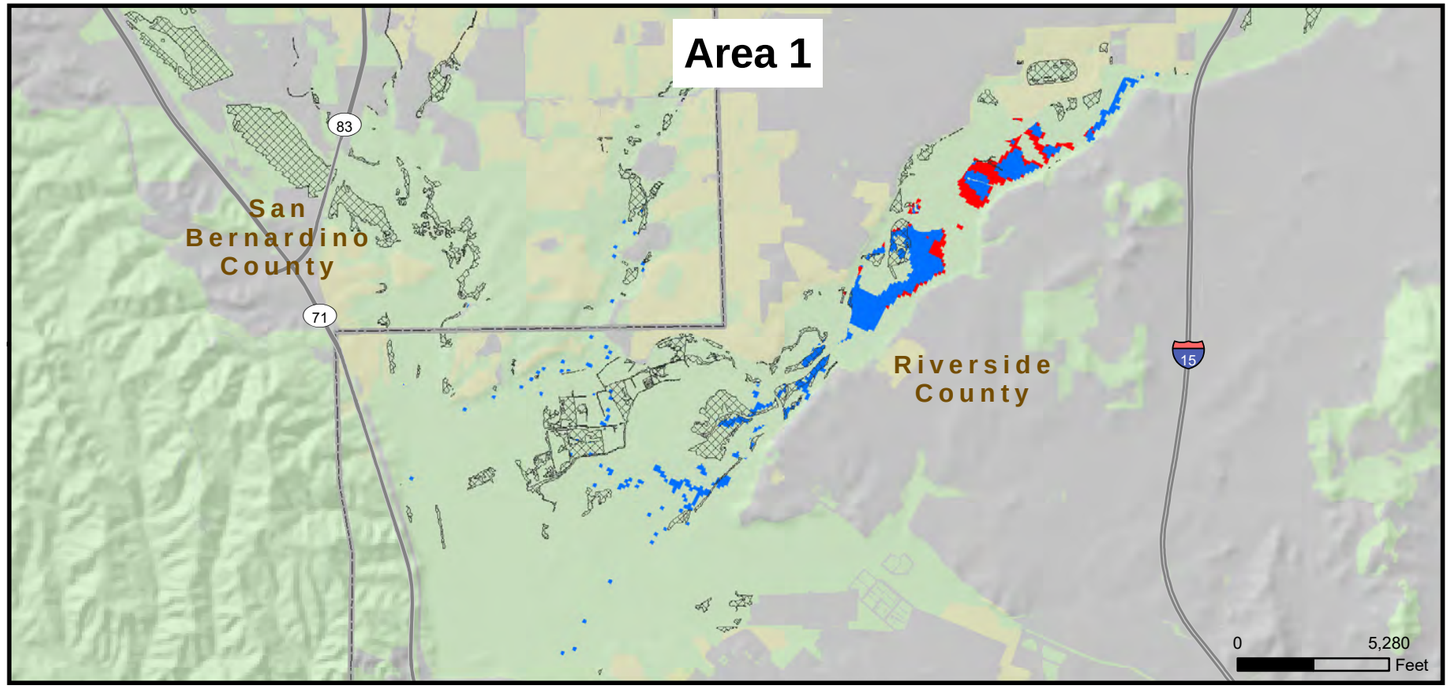
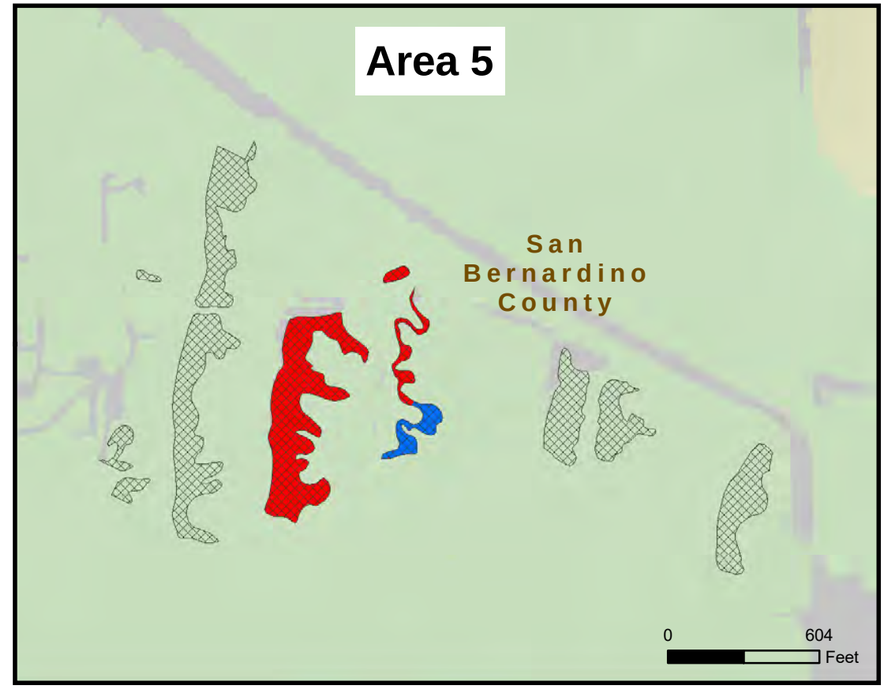




\\PDCCITRDSGIS2\Irvine\GIS\Projects\SBWCD\00455_13_UpperSAR\mapdoc\HCP_Figures\Figures\Figure 4-10 Goundwater Transitions Wetlands.mxd Date: 5/27/2020, 34153

Figure 4-10
Groundwater Transitions in Wetlands

Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Chapter 5
Conservation Strategy

5.1 Introduction and Approach

The conservation strategy for the Upper Santa Ana River (SAR) Habitat Conservation Plan (HCP) is designed to avoid, minimize, and mitigate impacts of the taking of the Covered Species to the maximum extent practicable. The strategy was designed to meet the regulatory requirements of the federal and state Endangered Species Acts and to streamline compliance with other applicable state and federal environmental laws and regulations (Chapter 1, *Introduction*).

Implementation of the Conservation Strategy is the responsibility of the Upper Santa Ana River Sustainable Resources Alliance (Alliance), which will be established as a Joint Powers Authority (JPA) of the HCP. The Alliance will be responsible for implementing the HCP and all conservation actions described in the Conservation Strategy, and assisting the other Permittee Agencies in complying with the conditions of the HCP Incidental Take Permit in connection with their Covered Activities.

The conservation strategy, as organized in this chapter, first describes the more general elements then proceeds to more specific elements, organized by each Covered Species. All conservation actions will be implemented using an adaptive management and monitoring approach (Section 5.12, *Comprehensive Adaptive Management and Monitoring Program*).

5.2 Elements of the Conservation Strategy

The following sections summarize the elements of the conservation strategy, which include all conservation actions as mitigation to offset the impacts of take of Covered Activities to the maximum extent practicable. The conservation actions are based on the biological needs of the Covered Species and, when fully implemented, will meet the biological goals and objectives of the HCP. The elements of the conservation strategy are listed below and are described in more detail in the sections that follow. The phasing of the implementation of these conservation actions in relationship to the implementation of Covered Activities is also described below.

Elements of the Upper Santa River HCP Conservation Strategy:

- *Biological Goals and Objectives* (Section 5.3)
- *HCP Preserve System* (Section 5.4)
  - *Conservation Areas* (acquisitions and easements) (Section 5.4.3)
  - *Restoration Areas* (Santa Ana sucker, wetland/riparian, and alluvial fan scrub) (Section 5.4.4)
- *Hydrologic Manipulation and Substrate Management* (Section 5.5)
- *Captive Rearing and Translocation* (Section 5.6)
- *Species and Habitat Research* (Section 5.7)
- *Conservation Bank Credits* (Section 5.8)

- *Species-Specific Conservation Strategies* (Section 5.9)
- *Fully Avoided Species* (Section 5.10)
- *Measures to Avoid and Minimize Take* (Section 5.11)
- *Comprehensive Adaptive Management and Monitoring Program* (Section 5.12)

5.3 Biological Goals and Objectives

Biological goals and objectives are required elements of an HCP (USFWS and NMFS 2016). Biological goals are broad, guiding principles based on the conservation needs of the Covered Species. Biological objectives are expressed as conservation targets or desired future conditions and are designed to achieve the biological goals. The Upper Santa Ana River HCP has four overarching goals and seven HCP Objectives as listed below.

The HCP Goals will be accomplished within the HCP Preserve System and are as follows:

HCP Goal 1: Conserve Covered Species and their habitats to contribute to the recovery of listed species or those that may become listed under the ESA.

HCP Goal 2: Sustain the ecological processes necessary to maintain the functionality of the natural communities and habitats upon which the Covered Species depend.

HCP Goal 3: Maintain and improve habitat connectivity in the HCP Preserve System and to adjacent protected habitat areas to facilitate movement and genetic exchange between populations of Covered Species.

HCP Goal 4: Actively manage lands within the HCP Preserve System to maintain or improve conditions for the benefit of Covered Species.

The following seven HCP Objectives will support the HCP Goals:

HCP Objective 1: Conserve and manage 1,901.5 acres of native habitat in the HCP Preserve System.

HCP Objective 2: Restore and re-establish 538.6 acres of habitat for Covered Species.

HCP Objective 3: Reduce anthropogenic and environmental threats to the HCP Preserve System.

HCP Objective 4: Maintain and enhance existing Santa Ana sucker habitat.

HCP Objective 5: Maintain and enhance existing San Bernardino kangaroo rat habitat.

HCP Objective 6: Implement Relocation or Translocation of Covered Species.

HCP Objective 7: Improve knowledge of Covered Species.

Species-specific objectives and species-specific conservation actions are presented for each Covered Species in Section 5.9, *Species-Specific Conservation Strategies,* to achieve the HCP-level goals and objectives.

5.4 HCP Preserve System

The Alliance—as the HCP Implementing Entity—will provide for the permanent conservation of approximately 1,902 acres within the HCP Preserve System. The HCP Preserve System will be assembled through a combination of property acquisitions, establishment of conservation easements, and other permanent conservation land designations. All habitat restoration will occur on land within the HCP Preserve System. The HCP Preserve System will be managed and monitored through the Comprehensive Adaptive Management and Monitoring Program (CAMMP) that will be implemented by the Alliance.

All conserved lands planned for within the HCP Preserve System are generally contiguous with existing open space and protected areas within the Planning Area (Figure 5-1), and will become an important component of the network of preserved lands that includes other HCPs and natural community conservation plans (NCCPs) (e.g., Upper Santa Ana River Wash HCP [Wash Plan HCP], Western Riverside Multiple Species Habitat Conservation Plan), open space parks and wildlife areas (e.g., County parks and California Department of Fish and Wildlife [CDFW] preserves), and other public lands (e.g., U.S. Forest Service [USFS] and Bureau of Land Management [BLM] lands). As can be seen in Figure 5-1, the HCP Preserve System includes Conservation and Restoration Areas that are generally well-connected to other existing protected areas.

The HCP Preserve System is composed of all Restoration Areas that are planned to be restored or enhanced as mitigation for the HCP (Figures 5-2 and 5-3), all Conservation Areas that are conserved through acquisition and/or easements and managed as mitigation for the HCP (Figures 5-4 through 5-6), and the Santa Ana Sucker Translocation Streams (Figure 5-1). These areas of the HCP Preserve System will be adaptively managed together for the long-term protection of the Covered Species and the habitats that support them. The Restoration Areas are shown in detail on Figures 5-2 and 5-3, while the Conservation Areas that make up the rest of the HCP Preserve System are shown on Figures 5-4 through 5-6.

The HCP Preserve System is divided into five main preserve units, as listed below (Figure 5-1). Preserve unit boundaries generally follow hydrologic unit code (HUC) 12 watershed boundaries, except the Santa Ana River Preserve Unit, which includes the natural habitat along the mainstem of the Santa Ana River and Prado Basin down to Prado Dam.

Santa Ana River Preserve Unit: The Santa Ana River Preserve Unit includes all the major tributary and riparian floodplain Restoration Areas, the main stem of the Santa Ana River, and several additional Conservation Areas to be acquired and/or established as conservation easements. The Santa Ana River Preserve Unit will protect and enhance habitat values for aquatic and riparian habitats for Covered Species and aquatic resources along the Santa Ana River and tributaries, improving habitat condition and habitat connectivity.

Alluvial Fan Preserve Unit A: The Santa Ana Wash Preserve Unit A includes a mix of alluvial fan sage scrub Restoration Areas and Conservation Areas to be acquired and/or establish conservation easements. The Santa Ana Wash Preserve Unit includes preservation and Restoration Areas adjacent to the Woolly-star Preserve Area, the Wash Plan HCP, and tributaries connecting up to the large areas of protected lands in the San Bernardino National Forest that provide important connectivity for both alluvial fan sage scrub, aquatic, and riparian Covered Species, habitats, and ecological processes.

Alluvial Fan Preserve Unit B: The Alluvial Fan Preserve Unit B includes several alluvial fan sage scrub, shrubland, woodland, and riparian Conservation Areas to be acquired and/or establish conservation easements. Similar to the Alluvial Fan Preserve Unit A, this Preserve Unit also includes preservation that provide important connectivity for both alluvial fan sage scrub, aquatic, and riparian species along these tributaries connecting up to the large areas of protected lands in the San Bernardino National Forest. Additionally, the Alluvial Fan Preserve Unit B also includes the Lytle Creek Conservation Bank and the Cajon Creek Conservation Bank (neither of which would be formally incorporated into the HCP Preserve System if credits were purchased as mitigation).

Santa Ana Sucker Translocation Preserve Units A and B: The Santa Ana Sucker Translocation streams are higher gradient headwater streams, and may include the Santa Ana River upstream of Seven Oaks Dam, as well as Plunge, Hemlock, Mill, Bear, Alder and Mountain Home Creeks. The Santa Ana Sucker Translocation Preserve Unit A also includes several Conservation Areas to be acquired and/or established as conservation easements, which will provide important connectivity for both alluvial fan sage scrub, aquatic, and riparian species along these tributaries connecting up to the large areas of protected lands in the San Bernardino National Forest.

5.4.1 Phases of HCP Preserve System Implementation

HCP implementation has been separated into phases to ensure, and to clearly describe, that the conservation actions and associated mitigation are able to occur before and stay ahead of the impacts of Covered Activities. The HCP conservation actions and mitigation as well as Covered Activity implementation are grouped into four phases: Phase 1 (years 0–5), Phase 2 (years 6–10, Phase 3 (years 11–15) and Phase 4 (years >15).

The HCP Preserve System will include a total of 1,901.5 acres, including preservation of land via acquisitions and/or easements, and habitat restoration. Table 5-1 summarizes in which phase these lands will be dedicated for conservation or restored to mitigate impacts. Approximately 1,406.3 acres (65%) of the HCP Preserve System will be dedicated for conservation during Phase 1 (years 0–5) of the permit duration and the remaining 495.2 acres (35%) will be dedicated in Phase 2 (Table 5-1). Approximately 235.2 acres (43%) of the habitat restoration will occur in Phase 1, 251 acres (51%) of the habitat restoration will occur in Phase 2, and the remaining 34.4 acres (6%) will be restored in Phase 3 of HCP implementation (Table 5-2).

As analyzed in detail in Chapter 4, *Take Assessment and Impact Analysis*, there will be approximately 1,968.1 acres of ground-disturbing impacts from Covered Activities (Table 5-3). Approximately 898.2 acres (46%) will be impacted during Phase 1, 679 acres (35%) during Phase 2, 198 acres (10%) during Phase 3, and 192 acres (9%) during Phase 4 of HCP implementation.

Table 5-1. Approximate Phasing of Conservation of Vegetation Communities in the HCP Preserve System (acres)

Conserved Vegetation Types	Phase 1 (Yrs 0–5)	Phase 2 (Yrs 6–10)	Phase 3 (Yrs 11–15)	Phase 4 (Yrs >15)	HCP Preserve System Total
Riparian	126.9	92.7	--	--	219.6
Wetlands	64.0	25.4	--	--	89.3
Permanent Water	35.5	17.2	--	--	52.7
Water in Existing Basins	--	--	--	--	--

Conserved Vegetation Types	Phase 1 (Yrs 0–5)	Phase 2 (Yrs 6–10)	Phase 3 (Yrs 11–15)	Phase 4 (Yrs >15)	HCP Preserve System Total
Dry Channel/Shrubland[1]	121.0 (98.0)	48.2 (4.7)	--	--	169.3 (102.7)
Shrublands[1]	856.0 (741.9)	266.6 (35.1)	--	--	1,122.6 (776.9)
Woodlands	21.0	--	--	--	21.0
Grasslands	155.2	44.8	--	--	200.0
Rock Outcrops	26.7	0.2	--	--	26.9
Total by Phase	**1,406.3**	**495.2**	**--**	**--**	**1,901.5**
Total Alluvial Fan Sage Scrub by Phase[1]	*839.9*	*39.8*	--	--	*879.6*

[1] Shrublands and Dry Channel/Shrubland include alluvial fan sage scrub acres as shown in parentheses.

Table 5-2. Approximate Phasing of Restoration and Enhancement Projects in the HCP Preserve System

Restored and Enhanced Habitats	Phase 1 (Yrs 0–5)	Phase 2 (Yrs 6–10)	Phase 3 (Yrs 11–15)	Phase 4 (Yrs >15)	Restoration Total
Tributary Stream Channel[1] (stream miles/acres)	1.5/1.7	2.4/1.9	--	--	3.9/3.6
Santa Ana River Microhabitat (acres)	1.5	--	--	--	1.5
Riparian[2] (acres)	27.6	188.6	--	--	216.2
Wetland[3] (acres)	--	54.1	--	--	54.1
Alluvial Fan Sage Scrub[4] (acres)	188.0	40.6	34.6	--	263.2
Total by Phase (stream miles)	*1.5*	*2.4*	--	--	*3.9*
Total by Phase (acres)	**218.8**	**285.2**	**34.6**	**--**	**538.6**
Additional Area[5]	--	--	--	--	89.3
Grand Total	**--**	**--**	**--**	**--**	**627.9**

[1] Tributary stream channel restoration at Hidden Valley Creek, Anza Creek, Old Ranch Creek, Lower Hole Creek, Evans Lake Creek and installation of Santa Ana River Microhabitat Structures.

[2] Floodplain restoration at Hidden Valley Creek and Ponds, Lower Hole Creek, Evans Lake Creek, Sunnyslope Creek.

[3] At Hidden Valley Creek and Ponds.

[4] Alluvial fan sage scrub restoration at Enhanced Recharge Basin restoration site, North Enhanced Recharge Basin restoration site, and Drainage A Woolly-Star restoration site (or alternate location).

[5] Additional area within restoration projects boundaries.

Table 5-3. Approximate Phasing Covered Activities and Associated Impacts in the Permit Area[1]

Vegetation Types	Phase 1 (Yrs 0–5)	Phase 2 (Yrs 6–10)	Phase 3 (Yrs 11–15)	Phase 4 (Yrs >15)	Total Impacts
Riparian	46.6	22.7	11.8	0.6	81.7
Wetlands	28.5	44.5	2.9	--	75.9
Permanent Water	15.2	23.5	--	0.6	39.3
Water in Existing Basins	335.5	280.3	--	2.9	618.7

Vegetation Types	Phase 1 (Yrs 0–5)	Phase 2 (Yrs 6–10)	Phase 3 (Yrs 11–15)	Phase 4 (Yrs >15)	Total Impacts
Dry Channel/Shrubland[2]	48.3 (18.9)	34.5 (15.5)	96.8 (91.1)	83.6 (82.2)	263.1 (207.7)
Shrublands[2]	210.2 (73.9)	145.9 (49.9)	80.9 (19.7)	85.9 (51.3)	522.9 (194.8)
Woodlands	3.4	1.7	--	--	5.1
Grasslands	205.1	115.8	4.9	18.7	344.5
Rock Outcrops	5.4	10.5	0.6	0.2	16.8
Total by Phase	**898.2**	**679.4**	**198.0**	**192.5**	**1,968.1**
Total Alluvial Fan Sage Scrub by Phase	*92.8*	*65.3*	*110.9*	*133.5*	*402.5*

[1] Acres of ground disturbance.

[2] Shrublands and Dry Channel/Shrubland include alluvial fan sage scrub acres as shown in parentheses.

Stay Ahead Provision

The phasing shown in Table 5-1 through Table 5-3 is based on the best estimates for approximate timing. The actual implementation of Covered Activities, restoration, and conservation may vary. Regardless, the restoration and conservation as mitigation established by the HCP will stay ahead of the impacts by a minimum of 10%. The Alliance will ensure that HCP implementation is in compliance with this Stay Ahead Provision by monitoring and tracking the establishment of the HCP Preserve System and restoration projects along with tracking of impacts through the consistency review process for Covered Activities (see the *Project Consistency Review* in Chapter 6, Section 6.5.2, *Implementing Entity Responsibilities*). Phase 1 of the HCP implementation will be well ahead of the Stay Ahead Provision (65% of conservation vs. 46% of impacts); however, if at any time the conservation is less than 10% ahead of the impacts, no additional Covered Activities will be implemented until the conservation is brought into alignment (>10%) of the provision. Figures 5-7 through 5-10 depict the Covered Activities associated with each phase of the HCP alongside the Conservation Areas and Restoration Areas to be established in the HCP Preserve System in each phase of HCP implementation.

Table 5-4. Stay Ahead Provision Tracking by HCP Phase

	Phase 1 (Yrs 0–5)	Phase 2 (Yrs 6–10)	Phase 3 (Yrs 11–15)	Phase 4 (Yrs >15)	Total
Conservation	65%	35%	--	--	100%
Restoration	43%	51%	6%	--	100%
Covered Activity Impacts	46%	35%	10%	9%	100%

5.4.2 Mitigation Reserve Program (Mitigation Accounting)

The Alliance will establish a Mitigation Reserve Program to account for and track the development of mitigation value (i.e., “credits”) and application of those mitigation values to future permit requirements for HCP Covered Activities. The purpose of the Mitigation Reserve Program is to establish a common understanding and legal framework for the conservation and mitigation values created by HCP conservation actions, and to establish a transparent mechanism for tracking those

values (debits and credits) over time. In this way the Mitigation Reserve Program will be used to inform and track regulatory compliance of the HCP Covered Activities, including species and aquatic resource mitigation.

The Mitigation Reserve Program will include a spatial (geographic information system [GIS]) accounting database to establish and track all mitigation credit generation (e.g., through acquisitions, conservation easements, restoration, and enhancement) and maintain records on the management of those resource values over time for the purposes of reporting, as required by the regulatory agencies. The GIS tracking component will provide an efficient mechanism to view and account for "stacked" mitigation credits for species habitat and aquatic resources in the HCP Preserve System. Stacked credits occur where mitigation for multiple resource types and regulations overlap such as when species credits and aquatic resource credits exist in the same conserved/enhanced area. The program will provide a spatial and tabular accounting of all mitigation credits as they are established (i.e., reserved in advance of any specific project's impact) and used (i.e., dedicated to offset a specific project's impacts) in the Mitigation Reserve Program by the Alliance. Once created, stacked credits cannot be unstacked; one credit, or portion thereof, may only be used to provide mitigation for one project. As Covered Activities are implemented under the HCP the impacts on species and aquatic resources will be monitored, tracked, and debited from the Mitigation Reserve Program for an efficient and transparent process of mitigation credit use. The establishment of mitigation credits and the use of mitigation credits will be summarized in annual reports to the regulatory agencies.

Several of the restoration areas will be developed as formal mitigation banks and species conservation banks. The mitigation credit established in those banks will also be simultaneously established and tracked in parallel in the Mitigation Reserve Program. Similarly, when mitigation credits in a bank are used, they will be simultaneously debited from the Mitigation Reserve Program. The mitigation and species conservation banks may include credits from restoration actions above and beyond what is included in the HCP. These credits are not considered part of the HCP conservation strategy.

The Mitigation Reserve Program will include development of legal agreements that will formalize the conservation/mitigation values created by establishment of Conservation Areas and Restoration Areas within the HCP Preserve System as recognized by the environmental regulatory agencies (U.S. Army Corps of Engineers [USACE], CDFW, Regional Water Quality Control Board [RWQCB], and U.S. Fish and Wildlife Service [USFWS]).

5.4.3 Conservation Areas

There are 14 Conservation Areas that have been identified to date as planned mitigation sites for the HCP (see Figures 5-3 to 5-5 and Table 5-5) and will be a part of the HCP Preserve System. These areas were identified because they had suitable habitat and, in many cases, known occurrences of Covered Species. Additionally, these areas were selected because they were adjacent to, or in close proximity to, other protected areas of habitat in the network of protected lands in the Upper SAR. Therefore, they have high potential for sustaining Covered Species on habitat to be monitored and managed under by the HCP. There are approximately 972 acres of habitat in Conservation Areas that will be acquired or have easements established under Phase 1 of the HCP (much of which will have already been achieved by the time of HCP permit issuance). Another 302 acres are identified for Phase 2. Because the acquisition and/or establishment of easements is dependent on willing sellers it is possible that not all 14 of these Conservation Areas will become a part of the HCP Preserve

System. Similarly, other potential Conservation Areas with suitable habitat for Covered Species may become available in the future and could become a part of the HCP Preserve System. Any Conservation Areas currently identified for acquisition and/or easements or identified in the future will require Wildlife Agencies' concurrence before becoming part of the HCP Preserve System and the mitigation credit is assigned to the HCP. All areas that become a part of the HCP Preserve System (Conservation Areas, as well as Restoration Areas) will be monitored and adaptively managed according to the CAMMP of the HCP.

Table 5-5. Acres of Habitat by Phase in HCP Conservation Areas[1]

HCP Conservation Areas by Phase	Riparian	Wetlands	Permanent Water	All Dry Channel/ Shrubland (Alluvial Fan Sage Scrub)	All Shrublands (Alluvial Fan Sage Scrub)	Grasslands	Woodlands	Rock Outcrops	Total Natural Habitats
Phase 1									
Bastidos-Greenspot Rd	--	--	--	0.3 (0.3)	18.3 (18,3)	--	--	--	18.6
CD-Greenspot Rd	--	--	--	0.3 (0.3)	6.9 (6.9)	--	--	--	7.2
CD-Mill Creek	3.6	48.7	9.4	13.7 (13.7)	313.1 (284.7)	12.6	--	16.3	417.2
DWR-Devil Creek	--	--	--	6.0 (6.0)	13.7 (11.9)	--	--	0.2	20.0
EV-City Creek	1.1	--	0.2	0.8 (0.5)	1.5 (--)	--	--	--	3.6
EV-SAR	--	--	--	-- (--)	10.9 (10.9)	--	--	--	10.9
Greenspot Corridor-SAR-East	--	--	--	0.1 (0.1)	10.1 (10.1)	--	--	--	10.2
Greenspot Corridor-SAR-West	--	--	--	0.1 (0.1)	4.1 (4.1)	--	--	--	4.2
Kuykendall-Greenspot Rd	--	--	--	-- (--)	0.9 (0.9)	--	--	--	0.9
Rossmore Enterprises-SAR	--	--	--	-- (--)	-- (--)	39.6	--	--	39.6
RPU-SAR	15.9	0.1	--	-- (--)	35.5 (7.4)	36.2	--	0.1	87.7
WD-Devil Creek	--	--	14.5	54.8 (54.5)	231.2 (179.2)	22.3	19.0	10.1	352.0
Phase 1 Total	*20.5*	*48.7*	*24.1*	*76.1 (75.7)*	*646.2 (534.6)*	*110.6*	*19.0*	*26.7*	*972.1*
Phase 2									
City Creek Water Co	9.8	3.4	3.5	17.0 (3.9)	223.9 (0.7)	2.7	--	0.2	260.4
Frost Trust-Plunge Creek	--	--	--	0.4 (0.4)	35.3 (34.4)	5.4	--	--	41.1
Phase 2 Total	*9.8*	*3.4*	*3.5*	*17.4 (4.3)*	*259.2 (35.1)*	*8.1*	--	*0.2*	*301.5*

HCP Conservation Areas by Phase	Riparian	Wetlands	Permanent Water	All Dry Channel/ Shrubland (Alluvial Fan Sage Scrub)	All Shrublands (Alluvial Fan Sage Scrub)	Grasslands	Woodlands	Rock Outcrops	Total Natural Habitats
Phase 3									
None	--	--	--	--	--	--	--	--	--
Phase 4									
None	--	--	--	--	--	--	--	--	--
All Phases Total	**30.3**	**52.1**	**27.6**	**93.5 (79.7)**	**905.4 (569.7)**	**118.7**	**19.0**	**26.9**	**1,273.6**

[1] Portions of the HCP Preserve System without planned restoration projects.

5.4.4 Restoration Areas

All habitat restoration will occur on land within the HCP Preserve System. Throughout the HCP the acreages of habitat contained in the Preserve System are quantified by natural vegetation community type (as in Table 5-6) and by acres of suitable habitat based on species habitat suitability models (see individual species tables in Section 5.9). However, the acres of potential restoration described in this section are based on early restoration designs for many of the sites, and/or other restoration expert judgement with respect to the restoration potential of each site. These acres represent the potential amount of suitable habitat that could be restored on each site, and will serve as a general restoration target for each site.

Implementation of each restoration project may result in greater or lesser acreages of individual species habitat depending on the final restoration site design and restoration site performance during the Habitat Management and Monitoring Plan (HMMP) phase of restoration (typically the first 5 years). Once the performance standards have been met for each site, the restoration project will continue to be managed within the HCP Preserve System under the CAMMP. The amount of suitable habitat achieved through restoration is expected to change over time due to the dynamic nature of the ecological processes of the Upper SAR and alluvial flood plain. Future restoration and enhancement projects will continue to be developed and implemented over time to ensure that the HCP is able to achieve and maintain its biological goals and objectives, and to maintain compliance with the HCP incidental take permits (ITPs).

The restoration projects are also considered Covered Activities; therefore, they are described in more detail in Chapter 2, Section 2.1.7, *Habitat Enhancement, Management, and Monitoring*. The restoration projects are divided into three groups, as detailed below.

The Tributary Stream Restoration Projects will be constructed predominantly during Phase 1 at the following tributary Restoration Areas: Anza Creek and Old Ranch Creek, Lower Hole Creek, Hidden Valley Creek, Hidden Valley Ponds, Evans Lake Drain, and Sunnyslope Creek (Figure 5-2). The Lower Hidden Valley Creek within the Hidden Valley Ponds site is planned to be constructed in Phase 3. The focus of these projects is to restore tributaries and the adjacent riparian buffers to created Santa Ana sucker habitat and habitat for other aquatic and riparian Covered Species.

The Riparian Floodplain Habitat Restoration Projects will be constructed predominantly during Phase 2 and include a number of additional potential restoration projects that could be undertaken on each of the sites listed above, with the exception of Anza Creek, Old Ranch Creek, and Lower Hole Creek. These restoration projects would restore the broader riparian floodplain beyond the riparian buffer associated with the tributary restoration projects discussed above (also Figure 5-2). The restoration of the eastern portion of the Hidden Valley Ponds site is planned for Phase 1, and the remainder of these riparian floodplain restoration projects are planned for Phase 2.

The Alluvial Fan Scrub Restoration Projects will focus on the restoration of habitat for alluvial scrub species, including the San Bernardino kangaroo rat and the Santa Ana woolly-star. The Enhanced Recharge Basin Restoration and North Enhanced Recharge Restoration will take place during Phase 1, and the Drainage A Woolly-star Restoration (or alternate location of similar acreage and restoration potential) is planned for Phase 2 (Figure 5-3).

Table 5-6. Acres of Habitat by Phase on HCP Restoration Areas[1]

HCP Restoration Areas by Phase	Riparian	Wetlands	Permanent Water (miles/acres)	All Shrublands (Alluvial Fan Sage Scrub)	Total Natural Habitats
Phase 1					
Hidden Valley Creek	22.7	--	0.8/0.7	-- (--)	23.5
Anza Creek	4.9	--	0.7/1.0	2.1 (--)	7.7
Santa Ana River Mainstem Microhabitat Enhancement	--	--	--/1.5	--	--
Enhanced Recharge Basins Restoration	--	--	--	185.9 (185.9)	185.9 (185.9)
Phase 1 Total	*27.6*	--	*1.5/3.2*	*188.0 (185.9)*	*218.8 (185.9)*
Phase 2					**--**
Hidden Valley Creek	102.4	2.4	--	--	104.8
Old Ranch Creek	15.3	--	1.3/0.8	--	16.1
Hidden Valley Ponds	--	48.7	--	--	48.7
Evans Lake	65.2		0.6/0.5	--	65.7
Loius Roubidoux Nature Center	--	3.0	0.5	--	--
Drainage A Woolly-star Restoration	--	--	--	40.6 (40.6)	40.6(40.6)
Lower Hole Creek	5.7	--	0.4/0.5	--	6.2
Phase 2 Total	*188.6*	*54.1*	*2.3/1.9[2]*	*40.6 (40.6)*	*285.2 (40.6)*
Phase 3					
North Enhanced Recharge Basin Restoration	--	--	-- (--)	34.6 (34.6)	34.6 (34.6)
Phase 3 Total	--	--	--	34.6 (34.6)	34.6 (34.6)
Phase 4					
None	--	--	--	--	--
All Phases – Total Area Planned for Restoration	216.3	54.1	3.9[2]	263.2 (261.1)	538.6
Additional Area within Restoration Projects Boundaries	--	--	--	--	89.3
Grand Total	**216.3**	**54.1**	**3.9[2]**	**263.2 (261.1)**	**627.9**

[1] Portions of the HCP Preserve System with planned restoration projects.
[2] Due to rounding, totals may not exactly match the sum of the numbers presented.

Tributary Stream Restoration Areas

The proposed Tributary Stream Restoration projects are designed to increase the amount and quality of habitat for the Santa Ana sucker, arroyo chub, and other aquatic and riparian Covered Species at Anza Creek and Old Ranch Creek, Lower Hole Creek, Hidden Valley Creek, Evans Lake, and Sunnyslope Creek. These projects include the creation of new channels, restoring or enhancing existing channels, expansion or creation of floodplains, controlling nonnative invasive vegetation, and limiting human disturbance. Proposed details for each tributary restoration project are described below based on information in *Site Characteristics and Preliminary Design of Santa Ana River Tributary Restoration Projects* (ICF 2015), *Opportunities and Constraints for Tributary Restoration Sites Report* (ICF 2018), and *30 Percent Design for Upper Santa Ana River Tributaries* (ICF

2019). The common elements of all restoration projects are presented below, followed by the restoration elements specific to each site.

Common Elements

The Tributary Stream Restoration projects contain the following common elements that would occur at all three sites.

Channel Enhancement/Recreation

Sites without an existing channel or with a poorly defined channel would require new channel construction. In general, the enhanced or newly constructed channels would create conditions necessary for Santa Ana sucker sustainability, such as diversity in flow depths and velocities, diversity in substrate size without excessive fine sediment accumulation, intermittent areas of shading and cover provided by vegetation on overhanging banks, and open canopy with appropriate substrate to promote algal growth and sucker feeding. A coarse channel liner composed of a sorted mixture of cobble, gravel, and fine sediment would be constructed under the bed of the new channel in specified reaches to limit water infiltration into the sandy and silty soils at the site, thereby limiting channel flow loss and maintaining flow depths and velocities in the new channel. The new channels would include sections constructed with pool and riffle morphology to create the topographic and hydraulic diversity necessary to sustain different habitats. The new channels would include sections constructed with pool and riffle morphology to create the topographic and hydraulic diversity necessary to sustain different habitats. Gravel would be added to new riffle sections and other areas that would have sufficient flow velocities to maintain suitable coarse substrate for Santa Ana sucker habitat.

Wood and Rock Habitat Structures

All of the tributary stream restoration projects include construction of wood and rock structures to add immediate habitat to the enhancement sites. The objective of these structures is to create a flow obstruction that would alter hydraulics in a manner necessary to keep sand from accumulating on the gravel substrate in the vicinity of the structure. The structures would also provide deeper pools and overhang for cover for Santa Ana suckers. One instream woody material structure would be constructed for approximately every 200 feet of channel to aid in diversifying hydraulic conditions that would create and sustain habitat complexity at each of the Restoration Areas.

Riparian Buffer Floodplain Creation

Floodplain construction would occur in channel reaches where the channel is incised and the banks are tall, steep, and unstable. Construction of new floodplains would allow flood water that is currently confined to spill out of the channel, thereby reducing the flow's energy and reducing the potential for future channel incision and bank erosion. Floodplain construction would also create the hydrologic conditions necessary to support certain native riparian species that cannot exist in upland environments. The new floodplain would be constructed by excavating the ground adjacent to the channel to lower the elevation of the top of the channel's bank and increase the frequency with which flood water would be able to spill out of the channel and overbank onto the new floodplain. The riparian buffer would be 100 feet wide (50 feet on each side of stream) on average.

Native Riparian Buffer Vegetation Restoration

The desired future condition of the tributary stream restoration projects is to produce riparian areas composed of native vegetation. However, currently some of the nonnative vegetation provides beneficial shade to aquatic life in the creeks and to terrestrial species, and it may be important to preserve some nonnative plants within the riparian buffer area that are identified as important sources of existing shade and roosting habitat, or that are providing bank stability until newly planted vegetation becomes established. Future design work will include a detailed tree survey of native and nonnative trees.

Public Education

The tributary stream restoration projects would include improvements for public education and outreach that would either enhance or be developed in partnership with existing educational programs; for example, those managed by the City of Riverside Parks and Recreation Department and the Riverside County Parks staff at the Hidden Valley Nature Center. Community education opportunities proposed at all project sites include interpretive trails and signage promoting natural resource protection and native species conservation.

Limited Human Disturbance of Restored Habitat

Measures would be implemented for successful management of the restored habitat to prevent or minimize habitat degradation by controlling human visitation and disturbance in appropriate ways, including eliminating intensive riparian corridor usage by permanent encampments, trash dumping, and off-road vehicle use, and unintended social trails that degrade vegetation and disturb wildlife, including Santa Ana sucker. Managing human access to maintain appropriate levels and areas of visitation would require public education and collaboration with partner agencies and local stakeholders. Regular monitoring and onsite patrol presence of uniformed County Parks officers would deter unhoused individuals from building or rebuilding semi-permanent structures in the project areas once they have been removed as part of the restoration activities. The cost of patrol and maintenance of these sites will be included in the long-term endowment set up for management of the Restoration Areas, in perpetuity.

Specific Restoration Area Elements

Each individual Tributary Stream Restoration project is described further below to include additional details not necessarily common to all sites.

Hidden Valley Creek (Rest.1)

The Hidden Valley Creek Restoration (see Figures 2-22 and 5-2) would be conducted during Phase 1 of HCP implementation. The Hidden Valley Creek site is bounded to the north and east by the Santa Ana River, to the south by a steep hillslope, and to the west by an historic wetland complex called the Hidden Valley Duck Ponds. The site currently supports a series of native riparian and floodplain vegetation communities. In addition, a large portion of the site supports nonnative California annual grassland. The Hidden Valley Creek site does not currently have a perennial source of water nor does it contain a functioning tributary channel to the Santa Ana River. There is an historic channel (canal) that used to convey water diverted from the Santa Ana River down the channel, through the Hidden Valley Ponds (i.e., managed wetlands) complex, and back to the Santa Ana River. The restoration proposed is anticipated to benefit Santa Ana sucker, arroyo chub, southwestern pond

turtle, south coast garter snake, southwestern willow flycatcher, least Bell's vireo, yellow-breasted chat, and yellow-billed cuckoo.

Channel Restoration

Portions of the existing canal would be restored starting near the former canal headworks near the eastern end of the site, and a new channel would be constructed, extending to the Santa Ana River confluence near the western end of the site. The total length of enhanced and created channel would be 4,200 linear feet.

Riparian Buffer Floodplain Creation

Approximately 18.8 acres of nonnative California annual grassland habitat occurs on site. A 3.9 acre portion of this habitat would be treated for nonnative species and revegetated with a series of appropriate vegetation communities. Approximately 1.3 acres of floodplain bench would be created, Approximately 6.3 acres of native vegetation would be planted, and 15.4 acres would have selective clearing and planting.

Enhance Native Riparian Buffer Vegetation

The riparian corridor surrounding the restored floodplain channel would be enhanced by removing nonnative plants. The riparian corridor extends along the length of the channel, and enhancement would target the entire area.

Provide a Perennial Water Source

The Hidden Valley Creek site does not currently have a perennial source of water. A perennial water source would be provided by Santa Ana River Sustainable Parks and Tributaries Water Reuse Project (RPU.10). If the Hidden Valley Creek restoration occurs prior to the completion of RPU.10, then well water would be used in the interim to provide a source of water in the new creek channel.

Anza Creek/Old Ranch Creek (Rest.5)

The Anza Creek and Old Ranch Creek restoration (see Figures 2-23 and 5-2) would be conducted during Phase 1 and Phase 2 of HCP implementation, respectively. The Anza Creek and Old Ranch Creek sites are bounded to the north by the Santa Ana River, to the east by the closed Tequesquite Landfill, and to the south and west by the Santa Ana River bicycle trail and Anza Narrows Park. The sites currently support a variety of native floodplain habitats, nonnative grassland, and nonnative riparian habitat. Restoration at this site is anticipated to benefit southwestern pond turtle, south coast garter snake, southwestern willow flycatcher, least Bell's vireo, yellow-breasted chat, yellow billed cuckoo, Santa Ana sucker, and arroyo chub.

Anza Drain is one of several surface area concrete-lined stormwater drains within the City and County of Riverside, with the upper portion originating in the Woodcrest and El Sobrante areas (ICF 2017). The Anza Drain flows under the bicycle trail and enters the area at the far southeast portion of the site, at which point the concrete channel turns into a natural, alluvial creek (Anza Creek). Anza Drain supplies little to no surface water flow to the site in dry months; thus, the upper portions of Anza Creek are largely dry. However, in the area of proposed restoration surface water is supplied by natural springs to create perennial flow connecting the creek to the Santa Ana River.

Old Ranch Creek is one of several surface area drains and stormwater systems, with the upper portion originating in the Wood Streets and lower portion receiving runoff from Jurupa Avenue and

over to Central Avenue. The Old Ranch Creek drainage enters the site through a small culvert under the bicycle path at the far southeast corner of the project site. Historically, the drainage conveyed more water than at present. However, currently the drainage is dry most of the year, typically only receiving water during storm events. Thus, the Old Ranch Creek site does not have a perennial source of water and no continuous channel connecting with the Santa Ana River. The Old Ranch Creek no longer exists in the northwestern downstream half of the project site; this area is the south floodplain of the Santa Ana River and requires a rare flood event for flows from the Santa Ana River to spill out into this floodplain area (ICF 2017).

Channel Enhancement/Recreation

Anza Creek

Approximately 1,107 linear feet of constructed channel and 2,322 linear feet of the existing Anza Creek channel would be enhanced by adding gravel to new riffle sections that would have sufficient flow velocities to maintain suitable coarse substrate for Santa Ana sucker habitat. The narrow and cattail-choked reach of the Anza Creek channel near the confluence with the Santa Ana River would be enhanced by clearing out the emergent vegetation plugs and reconfiguring the channel topography. This would be done to improve flow into the Santa Ana River to support sufficient flow velocities to maintain a coarse substrate suitable as Santa Ana sucker habitat in the Anza Drain channel upstream of the confluence. A deep pool, about 150 feet long and several feet deep, located at the base of the eroding bank, provides habitat for bass and other nonnative fishes that prey upon Santa Ana sucker migrating up the channel. This pool would be recontoured to reduce its width and depth to eliminate the backwater habitat suitable for nonnative fishes.

Old Ranch Creek

Approximately 3,870 linear feet of new channel would be constructed on the site. 3.144 linear feet of channel would be enhanced and follow the alignment of the Old Ranch Creek drainage that used to connect with the Santa Ana River and whose topography is still visible on the landscape. The downstream portion of the new channel would be constructed along a southwest alignment toward an eventual confluence with the Santa Ana River.

Riparian Buffer Creation

Anza Creek

Anza Creek has several reaches where the channel is confined by steep and tall banks with little to no floodplain connectivity. Approximately 1.1 acres of new floodplain bench would be created, spread out over five different areas, by excavating the high ground adjacent to the low-flow channel. The typical width of the inset floodplain areas would be 20–40 feet, and the average excavation depth would be 2–3 feet. A 580-foot-long section of Anza Creek's left bank adjacent to the bicycle trail at Martha-McLean-Anza Narrows Park is steep, unvegetated, up to 25 feet tall, and actively eroding into Anza Drain. The bank would be excavated to reduce its steepness, and 0.8 acre would be revegetated with a mixture of riparian plants near the base and coastal scrub in the upland portion. An additional 2.1 acres of coastal scrub would be planted upstream of the eroding bank in an unvegetated and sloping area of the site between the bicycle trail and the Anza Creek channel. Approximately 4.1 acres would have selective clearing and planting.

Old Ranch Creek

Approximately 0.6 acre of floodplain bench would be created adjacent in the Old Ranch Creek drainage. A new riparian corridor would be created, adjacent to which nonnative plants would be removed and new native vegetation would be planted. The riparian corridor would be approximately 100 feet wide (50 feet on either side of the channel); approximately 2.5 acres would be planted with native vegetation. And approximately 12.2 acres would have selective clearing and planting.

Provide a Perennial Water Source

The Old Ranch Creek site does not currently have a perennial source of water. A perennial water source would be provided by Santa Ana River Sustainable Parks and Tributaries Water Reuse Project (RPU.10).

Lower Hole Creek (Rest.4)

The Lower Hole Creek restoration (see Figures 2-22 and 5-2) would be conducted during Phase 2 of HCP implementation. The Lower Hole Creek site consists of approximately 6.2 acres, beginning downstream of Jurupa Avenue where the stream passes under the road through a large 40-foot concrete box culvert with extensive downstream protections that creates a 27-foot elevation difference between the channel upstream and downstream of the crossing. Lower Hole Creek consists of two drainage features: a small tributary and the main creek, which meets the Santa Ana River at the downstream end.

Native vegetation communities on the site include black willow thickets and California sycamore woodland along the creek channel, with upland areas consisting mostly of California annual grassland that is dominated by nonnative grasses. Nonnative invasive plants are present throughout the site and include date and fan palm trees, giant reed, ash, and tree of heaven, in addition to castor bean and tree tobacco (*Nicotiana glauca*). For more information on existing conditions at the Lower Hole Creek site, refer to the *Opportunities and Constraints for Tributary Restoration Sites* report (ICF 2018). The restoration work proposed at this site is anticipated to benefit Santa Ana sucker, arroyo chub, southwestern pond turtle, south coast garter snake, least Bell's vireo, southwestern willow flycatcher, and yellow-breasted chat.

Channel Enhancement/Recreation

Approximately 442 linear feet of existing channel downstream of Jurupa Avenue would be enhanced.

Riparian Buffer Floodplain Creation

In several long reaches downstream of Jurupa Avenue, the Lower Hole Creek channel is confined by steep, tall banks with little to no floodplain connectivity. Approximately 0.5 acre of new floodplain would be created, spread out over nine different areas, by excavating the high ground adjacent to the low-flow channel. The typical width of the inset floodplain areas would be 25–75 feet, and the average excavation depth would be 3–4 feet. The floodplain creation would provide additional areas where overbank flows can spread out into riparian zones and reduce the shear stress levels in the channel that contribute to channel downcutting and bank erosion. Approximately 3.5 acres would have selective clearing and planting.

Riparian Corridor Restoration

A new riparian corridor would be created in which nonnative plants would be removed and new native vegetation would be planted. The total width of the corridor would vary from 50 to 75 feet but would extend up to 400 feet in a pocket downstream of Jurupa Avenue. A total of approximately 1.7 acres of new riparian vegetation would be restored downstream of Jurupa Avenue.

Bank Stabilization

Approximately 575 linear feet of channel bank, split into five different areas located throughout Lower Hole Creek downstream of Jurupa Avenue, exhibits excessive erosion. Many of these areas are along the toes of steep hillslopes where floodplain excavation is not feasible. Consequently, they would require separate work outside of the grading that would occur as part of the floodplain construction. Bank stabilization in these areas would incorporate bank excavation to reduce steepness and methods of placing rock and large wood along the toe to build a narrow bench that separates the active channel from the eroding bank and provides a buffer to keep erosive shear stresses away from the erodible soil that makes up the hillslopes.

Evans Lake (Rest.6)

The Evans Lake Creek restoration (see Figures 2-23 and 5-2) would be conducted during Phase 2 of HCP implementation. The largest restoration opportunity at Evans Lake Creek is the rehabilitation of the riparian, stream, wetland, transitional, and upland habitat. The site is currently vegetated with several different invasive species, including, but not limited to, Brazilian pepper (*Schinus terebinthifolia*), palm (*Phoenix canariensis* and *Washingtonia robusta*), tamarisk (*Tamarix* spp.), eucalyptus (*Eucalyptus* spp.), fig (*Ficus carica*), mustard (*Brassica* spp.), fennel (*Foeniculum vulgare*), and nonnative grasses. In addition, due to the presence of unhoused encampments and transients there is substantial trash, debris, and illegal trails throughout the site. Removing the invasive species, trash, and debris; reclaiming the illegal trails; and replanting with native species would result in rehabilitation of the entire site. The restoration proposed is anticipated to benefit Santa Ana Sucker, arroyo chub, southwestern pond turtle, south coast garter snake, southwestern willow flycatcher, least Bell's vireo, and yellow-breasted chat.

Other restoration opportunities include the following:

- Laying back the channel banks in a portion of the spillway channel (0.29 acres of riparian habitat)
- Creating a secondary/high flow channel in the spillway channel (0.18 acres of riparian habitat)u
- Creating riffles and pools and adding wood and rock structure to the low-flow channel, providing supplemental flow to the low-flow channel (3,400 feet of stream channel enhancement).
- Creating a new low-flow channel west of the Santa Ana River levee (280 feet of channel creation)
- Selecting clearing and planting to rehabilitate native riparian vegetation (61.75 acres of riparian habitat)

Riparian Floodplain Habitat Restoration Areas

The Riparian Floodplain Habitat Restoration Areas include additional restoration actions to be undertaken by the Alliance to benefit Covered Species during Phases 2 of the HCP, depending on such factors as future assessments of habitat improvement needs and the availability of additional funding. These actions may occur at any of the sites identified in the Tributary Stream Restoration Project described above, or at other sites within the HCP Preserve System.

Hidden Valley Creek (Rest.1)

The Hidden Valley Creek riparian floodplain restoration (see Figures 2-22 and 5-2) would be conducted during Phase 1 and 2 of HCP implementation. Additional opportunities at the Hidden Valley Creek site include establishing an oxbow feature and further controlling nonnative invasive species. Restoration opportunities at the site are largely associated with enhancing habitat by removing nonnative plant species and planting native species. These activities would improve upland habitat conditions for other threatened and endangered species. The site is in an active part of the Santa Ana River floodplain that has experienced substantial erosion and deposition from flood flows. Groundwater and surface flows currently support one large perennial pond feature in the downstream portion of the site, likely a remnant of a previous river course. This feature provides a unique habitat for wildlife, as it represents a perennial, low-velocity water source with adjacent riparian habitat. Creation of a similar feature in the upstream portion of the site would increase the opportunity for wildlife to utilize this unique habitat type. Adding gently sloping shoreline habitat to the created feature would increase nesting opportunity for certain bird species and also provide benefits to pond turtle and garter snake. Due to the risk of future flooding associated with the active Santa Ana River, the proposed location for this feature is the southern portion of the floodplain outside of the regular channel migration zone. Collectively, the site has the potential to support approximately 15 acres of wetland habitat. The restoration proposed is anticipated to benefit southwestern pond turtle, south coast garter snake, southwestern willow flycatcher, least Bell's vireo, yellow-breasted chat, yellow-billed cuckoo, and tricolored blackbird.

Hidden Valley Ponds (Rest.2)

The Hidden Valley Ponds Restoration (see Figures 2-22 and 5-2) would be conducted largely during Phase 2 and will include restoring floodplains by opening levees and enhancing habitat, controlling nonnative species, restoring water to seasonal waterfowl ponds, restoring a floodplain tributary, enhancing public recreation and education, and enhancing the return channel (Phases 2 and 3). Restoring the floodplain tributary, return channel, and ponds will improve habitat for southwestern pond turtle, south coast garter snake, riparian birds, and tricolored blackbird. Additionally, there are enhancement opportunities at the site associated with removing nonnative plant species and planting native species, and focusing human use of the site through trails, interpretive signage, and controlled educational opportunities. Additional evaluation, agency coordination, and integration with regulatory compliance processes will need to continue to address uncertainties associated with future restoration designs at the sites, including determining the source, volume, and seasonal distribution of water supply for each site; the location, type, and design specifications for Covered Species habitat and Aquatic Resources creation and enhancement measures; and the extent and location of revegetation areas. Surface and groundwater hydrologic monitoring and possibly modeling, and designing measures to address the intense degree of human disturbance at the sites are also critical pursuits that will need to inform site design and long-term management and

monitoring strategies. The restoration proposed is anticipated to benefit southwestern pond turtle, south coast garter snake, and tricolored blackbird.

Louis Rubidoux Nature Center and Sunnyslope Creek (Rest.7)

The Louis Rubidoux Nature Center and Sunnyslope Creek riparian floodplain restoration (see Figures 2-23 and 5-2) would be conducted during Phase 2 of HCP implementation. Riverside County Parks and Open Space District owns the Louis Rubidoux Nature Center (LRNC), adjacent park, and Sunnyslope Creek but is leasing the property to the Louis Rubidoux Nature Center Consortium (Consortium). Five entities are part of the Consortium: the Inland Empire Resource Conservation District), San Bernardino Valley Municipal Water District (Valley District), Orange County Water District (OCWD), Huerta del Valle, and Sunshine Haven Animal Rescue and Wildlife Rehabilitation.

Restoration opportunities at this site are in the early planning stage, but include approximately 0.5 mile of channel enhancement for Santa Ana sucker and arroyo chub and approximately 3 acres of wetland habitat. The restoration proposed is anticipated to benefit Santa Ana sucker, arroyo chub, southwestern pond turtle, south coast garter snake, least Bell's vireo, southwestern willow flycatcher, and yellow-breasted chat.

Habitat Enhancement at Prado Basin (Rest.10)

The Habitat Enhancement at Prado Basin project (see Figures 2-23 and 5-2) involves the periodic removal of sediment from the River Road and Sand Trap sites, the one-time removal of sediment and restoration of the Pheasant Field site, and the maintenance of gabions, all within the Prado Basin of the Santa Ana River. These actions will result in benefits to the mainstem of the Santa Ana River upstream of the sediment removal sites by reducing the fine sediments and helping to restore the natural gradient of the river. While the majority of the sediment removed will be used for various projects unrelated to HCP Covered Activities, sorted larger sediment, generally composed of gravel and cobble, will be returned to the river at strategic locations to provide aquatic habitat benefits, further described below. Coarse sediments will likely initially be placed near existing gabions (described below) located upstream of the Prado Basin project area and potentially at the bridge footings at the River Road bridge; however, these actions will be monitored and adaptively managed to ensure that the desired habitat benefits are being achieved. The proposed augmentation of coarse sediment along the river is anticipated to benefit Santa Ana sucker and arroyo chub.

The activities proposed under this project are proposed as self-mitigating within the lands controlled and managed by OCWD. Impacts on riparian habitats will be mitigated through riparian restoration at the Pheasant Field site or in areas of Arundo burned in recent wildfires in the Prado Basin (described briefly under *Future Conservation Areas* below). In-stream benefits are anticipated for Santa Ana sucker and arroyo chub as described in detail below.

Site 1—River Road

The River Road project work area for sand removal will encompass most of the river's unvegetated banks and stream (open water) area from just downstream of River Road Bridge to approximately 1,000 feet upstream, similar to the area used for sand removal in the early 2000s. An unknown amount of coarse sediment is expected to be recovered and returned to the Santa Ana River from the sand removal and sediment sorting project each year. If stream conditions are similar to that of the early 2000s, a small but steady supply of coarse material will be generated from this project. The repeat addition of gravel to the streambed and/or streambank will provide a base of coarse material

that will be regenerated as it is eroded into sand or transported downstream. With time, the relative proportion of gravel to sand is anticipated to increase within the active channel with gravel remaining exposed along the bed (at least seasonally). This will be aided by the anticipated upstream effects caused by this project.

Site 2—Sand Trap

A second location, an in-stream sand trap, is also proposed for sand removal and is located approximately 2 miles downstream of River Road Bridge in Prado Basin. This location is dominated by nonnative vegetation, primarily giant reed and forbs. The sand trap is proposed to encompass approximately 14.3 acres of the Prado Basin and would be designed to capture the majority of the sediment that bypasses the River Road basins (located upstream) during baseflow conditions. Sediment transported during flood flows will largely bypass this trap as it is not sized to capture large pulses of sediment. An unknown amount of coarse sediment is expected to be recovered and returned to the Santa Ana River from the sand removal and sediment sorting project each year. As in the Rover Road project, if stream conditions are similar to those of the early 2000s, a small but steady supply of coarse material will be generated from this project. The ability to capture the initial flush of flood waters will likely increase the amount of coarse sediments captured and returned to the SAR, relative to the River Road project, because it is capturing high discharge flows that can transport larger sized particles and greater quantities of sediment. The repeat addition of gravel to the streambed and/or bank will provide a base of coarse material that will be replenished as it is eroded into sand or transported downstream. Over time, the relative proportion of gravel to sand is anticipated to increase within the active channel with gravel remaining exposed along the bed (at least seasonally). This will be aided by the anticipated upstream effects caused by this project.

Site 3—Pheasant Field

A third site for sand removal is proposed at Pheasant Field (approximately 24 acres in size), which is approximately 0.75 mile north and east of the sand trap and south of the OCWD diversion channel. This area contains nonnative annual plants and open sand. If additional sediment removal is needed to achieve the desired upstream habitat benefits, a one-time removal of surplus sand (2–4 feet) will be completed at this site. The sediment removal area would then be restored through the planting of native riparian plant species. Management and monitoring of this habitat area will be integrated into the HCP long-term habitat management and monitoring strategy. An unknown amount of course sediment is expected to be recovered from the sand removal and returned to the SAR. Although the sand removal portion of this project will be a one-time activity, the coarse sediment replacement to the SAR will occur over an extended period of time. Coarse sediment generated from this project will provide a cumulative increase in aquatic habitat benefit to that of the River Road and Sand Trap projects.

Gabions

There are 10 existing gabions that occur starting approximately 0.75 mile upstream of River Road Bridge that will be maintained as a part of this Covered Activity. These structures are evenly spaced and alternate between streambanks as you move upstream. The most recent gabion construction activities took place in Fall 2016. Each gabion is a rock filled cage, approximately 12 feet long by 3 feet wide. These structures are intended to create localized areas of scour that expose coarse substrate found below the surface layer of sand. Gabion maintenance will include placement of new rock or coarse sediment found during sand removal projects at Prado Basin. If the existing gabions

are not operable, as determined during routine monitoring, new gabions may be built at a new location(s) as agreed to by USFWS and CDFW. It is anticipated that the cumulative benefits from sand removal (downstream) in and near the Prado Basin will remove existing excess sediment at the gabion locations, exposing coarse sediments. Additionally, the steady supply of coarse sediments generated and supplied by the sediment removal projects will sustain the desired aquatic habitat that will likely become occupied by Santa Ana sucker and arroyo chub.

Anticipated Benefits

The Santa Ana River upstream of the Prado Basin shows signs of severe aggradation with excess fine sediments covering the larger sediments preferred by the Santa Ana sucker. The sediment transfer basins are expected to increase bed erosion and sediment transport during baseflow conditions, coarsening the streambed upstream of the sand removal areas. The *Santa Ana River Sediment Monitoring Program Phase 1* (Scheevel Engineering 2019) experimental project installed a small sediment trap (7,000 cubic yards, approximately 4 acres) immediately downstream of River Road in the Prado Basin that produced a 6-inch reduction in excess sediment from the thalweg (the deepest portion of the channel) near Dearborn Street, approximately 1.5 miles upstream of the basin. This area includes the existing gabions. The average rate of sediment transported into Prado Basin during baseflow is estimated at 60 to 80 tons per day at baseflow conditions. The relatively small experimental sediment trap tested by OCWD is estimated to have increased sediment transport at baseflow by transporting sediment at up to 115 tons per day and causing removal of up to 3 feet of sediment from the streambed, with the greatest effect found at the top of the trap. Beneficial results (deepening and coarsening of the streambed caused by a reduction in sediment) were observed when the sediment trap was functional (2 months) and diminished once the trap had filled. To ensure that the sediment basins and transport is providing the desired habitat effects, monitoring will be conducted along the stream to track the change in streambed elevation and grain size.

The gabions create in-stream structure that provides the deeper pools with coarse substrate habitat that benefit Santa Ana sucker and arroyo chub. Jointly with the sediment removal and coarse substrate replenishment projects, the gabions are anticipated to provide sustained habitat for Santa Ana sucker and arroyo chub, providing the opportunity for long-term occupancy.

Management of Santa Ana Sucker Restoration on Sunnyslope Creek (Rest. 11)

Annual management activities of the Santa Ana sucker restoration site occur within an area on Sunnyslope Creek (Figures 2-24 and 5-2). These activities may include the removal of flow obstructions, deep holes, and aquatic predators; and manipulation of the channel using equipment to concentrate the creek flow in a single channel that maximizes silt scour and hydrologic connectivity with the creek. As many as 10 cubic yards per year of rock, gravel, and smaller boulders would be imported to improve substrate conditions in the creek for Santa Ana sucker. The material would be surface gleaned from the adjacent alluvium and deposited in deeper holes in the creek to significantly reduce the depth of the pool complex where otherwise such holes have harbored large nonnative predatory fishes. Available techniques would be used to reduce the abundance of nonnative fishes and amphibious predators including electro-shocking, trapping, seining, fishing, and dip-netting. Trash and debris will be removed by hand and potentially by installing and operating a trash boom. The possibility of augmenting creek flow with well water will also be explored to alleviate drought-associated impacts on dry-weather creek flow. In addition to Santa Ana sucker, this management is expected to benefit arroyo chub.

Alluvial Fan Scrub Restoration Projects

There are three restoration projects that will restore alluvial fan scrub habitats: the Enhanced Recharge Basin Restoration, North Enhanced Recharge Restoration, and the Drainage A Woolly-star Restoration. Each is described briefly below.

Enhanced Recharge Basin Restoration (Rest.12)

The Enhanced Recharge Basin alluvial fan scrub restoration (see Figures 2-24 and 5-3) would be conducted during Phase 1 of HCP implementation. The restoration will create and enhance 185.9 acres of habitat for these species based on the recent research on microhabitat suitability for San Bernardino kangaroo rat conducted by the San Diego Zoo Institute for Conservation Research (Shier et al. 2019), and the evaluation of various methods of mechanical manipulation to simulate the effects of fluvial disturbance (ICF 2019). The project would involve managing interstitial spaces between the recharge basins, approximately 200 feet wide, for San Bernardino kangaroo rat, slender-horned spineflower, and Santa Ana River woolly-star habitat.

North Enhanced Recharge Restoration (Rest.13)

The North Enhanced Recharge alluvial fan scrub restoration (see Figures 2-24 and 5-3) is very similar to the Enhanced Recharge Basin Restoration, and would be conducted during Phase 1 of HCP implementation. This restoration project will mitigate the impacts on San Bernardino kangaroo rat and Santa Ana River woolly-star habitat by creating and enhancing 34.6 acres of habitat for these species (Figure 2-24). The restoration proposed is anticipated to benefit Los Angeles little pocket mouse, San Bernardino kangaroo rat, slender-horned spineflower, and Santa Ana River woolly-star.

Drainage A Woolly-star Restoration (Rest.15)

The Drainage A Woolly-star alluvial fan scrub restoration (see Figures 2-24 and 5-3) would be conducted during Phase 2 of HCP implementation. The Drainage A parcel is a portion of the diversion structure for the Riverside North Aquifer Storage and Recovery Project (RPU.5). The parcel and a smaller adjacent parcel are occupied by a large population of Santa Ana woolly-star (several thousand individual plants) in spite of the degraded habitat quality of the site. The Drainage A Woolly-star Restoration will enhance approximately 40 acres of degraded habitat by removing nonnative invasive species and by improving the overall protection, management, and monitoring of the site. The restoration project will benefit Santa Ana River woolly-star. As previously identified, mitigation actions at Drainage A are dependent on land availability; consequently, alternate lands may need to be acquired to complete this mitigation effort.

Future Conservation Areas

The following restoration projects are not a part of the HCP Conservation Strategy (i.e., the mitigation value that these projects will create is above and beyond what is needed to offset the impacts of the Covered Activities). These restoration projects are identified as Future Conservation Areas, and although their construction, monitoring, and management will be coordinated by the Alliance, the mitigation value will be tracked separately from the mitigation committed under the HCP. Some or all of the mitigation value created by these restoration projects in the Future Conservation Areas may be used to mitigate for impacts from other projects that *are not* Covered Activities under this HCP.

Preliminary designs have been prepared for the following restoration sites. While these restoration projects are not requirements or commitments of the HCP, they may still be implemented to create additional mitigation value and benefit species habitat and aquatic resources in the Planning Area.

Lower Hole Creek Floodplain (Rest.4)

Additional restoration opportunities at the Lower Hole Creek site include restoring upland vegetation and further controlling nonnative invasive plant and wildlife species, which would enhance Covered Species habitat. Restoration opportunities also exist upstream of the site that could further increase the size of contiguous riparian habitat. In addition to restoration on site, improved condition of the adjacent buffer habitat can further reduce stress to the creek. Currently, the buffer is highly accessible to the public and functions in a degraded state with high human use, soil disturbance, and nonnative cover. Restoration of the upland areas to coastal sage scrub vegetation would protect wetland conditions and create additional opportunities for Covered Species. The restoration proposed is anticipated to benefit southwestern pond turtle, south coast garter snake, least Bell's vireo, southwestern willow flycatcher, and yellow-breasted chat.

Anza Creek and Old Ranch Creek Floodplain (Rest.5)

Additional restoration opportunities at the Anza Creek/Old Ranch creek sites include alkali marsh rehabilitation, upland rehabilitation, floodplain expansion, and further management of invasive wildlife species. These restoration opportunities would improve habitat quality for Covered Species by reducing the threat from invasive wildlife species such as bullfrogs (*Lithobates catesbeianus*), wild boar, mosquitofish (*Gambusia affinis*), and brown-headed cowbird. Control methods are as yet undetermined and may include methods such as seasonal variation in water supply and trapping.

The site currently supports alkali meadow habitat at several locations in the outer floodplains that illustrate near-reference conditions for that vegetation community. There are also areas on site where historic alkali meadow has become degraded by past human use and an influx of nonnative species. In particular, the southeastern corner of this site provides an ideal opportunity for alkali marsh restoration, including control of nonnative species, planting of native species, and improvements to hydrology by connecting the area to the Old Ranch Creek drainage. This area is dominated by nonnative grasses, but there are still native alkali species present such as salt grass and creeping wild rye (*Elymus triticoides*). The presence of these species, the adjacent reference condition, and the topography (low depression) are all indicators that this area can be successfully restored to alkali meadow. Additional restoration opportunities exist throughout the floodplain, as much of the area supports lower densities of native alkali species.

The northeastern corner of the site, immediately downstream of the landfill, is at a higher elevation than much of the site, with extensive areas of disturbed bare ground, invasive species, and human disturbance. The higher elevation appears to be a result of historic fill, potentially in association with past landfill practices. Removal of fill material would allow this area to reengage the active floodplain at a frequency similar to that of the riparian zone along the river. As this area is artificially armored by the presence of the landfill, there is also the opportunity to further excavate an area in the southern portion of this site to emulate a relic channel in the form of an oxbow. This would require excavation to and below groundwater levels to support a perennial water source.

The restoration proposed is anticipated to benefit southwestern pond turtle, south coast garter snake, southwestern willow flycatcher, least Bell's vireo, yellow-breasted chat, tricolored blackbird, and yellow-billed cuckoo.

Lower Hidden Valley Creek (Rest.3)

The Lower Hidden Valley Creek Restoration project includes restoring the stream channel downstream of Hidden Valley ponds, between the ponds and the mainstem of the Santa Ana River. Restoration activities may include stabilizing the channel, habitat enhancements in the existing channel for Santa Ana sucker, restoring the riparian corridor along the existing channel through exotics removal and replanting of native species, reestablishing floodplain, control of invasive wildlife species, reducing human disturbance, and restoring upland buffer vegetation. The restoration proposed is anticipated to benefit Santa Ana sucker, arroyo chub, southwestern pond turtle, south coast garter snake, southwestern willow flycatcher, least Bell's vireo, yellow-breasted chat, and yellow cuckoo.

Pedley Landfill Restoration (Rest.9)

The Pedley Landfill is located on a 13.5-acre parcel owned by CDFW. Previously, in 1932 the County of Riverside had a burn operation at the site, and in 1957 through 1958 the County used the site as a cut and fill operation before selling it to CDFW in February 1974. The parcel is at the immediate confluence of the Santa Ana River mainstem and Hole Creek, just west of Van Buren Boulevard. During an evaluation of restoration opportunities for Hole Creek, Pedley Landfill was identified as one of the largest constraints to meaningful restoration in the creek. In addition to constraining the physical movement of Hole Creek the landfill has become increasingly unstable as the mainstem Santa Ana River has moved south, resulting in damage and likely contamination issues. At least three recent erosional site failures have occurred: December 2010, where half an acre was washed away, followed by erosion of the north slope during a spring storm in March 2014, and then again in November 2015. The repairs are costly and pose a risk to the river system downstream. In addition, the physical constraints of the landfill, which flanks the lowermost 1,200 feet of Hole Creek's east bank, limit the ecological conditions of the creek, including a lack of floodplain, riparian habitat, suitable buffer, and channel migration. CDFW and Valley District are considering complete removal or substantially reducing the size of the landfill to protect downstream water resources and facilitate additional restoration opportunities for Lower Hole Creek. Reclamation and revegetation of the landfill would result in the creation of approximately 4 acres of riparian habitat. The restoration proposed is anticipated to benefit southwestern pond turtle, south coast garter snake, least Bell's vireo, southwestern willow flycatcher, and yellow-breasted chat.

Habitat Enhancement at Prado Basin (Rest.10)

There are some portions of the Prado Basin under OCWD control that burned in recent wildfires. These areas had also been heavily invaded by Arundo. OCWD has ongoing efforts to restore these areas to functioning native riparian habitats. If needed, these areas may be used to offset impacts from OCWD Covered Activities and would become a part of the HCP Preserve System. These areas as a whole are classified as Future Conservation Areas.

5.5 Hydrologic Manipulation and Substrate Management

5.5.1 Mainstem Santa Ana River Microhabitat Creation

The goal of this habitat management action is to create a minimum of six nodes of habitat created by installing series of structures within the stream flow of the Santa Ana River to manipulate water movement and create suitable microhabitat areas. The expectation is that these structures (made of natural materials) will increase the total amount of suitable habitat available to sucker, including riffles, small scour pools, and exposed patches of gravel/cobble substrate. Strategically placing the microhabitat creation structures downstream of the San Bernardino/Colton Rapid Infiltration and Extraction Facility (RIX) discharge location between occupied reaches will create "steppingstone" nodes of habitat to connect the occupied areas and facilitate movement of sucker between these currently occupied areas.

There are several alternatives to create these nodes of habitat. What has been experimentally tested to date within the river is the placement of coarse substrate along reaches of stream with a large component of sandy substrate (e.g., OCWD, USACE, and Santa Ana Watershed Project Authority projects). These projects have largely failed to achieve the desired habitat enhancement effect of coarsening the streambed. A significant component of the failure of these projects is the disappearance of coarse sediment grains after construction. This may occur through localized bed erosion (rocks sink into the sand), bed aggradation (rocks are covered by sand deposits), saltation (rocks rolling downstream), or a combination of these processes. The incorporation of large woody debris into the design of enhancement projects using coarse grained sediment may provide added benefit and reduce the potential for failure.

Field sampling has shown that bed elevation of the Santa Ana River can increase dramatically over hours and days, increasing by more than 12 inches (Scheevel 2017). Sand deposition within the inset perennial channel occurs during and after storm events when heavy flow transports large amounts of sediment from the upper watershed. Aggradation occurs in the inset perennial stream where sediment-heavy stormflow deposits its bed load. This deposited sediment, mostly sand, migrates downstream with the sediment-free tertiary-treated base flow. The process of high flow eroding and saltating coarse sediments, combined with aggradation during base flow makes it difficult to maintain a streambed enhancement feature that has been artificially coarsened.

A relatively simple solution to the sand aggradation problem is to cause stream bifurcation or braiding. The Santa Ana River floodplain is full of remnant channels (distributaries). If a new braid is created in an existing channel the deeper channel will generally transport the bulk of the bed load, leaving flow entering the new channel relatively sediment free. This type of diversion is commonly done for irrigation canals. Assuming the diversion has adequate flow velocity to move sand, it will coarsen the streambed, enhancing the overall stream habitat for Santa Ana sucker. An additional benefit is that habitat enhancement features can be created prior to stream diversion, when the streambed is dry, avoiding aquatic species impacts during construction.

The process for choosing a location for this type of stream enhancement would start with an aerial imagery search for distributaries that could be re-wet. Locations where a diversion would have limited disturbance to the perennial stream as well as to other public trust resources would be prioritized. With a location chosen any habitat features important to resources in that part of the

stream would be constructed prior to stream diversion (e.g., placement of large woody debris, addition of coarse sediment, building of floodplain features and terraces).

The stream diversion feature would be an engineered structure to serve multiple purposes, at minimum to include water diversion and sediment exclusion, and may include a weir, boulder clusters, large woody debris, groin, etc. The intent of the structure would be to cause a bifurcation in flow, with the new minor channel braid holding a significant portion of the total flow, potentially greater than 50%, but with a minor contribution of sand. Avoidance and minimization measures would be in place to limit adverse impacts on aquatic and terrestrial species during the construction of the stream diversion feature as well as when necessary along the length of the dry channel.

Any created stream bifurcation would be a temporary feature, potentially altered or eliminated by future storm flow events. The decision to rebuild or abandon in-stream structures would be an adaptive management process, whereby survey data gathered during monitoring (between March and July) would be used to assess and determine management actions. Construction of larger projects would occur outside of spawning season for native fishes and outside of nesting season for migratory birds. Smaller projects may be appropriate to build during both spawning and nesting season if only hand work is required. The ability to build and maintain these diversions after the threat of flooding has passed and ahead of summer warming will be critical to the overall success of these projects to increase the available habitat for native fish use.

The implementation of the above measures to create the habitat nodes will be conducted as a part of the adaptive management and monitoring program. Annual monitoring will include, at minimum, water quality, spring and fall visual estimates of substrate cover types, staff gauge to measure changes in bed elevation, and fish surveys. Specific variables, data collection frequency, methodology, and analysis to determine success will be developed as part of the adaptive management and monitoring program.

5.5.2 Substrate Management Activities

Substrate augmentation (e.g., river gravel and cobble) will occur as needed to enhance perennial stream habitat function in and upstream of the microhabitat creation sites described above. Substrate augmentation will occur as a part of structure creation and maintenance when monitoring indicates that additional coarse substrate is needed.

5.5.3 Flow and Path Manipulation Activities Within Mainstem

The path of flow of the mainstem of the Santa Ana River is dynamic and regularly shifts during larger storm events. While the river is most frequently flowing through a single channel downstream of the Rialto Channel, some portions become split into multiple channels following storm events. When flow is separated into multiple channels it reduces the effective flow velocity and depth in each channel resulting in decreased habitat suitability for Santa Ana sucker. Where appropriate, structures made of natural materials such as boulders, large cobble, and large woody debris will be used to manipulate the flow and path of the river to maintain a single channel and increased habitat suitability.

5.5.4 Rialto Channel Flow and Water Quality Management

The purpose of this mitigation action is to reduce water temperatures in Rialto Channel to tolerable levels (less than 86 degrees Fahrenheit [°F]) during summer months. In recent years the temperatures within the natural bottom reach of Rialto Channel were found to be outside the tolerable range for sucker (USFWS 2010) and generally greater than 80°F in summer and fall (USGS 2015). This measure will add relatively cool groundwater (67–70°F), from up to four wells or other water sources, in order to decrease the water temperature in Rialto Channel to tolerable levels for sucker.

5.5.5 Tequesquite Creek Supplementary Flows

Supplemental water will be provided via a recycled water pipeline from the Santa Ana River Sustainable Parks and Tributaries Water Reuse Project (RPU.10) to the Tequesquite Creek Aquatic Restoration site. The restoration project included removal of trash, clearing of invasive, nonnative plant species, and the removal of fish barriers to improve the quality and access to spawning habitat for listed fish species including Santa Ana sucker and arroyo chub. The supplementary flows will improve the abundance and quality of the aquatic habitat.

5.6 Captive Rearing and Translocation

There are two captive rearing and translocation programs underway that are supported in part by this HCP, including for Santa Ana sucker and mountain yellow-legged frog. Both programs are described in more detail below.

5.6.1 Santa Ana Sucker Translocation

The purpose of this mitigation action is to increase the abundance, distribution, and resilience of the Santa Ana sucker population in the Santa Ana River Watershed by establishing redundant populations in upper watershed tributaries. A minimum of three new populations of sucker will be established within the highest-ranking streams that meet the suitability criteria established in the Santa Ana Sucker Translocation Plan. Streams considered for translocations sites include the Santa Ana River upstream of Seven Oaks Dam, and Plunge, Hemlock, Mill, Bear, and Alder Creeks.

Restoring Santa Ana sucker to historic habitat is a major recovery goal and objective listed in this HCP (see Section 5.9, SAS Objectives 6 and 7). The Santa Ana Sucker Translocation Plan (Dudek 2018) will guide the effort to translocate Santa Ana sucker into areas where suitable habitat is present in areas of its historic range where it has been extirpated.

The Translocation Plan is intended to serve as a framework for evaluating potential translocation sites, translocating Santa Ana sucker to those sites should they be suitable, and monitoring the translocated population, with the ultimate goal of producing viable populations that are resilient to natural and anthropogenic changes in Santa Ana sucker habitat. These efforts would be conducted consistent with the *Recovery Plan for the Santa Ana Sucker* (USFWS 2017) and the *Programmatic Intra-Service Formal Section 7 Consultation on Issuance of 10(a)(1)(A) Permits for the Santa Ana Sucker* (USFWS 2015a), in coordination with the Upper SAR HCP, and with support from the Riverside-Corona Resource Conservation District.

The Translocation Plan is intended to function as a living document. The intention is to provide a robust monitoring program within an adaptive management framework that can be modified or expanded as new knowledge becomes available to meet proposed success criteria provided in the plan. The following is a summary of the Translocation Plan components.

In order to assess the potential suitability of an identified stream for Santa Ana sucker translocation, a two-staged approach to evaluating a potential translocation site will be conducted. The first phase is to conduct a desktop assessment of the stream under consideration. The purpose of the Stage 1 Evaluation for any given stream is to: (1) identify stream reaches that have the potential to support Santa Ana sucker, and (2) conduct constraints analyses to determine if there are any fatal flaws that may preclude successful Santa Ana sucker translocation, identify physical threats to a successful Santa Ana sucker translocation, and evaluate potential conflicts (landowners, land managers, or human uses) that could adversely affect the success of a Santa Ana sucker translocation effort.

If, after completing the Stage 1 Evaluation, the stream under consideration for Santa Ana sucker introduction is initially determined to be suitable for reintroduction, the Stage 2 Habitat Suitability Evaluation is conducted. The Stage 2 Evaluation quantitatively evaluates the suitability of the stream to support Santa Ana sucker and provides valuable information for determining the general overall status or functioning of the stream. The Stage 2 Evaluation consists of two parts: (1) a comprehensive stream bioassessment following the State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) Standard Operating Procedures, and (2) a targeted survey of habitat/flow conditions and Santa Ana sucker life-stage specific habitat characteristics and their relative abundance.

Sources of translocated fish include a captive breeding and rearing program at the Riverside-Corona Resource Conservation District Greenbelt Facility, and direct translocation of fish captured from the Santa Ana River. The Translocation Plan describes procedures for the translocations, including age classes and number of individuals to be translocated at a chosen translocation site, release timing, and transportation and release procedures.

Finally, the Translocation Plan includes assessment methodology for evaluating the success of translocation efforts. These involve regular assessments of translocated populations to determine establishment and distribution; if Santa Ana sucker are successfully spawning and recruiting new generations, and if new generations are surviving to successful reproduction (self-sustaining); condition of the translocated fish (an indicator of successful fish energy acquisition and storage, most often linked to food availability), population estimate, genetic variability, physical habitat conditions, and population persistence.

5.6.2 Mountain Yellow-Legged Frog Captive Rearing and Translocation

Populations of mountain yellow-legged frogs have declined considerably in Southern California over the past several decades. As stated in the mountain yellow-legged frog 5-year review (USFWS 2012), the primary way to accomplish goals for recovery of the species is through a captive breeding program and possible future translocation between existing populations. In 2011 an emergency salvage was conducted to collect any remaining individuals from East Fork City Creek because reproduction had not been detected at this locality in over 7 years, and the number of adults had been low for many years. This was the last known population in the San Bernardino Mountains and the only population in the Planning Area. The frogs salvaged from City Creek became part of the San

Diego Zoo Institute for Conservation Research yellow-legged frog captive rearing and reintroduction program. To date, hundreds of tadpoles have been reintroduced to City Creek and are being monitored for survival and signs of successful breeding.

Currently, populations of mountain yellow-legged frogs occur in the Angeles and San Bernardino National Forests. The U.S. Geological Survey (USGS) has been monitoring the remaining populations of the southern clade of this species since the late 1990s. This work includes restoration and monitoring surveys focused on assessing population size and animal health. Valley District, on behalf of the HCP Permittee Agencies, is contributing $64,382 to continue this work in 2020.

Surveys and restoration work in 2020 will be a continuation of the USGS's 20-year conservation effort. The information gained from these surveys will be applied to the recovery actions currently implemented by the Southern California Mountain Yellow-legged Frog Working Group. This group is composed of representatives from USFWS, USGS, Angeles National Forest, San Bernardino National Forest, CDFW, the Los Angeles Zoo, the San Diego Zoo's Institute for Conservation Research, Henry Doorly Zoo, Santa Ana Zoo, and the James San Jacinto Mountains Reserve, University of California Natural Reserve System. Surveys will allow the Working Group to monitor current population trends and die-offs.

Most of the work for 2020 will be funded through a CDFW Section 6 grant. The captive rearing and translocation program would augment gaps in the CDFW Section 6 grant to better replicate work for mountain yellow-legged frogs completed in previous years and dedicate funding to the San Bernardino National Forest translocation efforts.

USGS will monitor known populations of mountain yellow-legged frogs within the Santa Ana River watershed during three surveys at each of the following sites: City Creek (East Fork), Fuller Mill Creek (lower), and Dark Canyon. The focus of these surveys will be to collect data on frog demographics, distribution, and population size. Data will also be collected on disease, water quality, habitat parameters, and site disturbances. In addition, USGS will be assisting with releases of captively produced mountain yellow-legged frogs within the Santa Ana River watershed, a process that will be discussed and agreed upon by the Mountain Yellow-legged Frog Working Group.

5.7 Species and Habitat Research

5.7.1 Santa Ana Sucker Population Genetics Research and Management

The focus of Santa Ana sucker translocation efforts is to reestablish the functionality of the population consistent with the species' evolution in Southern California, to the extent this is possible in a modified watershed. Successful translocation of Santa Ana sucker into different parts of the Santa Ana River watershed will require careful management and maintenance of conditions to enhance the genetic diversity of reintroduced populations. Management considerations include spatial placement of recipient sites within the watershed and the genetic diversity of source populations. USFWS, USGS, and the Alliance will create a management plan to provide guidance that addresses these management considerations, based on available habitat and genetic data.

Genetic shifts in Santa Ana sucker occur frequently in the species' Santa Ana River population due to natural boom-and-bust demographic cycles, the absence of immigration from outside sources, and human-induced mortality caused by disrupted flow releases from the RIX. Since 2013 the Santa Ana

River has been completely dewatered when RIX periodically shuts down due to water quality or power supply issues. RIX provides approximately 82% of the total summer flow to the reach of the Santa Ana River that is occupied by Santa Ana sucker. These shifts occur primarily due to the loss of genetic variation as a consequence of reduction in the effective population size, which can have long-term adverse effects on Santa Ana sucker fitness. As a result, it is important to characterize the current genetic health of the population and to test whether genetic variability has declined or remained stable over time. USFWS, USGS, and the Alliance are collaborating on a Santa Ana sucker genetics study which will provide updated information on the population genetics of Santa Ana sucker in the Santa Ana River using restriction site-associated DNA sequencing (RADseq). This study will assess whether the Santa Ana River population has maintained or lost genetic diversity over time. The information collected will also be helpful to guide the captive breeding and translocation program that will ultimately provide fish for the reestablishment efforts in portions of the species' historic range within the Santa Ana River watershed. The study will also collect data from a contemporary sample of Santa Ana sucker in the San Gabriel River to determine whether the two watersheds show evidence of past genetic exchange; if so the mixing of individuals may be appropriate for increasing the genetic diversity in the Santa Ana River population.

The Alliance, on behalf of the Permittee Agencies, is contributing $20,000 (22%) of the funding to conduct the Santa Ana Sucker Translocated Populations Genetics Management program, and contributing $55,000 (60%) of the funding to conduct the Santa Ana Sucker Population Genetics study as a part of the mitigation for potential impacts on Santa Ana sucker from Covered Activities covered by the HCP.

5.7.2 Mountain Yellow-Legged Frog Surveys

Ongoing Surveys

Mountain yellow-legged frog has declined from more than 99% of its historic range in Southern California over the past several decades. USGS has been monitoring the remaining known populations on East Fork City Creek within the Planning Area, and two sites outside the Planning Area (Lower Fuller Mill Creek and Dark Canyon Creek) since the late 1990s by conducting surveys focused on assessing population size and animal health. These surveys will continue in 2020. The focus of these efforts will be to collect data on mountain yellow-legged frog demographics, distribution, and population size as well as disease, water quality, habitat parameters, and site disturbances. USGS will also be assisting with releases of captively reared mountain yellow-legged frog within the Santa Ana River watershed.

The Alliance, on behalf of the Permittee Agencies, is contributing funds as noted in the mountain yellow-legged frog translocation discussion above to conduct these surveys as a part of the mitigation for potential impacts on mountain yellow-legged frog from Covered Activities covered by the HCP.

Environmental DNA Survey

Surveys over the past decade have proven costly and labor-intensive because mountain yellow-legged frog is difficult to detect through traditional survey techniques. The Environmental DNA (eDNA) survey will utilize a new technique that may be less expensive while providing data needed to achieve current protocols. eDNA is DNA that has been introduced into the aquatic system by species from shed skin cells, feces, urine, or other means and can be collected from water samples

using flow-through filters and then analyzed with DNA "fingerprinting" techniques. Studies have demonstrated that recovering eDNA from stream water is possible even with low densities of amphibian populations (Goldberg et al. 2011). The technique can be applied to detect the presence of multiple species simultaneously. For example, water samples can be analyzed to identify new locations of mountain yellow-legged frog presence, evaluate threats of known predators (e.g., rainbow trout, bullfrogs, garter snakes) and/or pathogens, and to determine the effectiveness of nonnative fish removal programs. Therefore, eDNA can be used as a proxy for ecosystem health and can help identify and prioritize where management efforts are most needed.

The eDNA study will complete the following: (1) determine if eDNA from mountain yellow-legged frog and other aquatic species are detectable in Southern California streams; (2) develop protocols for eDNA collection and analysis; and (3) assess the power to detect species across a range of environmental variables. If successful, the benefits of using eDNA could include cost savings, reduction in permitting issues, and a more efficient and less invasive means of data collection.

The Alliance, on behalf of the Permittee Agencies, is contributing $70,000 (54%) of the funding to complete the eDNA survey as a part of the mitigation for potential impacts on mountain yellow-legged frog from Covered Activities covered by the HCP.

5.7.3 Western Spadefoot Updated Population Survey

There is limited information about western spadefoot distribution within the Planning Area. USGS recently completed habitat suitability modeling for the northern range of the spadefoot that predicts potential habitat and is developing a similar model for the Southern California population of the species. This survey effort will allow for field testing of the new Southern California model. USGS will also compile historic records for the species, conduct surveys to evaluate occupancy of spadefoot at these sites, and identify breeding sites.

The Alliance, on behalf of the Permittee Agencies, is contributing $20,000 (66%) of the funding to conduct these surveys and analysis as a part of the mitigation for potential impacts on spadefoot toad from Covered Activities covered by the HCP.

5.7.4 Santa Ana Speckled Dace Population Survey and Threats Analysis

In Southern California, including the Santa Ana River watershed, Santa Ana speckled dace have suffered dramatic declines due to habitat loss, altered hydrology, and the effects of fire/flood regimes in the upper watershed creeks of the San Bernardino National Forest. However, the status and distribution of this species is largely unknown throughout much of its former range. All known information on the status and distribution within the Santa Ana River watershed will be compiled to develop contemporary and historic distribution maps. Surveys will be completed in many localities to fill in gaps in information on presence/absence, demographics, and remaining suitable habitat. Genetic samples will be collected for future genetic analysis and to help develop a threat assessment at locations where surveys take place.

The Alliance, on behalf of the Permittee Agencies, is contributing $20,000 (93%) of the funding to conduct these surveys and analysis as a part of the mitigation for potential impacts on Santa Ana speckled dace from Covered Activities covered by the HCP.

5.7.5 Southwestern Pond Turtle Population Survey and Threats Analysis

Southwestern pond turtle is currently being evaluated for listing under the federal Endangered Species Act. In Southern California, dramatic declines have occurred due to habitat loss, altered hydrology, and the introduction of nonnative species. However, the status and distribution of this species is largely unknown throughout much of its former range. Within the Santa Ana River watershed, surveys are needed in many localities to establish presence/absence, demographics, and remaining suitable habitat. This data is needed to establish the existing population level in the HCP Planning Area in order to demonstrate the benefits of restoration and conservation activities over time.

Several sporadic observations have been made in recent years along the Santa Ana River upstream of Prado Dam, in Sunnyslope Creek, and San Timoteo Creek. This project will use turtle trapping surveys in the wetted reaches of the Santa Ana River and its tributaries to further document the occupied areas within western Riverside and southwestern San Bernardino Counties, as well as record demographics to assess the health of remaining populations. The surveys will include habitat suitability assessments to determine whether appropriate habitat exists at survey locations where southwestern pond turtles are not detected. Additionally, threats from invasive species will be identified, especially nonnative turtles. Nonnative turtles and any other invasive species, such as bullfrogs, will be recorded and removed from the environment, when possible.

The survey and threat analysis will include reconnaissance surveys, trapping surveys; removal of nonnative turtles and other invasive species as possible, from surveyed areas after completing each survey; and compilation of all survey results into a report to be submitted to USFWS and the California Natural Diversity Database (CNDDB).

The Alliance, on behalf of the Permittee Agencies, is contributing $30,000 (33%) of the funding to conduct these surveys and analysis as a part of the mitigation for potential impacts on southwestern pond turtle from Covered Activities covered by the HCP.

5.8 Conservation Bank Credits

The Lytle Creek Conservation Bank and Cajon Creek Conservation Bank are in the alluvial floodplain and active channel of Lytle Creek and Cajon Creek, respectively, near the confluence of Lytle and Cajon Creeks (north of Interstate [I-] 210 and west of I-215). Both banks have habitat mitigation credits available to mitigate impacts on San Bernardino kangaroo rat and Santa Ana River woolly-star if needed.

It is expected that the mitigation needs of the HCP will be met through the conservation actions described above and in the species-specific conservation actions in Section 5.9. However, if additional mitigation is needed above and beyond these actions then the mitigation credits in the Lytle Creek or Cajon Creek (Vulcan Bank) Conservation Banks may be used.

5.9 Species-Specific Conservation Strategies

The species-specific conservation strategies are the heart of the HCP conservation strategy. Each strategy is described in terms of the conservation objectives and conservation actions developed

specifically for that species. The strategy describes the species-specific avoidance and minimization measures (AMMs) to be implemented in addition to the general avoidance and minimization measures for the HCP (Section 5.11, *Measures to Avoid and Minimize Take*). The species-specific conservation strategy then describes the Expected Outcome for the species, taking into consideration the impacts from all Covered Activities, in balance with the expected mitigation resulting from implementation of the HCP Preserve System (restoration projects, acquisitions and easements, monitoring and management), avoidance and minimization measures, and other supporting research. Each species-specific conservation strategy brings together all the analysis of the HCP that is relevant to the species in order to determine the net effect on the species (and Critical Habitat if designated) and to demonstrate that the mitigation measures offset the take to the maximum extent practicable such that an incidental take permit may be issued for the species under the HCP.

For each Expected Outcome a table is included that summarizes the total impact of Covered Activities in acres side-by-side with the mitigation in acres in the HCP Preserve. The Expected Outcome is an estimate based on acres of modeled habitat impacted and conserved for each species. Note that only a subset of modeled habitat would be expected to be occupied; however, all suitable habitat within the HCP Preserve System will be managed and monitored to benefit the Covered Species. In addition, the Expected Outcome includes an estimate of habitat to be restored for the species. A portion of this area is included in the modeled habitat for the species, while other portions are not currently suitable habitat but would be restored to be suitable for the species.

While this section describes species-specific conservation strategies and avoidance and minimization measures for all Covered Species, there are two species, Delhi Sands flower-loving fly and arroyo toad, that are also addressed below. These two species will be completely avoided, and therefore will not require coverage for incidental take under this HCP. To ensure that all Covered Activities completely avoid impacts on these two species, avoidance measures (AMs) to fully avoid these species are included in Section 5.10, *Fully Avoided Species*.

Management to maintain and enhance habitat and monitoring to ensure the compliance with and effectiveness of the conservation actions listed below will be conducted according to the CAMMP. A framework for the CAMMP is provided in Section 5.12. Detailed Preserve Unit Plans (PUPs) will be developed under the CAMMP for each of the five preserve units in the HCP Preserve (see Section 5.4, *HCP Preserve System*, and Section 5.12). The PUPs will be developed to focus on the specific management and monitoring needs of the species that occur in those habitats in each geographic region of the Preserve System. Unless otherwise identified, monitoring actions for Santa Ana sucker and arroyo chub within the mainstem of the Santa Ana River will be completed annually. All other species monitoring and survey activities will occur within a year of conservation lands being added to the HCP Preserve System and at intervals determined in the CAMMP (see Section 5.12).

Table 5-7 summarizes how the HCP Goals and Objectives benefit each Covered Species through the implementation of species-specific conservation actions.

Table 5-7. Summary of Conservation Actions to Accomplish the HCP Goals and Objectives by Preserve Unity and Habitat Community

HCP Conservation Goals and Objectives	Species Conservation Benefit	Associated Species Conservation Actions
HCP Goals • Conserve Covered Species and their habitats to contribute to the recovery of species listed or those that may become listed under the ESA. • Sustain the ecological processes necessary to maintain the functionality of the natural communities and habitats upon which the Covered Species depend. • Maintain and improve habitat connectivity in the HCP Preserve System and to adjacent protected habitat areas to facilitate movement and genetic exchange between populations of Covered Species. • Actively manage lands within the HCP Preserve System to maintain and improve conditions for the benefit of Covered Species.		
HCP Objective 1: Conserve and manage 1,901.5 acres of native habitat in the HCP Preserve System		
Alluvial Fan Preserve Units (A and B)		
Alluvial Fan Sage Scrub and other Shrubland and other natural habitats: 1,289.1 acres of conserved and managed lands (260.9 acres restored*).	Burrowing owl	BUOW 1A, 1B
	Cactus wren	CACW 1A, 1B, 1C
	California glossy snake	CGSN 1
	Coastal California gnatcatcher	CAGN 1
	Los Angeles little pocket mouse	LAPM 1
	San Bernardino kangaroo rat	SBKR 1
	Santa Ana River woolly-star	SARW 1, 2
	Slender-horned spineflower	SHSF1A, 2A
	Western spadefoot	WESP 1, 2
Santa Ana River Preserve Unit		
Riparian, Aquatic, and other natural habitats: 384.3 acres conserved and managed (240.3 acres restored*).	Santa Ana sucker	SAS 1, 4A, 4B, 4D, 5A
	Arroyo chub	ARCH 1, 2, 3, 4
	Least Bell's vireo	LBVI 1, 2
	Mountain yellow-legged frog	MYLF 1A, 1B
	South coast garter snake	SCGS 1
	Southwestern pond turtle	SWPT 1A, 1B
	Southwestern willow flycatcher	SWFL 1
	Tricolored blackbird	TRBL 1, 2C

HCP Conservation Goals and Objectives	Species Conservation Benefit	Associated Species Conservation Actions
	Western spadefoot	WESP 1
	Western yellow-billed cuckoo	WYBC 1
	Yellow-breasted chat	YBCH 1A
Santa Ana Sucker Translocation Units		
Riparian, Aquatic, Shrubland, and other natural habitats: 264.0 acres conserved and managed.	Santa Ana sucker	SAS 1, 4A, 4B, 4D, 5A
	Mountain yellow-legged frog	MYLF 1A, 1B
	Santa Ana speckled dace	SASD 2A, 2B
HCP Objective 2: Restore and re-establish 538.6 acres of habitat for Covered Species		
Santa Ana River Preserve Unit		
Aquatic (stream) and Riparian habitats in and along tributaries: increase the amount and quality of available foraging and spawning habitats along 3.5 miles (3.6 acres of tributary stream habitat) of mainstem Santa Ana River tributary streams at Anza, Old Ranch, Lower Hole, and Hidden Valley Creek Restoration Areas through substrate augmentation. Provide supplemental surface flow (tertiary treated wastewater) to these four streams, Arroyo Tequesquite Creek, and Lake Evans.	Arroyo chub	ARCH 2, 4
	Least Bell's vireo	LBVI 2
	Santa Ana sucker	SAS 1A, 3A, 3B, 3C, 3D, 3E, 4D, 5A
	South coast garter snake	SCGS 2A
	Southwestern pond turtle	SWPT 2A, 2B, 2C
	Southwestern willow flycatcher	SWFL 2
	Tricolored blackbird	TRBL 2A
	Western yellow-billed cuckoo	WYBC 2
	Yellow-breasted chat	YBCH 2
Aquatic (pond and wetland) and Riparian habitats in the floodplain: increase the amount and quality of available open water habitat within the mainstem Santa Ana River floodplain (220.6 acres*).	Least Bell's vireo	LBVI 2
	Southcoast garter snake	SCGS 2B
	Southwestern pond turtle	SWPT 2A, 2B, 2C
	Southwestern willow flycatcher	SWFL 2
	Tricolored blackbird	TRBL 2A, 2B
	Western yellow-billed cuckoo	
	Yellow-breasted chat	YBCH 2
Alluvial Fan Preserve Units (A and B)		
	Cactus wren	CACW 2A, 2B, 3

HCP Conservation Goals and Objectives	Species Conservation Benefit	Associated Species Conservation Actions
Alluvial Fan Scrub habitats: restore and enhance alluvial fan scrub habitat in the Enhanced Recharge Basin (185.9 acres*), North Enhanced Recharge Basin (34.6 acres*), and Drainage A Woolly-star Restoration (40.6 acres*). Conserve high quality topsoil by sequestering and maintaining topsoil during ground-disturbing activities and re-applying to restoration projects where appropriate.	Coastal California gnatcatcher	CAGN 2
	Los Angeles little pocket mouse	LAPM 2A, 2C
	San Bernardino kangaroo rat	SBKR 2A, 2B, 2C, 2D
	Santa Ana River woolly-star	SARW 2
	Slender-horned spineflower	SHSF 1B
HCP Objective 3: Reduce anthropogenic and environmental threats to the HCP Preserve System		
All Preserve Units		
Aquatic (stream) and Riparian habitats: reduce anthropogenic impacts on Santa Ana sucker and sucker habitat, for example (1) install trash racks at lowland tributaries; (2) install signs to educate the general public on the sensitivity of the Santa Ana sucker and goals of the HCP; (3) protect riparian habitat from off-highway vehicle use; (4) coordinate with flood control agencies to reduce the amount of riparian mowing adjacent to Santa Ana sucker habitat; and (5) reduce the impact of migrant encampments within the Preserve System.	Arroyo chub	ARCH 3A, 3B
	Burrowing owl	BUOW 1B, 1C
	Mountain yellow-legged frog	MYLF 1D
	Least Bell's vireo	LBVI 3
	Los Angeles little pocket mouse	LAPM 2B
	San Bernardino kangaroo rat	SBKR 2B
	Santa Ana River woolly-star	SARW 3B, 3C,
	Santa Ana speckled dace	SASD 2C
	Santa Ana sucker	SAS 4A, 4B
	Slender-horned spineflower	SHSF 1B
	South coast garter snake	SCGS 2C
	Southwestern pond turtle	SWPT 1C, 3
	Southwestern willow flycatcher	SWFL 1B
	Tricolored blackbird	TRBL 1A, 2A, 2C
	Western yellow-billed cuckoo	WYBC 1A, 2A
	Yellow-breasted chat	YBCH 1B
HCP Objective 4: Maintain and enhance existing Santa Ana sucker habitat		
Santa Ana River Preserve Unit		

HCP Conservation Goals and Objectives	Species Conservation Benefit	Associated Species Conservation Actions
Aquatic (stream) habitat in the mainstem of the Santa Ana River: enhance Santa Ana sucker habitat in the mainstem of the Santa Ana River with the addition of at least six habitat nodes and/or stream bifurcation structures. Removal of fine sediment in the Prado Basin to enhance habitat for native fishes with a goal of enhancing (increasing) bed coarseness by transporting fine-grained sediment off of existing coarse sediment. Aquatic (stream) habitat in the Rialto Channel: reduce water temperature in Rialto Channel to less than 86°F to provide year-round habitat for Santa Ana sucker.	Arroyo chub	ARCH 1, 4
	Santa Ana sucker	SAS 1A, 2A-E, 3A-E, 4D, 4E, 5A
HCP Objective 5: Maintain and enhance existing San Bernardino kangaroo rat habitat		
Alluvial Fan Preserve Units (A and B)		
Restore and enhance 260.9 acres of alluvial fan sage scrub habitat through the mechanical manipulation of soils to approximate natural fluvial disturbances and vegetation management.	Santa Ana River woolly-star	SARW2
	Los Angeles little pocket mouse	LAPM 2A, 2B, 2C
	San Bernardino kangaroo rat	SABK 2A, 2B, 2C, 2D, 2F
HCP Objective 6: Implement Relocation or Translocation of Covered Species		
Alluvial Fan Preserve Units (A and B)		
Restore and provide long-term management of Los Angles little pocket mouse and San Bernardino kangaroo rat habitat to promote genetically diverse populations in appropriate areas within the Preserve System.	San Bernardino kangaroo rat	SBKR 3C
Santa Ana Sucker Translocation Preserve Units (A and B)		
Provide long-term management of Santa Ana sucker habitat in the San Bernardino National Forest to establish and support three or more new populations of Santa Ana sucker. Provide support for Santa Ana	Mountain yellow-legged frog	MYLF 1C, 4
	Santa Ana sucker	SAS 6A, 6B
	Santa Ana speckled dace	SASD 2A, 2B, 2D

HCP Conservation Goals and Objectives	Species Conservation Benefit	Associated Species Conservation Actions
speckled dace, and mountain yellow-legged frog populations and translocation and relocation efforts.		
HCP Objective 7: Improve knowledge of Covered Species to Inform Management Actions		
All Preserve Units		
Support or conduct studies to further the current understanding of Covered Species including: habitat requirements, population and genetics studies, threat assessments, and general species information.	Burrowing owl	BUOW 1D
	California glossy snake	CGSN 2A, 2B
	Los Angeles little pocket mouse	LAPM 3A, 3B
	Mountain yellow-legged frog	MYLF 2, 3
	San Bernardino kangaroo rat	SBKR 2E, 3A, 3B
	Santa Ana River woolly-star	SARW 3A
	Santa Ana sucker	SAS 1B, 4C, 5B, 7A, 7B
	Santa Ana speckled dace	SASD 1, 2A
	Slender-horned spineflower	SHSF 2B, 2C

*Restored acres are included within the total area of conserved lands. The restoration acres shown represent the entire restoration project; however, the entire project may not equally benefit all species listed. Refer to the subsections that follow for species specific acreages.

5.9.1 Slender-Horned Spineflower (SHSF)

Conservation Objectives and Actions

SHSF Objective 1: Permanently conserve and manage slender-horned spineflower patches of occupied habitat within the HCP Preserve System to fully mitigate the effects of any direct impacts on slender-horned spineflower individuals resulting from Covered Activities.

SHSF Action 1A: Conserve an extant patch of at least equal size and viability for any slender-horned spineflower patch impacted by ground-disturbing Covered Activities (based on HCP Preserve System inventory, monitoring, and tracking).

SHSF Action 1B: Enhance all known patches of slender-horned spineflower in the HCP Preserve System through nonnative plant species management. Specific success criteria and monitoring and management techniques and frequency will be developed in the CAMMP.

SHSF Objective 2. Conserve slender-horned spineflower habitat to accommodate future changes in distribution in response to environmental conditions or management actions undertaken for the benefit of slender-horned spineflower or other Covered Species.

SHSF Action 2A: Conserve a total of 877 acres of modeled habitat in the HCP Preserve System with confirmed occupancy or in areas connected to occupied habitat determined through

modelling and subsequent onsite evaluations. Suitable habitat will be determined using known characteristics of slender-horned spineflower habitat; for example, areas associated with Riversidian alluvial fan sage scrub on benches and terraces away from active flood channels in areas receiving little surface disturbance from flooding, but subject to sheet or overland flows, associated with junipers, and cryptogrammic soils and those determined in the course of adaptive management.

SHSF Action 2B: Coordinate with the Upper Santa Ana River Wash HCP (Wash Plan) Spineflower Restoration Program as appropriate to facilitate optimization of conservation benefits for the species through adoption of best available science to inform the adaptive management and monitoring program.

SHSF Action 2C: Determine the current extent and location of slender-horned spineflower patches in the HCP Preserve System and monitor population trends over time.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Effects

SHSF AMM-1: New construction projects in occupied slender-horned spineflower habitat will be avoided if feasible. For projects where the exact location of the facility has not been determined the Permittee Agency must consider alternatives outside of occupied habitat. If an alternative in occupied habitat is selected, the Permittee Agencies must demonstrate to the Alliance why it was not possible to locate the project in unoccupied habitat and must limit the impact to no more than 20% of the plants at that site.

SHSF AMM-2: A qualified botanist will conduct pre-activity surveys in areas where permanent impacts will occur using the CDFW rare plant survey protocol. If plants are detected, seed will be collected prior to ground disturbance. Seed will be stored for future use in restoration and enhancement projects by an entity that has a Memorandum of Understanding (MOU) with USFWS to process and handle the seeds of endangered plants. Soil will also be collected if research indicates it would be of value to restoration efforts. No additional surveys are required after the first survey if slender-horned spineflower are not detected.

SHSF AMM-3: Erect a temporary fence to protect known occurrences within 50 feet of Covered Activities. A qualified botanist and/or biological monitor will monitor construction activities, maintain the markers limiting construction, and maintain the fence protecting the plants to prevent accidental disturbance.

SHSF AMM-4: Surface soils will be removed and sequestered at the beginning of any ground-disturbing construction or operations and maintenance (O&M) activity where slender-horned spineflower is present or in the immediate vicinity. If cryptogamic soil crust is also present, it will be harvested in blocks, preserved, and placed back on the site in areas of temporary impact. If the impacts are permanent, an alternate site in suitable habitat will be selected in consultation with a qualified botanist or restoration biologist. After the sequestered soil is returned to a site, it will be replanted with the previously collected slender-horned spineflower seed over consecutive years following the ground disturbance. The timing and methods of planting will be determined by the Alliance in consultation with a restoration biologist and will incorporate adaptive management.

Expected Outcomes

Table 5-8 summarizes the estimated impacts and conservation of modeled habitat for slender-horned spineflower. Implementation of the conservation actions described above would meet the conservation objectives for the species and would avoid and minimize potential effects and offset the impact on slender-horned spineflower, resulting in long-term conservation benefits to the species.

Approximately 877.2 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 261.1 acres of alluvial fan sage scrub restoration is planned within the Alluvial Fan Scrub Restoration Areas that may benefit slender-horned spineflower.

As described in the effects analysis for slender-horned spineflower in Section 4.6.2, *Plant Species*, implementation of the Covered Activities would result in a permanent loss of 283.3 acres of modeled habitat within the Planning Area and the temporary loss of 116.3 acres of modeled habitat. There are no anticipated impacts on known occurrences of slender-horned spineflower except for disturbances from possible seed collecting activities to support restoration efforts.

When considered along with the amount of modeled habitat that will be restored and/or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-8. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Slender-Horned Spineflower

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Current Occupied Habitat			
Phase 1	0.0	0.0	0.2
Phase 2	0.0	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.0*	*0.0*	*0.2*
Historic Occupied Habitat			
Phase 1	0.05	0.0	--
Phase 2	0.0	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.05*	*0.0*	--
Potentially Suitable Habitat			
Phase 1	97.2	64.2	792.8
Phase 2	22.4	50.3	84.2
Phase 3	79.6	0.2	--

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Phase 4	84.0	1.6	--
Total	*283.2*	*116.3*	*877.0*
Total Modeled Habitat	**283.3**	**116.3**	**877.2**
Planned Habitat Restoration			**261.1**

5.9.2 Santa Ana River Woolly-Star (SARW)

Conservation Objectives and Actions

SARW Objective 1. Permanently conserve and manage Santa Ana River woolly-star patches of occupied habitat within the HCP Preserve System to fully mitigate the effects of any direct impacts on Santa Ana River woolly-star individuals resulting from Covered Activities.

SARW Action 1: Conserve 728 acres of potentially suitable habitat (alluvial fan sage scrub), occupied habitat, or habitat adjacent to occupied habitat within the HCP Preserve System.

SARW Objective 2: Conserve and restore Santa Ana River woolly-star habitat within the HCP Preserve system to improve the ecological processes and available alluvial fan habitat.

SARW Action 2: Conserve and restore up to 261.1 acres of alluvial fan scrub habitat that is expected to benefit Santa Ana River woolly-star within the restoration projects within the HCP Preserve System. This includes the 40.6-acre Drainage A Woolly-star Restoration Project focused on improving woolly-star habitat (an alternate location of similar acreage will be preserved if lands associated with Drainage A cannot be acquired). A portion of this area is included in the modeled habitat for the species, while other portions are not currently suitable habitat but would be restored to be suitable for the species

SARW Objective 3: Expand the distribution of Santa Ana River woolly-star in the HCP Preserve System.

SARW Action 3A: Determine the current extent and location of Santa Ana River woolly-star in the HCP Preserve System, monitor population trends over time, and assess the effectiveness of management actions.

SARW Action 3B: Collect Santa Ana River woolly-star seeds, through collection within the HCP Preserve System or from Covered Activity impact areas to be used at restoration sites.

SARW Action 3C: Plant collected Santa Ana River woolly-star seed at restoration sites and identified areas within the HCP Preserve System that have achieved nonnative plant control objectives. Planting will be scheduled and implemented by the Alliance and will follow currently accepted planting methods and timing.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Effects

SARW AMM-1: New construction projects in occupied Santa Ana River woolly-star habitat will be avoided if feasible. For projects where the exact location of the facility has not been determined the Permittee Agency must consider alternatives outside of occupied habitat. If an alternative in occupied habitat is selected, the Permittee Agencies must demonstrate to the Alliance why it was not possible to locate the project in unoccupied habitat.

SARW AMM-2: Prior to ground disturbance from new construction and O&M activities in potentially suitable Santa Ana River woolly-star habitat, surveys will be conducted by a qualified botanist to determine if the plant is present. Surveys will be conducted during the appropriate season and in accordance with the CDFW protocols for surveying special-status plant populations.

SARW AMM-3: When Covered Activities will take place within 50 feet of known occurrences of Santa Ana River woolly-star, a temporary fence will be erected to protect them. A qualified botanist and/or biological monitor will monitor construction activities, maintain the markers limiting construction, and maintain the fence protecting the Santa Ana River woolly-star, to prevent accidental disturbance.

SARW AMM-4: If Santa Ana River woolly-star is detected during pre-project surveys, seeds will be collected at the appropriate time prior to ground disturbance.[1] Seed collection and storage will be by an entity that is qualified to process and handle the seeds of endangered plant taxa. In areas of temporary impacts, the seed may be replanted in the temporarily disturbed area. The seed planting time and location will be determined by the Alliance using best available science and information.

SARW AMM-5: Sites where temporary impacts occur will be replanted with the previously collected Santa Ana River woolly-star seed over consecutive years following the ground disturbance. The timing and methods of planting will be determined by the Alliance in consultation with a qualified botanist or restoration biologist with Santa Ana River woolly-star experience and will incorporate adaptive management. If the impacts are permanent, an alternate site in suitable habitat will be selected by a qualified restoration biologist or botanist.

SARW AMM-6: The replanting site will be monitored and managed to achieve and maintain success criteria developed by the HCP Preserve System Management Committee.

Expected Outcomes

Table 5-9 summarizes the estimated impacts and conservation of modeled habitat for the Santa Ana River woolly-star. Implementation of the conservation actions described above would meet the conservation objectives for the species and would avoid and minimize potential effects and offset the impact on Santa Ana River woolly-star, resulting in long-term conservation benefits to the species.

A total of 728.2 acres of modeled habitat are expected to be conserved within the HCP Preserve System, and 261.1 acres of Santa Ana River woolly-star habitat would be restored and managed to benefit the species within the restoration project areas.

[1] Seed collection and storage will be by the entity that has an MOU with USFWS to process and handle seeds of endangered plant taxa. The Alliance or an entity contracted by the Alliance may collect woolly-star seed on behalf of the entity holding the MOU if they first obtain clearance from the Wildlife Agencies, and they receive supervised instruction in the collection and handling of woolly-star seed.

As described in the effects analysis for Santa Ana River woolly-star in Section 4.6.2, implementation of the Covered Activities would result in a permanent loss of 392.6 acres of modeled habitat within the Planning Area and the temporary loss of 53.1 acres of modeled habitat.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-9. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Santa Ana River Woolly-Star

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	63.4	49.8	656.7
Phase 2	16.6	1.2	71.5
Phase 3	175.0	0.2	--
Phase 4	137.0	2.0	--
Total Modeled Habitat	**392.6**	**53.1**	**728.2**
Planned Habitat Restoration			**261.1**

5.9.3 Santa Ana Sucker (SAS)

Conservation Objectives and Actions

SAS Objective 1: Maintain a minimum baseflow to support Santa Ana sucker within the mainstem of the Santa Ana River through adaptive management of the water infrastructure system.

SAS Action 1A: Monitor flows within the mainstem of the Santa Ana River and adaptively manage flow to support Santa Ana sucker.

SAS Action 1B: Research to determine the effective population size of Santa Ana sucker (e.g., number of breeding females, or reproductive adults).

SAS Objective 2: Increase the amount and quality of available foraging, refugia, and spawning habitat in the mainstem of the Santa Ana River through restoration and enhancement. A portion of this area is included in the modeled habitat for the species, while other portions are not currently suitable habitat but would be restored to be suitable for the species.

SAS Action 2A: Enhance sucker habitat in the mainstem of the Santa Ana River with the addition of at least six habitat nodes and/or stream bifurcation structures, enhancing at least 1.5 acres of habitat (see Section 5.5.1, *Mainstem Santa Ana River Microhabitat Creation*).

SAS Action 2B: Where appropriate within the mainstem of the Santa Ana River, create linked microhabitat areas of deep pools, exposed gravel, and faster water, made of natural materials such as boulders, large cobble, and large woody debris to manipulate the flow and path of the

river to maintain a single channel and increased habitat suitability (see Section 5.5.3, *Flow and Path Manipulation Activities Within Mainstem*).

SAS Action 2C: Reduce the water temperature in Rialto Channel to less than 86°F during summer months through the addition of relatively cool groundwater (67–70°F) (see Section 5.5.4, *Rialto Channel Flow and Water Quality Management*).

SAS Action 2D: Develop a protocol for RIX WWTP discharge events to simulate high flow events with a goal of moving fine-grained sand to expose high-quality sucker habitat.

SAS Action 2E: Restore riparian habitat along stream reaches within the HCP Preserve System to improve habitat cover and water temperature mediation for Santa Ana sucker.

SAS Objective 3: Increase the amount and quality of available spawning habitat in lowland tributaries to the mainstem of the Santa Ana River.

SAS Action 3A: Create or restore 3.6 stream miles of suitable habitat, including stream restoration in the Anza Creek, Old Ranch Creek, Hidden Valley Creek, Lower Hole Creek, Evans Lake, and Hidden Valley Ponds Restoration Areas.

SAS Action 3B: Supplement or provide flow to Anza Creek, Old Ranch Creek, Hidden Valley Creek, and Lower Hole Creek Tributary Restoration Areas via the Santa Ana River Sustainable Parks and Tributaries Water Reuse Project (RPU.10).

SAS Action 3C: Provide supplemental water to the Tequesquite Creek Aquatic Restoration site via the Santa Ana River Sustainable Parks and Tributaries Water Reuse Project (RPU.10) (see Section 5.5.5, *Tequesquite Creek Supplementary Flows*).

SAS Action 3D: Enhance aquatic habitat for sucker in Anza Creek, Old Ranch Creek, Hidden Valley Creek, and Lower Hole Creek Tributary Restoration Areas by manipulating water movement to create suitable microhabitat areas, including the addition of natural materials such as rock (gravel, cobble, boulder) and large woody debris, and by maximizing pool scouring.

SAS Action 3E: Restore riparian habitat along tributary stream reaches at the Anza Creek, Old Ranch Creek, Hidden Valley Creek, and Lower Hole Creek Tributary Restoration Areas to maintain channel stability and improve aquatic habitat suitability (e.g., mediate water temperature, and provide overhanging vegetation for cover).

SAS Objective 4: Reduce threats to sucker in the HCP Preserve System by actively managing Santa Ana sucker habitat within the occupied reaches of the mainstem, Tributary Restoration Areas, and Translocation Sites.

SAS Action 4A: Remove exotic predators (e.g., bass, sunfish, tilapia, carp, and catfish, American bullfrog, mosquito fish) and manage nonnative plants as well as specific native plants when they become problematic (e.g., cattail) within Santa Ana sucker managed reaches on the mainstem river, Tributary Restoration Areas, and Translocation Sites.

SAS Action 4B: Reduce anthropogenic impacts on Santa Ana sucker and sucker habitat; for example, (1) install trash racks at lowland tributaries, (2) install signs to educate the general public on the sensitivity of the Santa Ana sucker and the goals of the HCP, (3) protect riparian habitat from off-highway vehicle use, and (4) coordinate with flood control agencies to reduce the amount of riparian mowing adjacent to Santa Ana sucker habitat.

SAS Action 4C: Study other potential threats to Santa Ana sucker such as (1) the sources of contaminants that reduce water quality and effects on sucker; (2) the effect of gambusia on sucker recruitment; (3) strategies to manage invasive beard algae (*Compsopogon caeruleus*); and (4) the effects of water temperature on Santa Ana sucker migration, spawning, and recruitment.

SAS Action 4D: If determined necessary, add cool water from local groundwater aquifers to maintain appropriate water temperature during summer and fall months.

SAS Action 4E: Remove sediment from the lower reaches of the river (Prado Basin) to maintain the river gradient and supplement the mainstem river with coarse sediment.

SAS Objective 5: Manage surface and groundwater supply and hydrologic processes to benefit sucker in the HCP Preserve System.

SAS Action 5A: Coordinate with U.S. Army Corps of Engineers and Orange County Flood Control District to schedule releases from Seven Oaks Dam as part of the CAMMP.

SAS Action 5B: Include the following in a study: (1) determine what entities have water rights hat may influence surface flows and sucker habitat in future drought years, (2) determine all wells and other sources of water that may be used to supply the mainstem and lowland tributaries, and (3) maintain and use the integrated surface-groundwater model to assess gaining and losing reaches of the watershed.

SAS Objective 6: Expand Santa Ana sucker distribution within the Santa Ana River Watershed Recovery Unit by creating new local populations of sucker in the HCP Preserve System.

SAS Action 6A: Conduct multiple translocations of sucker into mountain tributaries with parental stock derived from various locations from the Santa Ana River, and successfully translocate and maintain a sucker population in at least three mountain tributaries.

SAS Action 6B: Reestablish or enhance local sucker populations that may become extirpated after threats causing extirpation have passed (winter storms) by relocating individual Santa Ana sucker that become stranded downstream of mountain tributary streams after flood flow recedes.

SAS Objective 7: Manage for a genetically diverse population of sucker throughout the HCP Preserve System.

SAS Action 7A: Study and identify artificial and natural barriers to fish migration and install fish passage if appropriate to enhance connectivity and enable dispersal and gene flow.

SAS Action 7B: Use population genetic studies to determine mechanisms of genetic drift to help guide both the captive rearing and translocation efforts (see Section 5.7.1, *Santa Ana Sucker Population Genetics Research and Management*).

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

In addition to the measures below, the general avoidance and minimization measures to protect water quality and to protect special-status fish and other aquatic species are applicable to this species.

SAS AMM-1: Avoid work in the active channel for restoration or other purposes during the sucker spawning season (currently determined to be February 15 to July 31).

SAS AMM-2: During work within the active channel, a qualified biologist will be present to monitor the activities. A qualified biologist is defined as an individual that holds a current 10(a)(1)(A) recovery permit for Santa Ana sucker. This individual, or any other project biologist, can stop activities at any time if impacts on native aquatic species are observed. If impacts on Santa Ana sucker occur, the Alliance will be contacted immediately to determine if additional measures to further minimize project impacts are needed.

SAS AMM-3: Prior to diverting any water or de-watering a reach of the river, qualified biologists will conduct a preliminary survey of the affected reach(es) to determine the presence of Santa Ana sucker. Any sucker located within the reach will be captured and relocated to nearby suitable habitat outside of the impact area. The affected reach(es) will be surveyed for fishes throughout the duration of the project using seining, traps, or electrofishing, as necessary.

Expected Outcomes

The conservation actions described above meet the conservation objectives for the Santa Ana sucker and are anticipated to avoid and minimize potential effects and offset the anticipated impacts on Santa Ana sucker resulting in long-term conservation benefits to the species. Table 5-10 summarizes the estimated impacts and conservation within modeled habitat for the Santa Ana sucker; however, it is important to note that many of the conservation actions for this species cannot be quantified in acres or miles of habitat restored. Therefore, the total benefits of conservation actions for Santa Ana sucker are expected to be substantially more than those that can be quantified here. For example, beneficial sediment removal projects occurring in the Santa Ana River mainstem do not have quantified acreage benefits though they will improve habitat and support the continued existence of the species. The installation of gabions to encourage scour and create smaller patches of viable habitat are also important to the continued existence of the species, but do not have a quantified acreage of expected habitat enhancement associated with them. Translocation will increase the viability of the species by increasing the amount of occupied habitat and by increasing the number of local populations, which will substantially reduce the risk of a catastrophic event impacting all of the occupied habitat. And finally, the proposed studies will help inform management of this species into the future.

The proposed impacts on Santa Ana sucker Critical Habitat (in seasonally dry upper channel designated as Critical Habitat as a source of coarse sediment) include approximately 83.3 acres of permanent impacts and 20.2 acres of temporary impacts; approximately 14.1 acres of the conservation sites and 167.5 acres of the restoration sites will protect Critical Habitat in these upper channel areas.

The hydrologic impacts from Covered Activities will result in a loss of approximately 1.3 acres of modeled suitable habitat. The conservation actions will create approximately 3.6 acres of stream habitat in the Santa Ana River tributary restoration sites, and will enhance another 1.5 acres of habitat in the mainstem of the Santa Ana River. When impacts are considered along with the amount of habitat that will be restored or enhanced, and the additional measures proposed to ensure the long-term viability of Santa Ana sucker, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-10. Acres Expected to Be Conserved or Restored for Santa Ana Sucker

	Impacts		Mitigation		
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**Preservation (Acquisitions and Easements)**	**SAR Mainstem Enhancement (acres)**	**Tributary Restoration (acres of wetted area)**
Foraging Habitat					
Phase 1	1.3	--	--	1.5	1.7
Phase 2	--	--	--	--	1.9
Phase 3	--	--	--	--	--
Phase 4	--	--	--	--	--
Total	**1.3**	**--**	**--**	**1.5**	**3.6**

5.9.4 Arroyo Chub (ARCH)

Conservation Objectives and Actions

ARCH Objective 1: Increase the amount and quality of available habitat in the mainstem of the Santa Ana River through restoration and enhancement.

ARCH Action 1: Refer to the conservation actions under *SAS Objective 2*, which will also benefit arroyo chub.

ARCH Objective 2: Increase the amount and quality of available habitat in lowland tributaries in the main stem of the Santa Ana River. A portion of this area is included in the modeled habitat for the species, while other portions are not currently suitable habitat but would be restored to be suitable for the species.

ARCH Action 2: Refer to the conservation actions under *SAS Objective 3,* which will also benefit arroyo chub.

ARCH Objective 3: Reduce threats to the arroyo chub in the HCP Preserve System by actively managing arroyo chub habitat within the occupied reaches of the mainstem and Tributary Restoration Areas.

ARCH Action 3A: Within arroyo chub managed reaches on the mainstem and Tributary Restoration Areas, remove exotic predators (e.g., bass, sunfish, tilapia, carp, and catfish, American bullfrog, mosquito fish) and invasive plants by removing and/or controlling the presence of cattail, giant reed.

ARCH Action 3B: Reduce anthropogenic impacts on arroyo chub habitat though methods such as: (1) install trash racks at lowland tributaries, (2) install signs to educate the general public on the sensitivity of the arroyo chub and goals of the HCP, (3) protect riparian habitat from off-highway vehicle use, and (4) coordinate with flood control agencies to reduce the amount of riparian mowing adjacent to arroyo chub habitat.

ARCH Objective 4: Manage surface water and groundwater and hydrologic processes to benefit arroyo chub in the watershed.

ARCH Action 4: Refer to the conservation actions under the *SAS Objective 5,* which will also benefit arroyo chub.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Effects

The general avoidance and minimization measures to protect water quality and to protect special-status fish and other aquatic species are applicable to this species. The additional measures described for the Santa Ana sucker will further avoid and minimize impacts on arroyo chub.

Expected Outcomes

The conservation actions described above meet the conservation objectives for the species and are anticipated to avoid and minimize potential effects, and offset the impact on arroyo chub, resulting in long-term conservation benefits to the species. Table 5-11 summarizes the estimated impacts and conservation within modeled habitat for the arroyo chub; however, it is important to note that some of the conservation actions for this species cannot be quantified in acres or miles of habitat restored. Therefore, the total benefits of conservation actions for the arroyo chub are expected to be substantially more than those that can be quantified here. There are habitat creation and restoration projects proposed that will directly benefit arroyo chub by providing 3.6 acres in the Tributary Restoration sites. Nonnative predatory species removal projects occurring in the SAR mainstem and Tributary Restoration sites, however, do not have quantified acreage benefits though they will improve habitat and support the continued existence of the species. Additionally, the management of surface and groundwater will help to remove the current threat to this species from unseasonably inconsistent flows.

When impacts are considered along with the amount of habitat that will be restored or enhanced, and the additional measures proposed to ensure the long-term viability of arroyo chub, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-11. Acres Expected to Be Conserved or Restored for Arroyo Chub

	Impacts		Mitigation	
Modeled Habitat Type	**Permanent Impact**	**Temporary Impacts**	**Preservation (Acquisitions and Easements)**	**Tributary Restoration (acres of wetted area)**
Habitat (wetted area, depths >15 inches)			**Restored Stream Habitat**	
Phase 1	2.4	--	--	1.7
Phase 2	--	--	--	1.9
Phase 3	--	--	--	--
Phase 4	--	--	--	--
Total	**2.4**		**--**	**3.6**

5.9.5 Santa Ana Speckled Dace (SASD)

Conservation Objectives and Actions

SASD Objective 1: Increase the understanding of Santa Ana speckled dace distribution and threats to improve management of the species.

SASD Action 1: Contribute $20,000 in funding to conduct a Santa Ana speckled dace population survey and threats analysis in the Planning Area (see Section 5.7.4, *Santa Ana Speckled Dace Population Survey and Threats Analysis*).

SASD Objective 2: Based on the results of the Santa Ana speckled dace population survey and threats analysis in SASD Objective 1, reduce threats by actively managing habitat within the occupied reaches where they co-occur with Santa Ana sucker translocation streams (e.g., City Creek, Plunge Creek).

SASD Action 2A: Conduct long-term management and monitoring of Santa Ana speckled dace local populations.

SASD Action 2B: Manage instream connectivity for local population of Santa Ana speckled dace by identifying artificial and natural barriers to fish migration and installing fishway passage where appropriate.

SASD Action 2C: Identify stream segments that have nonnative invasive species and conduct eradication in these high priority areas.

SASD Action 2D: Relocate individual dace that become stranded downstream of mountain tributary streams after flood flow recedes.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

The general avoidance and minimization measures to protect water quality and to protect special-status fish and other aquatic species are applicable to this species. The additional measure described below will further avoid and minimize impacts on speckled dace.

SASD AMM-1: Prior to diverting any water or de-watering a reach of the river, qualified biologists will conduct a preliminary survey of the affected reach(es) to determine the presence of Santa Ana speckled dace. Any dace located within the reach will be captured and relocated to nearby suitable habitat outside of the impact area. The affected reach(es) will be surveyed for fishes throughout the duration of the project using seining, traps, or electrofishing, as necessary.

Expected Outcomes

The conservation actions described above meet the conservation objectives for the species and are anticipated to avoid and minimize potential effects and offset the impact on Santa Ana speckled dace, resulting in the long-term conservation of the species. There is no proposed preservation or restoration of habitat for this species as the conservation actions for this species are largely concentrated in the nonnative predator reduction and relocation program, which will benefit the species within occupied tributary streams (Table **5-12**).

When the minimal impacts are considered along with the additional measures proposed to benefit habitat conditions for Santa Ana speckled dace, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-12 **Acres Expected to Be Conserved or Restored for Santa Ana Speckled Dace**

	Impacts		
Modeled Habitat Type	**Permanent Impacts[1]**	**Temporary Impacts**	**Mitigation**
Suitable Habitat (wetted area)			**Preservation (Acquisitions and Easements)**
Phase 1	--	--	While there is no stream restoration specific to speckled dace habitat, the proposed relocation actions and nonnative predator control will mitigate for impacts on this species.
Phase 2	--	--	
Phase 3	--	--	
Phase 4	0.1	--	
Total	**0.1**		

5.9.6 Mountain Yellow-Legged Frog (MYLF)

Conservation Objectives and Actions

MYLF Objective 1: Permanently conserve and manage mountain yellow-legged frog habitat within the HCP Preserve System in a configuration that benefits this species.

MYLF Action 1A: Conserve 248 acres of modeled Refugia/Foraging/Dispersal Habitat and 16 acres of Aquatic Habitat within the HCP Preserve System.

MYLF Action 1B: Protect vegetation communities suitable for mountain yellow-legged frog habitat. Ensure aquatic habitat includes Critical Habitat Primary Biological Features (PBFs).

MYLF Action 1C: Coordinate with mountain yellow-legged frog relocation efforts to relocate mountain yellow-legged frogs from streams where environmental conditions have deteriorated (e.g., drought and low flow or other threats) to suitable habitat.

MYLF Action 1D: Support and coordinate with USFS to implement fuel reduction to limit the potential for high-intensity wildfires in mountain yellow-legged frog habitat.

MYLF Objective 2: Support the ongoing research to identify effective chytrid fungus treatments for mountain yellow-legged frog populations.

MYLF Action 2: Continue to provide financial support for chytrid fungus research.

MYLF Objective 3: Support the ongoing environmental DNA research (eDNA) to determine if this genetic survey method can be used as a proxy to understand ecosystem health and pinpoint where management is most critical.

MYLF Action 3: Continue to provide financial support for eDNA research.

MYLF Objective 4: Expand mountain yellow-legged frog distribution within the Santa Ana River watershed by enhancing or reestablishing local populations.

MYLF Action 4: Contribute to the captive breeding and translocation programs in order to support achieving the recovery goals for the species as stated in the 5-year review (USFWS 2012).

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

MYLF AMM-1: All individuals working in potential mountain yellow-legged frog habitat will follow the disease prevention protocols described in the USFWS' *Declining Amphibian Population Task Force Code of Practice* (USFWS 2009).

Expected Outcomes

Table 5-13 summarizes the estimated impacts and conservation of modeled habitat for the mountain yellow-legged frog. Implementation of the conservation actions described above would meet the conservation objectives for the species, and would avoid and minimize potential effects and offset the impact on mountain yellow-legged frog, facilitating long-term conservation efforts to benefit the species.

Approximately 263.6 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Other conservation actions to be undertaken by the Alliance as part of the conservation strategy to support the conservation and recovery of the species are addressed in Section 5.6, *Captive Rearing and Translocation,* and Section 5.7, *Species and Habitat Research,* and include funding the following:

- Contribute to ongoing USGS captive breeding program to help accomplish recovery goals for the species, as stated in the 5-year review (USFWS 2012), by reintroducing individuals to suitable habitat in the Santa Ana River basin.
- Contribute to ongoing population surveys and threats assessments to continue to increase understanding of population distribution, demographics, and health in order to inform future management, translocation, and reintroduction efforts.
- Support eDNA studies to determine how these methods can increase the cost effectiveness of mountain yellow-legged population surveys and threats assessments to inform future management of the species in the Planning Area.

As described in the effects analysis for mountain yellow-legged frog in Section 4.6.3, *Wildlife Species*, implementation of the Covered Activities would result in a permanent loss of 112.7 acres of modeled habitat within the Planning Area and the temporary loss of 15.7 acres of modeled habitat. In addition, while mountain yellow-legged frog is directly reliant on surface water that may be supported by groundwater (Rohde et al. 2019), only 0.2 acre of modeled wetted area would be lost with reaches downstream of Covered Activities within modeled habitat. Therefore, groundwater effects would be small. There are no proposed impacts on mountain yellow-legged frog Critical Habitat; and approximately 52 acres of Critical Habitat will be conserved within the HCP Preserve System.

When the impacts are considered along with the amount of modeled habitat that will be conserved and managed in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-13. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Mountain Yellow-Legged Frog

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts[1]**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Aquatic Habitat			
Phase 1	2.2	0.1	--
Phase 2	1.7	0.0	15.7
Phase 3	0.0	0.0	--
Phase 4	0.0	0.2	--
Total	*3.9*	*0.3*	*15.7*
Refugia/Foraging/Dispersal Habitat			
Phase 1	16.4	13.8	3.2
Phase 2	92.1	0.0	244.7
Phase 3	0.3	0.0	--
Phase 4	0.0	1.5	--
Total[1]	*108.8[1]*	*15.3[1]*	*247.9*
Total Modeled Habitat	**112.7**	**15.7**	**263.6**

[1] Impacts on Refugia/Foraging/Dispersal Habitat are on Waterman and East Twin Creeks, primarily from existing groundwater recharge basins. Mountain yellow-legged frog have been extirpated from these creeks. The mitigation is on City Creek where there are existing populations that have been enhanced with recent translocations and will be monitored and managed.

5.9.7 Western Spadefoot (WESP)

Conservation Objectives and Actions

WESP Objective 1: Permanently conserve and manage WESP habitat within the HCP Preserve System in a configuration that benefits this species, and maintains or increases connectivity between occupied breeding habitat.

WESP Action 1: Conserve 987 acres of modeled WESP habitat within the HCP Preserve System, especially temporary pools and adjacent habitat.

WESP Action 2: Survey areas of potentially suitable habitat within a week of the first significant winter rain (as early as October or November) to identify and map suitable ephemeral breeding pools for subsequent monitoring and management.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

WESP AMM-1: Avoid mortality of spadefoot from recharge basin maintenance by conducting maintenance during dry periods (generally May through October) when recharge basins are free of

water. If water is present within recharge basins, monitor for spadefoot presence. If spadefoot are present, delay maintenance until recharge ponds are dry; or collect spadefoot tadpoles, if present, from basins prior to maintenance and move to basins not scheduled for maintenance that year.

WESP AMM-2: All individuals working in potential spadefoot habitat will follow the disease prevention protocols described in the USFWS Declining Amphibian Population Task Force Code of Practice (USFWS 2009).

Expected Outcomes

Table 5-14 summarizes the estimated impacts and conservation of modeled habitat for the western spadefoot. Implementation of the conservation actions described above would meet the conservation objectives for the species and would avoid and minimize potential effects and offset the impact on western spadefoot, resulting in long-term conservation benefits to the species.

Other conservation actions to be supported by the Alliance as part of the conservation strategy to support the conservation and recovery of the species are addressed in Section 5.7.3, *Western Spadefoot Updated Population Survey*.

- Continue potential habitat surveys and modeling efforts specific to the Southern California population of western spadefoot.
- Conduct surveys to evaluate occupancy of spadefoot at these sites, and identify breeding sites.

Approximately 986.6 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Additionally, western spadefoot habitat would be restored and managed to benefit the species within the Louis Rubidoux Restoration project area., which is in the conceptual plan phase. Estimated restoration acreages are currently unknown.

As described in the effects analysis for western spadefoot in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 612.1 acres of modeled habitat within the Planning Area and the temporary loss of 110.7 acres of modeled habitat.

When considered along with the conservation actions and the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-14. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Western Spadefoot

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	198.7	61.5	921.6
Phase 2	241.6	46.4	65.0
Phase 3	74.0	0.2	--
Phase 4	97.0	2.6	--
Total Modeled Habitat	**612.1**	**110.7**	**986.6**

5.9.8 California Glossy Snake (CGSN)

Conservation Objectives and Actions

CGSN Objective 1: Permanently conserve and manage glossy snake habitat within the HCP Preserve System in a configuration that benefits this species, and maintains or increases connectivity between occupied habitat areas.

CGSN Action 1: Conserve and manage 1,209 acres of modeled glossy snake habitat within the HCP Preserve System.

CGSN Objective 2: Coordinate with USGS researchers to conduct an ecological needs and threats study for glossy snake in the HCP Preserve System to inform management and monitoring actions for the species.

CGSN Action 2A: Determine characteristics of glossy snake habitat in the HCP Preserve System.

CGSN Action 2B: Identify and delineate occupied habitat in the HCP Preserve System to determine areas for management and monitoring.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

No species-specific AMMs are identified for this species.

Expected Outcomes

Table 5-15 summarizes the estimated impacts and conservation of modeled habitat for the California glossy snake. Implementation of the conservation actions described above would meet the conservation objectives for the species and would avoid and minimize potential effects and offset the impact on California glossy snake, resulting in the long-term conservation benefits to the species.

Approximately 1,208.8 acres of modeled habitat are expected to be conserved within the HCP Preserve System.

As described in the effects analysis for California glossy snake in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 718.4 acres of modeled habitat within the Planning Area and the temporary loss of 178.6 acres of modeled habitat.

When considered along with the amount of modeled habitat that will be conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-15. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for California Glossy Snake

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	246.2	116.4	1,030.7
Phase 2	169.3	59.5	178.1
Phase 3	159.3	0.5	--
Phase 4	142.7	2.1	--
Total Modeled Habitat	**718.4**	**178.6**	**1,208.8**

5.9.9 South Coast Garter Snake (SCGS)

Conservation Objectives and Actions

SCGS Objective 1: Permanently conserve and manage south coast garter snake habitat within the HCP Preserve System in a configuration that benefits this species, and maintains or increases connectivity.

SCGS Action 1: Conserve 193 acres of suitable modeled aquatic habitat and adjacent upland habitat for south coast garter snake in the HCP Preserve System.

SCGS Objective 2: Increase the amount and quality of available south coast garter snake habitat in lowland tributaries to the mainstem of the Santa Ana River.

SCGS Action 2A: Restore 3.5 miles of aquatic habitat that is expected to benefit south coast garter snake at the Anza Creek, Old Ranch Creek, Hidden Valley Creek, Lower Hole Creek, Evans Lake, and Hidden Valley Ponds Restoration Areas. A portion of this area is included in the modeled habitat for the species, while other portions are not currently suitable habitat but would be restored to be suitable for the species.

SCGS Action 2B: Restore and enhance 129.1 acres of riparian habitat where appropriate in the HCP Preserve System. A portion of this area is included in the modeled habitat for the species, while other portions are not currently suitable habitat but would be restored to be suitable for the species.

SCGS Action 2C: Implement bullfrog and other nonnative predator control in occupied south coast garter snake habitat in the HCP Preserve System.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

No species-specific AMMs are identified for this species.

Expected Outcomes

Table 5-16 summarizes the estimated impacts and conservation of modeled habitat for the south coast garter snake. Implementation of the conservation actions described above would meet the conservation objectives for the species and offset the impact on south coast garter snake, resulting in long-term conservation benefits to the species.

Approximately 193.1 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 129.1 acres of south coast garter snake upland habitat and 3.5 miles of aquatic habitat would be restored or created and managed to benefit the species within the restoration project areas, including the Hidden Valley Creeks and Ponds, Anza Creek, Old Ranch Creek, Lower Hole Creek, Evans Lake, and Louis Rubidoux Nature Center and Sunnyslope Creek projects described in Section 5.4.4, *Restoration Areas*.

As described in the effects analysis for south coast garter snake in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 14.6 acres of modeled habitat within the Planning Area and the temporary loss of 6.7 acres of modeled habitat. South coast garter snake is directly reliant on groundwater-supported wetlands (Rohde et al. 2019), and adverse impacts could be exacerbated in the areas of falling groundwater within modeled habitat. As described in Section 4.6, *Effects on Covered Species*, there is an anticipated loss of 19.5 acres of wetted area of south coast garter snake habitat resulting from the Covered Activities.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-16. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for South Coast garter snake

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	14.5	5.6	93.5
Phase 2	0.1	1.1	99.4
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total Modeled Habitat	**14.6**	**6.7**	**193.1**

5.9.10 Southwestern Pond Turtle (SWPT)

Conservation Objectives and Actions

SWPT Objective 1: Permanently conserve and manage southwestern pond turtle habitat within the HCP Preserve System to provide long-term conservation benefits to this species, including aquatic habitat with suitable adjacent upland nesting habitat.

SWPT Action 1A: Conserve 344 acres of modeled upland and aquatic habitat in a configuration to facilitate habitat connectivity. Identify and manage known upland breeding sites within the HCP Preserve System.

SWPT Action 1B: Conserve stream segments or ponds that currently provide or could provide high quality basking, breeding, and nesting habitat (vegetated banks and at least 150 feet of adjacent upland habitat) for southwestern pond turtle.

SWPT Action 1C: Implement bullfrog and other nonnative predator control in occupied southwestern pond turtle habitat in the HCP Preserve System.

SWPT Objective 2: Increase the amount of high-quality aquatic and associated upland habitat available and southwestern pond turtle habitat in lowland tributaries to the mainstem of the Santa Ana River.

SWPT Action 2A: Restore 3.5 miles of aquatic habitat that is expected to benefit southwestern pond turtle at the Anza Creek, Old Ranch Creek, and Hidden Valley Creek, Lower Hole Creek, Evans Lake, and Hidden Valley Ponds Restoration Areas. A portion of this area is included in the modeled habitat for the species, while other portions are not currently suitable habitat but would be restored to be suitable for the species.

SWPT Action 2B: Install woody debris around perimeter and in submerged banks of ponds and wetlands to create basking habitat and cover for native juvenile turtles.

SWPT Action 2C: Restore 192.6 acres of riparian habitat adjacent to the aquatic habitat restoration sites listed in SWPT Action 2A.

SWPT Objective 3: Reduce or prevent anthropogenic impacts on conserved and restored southwestern pond turtle habitat within the HCP Preserve System.

SWPT Action 3: Install fencing and/or signage in strategic locations adjacent to occupied or restored southwestern pond turtle habitat within the HCP Preserve System.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

No species-specific AMMs are identified for this species.

Expected Outcomes

Table 5-17 summarizes the estimated impacts and conservation of modeled habitat for southwestern pond turtle. Implementation of the conservation actions described above would meet the conservation objectives for the species and would avoid and minimize potential effects and offset the impact on southwestern pond turtle, resulting in long-term conservation benefits to the species.

Other conservation actions to be supported by the Alliance as part of the conservation strategy to inform the management and support the conservation and recovery of the species are addressed in Section 5.7.5, *Southwestern Pond Turtle Population Survey,* and include funding the following:

- Conducting turtle trapping surveys of the wetted reaches of the Santa Ana River and its tributaries to further document the occupied areas within western Riverside and southwestern San Bernardino Counties.
- Analyzing pond turtle demographics to assess the health of remaining populations.
- Assessing habitat suitability and threats.

Approximately 344.1 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 192.6 acres or upland habitat and 3.5 miles of southwestern pond turtle aquatic habitat would be restored or created and managed to benefit the species within the Tributary Stream restoration project areas including the Hidden Valley Creeks and Ponds, Anza Creek, Old Ranch Creek, Lower Hole Creek, Evans Lake, and Louis Rubidoux Nature Center and Sunnyslope Creek described in Section 5.4.4.

As described in the effects analysis for southwestern pond turtle in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 19.3 acres of modeled habitat within the Planning Area and the temporary loss of 14.9 acres of modeled habitat.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-17. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Southwestern Pond Turtle

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Aquatic Habitat			
Phase 1	0.9	0.8	11.3
Phase 2	0.0	0.0	17.5
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.9*	*0.8*	*28.8*
Potentially Suitable Upland Habitat			
Phase 1	18.1	11.0	175.7
Phase 2	0.3	3.1	139.6
Phase 3	0.0	0.0	--
Phase 4	0.0	0.1	--
Total	*18.4*	*14.1*	*315.3*
Total Modeled Habitat	**19.3**	**14.9**	**344.1**
Planned Habitat Restoration			**192.6**

5.9.11 Tricolored Blackbird (TRBL)

Conservation Objectives and Actions

TRBL Objective 1: Permanently conserve and manage tricolored blackbird habitat within the HCP Preserve System in a configuration that supports breeding and foraging for this species.

TRBL Action 1: Conserve 243 acres of modeled habitat, including 86 acres of suitable colony habitat, in the HCP Preserve System in a spatial distribution to benefit the species by facilitating habitat connectivity between existing populations and breeding/foraging sites, providing the potential for expansion of populations.

TRBL Objective 2: Enhance and restore tricolored blackbird colony and foraging habitat within the HCP Preserve System.

TRBL Action 2A: Enhance and restore up to 137.4 acres of tricolored blackbird colony habitat within the HCP Preserve System. A portion of this area is included in the modeled habitat for the species, while approximately 130.8 acres are not currently suitable breeding habitat but would be restored to be suitable for the species.

TRBL Action 2B: Target colony habitat enhancements in areas of shallow open water to create appropriate nesting substrate at breeding colonies. Restore nesting substrate habitat in riparian floodplain restoration areas at Hidden Valley Wetlands through planting of native vegetation, removal of invasive species, creation of a wetland oxbow feature, and restoration of floodplain hydrology. Additional restoration activities for tricolored blackbird at Hidden Valley Ponds will include restoring water to seasonal ponds.

TRBL Action 2C: Maintain preferred breeding habitat (e.g., emergent vegetation/younger cattails) in the HCP Preserve System through vegetation management (e.g., cutting and removing) at appropriate intervals, as identified in the CAMMP.

TRBL Action 2D: Enhance and restore up to 14.7 acres of natural foraging habitat within the HCP Preserve System. A portion of this area is included in the modeled foraging habitat for this species, but approximately 13.9 acres are not currently suitable foraging habitat and would be restored to be suitable for this species.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

TRBL AMM-1: When possible, manage basin vegetation within basins to support preferred breeding habitat as described in TRBL Action 2C.

Expected Outcomes

Table 5-18 summarizes the estimated impacts and conservation of modeled habitat for tricolored blackbird. Implementation of the conservation actions described above would meet the conservation objectives for the species and would avoid and minimize potential effects and offset the impact on tricolored blackbird, resulting in long-term conservation benefits to the species within the HCP Preserve System.

Approximately 242.6 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 144.6 acres of tricolored blackbird suitable colony habitat would be restored, including 130.8 acres not currently modeled as colony habitat, and managed to benefit the species within the restoration project areas. An additional 13.9 acres of foraging habitat that is not currently modeled as benefiting tricolored blackbird will be restored to benefit this species.

As described above and in the effects analysis for tricolored blackbird in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 278.0 acres of modeled habitat within the Planning Area and the temporary loss of 147.6 acres of modeled habitat. It is also important to note that routine maintenance of basins that provide breeding habitat has been quantified as an impact, but some of these activities will likely benefit the breeding habitat by providing the young emergent plant growth preferred for nesting by this species (Meese and Beedy 2015).

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-18. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Tricolored Blackbird

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Suitable Colony Habitat			
Phase 1	24.0	0.8	63.6
Phase 2	28.3	0.5	22.0
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*52.3*	*1.4*	*85.6*
Breeding Season Foraging – Natural			
Phase 1	87.9	18.7	78.7
Phase 2	69.8	24.6	23.0
Phase 3	0.1	0.2	--
Phase 4	0.5	0.3	--
Total	*158.2*	*43.7*	*101.7*
Breeding Season Foraging – Agriculture			
Phase 1	43.5	15.5	55.3
Phase 2	23.5	75.1	--
Phase 3	0.0	0.6	--
Phase 4	0.0	0.0	--
Total	*67.0*	*101.1*	*55.3*
Non-Breeding Season Foraging – Natural			
Phase 1	0.4	0.4	--
Phase 2	0.0	0.0	--

Modeled Habitat Type	Impacts: Permanent Impacts	Impacts: Temporary Impacts	Mitigation: HCP Preserve System
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.4*	*0.4*	--
Non-Breeding Season Foraging – Agriculture			
Phase 1	0.0	0.2	--
Phase 2	0.1	0.6	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.1*	*0.9*	--
Total Modeled Habitat	**278.0**	**147.6**	**242.6**
New Colony Habitat Created through Restoration			**130.8**
New Foraging Habitat Created through Restoration			**13.9**
Total Habitat in the HCP Preserve System			**387.3**

5.9.12 Burrowing Owl (BUOW)

Conservation Objectives and Actions

BUOW Objective 1: Permanently conserve and manage burrowing owl habitat within the HCP Preserve System to provide long-term conservation benefits to the species.

BUOW Action 1A: Conserve 1,013 acres of modeled burrowing owl habitat within the HCP Preserve System in a spatial distribution to maintain populations, to facilitate habitat connectivity between existing populations and breeding/foraging sites, and to provide opportunity for expansion of populations.

BUOW Action 1B: Maintain the fossorial mammal (e.g., ground squirrel) populations within burrowing owl habitat identified within the HCP Preserve System to support burrow creation for roosting and breeding. Prevent rodent control efforts within the HCP Preserve System. Coordinate with adjacent landowners or agricultural operators to limit the use of rodenticides and understand the importance of fossorial mammals for burrowing owl conservation.

BUOW Action 1C: Provide opportunities for relocation of owls into the HCP Preserve System. If impacts on occupied burrowing owl burrows are unavoidable for the implementation of a Covered Activity, relocate the affected owls from the impact site to suitable unoccupied habitat within the preserve using the best available hacking and relocation techniques, including the construction of artificial burrows (see BUOW AMM-1). All of the HCP Preserve System will be a receiver site for displaced burrowing owls from other non-HCP related impacts.

BUOW Action 1D: In areas of suitable habitat within the HCP Preserve System, conduct a threat assessment to identify opportunities for habitat enhancement. Document the following: (1) observations of predators such as coyotes or raptors, (2) signs of unauthorized access such as

off-road vehicle use, (3) lack of mammal burrows, (4) potential use of rodenticides, and (5) thick or tall vegetation.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

BUOW AMM-1: If owl burrows cannot be avoided, translocate pairs in support of BUOW Action 1C and in accordance with a translocation and monitoring plan to be developed based on best available information from prior burrowing owl translocation studies and approved by the Preserve Management Committee.

Expected Outcomes

Table 5-19 summarizes the estimated impacts and conservation of modeled habitat for the burrowing owl. Implementation of the conservation actions described above would meet the conservation objectives for the species, and would avoid and minimize potential effects and offset the impact on burrowing owl, resulting in long-term conservation benefits for the species within the HCP Preserve System.

Approximately 1,013.2 acres of modeled habitat are expected to be conserved within the HCP Preserve System. While restoration of burrowing owl habitat is not proposed under this HCP, up to 220.3 acres of habitat within the restoration sites will be restored to support the San Bernardino kangaroo rat, which are also anticipated to benefit burrowing owl.

As described in the effects analysis for burrowing owl in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 632.8 acres of modeled habitat within the Planning Area and the temporary loss of 243.7 acres of modeled habitat.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-19. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Burrowing Owl

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	333.7	115.4	922.5
Phase 2	152.8	125.4	90.7
Phase 3	83.6	1.4	--
Phase 4	62.2	1.6	--
Total Modeled Habitat	**632.8**	**243.7**	**1,031.2**

5.9.13 Cactus Wren (CACW)

Conservation Objectives and Actions

CACW Objective 1: Permanently conserve and manage habitat within the HCP Preserve System in a configuration that provides long-term conservation benefits to the species. This will include maintaining the quality of habitat within the HCP Preserve System.

CACW Action 1A: Conserve 1,069 acres of modeled habitat within the HCP Preserve System in a spatial distribution to maintain populations, to facilitate habitat connectivity between existing populations and breeding/foraging sites, and to allow for expansion of populations.

CACW Action 1B: Of the conserved modeled habitat, preserve 1,018 acres of modeled potential nesting and foraging habitat in the HCP Preserve System.

CACW Action 1C: To minimize the threat of fire to cactus patches, control nonnative plants (grasses and other nonnative plant species) following methodology identified in the CAMMP.

CACW Objective 2: Enhance cactus wren habitat within the HCP Preserve System, using best available science, as described in the CAMMP.

CACW Action 2A: Enhance nesting and foraging habitat within alluvial fan restoration projects, and as appropriate in suitable habitat throughout the HCP Preserve System.

CACW Action 2B: Salvage appropriate cactus species from areas that will be permanently impacted by Covered Activities, and transplant them to appropriate habitat in the HCP Preserve System.

CACW Objective 3: Restore cactus patches within the HCP Preserve System damaged or destroyed by wildfire.

CACW Action 3: Within 6 months of wildfire in the HCP Preserve System, inspect the burned area for damaged or destroyed cactus patches. Collect appropriate cactus species from existing dense and locally occurring “donor” stands of cactus for transplantation into burn recovery areas.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

No species-specific AMMs are identified for this species.

Expected Outcomes

Table 5-20 summarizes the estimated impacts and conservation of modeled habitat for the cactus wren. Implementation of the conservation actions described above would meet the conservation objectives for the species, and would avoid and minimize potential effects and offset the impact on cactus wren, resulting in long-term conservation benefits to the species.

Approximately 1,069.4 acres of modeled habitat are expected to be conserved within the HCP Preserve System; a portion of this habitat would be restored and managed to benefit the species within the restoration project areas as appropriate.

As described in the effects analysis for cactus wren in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 632.0 acres of modeled habitat within the Planning Area and the temporary loss of 188.7 acres of modeled habitat.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-20. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Cactus Wren

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Known Suitable Nesting			
Phase 1	0.1	0.4	48.0
Phase 2	0.0	0.0	--
Phase 3	0.3	0.0	--
Phase 4	0.0	0.0	--
Total	0.4	0.4	48.0
Potential Nesting and Foraging Habitat			
Phase 1	281.6	98.0	897.1
Phase 2	172.0	81.0	120.8
Phase 3	83.5	0.9	--
Phase 4	92.9	2.0	--
Total	*630.0*	*181.8*	*1,017.9*
Recently Burned (2008–2018)			
Phase 1	1.3	2.4	3.5
Phase 2	0.4	4.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*1.6*	*6.4*	*3.5*
Total Modeled Habitat	**632.0**	**188.7**	**1,069.4**

5.9.14 Yellow-Breasted Chat (YBCH)

Conservation Objectives and Actions

YBCH Objective 1: Permanently conserve and manage yellow-breasted chat habitat within the HCP Preserve System in a configuration that provides long-term conservation benefits for this species.

YBCH Action 1A: Conserve 257 acres habitat in a spatial distribution to maintain populations, to facilitate habitat connectivity between existing populations and breeding/foraging sites, and to allow for expansion of populations.

YBCH Action 1B: Reduce nest parasitism by cowbirds using cowbird control and removal practices when surveys indicate control measures are warranted.

YBCH Objective 2: Enhance and restore riparian yellow-breasted chat habitat in the HCP restoration sites within the HCP Preserve System.

YBCH Action 2: Enhance and restore 220.6 acres of riparian habitat in HCP Preserve System restoration sites, following methodology identified in the CAMMP. A portion of this area is included in the modeled habitat for the species: approximately 50.7 acres are not currently suitable habitat but would be restored to be suitable for the species.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

No species-specific AMMs are identified for this species.

Expected Outcomes

Table 5-21 summarizes the estimated impacts and conservation of modeled habitat for the yellow-breasted chat. Implementation of the conservation actions described above would meet the conservation objectives for the species, and would avoid and minimize potential effects and offset the impact on yellow-breasted chat, resulting in long-term conservation benefits for the species within the HCP Preserve System.

Approximately 257.2 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 220.6 acres of yellow-breasted chat habitat would be restored and managed to benefit the species within the restoration project areas. The restoration projects will restore 50.7 acres of habitat that is not currently identified as modeled habitat for the yellow breasted chat, resulting in a net increase in habitat that will support this species. A total of 307.9 acres of yellow breasted chat habitat will be conserved within the HCP Preserve System.

As described in the effects analysis for yellow-breasted chat in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 120.3 acres of modeled habitat within the Planning Area and the temporary loss of 29.4 acres of modeled habitat.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-21. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Yellow-Breasted Chat

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Potentially Suitable Habitat			
Phase 1	56.3	16.7	143.4
Phase 2	49.2	12.1	113.8
Phase 3	14.7	0.0	--

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Phase 4	0.0	0.6	--
Total Modeled Habitat	**120.3**	**29.4**	**257.2**

5.9.15 Western Yellow-Billed Cuckoo (WYBC)

Conservation Objectives and Actions

WYBC Objective 1: Permanently conserve and manage western yellow-billed cuckoo habitat within the HCP Preserve System in a configuration that supports the potential for breeding and foraging of this species.

WYBC Action 1: Conserve 143 acres of habitat in a spatial distribution to support occupancy, to facilitate habitat connectivity between breeding/foraging sites, and to allow for expansion of a population into the HCP Preserve System.

WYBC Objective 2: Enhance and restore riparian western yellow-billed cuckoo habitat restoration sites within the HCP Preserve System.

WYBC Action 2: Enhance up to 175.3 acres of riparian habitat on the Hidden Valley Creek, Anza Drain, Old Ranch Creek, and Evans Lake restoration sites within the HCP Preserve System. Implement appropriate management techniques to restore, enhance, and create suitable habitat. A portion of this area is included in the modeled habitat for the species; however, 62.3 acres that are not currently suitable habitat would be restored to be suitable for the species.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

WYBC AMM-1: New construction and O&M activities conducted within suitable cuckoo habitat containing the physical and biological features defined in the Critical Habitat designation will be avoided to the extent feasible during the breeding season (May 15–September 15).

Expected Outcomes

Table 5-22 summarizes the estimated impacts and conservation of modeled habitat for the western yellow-billed cuckoo. Implementation of the conservation actions described above would meet the conservation objectives for the species, and would avoid and minimize potential effects and offset the impact on western yellow-billed cuckoo, resulting in long-term conservation benefits for the species within the HCP Preserve System.

Approximately 142.8 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 175.3 acres of western yellow-billed cuckoo habitat would be restored and managed to benefit the species within the restoration project areas. A portion of this area is included in the modeled habitat for the species; however, approximately 62.3 acres are not currently suitable habitat but would be restored to be suitable for the species.

As described in the effects analysis for western yellow-billed cuckoo in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 8.8 acres of modeled habitat within the Planning Area and the temporary loss of 8.4 acres of modeled habitat. USFWS has proposed, but not finalized, Critical Habitat for western yellow-billed cuckoo. There is no proposed Critical Habitat identified within the Planning Area (USFWS 2020).

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-22. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Yellow-Billed Cuckoo

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
High Value Breeding Habitat			
Phase 1	0.0	0.0	22.1
Phase 2	0.0	0.1	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.0*	*0.1*	*22.1*
Potentially Suitable Breeding Habitat			
Phase 1	8.7	6.6	80.3
Phase 2	0.1	1.7	40.5
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*8.7*	*8.2*	*120.8*
Total Modeled Habitat	**8.8**	**8.4**	**142.8**
New Habitat Created Through Restoration			**62.3**
Total Habitat in the HCP Preserve System			**205.1**

5.9.16 Southwestern Willow Flycatcher (SWFL)

Conservation Objectives and Actions

SWFL Objective 1: Permanently conserve and manage southwestern willow flycatcher habitat within the HCP Preserve System in a configuration that supports the potential for breeding and foraging of this species.

SWFL Action 1A: Conserve 257 acres of southwestern willow flycatcher habitat in a spatial distribution to support occupancy, to facilitate habitat connectivity between breeding/foraging sites, and to allow for expansion of populations.

SWFL Action 1B: Reduce nest parasitism by cowbirds using cowbird control and removal practices when surveys indicate control measures are warranted.

SWFL Objective 2: Enhance and restore riparian southwestern willow flycatcher habitat on the HCP restoration sites within the HCP Preserve System.

SWFL Action 2: Restore and enhance 221 acres of riparian habitat where appropriate in the HCP Preserve System. A portion of this area is included in the modeled habitat for the species; however, approximately 51 acres are not currently suitable habitat but would be restored to be suitable for the species.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

SWFL AMM-1: New construction and O&M activities within suitable flycatcher habitat containing the physical and biological features defined in the Critical Habitat designation will be avoided to the extent feasible during the breeding season (May 1–August 31).

Expected Outcomes

Table 5-23 summarizes the estimated impacts and conservation of modeled habitat for southwestern willow flycatcher. Implementation of the conservation actions described above would meet the conservation objectives for the species, and would avoid and minimize potential effects and offset the impact on southwestern willow flycatcher, resulting in long-term conservation benefits for the species within the HCP Preserve System.

Approximately 257.2 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 220.6 acres of southwestern willow flycatcher habitat would be restored and managed to benefit the species within the restoration project areas. The restoration projects will restore 50.7 acres of habitat that is not currently identified as modeled habitat for the southwestern willow flycatcher, resulting in a net increase in habitat that will support this species. A total of 307.9 acres of southwestern willow flycatcher habitat will be conserved within the HCP Preserve System.

As described in the effects analysis for southwestern willow flycatcher in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 120.3 acres of modeled habitat within the Planning Area and the temporary loss of 29.4 acres of modeled habitat. The proposed impacts include approximately 95.9 acres of permanent impacts and 12.1 acres of temporary impacts on southwestern willow flycatcher final Critical Habitat; approximately 10.1 acres of the restoration sites are within Critical Habitat areas. While the proposed impacts on Critical Habitat are currently greater than the proposed conservation, additional avoidance and minimization measures will be taken when a project is proposed within Critical Habitat that exhibits the required physical and biological characteristics for southwestern willow flycatcher to further avoid and minimize impacts on these areas.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-23. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Southwestern Willow Flycatcher

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Core Southwestern Willow Flycatcher Habitat			
Phase 1	9.5	2.9	--
Phase 2	6.0	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.1	--
Total	*15.5*	*3.1*	--
Very High Value Habitat			
Phase 1	0.0	0.1	28.8
Phase 2	0.0	0.1	14.6
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	0.0	0.2	43.4
High Value Habitat			
Phase 1	0.0	0.1	18.1
Phase 2	0.0	0.0	25.6
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.0*	*0.1*	*43.6*
Moderate Value Habitat			
Phase 1	0.0	0.0	5.7
Phase 2	0.0	0.0	18.5
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.0*	*0.0*	*24.2*
Other Potentially Suitable Habitat			
Phase 1	46.8	13.6	90.8
Phase 2	43.3	12.1	55.3
Phase 3	14.7	0.0	--
Phase 4	0.0	0.5	--
Total	*104.7*	*26.1*	*146.1*
Total Modeled Habitat	**120.3**	**29.4**	**257.2**
New Habitat Created Through Restoration			**50.7**
Total Habitat in the HCP Preserve System			**307.9**

5.9.17 Coastal California Gnatcatcher (CAGN)

Conservation Objectives and Actions

CAGN Objective 1: Permanently conserve and manage coastal California gnatcatcher habitat within the HCP Preserve System in a configuration that provides long-term conservation benefits to the species.

CAGN Action 1: Conserve 843 acres of habitat in a spatial distribution to maintain populations, to facilitate habitat connectivity between existing populations and breeding/foraging sites, and to allow for expansion of populations.

CAGN Objective 2: Enhance and restore shrubland habitat within the HCP Preserve System.

CAGN Action 2: Restore and enhance 222.4 acres of shrublands where appropriate in the HCP Preserve System.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

CAGN AMM-1: New construction and O&M activities within suitable gnatcatcher habitat containing the physical and biological features defined in the Critical Habitat designation will be avoided to the extent feasible during the breeding season (February 15–August 30).

Expected Outcomes

Table 5-24 summarizes the estimated impacts and conservation of modeled habitat for the coastal California gnatcatcher. Implementation of the conservation actions described above would meet the conservation objectives for the species, and would avoid and minimize potential effects and offset the impact on coastal California gnatcatcher, resulting in long-term conservation benefits to the species within the HCP Preserve System.

Approximately 843.1 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 222.4 acres of alluvial fan sage scrub habitat would be restored and managed to benefit the species within the restoration project areas.

As described in the effects analysis for coastal California gnatcatcher in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 329.4 acres of modeled habitat within the Planning Area and the temporary loss of 114.2 acres of modeled habitat. The proposed impacts include approximately 2.9 acres of permanent impacts and 3.0 acres of temporary impacts on coastal California gnatcatcher final Critical Habitat; none of the conservation or restoration sites are within Critical Habitat areas. While the HCP Preserve System does not include any Critical Habitat for this species, approximately 372 acres of modeled habitat within the HCP Preserve System is High or Very High Value habitat. The proposed mitigation is overwhelmingly of higher quality habitat than that of the habitat that the proposed impacts would affect.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-24. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Coastal California Gnatcatcher

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System[1]**
Very High Value Habitat			
Phase 1	10.2	5.8	97.3
Phase 2	1.0	0.5	21.4
Phase 3	1.2	0.1	--
Phase 4	5.9	0.1	--
Total	*18.3*	*6.5*	*118.6*
High Value Habitat			
Phase 1	10.5	13.9	184.1
Phase 2	4.2	3.6	7.6
Phase 3	5.0	0.0	--
Phase 4	28.6	0.0	--
Total	*48.3*	*17.5*	*191.7*
Moderate Value Habitat			
Phase 1	15.6	9.8	159.0
Phase 2	12.7	10.8	6.7
Phase 3	0.8	0.2	--
Phase 4	14.0	0.3	--
Total	*43.0*	*21.1*	*165.7*
Low Value Habitat			
Phase 1	83.2	30.0	335.3
Phase 2	37.5	33.3	10.7
Phase 3	3.5	0.0	--
Phase 4	25.3	1.2	--
Total	*149.5*	*64.5*	*346.0*
Other Suitable Habitat			
Phase 1	0.8	3.1	20.0
Phase 2	0.1	1.5	1.1
Phase 3	68.6	0.0	--
Phase 4	0.8	0.0	--
Total	*70.3*	*4.6*	*21.1*
Total Modeled Habitat	**329.4**	**114.2**	**843.1**

[1]Areas shown within the HCP Preserve System that are smaller than the required minimum patch size are located within or adjacent to modeled habitats of appropriate size.

5.9.18 Least Bell's Vireo (LBVI)

Conservation Objectives and Actions

LBVI Objective 1: Permanently conserve and manage least Bell's vireo habitat within the HCP Preserve System in a configuration that provides long-term conservation benefits to the species.

LBVI Action 1: Conserve 257 acres of riparian habitat, including high-quality early successional riparian scrub and woodland habitat to benefit existing populations and to allow for movement between and expansion of populations.

LBVI Objective 2: Enhance and restore riparian habitat on the HCP restoration sites within the HCP Preserve System.

LBVI Action 2: Restore and enhance 220.6 acres of riparian habitat in the HCP Preserve System. A portion of this area is included in the modeled habitat for the species; however, approximately 50.7 acres are not currently suitable habitat but would be restored to be suitable for the species.

LBVI Objective 3: Enhance conditions within the HCP Preserve System to at a minimum maintain, and potentially increase, reproductive success of least Bell's vireo within the HCP Preserve System.

LBVI Action 3: Reduce nest parasitism by cowbirds using cowbird control and removal practices when surveys indicate control measures are warranted.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

LBVI AMM-1: New construction and O&M activities will be avoided to the extent feasible during the breeding season within modeled vireo habitat (March 15–July 31).

Expected Outcomes

Table 5-25 summarizes the estimated impacts and conservation of modeled habitat for least Bell's vireo. Implementation of the conservation actions described above would meet the conservation objectives for the species, and would avoid and minimize potential effects and offset the impact on least Bell's vireo, resulting in long-term conservation benefits to the species within the HCP Preserve System.

Approximately 257.2 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 220.6 acres of least Bell's vireo habitat would be restored and managed to benefit the species within the restoration project areas. The restoration projects will restore 50.7 acres of habitat that is not currently identified as modeled habitat for least Bell's vireo, resulting in a net increase in habitat that will support this species. A total of 307.9 acres of least Bell's vireo habitat will be conserved within the HCP Preserve System.

As described in the effects analysis for least Bell's vireo in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 120.3 acres of modeled habitat within the Planning Area and the temporary loss of 29.4 acres of modeled habitat. The proposed impacts include approximately 1.9 acres of permanent impacts and 11.7 acres of temporary impacts on least Bell's vireo final Critical Habitat; however, approximately 144.4 acres of the restoration sites are within Critical Habitat areas.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-25. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Least Bell's Vireo

	Impacts		Mitigation
Modeled Habitat Type	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Core Breeding Habitat			
Phase 1	0.3	1.6	29.1
Phase 2	0.0	0.2	61.5
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.3*	*1.8*	*90.6*
Other Breeding Habitat			
Phase 1	56.1	15.1	114.3
Phase 2	49.2	12.0	52.4
Phase 3	14.7	0.0	--
Phase 4	0.0	0.6	--
Total	*120.0*	*27.6*	*166.6*
Total Modeled Habitat	**120.3**	**29.4**	**257.2**
New Habitat Created through Restoration			**50.7**
Total Habitat in the HCP Preserve System			**307.9**

5.9.19 Los Angeles Little Pocket Mouse (LAPM)

Conservation Objectives and Actions

LAPM Objective 1: Permanently conserve and manage Los Angeles little pocket mouse habitat within the HCP Preserve System in a configuration that provides long-term conservation benefits to the species.

LAPM Action 1: Conserve 1,007 acres of modeled Los Angeles little pocket mouse habitat in a configuration to facilitate habitat connectivity.

LAPM Objective 2: Expand the distribution of Los Angeles little pocket mouse by increasing habitat quality for Los Angeles little pocket mouse within the HCP Preserve System and increasing connectivity between patches of Los Angeles little pocket mouse habitat.

LAPM Action 2A: Enhance and restore up to 220.3 acres of alluvial fan sage scrub habitat at the Drainage A Woolly-star Restoration Area (or alternate location), Enhanced Recharge Basin Restoration, and North Enhanced Recharge Restoration Areas within the HCP Preserve System. A portion of this area is included in the modeled habitat for the species, while other portions are not currently suitable habitat but would be restored to be suitable for the species.

LAPM Action 2B: Manage nonnative grass and plant cover to maintain or enhance habitat for the benefit of Los Angeles little pocket mouse, following methodology described in the CAMMP.

LAPM Action 2C: Restore suitable habitat in the interstitial spaces between new groundwater recharge basins (e.g., City Creek Diversion and Basin, Lytle-Cajon Diversion and Basin) to maintain or enhance connectivity across the site.

LAPM Objective 3: Contribute to studies on the genetic structure and diversity of Los Angeles little pocket mouse to better understand population genetics of this species within the HCP Preserve System.

LAPM Action 3A: Coordinate with the Wildlife Agencies to further our understanding of population genetics for this species, and identify actions that may be needed to improve genetics for Los Angeles little pocket mouse, where needed.

LAPM Action 3B: Coordinate with the Wildlife Agencies to identify areas within the HCP Preserve that would benefit from population genetics conservation actions.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

All of the San Bernardino kangaroo rat AMMs also apply for Los Angeles little pocket mouse and should be applied.

Expected Outcomes

Table 5-26 summarizes the estimated impacts and conservation of modeled habitat for the Los Angeles little pocket mouse. Implementation of the conservation actions described above would meet the conservation objectives for the species, and would avoid and minimize potential effects and offset the impact on Los Angeles little pocket mouse, resulting in long-term conservation benefits to the species.

Approximately 1,007.2 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 220.3 acres of alluvial fan sage scrub habitat would be restored and managed within the restoration project areas.

As described in the effects analysis for Los Angeles little pocket mouse in Section 4.6.3, implementation of the Covered Activities would result in a permanent loss of 593.4 acres of modeled habitat within the Planning Area and the temporary loss of 145.4 acres of modeled habitat.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-26. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for Los Angeles Little Pocket Mouse

	Impacts		Mitigation
Modeled Habitat Type	Permanent Impacts	Temporary Impacts	HCP Preserve System
Potentially Suitable Habitat			
Phase 1	262.8	86.7	935.1
Phase 2	154.6	55.9	72.1
Phase 3	83.1	0.9	--
Phase 4	92.9	2.0	--
Total Modeled Habitat	**593.4**	**145.4**	**1,007.2**

5.9.20 San Bernardino Merriam's Kangaroo Rat (SBKR)

Conservation Objectives and Actions

SBKR Objective 1: Permanently conserve and manage SBKR habitat within the HCP Preserve System in a configuration that provides long-term conservation benefits to the species.

SBKR Action 1: Conserve 894 acres of modeled habitat in a configuration to facilitate habitat connectivity to occupied SBKR habitat within the HCP Preserve System and to adjacent protected areas.

SBKR Objective 2: Expand the distribution of SBKR by increasing habitat quality for SBKR within the HCP Preserve System and increasing connectivity between areas of occupied or highly suitable SBKR habitat.

SBKR Action 2A: Enhance and restore up to 220.3 acres of SBKR habitat at the Enhanced Recharge Basin Restoration and North Enhanced Recharge Restoration Areas within the HCP Preserve System. A portion of this area is included in the modeled habitat for the species, while other portions are not currently suitable habitat but would be restored to be suitable for the species.

SBKR Action 2B: Manage nonnative grass and plant cover to create high quality SBKR habitat.

SBKR Action 2C: Identify areas of substantial erosion and/or streambed coarsening in SBKR habitat within the HCP Preserve System to determine where sediment replenishment would benefit SBKR habitat suitability.

SBKR Action 2D: Reintroduce high quality sediment to areas identified as benefiting from sediment replenishment. Sediment quality and quantity, and replenishment methods, locations, and timing will be defined by the CAMMP.

SBKR Action 2E: Contribute to range-wide surveys for SBKR within the HCP Preserve System.

SBKR Action 2F: Restore suitable habitat in the interstitial spaces between new groundwater recharge basins (e.g., City Creek Diversion and Basin, Lytle-Cajon Diversion and Basin) to maintain or enhance connectivity across the site.

SBKR Objective 3: Contribute to studies on the genetic structure and genetic diversity of SBKR within the HCP Preserve System.

SBKR Action 3A: Coordinate with the Wildlife Agencies to further the understanding of population genetics and identify actions that may be needed to improve genetics for SKBR.

SBKR Action 3B: Coordinate with the Wildlife Agencies to identify areas within the HCP Preserve that would benefit from population genetics conservation actions.

SBKR Action 3C: Coordinate with the Wildlife Agencies to determine how best to enhance gene flow and genetic diversity between SBKR populations within the HCP Preserve Area.

Monitoring of species conservation actions is addressed in Section 5.12.

Measures to Avoid and Minimize Take

SBKR AMM-1: If there is modeled habitat for SBKR, conduct SBKR habitat assessment of the proposed project site, including both temporary and permanent impact areas, and immediately adjacent areas, to look for signs of small mammal use and potential SBKR occupancy. The initial habitat assessment effort will focus on determining if potentially occupied SBKR habitat would be directly and/or indirectly impacted as a result of project initiation. The habitat assessment will be conducted by a qualified biologist. If no potentially occupied SBKR habitat is identified during the habitat assessment, then no further avoidance measures are required.

SBKR AMM-2: If a ground-disturbing activity from new construction or O&M occurs in or adjacent to potentially occupied habitat for SBKR, an appropriate exclusionary fence meeting wildlife agency standards will be placed and maintained around the perimeter of the site. Biological monitoring will occur during the construction activity to ensure the fence remains intact.

SBKR AMM-3: If potentially occupied SBKR habitat is identified, then SBKR trapping surveys will be implemented. SBKR will be captured and relocated out of harm's way in areas where ground disturbance will likely impact the species. The best available science will be used to determine the methods to minimize impacts on SBKR, which may include duration to hold animals during temporary impacts, release back into temporary impact areas, or translocate to new receiver locations.

SBKR AMM-4: When new construction or O&M activities with temporary ground disturbance occur, including trenching, in SBKR suitable habitat, the topsoil will be conserved and replaced as defined by the CAMMP. As an example, the top 20 inches of soil/substrate will be segregated, preserved, and placed back in the same location and approximate configuration when the trench is backfilled. The soil within the top 20 inches will remain decompacted (loose) upon final placement. If significant (over 30%) nonnative weed cover is found, the topsoil will not be replaced in the top uncompacted fill but will be used for lower compacted backfill. In all cases the top 20 inches will be uncompacted and made as suitable for SBKR burrowing as possible.

SBKR AMM-5: When new construction or O&M activities with permanent ground disturbance occurs, salvage appropriate soil for use in habitat enhancement areas.

SBKR AMM-6: Fence temporary stockpiles of soil during new construction and O&M activities in or adjacent to SBKR habitat to minimize the potential for impacts on SBKR.

SBKR AMM-7: Construction should occur during daylight hours and the use of night lighting will be avoided whenever possible. If night lighting is required, lights will be shielded to minimize lighting of habitat outside of the construction area.

Expected Outcomes

Table 5-27 summarizes the estimated impacts and conservation of modeled habitat for the SBKR. Implementation of the conservation actions described above would meet the conservation objectives for the species, and would avoid and minimize potential effects and offset the impact on SBKR, providing for long-term conservation benefits to the species.

Approximately 894.0 acres of modeled habitat are expected to be conserved within the HCP Preserve System. Approximately 220.3 acres of SBKR habitat would be restored and managed to benefit the species within the restoration project areas. Of the SBKR habitat identified in Table 3-15, 11,076 acres are located outside of the 100-year floodplain and are considered refugia habitat. A total of 603 acres of modeled refugia habitat will be conserved within the HCP Preserve System.

As described in the effects analysis for SBKR in Section 4.6.3, impacts by Covered Activities could result in the permanent loss of 496.4 acres of modeled habitat within the Planning Area and the temporary loss of 55.4 acres of modeled habitat. Of these losses, 83.2 acres will be a permanent impact on modeled refugia habitat and 30.4 acres will be a temporary impact on modeled refugia habitat. The proposed impacts also include approximately 616.3 acres of permanent impacts and 107.5 acres of temporary impacts on SBKR final Critical Habitat; approximately 932.7 acres of the conservation sites and 251.3 acres of the restoration sites are within Critical Habitat areas.

The areas of known occupied and higher quality habitat that are included in the HCP Preserve System area generally well-connected to areas of protected habitat (e.g., Wash Plan HCP Preserve Area), which increases the long-term viability of the species in these areas. The margins and interstitial spaces around several Covered Activities (primarily groundwater recharge basins) that would be located in SBKR habitat will restored and/or managed to function as suitable habitat for SBKR and to maintain connectivity across these sites. Existing groundwater recharge basins located within the HCP Preserve System (e.g., Mill Creek spreading grounds) will continue to operate. Many of these areas are currently occupied, and ongoing operations are not expected to affect the viability or occupancy of these areas. Because these basins are dry most of the year, the basin bottoms offer additional habitat that allow for dispersal of SBKR.

The amount of acreage of likely unoccupied habitat, including low and very low quality mapped habitats, ecological process areas, and modeled suitable habitat, that will be permanently removed is a relatively large portion of the potentially suitable habitat that exists in the Permit Area. These modeled habitat types have much lower amounts of early seral stages of Riversidean Alluvial Fan Sage Scrub habitat that is preferred by SBKR and higher cover (51% and above) of nonnative annual grasses; therefore, permanent removal of these modeled habitat types would be less likely to result in direct impacts on SBKR.

The changes in hydrology from the Covered Activities will have an effect on sediment transport, a key ecological process for the SBKR. The extent of these impacts is not quantified; however, sediment transport replenishment measures identified in the Basin Sediment Management Plan will re-entrain the majority of the sediment diverted by the project, minimizing impacts on SBKR habitat associated with reduced sediment supply and channel incision.

When considered along with the amount of modeled habitat that will be restored or conserved in the HCP Preserve System, along with the monitoring and adaptive management to continually enhance habitat conditions and improve connectivity, the implementation of HCP Covered Activities would not threaten the continued existence of the species.

Table 5-27. Acres of Modeled Habitat Estimated to Be Impacted and Conserved for San Bernardino Merriam's Kangaroo Rat

	Impacts		Mitigation
Modeled Suitable Habitat Type[1]	**Permanent Impacts**	**Temporary Impacts**	**HCP Preserve System**
Suitable			
Phase 1	18.0	31.8	614.8
Phase 2	22.4	0.2	39.8
Phase 3	68.1	0.0	--
Phase 4	51.4	1.5	--
Total	*159.9*	*33.6*	*654.7*
High			
Phase 1	0.1	0.0	--
Phase 2	0.6	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*0.7*	*0.0*	--
Medium			
Phase 1	0.1	0.3	0.8
Phase 2	1.3	0.0	--
Phase 3	0.0	0.0	--
Phase 4	0.0	0.0	--
Total	*1.4*	*0.3*	*0.8*
Low			
Phase 1	3.1	2.3	0.3
Phase 2	71.6	0.1	--
Phase 3	0.0	0.0	--
Phase 4	19.2	0.0	--
Total	*93.9*	*2.4*	*0.3*
Very Low			
Phase 1	17.6	18.0	238.2
Phase 2	133.2	0.0	--
Phase 3	0.7	0.6	--
Phase 4	2.6	0.3	--
Total	*154.1*	*18.5*	*238.2*
Ecological Process Area			

Modeled Suitable Habitat Type[1]	Impacts		Mitigation
	Permanent Impacts	Temporary Impacts	HCP Preserve System
Phase 1	0.2	0.5	--
Phase 2	3.3	0.0	--
Phase 3	35.6	0.0	--
Phase 4	47.3	0.0	--
Total	*86.4*	*0.5*	--
Total Modeled Habitat	**496.4**	**55.4**	**894.0**

[1] Note that habitat suitability categories of High, Medium, Low, Very Low, and Ecological Process Area were only mapped by USFWS within the boundaries of the Upper Santa Ana River Wash HCP and the area of the Lytle-Cajon confluence (see Figure 3-57). Outside of these areas the San Bernardino Merriam's kangaroo rat model identifies San Bernardino Merriam's kangaroo rat habitat as Suitable.

5.10 Fully Avoided Species

Delhi Sands flower-loving fly and arroyo toad are included in this HCP because there are Covered Activities that overlap with known or modeled habitat areas; however, all take will be avoided by implementing both the general measures to avoid take described in Section 5.11 and the specific measures described below. This HCP does not provide incidental take coverage for either species.

5.10.1 Delhi Sands Flower-Loving Fly (DSFF)

The below measures will be employed to avoid all take of the Delhi Sands flower-loving fly by Covered Activities. If the proposed Covered Activity does not have the potential to directly or indirectly result in "take" of the Delhi Sands flower-loving fly, including temporary or permanent impacts on their habitat, no additional mitigation or minimization measures would be required for this species.

Measures to Avoid Take

DSFF AM-1: If there is modeled habitat for the Delhi Sands flower-loving fly within the project site of a Covered Activity, conduct a habitat assessment of the proposed project site including both temporary and permanent impact areas, and immediately adjacent areas. The initial survey effort will focus on determining if potential Delhi Sands flower-loving fly habitat would be directly and/or indirectly impacted as a result of the project. The survey will be conducted by a qualified biologist familiar with the soil, preferred nectar flowers, and habitat requirements of the Delhi Sands flower-loving fly and will include mapping of the soil substrate to determine if the site includes soil characteristics suitable for Delhi sands flower-loving fly. If no potential habitat is identified during the surveys, then no further avoidance measures are required.

DSFF AM–2: If suitable soil characteristics or nectar flowers are discovered within a project site, a 300-foot buffer will be established and maintained between the Covered Activity and the suitable soil area. The buffer will be marked with high visibility exclusionary fencing.

a. The integrity of the exclusionary fencing will be assessed by onsite personnel on a daily basis. All breaches will be immediately repaired.

b. A biological monitor will visit the proposed project site at least once a week to ensure that the fencing has not been breached and all project-related general best management practices (BMPs) are being successfully implemented.

DSFF AM-3: Night lighting adjacent to the 300-foot buffer area will be directed away from suitable habitat and/or shielded to prevent nocturnal lighting of the suitable habitat.

DSFF AM-4: An environmental awareness briefing will be conducted prior to the initiation of project-related activities in order to fully inform all onsite personnel of the biologically sensitive resources associated with the proposed project. A handout will also be created and distributed that describes and illustrates the species, including contact information and course of action if detected within the proposed project site.

5.10.2 Arroyo Toad (ARTO)

The below measures will be employed to avoid all take of the arroyo toad by Covered Activities. If the proposed Covered Activity does not have the potential to directly or indirectly result in take of the arroyo toad, including temporary or permanent impacts on breeding or upland habitats, no additional mitigation or minimization measures would be required for this species.

Measures to Avoid Take

ARTO AM-1: If there is modeled habitat for arroyo toad within the project site of a Covered Activity, conduct an arroyo toad habitat assessment of the proposed project site including both temporary and permanent impact areas, and immediately adjacent areas. Immediately adjacent areas that should be included in the surveys include a minimum of 300–750 feet laterally from the channel (depending on topography), as well as 0.5 mile upstream and downstream of the project, as accessible. The initial survey effort will focus on determining if potential arroyo toad breeding and/or upland habitats would be directly and/or indirectly impacted as a result of project construction. The survey will be conducted by a qualified biologist familiar with breeding, upland habitat utilization, activity patterns, and movement potential of the arroyo toad. If no potential breeding or upland habitat is identified during the surveys, then no further avoidance measures are required.

ARTO AM-2: If suitable arroyo toad habitat (breeding/upland/movement routes) is identified or has previously been documented within or adjacent to the proposed project area, either focused surveys will be conducted during the breeding season (January–July, when flows are present in the channel) to determine presence/absence, or the species will be presumed present. If the species is documented within or adjacent to the proposed project area or presumed present, the following avoidance measures will be followed:

a. If habitat containing the required physical and biological features for arroyo toad is identified within a project that is located within identified arroyo toad Critical Habitat, the project will be redesigned to avoid impacts on that habitat.

b. No activities will be initiated during the breeding season. In an effort to determine the status of arroyo toad breeding, a qualified biologist will monitor breeding activity within and adjacent to

the proposed project site to determine when all larvae have completed metamorphosis. This effort will generally involve a combination of diurnal clutch/larvae and nocturnal surveys.

c. An environmental awareness briefing will be conducted prior to the initiation of project-related activities in order to fully inform all onsite personnel of the biologically sensitive resources associated with the proposed project. A handout will also be created and distributed that describes and illustrates the species, including contact information and course of action if detected within the proposed project site.

d. A qualified biologist will be onsite during all project-related exclusionary fence installation, vegetation clearing/grubbing, and ground disturbance.

e. The integrity of the exclusionary fencing will be assessed by onsite personnel on a daily basis.

f. A biological monitor will visit the proposed project site at least once a week to ensure that the fencing has not been breached and all project-related general BMPs are being successfully implemented.

ARTO-AM-3: Results of the initial arroyo toad habitat assessment and proposed minimization measures (if warranted) would be submitted to the Wildlife Agencies for review and authorization to implement site-specific measures and to determine if formal consultation is warranted.

ARTO AM-4: All individuals working in potential arroyo toad habitat will follow the disease prevention protocols described in the USFWS' *Declining Amphibian Population Task Force Code of Practice* (USFWS 2009, Appendix D).

5.11 Measures to Avoid and Minimize Take

As required by the Endangered Species Act (Section 10 [a][2][A][ii]), the HCP includes measures with a primary focus of avoiding or minimizing take of the Covered Species (i.e., death or injury to species) and effects on habitat that may be affected by Covered Activities. These measures to avoid and minimize impacts are designed to achieve the following objectives:

- Provide avoidance of Covered Species during implementation of Covered Activities throughout the Planning Area.
- Prevent take of individuals from Covered Activities as prohibited by law (e.g., take of fully protected species).
- Minimize adverse effects on Covered Species and their habitat where conservation actions will take place.

This section describes the BMPs and AMMs that apply generally to Covered Species and Covered Activities. Species-specific AMMs, including the timing of species habitat surveys, preconstruction surveys, and construction monitoring relative to impacts, are provided in Section 5.9 for Covered Species that require additional measures. For long-term projects and projects that are phased,[2] the frequency and timing of surveys relative to impacts should also be phased such that surveys and monitoring (if required) will be conducted prior to each construction phase if the entire project area is not continuously disturbed between phases.

[2] Phasing may include planned phasing of construction components of a project (e.g., multi-year phasing of a road or pipeline construction project), or unplanned gaps in construction activity.

It is the responsibility of project proponents to design and implement their projects in compliance with these measures. Avoidance and minimization measures may be revised over the course of the permit duration based on results of implementation through the adaptive management process and in accordance with Section 6.7, *Plan Changes and Amendments*. Even with these avoidance and minimization measures, other forms of take (e.g., harm) of Covered Species may still occur.

5.11.1 General Avoidance and Minimization Measures

The AMMs listed below may apply to the initial project construction, O&M, or both. The AMMs that specifically apply to the initial project construction are further identified as BMPs. A table showing which AMMs are expected to apply to each project is included in Appendix G, *Covered Activity AMMs*.

All Covered Activities

AMM-1: Retain qualified biologists, botanists, and/or biological monitors approved by the Alliance to ensure compliance with protective measures for Covered Species and migratory birds. They will be required for monitoring of any new construction or O&M activities that may result in impacts on Covered Species or migratory birds.

AMM-2 (BMP): Minimize to the extent possible all construction activity and access roads located in in any drainage, stream, pool, or other feature that could be under the jurisdiction of USACE, the State Water Resources Control Board, and/or CDFW. Any unavoidable impacts on these resources must obtain any necessary state or federal aquatic resources permits prior to construction.

AMM-3: Confine the area of Covered Activity disturbances to the smallest practical area, considering topography, placement of facilities, location of Covered Species habitat, public health and safety, and other limiting factors, and locate impacts in previously disturbed areas to the extent possible. Project design will prioritize the avoidance of Covered Species habitats.

AMM-4 (BMP): Mark the limits of construction for all new Covered Activities; fence and maintain these markers until work is completed. Personnel will strictly limit their activities, vehicles, equipment, and construction materials to the designated work area. A qualified biologist will regularly check this fencing to ensure that it is in good condition and properly placed to protect habitats outside of the limits of construction.

AMM-5 (BMP): Confine the ingress and egress of construction equipment and personnel to designated access points and onsite roadways. Prohibit cross-country travel by vehicles and equipment.

AMM-6: Develop an integrated weed management plan (IWMP) to be implemented by the Permittee Agency for all Covered Activities in or adjacent to natural habitats to minimize the potential introduction of new weeds as a result of Covered Activities and to control the spread of weeds (both terrestrial and aquatic) resulting from ground disturbance. The IWMP will be developed by the Alliance within the first year following issuance of the ITP and will be provided to each Permittee Agency as a part of the project consistency review process as a required element of project implementation.

AMM-7: Clean equipment (e.g., passenger vehicles, trucks, and heavy equipment) prior to entering the worksite and between worksites to prevent the importation and spread of invasive plant species. This measure applies to both new construction and O&M.

AMM-8: Avoid the use of pesticides for all covered activities within or adjacent to the HCP Preserve System or other natural areas (including herbicide, rodenticides, and insecticides) as much as possible and consider alternative methods of control such as mechanical vegetation removal and small fossorial (burrowing) mammal trapping only when fossorial mammals directly threaten the integrity of Permittee Agency facilities. Covered activities that require the use of these chemicals or generate byproducts that are potentially toxic or may adversely affect wildlife and plant species, habitat, or water quality, will incorporate measures to ensure that application of such chemicals does not result in any discharge to the HCP Preserve System or other natural areas. Covered activities will specifically avoid or minimize the use of pesticides during bird breeding seasons and near bird breeding habitat.

AMM-9: Restore all areas affected during construction and O&M activities that contain native vegetation after the project is completed.

AMM-10 (BMP): Cover, fence, or provide escape ramps with a minimum 3:1 slope for all open trenches or holes before leaving the site at the end of the workday. If trenches are not covered, they will be inspected for trapped wildlife by a qualified biologist or biological monitor daily. Animals found will be captured and moved to the nearest safe location outside the construction area.

AMM-11 (BMP): Control dust. If water trucks are used, pooling water will be avoided to minimize the potential of attracting opportunistic predators.

AMM-12 (BMP): Conduct covered activities, including new project construction, during daylight hours to the extent feasible. If night work cannot be avoided, the project proponent will consult with the Alliance to determine measures to reduce impacts on Covered Species from lighting and noise.

AMM-13 (BMP): Promptly cover or mulch all exposed soil areas associated with the proposed project before the onset of precipitation if unexpected rainfall is forecast during the time grading activities are being performed.

AMM-14 (BMP): During construction where there are permanent disturbance areas with native cactus, salvage all native cactus such as cholla and beavertail and transplant to HCP Preserve System sites in areas suitable for cactus. If a suitable transplant location is immediately available for replanting (preferably within 2.5 miles of occupied cactus wren habitat), plants should be salvaged and transplanted whole. When removing cacti, care should be taken to keep root systems intact, to collect adjacent soil for transplanting, and to mark orientation of the cactus at the removal site. Transplanted cactus should be placed in the same orientation as the removal site. If a transplant site is not immediately available, multi-stem cactus plants should be salvaged by breaking off sections at the joint of a minimum of two pads/segments, with larger cuttings containing multiple pads/segments being preferred. Single-stem cactus plants should be excavated whole and roots should be trimmed to within 2 to 3 inches of the base of the plant. Cacti should be stored outside and covered. If possible, cactus salvage should occur outside of late fall so plants are the least drought stressed. If salvaging prickly pear cactus, ensure that it has not hybridized with the nonnative mission fig (*Opuntia ficus-indica*).

AMM-15: Except in paved roads with posted speed limits, limit vehicle speeds to a maximum 15 miles per hour during travel associated with the Covered Activities. If work must take place at night, the maximum speed limit is 10 miles per hour.

AMM-16: For Covered Activities adjacent occupied breeding bird habitat (see breeding seasons for HCP covered bird species) that generate noise in excess of 60 dBA L_{eq} hourly, incorporate setbacks,

berms, or walls, as appropriate, to minimize the effects of noise in the adjacent occupied breeding bird habitat.

AMM-17: Implement litter control measures. Trash and food items will be contained in closed containers and removed daily to reduce the attractiveness to animals in the area.

AMM-18: Avoid discarding of human-provided food in Covered Activity project sites or adjacent natural habitats.

AMM-19: Reduce the risk of wildfire ignition when conducting Covered Activities. Spark arrestors should be installed and operational on equipment used for construction. Construction or field crews should coordinate safety plans to include fire management, including actions such as parking in cleared areas to avoid ignitions and smoking bans. Crews should be aware of weather conditions and potential for fire ignition and activity for field or construction planning. Any hot work, such as welding, should not occur on high fire danger days (e.g., red flag wind warning, fire weather warning). During periods of high fire danger, crews should coordinate with local agencies for any additional measures to prevent fire ignitions.

AMM-20: Maintain adequate fire suppression capability in active construction areas. Require adequately sized fire extinguishers on all construction or field vehicles. For construction during periods of high fire danger, equipment such as a water tender or tanker should be onsite. Crews should coordinate with local agencies during periods of high fire danger regarding construction plans to accommodate efficient response to any fire ignitions.

Riparian Area and Aquatic Habitat Protection

AMM-21: Avoid and minimize all impacts on riparian and aquatic habitats to the extent practicable.

AMM-22: Treat materials identified for restoration and enhancement projects, where necessary, to ensure that only clean materials are introduced into the pond, wetland, or riparian area, minimizing potential adverse affects on amphibians that may be present.

AMM-23: Protect riparian habitat from recreational activities (e.g., trails, campsites, off-road vehicles, fires) within the HCP Preserve System.

AMM-24: Implement a stormwater pollution prevention plan (SWPPP) during vegetation and access road maintenance activities, including implementing measures to control silt and sediment from reaching any tributaries to, or the mainstem of, the Santa Ana River. Install silt screens at the toe of the slope and around the perimeter of any area to be graded prior to initiating grading activities. Repair or maintain sediment and erosion controls as needed.

AMM-25: Reduce the potential for spills associated with Covered Activities by refueling vehicles outside of rivers, creeks, basins, and their banks. Equipment storage, fueling, and staging areas will be located on upland sites with limited risks of direct drainage into the HCP Preserve System or other sensitive habitat or riparian areas. Precautions will be taken to prevent the release of substances into surface waters. Project-related spills of hazardous materials will be reported to appropriate entities—including, but not limited to, the applicable jurisdictional city or county, USFWS, CDFW, and RWQCB—and will be cleaned up immediately. Contaminated soils will be removed to approved disposal areas.

AMM26: Control pollutants affecting water quality. To reduce potential water quality impacts (e.g., from bentonite plumes), holes drilled for new wells or geotechnical studies will be refilled with native material or via another method approved by the RWQCB.

AMM-27: Conduct in-channel work within ephemeral or intermittent channels during the dry season (April 1–October 30) to avoid flowing water whenever possible. When stream flows must be diverted, the diversions will be conducted using sandbags and other methods requiring minimal instream impacts. Silt fencing of other sediment trapping materials will be installed at the downstream end of the construction activity to minimize the transport of sediments off site. Settling ponds where sediment is collected will be cleaned out in a manner that prevents the sediment from reentering the stream. Care will be exercised when removing silt fences to prevent debris or sediment from returning to the stream. All stream diversions will have a project-specific diversion plan approved by CDFW, RWQCB, and USFWS, as applicable.

Alluvial Fan Sage Scrub Protection:

AMM-28: When new construction or O&M activities with ground disturbance occurs, including trenching activities, within areas of alluvial fan sage scrub habitat with <30% nonnative grass and plant cover, remove and sequester surface soils at the beginning of any ground-disturbing activity. If cryptogamic soil crust is also present, it will be harvested in blocks, preserved, and placed back on the site in areas of temporary impact. If the impacts are permanent, an alternate site in suitable habitat will be selected in consultation with a qualified botanist or restoration biologist for placement of the topsoil of cryptogamic soil crust. The soil within the top 20 inches will remain decompacted (loose) upon final placement.

Special-Status Fish and Other Aquatic Species Protection:

AMM-29: Prior to any in-water work, have a qualified biologist conduct a survey for special-status fish and other aquatic species. No work will be conducted in the flowing portion of the stream and water will be diverted around the work area in accordance with a project-specific diversion plan (see AMM-27). Block nets or other barriers may be required if special-status fish or other aquatic species are present as determined by the preconstruction survey. A qualified biologist will be onsite to monitor installation of the diversion and to relocate special-status species from the area to be isolated for construction activities. The monitor will have the authority to stop all work if issues are noted until corrective measures have been implemented. Rescued special-status species will be relocated immediately to suitable habitat upstream or downstream of the diversion area.

AMM-30: Relocate translocated fish upstream of diversions prior to repairing diversions that would result in stranding of fish. For example, at the Alder Creek Diversion (SCE.2) in Alder/Hemlock Creek, the water diversion is approximately 100% of flow. Between the Alder Creek Diversion and the Santa Ana River is a reach of stream that flows only when the diversion berm is breached; this stream is ephemeral. Any translocated fish (e.g., Santa Ana sucker, arroyo chub, or Santa Ana speckled dace) that wash downstream of the diversion berm but upstream of the Santa Ana River would be trapped once the diversion berm is reconstructed.

AMM-31: Assess the need for fish screens at all diversions or sand boxes where translocated fish may come into contact with the operation of hydropower facilities. Install fish screens on diversions or sand boxes where they would reduce the risk of entrapment or being drawn into a powerhouse. Conduct regular maintenance of fish screens in fish translocation sites for translocated fish.

Migratory Birds

AMM-32: Avoid new construction and O&M activities conducted within natural habitat areas to the extent feasible during the breeding season (February 1–August 31. If a Covered activity resulting in surface disturbance takes place during the nesting season, a qualified biologist will conduct pre-activity nest surveys. The area to be disturbed and a 500-foot buffer will be surveyed for 5 consecutive days to determine if migratory birds are nesting in or near the construction or O&M area. If an active nest or colony is present, a 300-foot buffer will be established and maintained between the Covered Activity and the nest area until nesting is completed.

AMM-33: Avoid human intrusion into breeding colonies or nesting areas during the breeding season (March 15–September 15). A qualified biologist will conduct training of construction and/or O&M personnel on avoidance procedures, buffer zones, and protocols in the event that an active breeding colony occurs near a construction or O&M area.

5.12 Comprehensive Adaptive Management and Monitoring Program

This section describes an adaptive management and monitoring framework for the HCP, including guidelines, and specific recommendations that will help the Alliance develop the Upper SAR HCP CAMMP. The purposes of this CAMMP framework, and one of the primary purposes of the CAMMP itself, are to ensure compliance with the HCP, to assess the status of Covered Species within the HCP Preserve System, and to evaluate the effects of management actions such that the conservation strategy, including the biological goals and objectives of the HCP, are achieved. Adaptive management and monitoring are integrated processes in the CAMMP, and monitoring will inform and change management actions to continually improve outcomes for Covered Species. The following presents an overview of the program, monitoring and adaptive management actions, and data and reporting requirements.

5.12.1 Overview

CAMMP and Preserve Unit Plans

The CAMMP is an all-encompassing adaptive management and monitoring program for the entire HCP Preserve System. The HCP Preserve System is divided into five main Preserve Units based on their geographic location and primary habitat types. There are two Santa Ana sucker translocation preserve units in the upper headwater tributaries (A-Santa Ana River tributaries and B-Lytle/Cajon tributaries); there are two alluvial fan sage scrub preserve units (A-Santa Ana River Wash and B-Lyte/Cajon Wash) and one preserve unit on the mainstem of the Santa Ana River downstream of the wash. The preserve units are described in more detail in Section 5.4, *HCP Preserve System*. In addition to the CAMMP, area-specific monitoring and management plans will be prepared for each of these preserve units. These PUPs will apply the guidance and directives of the CAMMP to the preserve unit, focusing on the specific habitat types, Covered Species, and management issues prevalent in each preserve unit. The fine-scale nature of the PUPs will enable focused application of conservation actions, monitoring methods, and prioritization of management needs. Both the CAMMP and the PUPs will require periodic updating as significant new information and tools are available; however, the PUPs will require more frequent updating to integrate the adaptive

management results and reprioritize management needs. The CAMMP and PUPs will be maintained as "living" documents in the Upper SAR online portal (described more under *Roles and Responsibilities*, below), greatly simplifying the update process.

Regulatory Context

An HCP must provide for the establishment of a monitoring program that generates information necessary to assess compliance and verify progress toward achieving the biological goals and objectives of the plan (50 Code of Federal Regulations [CFR] 17.22(b)(2)(A-F), 50 CFR 17.32(b)(2)(i-iii), and 50 CFR 222.307(b)(5)). Adaptive management programs are generally recommended for large, programmatic plans and those with data gaps and scientific uncertainty that could affect how species are managed and monitored in the future. The *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (USFWS and NMFS 2016) describes adaptive management as a method for addressing uncertainty in natural resource management and states that management must be linked to measurable biological goals and monitoring. Species-specific biological goals and objectives are paired with conservation and monitoring actions to ensure evaluation of conservation measures and implementation of the biological goals and objectives (Section 5.9*)*. Conservation measures listed in Table 5-7 can be modified in response to new information within an adaptive management framework.

The monitoring and adaptive management framework described in this chapter will fulfill HCP requirements, which will be supported by the development of the CAMMP. This program incorporates recommendations for monitoring and adaptive management based on guidelines provided by the USGS, Biological Resources Division; CDFW; and USFWS for regional HCPs and NCCPs (Atkinson et al. 2004).

Roles and Responsibilities

The Alliance will be the HCP Implementing Entity on behalf of the Permittee Agencies and will implement conservation actions, and monitor and evaluate the effectiveness of the conservation actions and HCP Preserve System management (see Section 6.5, *HCP Implementing Entity*). Regular coordination will occur between the Alliance and Wildlife Agencies to ensure that all Covered Activities and conservation actions are consistent with commitments made within the HCP. The Alliance will be responsible for the preparation of the CAMMP and of PUPs as well as the HCP annual report. The Wildlife Agencies will review and approve these documents and will be involved in regular HCP Preserve System oversight through annual meetings. These documents will be available to the public for review and input. In addition, coordination with other preserve managers in the Planning Area will help determine and address regional and local trends in adaptive management that may be occurring across the Planning Area.

Implementation of the CAMMP will be the responsibility of the Alliance. The Alliance will employ a Preserve System Manager, who will be responsible for ensuring that success criteria are being met within the HCP Preserve System through conservation actions that contribute to the conservation strategy of the HCP. The Alliance will be responsible for overall HCP compliance. These responsibilities include ensuring implementation of the specific mitigation requirements in the conservation strategy, as well as all biological monitoring, reporting, and adaptive management requirements as described in this chapter. The Alliance will also be responsible for ensuring compliance of the Permittee Agencies to implement Covered Activities consistent with the commitments of the HCP, which will be enforced through the Project Consistency Review process.

To accomplish this the Alliance will also employ a Program Compliance Manager, who will be responsible for ensuring that Covered Activities are implemented in manner consistent with their description in Chapter 2 of the HCP.

Note that the implementation of the HCP and other elements of the Upper SAR Program will be coordinated, tracked, and managed through and online spatial mapping database and information portal. One of the primary objectives of this online portal will be to make HCP Preserve System management and monitoring information accessible to the regulatory agencies. While static hard copy reports would be sufficient to meet the annual reporting requirements, the expectation is that the results of monitoring and management will be available in near real-time through the Upper SAR online portal, which will have the ability to generate any one of a variety of reports as needed—including to meet the annual reporting permit requirements.

Adaptive Management and Monitoring Objectives

The overarching objective of the CAMMP is to ensure that the conservation strategy described in this chapter and the biological goals and objectives are being achieved. Additional objectives of the CAMMP include the following:

1. Provide an organizational framework and decision-making process using the results of monitoring, targeted studies, and other data to adjust management actions.
2. Document the baseline condition of biological resources in the HCP Preserve System using existing data and the results of ongoing field surveys.
3. Develop conceptual models for vegetation communities and Covered Species that can be used as the basis for collecting information, verifying hypotheses, and designing and changing management practices.
4. Incorporate hypothesis testing and experimental management, including targeted studies to address key uncertainties and to improve management and monitoring efforts.
5. Develop and implement scientifically valid monitoring protocols at multiple levels to ensure that data collected will inform management and integrate with other monitoring efforts.
6. Ensure that monitoring data are collected, analyzed, stored, and organized so the data are accessible to the Participating Entities, regulatory agencies, scientists and, as appropriate, the public.

5.12.2 An Adaptive Approach to Management

Adaptive management is a decision-making process that promotes flexible management such that actions can be adjusted as uncertainties become better understood or as conditions change. Monitoring the outcomes of management is the foundation of an adaptive approach, and thoughtful monitoring can both advance scientific understanding and improve the effectiveness of management actions iteratively (Williams et al. 2009).

Monitoring and adaptive management of the HCP Preserve System will follow guidelines set forth in Atkinson et al. (2004) and refined in later documents (e.g., Hierl et al. 2007, Lewison and Deutschman 2014, and SDMMP and TNC 2017). This approach includes discrete steps for setup, planning, and action and should be initiated early in HCP Preserve System management and monitoring plan development (CAMMP and PUPs). The *Set-up* step identifies site-level conservation

resources and potential threats and stressors. The *Planning* step defines and prioritizes monitoring and management issues. The *Action* step (1) monitors resources to assess status or trends and determine management needs, (2) implements management actions to enhance resource functions and reduce adverse effects from threats and stressors, (3) evaluates resource response to management actions, and (4) modifies monitoring and management actions, as necessary. Except for the initial site evaluation, all elements are iterative; thus, planning and action phases may overlap (Figure 5-11).

It is important to reiterate that adaptive management is used when there is uncertainty regarding management outcomes. Management issues that do not include uncertainty do not require an adaptive management approach. This topic is discussed further in Section 5.12.3, *Management of the HCP Preserve System*.

Adaptive Management Guidance

The sections below provide guidance for developing, implementing, and evaluating monitoring and management actions to protect and enhance conserved resources, minimize or avoid threats to those resources, and improve management effectiveness and efficiency through iterative learning.

Key elements of site-level adaptive management and monitoring include:

- Site Evaluation
- Goals, Objectives, and HCP Conservation Actions
- Conceptual Models
- Management
- Monitoring
- Evaluation Process
- Uncertainties
- Research Needs

The relationship of these elements in the adaptive management and monitoring feedback loop are shown in Figure 5-11.

Site Evaluation

While many of the parcels identified for inclusion in the HCP Preserve System have already been enrolled in the Preserve through acquisition and/or establishment of conservation easements, additional parcels will continue to be added in the early phases of HCP implementation. Site evaluations will be conducted within 1 year of the issuance of the incidental take permit or within 1 year of acquisition (or establishment of conservation easement) for parcels added to the HCP Preserve System in the future. The Alliance will evaluate available data for parcels in the HCP Preserve System, conduct site reconnaissance to identify what field surveys should be prioritized and a proposed timeframe (e.g., for Covered Species), identify appropriate land uses and roads or trails that should be closed, and identify immediate management and maintenance needs (e.g., fencing, runoff from adjacent properties, invasive species, removal of structures or trash). Baseline surveys for conserved resources will be conducted subsequent to the site reconnaissance in order to obtain data necessary to assess resource status and management needs. Plan goals and objectives

will focus the evaluation on key conservation resources (e.g., Covered Species, vegetation communities, ecological processes, and connectivity) and potential threats and stressors.

Existing regional and preserve-level documentation will be reviewed to identify and describe conservation resources (including types of data available), data gaps, and site history (i.e., land uses, fire, any previous management and monitoring) relevant to resource management. Potential data sources include (but are not limited to) this HCP, biological reports, regional databases (e.g., CNDDB, Biogeographic Information and Observation System [BIOS], California Invasive Plant Council [Cal-IPC] Weed Mapper), other conserved lands near the site, and expert opinion (species experts, science advisors, other Preserve Managers, Wildlife Agencies). Based on this assessment, the Alliance will prepare a site-specific list of conservation resources and data gaps, including potential threats and stressors to be included in the PUP in which the site falls.

As part of the initial site reconnaissance or subsequent baseline surveys, the Alliance will map vegetation communities (using *A Manual of California Vegetation* [Sawyer et al. 2009]) and level of disturbance, identify threats and stressors, and evaluate the potential of the property to support Covered Species and meet overall biological goals and objectives. Prior to surveys, the Alliance will identify types of data required to evaluate status and/or management needs for each resource to ensure appropriate data collection and desired outputs. The emphasis during this stage is on surveys that are broad-based, comprehensive, and relatively rapid, with a focus on habitat condition and potential to support Covered Species (Lewison and Deutschman 2014).

Upon completion of site evaluation (site reconnaissance and baseline monitoring), the Alliance, in consultation with the Wildlife Agencies, will incorporate the results into the PUP in which it occurs, including the 5-year timeline of priority surveys and management needs in the PUP.

Information from the success criteria of the HMMPs for restoration areas will be used to develop goals and objectives for those restoration sites in place of the evaluation procedures described here for conservation sites without major restoration projects.

Goals, Objectives, and Conservation Actions

The HCP goals and objectives, Preserve Unit objectives, and species-specific objectives and conservation actions will be summarized and integrated as they apply to each individual PUP (e.g., Santa Ana sucker translocation goals, objectives, and actions would only apply to the Translocation Preserve Units and respective PUPs). With the additional specificity derived from the Site Evaluation (above), the objectives and conservation actions should be refined and described in further detail to specify where and how they apply to individual preserve areas in each Preserve Unit. The conceptual models, threats and stressors, and other uncertainties should be considered when adapting the objectives and conservation actions to the Preserve Unit.

Conceptual Models

Conceptual models allow for structured decision-making and should be used as a tool to test management hypotheses and identify appropriate monitoring targets, uncertainties, and research needs. Conceptual models provide a vision or concept of how a species, habitat, or ecosystem functions and how it might be influenced by management actions (Atkinson et al. 2004, Hierl et al. 2007, Williams et al. 2009, Deutschman et al. 2012, Lewison and Deutschman 2014). Further, conceptual models organize and articulate the relationship between change agents and natural drivers. For example, a conceptual model for a Covered Species will depict life history traits that

influence species persistence, as well as natural and anthropogenic drivers (threats and stressors) and uncertainties that may affect those traits.

Conceptual models vary in complexity and format, and numerous sources are available to assist in model development (e.g., Atkinson et al. 2004, Hierl et al. 2007, Williams et al. 2009, Deutschman et al. 2012, Lewison and Deutschman 2014). To be scientifically defensible, model development must be based on existing data and literature- or field-based assumptions; documentation of these sources is an integral part of model development. Preliminary conceptual models have been developed for this HCP for each of the Covered Species. These conceptual models are relatively simple, identifying the natural drivers, threats, and stressors for each species, and will be further refined during the CAMMP preparation process.

The following principles and format elucidated in Hierl et al. (2007) and refined by the Institute for Ecological Monitoring and Management (IEMM) in a conceptual model workshop (Deutschman et al. 2012), Adaptive Management Framework (Lewison and Deutschman 2014), and species-specific models (Strahm 2012) are useful guidelines for model development for adaptive management:

Simpler models that represent the current state of knowledge and are supported by data are preferable to complex models with a high degree of uncertainty.

- Models should clearly identify management and monitoring goals.
- Models should include those life history traits (species variables) that influence persistence and should focus on those variables that may respond to monitoring and adaptive management (potential monitoring targets).
- Models should identify and differentiate between anthropogenic (threats and stressors) and natural drivers of the system.
- Putative or secondary relationships, if included, should be differentiated from data-based primary relationships.
- Proposed management actions should support the management goal; proposed monitoring should measure the effectiveness of management actions, followed by a modification in management, if warranted.

The Alliance will work with experts to further refine the conceptual models to guide the adaptive management process.

Management

The primary purpose of management of the HCP Preserve System is to maintain and enhance the quality of the conserved habitats within the HCP Preserve System. Management of the preserve consists of the basic elements of preserve stewardship (e.g., maintaining fences, picking up trash, and controlling public access on designated trails), addressing of preserve-wide management needs (e.g., implementation of invasive species control measures), and the implementation of the species-specific management-oriented conservation actions. The HCP Preserve Management Committee and HCP Technical Advisory Committee will be consulted regularly to advise on questions related to the establishment and long-term management of the HCP Preserve System. Management of this HCP is further described in Section 5.12.3.

Monitoring

The monitoring program will provide the information necessary to assess HCP compliance and Covered Activity effects, verify progress toward achieving the biological goals and objectives, and provide the scientific data necessary to evaluate the success of the HCP's conservation strategy. The CAMMP will include three main types of monitoring: compliance monitoring, effectiveness monitoring, and targeted studies. All monitoring will be planned and conducted to support and inform the adaptive management approach of HCP implementation. The HCP Technical Advisory Committee will be consulted regularly to advise on questions related to the establishment and long-term management of the HCP Preserve System. Monitoring of this HCP is further described in Section 5.12.4, *Monitoring of the HCP Preserve System*.

Evaluation Process

The final step in the adaptive management process is evaluating or interpreting data to determine whether goals and objectives have been met and to guide future management and monitoring. This evaluation will be conducted yearly, and information will be used to refine goals, objectives, conceptual models, monitoring methods, and conservation and management actions.

Implementation of adaptive management is defined as successful if progress is made toward achieving management goals through a learning-based (adaptive) decision process. The PUPs will include an adaptive management component to ensure that site-specific objectives are being met and are contributing to the overarching goals and objectives of the HCP. Revisions to management components identified through adaptive management will be documented in the annual report and incorporated as a revised approach/method in the annual work plan as applicable for each Preserve Unit.

Data Entry and Storage. It is anticipated that a significant amount of data will be collected yearly in each Preserve Unit. The Alliance will maintain a GIS database of monitoring results from all Preserve Units in a format that is compatible with other state and regional monitoring databases, such as BIOS and CNDDB. The GIS database will include species, habitat, and management-relevant data, and should allow data to be input and extracted easily. Additional databases may be required to store non-digital data (e.g., data forms, photodocumentation). The HCP Preserve System will be coordinated, tracked, and managed through an online spatial mapping database and information portal. Therefore, the data entry and storage structure will be developed as a key component of online system.

Data Analysis and Interpretation. Data analysis and interpretation are necessary to evaluate management effectiveness, improve understanding of the system, and reduce uncertainty. Data analysis can be simple or complex, depending on the management approach selected. Where uncertainty is absent or low, analyses may consist of graphics, summary statistics, or simple hypothesis testing. Where uncertainty is high, complex statistical analyses may be required. In the latter case, the Alliance may need to work with outside entities to ensure that data are analyzed appropriately. Data results and interpretation will be presented in the HCP Annual Report. The Alliance will include results, analyses, and recommendations from each Preserve Unit in the HCP Annual Report.

Evaluation. Evaluation completes the "feedback loop" or iterative learning process for adaptive management. Evaluation includes documentation and dissemination of results and

recommendations, and refinements to goals, objectives, conceptual models, monitoring methods, and management actions, as necessary.

Decision-making. The accumulation of understanding and subsequent adaptation of a management strategy depends on feeding information obtained from monitoring results back into the decision-making process. The link between the technical and decision-making steps requires regular interaction and an exchange of information between the technical staff and decision-makers. This will be accomplished by bi-annual meetings involving the Alliance and the Wildlife Agencies where both regulatory and technical expertise can be integrated into revising goals and objectives, refining models, adjusting management and/or monitoring activities, or allocating funding. Meetings should be timed such that any new information discussed assists with the planning of upcoming seasonal work (i.e., invasive species control, vegetation management, or biological surveys). Timing some meetings to coordinate with other regional conservation planning meetings is encouraged to maximize communication and cooperation in the region.

Annual Report. The Alliance will prepare an annual report that summarizes monitoring and management activities in the HCP Preserve System including (but not limited to) baseline surveys, general stewardship monitoring, effectiveness monitoring, and targeted monitoring. The report will document monitoring results and link results to goals and objectives. The report will identify new or ongoing management issues and threats and stressors, and provide recommendations for future monitoring, management, and research. The establishment of mitigation credits and the use of mitigation credits will also be summarized in the annual report. The following information should be available with the annual report and be included in the HCP GIS database.

- A digital copy of monitoring data, including metadata (e.g., Excel spreadsheet).
- Spatial data (GIS shapefiles).
- Photo documentation.
- A comprehensive annual assessment identifying and documenting the major threats to conserved habitat and Covered Species, impacts from public use, management needs, and issues requiring focused research.

While static hard copy reports would be sufficient to meet the annual reporting requirements, the expectation is that the results of monitoring and management will be available in near real-time through the Upper SAR online portal, which will have the ability to generate any one of a variety of reports as needed—including to meet the annual reporting permit requirements.

Management Actions Evaluation. The Alliance will evaluate management actions yearly (or at a frequency determined by the management action) to determine whether changes are warranted based on resource response and/or new information. This evaluation will address progress (positive and negative) toward goals and objectives. Proposed changes will be summarized in the annual report and detailed in the PUPs and associated work plans for the upcoming year.

Monitoring Program Evaluation. The Alliance will evaluate the monitoring program yearly to ensure that data are (1) collected efficiently, (2) address information needs, and (3) adequately assess resource responses to management actions. Changes in monitoring methods, protocols, or frequency will be summarized in the HCP Annual Report and detailed in the PUPs and associated work plans for the upcoming year.

Goals and Objectives Evaluation. The Alliance, in consultation with the Wildlife Agencies, will evaluate monitoring or management results that indicate that conservation actions are not meeting the HCP goals and objectives. Where the cause of poor performance is understood, prescriptive actions will be implemented, including (but not limited to) adjusting success criteria based on monitoring data or other scientifically defensible sources of information, or implementing alternative management actions.

Conceptual Models Update. Based on results from monitoring or other sources (e.g., literature reviews, species experts, science advisors, other Preserve Managers, and the Wildlife Agencies), the Alliance will update conceptual models, as appropriate, to reflect new information and guide future monitoring and management. Information that results in changes to underlying assumptions or hypotheses may warrant changes in monitoring and/or management. Revised conceptual models (including documentation of changes) will be included in the HCP Annual Report.

Coordination. The Alliance will promote coordination among Preserve Managers in the region and within Southern California to ensure that results of monitoring and management are shared and to encourage consistency in goals, objectives, monitoring methods, and monitoring priorities. Forums for coordination may be annual or bi-annual meetings or regional workshops. The Upper SAR online portal is planned and expected to be a hub for science and collaboration, and will be an important tool to enhance coordination and data sharing across the region.

Funding. The support required for an adaptive approach includes not only funding for monitoring and evaluation but also an investment in inclusive and robust decision-making processes. The Alliance have included adaptive management as part of the formula for determining long-term funding requirements on the HCP (see Chapter 7. *Funding*). Identification of a long-term funding mechanism demonstrates the Alliance's commitment to adaptive management, and it strengthens the planning and implementation approach for successful adaptive management (Williams et al. 2009). Management and monitoring objectives and budgets should be formulated on a 5-year schedule, and adjusted as necessary annually.

Uncertainties

Sources of uncertainty will be identified through the site evaluation process and visualized through conceptual models. Types of uncertainty may include (1) effectiveness of management actions, (2) relationship between resource function and threats and stressors, and (3) larger ecosystem processes (e.g., annual variations in climate and climate change). Although many of these uncertainties may be addressed and reduced through HCP Preserve System-level management and monitoring, others are best addressed at regional or landscape-levels. For the latter, external sources (e.g., literature, regional monitoring programs) may be useful in understanding and reducing uncertainties.

Research Needs

Potential research needs will be identified through site evaluation, development of conceptual models, and responses to management actions. Appropriately structured monitoring programs are expected to answer some research questions, particularly those that have a direct bearing on management. The Alliance will ensure that HCP Preserve System-level data are available for analysis by other management entities or researchers focused on key management questions. The HCP conservation strategy already includes an important research component (Section 5.7, *Species and Habitat Research*). The Alliance will continue to encourage research on the HCP Preserve System

lands by qualified (and funded) researchers where these efforts benefit Covered Species and protected biological resources.

5.12.3 Management of the HCP Preserve System

In order to maintain and enhance the quality of the conserved habitats within the HCP Preserve System, the Alliance will implement regular management activities with an adaptive management approach when monitoring efforts show that regular management methods are not maintaining the habitats in a condition to provide benefits to the Covered Species. The HCP Preserve Management Committee will be consulted regularly to advise on questions related to the establishment and long-term management of the HCP Preserve System. This section describes several management programs that will be developed and implemented as appropriate throughout the HCP Preserve System.

Invasive Species Control and Management (CAMMP 1)

Invasive species control and management is typically the most labor-intensive and costly component of preserve management. Aquatic species make up a significant portion of the Covered Species and are threatened by nonnative aquatic predators. Similarly, exotic nonnative invasive plant species are a persistent threat to the integrity of native habitats throughout the Planning Area. Lastly, cowbirds are brood parasites, reducing nesting success by leaving their eggs in the nests of other species, including the coastal California gnatcatcher and least Bell's vireo.

To address this persistent threat, the CAMMP will include an Aquatic Predator Control Program to monitor the presence of and remove aquatic predators, an Exotic Vegetation Management Program to monitor the distribution of and manage nonnative plants throughout the HCP Preserve System, and a Cowbird Management Program. The invasive species control and management provided by these programs are described briefly below.

Aquatic Predator Control Program (CAMMP 1A)

The primary purpose of the Aquatic Predator Control Program is to reduce the abundance of nonnative predators in areas occupied by native fish and other aquatic species to maximize the aquatic Covered Species survival and reproduction. The program will be implemented in order to offset the potential increase in nonnative predator habitat (pools or other microhabitats that provide relatively deep and slow velocity water flow) resulting from the effects of Covered Activities that reduce flow volume in the reaches occupied by aquatic Covered Species.

The nonnative predator removal program will be focused on reducing the abundance of nonnative aquatic predators immediately preceding the start of the Santa Ana sucker spawning season (approximately February 16). Species to be removed may include nonnative fish, nonnative amphibians, and nonnative reptiles such as mosquitofish, largemouth bass, black bullhead catfish, green sunfish, African clawed frog, American bullfrog, and red-eared slider. This activity will occur at minimum one time per year outside of the sucker spawning season (August 1 to February 15). The locations of where to conduct electroshocking and aquatic predator removal will be based on the most recent fish and/or other surveys conducted upstream of Prado Basin in the Santa Ana River as well as at the tributary restoration sites. Pre-spawning predator removal will occur annually prior to February 15 in areas of highest ecological value to Santa Ana sucker reproduction. If many aquatic predators are found during the pre-spawning predator removal another predator

removal effort will be conducted after August 1. While the aquatic species predator control is focused on removing threats to the Santa Ana sucker, all of the other aquatic Covered Species will also benefit from these actions. The Aquatic Predator Control Program will be developed as a component of the overall CAMMP.

Exotic Weed Management Program (CAMMP 1B)

The primary purpose of the Exotic Weed Management Program is to maintain a low abundance and cover of nonnative vegetation in all Preserve Units of the HCP Preserve System (Restoration Areas and Conservation Areas). The program will focus on the removal of giant reed, tamarisk, and castor bean in riparian areas and on the removal of nonnative grasses in upland habitats areas of alluvial fan sage scrub throughout the HCP Preserve System. The Exotic Weed Management Program will be developed as a component of the overall CAMMP.

Cowbird Management Program (CAMMP 1C)

Cowbird trapping and management will be conducted in and adjacent to identified habitats for the yellow-breasted chat, coastal California gnatcatcher, southwestern willow flycatcher, and least Bells' vireo when surveys indicate control measures are warranted. Trapping will be conducted by qualified biologists. The Cowbird Management Program will be developed as a component of the overall CAMMP.

Basin Sediment Management Program (CAMMP 2)

To mitigate the temporary capture of sediment in basins, the basins will be managed as a part of a Basin Sediment Management Plan, which will require sediment be periodically excavated from basins to maintain basin capacity and then be sorted with suitable substrate and deposited downstream of each basin to allow continued transport along the tributary and into the Santa Ana River. The Basin Sediment Management Plan will be developed as a component of the overall CAMMP.

Encampment Prevention and Removal (CAMMP 3)

People living in public rights-of-way or in natural open space or recreational areas are a problem for natural habitat and Covered Species as well as a public safety concern along the Upper Santa Ana River throughout the Planning Area. Encampment sites contain garbage, structures such as trailers, vehicles, solar panels, electronic devices, fencing, and other materials. Removal efforts include fuel extraction from the vehicles prior to hauling them offsite to avoid polluting water during transport as well as trash and hazardous materials removal, and other disturbances associated with physically relocating people and their belongings from the site.

The CAMMP will include an Encampment Prevention and Removal Strategy that will focus on prevention of encampment establishment rather than cleanup and removal as the most cost-effective means to protect and maintain habitat values. Monitoring the Santa Ana River and other protected areas will attempt to prevent individuals from building semi-permanent structures and other activities that degrade habitat value. The Encampment Prevention and Removal Strategy will include procedures to coordinate with local jurisdictions and law enforcement who would work to prevent and deter people from building encampments and polluting public areas while also providing services to help them improve their circumstances. It is anticipated that implementation

of the HCP will continue to require some routine cleanup and maintenance even after the initial removal of encampments.

5.12.4 Monitoring of the HCP Preserve System

Recent guidance for regional conservation planning defines monitoring as the "systematic and usually repetitive collection of information typically used to track the status of a variable or system" (Atkinson et al. 2004). The monitoring program will provide the information necessary to assess HCP compliance and Covered Activity effects, verify progress toward achieving the biological goals and objectives, and provide the scientific data necessary to evaluate the success of the HCP's conservation strategy. The Alliance will monitor resources at the landscape, community, and species levels as appropriate and directly relevant to the HCP goals and objectives. In addition to these levels, the Alliance will conduct three main types of monitoring: compliance monitoring, effectiveness monitoring, and targeted studies. All monitoring will be planned and conducted to support and inform the adaptive management approach of HCP implementation. A description of each of these types is provided below.

The monitoring guidelines presented in this section will help the Monitoring Biologist and the Alliance collect the appropriate data to ensure that the goals and objectives of the HCP and individual conservation and restoration sites are met, determine if HCP Preserve System management strategies are having the desired effect, and evaluate if underlying biological assumptions are supported by field-collected data. These guidelines include the following activities:

- Tracking the distribution and condition of natural communities and habitats throughout the HCP Preserve System.
- Periodic monitoring of Covered Species to determine presence/absence and/or relative abundance and distribution within the HCP Preserve System over time.
- Monitoring to evaluate effectiveness of specific management actions.
- Identifying and monitoring threats to habitat condition and to Covered Species, including introduction or spread of invasive species and other edge effects.
- Monitoring the effects of public use, encroachment, and other activities within and adjacent to the conservation and restoration sites.

Biological monitoring measures the effectiveness of the overall conservation approach, supports informed adaptive management decisions, assists in defining and modifying biological goals and objectives, and provides the Alliance and Wildlife Agencies with information to conduct assessments of baseline conditions and species status.

The Alliance, in consultation with the Wildlife Agencies, will identify the appropriate types of monitoring to address management questions and select monitoring methods that align with goals and objectives. In some cases, consultation with species experts or experts in monitoring or sampling design may be necessary.

Phases of Monitoring the HCP Preserve System

Table 5-28 provides a summary of monitoring tasks in each phase of HCP implementation. A more detailed description of the HCP phases is found in Section 5.4.1, *Phases of HCP Preserve System Implementation*.

Table 5-28. Expected Monitoring Task by Phase

Monitoring Type/Phase	Summary Tasks
Phase 1	**Years 1–5**
Compliance	Set up tracking databases for impacts, acquisition, creation, and restoration.
Inventory	Initiate inventories in the HCP Preserve System.
	Develop reserve unit management plans with input from the Technical Advisory Committee and Wildlife Agencies within 5 years of the first acquisition for each reserve unit, or the issuance of the Permit, whichever is later. Each plan will contain a detailed monitoring and adaptive management plan; including the development of indicators, monitoring protocols, and success criteria for management actions.
	Prioritize conservation actions within each Preserve Unit and the Planning Area.
Targeted Studies	Develop conceptual models for Covered Species that identify critical management uncertainties.
	Prioritize and initiate pilot projects.
	Prioritize and initiate directed studies.
Long-term Monitoring	Develop experimental design for long-term management activities such as restoration and include as part of Preserve Unit management plans.
Phase 2	**Years 6–10**
Compliance	Continue tracking impacts, acquisition, creation, and restoration. Ensure that mitigation stays ahead of impacts.
Inventory	Continue baseline inventories as sites are added to the HCP Preserve System.
Targeted Studies	Complete pilot projects.
	Continue directed studies every five years from initialization of study.
Long-term Monitoring	Update GIS layer (every 5 years) and assess trends.
	Monitor Covered Species response to management actions.
	Monitor Covered Species using methodologies developed in targeted studies phase.
	Review existing literature and scientific knowledge and make changes to monitoring and management based on new information.
Phase 3	**Years 10–15**
Compliance	Continue tracking impacts, acquisition, creation, and restoration. Ensure that mitigation stays ahead of impacts.
Inventory	Continue baseline inventories as sites are added to the HCP Preserve System.
Targeted Studies	Complete targeted studies.
Long-term Monitoring	Continue to assess status and trends of Covered Species.
	Adapt management actions based on monitoring results of species response and success criteria for restoration and other management efforts.

Monitoring Type/Phase	Summary Tasks
	Continue to monitor Covered Species and adaptively manage species in response to monitoring results.
	Evaluate efficacy of monitoring protocols using results of pilot projects.
Phase 4	**> Year 15**
Compliance	Finalize impact tracking. Maintain database of any active ongoing mitigation.
Inventory	Finalize baseline inventories of parcels acquired after Year 15.
Long-term Monitoring	Continue to assess status and trends of Covered Species.
	Based on 15 years of implementation, develop reduced monitoring protocols for target species and/or communities.
	Promote directed studies in the HCP Preserve System that benefit Covered Species.

The Alliance is not responsible for collecting additional biological monitoring data (outside of the HCP Preserve System) for regional assessments but may contribute to such efforts, as appropriate and feasible, through the collection of comparable data. Data comparability will be facilitated through regular interaction with the Wildlife Agencies and Preserve Managers in other HCP areas to support the use of similar methods, coordination of survey schedules, and other relevant efforts regarding monitoring issues. The Alliance will provide access to the HCP Preserve System for other entities to collect regional biological monitoring data, as appropriate, and will submit HCP Preserve System data to an appropriate data repository, such as BIOS, CNDDB, or other regional databases.

Compliance Monitoring

Compliance monitoring, also known as implementation monitoring, is a process used to ensure that the conservation strategy is implemented in accordance with HCP incidental take permit requirements. Compliance monitoring provides information that allows the Wildlife Agencies to track HCP implementation. Key elements of compliance monitoring will include the following.

Tracking Impacts. The Alliance will be responsible for collecting and maintaining information that tracks impacts on natural resources resulting from Covered Activities to ensure that the amount of impacts that ultimately occur under the HCP stays below the amount of impacts estimated during HCP development. The Alliance will track impacts from Covered Activities for the following areas: (1) ground-disturbing impacts on modeled habitat for Covered Species; (2) hydrology impacts on aquatic habitat conditions for covered fish species; (3) hydrology impacts on sediment transport effects on aquatic habitat substrates and alluvial fan sage scrub ecological processes; and (4) impacts on groundwater-dependent ecosystems from altered hydrology. The Alliance will use this information to make sure the HCP maintains a rough proportionality of project impacts with conservation measures (see Table 5-4). The Alliance will also review each new Covered Activity proposed by Permittee Agencies before implementation to ensure it is in compliance with the HCP conditions (see *Project Consistency Review* in Section 6.5.2).

Oversight of Preserve System Management and Monitoring. The Alliance will actively coordinate with local agencies and law enforcement, and direct the HCP Preserve Manager in addressing the variety of issues related to public access, enforcement, adaptive management, and

funding. In addition, the Alliance will host bi-annual meetings involving the HCP Preserve System Manager, Monitoring Biologists, the HCP Administrator, and the Wildlife Agencies where implementation, policy, and technical issues of HCP Preserve System management will be addressed.

Tracking and Facilitation of Restoration Project Implementation. The Alliance will provide oversight and tracking of the restoration sites implemented under the HCP to ensure the restoration projects meet the following criteria under the Plan:

- The restored habitat meets final success criteria identified in final HMMPs approved by the Wildlife Agencies. The Wildlife Agencies will be responsible for the review and approval of restoration projects to sign off that success criteria has been met.
- The restored habitat is conserved through an existing real estate protection instrument or (as necessary) through a new conservation easement, deed restriction, or other mechanism approved by the Wildlife Agencies.
- The restoration site will be managed in accordance with activities outlined in an existing management plan or conservation easement that defines the role for managing the biological values of the restoration project location.
- When the restoration site has met its success criteria and received final sign off from the Wildlife Agencies, it will transition from management and monitoring under the HMMP into the CAMMP for long-term monitoring, management, and maintenance.

Groundwater Dependent Ecosystem Monitoring Program. The Alliance will develop a monitoring program to track both the shift of groundwater and any subsequent shifts to wetter or dryer habitat types due to changes in the depth to groundwater. Groundwater monitoring will generally be completed with a series of monitoring wells to determine the depth to groundwater along a gradient within sections of riparian habitat. The extent and health of groundwater dependent ecosystems will be completed through mapping and rapid assessments (such as RipRAM) of these habitats. The results of groundwater monitoring will be incorporated into the tracking of impacts and may trigger adaptive management measures if greater than anticipated impacts on groundwater-dependent ecosystems are observed. The Groundwater Dependent Ecosystem Monitoring Program will be developed as a component of the overall CAMMP.

Annual Reporting. The Alliance will prepare an annual report summarizing activities over the reporting year. A public meeting on the report will be held in conjunction with the report submittal. The annual report will include descriptions and location of Covered Activities completed, summary of any minor or major amendments, summary of impact tracking, status of HCP Preserve System management and monitoring, status of restoration projects, and summary of Plan funding. While static hard copy reports would be sufficient to meet the annual reporting requirements, the expectation is that the results of monitoring and management will be available in near real-time through the Upper SAR online portal, which will have the ability generate any one of a variety of reports as needed—including to meet the annual reporting permit requirements.

Inventory Monitoring

Each property added to the HCP Preserve System will be surveyed to identify and map habitat species occurrences, and triggers for management actions such as invasive species populations or encampments. Inventory monitoring will also make note of any facilities or infrastructure on the

site, their conditions, and their conservation benefits. This information, and site-specific directives specified in the PUPs, will inform the management of the site. Inventory monitoring includes the following monitoring actions:

- **Initial Reconnaissance Monitoring.** The site reconnaissance identifies survey needs, priorities, and a proposed timeframe (e.g., for Covered Species), identifies appropriate land uses and roads or trails that should be closed, and identifies immediate management and maintenance needs (e.g., fencing, runoff from adjacent properties, invasive species, removal of structures or trash).
- **Baseline (Inventory) Monitoring.** Baseline monitoring establishes conditions at a given point in time. This monitoring requires biological expertise and will be conducted by the Monitoring Biologist. It is a one-time event that characterizes the status of conserved resources, as well as threats and stressors, for planning or future comparisons.
- **General Stewardship Monitoring.** General stewardship monitoring identifies general management issues and documents whether management actions are carried out as planned. This monitoring is used for general land management activities (e.g., trail closures, erosion control, fence repair, signage installation, routine invasive plant inventory and control). General stewardship monitoring may commence upon HCP Preserve System acquisition and does not generally involve an adaptive management component because uncertainty in management outcomes is low and BMPs are available to address the issue(s) of concern. The Preserve Manager will conduct general stewardship monitoring visits (monthly or as appropriate) in each Preserve Unit as part of their ongoing responsibilities and will report any issues to the Alliance within 1 week of discovery. As part of general stewardship monitoring, the status and identified threats to biological resources in the Preserve Units will be recorded.

Effectiveness Monitoring

Effectiveness monitoring assesses the biological success of the Plan. Effectiveness monitoring evaluates whether the effects of implementing the HCP conservation strategy are consistent with the assumptions and predictions made during development of the HCP (USFWS and NMFS 2016). Effectiveness monitoring is used to assess whether implementation of the conservation strategy is achieving the HCP's biological goals and objectives. Effectiveness monitoring typically measures the effects of management actions on targeted habitats (e.g., cover of invasive plants in riparian areas before and after treatment) and Covered Species (e.g., status of least Bell's vireo on the HCP Preserve System), and status and trends of stressors to the biological resources (e.g., distribution of invasive species) (Atkinson et al. 2004). To conduct effectiveness monitoring, biological expertise in the resources is necessary to develop thresholds of success for management actions and to then assess if the thresholds are being met. These may include quantitative measures such as percent cover of invasive species and area of habitat suitable for Covered Species. Quantifying these conditions before and after management is the basis for judging success.

Effectiveness monitoring guidance will be developed by the Alliance to be incorporated into each PUP, including appropriate monitoring for the habitats present in that Preserve Unit: riparian (including floodplain), mainstem Santa Ana River aquatic, tributary aquatic, and alluvial fan sage scrub habitats. The effectiveness monitoring guidance will direct monitoring efforts within those habitat types in each Preserve Unit and across the HCP Preserve System, and will focus on the condition of Covered Species habitats within the HCP Preserve System and the results of management and conservation actions, almost all of which will be implemented within the HCP Preserve System. Wildlife Agencies and the HCP Technical Advisory Committee will have an

opportunity to provide input on and evaluate the proposed effectiveness monitoring and its results. Effectiveness monitoring is tied closely to the HCP goals and objectives. Examples of specific monitoring measures for each habitat type are included in Table 5-29.

Table 5-29. Examples of Potential Effectiveness Monitoring Actions for Each Species and Habitat Type

Habitat	Species	Potential Monitoring Actions
Alluvial Fan Sage Scrub	General	Monitor the vegetation species diversity, nonnative plant cover, total cover, and sediment transport within alluvial scrub habitats. Monitor the effects of vegetation management on known Covered Species populations and reproductive success. Monitor the percent cover of nonnative vegetation and bare ground to determine whether control efforts are successful on an annual basis. If nonnative cover is greater than desired targets, identify management methods to achieve targeted nonnative plant species cover and increase bare ground cover, especially in spring (March or April depending on precipitation) when impacts from nonnative cover on small fossorial mammals (i.e., Los Angeles little pocket mouse) dispersal would be greatest. Bare ground will include those areas without vegetation (dead or alive) and is exposed to direct sunlight (no native shrub component).
	Slender-horned spineflower	Establish monitoring plots and conduct baseline surveys for slender-horned spineflower in suitable habitat. Conduct regular monitoring, as determined in the CAMMP, after baseline surveys are complete. Map the size and extent of each extant patch during the baseline survey and estimate the number individuals from sample quadrats. • After baseline surveys are completed, survey for slender-horned spineflower in permanent and random sampling plots at a frequency described in the management and monitoring plan. • Compare sample plots in management treatment areas to those in untreated areas to assess the results of management actions.
	Santa Ana River woolly-star	Establish monitoring plots and conduct baseline surveys for SARW in the HCP Preserve System. After baseline surveys are completed, survey for SARW in permanent and random sampling plots at a frequency described in the management and monitoring plan.
	California glossy snake	Survey modeled suitable habitat areas at a frequency described in the management and monitoring plan to document species distribution in the HCP Preserve System.

Habitat	Species	Potential Monitoring Actions
	Burrowing owl	Monitor target sites for recolonization of burrowing owl, including the number of burrows and occupancy in burrowing owl habitat.
	Cactus wren	Monitor suitable cactus patches within the HCP Preserve System to benefit cactus wren. Monitor the survivorship, growth, and structure of transplanted cacti to evaluate the efficacy of transplantation and potential benefits to cactus wren.
	Coastal California gnatcatcher	Monitor the HCP Preserve System for presence in suitable CAGN habitat. Monitor Conservation and Restoration Areas expected to provide benefit for CAGN to ensure suitable vegetation structure exists.
	Los Angeles little pocket mouse	Contribute to range-wide surveys for Los Angeles little pocket mouse within the HCP Preserve System. Coordinate with the Wildlife Agencies to assess genetic structure and diversity of Los Angeles little pocket mouse within the HCP Preserve System.
	Western spadefoot	Monitor suitable WESP habitat within the HCP Preserve System for WESP occupancy and suitable vegetation coverage, including vegetation along stream channels and in adjacent uplands. Survey mammal burrows in targeted occupied/potential habitat for WESP.
	San Bernardino Merriam's kangaroo rat	Monitor the percent cover of nonnative vegetation and bare ground to determine whether control efforts are successful on an annual basis. Monitor sediment replenishment sites to evaluate the improvement of SBKR habitat. Contribute to range-wide surveys for SBKR within the HCP Preserve System. Coordinate on research to assess genetic structure and diversity of SBKR within the HCP Preserve System and collaborate on the development of strategies to enhance population genetics for the species.
Aquatic	General	Monitor groundwater levels to assess the potential for losses of surface flow to downwelling (mainstem).
	Santa Ana sucker	Monitor groundwater levels to assess the potential for losses of surface flow to downwelling. Monitor the Santa Ana sucker populations in both the mainstem of the Santa Ana River and in the HCP Preserve System to determine if they are stable or increasing.
	Arroyo chub	Monitor the arroyo chub populations in both the mainstem of the Santa Ana River and in the HCP Preserve System to determine if the population is stable or increasing.

Habitat	Species	Potential Monitoring Actions
	Santa Ana speckled dace	Monitor the Santa Ana speckled dace population reaches where they co-occur with Santa Ana sucker translocation streams to determine if they are stable or increasing.
	Mountain yellow-legged frog	Monitor water quality and quantity of perennial flows in Santa Ana sucker translocation streams to support mountain yellow-legged frog habitat within the HCP Preserve System.
	Western spadefoot	Monitor breeding ponds within the HCP Preserve System for pooled water throughout the western spadefoot breeding period. Monitor breeding ponds for successful breeding (through metamorphosis).
	Southwestern pond turtle	Survey all suitable habitat within the HCP Preserve System to estimate southwestern pond turtle distribution and demographics. Monitor occupied habitat periodically for southwestern pond turtle presence.
	South coast garter snake	Survey all suitable habitat within the HCP Preserve System to estimate south coast garter snake distribution and demographics. Monitor occupied habitat periodically for south coast garter snake presence.
Riparian	General	Conduct compliance monitoring, document the amount of habitat lost from Covered Activities, determine the amount of habitat protected in the HCP Preserve System, and field-verify suitable habitat and conduct surveys to establish a baseline and assess trends. Coordinate with existing efforts in the HCP Preserve System to monitor for presence of shothole borer. Monitor Restoration Areas targeted for riparian bird Covered Species to ensure suitable vegetation structure exists. Monitor the abundance of cowbirds in occupied least Bell's vireo, southwestern willow flycatcher, or yellow breasted chat habitat during riparian bird surveys, and the cowbird trapping rate in cowbird control traps when surveys indicate cowbird trapping is warranted.
	Mountain yellow-legged frog	Monitor for changes to vegetation composition and/or PBFs within mountain yellow legged from habitat.
	Southwestern pond turtle	Survey all suitable habitat within the HCP Preserve System to estimate southwestern pond turtle distribution and demographics. Monitor occupied habitat periodically for southwestern pond turtle presence. Monitor and quantify the effectiveness of created basking sites. Monitor the use of nesting locations to determine factors influencing nest success in areas of known SWPT use.
	South coast garter snake	Survey all suitable habitat within the HCP Preserve System to estimate south coast garter snake distribution and

Habitat	Species	Potential Monitoring Actions
		demographics. Monitor occupied habitat periodically for south coast garter snake presence.
	Tricolored blackbird	Integrate triennial monitoring data from the tricolored black bird statewide surveys to monitor occupancy of breeding sites in the HCP Preserve System and track trends in breeding colony size. Monitor the structure and species composition of suitable breeding colony habitat and the habitat quality in in the HCP preserve System.
	Yellow-breasted chat	Monitor the HCP Preserve System for presence and breeding activity in suitable YBCH habitat. Monitor occupied YBCH habitat in the HCP Preserve System to confirm the vegetation structure and species composition of habitat patches remains suitable for YBCH breeding.
	Western yellow-billed cuckoo	Monitor the HCP Preserve System for presence in suitable WYBC habitat. Monitor Restoration Areas expected to benefit for WYBC to ensure suitable vegetation structure exists.
	Southwestern willow flycatcher	Monitor the HCP Preserve System for presence in suitable SWFL habitat. Monitor Restoration Areas expected to benefit for SWFL to ensure suitable vegetation structure exists.
	Least Bell's vireo	Monitor the abundance of cowbirds in occupied vireo habitat during riparian bird surveys, and the cowbird trapping rate in cowbird control traps. Monitor nesting populations to determine nest success for the benefit of LBVI populations within core areas. If nest success is below a pre-determined threshold, factors adversely affecting nest success will be evaluated and appropriate management actions (such as cowbird control, habitat improvements) will be implemented.

Targeted Studies

Most targeted studies will be implemented to resolve critical uncertainties the resolution of which is required to achieve the HCP goals and objectives. Targeted studies that will be used to inform management decisions are discussed in detail in Section 5.7.

Targeted monitoring may also be used to answer specific management questions (hypotheses) and determine the effect of management actions on target resources. Targeted monitoring will be implemented by the Alliance in coordination with the HCP Technical Advisory Committee and may require additional input from outside experts with respect to sampling design, data collection, and analyses. In addition, results may be used to develop or refine BMPs. Targeted monitoring necessary to address site-specific threats to Covered Species and habitats in the HCP Preserve System will be identified and prioritized as part of the development of individual PUPs or through subsequent stewardship or effectiveness monitoring.

Selecting Appropriate Monitoring Methods

Method selection will be dependent on the monitoring target, as identified through existing protocols or conceptual models. There are many monitoring methods or protocols available to address goals, objectives, and management questions. Different methods may be required for different types of monitoring, and methods should be objective-driven. For example, if the objective is to determine whether a species occurs on the HCP Preserve System, then presence/absence monitoring will suffice. If the objective is to determine whether population size is stable, increasing, or declining over time (trend), full census/total counts, probability sampling (transects, quadrats, trapping lines, grids, visual encounter surveys), or mark-recapture surveys may be required. Further, linking change to specific threats will require some measure or assessment of those threats. For many resources, the monitoring target will be obvious (e.g., the species of concern), although targets may also be other objects of interest (e.g., burrows, nests, tracks). Finally, monitoring protocols should be consistent with other protocols in San Bernardino and Riverside Counties and/or Southern California to facilitate comparison and help inform data analysis.

It is important to point out that all species may not need the same level, frequency, or intensity of monitoring, depending on status and threats. Further, there are some species for which habitat monitoring may be sufficient to determine trends and threats. However, assumptions about species-habitat relations must be supported by data prior to relying on "surrogate" monitoring (Atkinson et al. 2004). Surrogate monitoring is generally more appropriate for widely distributed species that do not require specific vegetation characteristics and would benefit from habitat management.

The Alliance, in consultation with the HCP Technical Advisory Committee, Wildlife Agencies, and other species experts, will review and select the most appropriate monitoring method(s) to address resource-specific management questions. Recommended monitoring methods will be included in the CAMMP and PUPs, although the specific methods will be adapted and revised over time based in monitoring needs, effectiveness, and best available science and technology.

5.13 Recommended Additional Species Conservation Measures

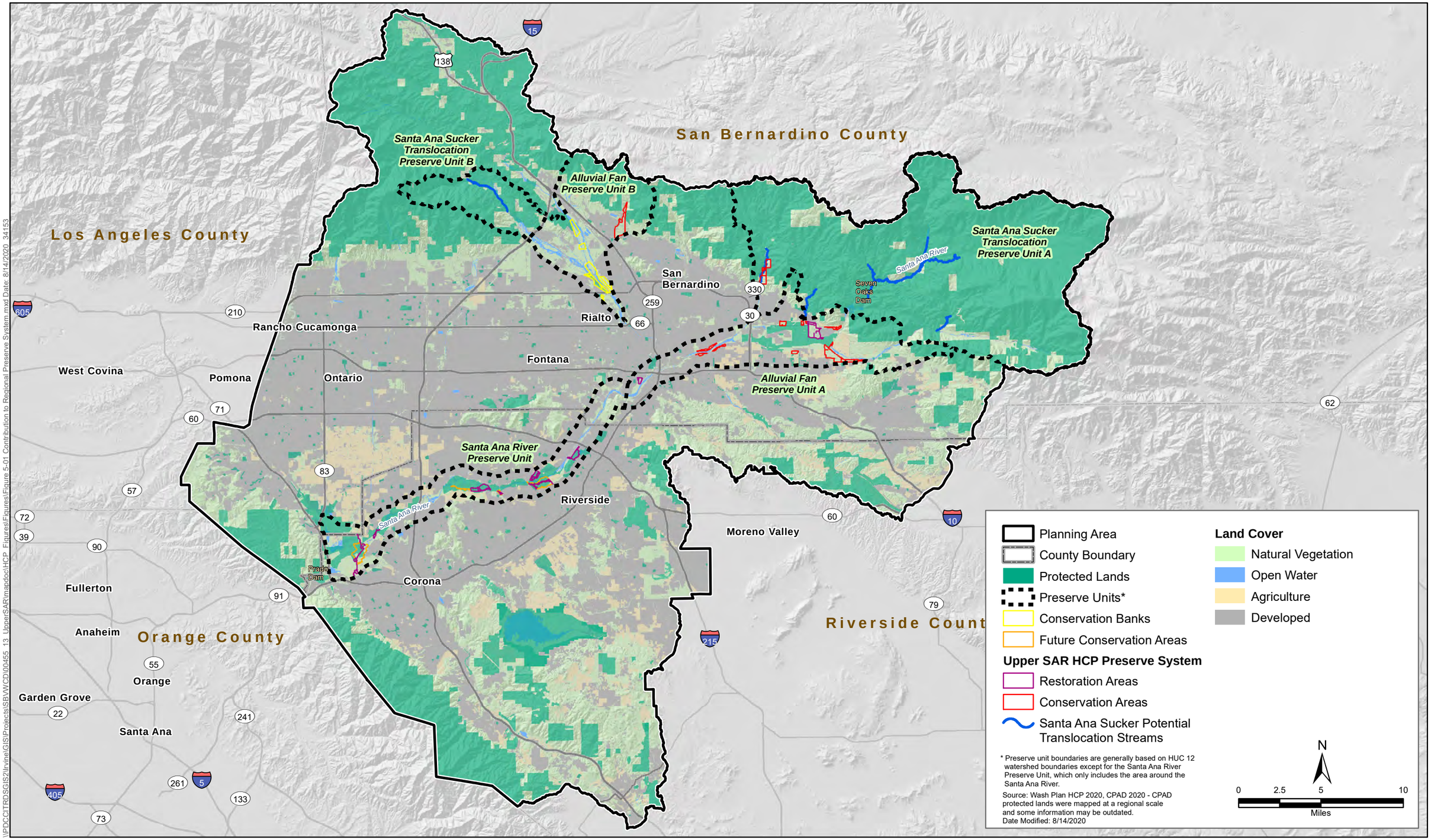
The following conservation measures are not requirements or commitments of the HCP, but are additional measures that are being contemplated and may potentially occur using other funding sources outside of the HCP funding obligations. These additional conservation measures are expected to complement the conservation actions of the HCP, but are not required for the success of the HCP conservation strategy. These include species-specific conservation measures and the implementation of restoration projects in Future Conservation Areas (described in Section 5.4.4).

Santa Ana Speckled Dace

- Study the isolated populations of speckled dace in Lytle, Cajon, Plunge, Mill, Big Tujunga, Haines, and Indian Creeks to maintain a working knowledge of the year-to-year distribution of speckled dace.
- Survey the perennial reaches of Lytle Creek, Plunge Creek, Mill Creek (the spring system at Thurman Flats), Etiwanda, Day, and Cucamonga Creeks for speckled dace.
- Coordinate with researchers and the Wildlife Agencies on management actions that may be needed for the species.

San Bernardino Merriam's Kangaroo Rat

Coordinate with researchers and the Wildlife Agencies to investigate techniques that may be employed to restore or create opportunities for connectivity between SBKR populations isolated from one another due to the presence of infrastructure that poses a barrier to movement.



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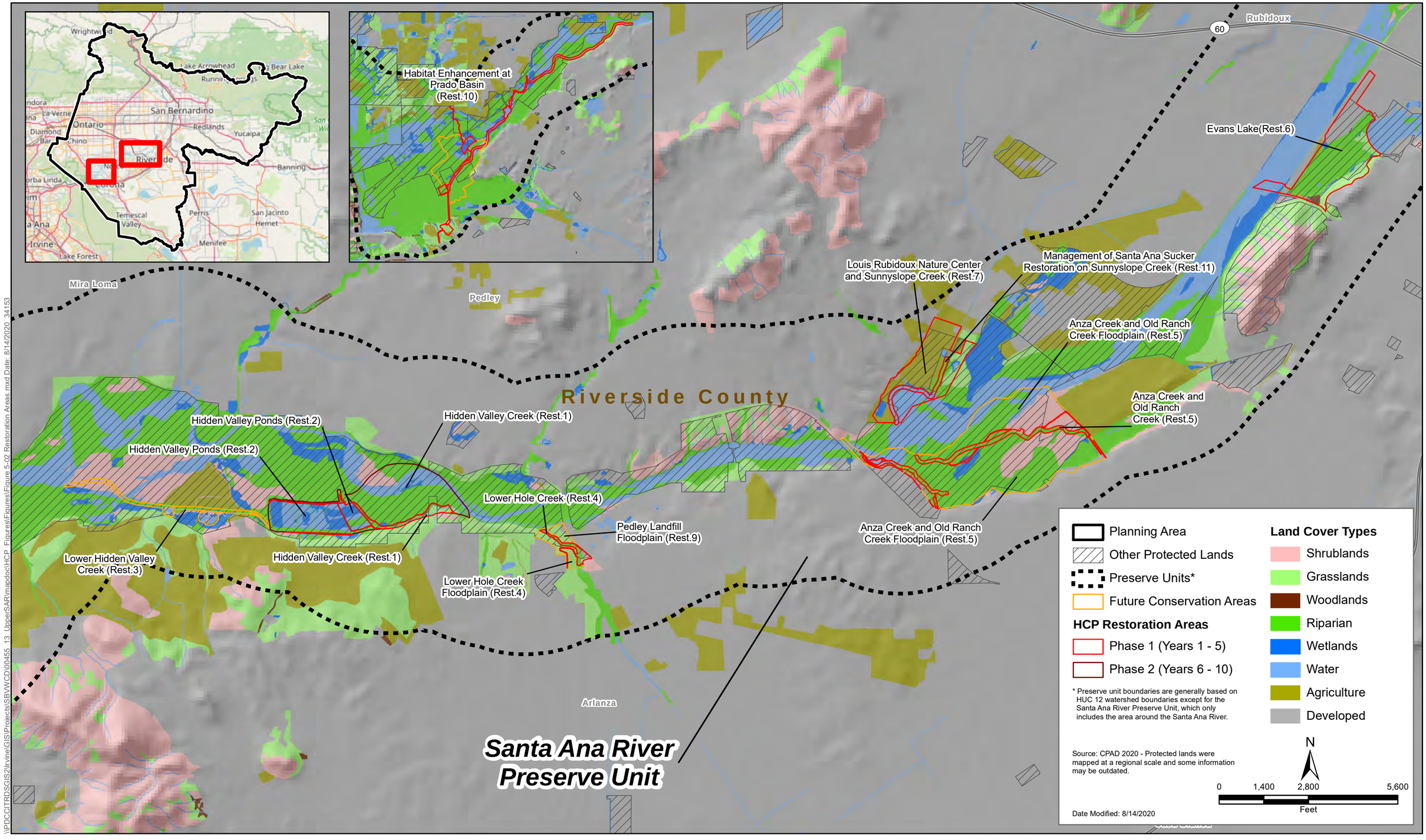
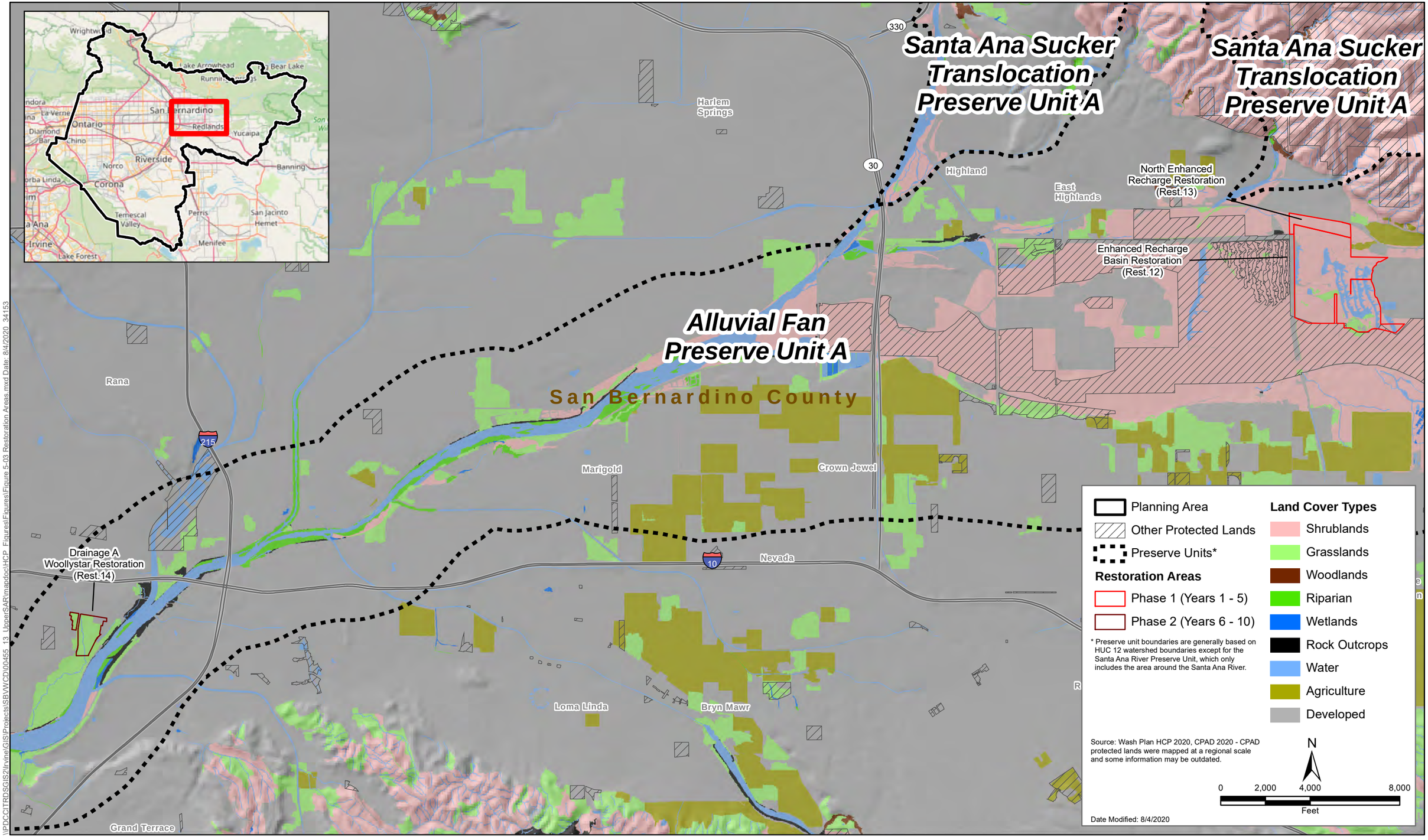
Upper Santa Ana River Habitat Conservation Plan

Figure 5-1
Upper Santa Ana River HCP Preserve System



Upper Santa Ana River Habitat Conservation Plan

Figure 5-2
Stream and Riparian Restoration Areas (Santa Ana River Preserve Unit)



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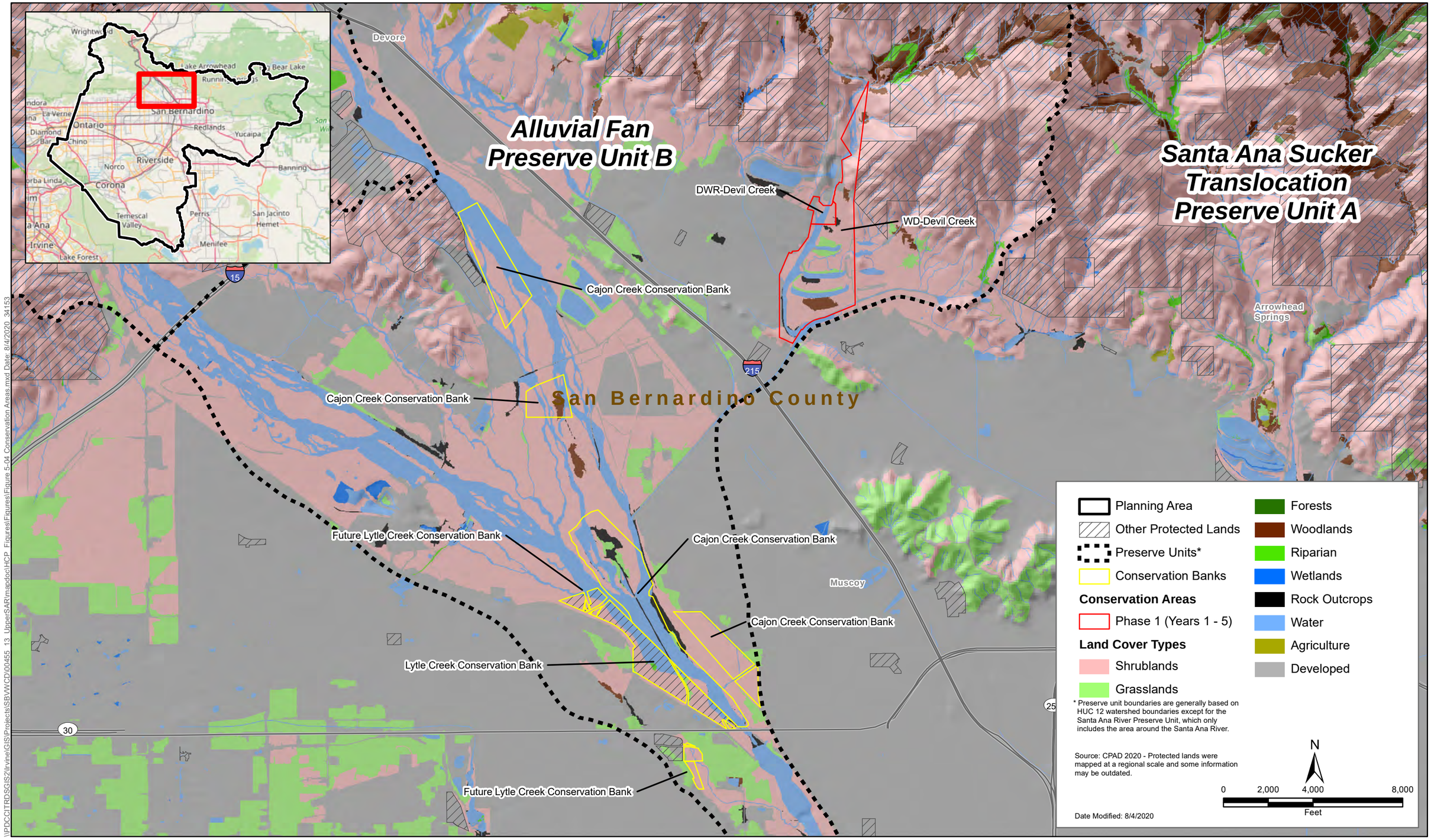
Upper Santa Ana River
Habitat Conservation Plan

Figure 5-3
Alluvial Fan Restoration Areas (Alluvial Fan and Santa Ana Sucker Translocation Preserve Units)



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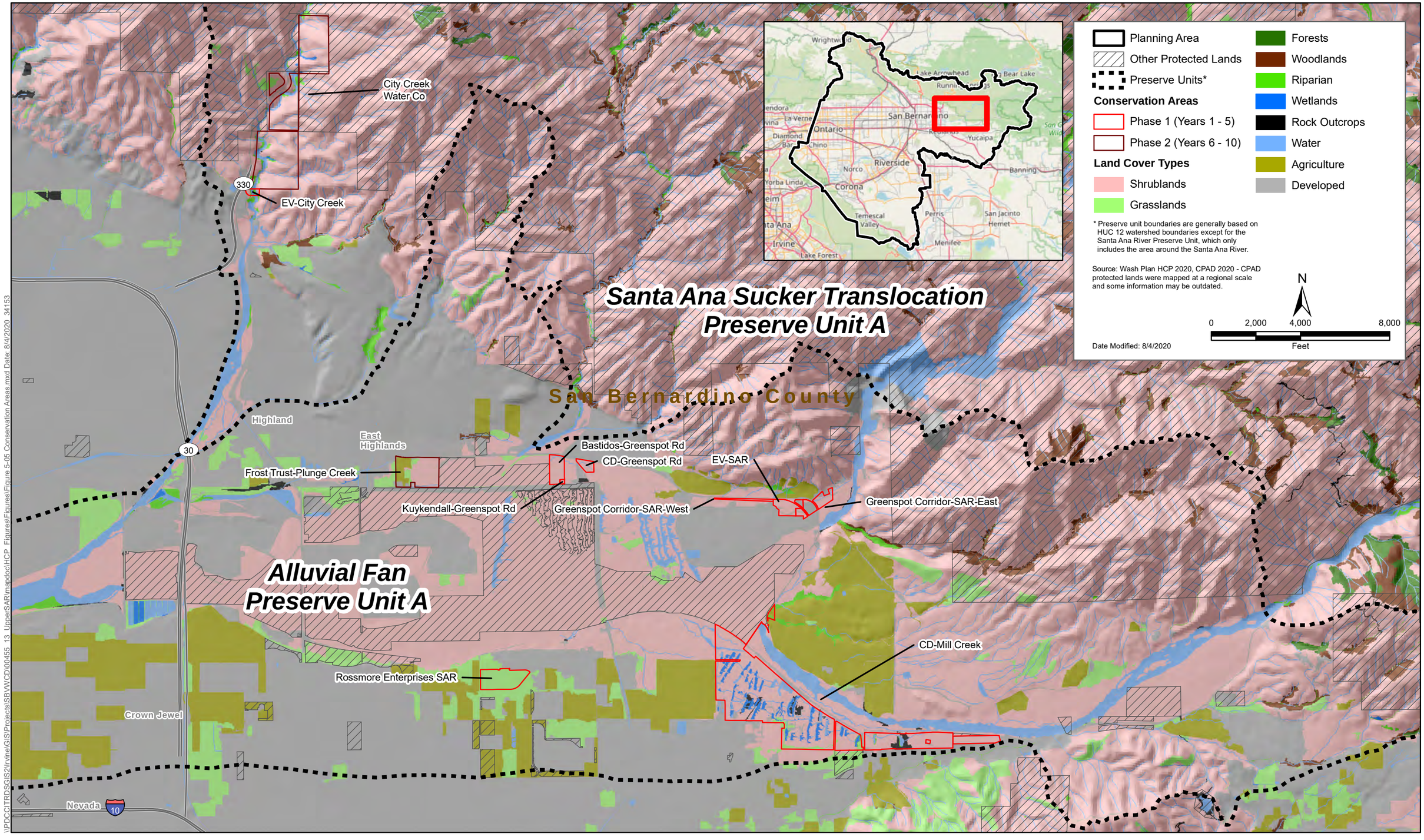
Upper Santa Ana River Habitat Conservation Plan

Figure 5-4
Alluvial Fan and Shrublands Conservation Areas (Alluvial Fan and Santa Ana Sucker Translocation Preserve Units)



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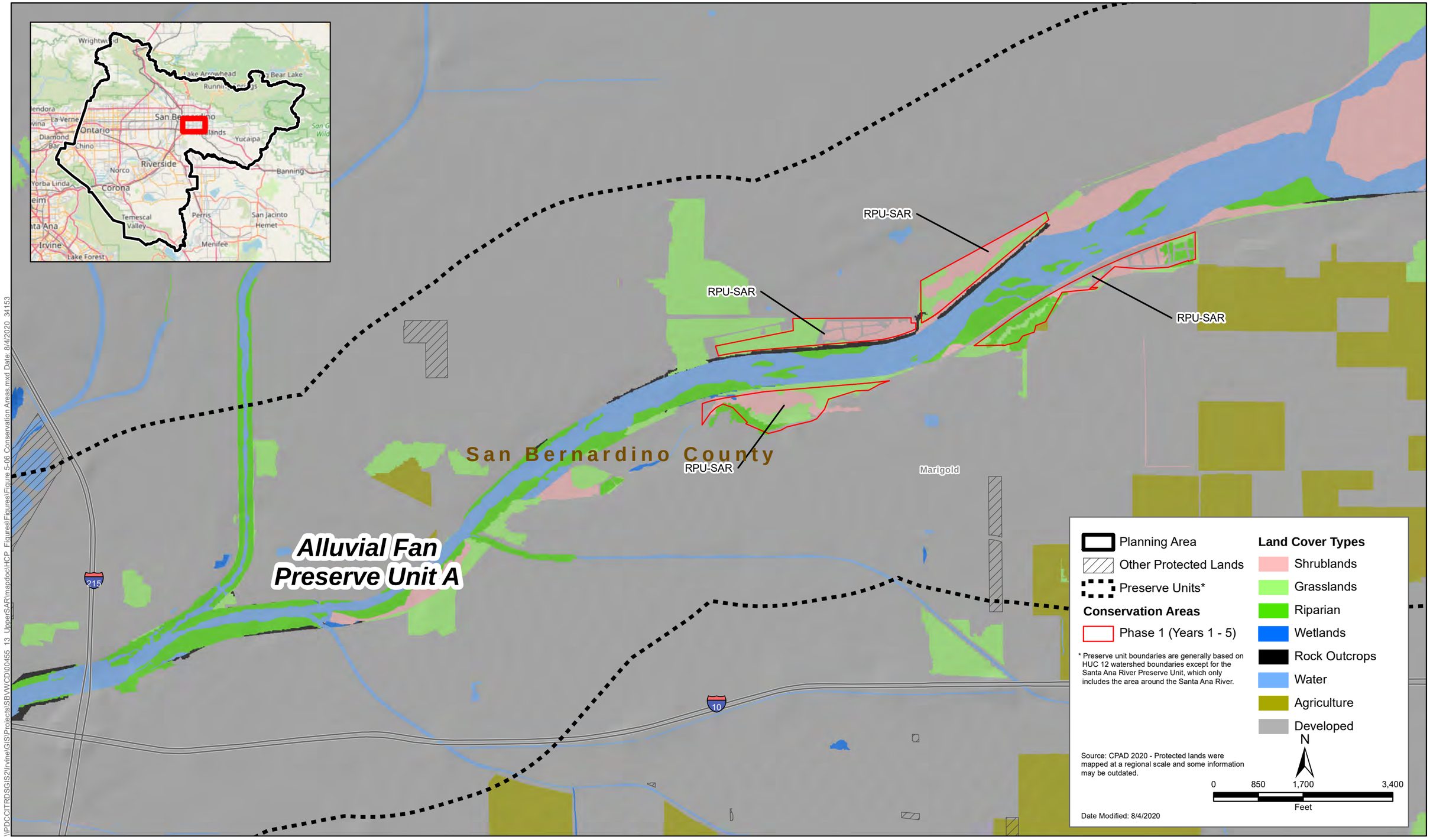
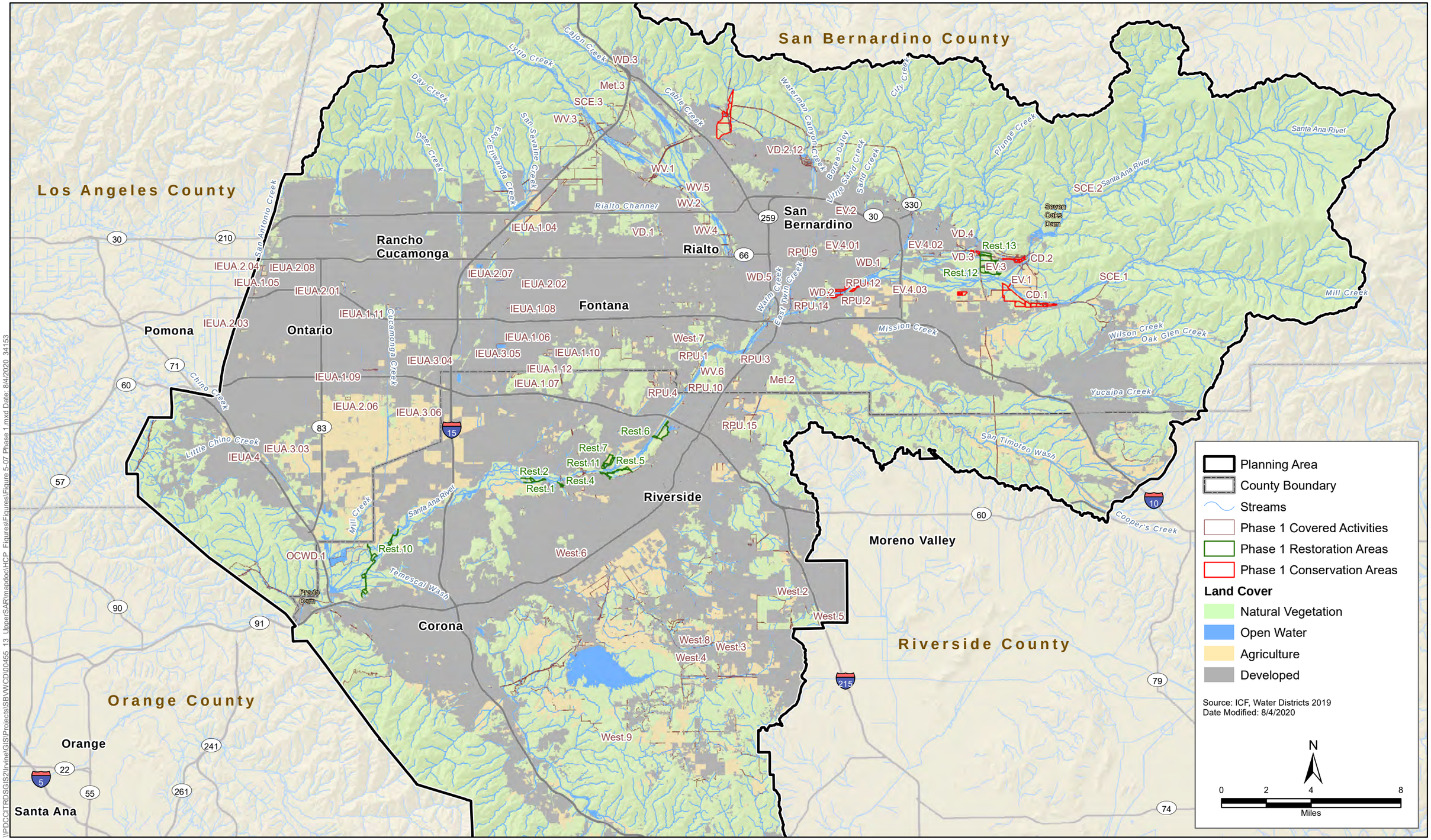
Upper Santa Ana River Habitat Conservation Plan

Figure 5-5
Alluvial Fan and Shrublands Conservation Areas (Alluvial Fan and Santa Ana Sucker Translocation Preserve Units)



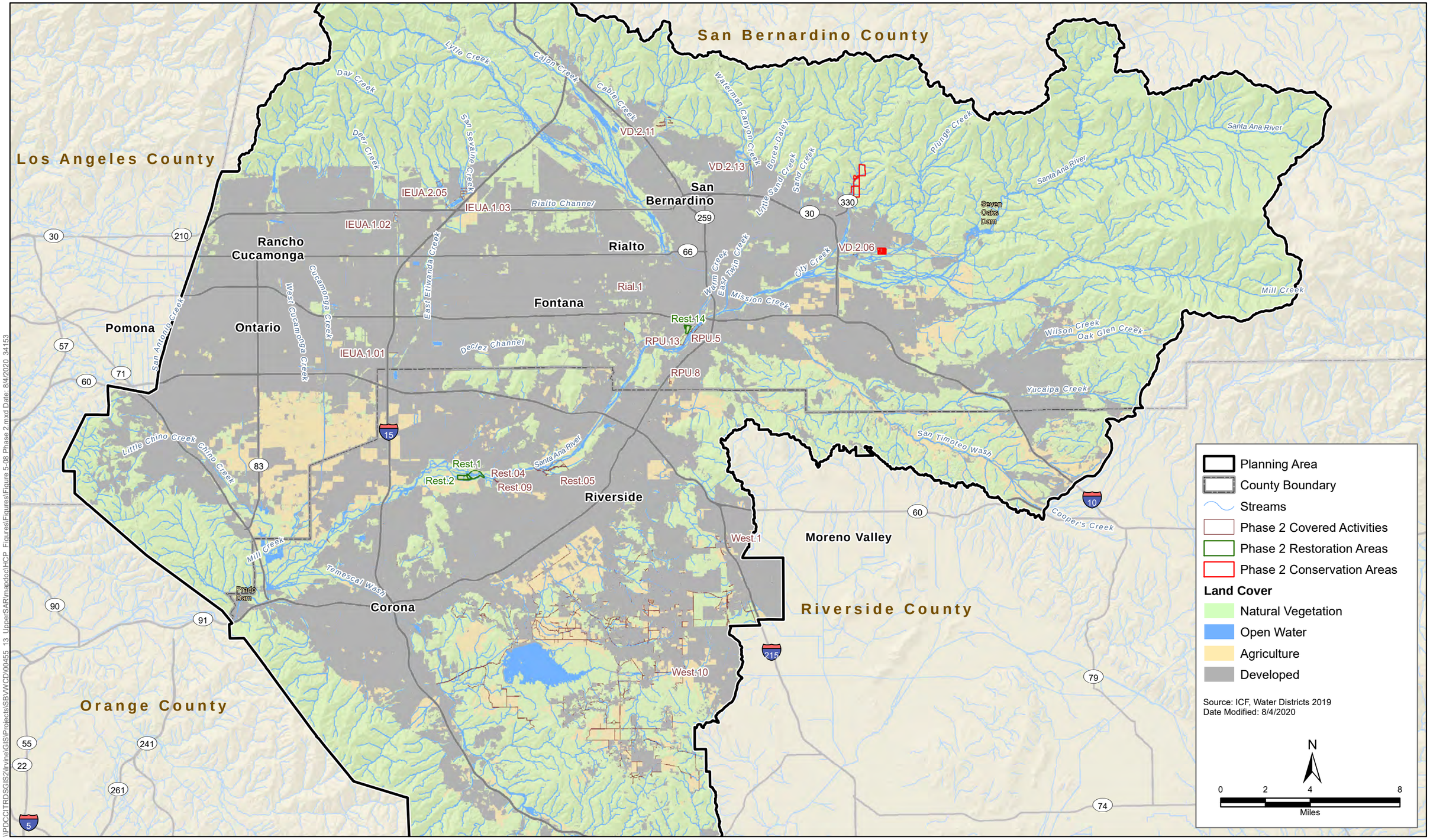
Upper Santa Ana River
Habitat Conservation Plan

Figure 5-6
Riparian and Shrublands Conservation Areas (Alluvial Fan Preserve Unit)



Upper Santa Ana River Habitat Conservation Plan

Figure 5-7
Phase 1: Covered Activities, Restoration Areas, and Conservation Areas



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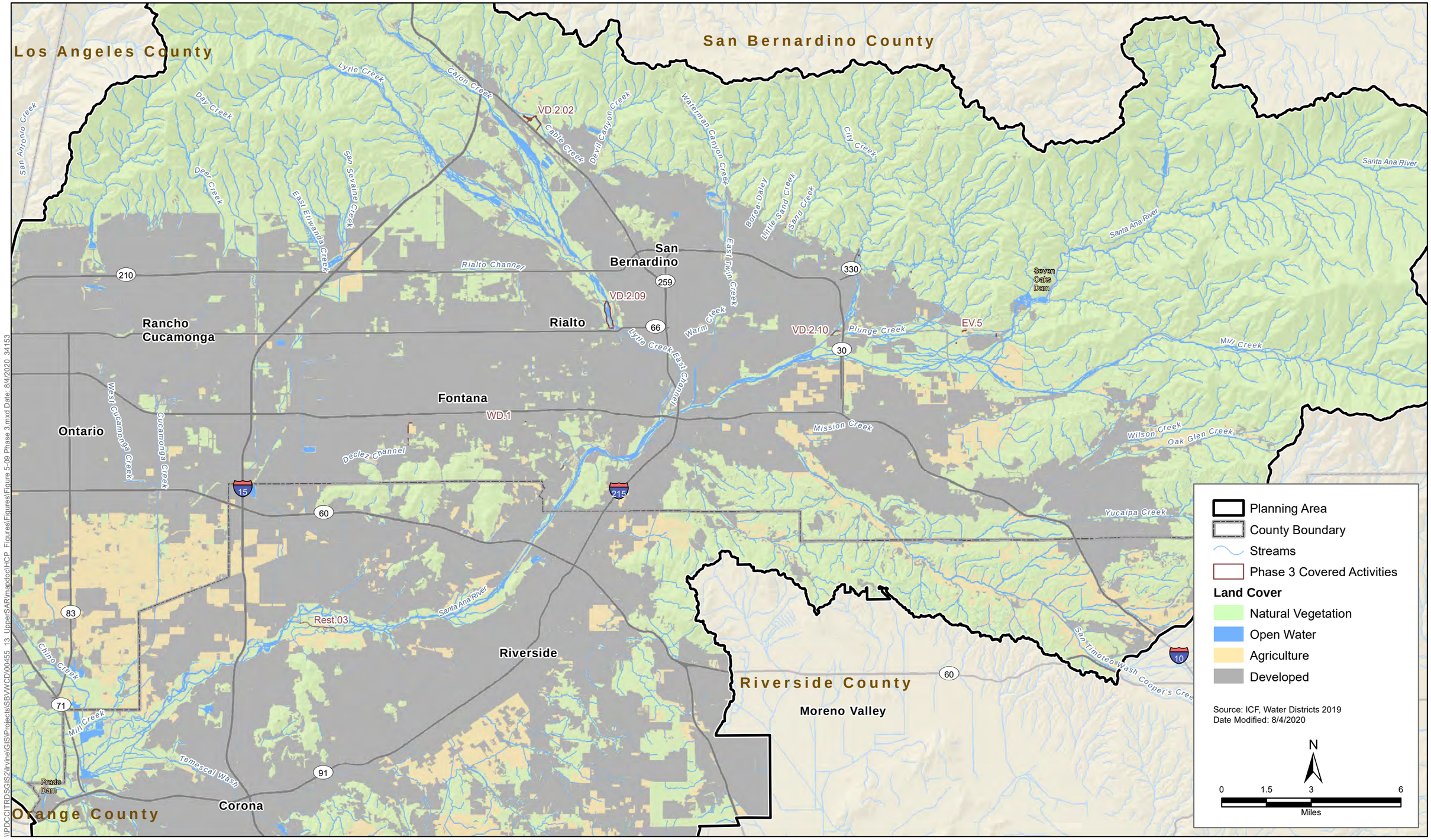
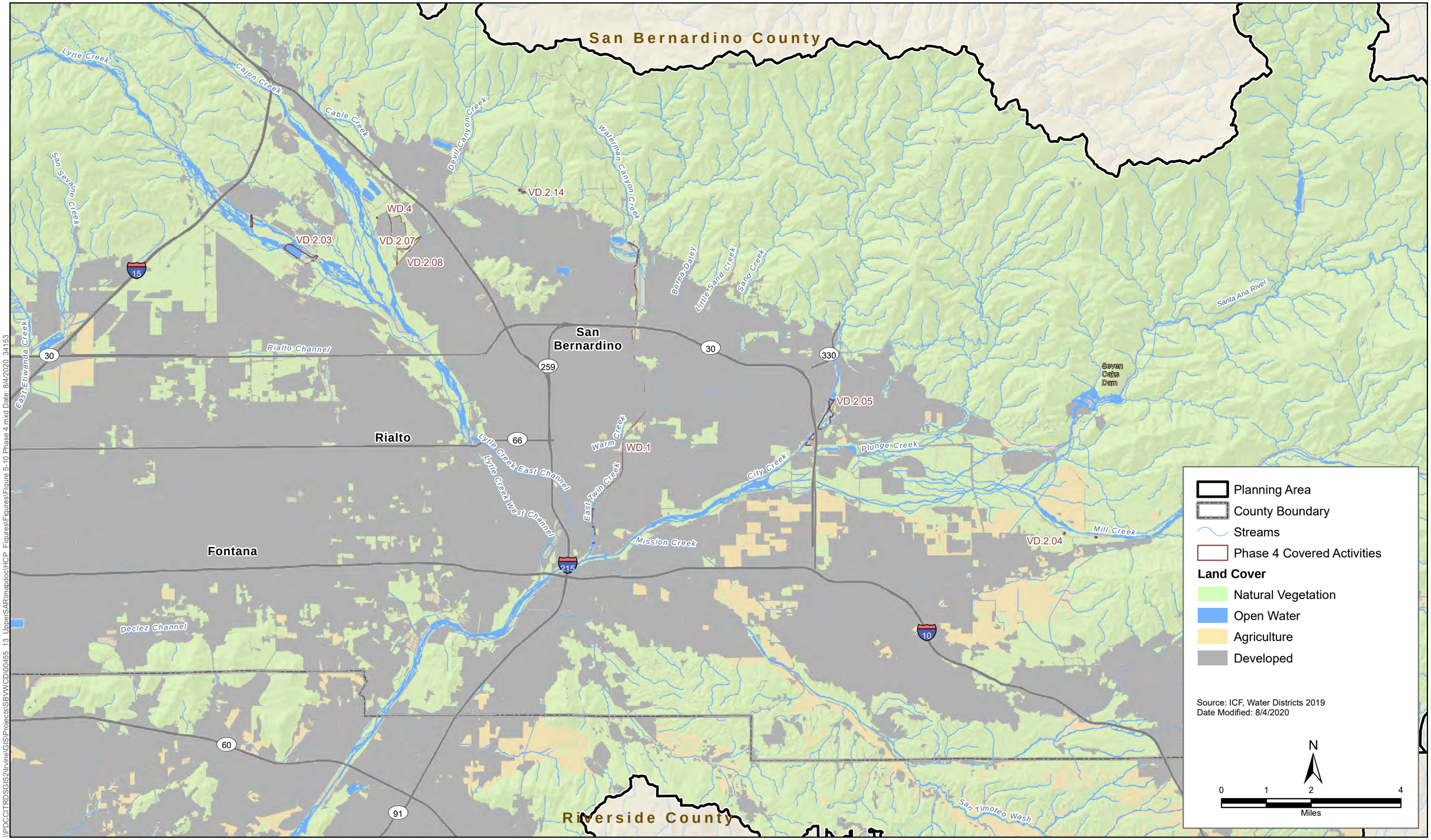
Upper Santa Ana River Habitat Conservation Plan

Figure 5-8
Phase 2: Covered Activities, Restoration Areas, and Conservation Areas



Upper Santa Ana River
Habitat Conservation Plan

Figure 5-9
Phase 3: Covered Activities



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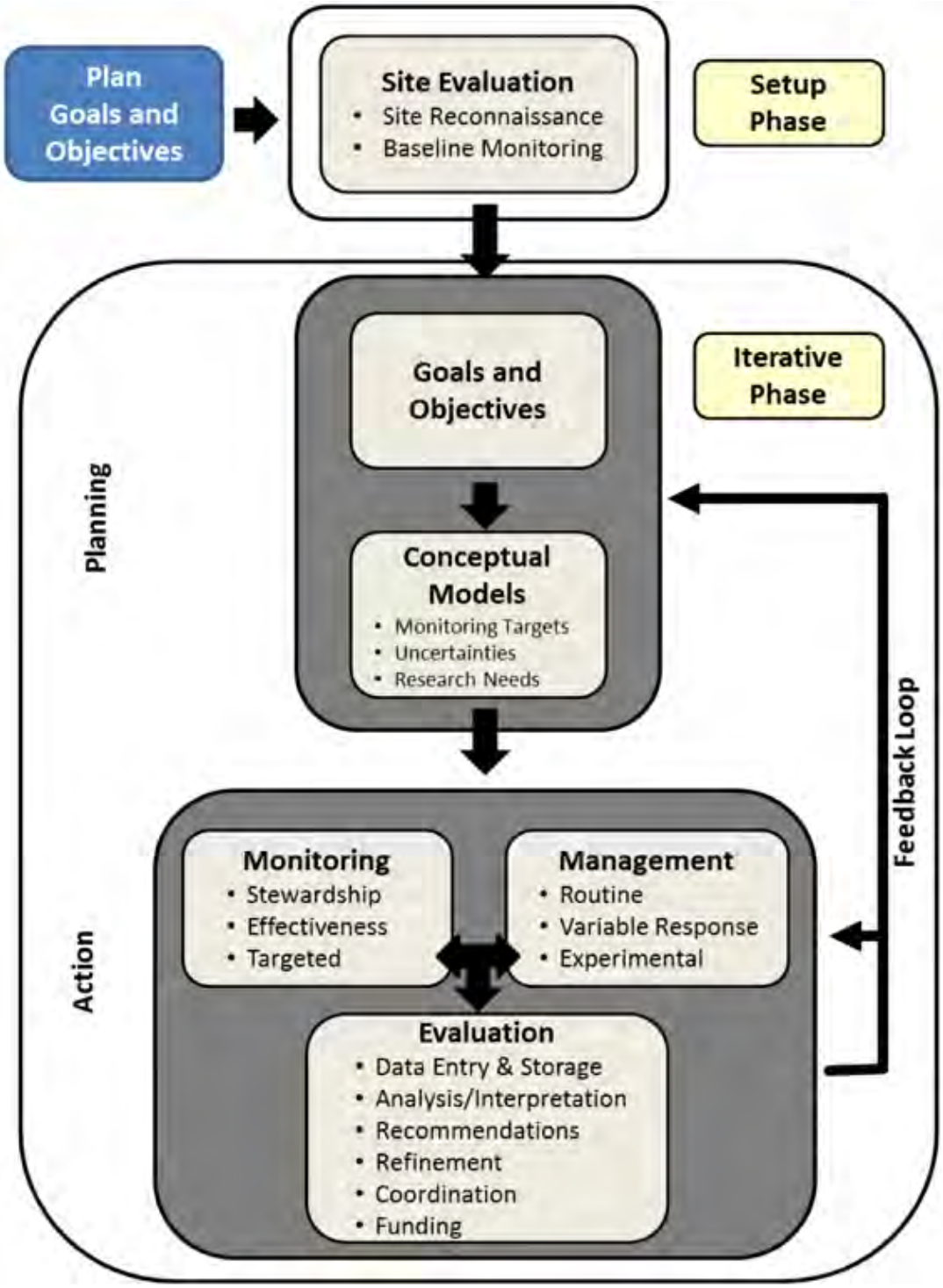
Upper Santa Ana River
Habitat Conservation Plan

Figure 5-10
Phase 4: Covered Activities



Source: Lewison and Deutschman 2014.

Figure 5-11
Adaptive Management Process
Upper Santa Ana River Habitat Conservation Plan

Chapter 6
Plan Implementation

6.1 Overview

The Upper Santa Ana River Habitat Conservation Plan (HCP) Joint Powers Authority (JPA), also referred to as the Upper Santa Ana River Sustainable Resources Alliance (Alliance), will serve as the Implementing Entity of the HCP. As more fully described below, in its role as Implementing Entity, the Alliance will be responsible for implementing the HCP and assisting the other Permittee Agencies in complying with the conditions of the Joint Incidental Take Permit in connection with their Covered Activities.

In many regional HCPs, the Implementing Entity serves as a single Master Permittee that issues certificates of inclusion to other entities who derive their incidental take authority through the Master Permittee. The Upper Santa Ana River HCP follows a different structure in which the Implementing Entity (i.e., the Alliance) and each of other the Permittee Agencies will receive incidental take authority directly from the U.S. Fish and Wildlife Service (USFWS) under a shared, joint incidental take permit (Joint ITP). Under this structure, the Joint ITP will (i) provide coverage to the Alliance for the take of species incidental to the Alliance's implementation of the conservation strategy (e.g., for restoration or other physical work) and (ii) provide coverage to each of the other Permittee Agencies for their respective Covered Activities. Although a single Joint ITP will be issued to the JPA and the other Permittee Agencies, the respective responsibilities of the various Permittees will be severable, as more fully described below.

This chapter describes the formation and structure of the JPA, as well as the overall HCP implementation structure, roles and responsibilities, annual reporting requirements, and procedures for amending the HCP. In addition, this chapter addresses how the JPA will respond to Changed and Unforeseen Circumstances that may occur during the duration of the HCP.

HCP Implementing Entity: Upper Santa Ana River Sustainable Resources Alliance

The Alliance will be responsible for a broad variety of tasks, including:

1. Overall plan administration and management, such as HCP budgeting and finance, monitoring, and enforcement.
2. Implementation of the conservation strategy, ensuring HCP compliance by the Permittee Agencies, project consistency review, and allocation of incidental take and mitigation credit.
3. Implementation of the Adaptive Management and Monitoring Program and updates, maintenance, and management of the HCP geographical information system (GIS) database and implementation and tracking tools.
4. Acting as a liaison between the Permittee Agencies and USFWS relative to HCP implementation and compliance, including annual reporting.
5. Implementation and compliance oversight of a Section 2081 Multi-Project ITP for take under the California Endangered Species Act.

6. Implementation and compliance oversight of all other programmatic permits (e.g., 404, 401, 1600), including providing assistance to Permittee Agencies in securing any necessary sub-permits for their respective Covered Activities.
7. Sponsoring the Upper Santa Ana River HCP mitigation/conservation banks.
8. Land acquisition, and HCP Preserve management and monitoring, all in coordination with the San Bernardino Valley Conservation Trust (as described below).
9. Public outreach and education (including establishment and management of the technical advisory and stakeholder committees).
10. Other administration functions, including providing GIS and other technical support to Permittee Agencies, grant administration, and third-party contracting (e.g., contracts between the JPA and Permittee Agencies or other parties for activities related to Plan implementation).

Each of these roles is described more fully in Section 6.5, *HCP Implementing Entity*.

6.2 HCP Permit Structure

6.2.1 Permittee Agencies

The Permittees under the Upper Santa Ana River HCP include the 11 water agencies, the Upper Santa Ana River Sustainable Resources Alliance, and the San Bernardino Valley Conservation Trust (referred to generally as the *Permittee Agencies*). The Permittee Agencies are listed in Table 6-1. Each Permittee Agency will receive incidental take authority to undertake their respective Covered Activities as described in Chapter 2. The 11 water agencies, the Alliance, and the Conservation Trust will operate under a single Joint ITP. A second ITP is expected to be issued to Southern California Edison (SCE), as more fully described below, to provide incidental take coverage for any Santa Ana suckers that may be translocated to waters covered by SCE's licenses from the Federal Energy Regulatory Commission (FERC).

Table 6-1. Permittees Agencies Under the Joint ITP

Water Agencies
City of Rialto
East Valley Water District
Inland Empire Utilities Agency
Metropolitan Water District of Southern California
Orange County Water District
City of Riverside, Riverside Public Utilities
San Bernardino Municipal Water Department
San Bernardino Valley Municipal Water District
San Bernardino Valley Water Conservation District
West Valley Water District
Western Municipal District
Upper Santa Ana River Sustainable Resources Alliance
San Bernardino Valley Conservation Trust

6.2.2 Joint ITP Permit Structure

The Joint ITP structure was selected over other permit structures based on a need to coordinate efforts on the river itself and the conflicts that might arise if each Permittee Agency were to operate under its own ITP. Because the Permittee Agencies are independent legal agencies, each of which is undertaking its own Covered Activities, a master permit structure (i.e., one master permit holder with multiple sub-permittees) was determined not to be institutionally feasible for this HCP. By contrast, a joint permit structure will facilitate ongoing coordination among the parties, which, as described below, will be managed by the Alliance in accordance with a JPA and other contractual arrangements to allocate operational and funding responsibilities, risks, and liabilities under the HCP.

To coordinate their activities under the HCP, the Permittee Agencies will establish the Alliance as a JPA in accordance with the Joint Exercise of Powers Act (California Government Code Section 6500) and will be governed by a JPA Agreement in accordance with that statute. As more fully described below, the Alliance will have primary responsibility for overall implementation of the HCP including, for example, mitigation, monitoring, and reporting, and assisting the Permittee Agencies plan and implement their respective Covered Activities. The costs of administration of the Alliance, and the HCP as a whole, will be borne by the Permittee Agencies in accordance with the JPA Agreement. A separate Participation and Financing Agreement (PFA) between the Permittee Agencies will account for and assign financial responsibility of the Alliance among the Permittee Agencies. As more fully described below, the JPA Agreement will establish the operational aspects of the HCP, while the PFA will describe the financial responsibilities of each of the Permittee Agencies with respect to the HCP and the Alliance, as well as their own individual responsibilities under the Joint ITP.

Although the Permittee Agencies will operate collectively under the Joint ITP, each will be fully responsible for any Covered Activity undertaken by that agency under the HCP and will be required to coordinate with the Alliance staff in order to ensure consistency of the Covered Activity with the Plan. Moreover, the responsibilities of the Permittee Agencies with respect to Covered Activities will be severable so that non-compliance by one of them will not compromise the rights of the others under the ITP. For example, if one Permittee Agency conducts a Covered Activity in a manner inconsistent with the HCP, that Permittee Agency's incidental take authority may be suspended or revoked without affecting the incidental take authority issued to the other Permittee Agencies or the Alliance. Moreover, any costs incurred by the Alliance or other Permittee Agencies as a result of non-compliance by one Permittee Agency will be borne by the non-complying Permittee Agency and reimbursed to the Alliance if the Alliance has incurred any associated costs.

Similarly, if one Permittee Agency withdraws from the Alliance, that withdrawal will occur in a manner that does not affect the ability of the other Permittee Agencies to operate under the HCP for the remainder of its terms. In particular, a withdrawing Permittee Agency will be required to "make the HCP whole" by (i) reimbursing the Alliance any costs incurred on behalf of or attributable to the Permittee Agency prior to withdrawal; (ii) making any remaining contributions in the form of an endowment as needed to assure that any mitigation attributable to any Covered Activity already undertaken by the Permittee Agency is funded in perpetuity; and (iii) covering (in the form of an endowment or otherwise) any and all other additional costs associated with the withdrawal (e.g., Alliance administrative time, cost of amending or modifying the HCP (if necessary) or any other permit documents or agreements, increased incremental mitigation, or other costs). If a Permittee Agency withdraws from the Alliance prior to undertaking a specific Covered Activity, that Covered Activity may be removed from the proposed Covered Activities and any unused take could be used

for a substituted new Covered Activity (see Section 6.7, *Plan Changes and Amendments*). If a withdrawing Permittee Agency has already undertaken a Covered Activity, that agency will not be released from any financial responsibilities associated with that Covered Activity. The precise requirements for withdrawal from the Alliance will be fully described in the JPA Agreement and the PFA.

6.2.3 Southern California Edison ITP

As described in Chapter 2, *Covered Activities,* and further below, certain of SCE's ongoing activities on the Upper Santa Ana River or tributaries are expected to require incidental take coverage as Santa Ana sucker populations are expanded within the watershed. In particular, the HCP's conservation strategy requires the translocation of Santa Ana suckers into at least three tributaries of the Santa Ana River, some of which may be near where SCE operates and maintains hydroelectric facilities in accordance with three, 30-year licenses issued by the FERC in 2003. The HCP provides coverage for SCE's activities under the FERC licenses to the extent those activities result in incidental take of Santa Ana suckers. SCE will be issued its own incidental take permit for those activities.

Although SCE is a Permittee under the HCP, SCE will not be responsible for the actions of the Alliance or the other Permittee Agencies, nor will it participate in the JPA. Moreover, SCE will not be responsible for implementing of avoidance or minimization measures associated with suckers that may be translocated into the area of SCE operations. That is, any avoidance and minimization measures associated with SCE operations will be the responsibility of the Alliance, which will undertake those measures (e.g., rescue and relocation) in coordination with SCE as and when necessary. SCE and the Alliance may enter into separate contractual arrangements by which operational or other specified costs to SCE associated with the HCP may be covered by the Alliance.

Because the FERC licenses are subject to renewal during the life of the HCP, SCE has requested some assurance that the presence of Santa Ana sucker in the area of its operations will not negatively affect SCE's long-term ability to operate in those areas. The HCP's regulatory assurances therefore explicitly apply to SCE's activities. To provide additional certainty to SCE, USFWS is expected to include in its biological opinion for the HCP all impacts of the long-term operations of SCE's hydropower facilities in these areas. The HCP biological opinion can be used in connection with the USFWS consultation on future FERC relicensing.

6.3 Other Regulatory Agency Permits

Many of the Covered Activities will require authorizations under other state or federal laws, including Section 2081 of the California Endangered Species Act, Section 1600 of the California Fish and Game Code (lake and streambed alterations), Sections 404 and 401 of the Clean Water Act, and the Porter-Cologne Water Quality Control Act (waste discharge requirements [WDRs] and Section 401 certifications). To facilitate implementation of Covered Activities under the HCP, the Permittee Agencies and the Alliance are also seeking authorizations under these laws. These separate authorizations will establish performance standards and mitigation requirements for various classes or aspects of Covered Activities. Except for the Section 2081 Multi-Project ITP (described below), these authorizations are expected to be programmatic in nature, thus enabling the proponents of those activities to secure project-level authorizations on a predictable and expedited

basis. The performance standards of the other regulatory agency permits are expected to be as consistent as possible with those of the HCP to increase the efficiency of mitigation and coordinated permit compliance and implementation.

6.3.1 Section 2081 Multi-Project ITP (California Department of Fish and Wildlife)

A California Endangered Species Act (CESA) ITP is required from California Department of Fish and Wildlife (CDFW) under Section 2081 of the California Fish and Game Code. The information, analysis, and conservation actions described in this HCP have been prepared to meet the needs of CDFW in the development and issuance of a long-term CESA ITP for all Covered Activities to be undertaken by the Permittee Agencies or the Alliance. The CESA ITP's authorization to take the Covered Species, which may be issued as a whole or in a phased manner, would expire 50 years from the date it is signed by CDFW.

The CESA ITP will be a Section 2081 Multi-Project ITP. When issued it will include all incidental take authority needed for the Covered Activities, and no "sub-permits" will be required. One benefit of this structure is that it will allow the Alliance to acquire and implement mitigation projects well ahead of incidental take without the need to rely on advance mitigation legal structures that are otherwise authorized specifically only under CDFW's Natural Community Conservation Plan (NCCP) or Regional Conservation Investment Strategy (RCIS) programs. This will provide both temporal mitigation benefits and assurance that mitigation will be available when needed by the Permittee Agencies or Alliance.

To assure that the assumptions and findings upon which the Section 2081 Multi-Project ITP are based remain valid throughout the life of the permit, the Alliance will review each permitted activity prior to its being undertaken, ideally through multiple consistency reviews performed at several stages of project planning and design. During the consistency review process, the Alliance will confirm that the permitted activity is consistent with the assumptions and impact calculations of the HCP and the Section 2081 Multi-Project ITP. The Alliance will monitor compliance with the CESA ITP and submit to CDFW periodic compliance reports prepared as a part of the annual regulatory reporting activities. The report will include at a minimum the following:

1. A list of projects completed over the reporting period, including projects that are currently in progress.
2. Acreages of impacts on Covered Species Habitat(s) over the reporting period, along with GIS mapping depicting impacts on Covered Species Habitat(s) over the last 10 years.
3. Acres of Covered Species Modeled Habitat that was preserved for projects during the reporting period.
4. Acres of Covered Species Habitat that was restored for projects during the reporting period.
5. Number of take of individual Covered Species, if available.
6. Any new information relevant to the conservation of the Covered Species and/or to the Upper Santa Ana River Habitat Conservation Planning Area.
7. A comprehensive summary and assessment of compliance with the Stay-Ahead provision to assure that mitigation requirements of the Conservation Strategy (i.e., as incorporated into the Section 2081 Multi-Project ITP) stay ahead of Covered Activity impacts.

6.3.2 Programmatic Individual Permit or Letter(s) of Permission (U.S. Army Corps of Engineers)

The HCP will be implemented in coordination with the regulatory permit required from the U.S. Army Corps of Engineers (USACE) under Section 404 of Clean Water Act for the discharge of dredged or fill material into waters of the United States. A USACE permit may be issued for a specifically identified activity (Individual Permit or IP) or they may also be issued on a programmatic basis for a class of activities. A Programmatic IP is not subject to any limitation that individual and cumulative adverse environmental effects be no more than minimal. Like general permits, however, Programmatic IPs do require Section 401 certification, coverage under a biological opinion, and compliance with Section 106 of the National Historic Preservation Act.

To assist in streamlining the issuance of Section 404 clearance for more significant fills associated with Covered Activities, the Permittee Agencies and the Alliance will seek from the USACE either a Programmatic IP or, in the alternative, one or more "letters of permission," or LOPs. A letter of permission is not technically a permit under Section 404, but it may be used to authorize a class of activities whose cumulative impacts are more than minimal. Whether the Permittees will seek just a Programmatic IP, or an LOP or LOPs, or some combination of the two, has yet to be determined. Whichever approach is selected, the HCP will be implemented in coordination with these permits.

6.3.3 Programmatic Section 401 Certification/Waste Discharge Requirement

The HCP will also be implemented in coordination with the Section 401 permitting process. Section 401 of the Clean Water Act requires that, prior to or as a condition of issuance of a USACE permit, a state certify that the proposed federally authorized discharge complies with state water quality standards. In California, Section 401 certifications are issued by the State Water Resources Control Board (SWRCB) or one of the nine regional water quality control boards (RWQCBs). In reviewing any proposed discharge for certification, the water boards apply the standards issued under California's Porter-Cologne Water Quality Control Act, California Water Code Division 7 (Porter-Cologne). Where a discharge to a water of the State does not require a USACE permit, the water boards will issue WDRs to authorize that discharge under Porter-Cologne.

In April 2019, the SWRCB adopted a state-wide wetlands definition and "Procedures for the Discharge of Dredged or Fill Material into Waters of the State." The "Procedures," which became effective on May 28, 2020, establish a uniform set of application, avoidance, and mitigation requirements for activities requiring Section 401 Certification or WDRs. Under the Procedures, the SWRCB or one of the RWQCBs may issue an "Order" that can serve as both a Section 401 Certification and WDRs. Orders may be issued on either an individual basis (like a USACE IP) or as a "General Order," which is programmatic in nature. In particular, the Procedures authorize the issuance of General Orders "for specific classes of … discharge activities that are similar; involve the same or similar types of discharges and possible adverse impacts requiring the same or similar conditions or limitations in order to alleviate potential adverse impacts to water quality; and are determined … to more appropriately be regulated under a general order rather than an Individual Order."

Under the Procedures, compensatory mitigation requirements for the discharge or dredged or fill material are determined based upon a watershed approach that may be developed from a

"watershed plan" that (i) has been approved for use by the RWQCBs and analyzed in an environmental document, (ii) includes monitoring provisions, and (iii) includes guidance on compensatory mitigation opportunities. A watershed plan is defined as a document, such as a habitat conservation plan, that has been developed in consultation with relevant stakeholders and a specific goal of which is aquatic resource restoration, establishment, enhancement, and preservation within a watershed. In addition to governing mitigation decisions, a watershed plan may be used to evaluate alternatives to fill under the Procedures' sequencing requirements. The Upper Santa Ana River HCP specifically has been developed to serve as a watershed plan under the Procedures.

The Permittee Agencies and the Alliance will apply to the Santa Ana and San Diego RWQCBs for a General Order under the Procedures.

The General Order will include Covered Activities proposed for authorization under any Programmatic IP or LOP issued by USACE. This Order will serve as a Section 401 certification for the Programmatic IP, as well as WDRs for any such activity that will result in a discharge to a water of the State but not a water of the United States. This Order will likely include terms and conditions, including mitigation requirements consistent with those imposed under the HCP, applicable to any activity permitted thereunder.

6.3.4 Master Streambed Alteration Agreement (California Department of Fish and Wildlife)

Similar to the above-mentioned regulatory processes, the HCP will also be implemented in coordination with implementation of a Master Streambed Alteration Agreement.

Any "entity" proposing to undertake an activity resulting in certain impacts (e.g., diversions, substantial alterations, certain discharges) to the bed, channel, or bank of a river, stream, or lake in California must secure an authorization from CDFW under Section 1600 et seq. of the California Fish and Game Code. This authorization takes the form of a negotiated agreement between the Department and the entity, which agreement is referred to as a "Lake and Streambed Alteration Agreement" (LSAA).

To secure authorization, the entity proposing the activity submits a "notification" to CDFW in accordance with the application requirements published on CDFW's website. Once the notification is complete or deemed complete, CDFW has 60 days to issue a draft LSAA. If CDFW fails or declines to act within that 60-day period, then the activity described in the notification becomes authorized as a matter of law. When it issues a draft agreement, CDFW includes "reasonable measures" to protect the fish and wildlife resources that may be substantially affected by the proposed activity. The entity may either enter into an LSAA as proposed by CDFW, or it may object to the protective measures and enter into discussions with CDFW. If CDFW and the entity fail to resolve those objections, then they may be submitted to binding arbitration.

Most LSAAs are authorized for specifically identified activities and carry a term of up to 5 years, subject to one extension. Under Section 1605 of the California Fish and Game Code, however, CDFW may enter into an LSAA for an initial term of longer than 5 years. Because of their longer terms, these LSAAs are subject to periodic reporting and reviews by CDFW to confirm that the measures in the agreement "continue to protect" the fish and wildlife resources affected by the activity covered.

Long-term agreements are often issued for classes of activities on a programmatic basis, much like a USACE general permit or a General Order from an RWQCB. These LSAAs are typically referred to as

"Master LSAAs." Although Master LSAAs provide programmatic coverage, an entity desiring to rely on that instrument must still submit to CDFW a "sub-notification" and pay specified fees, resulting in a project-specific LSAA between CDFW and the entity. The approval Master LSAAs is not subject to the 60-day issuance period associated with short-term LSAAs.

The Permittees and the Alliance intend to seek a Master LSAA from CDFW for the small or routine operation and maintenance activities proposed for inclusion in the Programmatic IP and General Order.

6.3.5 Wastewater Change Petition

The reduction of effluent discharge is an HCP Covered Activity for several wastewater treatment plants operated by Permittee Agencies in the Planning Area. A Change of Use Petition is required to be submitted for approval to the SWRCB for any proposed reduction in effluent discharge and must evaluate the effect on the water rights of other diverters as well as the effects on instream resources, including fish and wildlife (Water Commission Act, Section 1700–1707). Several Covered Activities have already received Orders from the SWRCB approving the Change of Use Petition; however, several others are in the approval process. The HCP is intended to reflect the impacts associated with the proposed Covered Activities requiring this permit and demonstrate that the HCP adequately offsets those impacts on instream resources through the implementation of the Conservation Strategy.

6.4 Upper SAR Joint Powers Authority

The Upper Santa Ana River HCP will be implemented as a long-term, multi-jurisdiction, regulatory compliance program designed to coordinate environmental permitting processes such that the benefits to Permittees and regulated natural resources are maximized. The implementation of this program will improve the health of the Santa Ana River through the coordinated efforts of 11 public water agencies, state and federal regulatory agencies, and interested stakeholders in order to provide a holistic conservation strategy that commits resources and assurances as needed for success. Although the overall purpose of the HCP to is to facilitate development and operation of the public infrastructure, it does so through a coordinated permit and conservation strategy that could involve hundreds of individual agency actions over the life of the Plan. Note that the JPA as Implementing Entity is referred to as the Upper Santa Ana River Sustainable Resources Alliance. However, in this section discussing JPA structure, membership, and governance, it is referred to simply as the JPA.

Given the complexity of the HCP and the number of agencies and other entities involved, it was determined appropriate to identify a single local implementing entity to assume overall responsibility for plan management, administration, and implementation. Rather than allocate this responsibility to just one Permittee Agency or a committee of agencies, the Permittee Agencies have formed a "joint exercise of powers authority" (JPA) to assume these responsibilities. Through this agreement the JPA is directed to be the HCP Implementing Entity identified as the Upper Santa Ana River Sustainable Resources Alliance.

A JPA is a legally created entity that allows two or more public agencies to exercise commonly held powers. The Joint Exercise of Powers Act, California Government Code Section 6500 et seq., which governs JPAs in California, does not require the agencies participating in a JPA to be the same kind of

agencies so long as the participating agencies independently possess the requisite powers. Based upon an analysis of the statutory authority of each of the Permittee Agencies, it has been determined that they have sufficient powers in common to enter into the JPA and sufficient authority for the JPA to act as the implementing agency under the HCP.

JPAs are formed by contract between two or more public agencies. The Joint Exercise of Powers Act provides for two different types of JPA arrangements: (1) two or more public agencies may contract to jointly exercise common powers or (2) two or more public agencies may contract to form a separate legal entity. Many JPAs take the form of a separate legal entity from the contracting agencies, which can be beneficial to the contracting agencies as the debts, obligations, and liabilities of a separate entity JPA remain distinct from and do not belong to the contracting parties themselves. For this reason, the JPA proposed for the Upper Santa Ana River HCP will be established as a separate legal entity.

The roles and functions of the JPA are further described below.

6.4.1 Membership and Governance

The JPA will be composed of the Permittee Agencies and will be governed by a board of directors (JPA Governing Board) composed of one of the elected officials from each Permittee Agency that will be appointed by each Permittee Agency to serve on the JPA, and who will vote on certain identified major decisions related to the HCP. It is anticipated that each Permittee Agency on the JPA (referred to as Permittee Agencies) generally will receive one vote on decisions made by the JPA Governing Board. However, given that Permittee Agencies are contributing different levels of resources for HCP implementation costs, it is expected that votes on certain financial decisions (e.g., annual budget approval) may be weighted based upon each agency's contribution commitment. The details of this voting structure are outlined more fully in the JPA Agreement, the instrument creating the JPA. The relative contributions of the JPA Permittee Agencies are presented in Table 6-2.

Table 6-2. Proportional Contribution of JPA Permittee Agencies to HCP Implementation

Permittee Agency	Total Share	Estimated Annual Operating Cost of Program Implementation[1]
San Bernardino Valley Municipal Water District	40%	$ 932,800
East Valley Water District	7%	$151,580
Riverside Public Utilities	5%	$116,600
Inland Empire Utilities Agency	20%	$466,400
Western Municipal Water District of Riverside County	15%	$349,800
San Bernardino Municipal Water Department	5%	$104,940
Metropolitan Water District of Southern California	2%	$46,640
City of Rialto Public Works	2%	$46,640
San Bernardino Valley Water Conservation District	3%	$69,960
Orange County Water District	1%	$23,320
West Valley Water District	1%	$23,320
Total	**100%**	**$2,332,000**

[1]Total and annual operating costs of Program implementation are calculated in Table 7-3.

The JPA Agreement will establish an HCP Executive Committee composed of the general managers of each of the Permittee Agencies, or some subset thereof. The purpose of the HCP Executive Committee is to oversee the administration of the JPA by JPA staff (described below), act as a liaison between the JPA and its Permittee Agencies, assist in resolving disputes between Permittee Agencies, approve annual budgets (subject to final approval by the JPA Governing Board), and report to the JPA Governing Board on significant policy and financial developments. The HCP Executive Committee will be chaired by the General Manager of the San Bernardino Valley Municipal Water District (Valley District), as the majority contributor to HCP implementation costs.

As described above, if one Permittee Agency withdraws from the JPA, that withdrawal will occur in a manner that does not affect the ability of the other Permittee Agencies to operate under the HCP for the remainder of its permit term. In particular, a withdrawing Permittee Agency will be required to make the JPA whole by (i) reimbursing the JPA any costs incurred on behalf of or attributable to the Permittee Agency prior to withdrawal; (ii) making any remaining contributions in the form of an endowment as needed to assure that any mitigation attributable to any Covered Activity already undertaken by the Member Agencies (i.e., as a Permittee Agency) is funded in perpetuity; and (iii) covering (in the form of an endowment or otherwise) any and all other additional costs associated with the withdrawal (e.g., JPA administrative time, cost of amending or modifying the HCP [if necessary] or any other permit documents or agreements, increased incremental mitigation or other costs).

If a Permittee Agency withdraws from the HCP and the JPA prior to that agency undertaking a Covered Activity, that Covered Activity may be "released" from the ITP, and any mitigation values allocated to that activity will be available for allocation to other Covered Activities under the HCP if needed. If a withdrawing Permittee Agency has already undertaken a Covered Activity, that agency will not be released for any responsibilities under the HCP or the ITP with respect to that activity. The precise requirements for withdrawal from the HCP and the JPA will be fully described in the JPA Agreement and the PFA.

6.4.2 JPA Termination

The JPA is intended to survive for the 50-year term of the HCP. At that time all Covered Activities, and all required mitigation, are anticipated to be implemented with endowments established for permanent management, monitoring, and reporting by a third party (i.e., the Conservation Trust). Given that the advisory and permit management functions of the JPA will no longer be necessary, it may terminate at that time. All remaining funds and liabilities will be distributed or allocated as specified in the JPA Agreement. However, the Permittee agencies may decide to pursue a renewal of the ITP or maintain the Alliance for HCP Preserve management or other reasons.

6.4.3 Participation and Financing Agreement

Although the JPA may receive grant funding for certain of its efforts, primary responsibility for JPA operation and HCP implementation will be funded by the Permittee Agencies themselves. The annual operational expenses of the JPA will be billed directly to the Member Agencies in accordance with budgets approved by the HCP Executive Committee and the JPA Governing Board. HCP-specific expenses will be funded in accordance with a separate PFA entered into between the Permittee Agencies and the JPA.

The purpose of the PFA is to ensure that each of the Permittee Agencies is committed to participate and comply with the terms of the HCP; that each of the Permittee Agencies bears the cost of each of its Covered Activities as set forth in the PFA, including its overall fair share of contributions (as set forth in Table 6-2) to the JPA; and that there is an established dispute resolution and enforcement mechanism to assure that Permittee Agencies perform their obligations in a manner that does not undermine the HCP ITP.

6.4.4 Conservation Easements, Fee Title, and Endowments

San Bernardino Valley Conservation Trust

The Alliance does not have the ability to hold conservation easements or the proper fiduciary mandates to hold endowments or other securities. Therefore, the San Bernardino Valley Conservation Trust (Conservation Trust), as a 501(c)(3) charitable corporation, will be charged with holding fee title to, or conservation easements covering, land secured as mitigation for Covered Activities. The Conservation Trust is qualified to hold conservation easements, endowments and other forms of security in accordance with Section 815 et seq. of the California Government Code. Financial management of the Conservation Trust will be in accordance with the prudent investor standards set forth in the California Probate Code, and the overall activities of the Conservation Trust will be governed by Senate Bill 1094, codified at Sections 65965-98 of the California Government Code. The Conservation Trust has an independent board of directors and management separate from the managers of the HCP. It is anticipated that there will be some form of Memorandums of Agreement or Memorandums of Understanding between the Conservation Trust and the Alliance establishing a long-term relationship for the purposes of plan compliance and implementation. The Conservation Trust will receive incidental take under the Joint ITP for any activities it may conduct under the HCP.

6.5 HCP Implementing Entity

As described in Section 6.4, *Upper SAR Joint Powers Authority*, the JPA is the HCP Implementing Entity, and as Implementing Entity it operates as the Upper Santa Ana River Sustainable Resources Alliance.

6.5.1 Staffing of the Upper Santa Ana River Sustainable Resources Alliance

The Alliance will be staffed primarily by employees of Valley District with supplemental assistance provided by contracted consultants or other entities, as needed. The day-to-day operations of the Alliance will be run by the Executive Director. Additionally, the Executive Director will serve as the Principal Scientist for the HCP with the responsibility for guiding the scientific work plan and maintaining the highest level of scientific integrity within the Plan. The primary responsibility of the Executive Director is to ensure the Alliance and Permittee Agencies remain in compliance with the ITPs associated with the HCP and other programmatic permits issued for Covered Activities. The Executive Director will be supported by a staff of professionals, including a Program Compliance Manager, who will be responsible for ensuring that Covered Activities are implemented in manner consistent with the Joint ITP and other agency permits (404, 401, 1602, 2081); and a Preserve

System Manager, who will be responsible for ensuring that success criteria are being met within the HCP Preserve System through conservation actions that contribute to the conservation strategy of the HCP, as well as the mitigation requirements of the additional permits as committed by the Alliance.

6.5.2 Implementing Entity Responsibilities

The Alliance's responsibilities are fully spelled out on the JPA Agreement and are summarized below.

Plan Implementation

The Alliance will serve as the overall implementing entity on behalf of the Permittee Agencies. Although each Permittee Agency will be responsible for any and all of its actions in connection with the Covered Activities, including compliance with the terms of the HCP and the Joint ITP, the Alliance will be responsible for implementing the overall conservation strategy. The Alliance will also be responsible for all financial aspects of the HCP, including budgeting, grant administration, and expenditures.

HCP Compliance

The Alliance will be responsible for overall HCP compliance. This includes ensuring implementation of the specific mitigation requirements in the conservation strategy, as well as meeting all biological monitoring, reporting, and adaptive management requirements as described in Chapter 5, *Conservation Strategy*. The Alliance will also be responsible for ensuring that the Permittee Agencies implement Covered Activities consistent with the assumptions of the HCP, which will be enforced through the Project Consistency Review process described below.

Project Consistency Review

Prior to implementing any Covered Activity, a Permittee Agency will provide to the Program Compliance Manager a description of the proposed Covered Activity, including project specifications and schedule to enable evaluation of the project's consistency with the HCP, as well as other regulatory permits and environmental compliance required for that project (e.g., California Environmental Quality Act [CEQA], aquatic resource permits, 2081 State ITP). While the project may also receive regulatory permits through the Upper SAR Aquatic Resources Programmatic Permits (CDFW Section 1600 Multi-Project Lake and Streambed Alteration Agreement, Clean Water Act Section 404 Regional General Permit and/or Programmatic IP, and Programmatic 401 Certification and/or General Order) and/or the Section 2081 Multi-Project ITP, each individual water agency will be responsible for their own project-specific CEQA compliance when required.

The Alliance will develop project review forms, checklists, and a fee schedule to streamline and support the project consistency review. The project consistency review will also document the specific amount of planned impact and proposed take of Covered Species and regulated resources to document the impacts and the associated mitigation to be used by the Covered Activity (see *Allocation of Incidental Take and Mitigation Credit*, below). Upon a determination that the Covered Activity is consistent with the HCP, the Program Compliance Manager shall issue a Project Consistency Determination to the applying Permitting Agency and a Notice to Proceed. Decisions of

the Program Compliance Manager may be appealed to the HCP Executive Committee. Regardless, the final Project Consistency Determination must be in compliance with the HCP.

Allocation of Incidental Take and Mitigation Credit

Upon issuance of a Project Consistency Determination and Notice to Proceed, the Program Compliance Manager shall enter the Covered Activity data into the GIS impact and mitigation tracking database including the amount of incidental take allocated to the project under the ITP, and the amount of mitigation allocated to the project. The GIS impact and mitigation tracking database is linked to the mitigation accounting system in the Mitigation Reserve Program and the parallel mitigation and species conservation banks to ensure full transparency of impact and mitigation tracking and reporting. The Program Compliance Manager will report quarterly to the HCP Executive Committee and JPA Governing Board the amount of incidental take and mitigation credit issued under the HCP. Impact and mitigation credit reporting will also include the extent to which mitigation has stayed ahead of impacts, and will identify any foreseeable challenges for upcoming mitigation credit needs relative to overall phasing and schedules for Covered Activity and mitigation action implementation.

Permit Coordination

The Alliance will provide advice and guidance to Permittee Agencies to support their project planning and implementation of Covered Activities to facilitate project streamlining and HCP compliance. Permit coordination support may include advisory input on project-specific CEQA needs, preconstruction surveys, avoidance and minimization requirements associated with the implementation of any Covered Activity, and other related regulatory advice for Covered Activity implementation. The Alliance will also provide advice to Permittee Agencies for coordinating, securing, and implementing any authorizations needed for Covered Activities under the Aquatic Resources Programmatic Permits issued by the USACE, the Santa Ana or San Diego RWQCB, and CDFW as described in Section 6.3, *Other Regulatory Agency Permits*.

Regulatory Agency Liaison

In addition to assisting in HCP and permit implementation, the Alliance will serve in a general liaison role between the Permittee Agencies and USFWS and other regulatory agencies, thus providing streamlined feedback to and coordination between the Permittee Agencies and Regulatory Agencies.

Land Acquisition and Mitigation/Conservation Bank Management

The Alliance will be responsible for implementing the mitigation requirements of the HCP. This will include the acquisition and funding of conservation easements to be held by the Conservation Trust, as well as serving as sponsor of the mitigation and species conservation banks described above. The Alliance will be responsible for overall management of the preserve established under the HCP, although specific responsibilities will be undertaken by the Conservation Trust or other easement- or landholders.

Adaptive Management and Monitoring Oversight

The Alliance is responsible for implementation of the Comprehensive Adaptive Monitoring and Management Program (CAMMP). The CAMMP includes adaptive management guidance that applies

across all areas of the HCP Preserve System as well as guidance for detailed management actions to be developed at the Preserve Unit-level for specific management issues. The Alliance will be responsible for collecting the appropriate data to ensure that the goals and objectives of the HCP and individual preserve areas are met, determine if HCP Preserve System management strategies are having the desired effect, and evaluate if underlying biological assumptions are supported by field-collected data from the preserves. A framework and guidance for preparation of the CAMMP can be found in Section 5.12, *Comprehensive Adaptive Management and Monitoring Program*.

GIS/Database Maintenance

The Alliance will maintain the overall GIS database required for HCP implementation, including monitoring and reporting and provision of other geospatial services. The GIS database will be available to Permittee Agencies to aid HCP implementation and administration of the other regulatory permits. The GIS database will be linked to the mitigation accounting system in the Mitigation Reserve Program and the parallel mitigation and species conservation banks to ensure full transparency of impact and mitigation tracking and reporting. The GIS database is also an integral part of the CAMMP implementation tool set.

Third-Party Contracting

The JPA will have the power to contract with third parties for various services required for HCP implementation. Most importantly, the JPA may enter into agreements with Permittee Agencies from time to time for specific HCP projects. For example, existing Memorandums of Understanding between Valley District and the City of Riverside, and between Valley District and the San Bernardino Municipal Water Department, relative to the Tributary Stream Restoration Projects and certain water supply issues, respectively, will be assigned to the JPA for implementation. The JPA may enter into other agreements with Permittee Agencies, or regulatory agencies, relative to specific actions required for implementation of the HCP conservation strategy or otherwise. The JPA will be party to any agreements with SCE and/or the U.S. Forest Service relative to implementation of the Santa Ana sucker translocation into streams in the SCE FERC operation areas.

Grant Administration

The Alliance will be responsible for writing and securing grants, and administering any grant funds available and needed for HCP implementation.

6.5.3 Public Input

Stakeholder Committee

To receive public input on the implementation of the HCP over its 50-year life, the JPA will form a committee of outside stakeholders that will meet periodically (at least twice per year). Ideally, the Stakeholder Committee will include participants with a range of views, including cities and counties, conservation organizations, the business community, and the public at large. The Stakeholder Committee will be provided with reports of ongoing HCP activity, upcoming decisions, significant policy issues, changes in management arising out of the HCP's adaptive management provisions, and other relevant information. The purpose is to secure a broad cross-section of community views to inform HCP decision-making.

Technical Advisory Committee

To receive technical input on the implementation of the HCP over its 50-year life, the JPA will form a Technical Advisory Committee that will meet periodically (at least once per year, or more frequently as needed). The Technical Advisory Committee will include scientists, engineers, and other professionals with expertise in biology, hydrology, and other relevant areas. Although the Technical Advisory Committee will be provided with reports of all ongoing HCP activity, its most important role will be to advise the Alliance on adaptive management questions that may arise over the life of the Plan. The Technical Advisory Committee may have some overlapping membership with the Preserve Management Committee described below.

Preserve Management Committee

The JPA, in conjunction with the Conservation Trust, will form a Preserve Management Committee to advise on questions related to the establishment and long-term management of the HCP Preserve System. This will include preparation of focused preserve management plans for each preserve unit (Preserve Unit Plans, or PUPs), monitoring and management of each preserve area and the overall health of the preserve, and identification and establishment of future preserve areas as needed to complete the mitigation obligations of the HCP. In addition to participation by the JPA and the Conservation Trust, this committee may also include members of the Technical Advisory Committee, Stakeholder Committee, the Wildlife Agencies, and other regulatory agencies.

The Preserve Management Committee will provide advice and input on the content of HCP Preserve System Annual Management Work Plan and 5-year update of the PUPs, along with the funding to be allocated to implement the Annual Management Work Plan and to be anticipated for each 5-year PUP.

Any potential for incidental take occurring from actions implemented under the Preserve System Annual Management Work Plan is covered by the HCP ITP, and will be documented by the Program Compliance Manager and entered into the GIS impact and mitigation tracking database.

Annual Public Meeting

The Alliance will hold a noticed public meeting to present the results in the Annual Report on HCP Implementation. The public meeting will include reports from the committees described above and a report from the wildlife agencies evaluating JPA compliance with the HCP ITP. The annual public meeting will be conducted to provide a transparent accounting of HCP implementation and to receive public input on matters of public concern or interest.

6.6 Mitigation/Conservation Bank Implementation

A mitigation bank is a vehicle by which a party may develop a mitigation project that can be relied on by future holders of USACE permits to satisfy the mitigation requirements of those permits. In other words, the sponsor of a mitigation bank will develop a mitigation project (e.g., enhance, re-establish or establish aquatic resources on a property, and preserve that property with a conservation easement) and secure the USACE's permission to sell "credits" in that project to third-party private and public developers. The USACE is authorized to approve mitigation banks in

accordance with detailed regulations it adopted in 2008 governing all types of mitigation (2008 Mitigation Rule).

USFWS may also approve banks for mitigation projects involving threatened or endangered species. Banks approved by USFWS are referred to "conservation banks," but they are often combined with USACE-approved mitigation banks through an inter-agency approval process articulated in the 2008 Mitigation Rule. CDFW may also participate in such banks for the purposes of generating credits under CESA, Section 1600 of the Fish and Game Code, or CEQA. CDFW has adopted a comprehensive banking policy to provide guidance. Although the SWRCB has not yet adopted its own policy on banking, their 2019 *Wetland Definition and Procedures for the Discharge of Dredged or Fill Material into Waters of the State* provide certain specific regulatory benefits for banks.

In order to account for the ecological benefits of restoration projects and other similar conservation projects that may be undertaken by the Permittee Agencies, it is anticipated that USACE and USFWS will approve a combined mitigation/conservation bank incorporating these projects' resource values. That is, USACE and USFWS will approve the creation of mitigation credits reflecting the aquatic resources mitigation values and the species conservation values generated by these projects. CDFW and the Santa Ana RWQCB may also choose to participate in this bank.

A mitigation or conservation bank is required to keep a detailed ledger of credits that have been generated by the bank (which may be generated, or "released" to the sponsor, in phases) and credits that have been sold to third parties, including an accounting of the purposes for which those credits have been sold (e.g., as wetland restoration credits or endangered species credits). As described below, the ledger established for the Upper Santa Ana River Mitigation/Conservation Banks will be used also to account internally for impacts under the HCP through the Mitigation Reserve Program (see Section 5.4.2).

6.6.1 Early Implementation of HCP Mitigation

Prior to approval of the Upper Santa Ana River HCP, some of the Permittee Agencies initiated conservation projects intended to benefit the Santa Ana sucker. In particular, Valley District entered into a cooperative arrangement with the City of Riverside to undertake certain restoration efforts in the Santa Ana River and its tributaries (Tributary Restoration Projects). The participants' intent was to begin these efforts as early implementation of the HCP (i.e., in advance of HCP approval) given the critical state of the Santa Ana sucker population, but to have the benefit of these efforts built into and accounted for in the HCP's conservation strategy, and to serve as mitigation for various Covered Activities under the HCP. The mitigation credit generated by these early implementation restoration efforts will be integrated into mitigation/conservation banks.

6.6.2 Mitigation/Conservation Banks Sponsor

The JPA will serve as the sponsor of the Upper Santa Ana River mitigation/conservation bank(s), and will have the ability to allocate credits to various Permittee Agencies undertaking projects in or around the Upper Santa Ana River through the Mitigation Reserve Program. Unlike a typical mitigation or conservation bank, however, the primary purpose for establishing these credits is for use by the HCP Permittees to mitigate impacts from Covered Activities, over a long period of time. The JPA will use the bank ledger process established in the Mitigation Reserve Program as an accounting mechanism to track the impacts of Covered Activities to assure they are fully mitigated over the life of the HCP. However, if for any reason one or more of the Permittee Agencies decides to

formally abandon a project covered by the HCP, thus leaving unused credits available in a bank, a secondary purpose of a mitigation/conservation bank is to enable the JPA to sell those unused credits to private or public third parties (i.e., who are not Permittees under the HCP) to recoup some portion of the cost of the mitigation projects. The process for credit generation, tracking, allocation and sale will, along with other aspects of the bank, be set forth in a "Bank Enabling Instrument(s)" between the JPA as bank sponsor and participating state and federal agencies, and will be integrated into the Mitigation Reserve Program.

6.6.3 Mitigation Credit on CDFW Lands

It should also be noted that, because two of the restoration projects will occur on land owned by CDFW, as a matter of CDFW policy they may not be included in a bank. These two restoration projects (Hidden Valley Creek and Lower Hole Creek) will instead be treated as "advance permittee responsible" mitigation projects. The mitigation value created through restoration on CDFW-owned lands will also be tracked through the Mitigation Reserve Program.

6.7 Plan Changes and Amendments

6.7.1 Withdrawal of Permittee Agencies

A Permittee Agency may withdraw as a Permittee Agency of the JPA if the JPA and the Wildlife Agencies determine that such withdrawal will not compromise the viability of the HCP (including its conservation strategy), and the withdrawing Permittee Agency makes the JPA whole as described below.

If a Permittee Agency wishes to withdraw, that Agency will provide written notice to the Executive Director, with a copy to each Permittee Agency and each Wildlife Agency, specifying the reasons and proposed timing of withdrawal. The Executive Director will thereafter make a recommendation as to those funds needed from the withdrawing agency to make the JPA whole as described in Sections 6.2, *HCP Permit Structure,* and 6.4, *Upper SAR Joint Powers Authority*, and as will be more fully set forth in the JPA Agreement and the PFA. The Executive Director's recommendation will be forwarded to the JPA Governing Board for a final determination regarding the terms and conditions of withdrawal, which, following the board's determination, will be forwarded to the withdrawing Permittee Agency.

No withdrawal shall occur until the JPA and the withdrawing Permittee Agency have entered into a binding agreement providing for payment of any funds and including such indemnities, hold harmless provisions, and other contractual assurances as may be determined by the JPA Governing Board to be appropriate and, if required, any amendments to the HCP completed together with appropriate environmental review. Until the withdrawal is complete, and unless agreed otherwise by the JPA, a withdrawing Permittee Agency shall remain in compliance with the JPA Agreement and the PFA. In no event shall a Permittee Agency be entitled to reimbursement of any costs incurred by the JPA prior to the date of withdrawal.

If a Permittee Agency has engaged in a Covered Activity in reliance upon the ITP, the Permittee Agency may not withdraw from the HCP or the JPA, but may seek to remove other Covered Activities from the HCP as described below.

6.7.2 Removal of Covered Activities

If a Permittee Agency determines that a Covered Activity will no longer be undertaken, then that Covered Activity may be removed from the HCP and ITP coverage. Removal will occur if a Permittee Agency decides to withdraw from the HCP and JPA in accordance with Section 6.4, or it may occur if a Permittee Agency decides to remove some but not all of its Covered Activities from the HCP and the ITP. Removal may occur only with the approval of the JPA and the Wildlife Agencies and will constitute a minor Amendment of the HCP. If a Covered Activity is removed, then any mitigation value generated by mitigation projects conducted under the HCP, and allocated by the JPA to the Covered Activity being removed either in the form of bank credits or as otherwise accounted for in the Mitigation Reserve Program, may be reallocated by the JPA to other Covered Activities.

Note that the JPA may choose not to reduce the overall mitigation requirements of the HCP and instead reserve the excess mitigation value available resulting from the removal of the Covered Activity and reallocate it to other Covered Activities proposed by the Permittee Agency removing a Covered Activity, or apply it as and if needed to address Changed Circumstances requiring the provision of additional mitigation. The terms of removal shall be approved by the JPA Governing Board and the Wildlife Agencies and shall not be effective until the JPA and the withdrawing Permittee Agency have entered into a binding agreement providing for payment of any funds and including such indemnities, and hold harmless provisions and other contractual assurances as may be determined by the JPA Governing Board to be appropriate; and, if required, any amendments to the HCP have been completed together with appropriate environmental review. In no event shall a Permittee Agency be entitled to reimbursement of any costs incurred by the JPA prior to the date a Covered Activity is removed from the ITP and the HCP, provided, however, that funds, mitigation, or other resources provided by a Permittee Agency may be reallocated as appropriate to other Covered Activities of that Permittee Agency that remain within the HCP and ITP.

6.7.3 Addition of Covered Activities

A Permittee Agency may request the JPA and the Wildlife Agencies to add a new Covered Activity to the HCP and the ITP that would potentially increase the amount of take above that allocated in the ITP. Any such addition would constitute a Major Amendment of the HCP (as described below), and shall occur only upon that Permittee Agency paying into the HCP an appropriate share of past and future HCP development and implementation costs as may be determined by the JPA and the Wildlife Agencies.

6.7.4 Substitution of Covered Activities

A Permittee Agency may request the JPA and the Wildlife Agencies substitute a new Covered Activity to the HCP and the ITP in exchange for removing a Covered Activity no longer planned for implementation such that the total take allocated in the ITP is the same or less. Any such substitution would constitute a Minor Amendment of the HCP (as described below), and shall occur only if the new project impacts are determined to be equal or lesser than the Covered Activity it replaced, and only with approval of the JPA Governing Board and the Wildlife Agencies.

6.7.5 HCP Amendment Process

Minor Amendments

Minor Amendments are changes that would not appreciably increase the HCP's impacts associated with Covered Activities, implementation of the conservation strategy, or additional amount of take, and therefore would not require an amendment to the ITP. A Minor Amendment is not appropriate to add a new species to be covered under the HCP, or to change the boundaries of the HCP. Examples of Minor Amendments include correction of spelling errors or minor corrections in boundary descriptions. The Minor Amendment process would be accomplished through an exchange of letters between the JPA and the USFWS Palm Springs Field Office. Proposed revisions will be reviewed by USFWS upon submission of each annual report to ensure the successful implementation of the conservation strategy. USFWS will review and respond within 30 days. Revisions to measures will be approved by USFWS prior to the JPA adopting revised measures.

Major Amendments

Major Amendments to the HCP would require an amendment to the ITP. Major Amendments involve changes that do affect the amount of impact from Covered Activities, implementation of the conservation strategy, or increase in the amount of take. A Major Amendment is required to add new species or to change significantly the boundaries of the HCP. Major Amendments often require amendments to the USFWS decision documents, including the NEPA document, the biological opinion, and findings and recommendations document. Major Amendments will often require additional public review and comment.

6.7.6 Suspension/Revocation

USFWS may suspend or revoke the Joint ITP if the JPA fails to implement the HCP in accordance with the terms and conditions of the permits or if suspension or revocation is otherwise required by law. Suspension or revocation of the Section 10(a)(1)(B) permit, in whole or in part, by USFWS shall be in accordance with its regulations in effect at the time of such suspension or revocation (see 50 Code of Federal Regulations [CFR] 13.27-29, 17.22(b)(8), and 17.32 (b)(8)). To avoid a situation in which a failure by one Permittee Agency compromises the incidental take authority enjoyed by the other Permittee Agencies, the IA and the PFA include mechanisms for the early identification and resolution of compliance issues. Where compliance by one Permittee Agency is not addressed following notice from USFWS and an opportunity to cure, USFWS may suspend the incidental take authorization of the non-complying Permittee Agency until such time as compliance is achieved and, if appropriate, any mitigation for a default affecting the environment has been provided or assured. Unless the identified non-compliance affects the overall viability of the HCP, or the default is not severable, it is not anticipated that USFWS would suspend or revoke the Joint ITP as a whole.

6.7.7 Permit Renewal

Upon expiration, the Section 10(a)(1)(B) permit may be renewed without the issuance of a new ITP, in accordance with the permit renewal regulations then in effect, provided that the biological circumstances and other pertinent factors affecting Covered Species are not significantly different than those described in the original HCP. To renew the ITP, the JPA will submit the following to USFWS, in writing:

- A request to renew the ITP with reference to the original permit number.
- A certification that all statements and information provided in the original HCP and ITP application, together with any approved HCP amendments, are still true and correct, and inclusion of a list of changes.
- A description of all take that has occurred under the existing ITP.
- A description of any portions of Covered Activities still to be completed.

If USFWS concurs with the information provided in the request, it will renew the ITP consistent with permit renewal procedures required by federal regulation in effect at the time of the ITP renewal request (see 50 CFR 13.22). If the JPA files a renewal request and the request is on file with the issuing USFWS office at least 30 days prior to the ITP expiration, the ITP will remain valid while the renewal is being processed, provided the existing ITP is renewable. However, the Permittees may not take listed species beyond the quantity authorized by the original ITP or change the scope of the HCP. If the JPA fails to file a renewal request within 30 days prior to ITP expiration, the ITP will become invalid upon expiration. The Permittees must have complied with all annual reporting requirements to qualify for a permit renewal.

6.8 Implementing Agreement

6.8.1 Purpose of the Implementing Agreement

USFWS and the JPA will enter into an "Implementing Agreement" (IA) relating to the Upper Santa Ana River HCP concurrent with HCP approval and issuance of the Joint ITP. The IA will have a term equal to that of the HCP. Although not legally required under the Endangered Species Act, IAs are recognized in the USFWS HCP Handbook (USFWS 2016) as a potentially valuable tool that lays out the legal obligations of the parties in more detail than may be appropriate in an HCP. Given the multiple parties and wide range of Covered Activities under the HCP, USFWS determined than an IA is appropriate in this case.

The stated purposes of the IA are to (i) ensure implementation of each of the terms and conditions of the HCP and the Joint ITP; (ii) provide long-term assurances to the Permittee Agencies that, pursuant to the federal "No Surprises" provisions of 50 CFR 17.22(b)(5) and 17.32(b)(5), as long as the terms and conditions of the IA, the HCP, and the ITP are fully satisfied, USFWS will not require the Permittee Agencies to commit additional land, water, or financial compensation, or to accept additional restrictions on the use of land, water, or other natural resources, either to minimize and mitigate the impacts of Authorized Take, or to provide for the conservation and management of the Covered Species in the Planning Area, except as provided in the IA and the HCP; and (iii) describe remedies and recourse should any Party fail to perform its obligations as set forth in the IA.

6.8.2 Contents of the Implementing Agreement

The IA outlines the basic responsibilities of USFWS, the JPA, and the Permittee Agencies under the HCP, largely along the lines described in this chapter of the HCP. It then addresses specific areas of JPA responsibility, including (i) overall plan implementation, (ii) implementation of plan-wide conservation measures, (iii) implementation of conditions on Covered Activities, (iv) establishment and management of the HCP Preserve System, (v) monitoring and adaptive management, (vi)

operation of the mitigation/conservation bank and other conservation actions, and (vii) coordination of the HCP ITP with the other regulatory permits. Additional topics covered by the IA include the scope and joint nature of incidental take coverage, regulatory assurances, requirements for coverage under Section 7 of the ESA, funding sources and assurances, reporting obligations, and remedies and enforcement. Remedies may include, among others, suspension or revocation of the incidental take authority under the Joint ITP of any Permittee Agency that falls out of compliance with the HCP.

6.8.3 Relationship to Other Bank Instruments

The IA incorporates the HCP by reference. The IA includes similar language to the PFA because the PFA is intended to support the JPA's obligations under the IA. To ensure that the JPA can remain in compliance with the IA, the PFA provides to each of the Permittee Agencies a right to cure defaults by other Permittee Agencies on the part of the JPA, and a dispute resolution process to assure that, in light of the interdependent nature of the activities of the Permittee Agencies, all appropriate efforts are taken to ensure the continued success of the HCP (and the JPA's continuing performance under the IA) even if one Permittee Agency breaches or otherwise has difficulties with compliance with the terms of the HCP.

6.8.4 Dispute Resolution Process

The IA will incorporate the principles of severability included in the JPA and PFA as described in Sections 6.2 and 6.4 above. In particular, the IA will assure that, if one Permittee Agency conducts a Covered Activity in a manner inconsistent with the HCP, (i) that Permittee Agency's incidental take authority may be suspended or revoked without affecting the incidental take authority issued to the other Permittee Agencies or the JPA and (ii) any costs incurred by the JPA or other Permittee Agencies as a result of non-compliance by one Permittee Agency will be borne by the non-complying Permittee Agency and shall be reimbursed to the JPA if the JPA has incurred any associated costs. The IA also provides for notice of default, opportunity to cure, and dispute resolution provisions to assure that the HCP may continue to operate without disruption, to the extent possible, while any disputes between the parties are resolved.

If a dispute should arise between the Alliance and USFWS (or other regulatory agency), a dispute resolution process will be implemented to encourage expedient resolution of the dispute. Most issues and decisions are expected to be readily resolved at the Alliance and agency Staff Level. However, if disputes are not resolved relatively quickly, they will be elevated to the Managers Group. If the Managers Group cannot resolve the dispute in one meeting, it will be elevated to the Directors Group, then the State Managers Group, and finally to the Appointed and Elected Official Level for final arbitration and decision (Figure 6-1).

6.9 Responses to Changed Circumstances

Section 10 regulations (50 CFR 17.22(b)(2) and 17.32(b)(2)) require that an HCP specify the procedures to be used for dealing with changed and unforeseen circumstances that may arise during the implementation of the HCP. In addition, the HCP No Surprises Rule (69 *Federal Register* 71723, December 10, 2004, as codified in 50 CFR 17.22 (b)(5) and 17.32(b)(5)) describes the obligations of the Permittees and USFWS. The purpose of the No Surprises Rule is to provide assurance to the non-

federal landowners participating in habitat conservation planning under the Endangered Species Act that no additional land restrictions or financial compensation will be required for species adequately covered by a properly implemented HCP, in light of unforeseen circumstances, without the consent of the Permittees.

Changed Circumstances are defined in 50 CFR 17.3 as changes in circumstances affecting a species or geographic area covered by an HCP that can reasonably be anticipated by the Permittees and USFWS and for which contingency plans can be prepared (e.g., a fire, or other natural catastrophic event in areas prone to such event). If additional conservation and mitigation measures are deemed necessary to respond to Changed Circumstances and these additional measures were provided for in the Plan's responses to the identified Changed Circumstances (e.g., conservation management activities or mitigation measures expressly agreed to in the HCP), then the Permittees will implement those measures as specified in the Plan. However, if additional conservation management and mitigation measures are deemed necessary to respond to Changed Circumstances and such measures were not provided for in the Plan's responses to the identified Changed Circumstances, USFWS will not require these additional measures absent the consent of the Permittees, provided that the HCP is being "properly implemented" (to properly implement the HCP means fully implementing all commitments and provisions agreed to in the HCP, the IAs, and the ITPs).

Chapter 7, *Funding*, estimates an average annual cost for Changed Circumstances of approximately $285,000 to implement the HCP. Annual funding of the Changed Circumstances Reserve will be higher in early years of HCP implementation to establish the reserve (see Chapter 7, Section 7.4.8).

The HCP has identified and addresses six Changed Circumstances that can be reasonably anticipated in the Planning Area: Climate Change, Fire, Drought, Flood, Invasion of New Exotic Species, and Future Listing of Non-Covered Species. Each of these Changed Circumstances is described below.

6.9.1 Climate Change

There are clear scientific data indicating that alteration of the atmosphere is causing changes in climate, including increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising sea levels. In California, it is anticipated that there will be warmer temperatures, greater extremes in weather, and larger variation between wet and dry years, but precipitation patterns are more difficult to project (Bedsworth et. al. 2018). Though annual precipitation may not vary greatly, a greater proportion of precipitation will come from larger storm events allowing for higher variability in annual rainfall depending on the size of the larger storms (Dettinger 2016). Higher nighttime temperatures are predicted, perhaps altering days of frost, daily temperature extremes, and distribution of some species (IPCC 2007). Some of the most dramatic potential climate change impacts include increased frequency and severity of extreme events, such as heat waves, wildfires, and flooding (Lenihan et al. 2006, IPCC 2007, Bedsworth et. al. 2018)). To accommodate shifts in distribution, species will need a range of large-core habitat areas connected by landscape-level linkages (Keeley et. al. 2018). The species most at risk are those that have specific habitat requirements, have limited ability to relocate, or are surrounded by development (leaving few relocation options).

Although the extent and nature of impacts from climate change within the Planning Area are unknown, some climatic models suggest that there may be changes in vegetation patterns and increases in wildfire size and frequency (Bedsworth et. al. 2018).

Response to Climate Change: The Upper Santa Ana River HCP conservation strategy protects and enhances through restoration and management the habitat connectivity in the region. Protection of habitat connectivity, especially along ecological gradients such as elevational gradients and along natural hydrologic features, provides the opportunity for species to shift their range and area of occupied habitat in response to climate change. Additional adaptive management may be needed to enhance connectivity at key locations, or to translocate individuals across existing barriers to movement. Long-term monitoring of the distribution of Covered Species and their habitat may indicate shifts in distribution and the need to adaptively manage the integrity and function of habitat connectivity at key locations. Monitoring will occur as a part of the Adaptive Management and Monitoring Plan (AMMP) implementation, and response to climate change will be managed through enhancement of connectivity for species movement at key locations as needed.

6.9.2 Fire

A repetitive fire that results in or substantially increases the risk of type conversion (e.g., converting shrub lands to non-native grasslands or loss of riparian overstory) constitutes a Changed Circumstance. USFWS has indicated that for sage scrub and riparian habitat, repeat fires within the same footprint within 10 years of the original burn can adversely hamper natural regrowth and interrupt the ability of the habitat to rejuvenate. Diffendorfer et al. (2007) cite several sources that indicate fire cycles of 1 to 3 years within sage scrub can increase the presence of exotic weeds and lead to conversion to grassland. Ten years after a fire, shrub-dominated habitat types are expected to be fully re-established and capable of natural regeneration. In riparian habitats, invasive species such as Arundo and tamarisk appear to be making riparian areas more fire prone, and are better adapted to recover from fire than native species, leading to a decline in native species after fires (Lambert et. al. 2010). Of particular problem in the Planning Area is the prevalence of homeless encampments in riparian habitats where cooking and heating fires spark wildfire in the surrounding riparian vegetation.

Response to Fire: Based on the frequency, extent, and severity of damage from a repetitive fire, specific adaptive management tasks will be identified and implemented. Natural regrowth within the damaged area will be monitored and measures to control invasion of exotic plant species, excessive erosion, and/or type conversion will be applied as part of the AMMP implementation. The damage caused by wildfires will be addressed as follows:

- Nonnative annual grasses and other invasive plants becoming established in the burn area will be controlled.
- Seed-free straw wattles or their equivalent will be placed in areas vulnerable to erosion.
- Native trees, shrubs, and annual forbs will be revegetated through seeding and/or container plants if, within 5 years of the fire, the percent cover of native vegetation is less than 30% of the pre-fire perennial and annual cover and/or in an adjacent unburned area of similar habitat.

6.9.3 Drought

For the purpose of defining Changed Circumstances, drought is defined as climatic drought of 5 to 10 years in length, as declared by the California State Department of Water Resources or, if needed, by the JPA. Longer periods of drought (greater than 10 years) are considered *Unforeseen Circumstances*.

Response to Drought: Depending upon the extent and severity of the drought, a specific adaptive management action plan will be developed and implemented as part of the AMMP implementation. Management activities may include increased effort to control nonnative weeds and other invasive species. In extreme cases and if feasible, water stored in the Bunker Basin or other sources managed by the Permittee Agencies could be available as a potential management tool for supplemental water and habitat maintenance.

6.9.4 Flood

A 100-year flood event as classified by the Federal Emergency Management Agency (FEMA) and determined by the Flood Control constitutes a Changed Circumstance under this HCP. However, flooding is a natural event and is not anticipated to cause sufficiently severe damage that would prevent natural regeneration within the HCP Preserve.

Response to Flood: If the extent and severity of flood damage indicate a need for monitoring or management, measures will be identified and applied as part of AMMP implementation.

6.9.5 Invasion of New Exotic Species

For the purpose of defining Changed Circumstances, invasion of new exotic species is defined as an introduction of a nonnative species within the HCP Preserve that has either: (a) not previously been known to occur in the Planning Area and has been shown to be problematic elsewhere or (b) is a particularly problematic variety of nonnative species that is resistant to typical control measures (e.g., herbicide-resistant variety of plant). Unforeseen Circumstances would be defined as invasion within the HCP Preserve of a species not currently known to be problematic elsewhere, but that becomes so upon establishment in the HCP Preserve.

Response to Invasion of New Exotic Species: When invasive species are discovered, actions designed to reduce such species will be applied. If an unanticipated invasion by exotic species occurs as a result of another Changed Circumstance identified in this section (e.g., repeated fires), USFWS will be notified. The damage caused by the unanticipated invasion by exotic species will be addressed as follows:

- The invasive species will be mapped and their abundance at each location will be noted.
- Mapped infestations of the invasive species will be treated and re-treated as necessary to achieve control and eventual eradication.
- The response of species/habitats to the action(s) taken will be monitored.

For new invasive terrestrial plant species, where the influx of invasive species involves a species included on the California Invasive Plant Council (Cal-IPC) “List A” or state or federal “noxious” weeds, USFWS and CDFW will be notified and a plan of action will be determined within 30 days of such notice.

For new invasive aquatic plants and animals, the presence and abundance of invasive species will be recorded during periodic Covered Species and habitat surveys. Any new invasive species not previously documented in the Planning Area (constituting a Changed Circumstance) will be brought to the immediate attention of the JPA and wildlife agencies, and a plan to assess the threat and response will be developed within 30 days. For previously known but particularly noxious species,

an invasive species control and eradication plan will be developed and implemented within 6 months of detection.

6.9.6 Future Listings of Non-Covered Species

In the event that a species that occurs or has the potential to occur within the Planning Area that is not a Covered Species under this HCP is listed by USFWS subsequent to the issuance of the ITP, such listing will be considered a Changed Circumstance.

Response to Future Listings of Non-Covered Species: The JPA, with assistance from USFWS, will evaluate the potential effects of Covered Activities on the newly listed species and any designated critical habitat. If there is a potential for adverse effects to occur during implementation of Covered Activities, the JPA will implement measures identified by USFWS to avoid the likelihood of take of the newly listed non-Covered Species, or modification of the newly designated critical habitat, until the HCP and Joint ITP are amended to include such species, or until USFWS notifies the JPA that such measures are no longer needed. The JPA may enter into negotiations with USFWS regarding necessary modifications to the HCP, if any, to revise or amend the Joint ITP to cover the newly listed species. If the JPA decides to pursue coverage of the species under this HCP, USFWS will provide technical assistance in identifying appropriate modifications to the HCP that will be necessary to revise or modify the Joint ITP to cover the newly listed species. USFWS will take into account habitat benefits for the newly listed species provided by existing HCP management activities. A revision to the Joint ITP to include a new species would be processed as a Major Amendment to the HCP.

6.10 Responses to Unforeseen Circumstances

Unforeseen Circumstances are defined in 50 CFR 17.3 as changes in circumstances that affect a species or geographic area covered by the HCP that could not reasonably be anticipated by the Permittees or USFWS at the time of the HCP's negotiation and development, and that result in a substantial and adverse change in status of the Covered Species. The purpose of the No Surprises Rule is to provide assurances to non-federal landowners participating in habitat conservation planning under the ESA that no additional land restrictions or financial compensation will be required for species adequately covered by a properly implemented HCP, in light of Unforeseen Circumstances, without the consent of the Permittees.

In case of an unforeseen event for the Upper Santa Ana River HCP, the JPA will immediately notify USFWS staff who have functioned as the principal contacts for the HCP. In determining whether such an event constitutes an Unforeseen Circumstance, USFWS will consider, but not be limited to, the following factors: size of the current range of the affected species, percentage of range adversely affected by the HCP, percentage of range conserved by the HCP, ecological significance of that portion of the range affected by the HCP, level of knowledge about the affected species and the degree of specificity of the species-specific conservation strategy under the HCP, and whether failure to adopt additional conservation measures would appreciably reduce the likelihood of survival and recovery of the affected species in the wild.

If USFWS determines that additional conservation and mitigation measures are necessary to respond to the Unforeseen Circumstances where the HCP is being properly implemented, the additional measures required of the JPA must be as close as possible to the terms of the original HCP and must be limited to modifications within any conserved habitat area or to adjustments within

lands or waters that are already set-aside in the HCP's planned preserve system. Additional conservation and mitigation measures will not involve the commitment of additional land, water, or financial compensation or restrictions on the use of land, water, or other natural resources otherwise available for use by Covered Activities under original terms of the HCP, unless agreed to by the JPA and Permittee Agencies.

STAFF LEVEL

ROLES & APPROACH FOR ISSUE RESOLUTION

- Regular meetings occurring quarterly or more frequently as needed
- If issue arises, clearly define issues before elevating for resolution
- If issue cannot be resolved relatively quickly (1-2 meetings), elevate immediately

TEAM

- Alliance: Preserve System Manager and/or Program Compliance Manager
- USFWS: Palm Springs Field Office staff
- CDFW: Region 6/Ontario office staff
- USACE: Los Angeles District Project Manager
- RWQCB: Santa Ana RWQCB Staff

MANAGERS GROUP

ROLES & APPROACH FOR ISSUE RESOLUTION

- Periodic meetings scheduled on a regular basis, even if there are not specific issues to elevate
- If group cannot resolve issue in one meeting, elevate immediately

TEAM

- Alliance: Technical Advisory Committee and/or Preserve Management Committee
- USFWS: Assistant Field Supervisor, Carlsbad Field Office
- CDFW: Environmental Program Manager, South Coast Region
- USACE: Chief, Los Angeles and San Bernardino Counties Section, Regulatory Division
- RWQCB: Santa Ana Team RWCQB Senior Regulatory Staff

DIRECTORS GROUP

ROLES & APPROACH FOR ISSUE RESOLUTION

- Quarterly meetings scheduled, even if there are not specific issues to elevate
- Meetings would include a briefing for group on progress and status/milestones

TEAM

- Alliance: Executive Director
- USFWS: Field Supervisor, Carlsbad Field Office
- CDFW: Regional Manager, South Coast Region
- USACE: Los Angeles Division Regulatory Branch Chief
- RWQCB: Santa Ana RWQCB Executive Officer

STATE MANAGERS

ROLES & APPROACH FOR ISSUE RESOLUTION

- Meeting scheduled if needed

TEAM

- Alliance: Executive Director and Valley District GM
- USFWS: Assistant Regional Director, HCP Coordinator Regional Office
- CDFW: Deputy Director, Ecosystem Conservation Division
- USACE: Los Angeled District Commander
- RWQCB: SWRCB Chief Deputy Executive Director for Water Quality

APPOINTED AND ELECTED OFFICIAL LEVEL

ROLES & APPROACH FOR ISSUE RESOLUTION

- Final arbitrator of elevation
- Meeting scheduled if needed

TEAM

- Alliance: Executive Director and Valley District GM
- USFWS: Regional Office Director
- CDFW: Director
- USACE: As Determined by ACOE
- RWQCB: SWRCB Executive Director

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Figure 6-1
Regulatory Agency Dispute Resolution Process
Upper Santa Ana River Habitat Conservation Plan

Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Chapter 7
Funding

This chapter provides planning-level estimates of the costs to implement the Habitat Conservation Plan (HCP), identifies funding sources to pay for implementation, and describes the rationale for funding assurances.

7.1 Cost and Benefit of the HCP

The HCP is estimated to cost approximately $187.5 million, paid incrementally over the 50-year permit term and excluding inflation, and shared among the Permittee Agencies.

Over 50 years, the $187.5 million in HCP costs will allow Permittee Agencies to develop over 4 million acre-feet of water for local use, or approximately 87,000 acre-feet per year (afy) by year 15 of HCP implementation. These water resources will reduce reliance on imports from other parts of the state, increasing the area's resilience to drought and regulatory restrictions that hamper water deliveries from the State Water Project, while also keeping more of the project spending in the local economy.

While the price tag of the HCP may appear surprisingly high upon first glance, the economic benefits of the plan to water users and the local economy as a whole are substantially greater than the costs. Without the HCP in place, Permittee Agencies would need to acquire this additional 87,000 afy of water supply from more costly alternative sources. Even with a conservative assumption that it would be possible to purchase that volume of water either from wholesalers or elsewhere in the market, the HCP is projected to save the region approximately $952 million over the life of the HCP on a net present value basis, and create secondary benefits from investment in the local economy.[1] This represents a benefit-cost ratio over 7.3.[2] This total net benefit illustrates the enormity and importance of this effort.

7.2 Purpose of Cost Estimate and Annual HCP Implementation Budget

The cost estimates presented in this chapter have been developed for the purpose of budgeting and are not to be confused with legally authorized or required cost expenditures. Actual year-to-year expenditures will be based on HCP implementation priorities as developed in the preserve management plans and annual reports, and as determined by the Upper Santa Ana River Sustainable Resource Alliance (Alliance), technical committee, and preserve management committee. This budget is based on a projected HCP implementation schedule that may not conform with how the HCP will be implemented in response to the actual timing of Covered Activity implementation. As

[1] Refer to Section 7.6, *HCP Benefits*, for a detailed accounting of this estimate. Net present value (NPV) calculations are made using an interest rate of 4.61% based on the rate used by the State Water Project in calculating water prices. A general inflation rate is assumed to be 2%. The net discount rate is 2.61%.

[2] The benefit-cost ratio is the net present value of the benefits divided by the net present value of the costs. In this case, the benefits are the avoided future costs of more expensive water sources. A ratio above 1.0 indicates net positive benefits over the life or a project or program.

the HCP is adapted to changing environmental conditions and schedules and scale of Covered Activities, this budgeted amount will also change. In addition, the budget will be updated to reflect general inflation and cost escalation that cannot be readily forecasted today. Using constant dollar budget estimates instead allows more readily for comparisons across years.

7.3 HCP Cost Estimate

The HCP is estimated to cost approximately $187.5 million in 2018 dollars, including costs over 50 years without discounting and inflation. Table 7-1 to Table 7-3 summarize the total, capital, and operational costs estimated to be necessary to carry out the HCP.

The cost analysis is based on a number of assumptions regarding the timing of implementation of various components of the HCP and the estimated unit costs of land, labor, and materials. Unit cost estimates were based on the best available information and represent average unit costs. The costs of individual items will fluctuate above and below these averages. The total cost presented herein should therefore be regarded as a planning-level estimate to aid in the determination of the approximate amount of funding needed to implement the HCP. Specific costs will be refined as they are ascertained during the first years of HCP implementation, and any adjustments to the overall costs, cost-sharing agreements among Permittee Agencies, and endowment requirements will be made as needed.

Costs are organized by the following cost categories:

- Land acquisition and easements
- Restoration
- Fish translocation
- Management and maintenance
- Monitoring and reporting
- Program administration
- Post-permit endowment
- Contingency

All cost categories are mutually exclusive so that summing the category costs yields the total expected cost to implement the HCP. Note, however, that some cost items are allocated across the categories. For example, Implementing Entity (Alliance) staff salaries and overhead are apportioned across the categories because staff will perform a range of functions. Each cost category is divided into capital and operational costs. Capital costs are typically one-time costs for land, equipment, structures, or improvements. Operational costs are ongoing costs such as staff salaries and contractor fees. Costs are summarized by 5-year periods spanning the 50-year permit period except for pre-permit and startup costs, which are shown as lump sums for Permit Year 0 (costs that will have been incurred prior to the initiation of HCP implementation). Costs are in 2018 dollars unless noted otherwise.

Table 7-1. Summary of Upper SAR HCP Total Implementation Costs (1,000s 2018 dollars)

	Implementation Period (Years)					
	Initial	Phase 1	Phase 2	Phase 3	Phase 4	Total
Total Costs[1]	**0[2]**	**1–5**	**6–10**	**11–15**	**16–20**	**Costs[3]**
Land Acquisition & Easements	$0	$26,372	$6,843	$0	$0	$33,215
Restoration	$24,350	$5,811	$4,548	$973	$1,561	$37,243
Fish Translocation	$255	$381	$122	$72	$504	$1,334
Management and Maintenance	$0	$1,788	$2,065	$2,138	$14,966	$20,957
Monitoring and Reporting	$0	$722	$722	$722	$4,798	$6,964
Staffing and Program Administration	$0	$6,245	$6,245	$6,117	$42,819	$61,426
Endowment Fund	$0	$1,484	$1,484	$1,484	$10,388	$14,840
Changed Circumstance Reserve	$3,660	$3,809	$1,659	$392	$1,952	$11,472
Total	$28,265	$46,612	$23,688	$11,898	$76,988	$187,451
Total Per Year		**$9,322**	**$4,738**	**$2,380**	**$2,200**	**$3,749**

[1] All costs rounded to the nearest $1,000.
[2] Year 0 costs are costs that will have been incurred prior to the start of the HCP.
[3]Total Costs sum across all years with no discounting

Table 7-2. Summary of Upper SAR HCP Capital Costs (1,000s 2018 dollars)

	Implementation Period (Years)					
	Initial	Phase 1	Phase 2	Phase 3	Phase 4	Total
Capital Costs[1]	**0[2]**	**1–5**	**6–10**	**11–15**	**16–20**	**Costs[3]**
Land Acquisition & Easements	$0	$26,372	$6,843	$0	$0	$33,215
Restoration	$24,350	$3,711	$800	$750	$0	$29,611
Fish Translocation	$255	$0	$0	$0	$0	$255
Management and Maintenance	$0	$0	$0	$0	$0	$0
Monitoring and Reporting	$0	$0	$0	$0	$0	$0
Staffing and Program Administration	$0	$0	$0	$0	$0	$0
Endowment Fund	$0	$0	$0	$0	$0	$0
Changed Circumstance Reserve	$3,660	$3,194	$804	$113	$0	$7,771
Total	$28,266	$33,277	$8,447	$863	$0	$70,852
Total Per Year		**$6,655**	**$1,689**	**$173**	**$0**	**$1,417**

[1] All costs rounded to the nearest $1,000.
[2] Year 0 costs are costs that will have been incurred prior to the start of the HCP.
[3] Total Costs sum across all years with no discounting.

Table 7-3. Summary of Upper SAR HCP Operating Costs (1,000s 2018 dollars)

	Implementation Period (Years)					
	Initial	Phase 1	Phase 2	Phase 3	Phase 4	Total
Operating Costs[1]	**0[2]**	**1–5**	**6–10**	**11–15**	**16–20**	**Costs[3]**
Land Acquisition & Easements	$0	$0	$0	$0	$0	$0
Restoration	$0	$3,065	$4,713	$922	$6,453	$15,153
Fish Translocation	$0	$1,108	$849	$547	$3,832	$6,337
Management and Maintenance	$0	$2,978	$3,256	$3,626	$25,385	$35,245
Monitoring and Reporting	$0	$1,744	$1,744	$1,964	$13,494	$18,946
Staffing and Program Administration	$0	$2,340	$2,340	$2,212	$15,484	$22,376
Endowment Fund	$0	$1,484	$1,484	$1,484	$10,386	$14,837
Changed Circumstance Reserve	$0	$616	$855	$280	$1,952	$3,703
Total	$0	$13,335	$15,240	$11,036	$76,986	$116,597
Total Per Year		**$2,667**	**$3,048**	**$2,207**	**$2,200**	**$2,332**

[1] All costs rounded to the nearest $1,000.
[2] Year 0 costs are costs that will have been incurred prior to the start of the HCP.
[3] Total Costs sum across all years with no discounting.

7.4 Cost Estimate Methodology

This section provides an explanation of each cost category and the methods that were used to develop the HCP cost estimate. The spreadsheets used to develop the HCP cost estimate are provided in Appendix H, *Upper Santa Ana River HCP Cost*.

7.4.1 Land Acquisition and Easements

Land acquisition and easement cost estimates are based on a geographic information system (GIS) database of the HCP restoration and conservation parcel areas. However, actual useable habitat under the HCP is sometimes smaller than the total GIS parcel areas. This section provides conservative cost estimates based on total land area. For more precise information on the actual planned areas of habitat restoration, creation, and enhancement, refer to Chapter 5, *Conservation Strategy*.

The HCP conservation strategy consists of the restoration and conservation of 628 acres and additional conservation of 1,274 acres, totaling 1,902 acres in the HCP strategy. The land parcels identified for acquisition or easements also include small amounts of developed or agricultural land (187 acres), bringing the total acreage of land to 2,089 acres.

In addition to the land planned for inclusion in the HCP Preserve System, additional habitat credits could be purchased from conservation banks if needed ($140,000 per acre). However, as these credits are not likely to be needed for mitigation under the HCP, those costs are not included in the overall cost estimates.

Costs for establishing land acquisitions and easements for the HCP Preserve System are divided into two categories:

- Restoration Areas
- Conservation Areas

Restoration Areas

The conservation strategy includes restoration of 628 acres of habitat. In order to acquire this area of land suitable for restoration, it will be necessary to either acquire or establish an easement on 726 acres of land, because the necessary parcels include about 98 acres of developed and agricultural land.

Parcels will either be purchased outright in an acquisition transaction or they will be used through establishment of an easement. Under an easement, ownership is retained by the original landholder and the implementing entity gains access to the land for limited purpose, in this case for habitat restoration and management.

Restoration project parcels can be separated into those that contain aquatic or riparian restoration projects and those in the alluvial fan areas.

All land costs will be incurred in the first 15 years of the project (by Phase 3). Table 7-4 shows the type and timing of all planned transactions for restoration project areas.

Table 7-4. Restoration Project Acreages

	Transaction Type	Phase 1	Phase 2	Phase 3	Total Acres
Anza Creek and Old Ranch Creek	Easement	26	0	0	26
Evans Lake	Easement	88	0	0	88
Hidden Valley Creek	Easement	11	102	0	112
Hidden Valley Ponds	Easement	13	55	0	69
Lower Hole Creek	Easement	5	0	0	5
Subtotal Aquatic/Riparian		**143**	**157**	**0**	**301**
Drainage A Woollystar Restoration	Acquisition	-	37	-	37
Enhanced Recharge Basin Restoration	Easement	209	-	-	209
Louis Rubidoux Nature Center and Sunnyslope Creek	Easement	38	-	-	38
Management of Santa Ana Sucker Restoration on Sunnyslope Creek	Easement	10	-	-	10
North Enhanced Recharge Restoration	Easement (HCP Partner-Owned)	34	-	-	34
Subtotal Alluvial Fan		**291**	**37**	**0**	**327**

	Transaction Type	Phase 1	Phase 2	Phase 3	Total Acres
Subtotal all restoration project land		**434**	**194**	**0**	**628**
Additional developed/ag land		94	4	0	98
Total		**528**	**198**	**0**	**726**

The cost of land varies depending on the type and quality of habitat as well as what alternative uses of the land are feasible. In many cases HCP-partner agencies will allow easements on their lands as an in-kind contribution to the HCP, with no additional per acre cost. In other cases, easements have already been established, so going-forward additional costs to the HCP are zero.

In addition to the per acre cost of the land, a $5,000 transaction fee is included for establishing an easement (on a per-parcel basis). This transaction cost does not apply to lands acquired outright through purchase.

Table 7-5 outlines the costs of all Restoration Area lands. Aquatic/riparian parcels will cost a total of $25,000, while alluvial fan lands will cost $31.9 million, for a total land cost of $31.9 million.

Table 7-5. Restoration Project Land Costs

	Cost Per Acre	Total Acres	Additional Easement Transaction Cost	Total Cost
Anza Creek and Old Ranch Creek	$0[1]	26	$5,000	$5,000
Evans Lake	$0[1]	115	$5,000	$5,000
Hidden Valley Creek	$0[2]	112	$5,000	$5,000
Hidden Valley Ponds	$0[2]	69	$5,000	$5,000
Lower Hole Creek	$0[2]	6	$5,000	$5,000
Subtotal Aquatic/Riparian		**328**	**$25,000**	**$25,000**
Drainage A Woollystar Restoration	$140,000	41	NA	$5,671,000
Enhanced Recharge Basin Restoration	$120,000	218	$5,000	$26,172,000
Louis Rubidoux Nature Center and Sunnyslope Creek	$0[3]	94	$5,000	$5,000
Management of Santa Ana Sucker Restoration on Sunnyslope Creek	$0[2]	10	$5,000	$5,000
North Enhanced Recharge Restoration	$0[4]	35	$5,000	$5,000
Subtotal Alluvial Fan		**397**	**$35,000**	**$31,858,000**
Total		**726**	**$60,000**	**$31,883,000**

[1] In-kind contribution from Permittee Agency
[2] CDFW retains ownership, no cost per acre
[3] Long-term lease at $5/year. Rounded to zero for this analysis.
[4] Purchase takes place before permit period; cost not included in analysis

Conservation Areas

The conservation strategy includes Conservation Areas of 1,274 acres of habitat. These lands will not require any active restoration work and will be managed as preserve lands for the entire permit term. In order to acquire this amount of suitable habitat it is necessary to either acquire or establish an easement on 1,363 acres of land, because the necessary parcels include 89 acres of developed and agricultural land that will not be part of the conservation strategy.

Parcels will either be purchased outright in an acquisition transaction or they will be used through establishment of an easement.

All land costs will be incurred in the first 10 years of the project (by Phase 2). Table 7-6 shows the type and timing of all planned transactions for Conservation Areas.

Table 7-6. Conservation Area Acreages

	Transaction type	Phase 1	Phase 2	Total Acres
Bastidos-Greenspot Rd	Easement (HCP Partner-Owned)	19	0	19
CD-Greenspot Rd	Easement (HCP Partner-Owned)	7	0	7
CD-Mill Creek	Easement	417	0	417
City Creek Water Co	Easement (HCP Partner-Owned)	0	260	260
DWR-Devil Creek	Easement	20	0	20
EV-City Creek	Easement (HCP Partner-Owned)	4	0	4
EV-SAR	Easement	11	0	11
Frost Trust-Plunge Creek	Acquisition	0	41	41
Greenspot Corridor-SAR-East	Acquisition	10	0	10
Greenspot Corridor-SAR-West	Acquisition	4	0	4
Kuykendall-Greenspot Rd	Easement (HCP Partner-Owned)	1	0	1
Rossmore Enterprises-SAR	Acquisition	40	0	40
RPU-SAR	Easement (HCP Partner-Owned)	88	0	88
WD-Devil Creek	Easement (HCP Partner-Owned)	352	0	352
Subtotal	**conservation-only land**	**972**	**302**	**1,274**
Additional developed/ag land		**72**	**18**	**89**
Total		**1,044**	**319**	**1,363**

Conservation Area land costs work the same as those for restoration projects. Land costs vary depending on the specific parcel and potential alternative uses. In many cases HCP-partner agencies allow easements on their lands as an in-kind contribution to the HCP, with no additional per acre cost. In other cases, easements have already been established, so going-forward additional costs to the HCP are zero.

In addition to the per acre cost of the land, a $5,000 transaction fee is included for establishing an easement (on a per-parcel basis). This transaction cost does not apply to lands acquired outright through purchase.

Table 7-7 outlines the costs of all Conservation Area lands. Costs total $1.3 million.

Table 7-7. Conservation Area Land Costs

	Cost Per Acre	Total Acres	Additional Easement Transaction Cost	Total Cost
Bastidos-Greenspot Rd	$0[1]	19	$5,000	$5,000
CD-Greenspot Rd	$0[1]	7	$5,000	$5,000
CD-Mill Creek	$0[2]	434	$50,0000	$50,000
City Creek Water Co	$0[2]	260	$25,000	$25,000
DWR-Devil Creek	$0[2]	25	$5,000	$5,000
EV-City Creek	$0[2]	4	$5,000	$5,000
EV-SAR	$0[2]	13	$15,000	$15,000
Frost Trust-Plunge Creek	$20,000	59	NA	$1,172,000
Greenspot Corridor-SAR-East	$0[3]	18	NA	$0
Greenspot Corridor-SAR-West	$0[3]	4	NA	$0
Kuykendall-Greenspot Rd	$0[1]	1	$5,000	$5,000
Rossmore Enterprises-SAR	$0[1]	40	NA	$0
RPU-SAR	$0[2]	102	$35,000	$35,000
WD-Devil Creek	$0[2]	377	$10,000	$10,000
Total		**1,363**	**$160,000**	**$1,332,000**

[1] Purchase takes place before permit period; cost not included in analysis
[2] In-kind contribution from HCP partner
[3] Acquired at no cost by land trade with owners

Land Acquisition and Easements Summary

Including both restoration and Conservation Area land costs, total land costs are estimated at $33.2 million. These costs are summarized by phase in Table 7-8.

Table 7-8. Summary of Total Land Costs

	Phase 1	Phase 2	Phase 3	Phase 4	Total Cost
Restoration					
Aquatic/Riparian	$25,000	$0	$0	$0	$25,000
Alluvial Fan	$26,187,000	$5,671,000	$0	$0	$31,858,000
Conservation					
Alluvial Fan	$160,000	$1,172,000	$0	$0	$1,332,000
Total	**$26,372,000**	**$6,843,000**	**$0**	**$0**	**$33,215,000**

7.4.2 Restoration Activity

Under the HCP strategy 628 acres of habitat will be restored, including both aquatic/riparian areas along Santa Ana River (SAR) and its tributaries as well as upland alluvial fan areas. All of the restoration projects entail increasing the amount and quality of available habitat in lowland tributaries and the Santa Ana River as well as alluvial fan scrub habitats. See Chapter 5, Section 5.4.4,

Restoration Areas, for more detail on the specific restoration activities planned at each restoration site. Restoration project costs are divided into the following four categories:

- Major restoration project costs
- Habitat Management and Monitoring Plan (HMMP) Implementation costs
- Santa Ana River microhabitat restoration project costs
- Supplemental streamflow costs

HMMP costs take place for 5 years following the restoration implementation. Long-term maintenance and monitoring costs for restoration projects are accounted for in Sections 7.4.4, *Preserve Management and Maintenance,* and 7.4.5, *Monitoring and Reporting.*

Major Restoration Project Costs

Major restoration project costs are estimated at $1.6 million.

Restoration project costs have been estimated for each restoration site. Major restoration project costs include design, planning, permitting, and construction costs for the specific restoration project (Santa Ana River tributary restoration including creek channel and riparian floodplain, as well as alluvial fan restoration projects). These costs may occur over the four phases of the HCP period but are all considered capital costs. These costs are summarized by phase and restoration site in Table 7-9.

Five of the sites listed in Table 7-9, have been identified for tributary restoration projects designed to enhance the amount and quality of Santa Ana sucker habitat. Restoration has been initiated at three of these sites. Restoration of the other two sites is expected to take place within the first 5 years of the permit term. The cost estimates in Table 7-9 are based on already incurred and expected costs at each restoration site.

Table 7-9. Restoration Implementation Capital Costs

	Phase 1	Phase 2	Phase 3 or 4	Total
Stream/Pond Restoration				
Anza/Old Ranch	$0	$0	$0	$0
Evans Lake	$0	$0	$0	$0
Hidden Valley Ponds	$0	$0	$750,000	$750,000
Hidden Valley Wetlands	$0	$0	$0	$0
Lower Hole Creek	$0	$0	$0	$0
Subtotal	**$0**	**$0**	**$750,000**	**$750,000**
Floodplain Restoration				
Evans Lake	$0	$0	$0	$0
Hidden Valley Wetlands	$0	$500,000	$0	$500,000
Subtotal	**$0**	**$500,000**	**$0**	**$500,000**
Wildlife Area Management Plans				
Evans Lake	$0	$0	$0	$0
Hidden Valley Ponds	$0	$0	$0	$0

	Phase 1	Phase 2	Phase 3 or 4	Total
Hidden Valley Wetlands	$0	$100,000	$0	$100,000
Lower Hole Creek	$0	$50,000	$0	$50,000
Subtotal	**$0**	**$150,000**	**$0**	**$150,000**
Alluvial Fan Restoration				
Enhanced Recharge Restoration	$0	$0	$0	$0
North Enhanced Recharge Restoration	$0	$0	$0	$0
Woollystar Restoration Site (Drainage A)	$0	$150,000	$0	$150,000
Subtotal	**$0**	**$150,000**	**$0**	**$150,000**
Total	**$0**	**$800,000**	**$750,000**	**$1,550,000**

Habitat Management and Monitoring Plan Implementation

HMMP implementation covers 5 years of maintenance and monitoring costs after restoration activities are complete. ICF staff created estimates for HMMP implementation based on their experience with other management and monitoring efforts. However, because precise plans have not yet been developed estimates are broad but conservative. We estimate the HMMP costs based on the at $5.6 million HMMP costs are included as an operations and maintenance (O&M) cost and are summarized by phase and restoration site in Table 7-10.

Table 7-10. HMMP Costs

	Phase 1	Phase 2	Phase 3 or 4	Total
Stream/Pond Restoration				
Anza/Old Ranch	$1,000,000	$0	$0	$1,000,000
Evans Lake	$0	$1,000,000	$0	$1,000,000
Hidden Valley Ponds	$0	$300,000	$0	$300,000
Hidden Valley Wetlands	$500,000	$0	$0	$500,000
Lower Hole Creek	$350,000	$0	$0	$350,000
Subtotal	**$1,850,000**	**$1,300,000**	**$0**	**$3,150,000**
Floodplain Restoration				
Evans Lake	$0	$250,000	$0	$250,000
Hidden Valley Wetlands	$0	$550,000	$0	$550,000
Subtotal	**$0**	**$800,000**	**$0**	**$800,000**
Wildlife Area Management Plans				
Evans Lake	$0	$500,000	$0	$500,000
Hidden Valley Ponds	$0	$0	$0	$0
Hidden Valley Wetlands	$0	$500,000	$0	$500,000
Lower Hole Creek	$0	$250,000	$0	$250,000
Subtotal	**$0**	**$1,250,000**	**$0**	**$1,250,000**

	Phase 1	Phase 2	Phase 3 or 4	Total
Alluvial Fan Restoration				
Enhanced Recharge Restoration	$250,000	$0	$0	$250,000
North Enhanced Recharge Restoration	$0	$100,000	$0	$100,000
Woollystar Restoration Site (Drainage A)	$0	$75,000	$0	$75,000
Subtotal	**$250,000**	**$175,000**	**$0**	**$425,000**
Total	**$2,100,000**	**$3,525,000**	**$0**	**$5,625,000**

Santa Ana River Microhabitat Restoration

The costs for Santa Ana River microhabitat restoration correspond to the following Santa Ana sucker (SAS) Actions associated with SAS Objective 2, as described in Chapter 5:

> **SAS Objective 2:** Increase the amount and quality of available foraging and spawning habitat in the mainstem of the Santa Ana River through restoration and enhancement. A portion of this area is included in the modeled habitat for the species, while other portions are not currently suitable habitat but would be restored to be suitable for the species.
>
> > **SAS Action 2A:** Enhance sucker habitat in the mainstem of the Santa Ana River with the addition of at least six habitat nodes and/or stream bifurcation structures, enhancing at least 1.5 acres of habitat (see Section 5.5.1, *Mainstem Santa Ana River Microhabitat Creation*).

Santa Ana River microhabitat restoration entails the installation of elevated inverts, open water runners, and partially submerged groins designed to provide suitable Santa Ana sucker habitat and shelter, particularly during migration periods. Unit costs for these structures are based on preliminary designs prepared by Scheevel Engineering. The costs are summarized in Table 7-11. In addition to the initial design, permitting, and construction costs, it is assumed that, on average, one habitat node will need to be rebuilt every 5 years due to washout or other event rendering the damaged node unsuitable Santa Ana sucker habitat. The replacement cost is set to the average cost per habitat node for the three habitat structures listed in Table 7-11.

Table 7-11. Santa Ana River Microhabitat Restoration Cost Estimate

	Elevated Inverts	Open Water Runners	Partially Submerged Groins	Total
Number of Microhabitat Nodes	4	6	6	
Total Habitat Created – low end (acres)	0.05	0.09	0.12	0.26
Total Habitat Created – high end (acres)	0.47	0.87	1.19	2.53
Construction Costs				
Design & Permitting	$76,000	$76,000	$76,000	$228,000
Construction	$976,000	$1,276,000	$1,186,000	$3,438,000
Total Capital Cost	**$1,052,000**	**$1,352,000**	**$1,262,000**	**$3,666,000**

	Elevated Inverts	Open Water Runners	Partially Submerged Groins	Total
Node replacement cost every 5 years[1]				$223,000
Expected Implementation	Years 1–5	Years 1–5	Years 1–5	

[1] Cost estimate assumes one habitat note will need to be rebuilt every 5 years due to washout or other event rendering the damaged node unsuitable Santa Ana sucker habitat.

Supplemental Streamflow Cost

To support Santa Ana sucker habitat restoration, 4,501 afy of water will need to be supplied to the Hidden Valley Creek and Old Ranch Creek channels. The supplemental flows to the Old Ranch Creek and Hidden Valley Creek sites would occur for 8 months each year (April–November) at a continuous rate of 3 cubic feet per second (cfs).

San Bernardino Valley Municipal Water District (Valley District) plans to use recycled water supplies to meet these water needs. To supply tributary restoration sites with continuous flows, recycled water from the existing Riverside Regional Water Quality Control Plant will be conveyed to points along the Santa Ana River. The City of Riverside Public Utilities Water Division has proposed the Santa Ana River Sustainable Parks and Tributaries Water Reuse Project (RPU.10) to expand the existing recycled water system to provide water to both Riverside Public Utilities (RPU) customers as well as providing water to tributary restoration sites.

According to the cost estimates developed for RPU.10 in their Habitat-Parks Recycled Water Preliminary Planning Report (RPU 2018), planning scenarios to supply water to both RPU customers and the HCP including capital costs are estimated at $48.7 million. This investment would be split evenly between the HCP and RPU, so the total capital cost included here is $24.4 million. Annual operations and maintenance costs, which include maintenance and electricity for the recycled water pump station, dichlorination, and labor, are estimated at $608,000, which would also be split evenly. In addition to capital and operating expenses, the planning report adds an additional amount of $71 per acre-foot of water for purchase of water from Riverside Public Works and a Regional Water Quality Control Plant onsite Recycled Water Infrastructure Capital Recovery charge. For the estimated 4,501 afy needed annually, this is an additional $320,000 per year. However, it is also anticipated that the project would receive approximately $625,000 per year in revenue from the Inland Empire Utilities Agency (IEUA) for sending water down the Santa Ana River to meet their legal requirements. Considering the revenue from IEUA, annual costs for the water source are estimated at zero.

Table 7-12 summarizes the cost of supplemental water.

Table 7-12. Summary of Supplemental Water Costs

	Summary	Total Capital	Total Annual	Total-5-Year Period
Capital Cost	0.5 x $48.7 million	$24,400,000		
Annual O&M Cost	0.5 x $608,000		$304,000	$1,520,000
Additional Annual Capital Recovery Charge Cost	4,501 afy x $71/acre-foot		$320,000	$1,600,000
IEUA Revenue			-$625,000	-$3,125,000
Total Annual Cost			**$0**	**$0**

Summary of Restoration Cost Estimate

Table 7-13 summarizes all restoration costs included in the HCP strategy. Capital investment costs for restoration projects are estimated to be $29.6 million in total; $24.4 million of which occurs prior to issuance of the HCP permit to expand the Riverside Regional Water Quality Control Plant. The remaining $5.2 million is spread out over the different phases to construct habitat improvements.

O&M costs range from $2.1 million in Phase 1, $3.7 million in Phase 2, and $1.8 million over the remainder of the 50-year permit.

The cost estimate in Table 7-13 does not include the long-term costs for management and monitoring of the restoration sites. As noted above, those costs are accounted for in Sections 7.4.4 and 7.4.5.

Table 7-13. Summary of Total Restoration Costs ($1,000s)

	Pre-Permit	Phase 1	Phase 2	Phases 3 and 4	Total
Restoration	$0	$0	$800	$750	$1,550
HMMP					$0
Microhabitat Restoration		$3,666			$3,666
Supplemental Streamflow (Expansion of RPU Regional Water Quality Control Plant)	$24,350	$0			$24,350
Capital Subtotal	**$24,350**	**$3,666**	**$800**	**$750**	**$29,566**
Restoration					$0[1]
HMMP	$0	$2,100	$3,525	$0	$5,625
Microhabitat Restoration		$0	$223	$1,784	$2,007
Supplemental Streamflow		$0	$0	$0	$0
O&M Subtotal	**$0**	**$2,100**	**$3,748**	**$1,784**	**$7,632**
Total[2]	**$24,350**	**$5,766**	**$4,548**	**$2,534**	**$37,243**

[1] O&M costs are zero because after construction, restoration sites will be managed as part of Conservation Areas in the preserve system. See Section 7.4.4, *Preserve Management and Maintenance,* for information on these costs.
[2] Note that total cost corresponds to total Restoration costs in Table 7-1. Numbers may not sum to total due to rounding.

7.4.3 Fish Translocation

Fish translocation entails creating new local populations of sucker in the mountain tributaries of the Santa Ana River, per Santa Ana sucker Objective 6, as described in Chapter 5. The costs presented in this subsection pertain to the following SAS Action*:*

- **SAS Action 6A:** Conduct multiple translocations of sucker into mountain tributaries with parental stock derived from various locations from the Santa Ana River, and successfully translocate and maintain a sucker population in at least three mountain tributaries.

Costs for fish translocation activities are divided into the following four categories:

- Fish translocation plan development
- Captive propagation facility construction and O&M
- Translocation contractor services
- U.S. Forest Service (USFS) coordinating agreement costs

Monitoring costs associated with fish translocation are accounted for in Section 7.4.5*.*

Fish Translocation Plan Development

The cost for development of the fish translocation plan that has been prepared was $255,000.

Captive Propagation Facility

Construction of the Santa Ana sucker captive propagation facility has already been paid for pre-permit, and is therefore not included as a going-forward HCP cost in this analysis. Annual O&M is estimated at $32,500 per fish raceway. For purposes of cost estimation, it is assumed the facility will operate two raceways for fish translocation during the first 5 years of the permit. For the remainder of the permit period, it is assumed the facility will, on average, operate one raceway in 2 out of 5 years in order to provide Santa Ana sucker stock sufficient for replacement of diminished or extirpated translocated Santa Ana sucker populations.

Translocation Contractor Services

Translocation of Santa Ana sucker populations is expected to be performed by an outside contractor. For purposes of cost estimation, it is assumed that the contractor will complete eight translocations at a cost of $7,000 per translocation during the first 5 permit years. For the remainder of the permit period, it is assumed the contractor will complete one translocation every 5 years to replace diminished or extirpated translocated Santa Ana sucker populations.

USFS Coordinating Agreement Costs

Fish translocation is expected to require coordinating agreements with and support from the USFS. Fees and other costs associated with USFS coordination are estimated to average $10,000 annually for the first 10 years of the project. However, because Valley District has an existing contract with USFS that should last for the 5 years of the project, additional coordinating agreement costs are only anticipated for years 6 through 10.

Summary of Fish Translocation Cost Estimate

Table 7-14 summarizes the fish translocation cost estimate. Lump sum capital costs for fish translocation are estimated to be approximately $255,000 for preparation of the translocation plan prior to issuance of the HCP permits. Translocation implementation, operations, and maintenance costs are approximately $1.3 million over the life of the HCP.

The cost estimate in Table 7-14 does not include fish translocation monitoring costs. As noted above, those costs are accounted for in Section 7.4.5.

Table 7-14. Summary of Total Fish Translocation Costs

	Pre-Permit Capital Costs	O&M Costs				
		Phase 1	Phase 2	Phase 3	Phase 4	Total
Fish Translocation Plan Preparation	$255,000					$255,000
Captive Propagation Facility	$0	$325,000	$65,000	$65,000	$455,000	$910,000
Translocation Contractor Services		$56,000	$7,000	$7,000	$49,000	$119,000
USFS Coordinating Agreement Costs		$0	$50,000	$0	$0	$50,000
O&M Subtotal		$381,000	$122,000	$72,000	$504,000	$1,079,000
Total	**$255,000**	**$381,000**	**$122,000**	**$72,000**	**$504,000**	**$1,334,000**

7.4.4 Preserve Management and Maintenance

Preserve Management and Maintenance costs are estimated at $21.0 million over the permit term. Costs cover the long-term management and maintenance of Conservation Areas. They also include the long-term management of Restoration Areas after restoration success criteria have been met during the 5-year HMMP period. Preserve management and maintenance costs are divided into the following categories:

- General land stewardship costs
- Conservation Areas long-term management
- Restoration Areas long-term management

For the 1,902 acres needed to mitigate impacts on Covered Species, 1,274 acres will be managed as Conservation Areas as they are acquired. The other 628 acres will undergo habitat restoration and then will be managed similar to the Conservation Areas after the 5-year HMMP monitoring period is completed.

It is assumed that management and maintenance costs will be similar, on a per acre basis, to the management and maintenance costs estimated for the Upper Santa Ana River Wash Plan HCP; therefore, those costs are used here for estimation purposes.

Some management and maintenance tasks will be required in perpetuity. These post-permit management and maintenance costs are addressed in Section 7.4.7, *Post-Permit Endowment*.

General Land Stewardship Costs

General land stewardship activities include:

- Restricting unauthorized access
- Minimization and clean-up of illegal dumping
- Maintenance of facilities and equipment needed for habitat management

These activities will be implemented primarily through contracts with the counties for ranger patrol and maintenance worker services. The costs for general land stewardship are summarized in Table 7-15 and are estimated to average $285,000 annually, or $1.4 million per 5-year period.

Table 7-15. General Land Stewardship Cost Estimate

Stewardship Activities	Assumptions	Average Annual Cost	Cost per 5-Year Period
County Parks Ranger Patrols	1 full-time employee (FTE) County Ranger Class I at fully burdened rate of $65/hour and 1 FTE County Ranger Class II at fully burdened rate of $70/hour	$254,000	$1,270,000
Maintenance	0.25 FTE County Maintenance Worker at fully burdened rate of $65/hour	$31,000	$155,000
Total		**$285,000**	**$1,425,000**

Conservation Areas Management

Basic habitat management activities include trash removal, thinning, and invasive plant control, including the herbicide use and grazing. It is assumed that these management costs will be similar, on a per acre basis, to the management and maintenance costs estimated for the Wash Plan HCP. These costs are summarized on a per acre basis in Table 7-16.

The 1,274 acres of Conservation Area will be managed as it is acquired. Table 7-16 shows how much Conservation Areas will be managed under each 5-year phase of the HCP. Total costs for managing Conservation Areas are $4.7 million over the life of the HCP.

Table 7-16. Conservation Areas Management Costs

	Cost/ Acre	Cost Phase 1 (972 acres)	Cost Phase 2 (1,274 acres)	Cost Phase 3 (1,274 acres)	Cost Phase 4 (1,274 acres)	Total
Trash removal	$11	$55,000	$72,000	$72,000	$506,000	$705,000
Thinning	$13	$63,000	$83,000	$83,000	$579,000	$808,000
Invasive plant control – herbicide	$46	$224,000	$293,000	$293,000	$2,051,000	$2,861,000
Invasive plant control – grazing	$5	$24,000	$32,000	$32,000	$223,000	$311,000
Total		**$366,000**	**$480,000**	**$480,000**	**$3,359,000**	**$4,685,000**

Restoration Areas Management

Management activities for Restoration Areas are the same as for Conservation Areas, including trash removal, thinning, and invasive plant control. However, these costs apply to Restoration Areas only after restoration activities and a 5-year HMMP period are complete.

The phasing in of the 628 acres of Restoration Area is shown in Table 7-17. Total long-term management costs for Restoration Areas is $2.1 million over the HCP term. These costs are broken down by phase and management activity in Table 7-17.

Table 7-17. Restoration Areas Management Costs

	Cost/ Acre	Cost Phase 1 (0 acre)	Cost Phase 2 (434 acres)	Cost Phase 3 (628 acres)	Cost Phase 4 (628 acres)	Total
Trash removal	$11	$0	$25,000	$36,000	$250,000	$311,000
Thinning	$13	$0	$28,000	$41,000	$286,000	$355,000
Invasive plant control – herbicide	$46	$0	$100,000	$144,000	$1,011,000	$1,255,000
Invasive plant control – grazing	$5	$0	$11,000	$16,000	$110,000	$137,000
Total		**$0**	**$164,000**	**$237,000**	**$1,657,000**	**$2,058,000**

Summary of Management and Maintenance Cost Estimate

Table 7-18 summarizes the estimate for preserve management and maintenance costs. Over the permit term, costs are estimated at $21.0 million.

Table 7-18. Summary of Total Management and Maintenance Costs

	Phase 1	Phase 2	Phase 3	Phase 4	Total
General Land Stewardship	$1,425,000	$1,425,000	$1,425,000	$9,975,000	$14,250,000
Conservation Areas Management	$366,000	$480,000	$480,000	$3,359,000	$4,685,000
Restoration Areas Management	$0	$164,000	$237,000	$1,657,000	$2,058,000
Total[1]	**$1,791,000**	**$2,069,000**	**$2,142,000**	**$14,991,000**	**$20,957,000**

[1] Note that total cost corresponds to total Management and Maintenance costs in Table 7-1. Numbers may not sum to total due to rounding.

7.4.5 Monitoring and Reporting

Monitoring and reporting costs are estimated to total $7.0 million over the permit term. Some monitoring and adaptive management tasks will be required in perpetuity. These post-permit monitoring and adaptive management costs are addressed in Section 7.4.7.

Monitoring and reporting are described fully in Chapter 6, *Plan Implementation*. Monitoring and reporting costs cover the following items:

- Planning, conducting, analyzing, and reporting on monitoring of ecosystems, natural communities, and Covered Species.
- Planning, conducting, analyzing, and reporting on the effectiveness of conservation measures and habitat restoration/creation projects.
- Planning surveys to assess properties prior to land acquisition.
- Preconstruction surveys and construction monitoring, if needed, prior to implementing projects such as habitat restoration.
- Research directed at management and conservation needs of the HCP.

It is assumed that Alliance staff will plan, coordinate, and oversee all compliance, monitoring, directed research, and adaptive management functions, while outside contractors will be selectively used as needed to conduct field surveys, collect and process monitoring data, and prepare field reports.

Contractor and Other Costs

Contractor costs for collecting monitoring data are based on the frequency and type of field surveys expected to be needed for effectiveness and compliance monitoring. Contracted surveys will be carried out once for every 5-year period for each of the following species categories: amphibians and reptiles, rare plant species, mammals, and bird species. Surveys of fish species will be carried out in-house by program staff and therefore do not have any additional contractor costs. Surveys will take place in year 1 and every 5 years thereafter. Including both the costs of the baseline survey and the costs of monitoring surveys every 5 years, total contractor survey costs are summarized in Table 7-19 and are expected to average $594,000 annually, or $2.97 million for every 5-year period.

Table 7-19. Estimated Costs for Field Surveys

Field Survey	Survey Costs Every 5-Year Period
Amphibians and Reptiles	$180,000
Rare Plant Species	$16,000
San Bernardino Kangaroo Rat, Pocket Mouse	$94,000
All Bird Species	$304,000
Fish Species[1]	$0
Total Annual Cost	**$594,000**

[1] Fish surveys will be carried out by HCP Staff and are therefore covered under staff costs. To prevent double counting the costs are not included in this table.

Vegetation Mapping

The HCP Preserve System will require periodic vegetation mapping in order to monitor changes to Covered Species habitat. Vegetation mapping will require having LiDAR flown over the Conservation Areas, as well as collection of aerial imagery to support the periodic update of vegetation maps. Collection of LiDAR data is estimated to cost $45,000, based on Valley District's past experience. Collection of aerial imagery is estimated at $47,000, but costs will be split between the HCP and RPU at a 70/30 cost share. Accordingly, $33,000 of the total cost will fall on the HCP.

Staff time to conduct the field surveys for vegetation mapping and to digitize the information into the HCP GIS database is conservatively estimated to be $50,000 based on the consulting team's analysis.[3]

It is estimated that vegetation mapping will be required every 5 years for the first 5 years, and 10 years thereafter, i.e. in years 0, 5, 10, and 15, 25, 35, 45. In addition, mapping will also be required after a large flooding event (defined as a 20-year recurrence interval event). For cost estimation purposes it is assumed that two addition mappings will be required after flooding events in years 20 and 30.

Table 7-20 summarizes the vegetation mapping costs.

Table 7-20. Vegetation Mapping Costs

	Year 0 (pre-permit)	Phase 1	Phase 2	Phase 3	Phase 4	Total
LiDAR	$45,000	$45,000	$45,000	$45,000	224000	$404,000
Aerial Imaging	$33,000	$33,000	$33,000	$33,000	165000	$297,000
Labor	$50,000	$50,000	$50,000	$50,000	250000	$450,000
Total	**$128,000**	**$128,000**	**$128,000**	**$128,000**	**$639,000**	**$1,151,000**

[3] Makela Mangrich -ICF Biologist, June 16, 2020.

Summary of Monitoring and Reporting Cost Estimate

Table 7-21 summarizes the estimate for monitoring and reporting costs. Over the permit term, costs are estimated total $7.0 million.

Table 7-21. Summary of Total Monitoring and Reporting Costs

	Year 0 (pre-permit)	Phase 1	Phase 2	Phase 3	Phase 4	Total
Contractor Surveys and Field Reports		$594,000	$594,000	$594,000	$4,158,000	$5,940,000
Vegetation Mapping	$128,000	$128,000	$128,000	$128,000	$639,000	$1,151,000
Total[1]	**$128,000**	**$722,000**	**$722,000**	**$722,000**	**$4,797,000**	**$6,964,000**

[1] Note that total cost corresponds to total Monitoring and Reporting costs in Table 7-1. Numbers may not sum to total due to rounding.

7.4.6 Program Administration

Program administration costs involve the support of employees, facilities, equipment, and vehicles to operate the office of the Alliance, the Joint Powers Authority (JPA) that will be the Implementing Entity of the HCP and associated regulatory compliance programs. Program administration costs also include associated costs such as travel, legal, and financial administrative assistance. Program administration costs are estimated to be, on average, $1.2 million annually during the permit term. Some program administration costs will continue beyond the permit term. These post-permit administration costs are addressed in subsection 7.4.7.

Staffing and Overhead

Employee costs comprise the annual salaries for program administration personnel. For the purposes of the cost estimate, it is assumed that the following positions would be staffed within the Upper Santa Ana River Sustainable Resource Alliance according to the roles described in Chapter 6. There are four full-time positions and three part-time positions. The four full-time positions that will support implementation of the HCP are:

- Executive Director/Principal Scientist
- HCP Program Manager/Lead Biologist
- Preserve System and Mitigation Reserve Program Manager
- GIS Analyst/Database Manager

Three additional part-time or seasonal positions may be required to meet the obligations of the incidental take permits (ITPs) and HCP. These positions are:

- Budget Analyst/Accountant (¾ time in Years 1–10 and ½ time thereafter)
- Senior Environmental Scientist (¾ time)
- Associate Environmental Scientist (½ time)

The annual salaries and associated overhead costs for these positions are allocated across the cost categories discussed above according to the amount of time each position is expected to devote to the different HCP functions. These allocations are shown in Table 7-22 for permit years 1–10 and in Table 7-23 for permit years 11–50. Overall, 25–30% of staff time is expected to be needed for general program administration, and the remainder will be devoted to program implementation functions. This split between general administration and program implementation functions is consistent with staffing allocations in other HCPs reviewed as part of the cost analysis.

Table 7-22. Staffing Allocation by Cost Category in Full-Time Equivalents, Permit Years 1–10

		Program Implementation Labor (FTEs)					
Staff Position	**Program Admin Labor (FTEs)**	**Tributaries Restoration**	**Fish Translocation**	**Terrestrial Habitat**	**Compliance & Monitoring**	**Preserve Management**	**Total FTEs**
Executive Director/Principal Scientist	0.50	0.10	0.05	0.15	0.15	0.05	1.00
HCP Program Manager/Lead Biologist	0.15	0.20	0.20	0.20	0.20	0.05	1.00
GIS Analyst/Database Manager	0.15	0.20	0.10	0.20	0.30	0.05	1.00
Preserve System and Mitigation Reserve Program Manager	0.20	0.15	0.05	0.15	0.20	0.25	1.00
Budget Analyst/Accountant	0.75	0.00	0.00	0.00	0.00	0.00	0.75
Senior Environmental Scientist	0.00	0.25	0.25	0.00	0.25	0.00	0.75
Associate Environmental Scientist	0.00	0.20	0.20	0.10	0.00	0.00	0.50
Total FTEs	**1.75**	**1.10**	**0.85**	**0.80**	**1.10**	**0.40**	**6.00**

Table 7-23. Staffing Allocation by Cost Category in Full-Time Equivalents, Permit Years 11–50

		Program Implementation Labor (FTEs)					
Staff Position	**Program Admin Labor (FTEs)**	**Tributaries Restoration**	**Fish Translocation**	**Terrestrial Habitat**	**Compliance & Monitoring**	**Preserve Management**	**Total FTEs**
Executive Director/Principal Scientist	0.50	0.10	0.05	0.15	0.15	0.05	1.00
HCP Program Manager/Lead Biologist	0.15	0.10	0.10	0.25	0.25	0.15	1.00
GIS Analyst/Database Manager	0.15	0.20	0.10	0.20	0.30	0.05	1.00
Preserve System and Mitigation Reserve Program Manager	0.20	0.10	0.05	0.15	0.25	0.25	1.00
Budget Analyst/Accountant	0.50	0.00	0.00	0.00	0.00	0.00	0.50
Senior Environmental Scientist	0.00	0.20	0.15	0.00	0.35	0.05	0.75
Associate Environmental Scientist	0.00	0.10	0.10	0.20	0.05	0.05	0.50
Total FTEs	**1.50**	**0.80**	**0.55**	**0.95**	**1.35**	**0.60**	**5.75**

Bureau of Labor Statistics (BLS) data on occupational wages in California were used to estimate annual salary costs for all positions other than the GIS Analyst (BLS 2018). In the case of the GIS Analyst, data from Transparent California was used to estimate the salary cost (Transparent California 2019). Table 7-24 shows the estimated base annual salary for each position. The salary percentile column in the table indicates the percentile of the reference position salary range used for the base salary estimate. Two positions are set to the 75th percentile of their reference salary range, reflecting the need to recruit senior and highly qualified candidates for these positions. The other three positions are set to the 50th percentile (median) of the reference salary range. Note that actual salary costs will depend on labor market conditions at the time of hiring and may differ from the values in the table.

Table 7-24. Base Annual Salary Cost Estimates

Staffing Position	BLS Code	BLS Title	Salary Percentile	Annual Salary ($/FTE)	Direct Labor Hours[2]	Direct Hourly Rate
Executive Director/ Principal Scientist	11-9121	Natural Science Manager	75th	$176,380	1,880	$93.82
HCP Program Manager/ Lead Biologist			50th	$146,380	1,880	$78.05
Preserve System and Mitigation Reserve Program Manager			50th	$146,380	1,880	$78.05
GIS Analyst/ Database Manager[1]	N/A	N/A	50th	$86,300	1,880	$45.90
Budget Analyst/ Accountant	13-2031	Budget Analyst	50th	$69,030	1,880	$36.72
Senior Environmental Scientist	19-2041	Environmental Scientist	75th	$108,050	1,880	$57.47
Associate Environmental Scientist			50th	$85,460	1,880	$45.46

[1]GIS Analyst salary set to the 50th percentile for a sample of 153 California public sector GIS Analyst positions; data are from Transparent California 2019.
[2]Direct labor hours exclude paid holiday, vacation, and sick time, which are assumed to average 200 hours per year (5 weeks).

A cost multiplier of 1.48 was used to estimate non-wage staffing costs, which include benefits, paid leave, insurance, retirement, and legally required benefits.[4] The overhead multiplier is based on 10 years of published national survey data on overhead rates for architectural, engineering, and environmental planning firms.

Multiplying the base salary costs in Table 7-24 by the overhead multiplier yields the fully burdened cost of each salaried position. The fully burdened annual salary costs are summarized in Table 7-25.

[4] This analysis uses average employer cost ratios for management, professional, and related positions, office and administrative support, and natural resources, construction, and maintenance. See: https://www.bls.gov/news.release/pdf/ecec.pdf

Table 7-25. Fully Burdened Annual Salary Cost Estimates

Staffing Position	Base Annual Salary ($/FTE)		Overhead Multiplier		Fully Burdened Annual Cost per FTE[1]
Executive Director/Principal Scientist	$176,000	x	1.48	=	$261,000
HCP Program Manager/Lead Biologist	$147,000	x	1.48	=	$217,000
Preserve Manager	$147,000	x	1.48	=	$217,000
GIS Analyst/Database Manager	$86,000	x	1.48	=	$128,000
Budget Analyst/Accountant	$69,000	x	1.48	=	$102,000
Senior Environmental Scientist	$108,000	x	1.48	=	$160,000
Associate Environmental Scientist	$85,000	x	1.48	=	$127,000

[1]Inclusive of direct and indirect labor expenses for primary and support staff and costs for space and utilities, office furniture, equipment, and general supplies.

Annual staffing and overhead costs are estimated by multiplying the fully burdened salary costs in Table 7-25 by the FTE allocations in Table 7-23 and Table 7-24. These costs are summarized in Table 7-26.

Table 7-26. Annual Staffing and Overhead Cost Estimate

	Phase 1	Phase 2	Phase 3	Phase 4	Total
Program Administration	$1,510,000	$1,510,000	$1,385,000	$9,695,000	$14,100,000
Restoration	$965,000	$965,000	$700,000	$4,900,000	$7,530,000
Fish Translocation	$725,000	$725,000	$475,000	$3,325,000	$5,250,000
Preserve Management	$1,190,000	$1,190,000	$1,490,000	$10,430,000	$14,300,000
Monitoring and Reporting	$1,020,000	$1,020,000	$1,240,000	$8,680,000	$11,960,000
Total	**$5,410,000**	**$5,410,000**	**$5,290,000**	**$37,030,000**	**$53,140,000**

Other Program Administration Allowances

In addition to staffing and overhead costs, the program administration cost estimate includes annual allowances for other anticipated expenditures, including vehicle use, travel, outside legal and accounting services, and public outreach. Allowances for each cost item are summarized in Table 7-27 and are based on a review of projected and incurred costs for these items by other HCPs.

Table 7-27. Annual Allowances for Other Program Administration Expenses

	Cost per Year	Cost per 5-Year Period
Vehicle/Mileage Reimbursement	$1,500	$7,500
Travel (non-vehicular)	$6,000	$30,000
Legal & Accounting	$133,000	$665,000
Public Relations/Outreach	$25,000	$125,000
Total	**$165,500**	**$827,500**

Summary of Program Administration Cost Estimate

Table 7-28 summarizes the program administration cost estimate. The estimated cost of program administration is $61.4 million over the life of the HCP, or from $6.1 to $6.2 million per 5-year period.

Table 7-28. Summary of HCP Program Administration Costs

	Phase 1	Phase 2	Phase 3	Phase 4	Total
Staff	$5,417,000	$5,417,000	$5,289,000	$37,023,000	$53,146,000
Vehicle/Mileage Allowance	$7,500	$7,500	$7,500	$52,500	$75,000
Travel	$30,000	$30,000	$30,000	$210,000	$300,000
Legal & Accounting	$665,000	$665,000	$665,000	$4,655,000	$6,650,000
Public Relations/ Outreach	$125,000	$125,000	$125,000	$875,000	$1,250,000
Total	**$6,244,500**	**$6,244,500**	**$6,116,500**	**$42,815,500**	**$61,426,000**

[1] Note that total cost corresponds to total Program Administration costs in Table 7-1. Numbers may not sum to total due to rounding.

7.4.7 Post-Permit Endowment

During the duration of the HCP permit, capital and operating costs of the program will be directly funded by the Permittee Agencies. As already noted, certain management and monitoring costs will continue after the permit expires. The purpose of the endowment will be to fund these post-permit costs in perpetuity. Post-permit costs are estimated to average $592,000 annually and are summarized in Table 7-29. Note that staffing costs are not included in the post-permit endowment costs because the JPA (Alliance) and JPA staff would no longer be needed after the permit expires. At that time Valley District will assume the responsibility for contracting qualified biologists and preserve management experts to conduct monitoring, management, and reporting in the post-permit period. The final calculation of post-permit costs includes a 3% contingency, bringing the annual cost to $609,000.

To account for real inflation over the life of the permit, this annual cost is inflated by 2% per year to estimate the amount that will be necessary to fund the program at the end of the permit term. The required endowment by the end of the permit term to fund these costs is $47.1 million (in 2018 dollars). It is assumed that the Permittee Agencies will pay into the endowment at the beginning of each year commencing in the first year of the permit and each year thereafter until the last year of the permit and that the endowment will be held and prudently managed by the San Bernardino Valley Conservation Trust[5] and will earn an annual real rate of return of 4% on average. Under these

[5] The San Bernardino Valley Conservation Trust (Conservation Trust) will be charged with holding fee title to, or conservation easements covering, land secured as mitigation for Covered Activities. The Conservation Trust is a 501(c)(3) charitable corporation qualified to hold conservation easements, endowments and other forms of security in accordance with Section 815 et seq. of the California Government Code. Financial management of the Conservation Trust will be in accordance with the prudent investor standards set forth in the California Probate Code, and the overall activities of the Conservation Trust will be governed by SB 1094, codified at Sections 65965-98 of the California Government Code. The Conservation Trust has an independent board of directors and management separate from the managers of the HCP. It is anticipated that there will be some form of Memorandum of Agreement (MOA) or Memorandum of Understanding (MOU)

assumptions, the annual contribution rate to the endowment over the term of the permit is $297,000 (in 2018 dollars).

Table 7-29. Estimated Post-Permit Annual Costs

Post-Permit Cost Items	Assumptions	Average Annual Cost
SAR Microhabitat	Average annual replacement cost for SAR microhabitat structures, per Table 7-11	$45,000
Management and Maintenance	Average annual land stewardship and habitat management costs, per Table 7-16 and Table 7-17	$428,000
Monitoring and Reporting	Average annual monitoring and reporting costs, per Table 7-21	$119,000
Total		**$592,000**

7.4.8 Cost Uncertainties and Changed Circumstances

Due to cost uncertainties and the possibility of changed circumstances that could affect annual program requirements and expenditures, contingency values are included in total cost calculations. Restoration costs, including upland tributaries restoration, alluvial fan restoration, and microhabitat creation include the greatest contingency at 15% to account for the greater level of uncertainty in these costs. A contingency of 10% is applied to land acquisition. The remaining cost categories, including administration and overhead, general maintenance, and monitoring all use a 3% contingency because their costs are reasonably certain over time. The average cost of the contingency is $229,000 annually.

7.5 Funding Sources and Assurances

The single joint ITP permit structure was determined to be the best arrangement to facilitate ongoing coordination among the Permittee Agencies. In particular, this structure will allow the Permittees to enter into enforceable arrangements to allocate operational and funding responsibilities, and rectify any occurrence of non-compliance by a Permittee Agency. For more details on the joint ITP arrangement, refer to Section 6.2*, HCP Permit Structure,* of this report.

The structure and organization of the JPA operating under the name of Upper Santa Ana River Sustainable Resources Alliance is fully described in Chapter 6. The costs of the HCP will be borne by the Permittee Agencies in accordance with the Joint Powers Authority Agreement, and a separate "Participation and Financing Agreement" (PFA) that fully accounts for and assigns financial responsibility of the Alliance among the Permittee Agencies. The PFA will describe the financial responsibilities of each of the Permittee Agencies with respect to the HCP and the Alliance. The cost of plan implementation will be shared among the Permittee Agencies, based on a cost-sharing mechanism developed and approved by all agencies. The cost-sharing mechanism will account for impacts of the individual Covered Activity as well as both the financial and in-kind contributions by the Permittee Agencies

between the Conservation Trust and the JPA establishing a long-term relationship for the purposes of plan compliance and implementation.

Each of the Permittee Agencies will be fully responsible for any Covered Activity undertaken by that agency under the HCP and will be required to coordinate with the Alliance staff in order to ensure consistency of the Covered Activity with the Plan. Any cost resulting from non-compliance with the terms of the ITP by any Permittee Agency will be the responsibility of the non-complying Agency.

7.6 HCP Benefits

While the price tag of the HCP may be large, the net benefits of this investment to water users and the local economy amount to an estimated $952 million as a whole, generating a benefit-cost ratio in excess of 7.3. This total net benefits illustrates the enormity of this HCP effort.

Over the 50-year life of the HCP, the $187.5 million investment will allow Permittee Agencies to develop over 4 million acre-feet of water cumulatively for local use, or approximately 87,000 afy by year 15. These water resources will reduce reliance on imported water from other parts of the state, increasing the area's resilience to drought and regulatory restrictions that hamper water deliveries from the State Water Project.

Without the Covered Activities enabled by the HCP and associated incidental take permits, the Permittee Agencies would not be able to optimize the use of local water resources. Instead, their best options for obtaining such a large volume of water at the same level of reliability are to purchase additional imported water or develop new supplies through desalination. It is true that in some years, particularly wet hydrologic years, a fraction of the 87,000 acre-feet of water may be available for Permittee Agencies to purchase through Valley District's State Water Project allotment. However, this water would only be available in other drier years, so it would not be reliable nor predictable. This reliability benefit is part of the reason that Permittee Agencies are pursuing the HCP.

Potential alternatives to meet the full 87,000 acre-feet of water include purchasing additional water or desalination. These options are costly compared to both current water supplies and to alternatives facilitated by the HCP. Imported water from the Metropolitan Water District of Southern California (Metropolitan), which represents the going rate of buying additional water supplies through the market, currently costs $2,007 per acre-foot for treated Tier 2 water. This Tier 2 rate is set at Metropolitan's cost of purchasing water transfers north of the Sacramento-San Joaquin Delta and includes all costs associated with moving that water to Southern California. Individual water districts could pursue their own water transfers from north of the Delta, but would be competing against Metropolitan. For this reason, the Tier 2 rate is the best proxy for the price Permittee Agencies would have to pay if they pursued their own private water transfers. Desalination is the other alternative water supply option available to Southern California that does not depend on moving water through the Delta. It is estimated to cost about $2,019 per acre-foot based on the midpoint of existing desalination projects in Southern California. Using the lower Metropolitan price as a proxy for what HCP partner agencies would need to spend to acquire new supplies, the same volume of water would cost $3.2 billion over the life of the HCP, on a net present value basis.[6] However, there is no guarantee that such a large volume of water would even be reliably available for purchase, and developing sufficient equivalent capacity of desalination projects presents its own regulatory and geographic hurdles. For these reasons, the $3.2 billion cost for an

[6] NPV calculations are made using an interest rate of 4.61% based on the rate used by the State Water Project in calculating water prices. The general inflation rate is assumed to be 2%. The net discount rate is 2.61%.

alternative portfolio is considered to be conservative and biased toward a low estimate of projected savings made possible by the HCP.

Based on the planned mix of Covered Activity water supply projects, Permittee Agencies will be able to develop the same amount of water at a net present value cost of approximately $2.2 billion. To estimate this cost, for conventional and groundwater supply Covered Activity projects, a value of $829 per acre-foot is used, based on average costs for managed aquifer recharge projects in California state grant applications (Perrone and Rhode 2016). For recycled water and indirect potable reuse projects, an average cost of $1,269 per acre-foot was used, based on the cost of the Water Replenishment District of Southern California's Groundwater Reliability Improvement Program Advanced Water Treatment Facility (Metropolitan 2016), Orange County Water District's Groundwater Replenishment System (Metropolitan 2016), and cost estimates developed by the Pacific Institute for Indirect Potable Reuse (Cooley and Phurisamban 2016).

The net present value (NPV) of water supply costs without the HCP is $3.2 billion, compared to an NPV of $2.2 billion with the HCP. This is an estimated savings of over $1.1 billion from water supply projects.

This potential savings puts the HCP total cost in perspective. The $187.5 million undiscounted total HCP cost translates to an NPV of $129 million. Based on the savings estimated from water supply projects and the cost of the HCP, pursuing the HCP over alternative water supply options could result in net savings of $952 million or more in net present value. This cost saving will be passed on to commercial and residential water customers throughout the HCP area.

Table 7-30. HCP Net Savings Estimate in Net Present Value ($1,000s)

	Water Supply Cost	HCP Cost	Net Savings (cost)
With HCP	$2,162	$129[1]	
Without HCP	$3,243	$0	
Total savings (cost)	**$1,081**	**-$129**	**$952**

[1] Note that this total HCP cost is presented in net present value (NPV). It is equivalent to the $187.5 million undiscounted total cost presented elsewhere in this chapter, but shown in NPV so that it can be compared to alternative scenarios on a comparable basis.

In addition, developing new water supplies through investment in local water supply projects as well as local investment in habitat conservation creates secondary impacts in the Planning Area economy similar to an economic stimulus, when compared to purchasing imported water from Metropolitan. Using IMPLAN[7] economic modelling software, if HCP and water project costs are spent in the local economy each year over the life of the project, the result would be an additional $350 million in economic activity,[8] and $114 million in additional income to local residents, in addition to the creation of approximately 50 jobs annually.

[7] IMPLAN software is an industry standard input-output model that allows users to estimate how regional economic impacts flow through the economy.
[8] Defined as economic output, equivalent to $368 million in value added to the economy.

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Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Chapter 8
Alternatives Considered but Rejected

Section 10 of the federal Endangered Species Act (ESA) requires that a habitat conservation plan (HCP) describe alternatives to the proposed incidental take covered in the HCP and the reasons why each alternative was not selected. As part of the development of this HCP, multiple alternatives to the proposed taking were considered.

8.1 Evolution of the Proposed HCP

As the Upper Santa Ana River (SAR) HCP development process has evolved over the time so have the analytical scenarios used as the basis for the Upper SAR HCP. Previous HCP iterations included Covered Activities that resulted in greater impacts on species and the riverine system than were acceptable or likely to be permittable under the federal and state ESAs. Preliminary impact analyses, including substantial hydrology modeling, led to the modifications to the Covered Activities to substantially reduce the potential biological and hydrological impacts resulting in the Covered Activities. Similarly, many iterations and additions to the conservation strategy led to substantial improvements in the measures to avoid and minimize take and the expected outcomes for each species covered by the HCP. The modifications resulted in reduced impact on the Santa Ana River and increased conservation values to species in a way that protects and enhances the ecological function of the system far more than earlier iterations of the HCP.

The largest change to the proposed Covered Activities was the modification of water reuse projects in order to reduce impacts on Santa Ana sucker and other aquatic species. In an early iteration of the HCP, the initial proposed versions of Covered Activities would have resulted in much larger reductions in baseflow in the Santa Ana River, and larger impacts on covered aquatic species, especially to the Santa Ana sucker and Arroyo chub. Most notably, the initial round of hydrologic modeling demonstrated that the water reuse projects, as proposed, would have resulted in a reduction of effluent discharge into the Rialto Channel and Santa Ana River by more than 50%, and a 73% loss of suitable sucker habitat (i.e., areas with suitable water depth, velocity, and river bottom substrate) in the upper reach of the Santa Ana River and a 100% loss of suitable sucker habitat in the lower reach. Given the unacceptable potential impacts on the Santa Ana sucker and other aquatic species resulting from this scenario, the original proposed version for the Covered Activities was rejected as a viable alternative. Using the hydrologic and habitat suitability modeling as a guide to determine a minimum flow necessary to maintain occupied Santa Ana sucker habitat, the Permittee Agencies then developed new alternatives for the Covered Activities, making the water reuse projects smaller and less impactful. This resulted in a commitment to a minimum amount of baseflow to be discharged into the river by the wastewater treatment plants, which reduced potential impacts on the Santa Ana sucker and other aquatic species to a level that could still sustain healthy populations in the Santa Ana River and could be fully offset through the conservation strategy of the HCP.

The current set of Covered Activities in the Upper SAR HCP, as now proposed, was determined through the partnership and the collaborative efforts with the Permittee Agencies, Wildlife Agencies, and involved stakeholders. The complete HCP conservation strategy for all covered species was also developed through this collaborative partnership, and includes a comprehensive strategy for long-

term protection, restoration, and conservation to manage the natural resources and species of the Upper SAR watershed in a way that ensures long-term ecological value to the region and species recovery.

Four alternatives were thoroughly considered as potentially viable options to this HCP. Those four alternatives and the reasons why each was not selected are described below.

8.2 Alternative 1: No Project

The No Project Alternative would include the future circumstances without the HCP Preserve System for the Upper SAR HCP and Section 10 Incidental Take Permit issued jointly to the Permittee Agencies for future implementation of the proposed Covered Activities, and would also include predictable actions by persons or entities if the HCP did not occur.

Under the No Project Alternative, Section 10 permit(s) would not be issued by the U.S. Fish and Wildlife Service (USFWS) for take of the proposed Covered Species through the Upper SAR HCP and there would be no implementation of the watershed-scale, coordinated conservation strategy as is committed to by the 11 Permittee Agencies for the Proposed Project. However, that is not to say that the individual water supply projects proposed by the various water agencies would not occur, rather the Permittee Agencies would likely pursue project-by-project incidental take permits from USFWS and the California Department of Fish and Wildlife (CDFW) for the take of listed species pursuant to the federal and state ESAs associated with implementation of Covered Activities. Conservation would also be negotiated on a project-by-project basis with each Wildlife Agency in order to appropriately offset the impacts of each individual project. There would be no regional approach to developing holistic conservation measures that provide long-term species and ecosystem benefits. Covered Activities could be implemented individually, but without the proposed Upper SAR HCP incidental take permit and the regulatory assurances that go along with it. The water resources projects that would occur under the No Project Alternative are essentially the same list of proposed future water infrastructure projects (the Covered Activities in this HCP); however, a more difficult and lengthy permitting process would likely occur if conducted individually and without any assurances that permits would be granted for any of the Covered Activities.

Impacts on species could occur under the No Project Alternative, including construction or expansion of water infrastructure or water facilities, if most or all the Covered Activities were implemented. However, the Permittee Agencies would need to seek incidental take permits through single-project HCPs (Section 10 of ESA), or through Section 7 consultation with USFWS, and through individual 2081 permits under the state ESA. Due to the difficulty in securing permits for all Covered Activities individually, it is also possible that some Covered Activities would be too costly to permit and fewer Covered Activities would be implemented, resulting in fewer impacts and incidental take under the No Project Alternative than would occur under this HCP.

While the impacts could be less than covered under this HCP if Permittee Agencies are not able to obtain take permits individually, there would also be less strategic conservation and less assurances for coordinated implementation of conservation measures. These added uncertainties adversely affect the ability of the Permittee Agencies to achieve their public mission to capture and store local water supply, which then makes the region more reliant on imported water from Northern California.

Another potential consequence of the No Project Alternative is the loss of the Upper SAR HCP as a regulatory mechanism to provide incidental take permit coverage for Santa Ana sucker translocation activities and other conservation measures, including the establishment of the HCP Preserve System. To date, no other mechanism has been identified that could provide long-term coverage to entities downstream of translocated sucker populations, such as Southern California Edison. USFWS has stated that establishment of new populations in the upper watershed is a requirement for the recovery of Santa Ana sucker. The Upper SAR HCP has the rare ability to enable the translocation effort to establish these new populations.

8.3 Alternative 2: Phase 1 Covered Activities Only

This alternative would result in an HCP that would provide incidental take coverage for only those high priority, near-term Covered Activities that are identified in Phase 1 (Years 0–5) of the Upper SAR HCP. Implementation of the Phase 1 Covered Activities would include construction and operation of fewer Covered Activities than are identified in the Upper SAR HCP.

This alternative would also only implement the Phase 1 conservation actions because mitigation is directly tied to impacts. While preservation and habitat restoration would occur during Phase 1, in proportion to Phase I impacts, the remainder of the proposed HCP Preserve System and Tributaries Restoration projects would not be implemented as part of the HCP regional conservation strategy. The full suite of mitigation lands and conservation actions is needed in order to attain a sustainable preserve system that incorporates the many habitat needs of species, including habitat for breeding, foraging, and connectivity. Potential impacts from Covered Activities would be reduced if only Phase I projects are implemented; however, it is likely that some or all future projects not included as Covered Activities under this alternative would be pursued individually by Permittee Agencies on a project-by project basis because they are key to long-term reliability of the regional water supply. If pursued independently, future development of the Covered Activities identified in Phases 2 through 4 of the Upper SAR HCP would likely result in a more difficult and lengthy permitting process. There would also be no assurances that permits would be issued for any of these Covered Activities. Conservation would also be negotiated on a project-by-project basis with each Wildlife Agency in order to appropriately offset the impacts of each individual project, which would not benefit from the regional approach and holistic conservation measures that provide long-term species and ecosystem benefits.

8.4 Alternative 3: Reduced Impacts on Santa Ana Sucker

This alternative would assume that water reuse and recycling projects that are most impactful to the Santa Ana sucker would not have permit coverage through the Upper SAR HCP, and this alternative would result in less baseflow reduction and reduced impacts on aquatic habitat in the Santa Ana River. Covered Activities that reduce baseflow have the most potential impact on Santa Ana sucker and other aquatic habitat, and therefore also require the greatest amount of conservation measures to offset their impacts. Water reuse projects like the SBMWD Recycled Water Project (WD.1) and the Rialto Wastewater Diversion and Reuse Project (Rial.1) would be substantially modified to reduce the impacts on Santa Ana sucker or would not be included as Covered Activities at all, and permit coverage for those water infrastructure projects would not be provided through the HCP.

While the reduced impacts on base flow in this alternative could likely eliminate the need for the Santa Ana Sucker Translocation project, some or all of the Tributaries Restoration projects, and many other enhancements in the Santa Ana River, there is an argument to be made that these measures to improve the long-term viability of the Santa Ana sucker population are needed now, regardless of Covered Activity implementation. Even with the current level of water in the Santa Ana River, the Santa Ana sucker population is under constant threat from rapid changes in instream flow, lack of high-quality habitat, no redundancy of other populations centers in the river system, and therefore frequent threat of extirpation. With this alternative, it is likely that many Santa Ana sucker recovery plan goals would not be achieved, or would not be implemented in a coordinated, watershed-scale manner.

8.5 Alternative 4: Reduced Impacts on San Bernardino Kangaroo Rat

Like the other alternatives, this alternative would involve implementation of fewer Covered Activities, specifically stormflow diversion projects, that are included in the Upper SAR HCP. This alternative would not include projects that divert storm flow into new or expanded recharge basins, nor would it include activities to operate and maintain new diversion structures or activities related to construction of new recharge basins and associated diversions. These projects could include substantial reduction or elimination of the Mill Creek Diversion Project (CD.1, Phase 1), Santa Ana Levee and Cuttle Weir Diversion (CD.2, Phase 1), and the Active Recharge Project (VD.2).

The elimination of these new stormflow diversion projects would eliminate the associated additional impacts on San Bernardino kangaroo rat (SBKR) in the alluvial fan sage scrub where most of these projects are proposed. The anticipated impacts from these new water capture projects create the need for a SBKR habitat conservation, restoration, and long-term protection as offsetting mitigation for these projects. If these Covered Activities are eliminated from the HCP as a part of this alternative, then these conservation measures for SBKR would not be required as mitigation.

Without the proposed conservation measures for SBKR, some USFWS recovery goals would likely not be achieved by the HCP. Loss of a funding source and regulatory mechanism like the Upper SAR HCP to provide long-term conservation actions would make the overall recovery of SBKR more difficult. This alternative would result in fewer impacts on SBKR habitat (primarily in lower-quality SBKR habitat areas) but also result in reduced high-quality conservation measures for SBKR. Permittee Agencies could still pursue many of the same future activities by seeking individual incidental take permits for each of these Covered Activities. However, future development associated with these Covered Activities would likely result in a more difficult and lengthy permitting process. There would also be no assurances that permits would be granted for any of these Covered Activities.

Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Chapter 9

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Chapter 10
Glossary

Adaptive Management – A decision process that promotes flexible decision making, which can be adjusted in the face of uncertainties as outcomes from management actions and other events are better understood. Careful monitoring of these outcomes advances scientific understanding and allows for the adjustment of policies and/or operations as part of an interactive learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity.

Air/Vacuum Valve – A valve used to vent the air that can become trapped in any pipeline conveying fluid.

Biological Goals – Broad, guiding principles based on conservation needs of the Covered Species developed through the Habitat Conservation Plan (HCP) process.

Biological Objectives – Conservation targets or desired future conditions designed to achieve Biological Goals of an HCP.

Biological Opinion – The document stating the opinion of the U.S. Fish and Wildlife Service (USFWS) and/or the National Oceanic and Atmospheric Administration's National Marine Fisheries Service as to whether or not a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat (50 Code of Federal Regulations [CFR] 402.02). A Biological Opinion is one of the decision documents of a consultation under Section 7 of the federal Endangered Species Act (FESA)**.**

Blow-Off – Dewatering of pipes that typically includes a point source of high velocity flow.

California Endangered Species Act – California Fish and Game Code Section 2050 et seq., including all regulations promulgated pursuant to that Act. The California Endangered Species Act (CESA) prohibits the California Department of Fish and Wildlife (CDFW) from authorizing any Incidental *take* of a state-listed threatened or endangered species if that take would jeopardize the continued existence of the species; all impacts on state-listed species must be fully mitigated.

California Environmental Quality Act – California Public Resources Code (PRC) 21000 21177 et seq., including all regulations promulgated pursuant to that Act. The California Environmental Quality Act (CEQA) requires state and local agencies to assess environmental impacts of proposed projects, to disclose those impacts to decision makers, and to reduce environmental impacts of a proposed project to the greatest extent practicable.

Changed Circumstances – Changes affecting a species or geographic area covered by an HCP that can reasonably be anticipated and planned for by HCP Permittees and USFWS.

Channel Pattern – Characterization of the geomorphic state of streams, including channel stability, texture and volume of sediment supply, stream gradient (sloe), and mode of sediment transport.

Clean Water Act – The Clean Water Act (33 United States Code [USC] Section 1251 et seq. [1972]) regulates discharges of pollutants into jurisdictional waters of the United States. Section 404 of the Clean Water Act regulates the discharge of dredged or fill material into jurisdictional waters,

including wetlands. Section 401 of the Clean Water Act requires certification that permits for discharge into Waters of the United States comply with water quality standards. Section 402 controls direct discharges into navigable waters through the issuance of National Pollutant Discharge Elimination System (NPDES) permits.

Clearing – The removal of natural vegetation by any means, including brushing and grubbing.

Conservation Actions – Any actions taken to preserve, manage, and monitor land for conservation of Covered Species that is suitable for the species and configured and connected such that the Covered Species can maintain sustainable populations within the HCP Preserve.

Conservation Easement – Any limitation in a deed, will, or other instrument in the form of an easement, restriction, covenant, or condition, which is or has been executed on behalf of the owner of the land subject to such easement, and is binding upon successive owners of such land, and the purpose of which is to retain land predominantly in its natural, scenic, historical, agricultural, forested, or open-space condition. (California Civil Code 815)

Conserve – The terms *conserve, conserving,* and *conservation* refer to the implementation of preservation, enhancement, management, and monitoring methods that are necessary to maintain and enhance natural resources to benefit a Covered Species habitat and population, and contribute to the species recovery as described by the biological goals and objectives, and the conservation actions of the HCP. The conservation actions are implemented within the HCP Preserve System.

Covered Activities – Activities in the *Planning Area* undertaken by the Permittees and covered by the authorizations for incidental take. Covered activities include projects and Operations and Maintenance (O&M). Projects are well-defined actions that occur once in a discrete location. O&M activities are actions that occur repeatedly in one area or over a wide area (e.g., bank stabilization, storm-damage repair, maintenance of roads and facilities).

Covered Species – Those species within the HCP that will be adequately conserved through implementation of the HCP.

Critical Habitat – An area designated by USFWS pursuant to FESA. Critical habitat are those areas, whether occupied by a listed species or not, that are determined to be essential for the conservation and management of the species.

Direct Effects – The direct or immediate effects of the project on the species or its habitats (FESA definition).

Disturbed Land – Land that has been significantly modified by previous, legally authorized human activity, but continues to retain a soil substrate is considered disturbed land. This includes areas that have been graded, repeatedly cleared for fuel management purposes, and/or have experienced recurring use resulting in compacted soils and minimal potential for natural revegetation (e.g., dirt parking lots, incised trails).

Dry-Weather Flows – The flow of water in streams during the dry season when it does not typically rain (May–October). This is often the average September flow in the Planning Area, when streamflows are typically the lowest.

Emergency – An event or situation that poses considerable risk to human health and safety. This risk includes, but is not strictly limited to, loss of human life, property damage, or air and water contamination threatening human health and safety.

Endangered Species – A species listed as endangered under FESA or CESA. FESA defines an endangered species as any species which is in danger of extinction throughout all or a significant portion of its range (FESA Section 3(6)). CESA defines an endangered species as a native species or subspecies of bird, mammal, fish, amphibian, reptile, or plant that is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease (California Fish and Game Code Section 2062)

Endangered Species Act – The Federal Endangered Species Act of 1973, as amended (16 USC 1531 et seq.), includes all regulations promulgated pursuant to FESA. The purpose of FESA is to "protect and recover imperiled species and the ecosystems upon which they depend." The California Endangered Species Act (Fish and Game Code, Chapter 1.5, Sections 2050–2115.5) conserves and protects plant and animal species at risk of extinction as identified by the California Fish and Game Commission.

Enhancement – The modification of natural resources through management actions to improve their function. Enhancement actions include invasive species removal, removal of an identified threat to the resource, management of the water sources to support habitat function, sediment management, and management of human visitation. Enhancement results in a modest gain in habitat function

Establishment (Creation) – The manipulation of the physical, chemical, or biological characteristics present to develop a habitat type or aquatic resource that did not previously exist in that space. Establishment results in a gain in both area and function.

Existing Conditions – The current physical conditions (e.g., geographic location, topography, geology, soils, climate, hydrology, and geomorphology) and biological environment of the Planning Area.

Force Main – A principal conduit (as in a sewer system) through which water is pumped as distinguished from one through which it flows by gravity.

Fully Protected Species – Those species listed in Sections 3511 (Fully Protected Birds), 4700 (Fully Protected Mammals), 5050 (Fully Protected Reptiles and Amphibians), and 5515 (Fully Protected Fish) of the California Fish and Game Code that may not be taken or possessed at any time and for which no licenses or permits may be issued for their take except for collecting these species for necessary scientific research and relocation of the bird species for the protection of livestock or as permitted under the Natural Community Conservation Planning Act (NCCPA) (California Fish and Game Code Section 2800 et seq.).

Gabion – A rock-filled cage used for erosion control, bank stabilization, and other civil engineering applications. As part of Covered Activities described in the HCP, gabions would be installed in-stream to create localized areas of scour intended to expose gravel substrate.

Geographic Information Systems – Computer-based mapping technology that manipulates geographic data in digital layers and enables one to conduct a wide array of environmental analyses.

Grading – Any excavating or filling or combination thereof, including the land in its excavated or filled condition according to a county's Grading Ordinance.

Groundwater Recharge – Activities related to construction of new structures associated with diversions, O&M of existing and new diversion structures for groundwater recharge, activities related to construction of new recharge basins, and O&M of existing and new recharge basins.

Grubbing – The removal of natural vegetation by any means, including removal of the root system.

Habitat Connectivity – The degree to which a landscape facilitates or impedes natural ecological processes, such as animal movement or seed dispersal.

Habitat Enhancement, Management, and Monitoring – Activities that support the restoration and maintenance of habitat values in the Planning Area, including species surveys, monitoring, research, and adaptive management activities.

Harm – An act that actually kills or injures wildlife, which may include significant habitat modification.

HCP Preserve – The HCP Preserve is defined as that area that will be conserved, managed, and monitored under the direction and responsibility of the Upper SAR HCP Joint Powers Authority (JPA). It includes the areas acquired or established conservation easements for preservation and the areas restored to improve habitat conditions for Covered Species. The HCP Preserve System management and monitoring will be overseen by the JPA.

Hydrologic Period – The duration of time that a feature is inundated for in any given year.

Incidental Take Permit – The permit granting take of listed species provided such take is incidental to and not the purpose of the carrying out of an otherwise lawful activity. For purposes of the Section 10(a)(1)(B) permit, *incidental take* refers solely to species other than plant species.

Increasing Groundwater – See *Rising Groundwater*.

Indirect Effects – Those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur (FESA definition).

Joint Powers Authority – A legally created entity that allows two or more public agencies to jointly exercise common powers. The Joint Exercise of Powers Act (California Government Code Section 6500) governs Joint Powers Authorities.

Jurisdictional Waters – State and federally regulated wetlands and other waterbodies. Federally regulated waters are defined under the Clean Water Act as *waters of the United States*. Waters of the State are defined under the *Porter-Cologne Water Quality Control Act* to include any surface or groundwater within the state of California.

Lake or Streambed Alteration Agreement – Under California Fish and Game Code Section 1600 et seq. CDFW has the authority to regulate work that will "substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake."

Linkage – An area of land that supports or contributes to the long-term movement of wildlife and genetic exchange by providing live-in habitat that connects to other habitat areas, including agricultural lands that contribute to wildlife movement.

Management Actions – Those actions taken to improve and maintain the suitability of the habitat for a Covered Species by restoring or enhancing the habitat, or by reducing, removing, or preventing threats that may degrade the habitat (e.g., invasive plant infestations or trespass).

Migratory Bird Treaty Act – The Federal Migratory Bird Treaty Act (MBTA) (16 USC 701 et seq.), including all regulations promulgated pursuant to the Act. The MBTA implements four international conservation treaties and is intended to ensure the sustainability of populations of migratory birds. The MBTA prohibits take of migratory birds, parts, nests, or eggs thereof. *Take*, as defined under the MBTA includes "pursue, hunt, shoot, would, kill, trap, capture, or collect."

Mitigation – The conservation actions that offset the impacts of taking on the Covered Species.

Monitoring Actions – Those actions that are taken to track the status and trend of Covered Species populations and of their habitats within the HCP Preserve System. Monitoring actions will be conducted within an adaptive management context so that monitoring results can be linked to management actions to inform and improve the efficacy and efficiency of management actions through time.

National Environmental Policy Act – The National Environmental Policy Act of 1969 (NEPA) (42 USC Section 4321 et seq.) requires federal agencies to assess the environmental effects of federal actions and provide the public a mechanism for public participation in making decisions.

National Historic Preservation Act – The National Historic Preservation Act (NHPA) (16 USC 470 et seq.) is intended to preserve historic and archaeological sites. Section 106 of the NHPA requires federal agencies to consider the effects of proposed actions on properties eligible for inclusion in the National Register of Historic Places.

Nationwide Permit – Under Section 404(e) of the Clean Water Act, the U.S. Army Corps of Engineers can issue general permits, called Nationwide Permits, that authorize activities that have only minimal individual and cumulative adverse environmental effects.

No Surprises Rule – The purpose of USFWS' No Surprises Rule is to provide assurances to non-Federal landowners participating in habitat conservation planning under FESA that no additional land restrictions or financial compensation will be required for species adequately covered by a properly implemented HCP, in light of unforeseen circumstances, without the consent of the Permittee.

Operations and Maintenance – Activities that occur repeatedly in one location and/or in many locations over a wide area periodically and include minor construction, earth moving, or vegetation clearing activities to infrastructure**.**

Permanent Impacts – Impacts that occur when existing habitat is permanently replaced by the construction or implementation of a Covered Activity.

Permit Area – The area covered by the Incidental Take Permit, which falls within but does not include the entire Planning Area, is referred to as the Permit Area. The Upper SAR HCP Permit Area is the geographic area where the impacts of the Covered Activities are expected to occur and is depicted as the ownership, easements, and areas of O&M where all Covered Activities are located within natural habitats. The Permit Area also includes the HCP Preserve System so that the Incidental Take Permits cover the potential take associated with habitat mitigation, management, and monitoring.

Permittee Agency – The agencies that will receive incidental take coverage through implementation of the HCP (also called the *Permittees*).

Physical and Biological Features – This term replaces "primary constituent elements" in the context of critical habitat. Physical and biological features of proposed or designated critical habitat are those features that are essential to the conservation of a species, including, but not limited to: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; (5) habitats that are protected from disturbance or are representative of the historic geographic and ecological distribution of a species.

Planning Area – The geographic area containing all Covered Activities and a sufficient additional area to adequately assess impacts and ensure that sufficient mitigation opportunities are available. For this HCP, the Planning Area includes portions of the Santa Ana River watershed in San Bernardino and Riverside Counties in California.

Population – An interbreeding group of individuals of the same species. The geographical limits of a population should be delineated as most appropriate for that species depending on its mobility, method of reproduction, and known distribution. Portions of a population will generally be determined based on the number of individuals; however, *area* may be the appropriate basis for some species.

Porter-Cologne Water Quality Control Act – This act governs the water quality regulation in California. It applies to surface water, groundwater, wetlands, and sources of pollution. The Act establishes Regional Water Quality Control Boards in the State Water Resources Control Board that are authorized to manage the quality of ground and surface water.

Preservation – The permanent protection and management of natural resources by setting aside or acquiring land in fee title or protected by a permanent conservation easement.

Preserve – The terms *preserve*, *preserving*, and *preservation* refer to the preservation of natural resources by setting aside or acquiring land in fee title or land protected by a permanent conservation easement. In limited circumstances, publicly owned lands that cannot be legally restricted will be considered as preservation when they will be managed under the terms of the HCP Preserve System.

Preserve Management – The actions taken to maintain, improve, and monitor a conservation or restoration site to ensure that it is in the providing the desired functions and maintained in the condition required to provide the habitat for HCP Covered Species. *Management* will include necessary measures such as trash removal, maintenance of required infrastructure (signs, gates, water conveyance structures), and access. *Monitoring* will include both monitoring of the condition of the property and the species and habitats.

Preserve System – The HCP Preserve System is composed of all Restoration Areas and Conservation Areas that will be restored, enhanced, conserved, and/or managed as mitigation for Covered Activities through implementation of the HCP.

Projects – Well-defined actions that occur once in a discrete location (e.g., construction of new facilities, infrastructure development, capital improvement projects).

Qualified Biologist – An individual with the appropriate level of knowledge and training to conduct surveys or monitoring for a particular species or habitat. For some listed species, a qualified biologist must hold a current Section 10(a)(1)A recovery permit that authorizes the individual to conduct surveys, monitor, or assess habitat conditions.

Recharge Basin – A depression in the ground with permeable soils where surface waters are put for the express purpose of increasing the quantity (recharging) of groundwater.

Reestablishment – The manipulation of the physical, chemical, or biological characteristics of a site with the intent of returning historic functions to a former habitat. Reestablishment results in rebuilding a former habitat, and in a gain in both habitat area and functions.

Restoration – The manipulation of the physical, chemical, or biological characteristics of an area with the goal of returning natural/historic functions to former habitats that historically supported such functions or species, but no longer do so because of the loss of one or more required ecological factor or as a result of past disturbance. Restoration is inclusive of reestablishment of functions in former habitats that no longer function as such, and rehabilitation of degraded and low functioning habitats. Restoration results in a gain of area or function. The term *restoration* is inclusive of *restoration, establishment*, and *reestablishment*.

Rising Groundwater – Occurs when the depth to groundwater decreases and the level of groundwater becomes closer to the surface of the ground than it was previously.

Sandbox – A settling pond that allows sediment and silt to drop out of the water before entering water flowlines.

Section 10(a)(1)(A) Permit – A permit issued by USFWS under Section 10(a)(1)(A) of FESA that allows take as part of activities intended to foster recovery of a listed species. Typical permitted activities include scientific research involving abundance surveys, presence/absence surveys, genetic research, relocations, telemetry surveys, and capture or marking.

Section 10(a)(1)(B) Permit – A permit issued by USFWS under Section 10(a)(1)(B) of FESA (16 USC 1539(a)(1)(B)) to allow the incidental take of Covered Species, to the extent take of such species is otherwise prohibited under Section 9 of FESA. *Take* under FESA does not apply to plant species, and take of listed plant species is not prohibited under FESA or authorized under a Section 10(a)(1)(B) permit. However, plant species adequately conserved by this HCP are listed in the 10(a)(1)(B) permit in recognition of the conservation measures and benefits provided for them under the HCP and receive assurances pursuant to USFWS' *No Surprises Rule*.

Section 1600 – Section 1600 of the California Fish and Game Code regulates alterations to permanent or intermittent stream courses.

Section 2081 – Section 2081(b) of CESA authorizes CDFW to allow, by permit, the take of an endangered, threatened, or candidate species, provided permit issuance criteria are met.

Section 7 – Section 7(a)(2) of FESA (16 USC 1536 (a)(2)) requires that any federal agency that permits, licenses, funds, or otherwise authorizes activities that may affect species listed under FESA consult with USFWS to ensure that its actions will not jeopardize the continued existence of any listed species or adversely modify the designated critical habitat of a listed species.

Sensitive Species – Species that meet any of the following criteria: (1) those species that are included on generally accepted and documented lists of plants and animals of endangered,

threatened, candidate, or of special concern by the federal government or State of California; (2) narrow endemic species or sensitive plant species (as defined herein); or (3) those species that meet the definition of "rare or endangered species" under Section 15380 of the CEQA Guidelines.

Solar Energy Development – Activities related to the construction and maintenance of new solar facilities.

Suitable Habitat – An area that meets the habitat needs of a species and is likely to be utilized by that species at some point within a 5-year period. If an area appears to contain the appropriate elements for a species and is within dispersal distance of known populations and without substantial barriers, it should be considered suitable unless demonstrated otherwise through appropriate and adequate field surveys.

Take – Refers to the meaning provided by FESA and the California Fish and Game Code, including relevant regulations and case law. Under FESA, *take* is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 USC 1532(19)) and *harm* has been further defined to "include any act which actually kills or injures fish or wildlife" including "significant habitat modification or degradation that significantly impairs essential behavioral patterns of fish or wildlife" (40 *Federal Register* 44412 and 46 *Federal Register* 54748).

Take Authorization – Permit authority granted through a Section 10(a)(1)(B) permit pursuant to FESA, a Section 2081 permit granted pursuant to CESA, or a Section 2835 permit pursuant to the NCCPA.

Temporary Impacts – Impacts that result in removal of habitat, but for which, following completion of the activity, the habitat is then restored or allowed to regrow and recover habitat value for Covered Species.

Threatened Species – A species listed as *threatened* under FESA or CESA that is likely to become *endangered* in the foreseeable future.

Unforeseen Circumstances – Changes in circumstances affecting a species or geographic area covered by the HCP that could not reasonably have been anticipated by HCP Permittees or USFWS at the time of the HCP's negotiation and development, which result in a substantial and adverse change in the status of the Covered Species.

Urban Runoff – Water that enters the system through storm drains. Urban runoff is generally caused by overwatering of landscaped areas, or other extraneous flows from residential, commercial, and industrial areas.

Viable – Capable of maintaining normal ecosystem functions over the long term that sustain a full suite of native or naturalized species without intensive direct human intervention.

Water Reuse Projects – Activities related to projects associated with water reuse, including construction of new water treatment plants and associated facilities, and O&M of existing and new water treatment plants and associated facilities.

Wells and Water Conveyance Infrastructure – Activities related to the creation of new wells and associated development (pipelines, access roads, reservoirs, bridges) and the O&M of this infrastructure and associated development.

Wet-Weather Flows – The time of year when streamflows are typically the highest. In the Planning Area, this is typically in March.

Width-Depth Ratio – Measurement of the ratio of a channel's wetted width to flow depth for a given flood stage.

Wildlife Corridor – A specific route that is used for movement and migration of species. A wildlife corridor may be different from a linkage because it represents a smaller or narrower avenue for movement.

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Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Chapter 11
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11.7 Chapter 7

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Appendix A

Covered Activities Permit Matrix

Table A-1. Expected Regulatory Permits and Environmental Compliances Needed by Each Covered Activity

Covered Activity ID	Federal ESA (USFWS Sec. 10 HCP)	State ESA (CDFW 2081 or NCCP)	Federal Clean Water Act (ACOE 404)	State Water Quality Certification and Waste Discharge Requirements (RWQCB 401 and Porter Cologne Water Quality Control Act)	State Lake and Streambed Alteration (CDFW 1602)	State Wastewater Change of Use Petition (1211 SWQCD)	Federal Rivers and Harbors Act (ACOE 408)	National Historic Preservation Act (NHPA 106 Compliance)	California Environmental Quality Control Act (CEQA Compliance)
CD.1	X	---	X	X	X	--	X	X	X
CD.2	X	---	X	X	X	--	X	X	X
EV.1	X	---	--	--	X	X	--	X	X
EV.2	X	X	X	X	X	--	--	X	X
EV.3	X	X	X	X	X	--	--	X	X
EV.4.01–4.03	X	X	X	X	X	X	X	X	X
EV.5	X	X	--	--	--	--	--	X	X
IEUA.1.01–1.13	X	X	X	X	X	--	--	X	X
IEUA.2	X	--	X	X	X	--	--	X	X
IEUA.3.01–3.06	X	--	--	--	--	--	--	X	X
IEUA.4	X	X	--	--	--	X	--	X	X
Met.1	X	--	--	--	--	--	--	X	X
Met.2	X	X	X	X	X	--	--	X	X
Met.3	X	X	X	X	X	--	--	X	X
OCWD.1	X	--	--	--	--	--	--	X	X
Rial.1	X	X	X	X	X	X	--	X	X
RPU.1	X	X	X	X	X	--	--	X	X
RPU.2	X	X	X	X	X	--	--	X	X
RPU.3	X	X	X	X	X	--	--	X	X
RPU.4	X	X	X	X	X	--	--	X	X
RPU.5	X	X	X	X	X	--	X	X	X
RPU.6	X	--	--	--	--	--	--	X	X
RPU.7	X	X	--	--	X	--	--	X	X
RPU.8	X	X	X	X	X	--	--	X	X
RPU.9	X	--	--	--	--	X	--	X	X
RPU.10	X	X	X	X	X	--	--	X	X

Covered Activity ID	Federal ESA (USFWS Sec. 10 HCP)	State ESA (CDFW 2081 or NCCP)	Federal Clean Water Act (ACOE 404)	State Water Quality Certification and Waste Discharge Requirements (RWQCB 401 and Porter Cologne Water Quality Control Act)	State Lake and Streambed Alteration (CDFW 1602)	State Wastewater Change of Use Petition (1211 SWQCD)	Federal Rivers and Harbors Act (ACOE 408)	National Historic Preservation Act (NHPA 106 Compliance)	California Environmental Quality Control Act (CEQA Compliance)
RPU.11	X					--	--	X	X
RPU.12	X	X	X	X	X	--	--	X	X
RPU.13	X	--	--	--	--	--	--	X	X
RPU.14	X	X	X	X	X	--	--	X	X
RPU.15	X	X	X	X	X	--	--	X	X
Rest.1	X	X	X	X	X	--	--	X	X
Rest.2	X	X	X	X	X	--	--	X	X
Rest.3	X	X	X	X	X	--	--	X	X
Rest.4	X	X	X	X	X	--	--	X	X
Rest.5	X	X	X	X	X	--	--	X	X
Rest.6	X	X	X	X	X	--	--	X	X
Rest.7	X	X	X	X	X	--	--	X	X
Rest.8	X	X	X	X	X	--	--	X	X
Rest.9	X	X	X	X	X	--	--	X	X
Rest.10	X	X	X	X	X	--	--	X	X
Rest.11	X	X	X	X	X	--	--	X	X
Rest.12	X	X	--	--	X	--	--	X	X
Rest.13	X	X	--	--	X	--	--	X	--
Rest.14	X	X	X	X	X	--	--	X	--
Rest.15	X	X	--	--	--	--	--	X	--
VD.1	X	--	--	--	--	--	X	X	X
VD.2.02–2.14	X	X	X	X	X	--	X	X	X
VD.3	X	X	X	X	X	--	--	X	X
VD.4	X	X	X	X	X	--	--	X	X
WD.1	X	X	X	X	X	X	--	X	X
WD.2	X	X	X	X	X	--	--	X	X
WD.3	X	--	X	X	X	--	--	X	X
WD.4	X	--	--	--	--	--	--	X	X

Covered Activity ID	Federal ESA (USFWS Sec. 10 HCP)	State ESA (CDFW 2081 or NCCP)	Federal Clean Water Act (ACOE 404)	State Water Quality Certification and Waste Discharge Requirements (RWQCB 401 and Porter Cologne Water Quality Control Act)	State Lake and Streambed Alteration (CDFW 1602)	State Wastewater Change of Use Petition (1211 SWQCD)	Federal Rivers and Harbors Act (ACOE 408)	National Historic Preservation Act (NHPA 106 Compliance)	California Environmental Quality Control Act (CEQA Compliance)
WD.5	X	X	X	X	X	--	--	X	X
West.1	X	X	X	X	X	--	--	X	X
West.2	X	X	X	X	X	--	--	X	X
West.3	X	--	--	--	--	--	--	X	X
West.4	X	--	X	X	X	--	--	X	X
West.5	X	--	X	X	X	X	--	X	X
West.6	X	--	X	X	X	--	--	X	X
West.7	X	X	X	X	X	--	--	X	X
West.8	X	X	X	X	X	--	--	X	X
West.9	X	--	X	X	X	--	--	X	X
West.10	X	--	--	--	--	--	--	X	X
WV.1	X	X	X	X	X	--	--	X	X
WV.2	X	X	X	X	X	--	--	X	X
WV.3	X	--	--	--	--	--	--	X	X
WV.4	X	--	X	X	X	X	--	X	X
WV.5	X	X	--	--	--	--	--	X	X
WV.6	X	X	X	X	X	--	--	X	X

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Appendix B

Selection of Baseline Period for Hydrology Analysis

Appendix B
Selection of Baseline Period for Hydrology Analysis

Hydrology Data Sources

Multiple hydrology data sources, both measured and modeled, have been analyzed for the Habitat Conservation Plan's (HCP's) baseline hydrology analysis. The primary sources include the measured U.S. Geological Survey (USGS) flow data and the modeled mean daily flow data (hydrology consultant sources: Wildermuth, and Geoscience). As part of our hydrology analysis we have performed statistical analysis on the flow data, including exceedance analysis, to determine how often flows of a given magnitude occur on a particular stream reach. In order to compare the modeling data sources with each other it is necessary to use the same base period of analysis for each data set. This is important not only for analyzing the differences between the modeled flow data for the same location, but also to enable use of all of the available data sets (some geographic areas are only covered by one or two of the data sets, yet comparisons need to be made across the entire study area). The periods of record among the data sources vary. For example, the period of record for the USGS data includes records for some gages extending back into the 1800s, while other gages have only been installed and collecting data for less than 20 years.

The modeled flow data (provided by Geoscience and Wildermuth) are based on precipitation records, which are used as input into rainfall-runoff- routing models. The Geoscience model is based on precipitation records from 1934–2008 and the Wildermuth model on precipitation records from 1950–1999. It should be noted that while the precipitation records for the modeled data extend back to 1934 and 1950, respectively, the land use conditions used in each model are based on recent land use patterns. Land use conditions are used in the models to determine how the precipitation translates into runoff and are based on recent conditions at the time each model was developed. Geoscience's Active Recharge Project model assumes 2005 land use conditions, and Wildermuth's Wasteload Allocation Model uses 2000 land use conditions. The modeled data uses a historic precipitation record to include a mixture of years that were drier and wetter than the long-term average to determine how the runoff volumes generated from the precipitation vary with water year type. In other words, the 1934 data from the Geoscience model should be interpreted as the amount of runoff that would occur under 2005 year land use conditions if the precipitation patterns from 1934 occurred in 2005.

Precipitation Analysis

The precipitation data and cumulative precipitation departure graph described below were prepared and provided by Farid Boushaki, Ph.D., P.E., with Riverside Public Utilities. Precipitation records from the San Bernardino Hospital Gage are available for 122 years spanning the period 1892–2014 (water years 1893–2014, see Figure B-1). The annual average precipitation over the 1892–2004 period is 16.0 inches. The annual minimum and maximum over this same period is 2.4 and 36.6 inches, respectively (calculated using water years that begin October 1 and end September 30). For the purposes of this analysis the rainfall record at this gage is assumed to be representative of climatic conditions for the area included in the Santa Ana River HCP with the acknowledgement

that absolute precipitation values vary widely throughout the region. The gage does not account for variability in annual snowpack.

Cumulative precipitation departure analysis is a technique used by hydrologists to characterize trends in precipitation time-series data. The cumulative departure line in Figure B-1 is calculated by calculating the difference between a given year's total annual rainfall and the long term average then cumulatively adding each successive year's precipitation departure to the running total from the previous year. A downward trend in the cumulative departure line indicates drier than average conditions whereas an upward trending line indicates wetter than average conditions. Wet and dry classifications are labeled at the bottom of Figure B-1. These classifications are based on interpretation of the precipitation trends. The data indicate the last wet trend occurred for 8 years from 1991–1998, which transitioned into a dry period that has lasted from 1999 to the most recent data in 2014. Although there have been individual years with wetter than average rainfall in the 1999–2014 period (i.e., 2004, 2005, and 2010), the overall pattern is drier than average conditions. Viewed historically, the 1892–1904 period had a greater negative cumulative departure than the 1999–2014 period[1]. Only by analyzing future years of data beyond 2014 will we be able to determine that if the current dry period continues it could cause the trend of net deficit to equal or exceed the deficit obtained in 1904.

Selection of Hydrology Base Period

The cumulative precipitation departure analysis was used to select a base period from the precipitation record that includes a mixture of years that is representative of the long-term average. The base period must begin no earlier than 1950 and end no later than 1999 in order to compare the Geoscience and Wildermuth data. For the reasons described below, we recommend selecting a 25-year base period that begins in 1966 and ends in 1990 as this period allows use of both modeling data sets and includes a dry and wet period that is representative of the long-term conditions measured at the precipitation gage.

Table B-1 compares precipitation statistics of the 1966–1990 period with the gage record of 1892–2014 and the past 20 years of 1995–2014. The annual average precipitation over the recommended base period of 1966–1990 is 16.4 inches, which is similar to the 1892–2014 period (16.0 inches) and slightly higher than the 1995–2014 period (14.0 inches). The percentage of the years with annual rainfall less than the long-term average over the 1966-1990 period is 60%, which is similar to both the 1892-2014 period (56%) and 1995-2014 period (65%). The minimum annual rainfall that occurred in the 1966-1990 period is 8.9 inches. This is higher than both the 1892-2014 and 1995-2014 periods since the lowest annual precipitation ever recorded at the gage of 2.4 inches occurred in 2001.

Figure B-2 shows frequency distributions of mean annual precipitation for both the 1892-2014 period and 1966–1990 period. The red columns indicate the actual number of years of precipitation within the frequency bin interval and the black line curve represents how the frequency distribution would look if the data had a normal distribution around the mean. The intent of showing the normal distribution curve on the graphs is to highlight that the actual distribution frequency is skewed and not normally distributed. The distribution curves were used to designate Dry, Intermediate, and Wet water year type classifications specific to this study. ICF designated Dry years have less than 11 inches of annual precipitation, Intermediate years have 11-19 inches, and Wet years have more than 19 inches of annual precipitation. Table B-2 compares water year type statistics for the 1892–

2014, 1995–2014, and 1966–1990 periods. The results show strong similarity in the percentage of years designated in each of the three water year types between the long term period of 1892–2014 and the selected baseline period of 1966–1990.

In summary, the precipitation record from the recommended base period of 1966–1990 is similar to both the long-term and previous 20-year records in terms of the annual average rainfall and distribution of wetter and drier than average years.

Table B-1. Statistical Comparison of Annual Precipitation for Different Hydrologic Periods

Period	Years In Period	Annual Average (inches)	% Years Below Annual Average	% Years Above Annual Average	Annual Minimum Over Period (inches)	Annual Maximum Over Period (inches)
1892–2014	122	16.0	56	44	2.4	36.6
1950–1999	50	16.0	64	36	6.0	34.4
1966–1990	25	16.4	60	40	8.9	32.4
1995–2014	20	14.0	65	35	2.4	32.7

Table B-2. Comparison of Water Year Type Characteristics Between the 1892–2014, 1995–2014, and 1966–1990 Periods

Period	Water Year Type	Rainfall (inches)	# Years	% Years	Average Rainfall (inches)
1892–2014	Dry	<11	30	24%	8.7
	Intermediate	11–19	62	50%	14.7
	Wet	>19	31	25%	25.4
1995–2014	Dry	<11	9	45%	7.7
	Intermediate	11–19	7	35%	14.4
	Wet	>19	4	20%	27.6
1966–1990	Dry	<11	6	24%	9.8
	Intermediate	11–19	14	56%	14.7
	Wet	>19	5	20%	29.3

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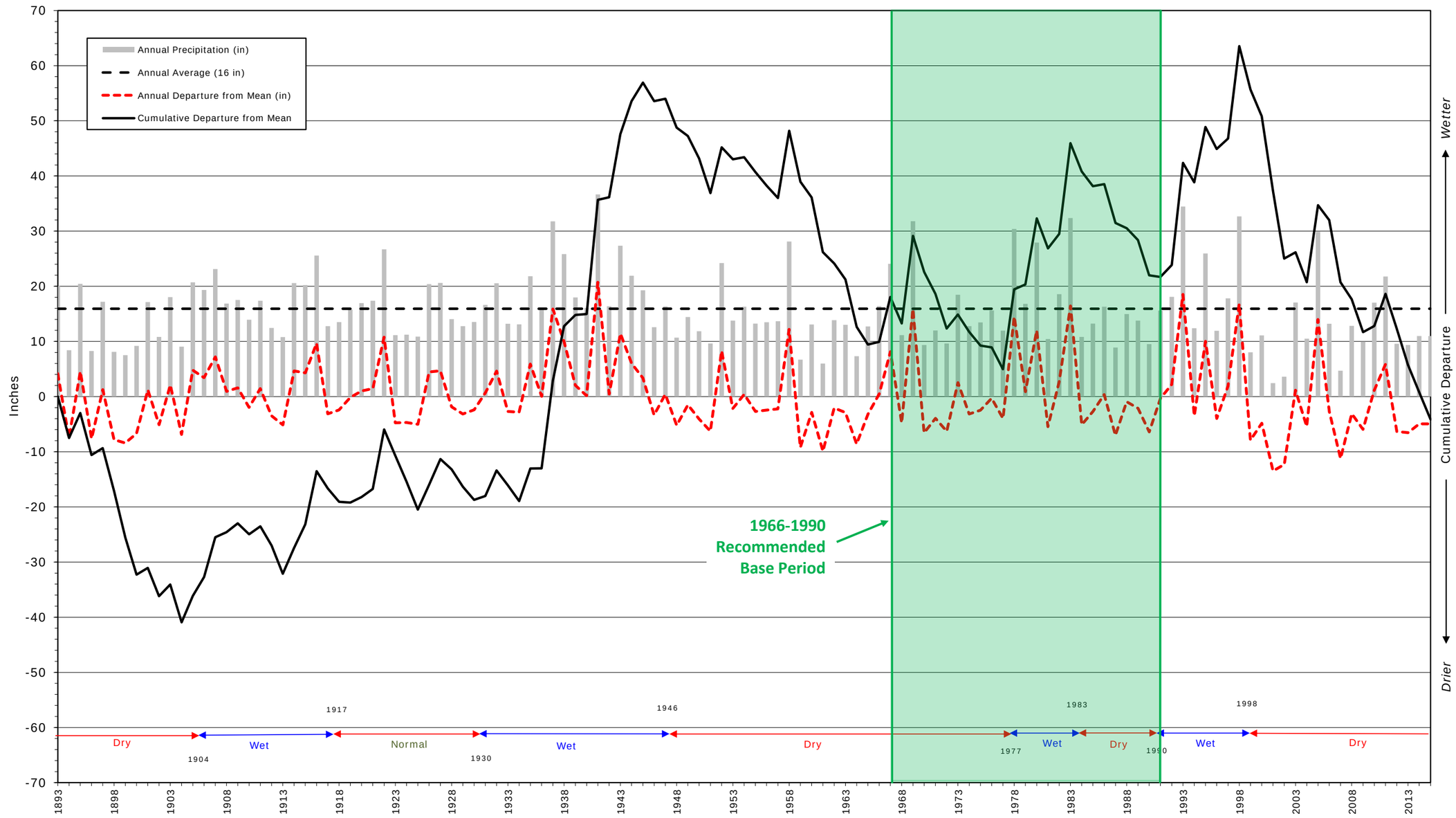

Source: Farid Boushaki, Riverside Public Utilities.

Figure B-1. San Bernardino Hospital Gage Cumulative Precipitation Departure Analysis from 1892–2014

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Figure B-2. Frequency Distribution Curves and Water Year Type Designations for 1892–2014, 1995–2014, and 1966–1990 Periods Based on San Bernardino Hospital Gage Precipitation Data

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Appendix C

Monthly and Annual Flows for Exceedance Probabilities at Existing Conditions and with Covered Activities

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Borea Daley Creek	SE-26	0.95	0.24	0.34	0.40	0.42	0.40	0.38	0.34	0.31	0.29	0.27	0.25	0.24	0.27
Borea Daley Creek	SE-26	0.75	0.35	0.51	0.58	0.50	0.46	0.42	0.38	0.34	0.32	0.29	0.27	0.29	0.35
Borea Daley Creek	SE-26	0.50	0.67	0.80	0.98	0.80	0.57	0.47	0.41	0.37	0.34	0.31	0.32	0.39	0.46
Borea Daley Creek	SE-26	0.25	1.14	1.84	3.39	1.79	1.16	0.73	0.53	0.44	0.40	0.40	0.41	0.79	0.83
Borea Daley Creek	SE-26	0.05	18.03	20.33	15.71	4.67	2.70	1.84	0.94	0.73	0.71	0.83	8.16	10.94	5.52
Borea Daley Creek	SE-26	mean	3.09	4.23	3.72	1.82	1.06	0.68	0.50	0.56	0.61	0.67	1.57	2.25	1.72
Borea Daley Creek	SE-25	0.95	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Borea Daley Creek	SE-25	0.75	0.02	0.09	0.11	0.06	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Borea Daley Creek	SE-25	0.50	0.17	0.21	0.30	0.21	0.07	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.03
Borea Daley Creek	SE-25	0.25	0.36	0.84	0.85	0.84	0.40	0.14	0.04	0.01	0.01	0.01	0.02	0.14	0.20
Borea Daley Creek	SE-25	0.05	1.24	2.67	3.17	1.91	1.13	0.84	0.18	0.09	0.07	0.10	0.39	0.86	1.23
Borea Daley Creek	SE-25	mean	0.46	1.12	1.05	0.53	0.30	0.13	0.04	0.03	0.02	0.03	0.08	0.25	0.33
Borea Daley Creek	SE-24	0.95	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Borea Daley Creek	SE-24	0.75	0.01	0.07	0.10	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Borea Daley Creek	SE-24	0.50	0.15	0.19	0.26	0.19	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.02
Borea Daley Creek	SE-24	0.25	0.30	0.81	0.81	0.81	0.39	0.13	0.03	0.00	0.00	0.00	0.01	0.10	0.17
Borea Daley Creek	SE-24	0.05	0.83	2.56	2.92	1.82	1.07	0.81	0.17	0.07	0.05	0.05	0.18	0.81	1.00
Borea Daley Creek	SE-24	mean	0.38	1.02	0.96	0.50	0.28	0.12	0.03	0.01	0.01	0.01	0.03	0.19	0.29
Cable Creek	NW-17	0.95	0.08	0.14	0.15	0.14	0.12	0.10	0.08	0.08	0.07	0.07	0.08	0.08	0.08
Cable Creek	NW-17	0.75	0.17	0.22	0.26	0.20	0.16	0.13	0.11	0.09	0.09	0.08	0.09	0.12	0.12
Cable Creek	NW-17	0.50	0.31	0.40	0.60	0.39	0.24	0.17	0.13	0.12	0.11	0.11	0.13	0.20	0.20
Cable Creek	NW-17	0.25	1.34	2.45	7.63	2.87	0.62	0.34	0.24	0.19	0.20	0.19	0.26	0.65	0.51
Cable Creek	NW-17	0.05	44.19	87.97	76.26	26.70	12.12	2.63	0.68	0.51	0.47	0.81	8.90	22.67	20.48
Cable Creek	NW-17	mean	9.55	21.21	17.16	5.43	2.29	0.52	0.23	0.55	0.69	0.71	3.08	5.56	5.50
Cable Creek	NW-16	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-16	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-16	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-16	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-16	0.05	0.39	17.45	12.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-16	mean	2.62	7.50	4.67	0.27	0.00	0.00	0.00	0.06	0.08	0.05	0.27	1.26	1.37
Cable Creek	NW-13	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-13	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-13	0.50	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-13	0.25	0.03	4.25	6.76	4.88	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-13	0.05	13.03	34.70	31.05	15.95	7.02	0.83	0.00	0.00	0.00	0.00	0.47	7.12	10.68
Cable Creek	NW-13	mean	3.92	10.31	8.91	3.45	1.18	0.12	0.00	0.06	0.09	0.08	0.52	2.02	2.52
Cable Creek	NW-12	0.95	0.17	0.49	1.28	0.78	0.50	0.35	0.27	0.21	0.18	0.17	0.16	0.16	0.18
Cable Creek	NW-12	0.75	0.61	2.06	2.79	2.00	1.18	0.67	0.43	0.30	0.23	0.20	0.19	0.24	0.35
Cable Creek	NW-12	0.50	3.39	4.23	5.45	4.46	2.33	1.05	0.60	0.40	0.31	0.26	0.29	0.57	1.03
Cable Creek	NW-12	0.25	5.55	10.07	12.28	10.94	6.45	3.14	1.31	0.76	0.56	0.43	0.60	2.66	3.85
Cable Creek	NW-12	0.05	17.03	38.32	35.84	21.46	12.79	6.71	3.08	1.60	1.66	1.95	5.10	12.36	16.07
Cable Creek	NW-12	mean	6.89	14.00	13.08	7.35	4.25	2.12	1.02	0.67	0.60	0.55	1.27	3.65	4.57
Cajon Wash	NW-19	0.95	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cajon Wash	NW-19	0.75	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cajon Wash	NW-19	0.50	0.02	0.03	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Cajon Wash	NW-19	0.25	0.07	0.11	0.45	0.12	0.06	0.03	0.02	0.02	0.02	0.02	0.02	0.04	0.04
Cajon Wash	NW-19	0.05	10.74	37.25	32.85	5.63	1.54	0.17	0.08	0.05	0.04	0.04	0.78	3.46	3.24
Cajon Wash	NW-19	mean	6.80	16.66	10.01	1.19	0.31	0.04	0.02	0.19	0.37	0.20	1.54	3.08	3.30
Cajon Wash	NW-18	0.95	0.02	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Cajon Wash	NW-18	0.75	0.04	0.06	0.10	0.05	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Cajon Wash	NW-18	0.50	0.14	0.19	0.23	0.17	0.07	0.04	0.03	0.02	0.03	0.03	0.03	0.05	0.05
Cajon Wash	NW-18	0.25	0.53	1.18	2.19	1.64	0.71	0.19	0.06	0.05	0.06	0.13	0.12	0.25	0.29
Cajon Wash	NW-18	0.05	11.43	32.59	31.11	16.07	10.25	3.47	1.70	0.89	0.58	0.28	1.18	3.83	8.41
Cajon Wash	NW-18	mean	4.23	8.00	7.51	2.55	1.68	0.66	0.28	0.20	0.37	0.15	1.09	1.97	2.36
Chino Creek	NCH16	0.95	40.00	36.90	32.10	25.60	22.00	12.50	14.60	12.20	14.60	19.80	25.30	39.20	12.30
Chino Creek	NCH16	0.75	40.00	36.90	32.10	25.70	22.10	12.70	14.60	12.20	14.70	20.00	25.30	39.20	14.70
Chino Creek	NCH16	0.50	40.00	36.90	32.70	26.00	22.20	12.90	14.60	12.30	14.80	20.10	25.30	39.20	25.30
Chino Creek	NCH16	0.25	70.80	95.50	104.35	35.50	22.30	13.10	14.70	12.40	15.00	20.20	29.50	55.75	39.20
Chino Creek	NCH16	0.05	1954.91	1572.10	1091.87	264.61	37.52	13.40	14.80	12.40	38.09	60.00	749.17	1079.09	418.05
Chino Creek	NCH16	mean	336.76	324.46	265.91	73.23	33.36	13.99	15.13	19.34	31.42	38.08	157.60	216.44	126.29
Chino Creek	NCH12	0.95	13.50	15.30	13.80	13.90	10.10	6.50	6.60	4.70	3.50	5.10	6.70	9.00	3.60
Chino Creek	NCH12	0.75	13.50	15.30	13.80	13.90	10.10	6.50	6.60	4.70	3.50	5.10	6.70	9.00	6.50
Chino Creek	NCH12	0.50	13.50	15.30	13.80	13.90	10.10	6.60	6.60	4.70	3.60	5.20	6.70	9.00	9.00
Chino Creek	NCH12	0.25	17.40	16.40	17.50	14.00	10.10	6.60	6.60	4.70	3.60	5.20	6.70	9.00	13.90
Chino Creek	NCH12	0.05	955.29	866.93	561.05	119.69	11.19	6.60	6.60	4.80	9.94	23.97	450.63	506.85	197.75
Chino Creek	NCH12	mean	148.39	151.08	119.29	35.18	15.51	7.62	6.86	9.04	13.45	15.32	75.82	95.65	57.33
Chino Creek	NCH11	0.95	13.50	15.30	13.80	13.90	10.10	6.50	6.60	4.70	3.50	5.10	6.70	9.00	3.60
Chino Creek	NCH11	0.75	13.50	15.30	13.80	13.90	10.10	6.50	6.60	4.70	3.50	5.10	6.70	9.00	6.50
Chino Creek	NCH11	0.50	13.50	15.30	13.80	13.90	10.10	6.60	6.60	4.70	3.60	5.20	6.70	9.00	9.00
Chino Creek	NCH11	0.25	17.10	16.18	17.00	14.00	10.10	6.60	6.60	4.70	3.60	5.20	6.70	9.00	13.80
Chino Creek	NCH11	0.05	776.39	708.45	481.87	105.09	11.05	6.60	6.60	4.80	9.26	19.22	386.20	439.51	174.65
Chino Creek	NCH11	mean	125.78	128.89	102.11	32.16	14.73	7.61	6.82	8.52	12.27	13.64	63.95	81.08	49.43
Chino Creek	NCH10	0.95	5.10	7.60	8.70	10.30	6.20	5.10	6.10	4.20	2.70	2.00	1.90	2.00	1.90
Chino Creek	NCH10	0.75	5.10	7.60	8.70	10.40	6.20	5.10	6.10	4.20	2.80	2.00	1.90	2.00	2.80
Chino Creek	NCH10	0.50	5.10	7.60	8.70	10.40	6.20	5.20	6.10	4.30	2.80	2.10	1.90	2.00	5.20
Chino Creek	NCH10	0.25	8.30	8.28	11.85	10.40	6.20	5.20	6.10	4.30	2.80	2.10	1.90	2.00	8.60
Chino Creek	NCH10	0.05	608.42	587.80	398.68	88.75	7.15	5.20	6.20	4.30	8.16	15.49	314.55	371.04	140.05
Chino Creek	NCH10	mean	99.69	103.35	83.47	26.22	10.31	6.19	6.30	7.78	10.49	9.25	49.66	62.58	39.31
Chino Creek	NCH09	0.95	5.10	7.60	8.70	10.30	6.20	5.10	6.10	4.20	2.70	2.00	1.90	2.00	1.90
Chino Creek	NCH09	0.75	5.10	7.60	8.70	10.40	6.20	5.10	6.10	4.20	2.80	2.00	1.90	2.00	2.80
Chino Creek	NCH09	0.50	5.10	7.60	8.70	10.40	6.20	5.20	6.10	4.30	2.80	2.10	1.90	2.00	5.20
Chino Creek	NCH09	0.25	7.95	8.28	11.75	10.40	6.20	5.20	6.10	4.30	2.80	2.10	1.90	2.00	8.55
Chino Creek	NCH09	0.05	559.59	558.20	372.19	85.02	7.15	5.20	6.20	4.30	8.10	13.79	285.34	348.13	131.25
Chino Creek	NCH09	mean	92.73	96.34	78.11	25.21	10.06	6.18	6.29	7.63	9.99	8.64	45.67	57.93	36.78
City Creek	SE-41	0.95	0.41	0.82	1.24	0.56	0.50	0.39	0.34	0.31	0.29	0.29	0.33	0.37	0.33
City Creek	SE-41	0.75	2.55	3.52	3.82	2.98	1.24	0.54	0.41	0.35	0.34	0.36	0.42	0.66	0.46
City Creek	SE-41	0.50	5.50	6.36	7.53	5.87	3.54	1.06	0.49	0.42	0.40	0.45	0.81	3.26	2.35
City Creek	SE-41	0.25	9.69	15.28	26.38	19.64	9.49	3.44	1.08	0.59	0.77	2.01	3.79	7.83	6.96
City Creek	SE-41	0.05	49.91	114.15	147.92	59.10	31.67	16.36	9.46	6.84	5.30	6.06	18.40	33.84	41.15
City Creek	SE-41	mean	20.56	44.25	36.82	15.50	8.38	4.02	2.19	1.68	1.65	1.87	5.60	11.78	12.69

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
City Creek	SE-39	0.95	0.17	0.45	0.89	0.18	0.13	0.04	0.01	0.01	0.01	0.02	0.08	0.12	0.02
City Creek	SE-39	0.75	2.08	2.93	3.30	2.36	0.77	0.12	0.04	0.03	0.03	0.09	0.15	0.35	0.13
City Creek	SE-39	0.50	4.87	5.74	6.64	5.24	3.02	0.59	0.10	0.08	0.08	0.14	0.47	2.72	1.85
City Creek	SE-39	0.25	8.43	13.71	22.37	17.43	8.77	2.96	0.58	0.17	0.26	1.39	3.28	6.91	6.23
City Creek	SE-39	0.05	34.20	111.02	140.86	55.82	29.63	15.14	8.77	6.11	4.66	5.28	12.52	23.59	35.95
City Creek	SE-39	mean	18.29	41.61	34.36	14.19	7.57	3.45	1.72	1.16	1.10	1.27	4.27	10.03	11.42
City Creek	SE-37	0.95	2.20	2.81	3.27	2.30	1.70	0.50	0.10	0.10	0.10	0.20	1.00	1.60	0.20
City Creek	SE-37	0.75	4.40	5.21	5.51	4.71	3.11	1.50	0.50	0.30	0.40	1.10	2.00	2.80	1.70
City Creek	SE-37	0.50	7.11	7.92	9.21	7.42	5.32	3.00	1.30	0.99	1.00	1.89	2.90	4.82	4.20
City Creek	SE-37	0.25	12.04	17.94	30.52	23.18	13.01	5.22	2.91	2.30	2.61	3.53	5.61	9.82	8.61
City Creek	SE-37	0.05	41.75	116.85	146.76	63.36	38.09	20.09	13.02	8.51	6.92	7.52	15.01	32.28	43.38
City Creek	SE-37	mean	21.18	44.69	38.05	18.10	10.95	5.82	3.21	2.26	2.28	2.87	6.46	12.75	13.89
City Creek Channel	SE-52	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-52	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-52	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-52	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-52	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-52	mean	0.21	0.39	0.14	0.00	0.00	0.00	0.00	0.05	0.05	0.04	0.11	0.22	0.10
City Creek Channel	SE-51	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-51	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-51	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-51	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-51	0.05	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-51	mean	0.18	0.28	0.12	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.10	0.17	0.08
City Creek Channel	SE-50	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-50	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-50	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-50	0.05	0.07	0.12	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-50	mean	0.18	0.25	0.12	0.01	0.00	0.00	0.00	0.03	0.03	0.03	0.10	0.15	0.07
Cucamonga Creek	NCC19	0.95	24.00	18.90	16.40	10.00	10.10	4.00	6.30	5.50	8.80	12.50	16.00	27.40	4.40
Cucamonga Creek	NCC19	0.75	24.00	18.90	16.40	10.10	10.20	4.10	6.30	5.50	8.80	12.60	16.00	27.40	8.70
Cucamonga Creek	NCC19	0.50	24.00	18.90	16.60	10.30	10.30	4.30	6.30	5.60	8.90	12.70	16.00	27.40	12.70
Cucamonga Creek	NCC19	0.25	40.10	46.58	71.35	16.33	10.40	4.40	6.40	5.60	9.10	12.80	18.18	34.55	24.00
Cucamonga Creek	NCC19	0.05	937.92	654.50	534.66	139.44	20.00	4.56	6.50	5.70	12.23	28.63	316.13	434.42	188.55
Cucamonga Creek	NCC19	mean	177.46	162.03	138.31	35.30	15.81	4.34	6.55	8.16	15.27	20.11	75.26	112.93	63.90
Cucamonga Creek	NCC18	0.95	24.00	18.90	16.40	10.00	10.10	4.00	6.30	5.50	8.80	12.50	16.00	27.40	4.40
Cucamonga Creek	NCC18	0.75	24.00	18.90	16.40	10.10	10.20	4.10	6.30	5.50	8.80	12.60	16.00	27.40	8.70
Cucamonga Creek	NCC18	0.50	24.00	18.90	16.60	10.30	10.30	4.30	6.30	5.60	8.90	12.70	16.00	27.40	12.70
Cucamonga Creek	NCC18	0.25	40.05	45.65	71.35	16.33	10.40	4.40	6.40	5.60	9.10	12.80	18.18	34.55	24.00
Cucamonga Creek	NCC18	0.05	872.10	645.43	531.56	139.11	20.00	4.50	6.50	5.70	12.23	28.60	302.95	429.42	185.10
Cucamonga Creek	NCC18	mean	173.44	157.69	135.23	34.96	15.75	4.34	6.55	8.08	15.15	19.97	73.50	110.67	62.57
Day Creek	NDY19	0.95	0.00	0.00	0.00	0.00	0.10	0.10	0.17	0.20	0.00	0.00	0.00	0.00	0.00
Day Creek	NDY19	0.75	0.10	0.10	0.00	0.30	0.20	0.30	0.20	0.20	0.10	0.00	0.00	0.00	0.20
Day Creek	NDY19	0.50	1.80	2.70	3.10	0.90	0.40	0.30	0.30	0.30	0.20	0.10	0.30	1.20	0.30

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Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Day Creek	NDY19	0.25	15.70	21.50	24.05	3.50	0.70	0.50	0.30	0.30	0.30	0.70	4.48	7.50	2.20
Day Creek	NDY19	0.05	256.14	199.25	153.03	40.30	3.36	1.16	0.50	1.43	4.31	7.54	95.17	126.29	73.05
Day Creek	NDY19	mean	58.57	53.36	42.77	8.72	2.08	0.48	0.36	1.41	2.25	2.84	21.22	30.87	18.60
Devil Canyon Creek	NW-11	0.95	0.05	0.08	0.09	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05
Devil Canyon Creek	NW-11	0.75	0.08	0.11	0.12	0.11	0.09	0.08	0.07	0.06	0.06	0.05	0.06	0.07	0.07
Devil Canyon Creek	NW-11	0.50	0.14	0.16	0.20	0.15	0.12	0.10	0.07	0.07	0.06	0.06	0.07	0.10	0.10
Devil Canyon Creek	NW-11	0.25	0.62	1.41	5.55	1.89	0.21	0.14	0.09	0.08	0.08	0.08	0.10	0.24	0.17
Devil Canyon Creek	NW-11	0.05	35.00	56.12	55.94	24.95	10.65	1.70	0.18	0.14	0.17	0.37	6.06	17.92	16.79
Devil Canyon Creek	NW-11	mean	5.84	12.37	11.13	4.42	1.88	0.30	0.09	0.33	0.42	0.44	2.23	3.47	3.53
Devil Canyon Creek	NW-10	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Devil Canyon Creek	NW-10	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Devil Canyon Creek	NW-10	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Devil Canyon Creek	NW-10	0.25	0.08	0.84	4.91	1.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Devil Canyon Creek	NW-10	0.05	27.96	51.01	52.65	24.28	10.27	1.48	0.00	0.00	0.00	0.00	4.41	13.77	14.53
Devil Canyon Creek	NW-10	mean	5.05	11.48	10.33	4.04	1.70	0.18	0.00	0.20	0.28	0.27	1.78	2.86	3.14
Devil Canyon Creek	NW-9	0.95	0.26	0.31	0.38	0.30	0.28	0.25	0.22	0.19	0.17	0.15	0.14	0.15	0.17
Devil Canyon Creek	NW-9	0.75	1.25	1.20	1.16	0.80	0.49	0.33	0.27	0.23	0.20	0.18	0.22	0.29	0.33
Devil Canyon Creek	NW-9	0.50	2.29	3.24	3.99	2.75	1.68	0.65	0.73	0.45	0.37	0.33	0.69	1.87	1.12
Devil Canyon Creek	NW-9	0.25	4.95	6.64	10.90	7.36	3.52	2.23	1.61	1.05	1.03	1.12	1.89	3.93	3.03
Devil Canyon Creek	NW-9	0.05	36.55	56.04	59.04	30.11	15.97	7.22	3.40	2.13	2.31	3.25	12.92	22.12	21.84
Devil Canyon Creek	NW-9	mean	8.17	14.91	13.99	7.22	4.03	1.81	1.08	0.98	1.09	1.20	3.46	5.46	5.23
Devil Canyon Creek	NW-2	0.95	0.02	0.02	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Devil Canyon Creek	NW-2	0.75	0.85	0.59	0.62	0.32	0.13	0.02	0.01	0.01	0.01	0.01	0.01	0.09	0.02
Devil Canyon Creek	NW-2	0.50	1.82	2.29	2.77	2.10	1.27	0.36	0.37	0.07	0.03	0.08	0.48	1.54	0.76
Devil Canyon Creek	NW-2	0.25	3.87	5.10	7.86	5.86	2.88	1.80	1.25	0.74	0.77	0.87	1.55	3.05	2.35
Devil Canyon Creek	NW-2	0.05	17.26	38.95	50.30	23.22	14.09	5.92	2.69	1.84	1.86	2.28	5.13	9.56	13.22
Devil Canyon Creek	NW-2	mean	5.06	10.90	10.41	5.53	3.17	1.34	0.75	0.55	0.61	0.64	1.94	3.26	3.64
Devil Canyon Creek	NW-1	0.95	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Devil Canyon Creek	NW-1	0.75	0.82	0.58	0.59	0.30	0.11	0.01	0.00	0.00	0.00	0.00	0.00	0.09	0.01
Devil Canyon Creek	NW-1	0.50	1.81	2.22	2.61	2.08	1.27	0.36	0.36	0.07	0.01	0.07	0.38	1.50	0.76
Devil Canyon Creek	NW-1	0.25	3.57	4.96	7.52	5.68	2.87	1.79	1.25	0.75	0.77	0.87	1.48	2.89	2.28
Devil Canyon Creek	NW-1	0.05	16.10	36.72	50.17	23.12	13.99	5.87	2.67	1.85	1.86	2.27	4.64	8.99	13.09
Devil Canyon Creek	NW-1	mean	4.86	10.68	10.21	5.45	3.13	1.33	0.74	0.54	0.58	0.61	1.83	3.11	3.55
East Twin Creek	SE-78	0.95	0.26	0.35	0.38	0.33	0.29	0.26	0.19	0.18	0.21	0.22	0.26	0.29	0.21
East Twin Creek	SE-78	0.75	0.41	0.46	0.50	0.42	0.34	0.31	0.23	0.21	0.23	0.24	0.29	0.36	0.28
East Twin Creek	SE-78	0.50	0.61	0.66	0.70	0.58	0.43	0.35	0.25	0.22	0.25	0.27	0.36	0.47	0.41
East Twin Creek	SE-78	0.25	1.04	1.89	5.92	2.01	0.75	0.52	0.34	0.29	0.32	0.38	0.49	0.91	0.68
East Twin Creek	SE-78	0.05	95.35	130.21	90.73	19.38	2.38	1.14	0.70	0.56	0.64	2.96	33.16	58.53	23.12
East Twin Creek	SE-78	mean	19.07	29.99	20.21	4.51	1.25	0.48	0.33	1.38	1.83	2.28	8.40	14.19	8.55
East Twin Creek	SE-54	0.95	0.43	0.57	0.63	0.63	0.61	0.57	0.43	0.39	0.42	0.42	0.45	0.45	0.44
East Twin Creek	SE-54	0.75	0.61	0.71	0.79	0.73	0.70	0.65	0.50	0.45	0.47	0.46	0.49	0.54	0.53
East Twin Creek	SE-54	0.50	0.86	0.96	1.03	0.94	0.81	0.72	0.56	0.50	0.51	0.51	0.57	0.68	0.71
East Twin Creek	SE-54	0.25	1.40	2.46	7.21	2.67	1.19	0.95	0.72	0.61	0.62	0.67	0.74	1.22	1.05
East Twin Creek	SE-54	0.05	107.31	138.23	98.94	19.12	3.35	1.67	1.22	1.01	1.06	3.64	34.13	56.39	23.05
East Twin Creek	SE-54	mean	19.71	30.75	21.40	5.27	1.76	0.87	0.67	1.66	2.14	2.63	8.92	14.66	9.10

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
East Twin Creek	SE-53	0.95	0.33	0.44	0.48	0.49	0.47	0.43	0.33	0.30	0.32	0.32	0.34	0.35	0.33
East Twin Creek	SE-53	0.75	0.46	0.54	0.60	0.56	0.54	0.50	0.39	0.35	0.36	0.35	0.38	0.41	0.41
East Twin Creek	SE-53	0.50	0.66	0.74	0.79	0.72	0.62	0.55	0.43	0.38	0.39	0.39	0.43	0.51	0.54
East Twin Creek	SE-53	0.25	1.07	1.90	5.83	2.00	0.91	0.72	0.55	0.46	0.47	0.50	0.56	0.93	0.79
East Twin Creek	SE-53	0.05	89.23	117.18	86.08	15.34	2.68	1.22	0.90	0.75	0.79	2.71	26.84	49.84	18.02
East Twin Creek	SE-53	mean	17.18	28.07	19.10	4.37	1.37	0.66	0.51	1.37	1.76	2.14	7.46	12.68	7.95
East Twin Creek	SE-32	0.95	0.22	0.29	0.32	0.33	0.32	0.29	0.23	0.21	0.22	0.22	0.23	0.23	0.23
East Twin Creek	SE-32	0.75	0.31	0.36	0.40	0.37	0.36	0.33	0.26	0.23	0.24	0.23	0.25	0.27	0.27
East Twin Creek	SE-32	0.50	0.44	0.48	0.52	0.48	0.42	0.37	0.29	0.26	0.26	0.26	0.29	0.34	0.35
East Twin Creek	SE-32	0.25	0.70	1.37	4.42	1.28	0.59	0.48	0.36	0.31	0.31	0.32	0.36	0.62	0.52
East Twin Creek	SE-32	0.05	82.99	111.08	81.32	12.25	1.93	0.74	0.55	0.47	0.52	2.01	24.17	47.52	15.13
East Twin Creek	SE-32	mean	15.75	26.33	17.72	3.76	1.03	0.43	0.33	1.11	1.46	1.81	6.63	11.48	7.22
East Twin Creek	SE-21	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-21	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-21	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-21	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-21	0.05	0.00	14.43	21.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-21	mean	3.64	10.47	6.32	0.60	0.00	0.00	0.00	0.00	0.02	0.00	0.55	2.54	1.97
East Twin Creek	SE-19	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-19	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-19	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-19	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-19	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-19	mean	0.20	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.05
East Twin Creek	SE-17	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-17	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-17	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-17	0.25	0.00	0.25	5.24	1.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-17	0.05	15.92	58.87	72.15	32.46	11.96	1.41	0.00	0.00	0.00	0.00	0.00	7.39	16.11
East Twin Creek	SE-17	mean	5.67	15.33	14.69	5.96	1.93	0.22	0.00	0.15	0.10	0.15	1.02	4.14	4.05
East Twin Creek	SE-13	0.95	0.98	1.14	1.21	0.91	0.98	0.61	0.41	0.41	0.41	0.31	0.51	0.51	0.43
East Twin Creek	SE-13	0.75	2.12	2.32	2.52	2.12	1.71	1.01	0.61	0.51	0.51	0.61	0.91	1.30	1.01
East Twin Creek	SE-13	0.50	3.03	3.44	4.41	3.58	2.53	1.51	0.91	0.71	0.81	1.01	1.52	2.65	2.11
East Twin Creek	SE-13	0.25	5.25	6.62	12.77	8.76	5.51	3.63	2.32	1.77	1.84	2.01	2.81	4.22	4.22
East Twin Creek	SE-13	0.05	22.92	40.61	63.15	31.59	17.10	11.06	6.93	4.72	4.11	5.45	10.45	15.74	19.54
East Twin Creek	SE-13	mean	7.66	13.84	14.69	8.79	5.32	3.11	1.98	1.69	1.52	1.97	3.62	6.50	5.85
Little Sand Creek	SE-30	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-30	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-30	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-30	0.25	0.00	0.22	2.07	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-30	0.05	29.55	33.54	23.87	4.40	0.67	0.00	0.00	0.00	0.00	0.41	12.00	16.21	6.01
Little Sand Creek	SE-30	mean	4.17	5.46	4.20	1.19	0.25	0.00	0.00	0.26	0.39	0.54	2.08	3.01	1.78
Little Sand Creek	SE-29	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-29	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-29	0.50	0.05	0.22	0.46	0.22	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Little Sand Creek	SE-29	0.25	0.82	1.50	3.79	1.44	0.68	0.15	0.01	0.00	0.00	0.00	0.00	0.36	0.31
Little Sand Creek	SE-29	0.05	29.12	32.97	23.98	5.75	2.48	1.40	0.41	0.20	0.21	0.54	12.95	16.84	7.46
Little Sand Creek	SE-29	mean	4.30	5.75	4.67	1.77	0.68	0.21	0.07	0.28	0.40	0.57	2.10	3.09	1.97
Little Sand Creek	SE-28	0.95	0.18	0.34	0.42	0.45	0.44	0.41	0.35	0.30	0.27	0.23	0.20	0.19	0.24
Little Sand Creek	SE-28	0.75	0.34	0.56	0.64	0.56	0.52	0.47	0.41	0.35	0.31	0.26	0.24	0.26	0.36
Little Sand Creek	SE-28	0.50	0.75	0.92	1.14	0.93	0.66	0.54	0.45	0.39	0.34	0.30	0.30	0.40	0.51
Little Sand Creek	SE-28	0.25	1.38	2.17	4.50	2.10	1.36	0.85	0.62	0.49	0.44	0.43	0.45	0.92	0.97
Little Sand Creek	SE-28	0.05	31.31	35.26	26.07	6.35	3.16	2.12	1.12	0.85	0.87	1.01	14.13	18.46	8.14
Little Sand Creek	SE-28	mean	4.96	6.49	5.42	2.43	1.30	0.78	0.57	0.72	0.81	0.93	2.52	3.60	2.52
Little Sand Creek	SE-27	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-27	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-27	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-27	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-27	0.05	1.42	1.53	0.95	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.42	0.00
Little Sand Creek	SE-27	mean	0.29	0.51	0.21	0.03	0.01	0.00	0.00	0.02	0.02	0.03	0.10	0.16	0.11
Little Sand Creek	SE-76	0.95	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Little Sand Creek	SE-76	0.75	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Little Sand Creek	SE-76	0.50	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Little Sand Creek	SE-76	0.25	0.02	0.02	0.04	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Little Sand Creek	SE-76	0.05	0.59	0.62	0.52	0.10	0.03	0.02	0.02	0.02	0.02	0.02	0.28	0.35	0.13
Little Sand Creek	SE-76	mean	0.19	0.39	0.15	0.04	0.02	0.01	0.01	0.02	0.02	0.02	0.05	0.09	0.08
Little Sand Creek	SE-75	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-75	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-75	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-75	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-75	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-75	mean	0.10	0.30	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04
Little Sand Creek	SE-23	0.95	0.02	0.05	0.09	0.07	0.06	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.03
Little Sand Creek	SE-23	0.75	0.06	0.14	0.18	0.12	0.09	0.07	0.05	0.04	0.04	0.03	0.03	0.03	0.05
Little Sand Creek	SE-23	0.50	0.25	0.30	0.39	0.31	0.16	0.10	0.07	0.06	0.05	0.04	0.04	0.06	0.10
Little Sand Creek	SE-23	0.25	0.45	0.96	1.07	1.02	0.57	0.25	0.14	0.09	0.08	0.06	0.07	0.20	0.29
Little Sand Creek	SE-23	0.05	1.73	3.73	3.88	2.38	1.44	0.75	0.31	0.19	0.17	0.17	0.48	1.20	1.59
Little Sand Creek	SE-23	mean	0.65	1.48	1.35	0.70	0.41	0.21	0.11	0.08	0.08	0.07	0.13	0.35	0.46
Little Sand Creek	SE-22	0.95	0.02	0.04	0.09	0.07	0.05	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02
Little Sand Creek	SE-22	0.75	0.05	0.13	0.17	0.12	0.09	0.06	0.05	0.04	0.03	0.03	0.02	0.03	0.04
Little Sand Creek	SE-22	0.50	0.22	0.28	0.36	0.30	0.16	0.10	0.07	0.05	0.04	0.04	0.03	0.06	0.09
Little Sand Creek	SE-22	0.25	0.41	0.93	0.99	1.00	0.55	0.24	0.14	0.09	0.07	0.06	0.06	0.16	0.27
Little Sand Creek	SE-22	0.05	1.45	3.67	3.71	2.33	1.41	0.73	0.30	0.19	0.15	0.15	0.31	1.06	1.45
Little Sand Creek	SE-22	mean	0.60	1.42	1.30	0.67	0.39	0.20	0.11	0.08	0.07	0.06	0.09	0.31	0.44
Lytle Creek	NW-28	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-28	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-28	0.50	0.00	0.00	0.36	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-28	0.25	1.23	2.16	5.59	4.19	2.05	0.12	0.00	0.00	0.00	0.04	0.00	0.67	0.63
Lytle Creek	NW-28	0.05	55.10	99.79	94.22	49.82	38.10	16.07	7.74	3.59	1.92	1.05	14.55	27.63	34.67
Lytle Creek	NW-28	mean	24.34	34.28	26.72	8.14	5.69	2.63	1.09	0.96	0.90	0.80	6.17	8.30	9.88

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Lytle Creek	NW-26	0.95	0.19	0.41	0.44	0.46	0.44	0.39	0.33	0.29	0.24	0.21	0.21	0.20	0.24
Lytle Creek	NW-26	0.75	0.58	0.74	0.85	0.84	0.70	0.55	0.44	0.37	0.32	0.28	0.27	0.31	0.42
Lytle Creek	NW-26	0.50	1.06	1.40	2.19	1.33	0.86	0.67	0.52	0.45	0.39	0.36	0.44	0.67	0.77
Lytle Creek	NW-26	0.25	3.88	5.70	10.23	9.00	5.64	1.59	1.05	0.83	0.89	1.51	1.33	2.71	2.81
Lytle Creek	NW-26	0.05	75.71	127.71	126.61	68.38	53.01	24.13	13.85	8.15	5.50	3.76	22.44	38.83	48.55
Lytle Creek	NW-26	mean	28.72	41.02	34.41	12.41	8.95	4.73	2.58	2.26	2.04	1.87	8.28	11.31	13.07
Lytle Creek	NW-20	0.95	0.10	0.13	0.12	0.11	0.10	0.08	0.07	0.06	0.06	0.06	0.07	0.09	0.07
Lytle Creek	NW-20	0.75	0.25	0.40	0.38	0.29	0.21	0.12	0.10	0.09	0.09	0.09	0.11	0.12	0.11
Lytle Creek	NW-20	0.50	0.61	0.65	0.95	0.63	0.43	0.26	0.13	0.11	0.12	0.15	0.24	0.41	0.40
Lytle Creek	NW-20	0.25	1.88	2.94	4.88	5.37	2.31	0.99	0.62	0.60	0.65	0.76	0.95	1.16	1.86
Lytle Creek	NW-20	0.05	22.96	81.17	98.98	63.12	53.18	24.76	14.17	8.62	5.51	3.42	3.30	7.91	27.99
Lytle Creek	NW-20	mean	17.88	21.54	21.93	9.76	8.35	4.51	2.35	1.60	1.05	0.83	4.32	4.90	8.19
Lytle Creek Channel	NW-29	0.95	0.06	0.08	0.09	0.10	0.10	0.10	0.09	0.09	0.08	0.07	0.07	0.06	0.07
Lytle Creek Channel	NW-29	0.75	0.08	0.10	0.11	0.11	0.11	0.11	0.10	0.09	0.09	0.08	0.07	0.07	0.09
Lytle Creek Channel	NW-29	0.50	0.11	0.14	0.51	0.14	0.12	0.12	0.11	0.10	0.09	0.08	0.08	0.09	0.11
Lytle Creek Channel	NW-29	0.25	1.70	2.71	7.58	5.01	2.48	0.19	0.13	0.12	0.12	0.14	0.11	1.04	1.02
Lytle Creek Channel	NW-29	0.05	72.10	110.81	100.58	52.68	38.96	16.68	8.25	4.03	2.33	1.63	21.64	37.80	39.60
Lytle Creek Channel	NW-29	mean	26.51	36.64	28.77	8.99	6.06	2.84	1.27	1.24	1.23	1.20	7.40	9.98	10.88
Mill Creek	SE-56	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mill Creek	SE-56	0.75	0.29	0.37	0.35	0.24	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mill Creek	SE-56	0.50	2.46	4.23	3.38	1.97	1.31	1.06	1.37	1.10	1.03	0.78	1.04	1.47	1.35
Mill Creek	SE-56	0.25	9.06	11.77	13.20	14.36	18.31	15.02	7.36	7.24	5.44	2.87	5.72	8.58	8.37
Mill Creek	SE-56	0.05	17.75	46.33	228.97	237.03	292.26	115.44	36.49	19.47	12.31	9.09	13.03	22.11	82.71
Mill Creek	SE-56	mean	23.79	32.63	44.84	38.91	38.35	20.76	7.06	4.44	4.82	2.29	7.84	13.09	19.82
Mission Creek	SE-73	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mission Creek	SE-73	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mission Creek	SE-73	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mission Creek	SE-73	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mission Creek	SE-73	0.05	76.15	83.31	54.98	6.54	0.00	0.00	0.00	0.00	0.00	0.08	20.07	35.03	7.86
Mission Creek	SE-73	mean	10.54	12.38	8.55	2.14	0.39	0.00	0.00	0.78	1.07	1.37	5.51	7.90	4.18
Mission Creek	SE-62	0.95	0.15	0.43	0.56	0.62	0.66	0.64	0.56	0.47	0.40	0.29	0.25	0.20	0.32
Mission Creek	SE-62	0.75	0.47	0.67	0.84	0.83	0.86	0.79	0.69	0.58	0.49	0.40	0.33	0.33	0.56
Mission Creek	SE-62	0.50	0.85	1.09	1.22	1.18	1.04	0.92	0.79	0.67	0.58	0.48	0.44	0.58	0.81
Mission Creek	SE-62	0.25	1.65	2.30	5.08	2.36	1.69	1.34	1.09	0.86	0.75	0.76	0.74	1.31	1.37
Mission Creek	SE-62	0.05	60.43	64.49	46.91	9.01	3.63	2.56	1.97	1.57	1.47	2.01	23.98	32.88	11.41
Mission Creek	SE-62	mean	8.83	10.52	8.57	3.53	1.81	1.18	0.98	1.34	1.48	1.69	4.81	6.68	4.25
Mission Creek	SE-61	0.95	0.87	1.14	1.27	1.32	1.37	1.35	1.27	1.19	1.11	1.00	0.96	0.91	1.03
Mission Creek	SE-61	0.75	1.17	1.37	1.54	1.53	1.56	1.50	1.40	1.30	1.21	1.11	1.05	1.04	1.27
Mission Creek	SE-61	0.50	1.54	1.77	1.90	1.87	1.73	1.62	1.50	1.38	1.29	1.19	1.15	1.27	1.51
Mission Creek	SE-61	0.25	2.22	2.83	5.46	2.86	2.35	2.02	1.79	1.57	1.46	1.46	1.44	1.92	2.02
Mission Creek	SE-61	0.05	56.72	59.43	43.48	8.95	4.20	3.19	2.63	2.25	2.12	2.28	22.69	30.49	10.96
Mission Creek	SE-61	mean	8.76	10.41	8.59	4.00	2.44	1.87	1.68	1.99	2.11	2.29	5.09	6.79	4.64
Mission Creek	SE-60	0.95	0.85	1.12	1.24	1.29	1.34	1.32	1.25	1.17	1.09	0.98	0.94	0.89	1.00
Mission Creek	SE-60	0.75	1.14	1.33	1.50	1.50	1.53	1.46	1.38	1.27	1.18	1.09	1.02	1.02	1.24
Mission Creek	SE-60	0.50	1.49	1.71	1.84	1.81	1.70	1.58	1.47	1.36	1.26	1.16	1.12	1.24	1.47

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Mission Creek	SE-60	0.25	2.06	2.67	5.25	2.76	2.29	1.98	1.75	1.54	1.42	1.41	1.39	1.77	1.93
Mission Creek	SE-60	0.05	53.93	56.69	40.93	8.31	4.08	3.11	2.57	2.20	2.04	2.17	21.60	28.99	10.31
Mission Creek	SE-60	mean	8.29	9.91	8.16	3.84	2.37	1.83	1.64	1.93	2.03	2.19	4.82	6.41	4.43
Plunge Creek	SE-57	0.95	0.07	0.14	0.16	0.10	0.09	0.07	0.06	0.05	0.05	0.05	0.05	0.06	0.06
Plunge Creek	SE-57	0.75	0.27	0.37	0.41	0.31	0.17	0.09	0.07	0.06	0.06	0.06	0.07	0.09	0.08
Plunge Creek	SE-57	0.50	0.54	0.69	1.04	0.62	0.36	0.15	0.08	0.07	0.07	0.07	0.10	0.33	0.26
Plunge Creek	SE-57	0.25	2.21	5.32	15.37	9.70	1.99	0.37	0.17	0.12	0.12	0.24	0.42	1.03	0.83
Plunge Creek	SE-57	0.05	57.71	162.44	200.00	51.32	17.72	6.66	1.98	0.85	0.61	0.73	10.50	18.62	28.63
Plunge Creek	SE-57	mean	23.40	56.37	42.96	10.66	3.91	1.25	0.41	0.46	0.64	0.62	5.13	13.03	13.01
Plunge Creek	SE-48	0.95	0.15	0.23	0.26	0.21	0.20	0.12	0.10	0.09	0.08	0.08	0.09	0.12	0.10
Plunge Creek	SE-48	0.75	0.31	0.40	0.49	0.38	0.29	0.18	0.12	0.11	0.10	0.11	0.12	0.20	0.16
Plunge Creek	SE-48	0.50	0.48	0.61	1.12	0.56	0.38	0.24	0.16	0.13	0.13	0.16	0.20	0.33	0.32
Plunge Creek	SE-48	0.25	1.42	3.18	6.71	4.94	1.96	0.52	0.34	0.26	0.21	0.23	0.40	0.77	0.70
Plunge Creek	SE-48	0.05	19.29	80.00	81.80	17.08	7.23	3.35	1.07	0.69	0.58	0.55	1.98	6.39	10.34
Plunge Creek	SE-48	mean	9.23	20.03	16.18	4.50	1.80	0.73	0.32	0.26	0.42	0.28	2.30	6.07	5.10
Plunge Creek	SE-45	0.95	0.40	0.55	0.65	0.50	0.42	0.20	0.13	0.12	0.10	0.12	0.13	0.27	0.15
Plunge Creek	SE-45	0.75	0.77	1.04	1.22	0.94	0.64	0.37	0.20	0.17	0.17	0.22	0.30	0.52	0.32
Plunge Creek	SE-45	0.50	1.24	1.53	2.93	1.42	0.95	0.55	0.30	0.25	0.25	0.35	0.45	0.85	0.75
Plunge Creek	SE-45	0.25	3.74	7.58	15.14	10.66	5.61	1.22	0.70	0.49	0.42	0.50	0.91	1.70	1.57
Plunge Creek	SE-45	0.05	36.04	87.53	90.15	28.06	13.35	7.10	2.22	1.25	1.07	1.12	4.99	14.14	19.25
Plunge Creek	SE-45	mean	11.26	21.99	19.69	7.64	3.61	1.60	0.63	0.46	0.75	0.55	3.02	7.55	6.48
Rialto Channel/Cactus Channel	NFRC06	0.95	9.60	9.50	9.40	9.20	9.20	9.10	9.00	9.00	9.20	9.40	9.50	9.60	9.00
Rialto Channel/Cactus Channel	NFRC06	0.75	9.60	9.50	9.40	9.20	9.20	9.10	9.00	9.00	9.20	9.40	9.50	9.60	9.20
Rialto Channel/Cactus Channel	NFRC06	0.50	9.60	9.50	9.40	9.20	9.20	9.10	9.00	9.00	9.20	9.40	9.50	9.60	9.40
Rialto Channel/Cactus Channel	NFRC06	0.25	11.40	10.60	14.00	9.20	9.20	9.10	9.00	9.00	9.20	9.40	9.50	9.90	9.60
Rialto Channel/Cactus Channel	NFRC06	0.05	147.69	134.08	103.24	32.04	9.90	9.10	9.00	9.00	9.65	15.03	92.71	104.64	46.80
Rialto Channel/Cactus Channel	NFRC06	mean	29.97	32.33	27.95	13.59	10.19	9.14	9.09	10.03	10.86	11.53	22.24	26.28	17.70
San Sevaine Creek	NSS31	0.95	0.00	0.00	0.00	1.30	1.40	1.50	1.80	1.70	1.30	0.80	0.00	0.00	0.00
San Sevaine Creek	NSS31	0.75	0.00	0.00	0.00	1.40	1.50	1.60	1.80	1.80	1.40	0.90	0.00	0.00	0.00
San Sevaine Creek	NSS31	0.50	0.00	0.00	0.00	1.50	1.60	1.90	1.90	1.90	1.40	1.00	0.00	0.00	1.50
San Sevaine Creek	NSS31	0.25	5.55	3.68	10.25	1.70	1.60	2.00	1.90	1.90	1.70	1.10	0.10	0.60	1.90
San Sevaine Creek	NSS31	0.05	376.10	347.65	244.29	46.14	3.40	2.00	2.00	2.00	2.40	10.49	168.81	211.65	91.40
San Sevaine Creek	NSS31	mean	68.17	71.63	52.85	11.37	3.70	2.08	2.13	3.57	4.71	5.40	31.50	42.52	24.76
San Timoteo Wash	SE-79	0.95	0.08	0.25	0.37	0.45	0.48	0.47	0.42	0.36	0.30	0.22	0.15	0.11	0.21
San Timoteo Wash	SE-79	0.75	0.41	0.45	0.64	0.62	0.65	0.60	0.51	0.43	0.37	0.29	0.24	0.24	0.45
San Timoteo Wash	SE-79	0.50	0.74	0.84	1.19	1.03	0.91	0.81	0.62	0.55	0.49	0.43	0.46	0.52	0.69
San Timoteo Wash	SE-79	0.25	1.77	2.04	4.49	2.36	1.62	1.25	0.99	0.86	0.78	0.76	1.24	1.53	1.36
San Timoteo Wash	SE-79	0.05	54.71	56.48	48.73	8.12	3.19	2.41	1.99	1.50	1.82	2.99	18.55	31.84	11.08
San Timoteo Wash	SE-79	mean	10.77	15.30	9.00	2.79	1.75	1.08	0.87	1.06	1.38	1.37	4.70	7.23	4.72
San Timoteo Wash	SE-77	0.95	0.10	0.13	0.15	0.15	0.15	0.15	0.14	0.13	0.13	0.12	0.11	0.11	0.12
San Timoteo Wash	SE-77	0.75	0.13	0.16	0.17	0.17	0.17	0.17	0.16	0.15	0.14	0.13	0.12	0.12	0.14
San Timoteo Wash	SE-77	0.50	0.18	0.20	0.22	0.21	0.19	0.18	0.17	0.15	0.15	0.14	0.13	0.15	0.17
San Timoteo Wash	SE-77	0.25	0.28	0.37	0.81	0.36	0.26	0.22	0.19	0.17	0.16	0.16	0.16	0.23	0.23
San Timoteo Wash	SE-77	0.05	8.49	8.55	6.72	1.42	0.55	0.36	0.28	0.23	0.23	0.31	3.74	4.91	1.73
San Timoteo Wash	SE-77	mean	1.26	1.41	1.21	0.54	0.30	0.21	0.18	0.23	0.26	0.29	0.73	0.98	0.63

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
San Timoteo Wash	SE-68	0.95	0.19	0.24	0.28	0.29	0.29	0.29	0.26	0.24	0.24	0.22	0.21	0.20	0.22
San Timoteo Wash	SE-68	0.75	0.30	0.30	0.36	0.35	0.35	0.32	0.29	0.27	0.26	0.24	0.23	0.24	0.29
San Timoteo Wash	SE-68	0.50	0.42	0.45	0.57	0.49	0.47	0.42	0.34	0.30	0.29	0.29	0.32	0.33	0.38
San Timoteo Wash	SE-68	0.25	1.00	0.99	2.30	1.14	0.89	0.69	0.57	0.50	0.45	0.48	0.71	0.79	0.70
San Timoteo Wash	SE-68	0.05	32.78	42.53	24.81	4.18	1.72	1.39	1.07	0.86	1.14	1.80	9.86	17.63	5.66
San Timoteo Wash	SE-68	mean	7.69	11.84	5.98	1.45	1.02	0.58	0.47	0.57	0.86	0.80	3.00	4.89	3.22
San Timoteo Wash	SE-64	0.95	0.10	0.13	0.14	0.15	0.16	0.15	0.14	0.13	0.13	0.12	0.11	0.10	0.12
San Timoteo Wash	SE-64	0.75	0.16	0.16	0.19	0.19	0.19	0.17	0.16	0.14	0.14	0.13	0.12	0.12	0.15
San Timoteo Wash	SE-64	0.50	0.24	0.25	0.36	0.29	0.29	0.24	0.19	0.17	0.16	0.15	0.17	0.18	0.22
San Timoteo Wash	SE-64	0.25	0.73	0.70	1.56	0.80	0.66	0.50	0.38	0.33	0.32	0.35	0.54	0.60	0.49
San Timoteo Wash	SE-64	0.05	24.05	36.81	18.24	2.65	1.34	1.12	0.84	0.70	0.97	1.43	6.41	11.77	3.87
San Timoteo Wash	SE-64	mean	6.63	10.64	4.96	0.98	0.77	0.40	0.31	0.37	0.64	0.54	2.38	4.07	2.68
San Timoteo Wash	SE-63	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
San Timoteo Wash	SE-63	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
San Timoteo Wash	SE-63	0.50	0.01	0.01	0.14	0.03	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01
San Timoteo Wash	SE-63	0.25	0.39	0.36	0.63	0.33	0.25	0.21	0.14	0.11	0.12	0.20	0.39	0.39	0.25
San Timoteo Wash	SE-63	0.05	19.84	28.99	14.23	1.18	1.01	0.76	0.55	0.52	0.72	1.02	3.11	5.54	2.11
San Timoteo Wash	SE-63	mean	5.65	9.53	3.98	0.49	0.47	0.17	0.12	0.15	0.39	0.28	1.80	3.30	2.16
Sand Creek	SE-33	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-33	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-33	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-33	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-33	0.05	0.00	1.14	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-33	mean	0.66	2.08	1.24	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.35
Sand Creek	SE-18	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-18	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-18	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-18	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-18	0.05	0.00	5.63	4.80	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-18	mean	0.78	2.42	1.75	0.19	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.33	0.45
Santa Ana River	NSAR381	0.95	202.07	160.90	146.77	126.40	105.30	82.20	76.00	73.50	79.80	95.90	116.00	147.27	74.55
Santa Ana River	NSAR381	0.75	204.90	162.30	152.20	132.10	110.30	84.83	77.10	73.70	81.70	99.20	119.90	152.90	88.80
Santa Ana River	NSAR381	0.50	208.60	168.90	163.40	138.10	116.40	88.55	79.40	74.10	84.00	103.60	126.90	157.20	128.60
Santa Ana River	NSAR381	0.25	317.50	352.13	553.10	278.15	139.15	95.08	82.60	76.15	87.80	107.90	143.75	224.30	189.45
Santa Ana River	NSAR381	0.05	4157.57	3513.38	2660.58	843.73	591.03	284.20	135.42	138.18	138.46	207.40	1631.47	2320.36	1116.05
Santa Ana River	NSAR381	mean	905.99	1011.43	800.78	309.92	204.48	115.89	89.39	99.47	122.66	142.59	411.78	571.40	395.92
Santa Ana River	NSAR38	0.95	125.70	86.50	82.70	77.80	70.70	64.90	61.20	61.10	62.70	67.10	72.60	79.80	61.40
Santa Ana River	NSAR38	0.75	127.30	87.20	85.00	80.30	72.70	66.00	61.75	61.20	63.30	68.40	74.20	82.40	67.40
Santa Ana River	NSAR38	0.50	130.30	92.90	93.50	83.25	75.40	67.55	62.80	61.40	64.30	70.20	77.45	84.30	80.20
Santa Ana River	NSAR38	0.25	181.40	204.03	373.85	159.90	91.05	71.90	64.20	62.50	65.78	72.10	86.68	113.90	118.85
Santa Ana River	NSAR38	0.05	1899.87	2069.08	1595.77	728.15	549.60	256.28	117.13	121.56	97.78	116.38	878.00	1283.06	709.75
Santa Ana River	NSAR38	mean	532.15	648.95	500.75	210.49	154.69	94.52	72.72	79.65	86.74	92.01	231.88	323.65	250.41
Santa Ana River	NSAR37	0.95	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Santa Ana River	NSAR37	0.75	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Santa Ana River	NSAR37	0.50	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30

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Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Santa Ana River	NSAR37	0.25	48.00	2.30	3.40	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Santa Ana River	NSAR37	0.05	284.36	548.50	502.33	175.45	60.20	8.92	2.30	2.30	2.30	2.40	47.16	112.69	66.00
Santa Ana River	NSAR37	mean	140.58	142.35	97.07	25.94	9.39	3.45	2.42	3.99	4.48	4.48	29.43	45.34	41.95
Santa Ana River	NSAR36	0.95	85.30	86.50	82.70	77.80	70.70	64.90	61.20	61.10	62.70	67.10	72.60	79.80	61.40
Santa Ana River	NSAR36	0.75	86.90	87.20	85.00	80.30	72.70	66.00	61.75	61.20	63.30	68.40	74.13	82.40	67.40
Santa Ana River	NSAR36	0.50	90.00	92.90	93.40	83.25	75.40	67.55	62.80	61.40	64.30	70.20	77.40	84.30	80.20
Santa Ana River	NSAR36	0.25	140.20	200.75	347.85	156.90	91.05	71.88	64.20	62.50	65.78	72.10	86.68	113.00	94.90
Santa Ana River	NSAR36	0.05	1612.82	1642.50	1239.89	562.70	498.15	256.28	116.82	120.52	97.78	113.93	818.03	1125.69	601.55
Santa Ana River	NSAR36	mean	400.66	511.87	408.28	188.04	148.27	93.74	72.63	78.03	84.67	90.03	205.38	281.89	212.15
Santa Ana River	NSAR352	0.95	85.30	86.50	82.70	77.80	70.70	64.90	61.20	61.10	62.70	67.10	72.60	79.80	61.40
Santa Ana River	NSAR352	0.75	86.90	87.20	85.00	80.30	72.70	66.00	61.75	61.20	63.30	68.40	74.13	82.40	67.40
Santa Ana River	NSAR352	0.50	90.00	92.90	93.40	83.25	75.40	67.55	62.80	61.40	64.30	70.20	77.40	84.30	80.20
Santa Ana River	NSAR352	0.25	140.20	200.75	347.50	156.90	91.05	71.88	64.20	62.50	65.78	72.10	86.68	113.00	94.90
Santa Ana River	NSAR352	0.05	1608.31	1642.28	1238.84	562.70	498.15	256.28	116.82	120.52	97.78	113.93	817.92	1125.00	599.10
Santa Ana River	NSAR352	mean	399.88	511.03	407.66	187.94	148.26	93.74	72.63	78.01	84.64	89.99	205.00	281.42	211.87
Santa Ana River	NSAR351	0.95	85.30	86.50	82.70	77.80	70.70	64.90	61.20	61.10	62.70	67.10	72.60	79.80	61.35
Santa Ana River	NSAR351	0.75	86.90	87.20	85.00	80.30	72.70	66.00	61.75	61.20	63.30	68.40	74.13	82.40	67.40
Santa Ana River	NSAR351	0.50	90.00	92.85	93.20	83.25	75.40	67.55	62.80	61.40	64.30	70.20	77.40	84.30	80.20
Santa Ana River	NSAR351	0.25	139.60	199.10	344.75	156.90	91.05	71.88	64.20	62.50	65.78	72.05	86.68	113.00	94.90
Santa Ana River	NSAR351	0.05	1581.72	1639.40	1231.56	562.70	498.15	256.28	116.82	120.52	97.78	113.90	813.57	1117.04	593.05
Santa Ana River	NSAR351	mean	395.29	506.11	403.89	187.18	148.11	93.73	72.62	77.84	84.35	89.69	202.60	278.51	210.20
Santa Ana River	NSAR35	0.95	85.30	86.50	82.70	77.80	70.70	64.90	61.20	61.10	62.70	67.10	72.60	79.80	61.35
Santa Ana River	NSAR35	0.75	86.90	87.20	85.00	80.30	72.70	66.00	61.75	61.20	63.30	68.40	74.13	82.40	67.40
Santa Ana River	NSAR35	0.50	90.00	92.85	93.20	83.25	75.40	67.55	62.80	61.40	64.30	70.20	77.40	84.30	80.20
Santa Ana River	NSAR35	0.25	139.60	199.10	344.75	156.90	91.05	71.88	64.20	62.50	65.78	72.05	86.68	113.00	94.90
Santa Ana River	NSAR35	0.05	1581.72	1639.40	1231.56	562.70	498.15	256.28	116.82	120.52	97.78	113.90	813.57	1117.04	593.05
Santa Ana River	NSAR35	mean	395.29	506.11	403.89	187.18	148.11	93.73	72.62	77.84	84.35	89.69	202.60	278.51	210.20
Santa Ana River	NSAR34	0.95	85.30	86.50	82.70	77.80	70.70	64.90	61.20	61.10	62.70	67.10	72.60	79.80	61.35
Santa Ana River	NSAR34	0.75	86.90	87.20	85.00	80.30	72.70	66.00	61.75	61.20	63.30	68.40	74.13	82.40	67.40
Santa Ana River	NSAR34	0.50	90.00	92.85	93.20	83.25	75.40	67.55	62.80	61.40	64.30	70.20	77.40	84.30	80.20
Santa Ana River	NSAR34	0.25	139.60	199.10	344.75	156.90	91.05	71.88	64.20	62.50	65.78	72.05	86.68	113.00	94.90
Santa Ana River	NSAR34	0.05	1581.72	1639.40	1231.56	562.70	498.15	256.28	116.82	120.52	97.78	113.90	813.57	1117.04	593.05
Santa Ana River	NSAR34	mean	395.29	506.11	403.89	187.18	148.11	93.73	72.62	77.84	84.35	89.69	202.60	278.51	210.20
Santa Ana River	NSAR332	0.95	86.40	87.60	83.70	78.90	71.70	65.90	62.30	62.20	63.70	68.10	73.70	80.80	62.40
Santa Ana River	NSAR332	0.75	88.00	88.30	86.10	81.40	73.80	67.10	62.80	62.30	64.40	69.50	75.23	83.50	68.40
Santa Ana River	NSAR332	0.50	91.00	93.90	94.30	84.30	76.40	68.60	63.80	62.40	65.30	71.30	78.50	85.40	81.30
Santa Ana River	NSAR332	0.25	140.70	194.13	345.90	157.95	92.10	72.90	65.30	63.50	66.80	73.10	87.75	114.10	95.95
Santa Ana River	NSAR332	0.05	1575.92	1639.58	1230.07	559.68	499.42	257.48	117.92	121.62	98.47	114.94	809.11	1115.57	592.20
Santa Ana River	NSAR332	mean	393.82	504.22	402.92	187.94	149.13	94.81	73.69	78.82	85.27	90.65	202.43	277.95	210.35
Santa Ana River	NSAR331	0.95	88.30	89.50	85.60	80.80	73.60	67.80	64.10	64.00	65.60	70.00	75.50	82.70	64.30
Santa Ana River	NSAR331	0.75	89.85	90.20	88.00	83.30	75.70	69.00	64.70	64.10	66.30	71.30	77.10	85.40	70.30
Santa Ana River	NSAR331	0.50	92.90	95.80	96.20	86.20	78.30	70.50	65.70	64.30	67.20	73.10	80.35	87.20	83.10
Santa Ana River	NSAR331	0.25	142.60	196.13	348.00	159.88	94.00	74.78	67.20	65.40	68.70	75.00	89.65	116.00	97.85
Santa Ana River	NSAR331	0.05	1607.90	1672.05	1248.86	561.88	501.52	259.48	119.82	123.52	100.37	116.84	811.57	1129.75	594.35
Santa Ana River	NSAR331	mean	398.13	509.02	407.02	190.29	151.11	96.69	75.56	80.79	87.26	92.64	205.38	281.40	213.15

			All Flows in Cubic Feet per Second												
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Santa Ana River	NSAR33	0.95	92.60	93.80	90.00	85.10	77.90	72.10	68.40	68.30	69.90	74.30	79.90	87.00	68.60
Santa Ana River	NSAR33	0.75	94.20	94.53	92.35	87.60	80.00	73.30	69.00	68.40	70.60	75.70	81.43	89.70	74.60
Santa Ana River	NSAR33	0.50	97.30	100.15	100.60	90.55	82.60	74.80	70.00	68.60	71.50	77.50	84.70	91.60	87.50
Santa Ana River	NSAR33	0.25	147.05	200.63	352.65	164.35	98.40	79.10	71.50	69.70	73.00	79.30	93.98	120.40	102.20
Santa Ana River	NSAR33	0.05	1642.72	1707.35	1260.20	566.78	506.35	264.08	124.25	127.92	104.67	121.24	816.67	1135.05	599.30
Santa Ana River	NSAR33	mean	405.01	516.61	413.61	195.01	155.57	101.06	79.88	85.21	91.70	97.08	210.73	287.26	218.42
Santa Ana River	NSAR321	0.95	94.70	96.03	92.10	87.05	79.90	74.00	70.40	70.30	71.90	76.40	82.05	89.10	70.60
Santa Ana River	NSAR321	0.75	95.90	96.50	94.10	89.20	81.90	75.20	70.95	70.40	72.60	77.70	83.50	91.30	76.50
Santa Ana River	NSAR321	0.50	97.10	99.00	99.00	91.50	84.40	76.60	72.00	70.60	73.40	79.20	86.00	93.20	88.70
Santa Ana River	NSAR321	0.25	124.65	159.05	327.85	153.40	99.75	80.08	73.40	71.05	74.80	81.10	89.18	107.40	99.90
Santa Ana River	NSAR321	0.05	1352.61	1527.73	1085.82	550.16	508.23	266.09	126.11	129.95	105.51	115.35	685.42	934.85	548.70
Santa Ana River	NSAR321	mean	349.61	466.46	373.85	188.70	155.81	102.86	81.79	86.12	91.77	96.56	192.15	259.24	202.41
Santa Ana River	NSAR32	0.95	96.80	98.20	94.30	89.20	82.00	76.10	72.50	72.40	74.00	78.50	84.15	91.27	72.70
Santa Ana River	NSAR32	0.75	98.10	98.60	96.30	91.40	84.00	77.30	73.05	72.50	74.70	79.80	85.60	93.40	78.60
Santa Ana River	NSAR32	0.50	99.20	101.10	101.10	93.60	86.50	78.70	74.10	72.70	75.50	81.30	88.20	95.30	90.90
Santa Ana River	NSAR32	0.25	126.85	161.13	330.25	155.68	101.90	82.18	75.50	73.15	76.90	83.20	91.28	109.55	102.10
Santa Ana River	NSAR32	0.05	1363.34	1547.23	1088.72	552.76	510.73	268.49	128.31	132.15	107.66	117.48	686.07	934.69	551.20
Santa Ana River	NSAR32	mean	352.84	470.03	377.01	190.96	158.01	105.01	83.91	88.29	93.93	98.73	194.65	261.97	204.94
Santa Ana River	NSAR311	0.95	99.70	101.20	97.20	90.50	83.30	77.00	73.70	73.50	75.30	80.30	87.10	94.20	73.70
Santa Ana River	NSAR311	0.75	101.00	101.50	99.20	92.73	85.30	78.30	74.20	73.60	76.00	81.55	88.50	96.30	80.20
Santa Ana River	NSAR311	0.50	102.00	103.60	103.50	95.20	87.90	80.10	75.10	73.70	77.10	83.20	91.05	98.20	92.70
Santa Ana River	NSAR311	0.25	122.45	145.63	268.25	151.30	101.15	83.15	76.35	74.30	78.40	85.30	93.48	109.25	103.80
Santa Ana River	NSAR311	0.05	958.28	1153.43	942.58	542.13	512.56	265.09	129.24	132.46	108.08	111.73	502.22	700.63	524.40
Santa Ana River	NSAR311	mean	288.04	402.17	327.75	182.57	157.30	105.90	84.74	87.70	92.21	96.30	166.12	222.63	183.33
Santa Ana River	NSAR31	0.95	102.07	103.50	99.57	92.80	85.60	79.30	76.00	75.80	77.60	82.60	89.40	96.50	76.00
Santa Ana River	NSAR31	0.75	103.30	103.90	101.50	95.10	87.60	80.60	76.50	75.90	78.30	83.85	90.90	98.70	82.50
Santa Ana River	NSAR31	0.50	104.40	106.00	105.90	97.50	90.20	82.40	77.40	76.00	79.40	85.50	93.40	100.50	95.00
Santa Ana River	NSAR31	0.25	124.85	148.03	270.80	153.70	103.45	85.45	78.65	76.60	80.70	87.60	95.78	111.55	106.15
Santa Ana River	NSAR31	0.05	962.04	1160.00	946.10	544.87	515.26	267.59	131.64	134.83	110.38	114.03	504.93	703.43	527.10
Santa Ana River	NSAR31	mean	290.95	405.40	330.74	185.03	159.68	108.24	87.05	90.04	94.55	98.65	168.65	225.32	185.90
Santa Ana River	NSAR301	0.95	108.20	109.63	105.70	98.90	91.70	85.40	82.00	81.80	83.60	88.70	95.50	102.67	82.10
Santa Ana River	NSAR301	0.75	109.50	110.00	107.70	101.20	93.70	86.70	82.50	81.90	84.33	89.90	97.00	104.80	88.50
Santa Ana River	NSAR301	0.50	110.50	112.10	112.00	103.60	96.30	88.50	83.40	82.10	85.50	91.60	99.50	106.70	101.10
Santa Ana River	NSAR301	0.25	131.05	153.70	274.35	159.70	109.65	91.18	84.70	82.60	86.78	93.70	101.88	117.40	112.25
Santa Ana River	NSAR301	0.05	947.80	1160.10	937.00	552.03	522.36	274.19	137.84	141.13	116.58	119.67	494.08	692.95	530.60
Santa Ana River	NSAR301	mean	294.95	408.88	335.08	190.76	165.81	114.37	93.11	96.03	100.43	104.53	173.33	229.92	191.15
Santa Ana River	NSAR30	0.95	110.90	112.33	108.40	101.60	94.40	88.10	84.70	84.50	86.30	91.40	98.15	105.37	84.70
Santa Ana River	NSAR30	0.75	112.20	112.70	110.40	103.90	96.40	89.33	85.20	84.60	87.03	92.55	99.60	107.50	91.20
Santa Ana River	NSAR30	0.50	113.20	114.80	114.70	106.30	99.00	91.20	86.10	84.70	88.10	94.30	102.20	109.40	103.80
Santa Ana River	NSAR30	0.25	133.75	156.50	277.25	162.50	112.35	93.88	87.40	85.30	89.40	96.35	104.58	120.10	114.95
Santa Ana River	NSAR30	0.05	951.96	1167.83	940.95	555.17	525.49	277.09	140.64	143.83	119.28	122.37	497.18	696.25	533.70
Santa Ana River	NSAR30	mean	298.31	412.62	338.54	193.60	168.58	117.07	95.78	98.74	103.15	107.25	176.26	233.02	194.12
Santa Ana River	NSAR29	0.95	112.00	113.50	109.50	102.75	95.50	89.20	85.80	85.60	87.40	92.50	99.30	106.50	85.80
Santa Ana River	NSAR29	0.75	113.30	113.90	111.50	105.00	97.50	90.50	86.30	85.70	88.13	93.70	100.80	108.60	92.30
Santa Ana River	NSAR29	0.50	114.40	116.00	115.90	107.45	100.10	92.30	87.20	85.80	89.25	95.40	103.30	110.50	104.90

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Santa Ana River	NSAR29	0.25	134.95	157.60	278.45	163.63	113.45	94.98	88.50	86.40	90.58	97.50	105.70	121.25	116.10
Santa Ana River	NSAR29	0.05	953.36	1169.30	942.35	556.47	526.79	278.29	141.74	145.03	120.43	123.50	498.48	697.55	535.00
Santa Ana River	NSAR29	mean	299.55	413.93	339.81	194.78	169.73	118.21	96.91	99.87	104.28	108.39	177.43	234.22	195.31
Santa Ana River	NSAR28	0.95	113.80	115.30	111.30	104.50	97.30	90.90	87.50	87.40	89.20	94.30	101.05	108.27	87.60
Santa Ana River	NSAR28	0.75	115.10	115.60	113.30	106.80	99.30	92.20	88.00	87.40	89.90	95.45	102.50	110.40	94.10
Santa Ana River	NSAR28	0.50	116.10	117.70	117.60	109.20	101.90	94.10	89.00	87.60	91.00	97.20	105.05	112.30	106.70
Santa Ana River	NSAR28	0.25	136.65	159.40	279.65	165.43	115.25	96.78	90.20	88.10	92.30	99.20	107.48	123.05	117.85
Santa Ana River	NSAR28	0.05	947.69	1170.78	934.17	558.47	528.79	280.19	143.54	146.83	122.18	125.27	493.65	692.20	536.15
Santa Ana River	NSAR28	mean	300.17	414.48	340.62	196.29	171.48	119.97	98.65	101.57	105.91	110.00	178.51	235.24	196.62
Santa Ana River	NSAR27	0.95	115.40	116.90	112.97	106.15	98.90	92.60	89.20	89.00	90.80	95.90	102.70	109.90	89.20
Santa Ana River	NSAR27	0.75	116.70	117.30	114.90	108.43	100.90	93.90	89.70	89.10	91.50	97.05	104.20	112.00	95.70
Santa Ana River	NSAR27	0.50	117.80	119.35	119.10	110.90	103.50	95.70	90.60	89.20	92.60	98.80	106.70	113.90	108.20
Santa Ana River	NSAR27	0.25	137.25	159.15	267.70	165.98	116.90	98.28	91.90	89.80	93.90	100.90	109.08	124.00	119.30
Santa Ana River	NSAR27	0.05	860.29	1159.53	895.35	556.46	530.39	281.99	145.24	148.53	123.88	125.98	467.42	633.66	530.45
Santa Ana River	NSAR27	mean	291.21	403.22	332.34	195.09	172.62	121.58	100.21	102.05	106.53	110.48	174.14	229.93	193.88
Santa Ana River	NSAR25	0.95	73.30	75.10	71.70	65.45	58.40	52.50	49.30	49.00	50.10	54.40	60.75	67.70	49.30
Santa Ana River	NSAR25	0.75	74.60	75.50	73.70	67.73	60.40	53.80	49.80	49.00	50.80	55.55	62.20	69.85	54.90
Santa Ana River	NSAR25	0.50	75.70	77.55	77.80	70.20	63.10	55.60	50.70	49.20	51.90	57.30	64.80	71.70	66.90
Santa Ana River	NSAR25	0.25	95.20	117.55	226.90	125.48	76.45	58.25	52.00	49.80	53.20	59.40	67.18	81.85	77.60
Santa Ana River	NSAR25	0.05	819.72	1119.73	855.68	516.91	491.02	242.49	105.64	108.73	83.28	84.58	426.43	592.73	491.10
Santa Ana River	NSAR25	mean	249.65	362.45	291.86	154.63	132.31	81.60	60.37	62.08	65.90	69.04	132.45	188.13	153.13
Santa Ana River	NSAR244	0.95	31.50	31.50	31.30	31.20	31.10	31.00	30.90	31.00	31.10	31.30	31.40	31.50	31.00
Santa Ana River	NSAR244	0.75	31.70	31.70	31.60	31.30	31.20	31.00	31.00	31.00	31.10	31.30	31.40	31.60	31.20
Santa Ana River	NSAR244	0.50	32.50	33.75	36.10	32.20	31.30	31.10	31.00	31.00	31.20	31.30	31.60	32.10	31.60
Santa Ana River	NSAR244	0.25	51.30	72.25	172.70	85.78	46.35	33.30	31.10	31.20	31.40	31.50	33.65	42.70	39.70
Santa Ana River	NSAR244	0.05	724.28	1031.55	782.30	475.25	459.49	218.83	85.05	80.80	62.51	55.61	357.84	496.56	447.75
Santa Ana River	NSAR244	mean	195.34	302.96	237.97	115.44	101.77	57.79	40.87	43.13	44.47	42.42	94.17	142.44	117.28
Santa Ana River	NSAR243	0.95	31.50	31.50	31.30	31.20	31.10	31.00	30.90	31.00	31.10	31.30	31.40	31.50	31.00
Santa Ana River	NSAR243	0.75	31.70	31.70	31.60	31.30	31.20	31.00	31.00	31.00	31.10	31.30	31.40	31.60	31.20
Santa Ana River	NSAR243	0.50	32.50	33.75	36.10	32.20	31.30	31.10	31.00	31.00	31.20	31.30	31.60	32.10	31.60
Santa Ana River	NSAR243	0.25	51.30	72.25	172.70	85.78	46.35	33.30	31.10	31.20	31.40	31.50	33.65	42.70	39.70
Santa Ana River	NSAR243	0.05	724.28	1031.55	782.30	475.25	459.49	218.83	85.05	80.80	62.51	55.61	357.84	496.56	447.75
Santa Ana River	NSAR243	mean	195.34	302.96	237.97	115.44	101.77	57.79	40.87	43.13	44.47	42.42	94.17	142.44	117.28
Santa Ana River	NSAR242	0.95	31.50	31.50	31.30	31.20	31.10	31.00	30.90	31.00	31.10	31.30	31.40	31.50	31.00
Santa Ana River	NSAR242	0.75	31.70	31.70	31.60	31.30	31.20	31.00	31.00	31.00	31.10	31.30	31.40	31.60	31.20
Santa Ana River	NSAR242	0.50	32.50	33.75	36.10	32.20	31.30	31.10	31.00	31.00	31.20	31.30	31.60	32.10	31.60
Santa Ana River	NSAR242	0.25	51.30	72.25	172.70	85.78	46.35	33.30	31.10	31.20	31.40	31.50	33.65	42.70	39.70
Santa Ana River	NSAR242	0.05	724.28	1031.55	782.30	475.25	459.49	218.83	85.05	80.80	62.51	55.61	357.84	496.56	447.75
Santa Ana River	NSAR242	mean	195.34	302.96	237.97	115.44	101.77	57.79	40.87	43.13	44.47	42.42	94.17	142.44	117.28
Santa Ana River	NSAR241	0.95	31.50	31.50	31.30	31.20	31.10	31.00	30.90	31.00	31.10	31.30	31.40	31.50	31.00
Santa Ana River	NSAR241	0.75	31.70	31.70	31.60	31.30	31.20	31.00	31.00	31.00	31.10	31.30	31.40	31.60	31.20
Santa Ana River	NSAR241	0.50	32.50	33.75	36.10	32.20	31.30	31.10	31.00	31.00	31.20	31.30	31.60	32.10	31.60
Santa Ana River	NSAR241	0.25	51.30	72.25	172.70	85.78	46.35	33.30	31.10	31.20	31.40	31.50	33.65	42.70	39.70
Santa Ana River	NSAR241	0.05	724.28	1031.55	782.30	475.25	459.49	218.83	85.05	80.80	62.51	55.61	357.84	496.56	447.75
Santa Ana River	NSAR241	mean	195.34	302.96	237.97	115.44	101.77	57.79	40.87	43.13	44.47	42.42	94.17	142.44	117.28

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Santa Ana River	NSAR24	0.95	31.50	31.50	31.30	31.20	31.10	31.00	30.90	31.00	31.10	31.30	31.40	31.50	31.00
Santa Ana River	NSAR24	0.75	31.70	31.70	31.60	31.30	31.20	31.00	31.00	31.00	31.10	31.30	31.40	31.60	31.20
Santa Ana River	NSAR24	0.50	32.50	33.75	36.10	32.20	31.30	31.10	31.00	31.00	31.20	31.30	31.60	32.10	31.60
Santa Ana River	NSAR24	0.25	51.30	72.25	172.70	85.78	46.35	33.30	31.10	31.20	31.40	31.50	33.65	42.70	39.70
Santa Ana River	NSAR24	0.05	724.28	1031.55	782.30	475.25	459.49	218.83	85.05	80.80	62.51	55.61	357.84	496.56	447.75
Santa Ana River	NSAR24	mean	195.34	302.96	237.97	115.44	101.77	57.79	40.87	43.13	44.47	42.42	94.17	142.44	117.28
Santa Ana River	NSAR232	0.95	31.50	31.50	31.30	31.20	31.10	31.00	30.90	31.00	31.10	31.30	31.40	31.50	31.00
Santa Ana River	NSAR232	0.75	31.70	31.70	31.60	31.30	31.20	31.00	31.00	31.00	31.10	31.30	31.40	31.60	31.20
Santa Ana River	NSAR232	0.50	32.50	33.70	36.10	32.15	31.30	31.10	31.00	31.00	31.20	31.30	31.60	32.10	31.60
Santa Ana River	NSAR232	0.25	51.05	72.25	170.40	83.88	46.35	33.30	31.10	31.20	31.40	31.50	33.43	42.70	39.60
Santa Ana River	NSAR232	0.05	685.41	972.85	778.07	474.07	459.49	218.83	85.05	80.59	62.18	52.15	339.06	473.27	443.25
Santa Ana River	NSAR232	mean	189.97	296.31	232.79	114.28	101.57	57.77	40.83	42.90	44.01	41.89	91.39	138.94	115.12
Santa Ana River	NSAR231	0.95	31.50	31.50	31.30	31.20	31.10	31.00	30.90	31.00	31.10	31.30	31.40	31.50	31.00
Santa Ana River	NSAR231	0.75	31.70	31.70	31.60	31.30	31.20	31.00	31.00	31.00	31.10	31.30	31.40	31.60	31.20
Santa Ana River	NSAR231	0.50	32.50	33.70	36.10	32.15	31.30	31.10	31.00	31.00	31.20	31.30	31.60	32.10	31.60
Santa Ana River	NSAR231	0.25	51.05	72.25	170.40	83.88	46.35	33.30	31.10	31.20	31.40	31.50	33.43	42.70	39.60
Santa Ana River	NSAR231	0.05	685.41	972.85	778.07	474.07	459.49	218.83	85.05	80.59	62.18	52.15	339.06	473.27	443.25
Santa Ana River	NSAR231	mean	189.97	296.31	232.79	114.28	101.57	57.77	40.83	42.90	44.01	41.89	91.39	138.94	115.12
Santa Ana River	NSAR23	0.95	31.50	31.50	31.30	31.20	31.10	31.00	30.90	31.00	31.10	31.30	31.40	31.50	31.00
Santa Ana River	NSAR23	0.75	31.70	31.70	31.60	31.30	31.20	31.00	31.00	31.00	31.10	31.30	31.40	31.60	31.20
Santa Ana River	NSAR23	0.50	32.50	33.70	36.10	32.15	31.30	31.10	31.00	31.00	31.20	31.30	31.60	32.10	31.60
Santa Ana River	NSAR23	0.25	51.05	72.25	170.40	83.88	46.35	33.30	31.10	31.20	31.40	31.50	33.43	42.70	39.60
Santa Ana River	NSAR23	0.05	685.41	972.85	778.07	474.07	459.49	218.83	85.05	80.59	62.18	52.15	339.06	473.27	443.25
Santa Ana River	NSAR23	mean	189.97	296.31	232.79	114.28	101.57	57.77	40.83	42.90	44.01	41.89	91.39	138.94	115.12
Santa Ana River	NSAR22	0.95	35.30	35.30	35.20	35.10	35.00	34.90	34.80	34.80	35.00	35.10	35.30	35.30	34.80
Santa Ana River	NSAR22	0.75	35.55	35.60	35.50	35.20	35.00	34.90	34.80	34.80	35.00	35.20	35.30	35.40	35.00
Santa Ana River	NSAR22	0.50	36.30	37.55	39.90	36.00	35.10	34.90	34.80	34.80	35.00	35.20	35.40	35.90	35.40
Santa Ana River	NSAR22	0.25	54.95	76.25	174.55	87.88	50.25	37.18	34.90	35.00	35.30	35.30	37.25	46.60	43.50
Santa Ana River	NSAR22	0.05	742.49	1048.58	846.89	486.11	468.46	223.13	89.05	84.59	66.18	56.05	343.56	485.11	448.75
Santa Ana River	NSAR22	mean	198.65	307.48	243.42	120.17	106.29	61.69	44.69	47.01	48.16	46.07	97.28	146.06	121.29
Santa Ana River	NSAR21	0.95	37.60	37.50	37.40	37.30	37.20	37.10	37.00	37.00	37.20	37.40	37.50	37.60	37.00
Santa Ana River	NSAR21	0.75	37.80	37.80	37.70	37.40	37.20	37.10	37.00	37.00	37.20	37.40	37.50	37.70	37.20
Santa Ana River	NSAR21	0.50	38.60	39.80	42.20	38.20	37.30	37.10	37.00	37.00	37.20	37.40	37.60	38.10	37.60
Santa Ana River	NSAR21	0.25	56.85	78.25	170.80	90.00	52.55	39.38	37.20	37.25	37.50	37.60	39.30	48.80	45.70
Santa Ana River	NSAR21	0.05	733.85	1035.10	844.28	494.07	475.49	225.63	91.35	85.84	68.48	55.99	342.93	489.38	451.30
Santa Ana River	NSAR21	mean	198.10	306.75	244.12	122.54	109.02	63.94	46.89	49.18	50.16	48.04	98.13	146.62	122.68
Santa Ana River	NSAR20	0.95	49.30	49.30	49.20	49.00	49.00	48.80	48.80	48.80	49.00	49.10	49.30	49.30	48.80
Santa Ana River	NSAR20	0.75	49.55	49.60	49.50	49.20	49.00	48.90	48.80	48.80	49.00	49.10	49.30	49.40	49.00
Santa Ana River	NSAR20	0.50	50.40	51.60	54.00	50.00	49.10	48.90	48.80	48.80	49.00	49.20	49.40	49.90	49.40
Santa Ana River	NSAR20	0.25	68.40	88.60	179.50	98.55	64.45	51.08	48.90	49.00	49.30	49.30	51.08	60.70	57.40
Santa Ana River	NSAR20	0.05	832.14	1127.55	937.45	549.55	525.62	238.73	103.65	97.30	80.48	66.95	334.47	533.59	487.85
Santa Ana River	NSAR20	mean	214.27	326.73	266.21	139.62	125.53	76.01	58.74	61.27	62.10	59.99	111.15	161.04	137.59
Santa Ana River	NSAR19	0.95	8.50	8.50	8.40	8.20	8.20	8.00	8.00	8.00	8.10	8.30	8.40	8.50	8.00
Santa Ana River	NSAR19	0.75	8.70	8.70	8.70	8.40	8.20	8.10	8.00	8.00	8.20	8.30	8.50	8.60	8.20
Santa Ana River	NSAR19	0.50	9.50	10.80	13.20	9.20	8.30	8.10	8.00	8.00	8.20	8.40	8.60	9.10	8.60

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Santa Ana River	NSAR19	0.25	27.55	47.80	138.70	57.75	23.65	10.28	8.10	8.20	8.50	8.50	10.20	19.90	16.60
Santa Ana River	NSAR19	0.05	793.77	1089.28	899.25	509.35	485.22	197.97	62.85	56.50	39.68	26.15	293.77	493.32	447.30
Santa Ana River	NSAR19	mean	173.64	286.18	225.67	98.91	84.79	35.20	17.94	20.47	21.30	19.18	70.41	120.35	96.87
Santa Ana River	NSAR18	0.95	0.30	0.30	0.40	0.30	0.20	0.20	0.10	0.10	0.10	0.10	0.20	0.20	0.10
Santa Ana River	NSAR18	0.75	0.80	0.90	1.00	0.60	0.40	0.30	0.20	0.10	0.20	0.20	0.30	0.50	0.30
Santa Ana River	NSAR18	0.50	2.60	3.90	5.90	2.35	0.60	0.30	0.20	0.20	0.20	0.30	0.60	1.50	0.60
Santa Ana River	NSAR18	0.25	14.25	30.18	98.90	44.23	16.50	3.70	0.50	0.60	0.60	0.60	3.28	10.95	9.00
Santa Ana River	NSAR18	0.05	657.83	939.75	816.93	497.15	480.92	192.03	56.39	50.40	32.60	13.16	201.14	376.11	408.70
Santa Ana River	NSAR18	mean	146.95	257.54	201.49	88.06	76.83	27.87	10.45	12.06	12.06	9.32	50.46	96.89	81.59
Santa Ana River	NSAR17	0.95	0.30	0.30	0.40	0.30	0.20	0.20	0.10	0.10	0.10	0.10	0.20	0.20	0.10
Santa Ana River	NSAR17	0.75	0.80	0.90	1.00	0.60	0.40	0.30	0.20	0.10	0.20	0.20	0.30	0.50	0.30
Santa Ana River	NSAR17	0.50	2.70	4.00	5.90	2.45	0.60	0.30	0.20	0.20	0.20	0.30	0.60	1.50	0.70
Santa Ana River	NSAR17	0.25	14.35	27.90	91.05	41.30	16.45	3.80	0.55	0.70	0.60	0.60	3.10	10.50	8.60
Santa Ana River	NSAR17	0.05	597.66	913.95	813.87	497.35	481.02	192.13	56.49	50.50	32.70	12.03	183.41	334.08	395.15
Santa Ana River	NSAR17	mean	141.12	251.33	196.48	86.89	76.63	27.89	10.45	11.20	11.61	8.72	47.95	92.31	79.32
Santa Ana River	NSAR16	0.95	0.40	0.50	0.50	0.40	0.30	0.30	0.20	0.20	0.20	0.20	0.30	0.30	0.20
Santa Ana River	NSAR16	0.75	1.10	1.30	1.40	0.90	0.50	0.40	0.30	0.20	0.20	0.30	0.40	0.70	0.40
Santa Ana River	NSAR16	0.50	3.40	4.70	6.60	3.15	0.80	0.50	0.30	0.30	0.30	0.40	0.80	2.10	0.90
Santa Ana River	NSAR16	0.25	15.05	28.68	91.85	42.00	17.15	4.50	0.75	0.90	0.90	0.80	3.80	11.30	9.40
Santa Ana River	NSAR16	0.05	602.78	923.03	822.77	500.45	483.82	192.93	57.29	51.23	33.50	12.80	184.21	334.95	396.25
Santa Ana River	NSAR16	mean	142.16	252.67	197.91	87.76	77.28	28.22	10.70	11.47	11.87	8.98	48.49	93.11	79.99
Santa Ana River	NSAR151	0.95	0.50	0.60	0.60	0.60	0.40	0.40	0.30	0.20	0.20	0.30	0.30	0.40	0.30
Santa Ana River	NSAR151	0.75	1.35	1.60	1.80	1.10	0.70	0.50	0.30	0.30	0.30	0.30	0.50	0.80	0.50
Santa Ana River	NSAR151	0.50	4.00	5.00	6.80	3.55	1.00	0.60	0.40	0.30	0.30	0.40	1.00	2.60	1.10
Santa Ana River	NSAR151	0.25	15.40	27.15	87.95	42.15	17.75	5.00	0.90	1.10	1.00	1.00	4.20	11.65	9.60
Santa Ana River	NSAR151	0.05	586.63	915.93	828.70	502.85	486.02	193.57	57.89	50.71	33.87	11.96	170.68	315.51	389.10
Santa Ana River	NSAR151	mean	138.36	248.55	194.78	87.45	77.57	28.47	10.88	11.00	11.69	8.63	46.92	90.27	78.66
Santa Ana River	NSAR15	0.95	0.70	0.90	0.90	0.80	0.60	0.50	0.40	0.30	0.30	0.40	0.40	0.60	0.40
Santa Ana River	NSAR15	0.75	1.85	2.20	2.50	1.50	0.90	0.70	0.50	0.40	0.40	0.40	0.70	1.15	0.70
Santa Ana River	NSAR15	0.50	4.70	5.80	7.60	4.25	1.40	0.80	0.60	0.40	0.50	0.60	1.40	3.30	1.60
Santa Ana River	NSAR15	0.25	16.15	27.85	88.75	42.95	18.55	5.78	1.30	1.50	1.40	1.40	4.98	12.45	10.40
Santa Ana River	NSAR15	0.05	591.55	925.20	837.80	506.21	488.95	194.43	58.69	51.51	34.67	12.76	171.48	316.41	390.20
Santa Ana River	NSAR15	mean	139.47	249.97	196.29	88.42	78.33	28.87	11.19	11.31	12.01	8.96	47.55	91.15	79.41
Santa Ana River	NSAR14	0.95	1.07	1.40	1.40	1.20	1.00	0.80	0.60	0.50	0.50	0.60	0.70	1.00	0.60
Santa Ana River	NSAR14	0.75	2.80	3.13	3.40	2.40	1.50	1.10	0.80	0.60	0.60	0.70	1.00	1.85	1.00
Santa Ana River	NSAR14	0.50	5.60	6.75	8.50	5.20	2.20	1.30	1.00	0.70	0.80	1.00	2.20	4.30	2.50
Santa Ana River	NSAR14	0.25	16.85	28.70	88.65	43.90	19.45	6.78	2.00	2.40	2.28	2.20	5.88	13.30	11.30
Santa Ana River	NSAR14	0.05	584.74	916.78	849.63	510.55	492.85	195.53	59.69	52.39	35.67	12.92	168.69	317.61	388.90
Santa Ana River	NSAR14	mean	139.94	250.68	197.40	89.55	79.40	29.51	11.68	11.73	12.41	9.40	47.95	91.72	80.06
Santa Ana River	RNASRP	0.95	1.66	2.08	2.23	1.93	1.52	1.33	0.93	0.76	0.83	0.92	1.05	1.47	0.94
Santa Ana River	RNASRP	0.75	3.65	4.03	4.33	3.25	2.26	1.69	1.17	0.93	0.96	1.06	1.55	2.75	1.56
Santa Ana River	RNASRP	0.50	6.47	7.66	9.35	6.09	3.05	2.01	1.47	1.13	1.20	1.53	3.11	5.16	3.37
Santa Ana River	RNASRP	0.25	16.97	27.87	83.93	44.92	20.29	7.68	2.84	3.32	3.09	3.06	6.75	14.24	12.03
Santa Ana River	RNASRP	0.05	539.98	883.61	846.90	513.21	496.17	196.62	60.63	53.31	36.67	13.75	160.48	305.59	382.57
Santa Ana River	RNASRP	mean	133.80	244.00	192.44	90.07	80.37	30.26	12.16	12.10	12.56	9.82	46.15	87.77	78.42

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Santa Ana River	NSAR13	0.95	1.67	2.10	2.20	1.90	1.50	1.30	0.90	0.80	0.80	0.90	1.10	1.50	0.90
Santa Ana River	NSAR13	0.75	3.65	4.03	4.30	3.30	2.30	1.70	1.20	0.90	1.00	1.10	1.53	2.75	1.60
Santa Ana River	NSAR13	0.50	6.50	7.65	9.30	6.10	3.10	2.00	1.50	1.10	1.20	1.50	3.10	5.20	3.40
Santa Ana River	NSAR13	0.25	16.95	27.85	83.90	44.90	20.30	7.68	2.80	3.30	3.10	3.05	6.78	14.20	12.00
Santa Ana River	NSAR13	0.05	539.98	883.63	846.92	513.20	496.15	196.63	60.60	53.30	36.67	13.75	160.45	305.56	382.60
Santa Ana River	NSAR13	mean	133.80	244.00	192.44	90.07	80.37	30.26	12.16	12.10	12.56	9.82	46.15	87.77	78.42
Santa Ana River	US RNASRP	0.95	1.66	2.08	2.23	1.93	1.52	1.33	0.93	0.76	0.83	0.92	1.05	1.47	0.94
Santa Ana River	US RNASRP	0.75	3.65	4.03	4.33	3.25	2.26	1.69	1.17	0.93	0.96	1.06	1.55	2.75	1.56
Santa Ana River	US RNASRP	0.50	6.47	7.66	9.35	6.09	3.05	2.01	1.47	1.13	1.20	1.53	3.11	5.16	3.37
Santa Ana River	US RNASRP	0.25	16.97	27.87	83.93	44.92	20.29	7.68	2.84	3.32	3.09	3.06	6.75	14.24	12.03
Santa Ana River	US RNASRP	0.05	539.98	883.61	846.90	513.21	496.17	196.62	60.63	53.31	36.67	13.75	160.48	305.59	382.57
Santa Ana River	US RNASRP	mean	133.80	244.00	192.44	90.07	80.37	30.26	12.16	12.10	12.56	9.82	46.15	87.77	78.42
Santa Ana River	SE-74	0.95	0.05	0.12	0.16	0.15	0.14	0.13	0.12	0.10	0.09	0.07	0.06	0.06	0.08
Santa Ana River	SE-74	0.75	0.25	0.22	0.36	0.29	0.26	0.21	0.16	0.13	0.12	0.10	0.10	0.11	0.16
Santa Ana River	SE-74	0.50	0.61	1.48	1.88	0.87	0.41	0.30	0.25	0.19	0.19	0.14	0.19	0.40	0.35
Santa Ana River	SE-74	0.25	5.79	13.45	48.36	28.87	12.13	5.09	1.12	0.93	0.94	0.44	1.10	4.19	3.82
Santa Ana River	SE-74	0.05	404.04	679.00	712.23	482.96	468.65	182.99	49.49	48.28	32.23	5.66	103.36	219.63	321.12
Santa Ana River	SE-74	mean	92.58	190.63	149.17	74.53	71.02	25.53	9.63	9.12	9.23	5.84	31.08	66.10	60.51
Santa Ana River	SE-58	0.95	0.03	0.04	0.06	0.05	0.05	0.05	0.05	0.04	0.03	0.03	0.02	0.01	0.03
Santa Ana River	SE-58	0.75	0.08	0.13	0.15	0.14	0.12	0.10	0.07	0.06	0.05	0.04	0.03	0.04	0.07
Santa Ana River	SE-58	0.50	0.84	1.64	1.57	0.69	0.32	0.25	0.28	0.20	0.28	0.11	0.20	0.62	0.37
Santa Ana River	SE-58	0.25	5.43	7.58	12.69	12.17	10.87	7.75	2.40	2.45	2.10	0.71	2.04	4.05	4.08
Santa Ana River	SE-58	0.05	73.43	314.19	439.81	499.64	506.18	231.99	61.96	57.25	40.15	3.97	24.63	70.25	242.07
Santa Ana River	SE-58	mean	34.41	85.01	80.86	67.37	76.49	32.76	13.28	10.24	6.97	1.94	10.66	28.69	37.12
Santa Ana River	SE-55	0.95	0.02	0.03	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Santa Ana River	SE-55	0.75	0.05	0.06	0.09	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02	0.02	0.04
Santa Ana River	SE-55	0.50	0.09	0.15	0.18	0.17	0.11	0.07	0.05	0.04	0.04	0.03	0.04	0.04	0.07
Santa Ana River	SE-55	0.25	0.28	0.79	0.71	0.72	0.44	0.29	0.20	0.14	0.15	0.07	0.08	0.13	0.28
Santa Ana River	SE-55	0.05	29.94	261.36	261.91	260.48	450.95	140.64	63.57	56.03	44.36	0.31	0.37	2.84	170.84
Santa Ana River	SE-55	mean	11.21	55.10	41.19	36.73	48.12	20.87	11.99	10.44	4.93	0.70	3.30	16.96	21.60
Temescal Wash	NTE24	0.95	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE24	0.75	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE24	0.50	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE24	0.25	48.00	2.30	3.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE24	0.05	279.97	548.50	502.33	175.45	60.20	8.92	2.30	2.30	2.30	2.40	45.31	109.04	65.30
Temescal Wash	NTE24	mean	139.40	140.65	95.90	25.78	9.37	3.44	2.42	3.96	4.43	4.43	28.96	44.81	41.50
Temescal Wash	NTE23	0.95	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE23	0.75	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE23	0.50	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE23	0.25	48.00	2.30	3.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE23	0.05	279.97	548.50	502.33	175.45	60.20	8.92	2.30	2.30	2.30	2.40	45.31	109.04	65.30
Temescal Wash	NTE23	mean	139.40	140.65	95.90	25.78	9.37	3.44	2.42	3.96	4.43	4.43	28.96	44.81	41.50
Temescal Wash	NTE22	0.95	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE22	0.75	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE22	0.50	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Temescal Wash	NTE22	0.25	48.00	2.30	3.15	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE22	0.05	258.43	539.73	502.33	175.45	58.87	8.92	2.30	2.30	2.30	2.40	38.11	94.13	61.30
Temescal Wash	NTE22	mean	135.14	134.90	91.86	25.13	9.28	3.41	2.41	3.84	4.21	4.19	26.98	42.51	39.89
The Zanja	SE-59	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
The Zanja	SE-59	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
The Zanja	SE-59	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
The Zanja	SE-59	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
The Zanja	SE-59	0.05	6.46	8.17	5.24	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.08	1.36	0.01
The Zanja	SE-59	mean	1.09	1.85	1.00	0.17	0.03	0.00	0.00	0.08	0.10	0.12	0.46	0.78	0.47
Upper Warm Creek	SE-31	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-31	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-31	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-31	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-31	0.05	28.61	33.55	19.52	0.59	0.00	0.00	0.00	0.00	0.00	0.00	5.05	9.09	0.80
Upper Warm Creek	SE-31	mean	4.96	7.11	4.36	0.72	0.13	0.00	0.00	0.39	0.50	0.60	2.28	3.59	2.03
Upper Warm Creek	SE-20	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-20	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-20	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-20	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-20	0.05	6.65	9.37	4.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.33	0.00
Upper Warm Creek	SE-20	mean	2.00	3.79	2.05	0.13	0.02	0.00	0.00	0.15	0.17	0.19	0.69	1.36	0.87
Warm Creek	NW-35	0.95	1.32	1.84	1.78	1.59	1.26	1.09	0.71	0.57	0.65	0.75	0.89	1.28	0.73
Warm Creek	NW-35	0.75	2.95	3.25	3.55	2.71	1.78	1.34	0.89	0.70	0.75	0.85	1.22	2.05	1.18
Warm Creek	NW-35	0.50	4.87	5.42	6.00	4.27	2.34	1.56	1.08	0.80	0.85	1.20	2.43	4.27	2.21
Warm Creek	NW-35	0.25	8.78	9.87	13.11	6.36	4.14	2.23	1.43	1.09	1.36	1.95	5.41	6.79	5.00
Warm Creek	NW-35	0.05	62.65	65.58	53.02	17.34	6.38	3.54	2.46	1.93	3.92	6.38	23.42	49.26	19.49
Warm Creek	NW-35	mean	14.70	16.73	14.50	6.55	3.29	1.88	1.26	1.74	2.10	2.78	7.66	11.69	7.03
Warm Creek	NW-34	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-34	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-34	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-34	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-34	0.05	0.00	1.78	3.44	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-34	mean	0.01	0.32	0.44	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Warm Creek	NW-33	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-33	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-33	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-33	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-33	0.05	12.53	11.97	8.66	0.65	0.00	0.00	0.00	0.00	0.00	0.02	3.36	5.49	0.91
Warm Creek	NW-33	mean	1.71	1.88	1.34	0.33	0.06	0.00	0.00	0.14	0.19	0.24	0.93	1.31	0.67
Warm Creek	NW-32	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-32	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-32	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-32	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-32	0.05	11.58	11.07	8.17	0.83	0.00	0.00	0.00	0.00	0.00	0.07	3.61	5.25	1.07
Warm Creek	NW-32	mean	1.54	1.69	1.23	0.32	0.06	0.00	0.00	0.12	0.17	0.22	0.85	1.18	0.61

			All Flows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Warm Creek	NW-31	0.95	0.03	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03
Warm Creek	NW-31	0.75	0.05	0.05	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.04	0.04	0.04
Warm Creek	NW-31	0.50	0.06	0.07	0.07	0.07	0.06	0.05	0.04	0.04	0.04	0.04	0.04	0.05	0.05
Warm Creek	NW-31	0.25	0.10	0.13	0.25	0.12	0.08	0.06	0.05	0.04	0.04	0.04	0.05	0.09	0.07
Warm Creek	NW-31	0.05	8.85	8.50	6.30	1.01	0.17	0.09	0.07	0.06	0.07	0.26	3.01	4.16	1.23
Warm Creek	NW-31	mean	1.27	1.39	1.06	0.34	0.12	0.06	0.05	0.13	0.17	0.22	0.71	0.98	0.54
Warm Creek	NW-30	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-30	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-30	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-30	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-30	0.05	2.29	2.35	1.17	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.29	0.02
Warm Creek	NW-30	mean	0.37	0.43	0.27	0.05	0.01	0.00	0.00	0.03	0.04	0.05	0.19	0.28	0.14
Waterman Canyon Creek	SE-12	0.95	0.06	0.26	0.77	0.41	0.22	0.13	0.09	0.06	0.06	0.05	0.05	0.06	0.06
Waterman Canyon Creek	SE-12	0.75	0.37	1.29	1.76	1.23	0.68	0.33	0.18	0.11	0.08	0.07	0.07	0.11	0.16
Waterman Canyon Creek	SE-12	0.50	2.16	2.72	3.49	2.81	1.43	0.57	0.28	0.17	0.13	0.12	0.13	0.34	0.58
Waterman Canyon Creek	SE-12	0.25	3.56	6.62	8.00	7.10	4.16	1.97	0.73	0.39	0.28	0.22	0.35	1.73	2.45
Waterman Canyon Creek	SE-12	0.05	11.52	25.35	23.10	13.92	8.33	4.36	1.92	0.94	0.96	1.20	3.22	8.07	10.48
Waterman Canyon Creek	SE-12	mean	4.46	8.93	8.37	4.75	2.70	1.29	0.56	0.35	0.32	0.30	0.81	2.33	2.90
Waterman Canyon Creek	SE-11	0.95	0.07	0.26	0.76	0.41	0.23	0.14	0.09	0.07	0.06	0.05	0.05	0.06	0.07
Waterman Canyon Creek	SE-11	0.75	0.35	1.23	1.70	1.21	0.67	0.33	0.19	0.12	0.09	0.08	0.07	0.11	0.16
Waterman Canyon Creek	SE-11	0.50	2.01	2.52	3.32	2.70	1.39	0.56	0.29	0.18	0.13	0.12	0.13	0.32	0.56
Waterman Canyon Creek	SE-11	0.25	3.28	6.13	7.37	6.64	3.90	1.86	0.71	0.38	0.27	0.21	0.33	1.49	2.30
Waterman Canyon Creek	SE-11	0.05	10.00	22.99	20.62	12.57	7.60	3.98	1.78	0.88	0.92	1.08	2.76	7.30	9.48
Waterman Canyon Creek	SE-11	mean	4.16	8.40	7.79	4.39	2.52	1.22	0.54	0.33	0.30	0.27	0.71	2.14	2.70

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Borea Daley Creek	SE-26	0.95	0.24	0.34	0.40	0.42	0.40	0.38	0.34	0.31	0.29	0.27	0.25	0.24	0.27
Borea Daley Creek	SE-26	0.75	0.35	0.51	0.58	0.50	0.46	0.42	0.38	0.34	0.32	0.29	0.27	0.29	0.35
Borea Daley Creek	SE-26	0.50	0.67	0.80	0.98	0.80	0.57	0.47	0.41	0.37	0.34	0.31	0.32	0.39	0.46
Borea Daley Creek	SE-26	0.25	1.14	1.84	3.39	1.79	1.16	0.73	0.53	0.44	0.40	0.40	0.41	0.79	0.83
Borea Daley Creek	SE-26	0.05	18.03	20.33	15.71	4.67	2.70	1.84	0.94	0.73	0.71	0.83	8.16	10.94	5.52
Borea Daley Creek	SE-26	mean	3.09	4.23	3.72	1.82	1.06	0.68	0.50	0.56	0.61	0.67	1.57	2.25	1.72
Borea Daley Creek	SE-25	0.95	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Borea Daley Creek	SE-25	0.75	0.02	0.09	0.11	0.06	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Borea Daley Creek	SE-25	0.50	0.17	0.21	0.30	0.21	0.07	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.03
Borea Daley Creek	SE-25	0.25	0.36	0.84	0.85	0.84	0.40	0.14	0.04	0.01	0.01	0.01	0.02	0.14	0.20
Borea Daley Creek	SE-25	0.05	1.24	2.67	3.17	1.91	1.13	0.84	0.18	0.09	0.07	0.10	0.39	0.86	1.23
Borea Daley Creek	SE-25	mean	0.46	1.12	1.05	0.53	0.30	0.13	0.04	0.03	0.02	0.03	0.08	0.25	0.33
Borea Daley Creek	SE-24	0.95	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Borea Daley Creek	SE-24	0.75	0.01	0.07	0.10	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Borea Daley Creek	SE-24	0.50	0.15	0.19	0.26	0.19	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.02
Borea Daley Creek	SE-24	0.25	0.30	0.81	0.81	0.81	0.39	0.13	0.03	0.00	0.00	0.00	0.01	0.10	0.17
Borea Daley Creek	SE-24	0.05	0.83	2.56	2.92	1.82	1.07	0.81	0.17	0.07	0.05	0.05	0.18	0.81	1.00
Borea Daley Creek	SE-24	mean	0.38	1.02	0.96	0.50	0.28	0.12	0.03	0.01	0.01	0.01	0.03	0.19	0.29
Cable Creek	NW-17	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-17	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-17	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-17	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-17	0.05	0.00	0.00	12.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-17	mean	3.42	12.48	7.18	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.36	1.37	2.02
Cable Creek	NW-16	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-16	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-16	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-16	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-16	0.05	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-16	mean	1.66	5.75	3.43	0.02	0.00	0.00	0.00	0.01	0.02	0.01	0.01	0.80	0.95
Cable Creek	NW-13	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-13	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-13	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-13	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-13	0.05	0.00	5.49	10.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-13	mean	1.70	6.13	4.29	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	1.07
Cable Creek	NW-12	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-12	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-12	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-12	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-12	0.05	0.00	11.11	14.92	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cable Creek	NW-12	mean	1.73	6.35	4.94	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	1.16
Cajon Wash	NW-19	0.95	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Cajon Wash	NW-19	0.75	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01
Cajon Wash	NW-19	0.50	0.01	0.02	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Cajon Wash	NW-19	0.25	0.03	0.05	0.06	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02
Cajon Wash	NW-19	0.05	0.40	1.54	1.75	0.14	0.10	0.07	0.04	0.03	0.02	0.02	0.11	0.15	0.13
Cajon Wash	NW-19	mean	2.77	8.43	3.70	0.07	0.03	0.02	0.01	0.02	0.02	0.02	0.18	0.95	1.31
Cajon Wash	NW-18	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cajon Wash	NW-18	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cajon Wash	NW-18	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cajon Wash	NW-18	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cajon Wash	NW-18	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cajon Wash	NW-18	mean	1.80	3.93	2.63	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.46	0.54	0.77
Chino Creek	NCH16	0.95	20.90	17.00	14.70	10.80	7.70	3.10	2.30	2.30	3.90	7.00	12.40	16.30	2.30
Chino Creek	NCH16	0.75	20.90	17.00	14.70	10.80	7.70	3.10	2.30	2.30	3.90	7.00	12.40	16.30	3.90
Chino Creek	NCH16	0.50	20.90	17.10	14.90	10.80	7.70	3.10	2.30	2.30	3.90	7.00	12.40	16.30	10.80
Chino Creek	NCH16	0.25	49.50	73.28	85.35	19.30	7.70	3.10	2.30	2.30	3.90	7.00	14.28	32.75	17.10
Chino Creek	NCH16	0.05	1920.79	1542.85	1062.60	248.60	22.19	3.60	2.30	2.40	19.01	41.83	723.41	1051.48	396.25
Chino Creek	NCH16	mean	315.54	302.41	247.11	57.68	18.69	4.24	2.77	9.15	19.69	24.36	142.02	191.76	110.45
Chino Creek	NCH12	0.95	7.70	5.40	5.40	4.60	3.10	0.80	0.80	0.80	0.80	0.80	3.10	4.60	0.80
Chino Creek	NCH12	0.75	7.70	5.40	5.40	4.60	3.10	0.80	0.80	0.80	0.80	0.80	3.10	4.60	0.80
Chino Creek	NCH12	0.50	7.70	5.40	5.40	4.60	3.10	0.80	0.80	0.80	0.80	0.80	3.10	4.60	3.10
Chino Creek	NCH12	0.25	11.45	6.45	9.40	4.60	3.10	0.80	0.80	0.80	0.80	0.80	3.10	4.70	5.40
Chino Creek	NCH12	0.05	939.59	854.63	550.16	110.25	4.26	0.80	0.80	0.80	6.46	16.49	446.18	499.19	189.85
Chino Creek	NCH12	mean	141.86	139.90	110.15	25.63	8.49	1.85	1.06	5.11	10.31	10.85	71.92	90.70	51.08
Chino Creek	NCH11	0.95	7.70	5.40	5.40	4.60	3.10	0.80	0.80	0.80	0.80	0.80	3.10	4.60	0.80
Chino Creek	NCH11	0.75	7.70	5.40	5.40	4.60	3.10	0.80	0.80	0.80	0.80	0.80	3.10	4.60	0.80
Chino Creek	NCH11	0.50	7.70	5.40	5.40	4.60	3.10	0.80	0.80	0.80	0.80	0.80	3.10	4.60	3.10
Chino Creek	NCH11	0.25	11.15	6.10	8.60	4.60	3.10	0.80	0.80	0.80	0.80	0.80	3.10	4.70	5.40
Chino Creek	NCH11	0.05	767.97	695.45	469.89	95.60	4.12	0.80	0.80	0.80	5.80	13.79	380.62	433.24	167.90
Chino Creek	NCH11	mean	119.26	117.71	92.98	22.61	7.71	1.83	1.02	4.59	9.12	9.17	60.05	76.13	43.17
Chino Creek	NCH10	0.95	3.10	1.50	1.50	1.50	1.50	0.00	0.00	0.00	0.00	0.00	1.50	1.50	0.00
Chino Creek	NCH10	0.75	3.10	1.50	1.50	1.50	1.50	0.00	0.00	0.00	0.00	0.00	1.50	1.50	0.00
Chino Creek	NCH10	0.50	3.10	1.50	1.50	1.50	1.50	0.00	0.00	0.00	0.00	0.00	1.50	1.50	1.50
Chino Creek	NCH10	0.25	6.20	2.20	4.60	1.50	1.50	0.00	0.00	0.00	0.00	0.00	1.50	1.60	1.50
Chino Creek	NCH10	0.05	603.88	578.30	389.02	79.25	2.62	0.00	0.00	0.00	4.64	12.99	312.53	368.47	136.95
Chino Creek	NCH10	mean	96.93	95.99	75.55	17.12	5.59	1.02	0.19	3.49	7.30	7.08	48.97	61.52	34.78
Chino Creek	NCH09	0.95	3.10	1.50	1.50	1.50	1.50	0.00	0.00	0.00	0.00	0.00	1.50	1.50	0.00
Chino Creek	NCH09	0.75	3.10	1.50	1.50	1.50	1.50	0.00	0.00	0.00	0.00	0.00	1.50	1.50	0.00
Chino Creek	NCH09	0.50	3.10	1.50	1.50	1.50	1.50	0.00	0.00	0.00	0.00	0.00	1.50	1.50	1.50
Chino Creek	NCH09	0.25	5.90	2.20	4.50	1.50	1.50	0.00	0.00	0.00	0.00	0.00	1.50	1.60	1.50
Chino Creek	NCH09	0.05	554.70	549.80	363.85	75.65	2.62	0.00	0.00	0.00	4.64	11.57	283.65	344.36	127.85
Chino Creek	NCH09	mean	89.98	88.98	70.19	16.11	5.33	1.01	0.18	3.34	6.80	6.47	44.98	56.87	32.26
City Creek	SE-41	0.95	0.22	0.32	0.35	0.37	0.37	0.35	0.31	0.28	0.27	0.25	0.24	0.23	0.26
City Creek	SE-41	0.75	0.33	0.40	0.46	0.43	0.43	0.40	0.35	0.32	0.30	0.27	0.26	0.27	0.33
City Creek	SE-41	0.50	0.49	0.56	0.65	0.58	0.50	0.44	0.38	0.34	0.32	0.30	0.30	0.37	0.42
City Creek	SE-41	0.25	0.84	1.14	2.58	1.12	0.77	0.60	0.50	0.42	0.39	0.41	0.44	0.67	0.67
City Creek	SE-41	0.05	19.98	44.62	85.01	10.60	1.89	1.29	0.91	0.75	0.70	0.85	6.47	11.22	7.86
City Creek	SE-41	mean	11.58	31.20	20.29	2.24	0.91	0.58	0.47	0.52	0.55	0.61	2.25	5.04	6.22

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
City Creek	SE-39	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek	SE-39	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek	SE-39	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek	SE-39	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek	SE-39	0.05	0.00	30.59	81.56	3.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek	SE-39	mean	9.30	28.50	17.88	0.93	0.10	0.00	0.00	0.00	0.00	0.00	0.92	3.28	4.95
City Creek	SE-37	0.95	2.20	2.81	3.27	2.30	1.70	0.50	0.10	0.10	0.10	0.20	1.00	1.60	0.20
City Creek	SE-37	0.75	4.40	5.21	5.51	4.71	3.11	1.50	0.50	0.30	0.40	1.10	2.00	2.80	1.70
City Creek	SE-37	0.50	7.11	7.92	9.21	7.42	5.32	3.00	1.30	0.99	1.00	1.89	2.90	4.82	4.20
City Creek	SE-37	0.25	12.04	17.94	30.52	23.18	13.01	5.22	2.91	2.30	2.61	3.53	5.61	9.82	8.61
City Creek	SE-37	0.05	41.75	116.85	146.76	63.36	38.09	20.09	13.02	8.51	6.92	7.52	15.01	32.28	43.38
City Creek	SE-37	mean	21.18	44.69	38.05	18.10	10.95	5.82	3.21	2.26	2.28	2.87	6.46	12.75	13.89
City Creek Channel	SE-52	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-52	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-52	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-52	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-52	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-52	mean	0.21	0.39	0.14	0.00	0.00	0.00	0.00	0.05	0.05	0.04	0.11	0.22	0.10
City Creek Channel	SE-51	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-51	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-51	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-51	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-51	0.05	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-51	mean	0.18	0.28	0.12	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.10	0.17	0.08
City Creek Channel	SE-50	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-50	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-50	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-50	0.05	0.07	0.12	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City Creek Channel	SE-50	mean	0.18	0.25	0.12	0.01	0.00	0.00	0.00	0.03	0.03	0.03	0.10	0.15	0.07
Cucamonga Creek	NCC19	0.95	10.80	9.30	7.80	4.60	3.10	0.80	0.80	0.80	1.50	4.60	7.80	9.30	0.80
Cucamonga Creek	NCC19	0.75	10.80	9.30	7.80	4.60	3.10	0.80	0.80	0.80	1.50	4.60	7.80	9.30	1.50
Cucamonga Creek	NCC19	0.50	10.90	9.30	7.80	4.60	3.10	0.80	0.80	0.80	1.50	4.60	7.80	9.30	4.60
Cucamonga Creek	NCC19	0.25	25.95	35.55	61.25	10.35	3.10	0.80	0.80	0.80	1.50	4.60	8.30	17.20	9.30
Cucamonga Creek	NCC19	0.05	891.87	641.55	524.15	131.43	12.19	1.20	0.80	0.80	4.00	15.12	292.85	397.57	176.30
Cucamonga Creek	NCC19	mean	162.89	151.50	128.99	29.44	8.49	0.88	1.00	3.21	7.44	11.46	64.66	93.62	54.90
Cucamonga Creek	NCC18	0.95	10.80	9.30	7.80	4.60	3.10	0.80	0.80	0.80	1.50	4.60	7.80	9.30	0.80
Cucamonga Creek	NCC18	0.75	10.80	9.30	7.80	4.60	3.10	0.80	0.80	0.80	1.50	4.60	7.80	9.30	1.50
Cucamonga Creek	NCC18	0.50	10.90	9.30	7.80	4.60	3.10	0.80	0.80	0.80	1.50	4.60	7.80	9.30	4.60
Cucamonga Creek	NCC18	0.25	25.30	34.83	61.15	10.35	3.10	0.80	0.80	0.80	1.50	4.60	8.30	17.00	9.30
Cucamonga Creek	NCC18	0.05	843.72	634.43	521.68	131.05	12.19	1.10	0.80	0.80	4.00	15.12	286.28	392.85	171.80
Cucamonga Creek	NCC18	mean	158.87	147.16	125.90	29.09	8.43	0.88	1.00	3.13	7.31	11.31	62.90	91.36	53.56
Day Creek	NDY19	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Day Creek	NDY19	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Day Creek	NDY19	0.50	0.80	1.80	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Day Creek	NDY19	0.25	9.90	14.90	15.75	1.40	0.00	0.00	0.00	0.00	0.00	0.00	1.88	4.35	0.60
Day Creek	NDY19	0.05	207.31	162.30	133.30	24.66	0.83	0.00	0.00	0.00	0.95	2.03	71.38	109.25	58.40
Day Creek	NDY19	mean	52.31	47.36	36.56	5.97	1.25	0.03	0.02	0.72	0.94	1.37	15.61	25.98	15.55
Devil Canyon Creek	NW-11	0.95	0.05	0.08	0.09	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05
Devil Canyon Creek	NW-11	0.75	0.08	0.11	0.12	0.11	0.09	0.08	0.07	0.06	0.06	0.05	0.06	0.07	0.07
Devil Canyon Creek	NW-11	0.50	0.14	0.16	0.18	0.15	0.12	0.10	0.07	0.07	0.06	0.06	0.07	0.10	0.10
Devil Canyon Creek	NW-11	0.25	0.24	0.32	1.20	0.32	0.20	0.14	0.09	0.08	0.08	0.08	0.10	0.19	0.17
Devil Canyon Creek	NW-11	0.05	16.45	29.17	35.35	2.99	0.40	0.26	0.18	0.14	0.16	0.24	2.58	5.62	2.73
Devil Canyon Creek	NW-11	mean	3.35	8.59	6.65	1.04	0.23	0.12	0.09	0.23	0.28	0.31	1.20	1.70	1.95
Devil Canyon Creek	NW-10	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Devil Canyon Creek	NW-10	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Devil Canyon Creek	NW-10	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Devil Canyon Creek	NW-10	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Devil Canyon Creek	NW-10	0.05	11.58	21.92	33.08	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.34	2.89	0.63
Devil Canyon Creek	NW-10	mean	2.56	7.70	5.84	0.65	0.03	0.00	0.00	0.11	0.13	0.14	0.75	1.09	1.55
Devil Canyon Creek	NW-9	0.95	0.13	0.21	0.26	0.27	0.25	0.22	0.20	0.18	0.16	0.15	0.13	0.13	0.15
Devil Canyon Creek	NW-9	0.75	0.22	0.36	0.41	0.34	0.30	0.26	0.23	0.20	0.18	0.16	0.15	0.16	0.21
Devil Canyon Creek	NW-9	0.50	0.50	0.62	0.80	0.61	0.40	0.31	0.26	0.22	0.19	0.18	0.19	0.25	0.30
Devil Canyon Creek	NW-9	0.25	1.06	1.61	3.73	1.58	0.87	0.52	0.36	0.29	0.26	0.24	0.26	0.65	0.64
Devil Canyon Creek	NW-9	0.05	21.36	31.50	39.59	9.75	2.34	1.28	0.70	0.51	0.51	0.67	8.30	11.66	8.65
Devil Canyon Creek	NW-9	mean	4.14	9.50	8.08	2.19	0.86	0.48	0.33	0.43	0.48	0.56	1.67	2.27	2.55
Devil Canyon Creek	NW-2	0.95	0.02	0.02	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Devil Canyon Creek	NW-2	0.75	0.85	0.59	0.62	0.32	0.13	0.02	0.01	0.01	0.01	0.01	0.01	0.09	0.02
Devil Canyon Creek	NW-2	0.50	1.82	2.29	2.77	2.10	1.27	0.36	0.37	0.07	0.03	0.08	0.48	1.54	0.76
Devil Canyon Creek	NW-2	0.25	3.87	5.10	7.86	5.86	2.88	1.80	1.25	0.74	0.77	0.87	1.55	3.05	2.35
Devil Canyon Creek	NW-2	0.05	17.26	38.95	50.30	23.22	14.09	5.92	2.69	1.84	1.86	2.28	5.13	9.56	13.22
Devil Canyon Creek	NW-2	mean	5.06	10.90	10.41	5.53	3.17	1.34	0.75	0.55	0.61	0.64	1.94	3.26	3.64
Devil Canyon Creek	NW-1	0.95	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Devil Canyon Creek	NW-1	0.75	0.82	0.58	0.59	0.30	0.11	0.01	0.00	0.00	0.00	0.00	0.00	0.09	0.01
Devil Canyon Creek	NW-1	0.50	1.81	2.22	2.61	2.08	1.27	0.36	0.36	0.07	0.01	0.07	0.38	1.50	0.76
Devil Canyon Creek	NW-1	0.25	3.57	4.96	7.52	5.68	2.87	1.79	1.25	0.75	0.77	0.87	1.48	2.89	2.28
Devil Canyon Creek	NW-1	0.05	16.10	36.72	50.17	23.12	13.99	5.87	2.67	1.85	1.86	2.27	4.64	8.99	13.09
Devil Canyon Creek	NW-1	mean	4.86	10.68	10.21	5.45	3.13	1.33	0.74	0.54	0.58	0.61	1.83	3.11	3.55
East Twin Creek	SE-78	0.95	0.26	0.35	0.38	0.33	0.29	0.26	0.19	0.18	0.21	0.22	0.26	0.29	0.21
East Twin Creek	SE-78	0.75	0.41	0.46	0.50	0.42	0.34	0.31	0.23	0.21	0.23	0.24	0.29	0.36	0.28
East Twin Creek	SE-78	0.50	0.61	0.66	0.70	0.58	0.43	0.35	0.25	0.22	0.25	0.27	0.36	0.47	0.41
East Twin Creek	SE-78	0.25	1.04	1.81	5.30	2.00	0.75	0.52	0.34	0.29	0.32	0.38	0.49	0.90	0.68
East Twin Creek	SE-78	0.05	92.79	122.02	80.35	18.58	2.38	1.14	0.70	0.56	0.64	2.96	33.16	43.22	20.96
East Twin Creek	SE-78	mean	17.76	27.60	18.12	4.03	1.25	0.48	0.33	1.38	1.81	2.28	7.97	13.22	7.92
East Twin Creek	SE-54	0.95	0.43	0.57	0.63	0.63	0.61	0.57	0.43	0.39	0.42	0.42	0.45	0.45	0.44
East Twin Creek	SE-54	0.75	0.61	0.71	0.79	0.73	0.70	0.65	0.50	0.45	0.47	0.46	0.49	0.54	0.53
East Twin Creek	SE-54	0.50	0.86	0.96	1.03	0.94	0.81	0.72	0.56	0.50	0.51	0.51	0.57	0.68	0.71
East Twin Creek	SE-54	0.25	1.40	2.39	6.95	2.66	1.19	0.95	0.72	0.61	0.62	0.67	0.74	1.19	1.05
East Twin Creek	SE-54	0.05	104.04	134.19	92.49	16.24	3.35	1.67	1.22	1.01	1.06	3.64	34.13	49.03	19.67
East Twin Creek	SE-54	mean	18.38	28.29	19.15	4.77	1.76	0.87	0.67	1.66	2.12	2.63	8.49	13.66	8.44

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
East Twin Creek	SE-53	0.95	0.33	0.44	0.48	0.49	0.47	0.43	0.33	0.30	0.32	0.32	0.34	0.35	0.33
East Twin Creek	SE-53	0.75	0.46	0.54	0.60	0.56	0.54	0.50	0.39	0.35	0.36	0.35	0.38	0.41	0.41
East Twin Creek	SE-53	0.50	0.66	0.74	0.79	0.72	0.62	0.55	0.43	0.38	0.39	0.39	0.43	0.51	0.54
East Twin Creek	SE-53	0.25	1.07	1.76	5.61	1.99	0.91	0.72	0.55	0.46	0.47	0.50	0.56	0.93	0.79
East Twin Creek	SE-53	0.05	86.50	111.53	76.73	12.60	2.68	1.22	0.90	0.75	0.79	2.71	26.84	38.99	15.41
East Twin Creek	SE-53	mean	15.85	25.62	16.85	3.86	1.37	0.66	0.51	1.37	1.74	2.14	7.02	11.68	7.29
East Twin Creek	SE-32	0.95	0.22	0.29	0.32	0.33	0.32	0.29	0.23	0.21	0.22	0.22	0.23	0.23	0.23
East Twin Creek	SE-32	0.75	0.31	0.36	0.40	0.37	0.36	0.33	0.26	0.23	0.24	0.23	0.25	0.27	0.27
East Twin Creek	SE-32	0.50	0.44	0.48	0.52	0.48	0.42	0.37	0.29	0.26	0.26	0.26	0.29	0.34	0.35
East Twin Creek	SE-32	0.25	0.70	1.25	4.27	1.28	0.59	0.48	0.36	0.31	0.31	0.32	0.36	0.62	0.52
East Twin Creek	SE-32	0.05	80.42	103.47	71.29	10.07	1.93	0.74	0.55	0.47	0.52	2.01	24.17	35.68	12.75
East Twin Creek	SE-32	mean	14.41	23.88	15.47	3.25	1.03	0.43	0.33	1.11	1.44	1.81	6.20	10.48	6.56
East Twin Creek	SE-21	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-21	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-21	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-21	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-21	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-21	mean	2.30	8.02	4.07	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.12	1.54	1.31
East Twin Creek	SE-19	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-19	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-19	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-19	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-19	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-19	mean	0.20	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.05
East Twin Creek	SE-17	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-17	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-17	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-17	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-17	0.05	0.00	21.55	41.54	3.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Twin Creek	SE-17	mean	2.67	9.98	7.92	1.14	0.03	0.00	0.00	0.00	0.02	0.00	0.28	1.74	1.94
East Twin Creek	SE-13	0.95	0.98	1.14	1.21	0.91	0.98	0.61	0.41	0.41	0.41	0.31	0.51	0.51	0.43
East Twin Creek	SE-13	0.75	2.12	2.32	2.52	2.12	1.71	1.01	0.61	0.51	0.51	0.61	0.91	1.30	1.01
East Twin Creek	SE-13	0.50	3.03	3.44	4.41	3.58	2.53	1.51	0.91	0.71	0.81	1.01	1.52	2.65	2.11
East Twin Creek	SE-13	0.25	5.25	6.62	12.77	8.76	5.51	3.63	2.32	1.77	1.84	2.01	2.81	4.22	4.22
East Twin Creek	SE-13	0.05	22.92	40.61	63.15	31.59	17.10	11.06	6.93	4.72	4.11	5.45	10.45	15.74	19.54
East Twin Creek	SE-13	mean	7.66	13.84	14.69	8.79	5.32	3.11	1.98	1.69	1.52	1.97	3.62	6.50	5.85
Little Sand Creek	SE-30	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-30	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-30	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-30	0.25	0.00	0.22	2.07	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-30	0.05	29.55	33.54	23.87	4.40	0.67	0.00	0.00	0.00	0.00	0.41	12.00	16.21	6.01
Little Sand Creek	SE-30	mean	4.17	5.46	4.20	1.19	0.25	0.00	0.00	0.26	0.39	0.54	2.08	3.01	1.78
Little Sand Creek	SE-29	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-29	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-29	0.50	0.05	0.22	0.46	0.22	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Little Sand Creek	SE-29	0.25	0.82	1.50	3.79	1.44	0.68	0.15	0.01	0.00	0.00	0.00	0.00	0.36	0.31
Little Sand Creek	SE-29	0.05	29.12	32.97	23.98	5.75	2.48	1.40	0.41	0.20	0.21	0.54	12.95	16.84	7.46
Little Sand Creek	SE-29	mean	4.30	5.75	4.67	1.77	0.68	0.21	0.07	0.28	0.40	0.57	2.10	3.09	1.97
Little Sand Creek	SE-28	0.95	0.18	0.34	0.42	0.45	0.44	0.41	0.35	0.30	0.27	0.23	0.20	0.19	0.24
Little Sand Creek	SE-28	0.75	0.34	0.56	0.64	0.56	0.52	0.47	0.41	0.35	0.31	0.26	0.24	0.26	0.36
Little Sand Creek	SE-28	0.50	0.75	0.92	1.14	0.93	0.66	0.54	0.45	0.39	0.34	0.30	0.30	0.40	0.51
Little Sand Creek	SE-28	0.25	1.38	2.17	4.50	2.10	1.36	0.85	0.62	0.49	0.44	0.43	0.45	0.92	0.97
Little Sand Creek	SE-28	0.05	31.31	35.26	26.07	6.35	3.16	2.12	1.12	0.85	0.87	1.01	14.13	18.46	8.14
Little Sand Creek	SE-28	mean	4.96	6.49	5.42	2.43	1.30	0.78	0.57	0.72	0.81	0.93	2.52	3.60	2.52
Little Sand Creek	SE-27	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-27	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-27	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-27	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-27	0.05	1.42	1.53	0.95	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.42	0.00
Little Sand Creek	SE-27	mean	0.29	0.51	0.21	0.03	0.01	0.00	0.00	0.02	0.02	0.03	0.10	0.16	0.11
Little Sand Creek	SE-76	0.95	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Little Sand Creek	SE-76	0.75	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Little Sand Creek	SE-76	0.50	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Little Sand Creek	SE-76	0.25	0.02	0.02	0.04	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Little Sand Creek	SE-76	0.05	0.59	0.62	0.52	0.10	0.03	0.02	0.02	0.02	0.02	0.02	0.28	0.35	0.13
Little Sand Creek	SE-76	mean	0.19	0.39	0.15	0.04	0.02	0.01	0.01	0.02	0.02	0.02	0.05	0.09	0.08
Little Sand Creek	SE-75	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-75	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-75	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-75	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-75	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Sand Creek	SE-75	mean	0.10	0.30	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04
Little Sand Creek	SE-23	0.95	0.02	0.05	0.09	0.07	0.06	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.03
Little Sand Creek	SE-23	0.75	0.06	0.14	0.18	0.12	0.09	0.07	0.05	0.04	0.04	0.03	0.03	0.03	0.05
Little Sand Creek	SE-23	0.50	0.25	0.30	0.39	0.31	0.16	0.10	0.07	0.06	0.05	0.04	0.04	0.06	0.10
Little Sand Creek	SE-23	0.25	0.45	0.96	1.07	1.02	0.57	0.25	0.14	0.09	0.08	0.06	0.07	0.20	0.29
Little Sand Creek	SE-23	0.05	1.73	3.73	3.88	2.38	1.44	0.75	0.31	0.19	0.17	0.17	0.48	1.20	1.59
Little Sand Creek	SE-23	mean	0.65	1.48	1.35	0.70	0.41	0.21	0.11	0.08	0.08	0.07	0.13	0.35	0.46
Little Sand Creek	SE-22	0.95	0.02	0.04	0.09	0.07	0.05	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02
Little Sand Creek	SE-22	0.75	0.05	0.13	0.17	0.12	0.09	0.06	0.05	0.04	0.03	0.03	0.02	0.03	0.04
Little Sand Creek	SE-22	0.50	0.22	0.28	0.36	0.30	0.16	0.10	0.07	0.05	0.04	0.04	0.03	0.06	0.09
Little Sand Creek	SE-22	0.25	0.41	0.93	0.99	1.00	0.55	0.24	0.14	0.09	0.07	0.06	0.06	0.16	0.27
Little Sand Creek	SE-22	0.05	1.45	3.67	3.71	2.33	1.41	0.73	0.30	0.19	0.15	0.15	0.31	1.06	1.45
Little Sand Creek	SE-22	mean	0.60	1.42	1.30	0.67	0.39	0.20	0.11	0.08	0.07	0.06	0.09	0.31	0.44
Lytle Creek	NW-28	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-28	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-28	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-28	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-28	0.05	0.00	37.05	48.62	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-28	mean	18.17	26.60	16.73	1.17	0.37	0.00	0.00	0.01	0.23	0.00	3.23	3.89	5.76

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Lytle Creek	NW-26	0.95	0.16	0.30	0.36	0.40	0.39	0.35	0.30	0.25	0.21	0.18	0.18	0.17	0.20
Lytle Creek	NW-26	0.75	0.32	0.46	0.57	0.53	0.51	0.45	0.38	0.32	0.27	0.22	0.20	0.21	0.33
Lytle Creek	NW-26	0.50	0.62	0.80	0.98	0.83	0.65	0.53	0.44	0.36	0.31	0.26	0.27	0.38	0.50
Lytle Creek	NW-26	0.25	1.49	2.35	6.04	2.33	1.33	0.87	0.67	0.51	0.46	0.47	0.50	1.06	1.03
Lytle Creek	NW-26	0.05	44.11	52.78	56.36	11.51	4.22	2.47	1.57	1.17	1.07	1.86	17.56	23.89	14.51
Lytle Creek	NW-26	mean	19.74	25.70	18.21	3.18	1.49	0.84	0.63	0.85	0.96	1.12	5.20	5.83	6.89
Lytle Creek	NW-20	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-20	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-20	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-20	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-20	0.05	0.00	5.19	29.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lytle Creek	NW-20	mean	11.61	12.42	9.67	0.23	0.00	0.00	0.00	0.00	0.00	0.00	2.10	0.76	3.02
Lytle Creek Channel	NW-29	0.95	0.06	0.08	0.09	0.10	0.10	0.10	0.09	0.09	0.08	0.07	0.07	0.06	0.07
Lytle Creek Channel	NW-29	0.75	0.08	0.10	0.11	0.11	0.11	0.11	0.10	0.09	0.09	0.08	0.07	0.07	0.09
Lytle Creek Channel	NW-29	0.50	0.11	0.12	0.14	0.13	0.12	0.12	0.11	0.10	0.09	0.08	0.08	0.09	0.11
Lytle Creek Channel	NW-29	0.25	0.17	0.22	1.17	0.27	0.16	0.14	0.13	0.11	0.10	0.10	0.10	0.14	0.14
Lytle Creek Channel	NW-29	0.05	23.19	51.79	50.95	10.41	2.53	0.22	0.18	0.16	0.15	0.28	7.53	10.30	7.88
Lytle Creek Channel	NW-29	mean	20.55	29.07	18.77	1.95	0.68	0.14	0.12	0.25	0.54	0.40	4.48	5.56	6.76
Mill Creek	SE-56	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mill Creek	SE-56	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mill Creek	SE-56	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mill Creek	SE-56	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mill Creek	SE-56	0.05	0.00	31.32	220.39	236.57	291.71	115.44	28.33	0.00	0.00	0.00	0.00	1.45	79.36
Mill Creek	SE-56	mean	17.84	24.22	38.77	35.44	35.77	18.15	3.20	0.23	1.42	0.03	4.09	7.97	15.54
Mission Creek	SE-73	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mission Creek	SE-73	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mission Creek	SE-73	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mission Creek	SE-73	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mission Creek	SE-73	0.05	76.15	83.31	54.98	6.54	0.00	0.00	0.00	0.00	0.00	0.08	20.07	35.03	7.86
Mission Creek	SE-73	mean	10.54	12.38	8.55	2.14	0.39	0.00	0.00	0.78	1.07	1.37	5.51	7.90	4.18
Mission Creek	SE-62	0.95	0.15	0.43	0.56	0.62	0.66	0.64	0.56	0.47	0.40	0.29	0.25	0.20	0.32
Mission Creek	SE-62	0.75	0.47	0.67	0.84	0.83	0.86	0.79	0.69	0.58	0.49	0.40	0.33	0.33	0.56
Mission Creek	SE-62	0.50	0.85	1.09	1.22	1.18	1.04	0.92	0.79	0.67	0.58	0.48	0.44	0.58	0.81
Mission Creek	SE-62	0.25	1.65	2.30	5.08	2.36	1.69	1.34	1.09	0.86	0.75	0.76	0.74	1.31	1.37
Mission Creek	SE-62	0.05	60.43	64.49	46.91	9.01	3.63	2.56	1.97	1.57	1.47	2.01	23.98	32.88	11.41
Mission Creek	SE-62	mean	8.83	10.52	8.57	3.53	1.81	1.18	0.98	1.34	1.48	1.69	4.81	6.68	4.25
Mission Creek	SE-61	0.95	0.87	1.14	1.27	1.32	1.37	1.35	1.27	1.19	1.11	1.00	0.96	0.91	1.03
Mission Creek	SE-61	0.75	1.17	1.37	1.54	1.53	1.56	1.50	1.40	1.30	1.21	1.11	1.05	1.04	1.27
Mission Creek	SE-61	0.50	1.54	1.77	1.90	1.87	1.73	1.62	1.50	1.38	1.29	1.19	1.15	1.27	1.51
Mission Creek	SE-61	0.25	2.22	2.83	5.46	2.86	2.35	2.02	1.79	1.57	1.46	1.46	1.44	1.92	2.02
Mission Creek	SE-61	0.05	56.72	59.43	43.48	8.95	4.20	3.19	2.63	2.25	2.12	2.28	22.69	30.49	10.96
Mission Creek	SE-61	mean	8.76	10.41	8.59	4.00	2.44	1.87	1.68	1.99	2.11	2.29	5.09	6.79	4.64
Mission Creek	SE-60	0.95	0.85	1.12	1.24	1.29	1.34	1.32	1.25	1.17	1.09	0.98	0.94	0.89	1.00
Mission Creek	SE-60	0.75	1.14	1.33	1.50	1.50	1.53	1.46	1.38	1.27	1.18	1.09	1.02	1.02	1.24
Mission Creek	SE-60	0.50	1.49	1.71	1.84	1.81	1.70	1.58	1.47	1.36	1.26	1.16	1.12	1.24	1.47

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Mission Creek	SE-60	0.25	2.06	2.67	5.25	2.76	2.29	1.98	1.75	1.54	1.42	1.41	1.39	1.77	1.93
Mission Creek	SE-60	0.05	53.93	56.69	40.93	8.31	4.08	3.11	2.57	2.20	2.04	2.17	21.60	28.99	10.31
Mission Creek	SE-60	mean	8.29	9.91	8.16	3.84	2.37	1.83	1.64	1.93	2.03	2.19	4.82	6.41	4.43
Plunge Creek	SE-57	0.95	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Plunge Creek	SE-57	0.75	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Plunge Creek	SE-57	0.50	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01
Plunge Creek	SE-57	0.25	0.04	0.07	0.09	0.06	0.04	0.02	0.02	0.01	0.01	0.01	0.02	0.03	0.03
Plunge Creek	SE-57	0.05	12.39	128.89	170.62	21.53	0.34	0.18	0.11	0.09	0.07	0.06	0.07	0.15	0.61
Plunge Creek	SE-57	mean	18.86	50.06	34.12	4.31	0.42	0.04	0.02	0.09	0.25	0.09	3.16	9.82	9.89
Plunge Creek	SE-48	0.95	0.15	0.23	0.26	0.21	0.20	0.12	0.10	0.09	0.08	0.08	0.09	0.12	0.10
Plunge Creek	SE-48	0.75	0.31	0.40	0.49	0.38	0.29	0.18	0.12	0.11	0.10	0.11	0.12	0.20	0.16
Plunge Creek	SE-48	0.50	0.48	0.61	1.12	0.56	0.38	0.24	0.16	0.13	0.13	0.16	0.20	0.33	0.32
Plunge Creek	SE-48	0.25	1.42	3.18	6.71	4.94	1.96	0.52	0.34	0.26	0.21	0.23	0.40	0.77	0.70
Plunge Creek	SE-48	0.05	19.29	80.00	81.80	17.08	7.23	3.35	1.07	0.69	0.58	0.55	1.98	6.39	10.34
Plunge Creek	SE-48	mean	9.23	20.03	16.18	4.50	1.80	0.73	0.32	0.26	0.42	0.28	2.30	6.07	5.10
Plunge Creek	SE-45	0.95	0.40	0.55	0.65	0.50	0.42	0.20	0.13	0.12	0.10	0.12	0.13	0.27	0.15
Plunge Creek	SE-45	0.75	0.77	1.04	1.22	0.94	0.64	0.37	0.20	0.17	0.17	0.22	0.30	0.52	0.32
Plunge Creek	SE-45	0.50	1.24	1.53	2.93	1.42	0.95	0.55	0.30	0.25	0.25	0.35	0.45	0.85	0.75
Plunge Creek	SE-45	0.25	3.74	7.58	15.14	10.66	5.61	1.22	0.70	0.49	0.42	0.50	0.91	1.70	1.57
Plunge Creek	SE-45	0.05	36.04	87.53	90.15	28.06	13.35	7.10	2.22	1.25	1.07	1.12	4.99	14.14	19.25
Plunge Creek	SE-45	mean	11.26	21.99	19.69	7.64	3.61	1.60	0.63	0.46	0.75	0.55	3.02	7.55	6.48
Rialto Channel/Cactus Channel	NFRC06	0.95	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Rialto Channel/Cactus Channel	NFRC06	0.75	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Rialto Channel/Cactus Channel	NFRC06	0.50	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Rialto Channel/Cactus Channel	NFRC06	0.25	8.85	8.10	11.60	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.30	7.00
Rialto Channel/Cactus Channel	NFRC06	0.05	145.16	131.58	100.87	29.84	7.70	7.00	7.00	7.00	7.46	12.66	90.21	102.07	44.35
Rialto Channel/Cactus Channel	NFRC06	mean	27.39	29.83	25.57	11.39	8.00	7.05	7.09	8.03	8.66	9.13	19.74	23.69	15.40
San Sevaine Creek	NSS31	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
San Sevaine Creek	NSS31	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
San Sevaine Creek	NSS31	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
San Sevaine Creek	NSS31	0.25	0.90	1.15	1.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
San Sevaine Creek	NSS31	0.05	273.36	265.38	182.54	7.66	0.20	0.00	0.00	0.00	0.25	1.03	132.88	155.17	24.10
San Sevaine Creek	NSS31	mean	51.39	50.65	35.34	5.15	1.02	0.04	0.16	1.04	1.94	2.44	21.81	30.22	16.62
San Timoteo Wash	SE-79	0.95	0.08	0.25	0.37	0.45	0.48	0.47	0.42	0.36	0.30	0.22	0.15	0.11	0.21
San Timoteo Wash	SE-79	0.75	0.41	0.45	0.64	0.62	0.65	0.60	0.51	0.43	0.37	0.29	0.24	0.24	0.45
San Timoteo Wash	SE-79	0.50	0.74	0.84	1.19	1.03	0.91	0.81	0.62	0.55	0.49	0.43	0.46	0.52	0.69
San Timoteo Wash	SE-79	0.25	1.77	2.04	4.49	2.36	1.62	1.25	0.99	0.86	0.78	0.76	1.24	1.53	1.36
San Timoteo Wash	SE-79	0.05	54.71	56.48	48.73	8.12	3.19	2.41	1.99	1.50	1.82	2.99	18.55	31.84	11.08
San Timoteo Wash	SE-79	mean	10.77	15.30	9.00	2.79	1.75	1.08	0.87	1.06	1.38	1.37	4.70	7.23	4.72
San Timoteo Wash	SE-77	0.95	0.10	0.13	0.15	0.15	0.15	0.15	0.14	0.13	0.13	0.12	0.11	0.11	0.12
San Timoteo Wash	SE-77	0.75	0.13	0.16	0.17	0.17	0.17	0.17	0.16	0.15	0.14	0.13	0.12	0.12	0.14
San Timoteo Wash	SE-77	0.50	0.18	0.20	0.22	0.21	0.19	0.18	0.17	0.15	0.15	0.14	0.13	0.15	0.17
San Timoteo Wash	SE-77	0.25	0.28	0.37	0.81	0.36	0.26	0.22	0.19	0.17	0.16	0.16	0.16	0.23	0.23
San Timoteo Wash	SE-77	0.05	8.49	8.55	6.72	1.42	0.55	0.36	0.28	0.23	0.23	0.31	3.74	4.91	1.73
San Timoteo Wash	SE-77	mean	1.26	1.41	1.21	0.54	0.30	0.21	0.18	0.23	0.26	0.29	0.73	0.98	0.63

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
San Timoteo Wash	SE-68	0.95	0.19	0.24	0.28	0.29	0.29	0.29	0.26	0.24	0.24	0.22	0.21	0.20	0.22
San Timoteo Wash	SE-68	0.75	0.30	0.30	0.36	0.35	0.35	0.32	0.29	0.27	0.26	0.24	0.23	0.24	0.29
San Timoteo Wash	SE-68	0.50	0.42	0.45	0.57	0.49	0.47	0.42	0.34	0.30	0.29	0.29	0.32	0.33	0.38
San Timoteo Wash	SE-68	0.25	1.00	0.99	2.30	1.14	0.89	0.69	0.57	0.50	0.45	0.48	0.71	0.79	0.70
San Timoteo Wash	SE-68	0.05	32.78	42.53	24.81	4.18	1.72	1.39	1.07	0.86	1.14	1.80	9.86	17.63	5.66
San Timoteo Wash	SE-68	mean	7.69	11.84	5.98	1.45	1.02	0.58	0.47	0.57	0.86	0.80	3.00	4.89	3.22
San Timoteo Wash	SE-64	0.95	0.10	0.13	0.14	0.15	0.16	0.15	0.14	0.13	0.13	0.12	0.11	0.10	0.12
San Timoteo Wash	SE-64	0.75	0.16	0.16	0.19	0.19	0.19	0.17	0.16	0.14	0.14	0.13	0.12	0.12	0.15
San Timoteo Wash	SE-64	0.50	0.24	0.25	0.36	0.29	0.29	0.24	0.19	0.17	0.16	0.15	0.17	0.18	0.22
San Timoteo Wash	SE-64	0.25	0.73	0.70	1.56	0.80	0.66	0.50	0.38	0.33	0.32	0.35	0.54	0.60	0.49
San Timoteo Wash	SE-64	0.05	24.05	36.81	18.24	2.65	1.34	1.12	0.84	0.70	0.97	1.43	6.41	11.77	3.87
San Timoteo Wash	SE-64	mean	6.63	10.64	4.96	0.98	0.77	0.40	0.31	0.37	0.64	0.54	2.38	4.07	2.68
San Timoteo Wash	SE-63	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
San Timoteo Wash	SE-63	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
San Timoteo Wash	SE-63	0.50	0.01	0.01	0.14	0.03	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01
San Timoteo Wash	SE-63	0.25	0.39	0.36	0.63	0.33	0.25	0.21	0.14	0.11	0.12	0.20	0.39	0.39	0.25
San Timoteo Wash	SE-63	0.05	19.84	28.99	14.23	1.18	1.01	0.76	0.55	0.52	0.72	1.02	3.11	5.54	2.11
San Timoteo Wash	SE-63	mean	5.65	9.53	3.98	0.49	0.47	0.17	0.12	0.15	0.39	0.28	1.80	3.30	2.16
Sand Creek	SE-33	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-33	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-33	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-33	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-33	0.05	0.00	1.14	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-33	mean	0.66	2.08	1.24	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.35
Sand Creek	SE-18	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-18	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-18	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-18	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-18	0.05	0.00	5.63	4.80	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Creek	SE-18	mean	0.78	2.42	1.75	0.19	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.33	0.45
Santa Ana River	NSAR381	0.95	156.47	115.60	104.37	85.20	64.80	46.90	39.10	38.70	43.00	56.40	77.60	98.00	39.10
Santa Ana River	NSAR381	0.75	159.55	117.10	108.95	89.90	69.00	49.10	39.90	38.75	44.80	59.90	81.43	103.20	49.80
Santa Ana River	NSAR381	0.50	161.50	119.45	113.40	95.80	74.40	52.50	41.40	39.00	47.20	64.10	87.90	107.30	84.10
Santa Ana River	NSAR381	0.25	234.60	225.65	304.75	134.08	80.10	56.70	43.20	39.90	50.20	68.90	96.75	139.05	119.90
Santa Ana River	NSAR381	0.05	3784.19	3182.13	2205.10	616.48	382.35	78.86	45.10	42.63	78.91	136.17	1379.22	2044.33	908.45
Santa Ana River	NSAR381	mean	800.48	881.80	666.19	214.98	128.75	60.25	42.82	56.43	78.08	95.79	339.50	475.78	317.43
Santa Ana River	NSAR38	0.95	99.80	61.20	57.90	51.89	45.10	39.70	36.60	36.30	37.20	41.10	47.30	53.90	36.50
Santa Ana River	NSAR38	0.75	101.20	61.70	59.90	53.90	46.80	40.60	36.90	36.40	37.80	42.60	48.80	56.30	40.30
Santa Ana River	NSAR38	0.50	102.40	63.70	62.30	56.20	48.80	42.00	37.60	36.50	38.70	44.10	51.60	57.90	50.90
Santa Ana River	NSAR38	0.25	127.75	100.45	149.70	67.65	51.20	43.70	38.50	36.70	39.80	45.80	54.85	66.80	63.90
Santa Ana River	NSAR38	0.05	1541.89	1606.10	1393.48	496.21	349.88	63.18	39.30	37.30	45.23	64.07	655.10	1041.99	471.75
Santa Ana River	NSAR38	mean	447.85	541.35	384.95	131.06	93.60	48.63	38.50	46.79	53.90	58.94	175.15	252.74	187.75
Santa Ana River	NSAR37	0.95	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Santa Ana River	NSAR37	0.75	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Santa Ana River	NSAR37	0.50	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Santa Ana River	NSAR37	0.25	48.00	2.30	3.40	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Santa Ana River	NSAR37	0.05	284.36	548.50	502.33	175.45	60.20	8.92	2.30	2.30	2.30	2.40	47.16	112.69	66.00
Santa Ana River	NSAR37	mean	140.58	142.35	97.07	25.94	9.39	3.45	2.42	3.99	4.48	4.48	29.43	45.34	41.95
Santa Ana River	NSAR36	0.95	59.40	61.20	57.90	51.80	45.10	39.70	36.60	36.30	37.20	41.10	47.30	53.90	36.50
Santa Ana River	NSAR36	0.75	60.80	61.70	59.90	53.63	46.80	40.60	36.90	36.40	37.80	42.60	48.80	56.30	40.30
Santa Ana River	NSAR36	0.50	62.00	63.70	62.20	55.80	48.80	42.00	37.60	36.50	38.70	44.10	51.60	57.90	50.70
Santa Ana River	NSAR36	0.25	86.15	98.60	132.00	60.68	51.15	43.50	38.50	36.70	39.80	45.80	54.85	66.45	61.50
Santa Ana River	NSAR36	0.05	1298.68	1358.38	917.18	327.47	304.78	54.58	39.30	37.30	44.57	63.36	552.36	765.02	378.75
Santa Ana River	NSAR36	mean	316.35	404.27	292.49	108.62	87.17	47.85	38.41	45.16	51.84	56.96	148.65	210.98	149.49
Santa Ana River	NSAR352	0.95	59.40	61.20	57.90	51.80	45.10	39.70	36.60	36.30	37.20	41.10	47.30	53.90	36.50
Santa Ana River	NSAR352	0.75	60.80	61.70	59.90	53.63	46.80	40.60	36.90	36.40	37.80	42.60	48.80	56.30	40.30
Santa Ana River	NSAR352	0.50	62.00	63.70	62.20	55.80	48.80	42.00	37.60	36.50	38.70	44.10	51.60	57.90	50.70
Santa Ana River	NSAR352	0.25	86.15	98.60	131.70	60.68	51.15	43.50	38.50	36.70	39.80	45.80	54.85	66.40	61.50
Santa Ana River	NSAR352	0.05	1295.98	1354.10	917.18	327.47	304.78	54.58	39.30	37.30	44.57	63.36	549.45	761.52	377.55
Santa Ana River	NSAR352	mean	315.58	403.43	291.86	108.52	87.16	47.85	38.41	45.14	51.80	56.92	148.28	210.50	149.21
Santa Ana River	NSAR351	0.95	59.40	61.20	57.90	51.80	45.10	39.70	36.60	36.30	37.20	41.10	47.30	53.90	36.50
Santa Ana River	NSAR351	0.75	60.80	61.70	59.90	53.63	46.80	40.60	36.90	36.40	37.80	42.60	48.80	56.30	40.30
Santa Ana River	NSAR351	0.50	62.00	63.70	62.20	55.80	48.80	42.00	37.60	36.50	38.70	44.10	51.60	57.90	50.70
Santa Ana River	NSAR351	0.25	85.50	96.73	128.80	60.68	51.10	43.50	38.50	36.70	39.80	45.80	54.85	66.35	61.50
Santa Ana River	NSAR351	0.05	1286.88	1332.75	917.18	326.94	304.78	54.58	39.30	37.30	44.57	63.36	526.08	751.57	367.30
Santa Ana River	NSAR351	mean	310.98	398.51	288.09	107.75	87.01	47.85	38.40	44.97	51.51	56.62	145.88	207.59	147.54
Santa Ana River	NSAR35	0.95	59.40	61.20	57.90	51.80	45.10	39.70	36.60	36.30	37.20	41.10	47.30	53.90	36.50
Santa Ana River	NSAR35	0.75	60.80	61.70	59.90	53.63	46.80	40.60	36.90	36.40	37.80	42.60	48.80	56.30	40.30
Santa Ana River	NSAR35	0.50	62.00	63.70	62.20	55.80	48.80	42.00	37.60	36.50	38.70	44.10	51.60	57.90	50.70
Santa Ana River	NSAR35	0.25	85.50	96.73	128.80	60.68	51.10	43.50	38.50	36.70	39.80	45.80	54.85	66.35	61.50
Santa Ana River	NSAR35	0.05	1286.88	1332.75	917.18	326.94	304.78	54.58	39.30	37.30	44.57	63.36	526.08	751.57	367.30
Santa Ana River	NSAR35	mean	310.98	398.51	288.09	107.75	87.01	47.85	38.40	44.97	51.51	56.62	145.88	207.59	147.54
Santa Ana River	NSAR34	0.95	59.40	61.20	57.90	51.80	45.10	39.70	36.60	36.30	37.20	41.10	47.30	53.90	36.50
Santa Ana River	NSAR34	0.75	60.80	61.70	59.90	53.63	46.80	40.60	36.90	36.40	37.80	42.60	48.80	56.30	40.30
Santa Ana River	NSAR34	0.50	62.00	63.70	62.20	55.80	48.80	42.00	37.60	36.50	38.70	44.10	51.60	57.90	50.70
Santa Ana River	NSAR34	0.25	85.50	96.73	128.80	60.68	51.10	43.50	38.50	36.70	39.80	45.80	54.85	66.35	61.50
Santa Ana River	NSAR34	0.05	1286.88	1332.75	917.18	326.94	304.78	54.58	39.30	37.30	44.57	63.36	526.08	751.57	367.30
Santa Ana River	NSAR34	mean	310.98	398.51	288.09	107.75	87.01	47.85	38.40	44.97	51.51	56.62	145.88	207.59	147.54
Santa Ana River	NSAR332	0.95	60.50	62.30	58.90	52.90	46.20	40.70	37.70	37.40	38.20	42.20	48.30	54.90	37.50
Santa Ana River	NSAR332	0.75	61.90	62.70	60.90	54.70	47.90	41.70	38.00	37.40	38.80	43.60	49.80	57.35	41.30
Santa Ana River	NSAR332	0.50	63.10	64.80	63.20	56.90	49.80	43.10	38.60	37.50	39.80	45.20	52.60	58.90	51.80
Santa Ana River	NSAR332	0.25	86.45	97.80	129.90	61.78	52.15	44.60	39.50	37.70	40.90	46.80	55.88	67.35	62.50
Santa Ana River	NSAR332	0.05	1280.45	1327.60	920.01	328.14	305.88	55.62	40.30	38.33	45.57	64.39	518.15	744.53	363.95
Santa Ana River	NSAR332	mean	309.30	396.38	286.90	108.40	87.99	48.91	39.45	45.94	52.41	57.56	145.57	206.85	147.59
Santa Ana River	NSAR331	0.95	62.30	64.20	60.80	54.70	48.00	42.60	39.50	39.20	40.00	44.00	50.20	56.80	39.40
Santa Ana River	NSAR331	0.75	63.80	64.60	62.80	56.53	49.70	43.50	39.80	39.20	40.70	45.40	51.70	59.20	43.20
Santa Ana River	NSAR331	0.50	64.90	66.60	65.10	58.70	51.70	44.90	40.50	39.30	41.60	47.00	54.50	60.80	53.60
Santa Ana River	NSAR331	0.25	88.30	99.70	131.80	63.60	54.00	46.40	41.30	39.50	42.70	48.70	57.78	69.20	64.40
Santa Ana River	NSAR331	0.05	1301.18	1350.23	926.50	330.20	307.98	57.48	42.10	40.13	47.42	66.29	520.31	746.80	366.05
Santa Ana River	NSAR331	mean	313.05	400.53	290.39	110.47	89.89	50.74	41.28	47.84	54.34	59.48	148.19	209.85	150.12

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Santa Ana River	NSAR33	0.95	66.60	68.50	65.10	59.00	52.30	46.80	43.70	43.40	44.30	48.30	54.40	61.10	43.60
Santa Ana River	NSAR33	0.75	68.10	68.90	67.10	60.83	54.00	47.80	44.10	43.50	44.90	49.70	56.00	63.50	47.40
Santa Ana River	NSAR33	0.50	69.20	70.95	69.40	63.00	56.00	49.20	44.70	43.60	45.90	51.30	58.80	65.10	57.90
Santa Ana River	NSAR33	0.25	92.65	104.10	136.20	67.90	58.30	50.70	45.60	43.80	47.00	52.90	62.05	73.55	68.70
Santa Ana River	NSAR33	0.05	1316.38	1368.98	931.63	334.84	312.58	61.78	46.40	44.43	51.67	70.59	525.16	751.83	370.75
Santa Ana River	NSAR33	mean	319.27	407.40	296.49	114.94	94.24	55.02	45.53	52.18	58.70	63.84	153.20	215.29	155.11
Santa Ana River	NSAR321	0.95	68.60	70.63	67.20	61.20	54.50	49.10	46.00	45.70	46.50	50.50	56.70	63.30	45.80
Santa Ana River	NSAR321	0.75	69.70	71.00	68.50	62.90	56.20	50.00	46.30	45.70	47.20	51.80	58.20	64.90	49.55
Santa Ana River	NSAR321	0.50	70.60	71.20	69.90	64.90	58.20	51.40	47.00	45.80	48.10	53.30	60.40	66.70	60.00
Santa Ana River	NSAR321	0.25	78.40	77.78	105.25	66.68	60.40	52.90	47.80	46.00	49.18	55.20	62.38	68.40	70.00
Santa Ana River	NSAR321	0.05	991.25	1122.60	801.31	329.71	313.04	64.02	48.60	46.40	50.86	67.00	474.86	620.89	344.70
Santa Ana River	NSAR321	mean	269.82	362.92	262.71	111.28	95.26	57.22	47.75	53.74	60.06	64.74	140.06	191.99	142.03
Santa Ana River	NSAR32	0.95	68.40	70.43	66.90	61.00	54.30	48.80	45.70	45.40	46.30	50.20	56.40	63.10	45.60
Santa Ana River	NSAR32	0.75	69.50	70.80	68.30	62.70	56.00	49.70	46.00	45.40	46.90	51.50	58.00	64.70	49.30
Santa Ana River	NSAR32	0.50	70.40	70.90	69.70	64.70	58.00	51.10	46.70	45.50	47.80	53.10	60.10	66.40	59.70
Santa Ana River	NSAR32	0.25	78.20	77.58	105.10	66.38	60.10	52.70	47.60	45.70	48.90	54.90	62.10	68.15	69.80
Santa Ana River	NSAR32	0.05	990.91	1116.53	800.12	329.76	313.04	63.78	48.40	46.10	50.56	66.77	473.96	617.92	344.45
Santa Ana River	NSAR32	mean	270.22	363.61	263.17	111.06	95.03	56.98	47.48	53.51	59.82	64.53	139.93	192.16	142.02
Santa Ana River	NSAR311	0.95	71.30	73.33	69.77	63.90	57.20	51.70	48.60	48.30	49.20	53.10	59.30	66.00	48.50
Santa Ana River	NSAR311	0.75	72.40	73.70	71.10	65.60	58.90	52.60	48.90	48.30	49.80	54.40	60.90	67.60	52.20
Santa Ana River	NSAR311	0.50	73.30	73.90	72.60	67.60	60.90	54.00	49.60	48.40	50.65	56.00	62.80	69.40	62.60
Santa Ana River	NSAR311	0.25	78.05	77.65	103.45	69.20	63.10	55.60	50.50	48.60	51.70	57.80	65.00	70.90	72.60
Santa Ana River	NSAR311	0.05	746.50	826.08	726.43	332.79	315.89	65.21	51.30	49.00	52.80	67.64	344.80	502.95	317.55
Santa Ana River	NSAR311	mean	221.83	316.41	231.07	108.75	96.93	59.85	50.21	55.41	60.79	65.00	120.94	164.88	128.38
Santa Ana River	NSAR31	0.95	73.60	75.63	72.07	66.20	59.50	54.00	50.80	50.50	51.40	55.40	61.60	68.30	50.70
Santa Ana River	NSAR31	0.75	74.70	76.00	73.40	67.90	61.20	54.90	51.20	50.60	52.10	56.70	63.10	69.90	54.40
Santa Ana River	NSAR31	0.50	75.60	76.20	74.90	69.90	63.10	56.30	51.80	50.70	52.95	58.20	65.10	71.70	64.90
Santa Ana River	NSAR31	0.25	80.35	79.95	105.75	71.50	65.30	57.80	52.70	50.90	54.00	60.10	67.30	73.20	74.90
Santa Ana River	NSAR31	0.05	749.37	828.98	729.26	335.35	318.42	67.51	53.50	51.30	55.10	69.94	347.36	505.65	320.10
Santa Ana River	NSAR31	mean	224.55	319.44	233.87	111.10	99.25	62.11	52.47	57.70	63.09	67.28	123.37	167.45	130.85
Santa Ana River	NSAR301	0.95	79.70	81.70	78.10	72.20	65.40	59.90	56.80	56.50	57.40	61.40	67.60	74.30	56.70
Santa Ana River	NSAR301	0.75	80.65	82.10	79.40	73.90	67.20	60.90	57.10	56.50	58.00	62.60	69.10	75.90	60.40
Santa Ana River	NSAR301	0.50	81.60	82.20	80.90	75.90	69.10	62.30	57.80	56.60	58.85	64.20	71.10	77.70	70.90
Santa Ana River	NSAR301	0.25	86.40	86.03	111.20	77.50	71.30	63.80	58.70	56.80	59.90	66.10	73.30	79.20	80.90
Santa Ana River	NSAR301	0.05	730.96	819.80	733.26	340.16	325.12	73.51	59.50	57.20	61.00	75.73	335.04	491.71	325.85
Santa Ana River	NSAR301	mean	228.03	322.40	237.69	116.52	105.19	68.08	58.39	63.56	68.82	73.01	127.77	171.71	135.82
Santa Ana River	NSAR30	0.95	79.20	81.23	77.60	71.80	65.00	59.40	56.30	56.00	56.90	60.90	67.10	73.90	56.20
Santa Ana River	NSAR30	0.75	80.25	81.60	78.90	73.50	66.70	60.40	56.60	56.00	57.50	62.20	68.70	75.50	59.90
Santa Ana River	NSAR30	0.50	81.20	81.80	80.50	75.50	68.70	61.80	57.30	56.10	58.35	63.70	70.70	77.20	70.40
Santa Ana River	NSAR30	0.25	86.00	85.63	110.80	77.10	70.90	63.30	58.20	56.30	59.40	65.60	72.80	78.80	80.50
Santa Ana River	NSAR30	0.05	731.16	820.00	733.46	340.06	325.02	73.11	59.00	56.70	60.60	75.26	334.94	491.71	325.75
Santa Ana River	NSAR30	mean	228.08	322.82	237.84	116.15	104.78	67.61	57.91	63.10	68.38	72.57	127.48	171.58	135.57
Santa Ana River	NSAR29	0.95	80.30	82.40	78.77	72.90	66.10	60.50	57.40	57.10	58.00	62.00	68.20	75.00	57.30
Santa Ana River	NSAR29	0.75	81.35	82.80	80.10	74.60	67.80	61.50	57.80	57.10	58.60	63.30	69.80	76.60	61.00
Santa Ana River	NSAR29	0.50	82.30	82.90	81.60	76.60	69.80	62.90	58.40	57.20	59.45	64.80	71.80	78.40	71.60

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Santa Ana River	NSAR29	0.25	87.10	86.73	111.95	78.20	72.00	64.40	59.30	57.50	60.50	66.70	73.90	79.90	81.60
Santa Ana River	NSAR29	0.05	732.53	821.40	734.76	341.26	326.22	74.21	60.10	57.80	61.70	76.43	336.14	493.01	326.95
Santa Ana River	NSAR29	mean	229.27	324.08	239.05	117.28	105.91	68.72	59.02	64.22	69.48	73.69	128.63	172.75	136.72
Santa Ana River	NSAR28	0.95	82.10	84.10	80.50	74.60	67.80	62.30	59.10	58.80	59.70	63.70	70.00	76.70	59.00
Santa Ana River	NSAR28	0.75	83.10	84.50	81.80	76.30	69.50	63.20	59.50	58.90	60.30	65.00	71.50	78.30	62.70
Santa Ana River	NSAR28	0.50	84.00	84.60	83.40	78.30	71.50	64.60	60.10	59.00	61.20	66.60	73.50	80.10	73.30
Santa Ana River	NSAR28	0.25	88.80	88.45	113.20	79.90	73.70	66.20	61.00	59.20	62.30	68.40	75.70	81.70	83.40
Santa Ana River	NSAR28	0.05	722.02	821.15	732.45	341.91	328.12	75.91	61.80	59.50	63.40	78.06	332.49	486.87	328.10
Santa Ana River	NSAR28	mean	229.82	324.56	239.78	118.73	107.60	70.45	60.71	65.88	71.08	75.27	129.67	173.70	137.99
Santa Ana River	NSAR27	0.95	80.60	82.63	79.00	73.10	66.30	60.80	57.60	57.30	58.20	62.20	68.50	75.20	57.50
Santa Ana River	NSAR27	0.75	81.65	83.00	80.30	74.80	68.10	61.70	58.00	57.40	58.90	63.50	70.10	76.80	61.20
Santa Ana River	NSAR27	0.50	82.60	83.20	81.80	76.80	70.10	63.10	58.60	57.50	59.70	65.10	72.00	78.60	71.60
Santa Ana River	NSAR27	0.25	86.40	86.75	110.15	78.50	72.30	64.70	59.50	57.70	60.80	67.00	74.20	80.20	81.90
Santa Ana River	NSAR27	0.05	659.28	743.95	672.49	339.29	326.89	73.52	60.30	58.10	61.90	74.99	290.90	429.82	317.90
Santa Ana River	NSAR27	mean	217.71	310.14	228.34	114.38	105.61	68.91	59.15	63.22	68.57	72.62	122.16	165.25	132.10
Santa Ana River	NSAR25	0.95	64.40	66.43	62.80	56.90	50.10	44.50	41.30	41.00	41.90	46.00	52.20	59.00	41.20
Santa Ana River	NSAR25	0.75	65.45	66.90	64.10	58.60	51.80	45.40	41.70	41.10	42.60	47.20	53.80	60.60	45.00
Santa Ana River	NSAR25	0.50	66.40	67.00	65.60	60.60	53.80	46.90	42.30	41.20	43.40	48.80	55.80	62.40	55.40
Santa Ana River	NSAR25	0.25	70.20	70.58	94.05	62.30	56.00	48.40	43.20	41.40	44.50	50.70	58.00	64.00	65.70
Santa Ana River	NSAR25	0.05	644.48	729.25	657.69	323.83	311.42	57.28	44.00	41.70	45.60	58.79	275.40	414.52	302.40
Santa Ana River	NSAR25	mean	201.90	294.76	212.72	98.26	89.47	52.64	42.84	46.93	52.31	56.37	106.10	149.33	116.06
Santa Ana River	NSAR244	0.95	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
Santa Ana River	NSAR244	0.75	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
Santa Ana River	NSAR244	0.50	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
Santa Ana River	NSAR244	0.25	25.90	26.08	47.75	23.40	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.75	23.00
Santa Ana River	NSAR244	0.05	499.52	626.05	581.82	283.56	281.06	32.79	23.00	23.00	24.10	31.53	217.43	311.99	239.85
Santa Ana River	NSAR244	mean	147.58	235.26	158.81	59.06	58.91	28.82	23.31	27.96	30.87	29.74	67.80	103.63	80.19
Santa Ana River	NSAR243	0.95	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Santa Ana River	NSAR243	0.75	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Santa Ana River	NSAR243	0.50	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Santa Ana River	NSAR243	0.25	22.90	23.00	44.75	20.40	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.70	20.00
Santa Ana River	NSAR243	0.05	496.52	622.98	578.82	280.56	278.06	29.79	20.00	20.00	21.06	28.46	214.43	308.99	236.85
Santa Ana River	NSAR243	mean	144.57	232.26	155.80	56.05	55.90	25.82	20.31	24.96	27.87	26.74	64.80	100.62	77.19
Santa Ana River	NSAR242	0.95	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Santa Ana River	NSAR242	0.75	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Santa Ana River	NSAR242	0.50	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Santa Ana River	NSAR242	0.25	22.90	23.00	44.75	20.40	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.70	20.00
Santa Ana River	NSAR242	0.05	496.52	622.98	578.82	280.56	278.06	29.79	20.00	20.00	21.06	28.46	214.43	308.99	236.85
Santa Ana River	NSAR242	mean	144.57	232.26	155.80	56.05	55.90	25.82	20.31	24.96	27.87	26.74	64.80	100.62	77.19
Santa Ana River	NSAR241	0.95	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Santa Ana River	NSAR241	0.75	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Santa Ana River	NSAR241	0.50	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Santa Ana River	NSAR241	0.25	22.90	23.00	44.75	20.40	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.70	20.00
Santa Ana River	NSAR241	0.05	496.52	622.98	578.82	280.56	278.06	29.79	20.00	20.00	21.06	28.46	214.43	308.99	236.85
Santa Ana River	NSAR241	mean	144.57	232.26	155.80	56.05	55.90	25.82	20.31	24.96	27.87	26.74	64.80	100.62	77.19

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Santa Ana River	NSAR24	0.95	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Santa Ana River	NSAR24	0.75	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Santa Ana River	NSAR24	0.50	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Santa Ana River	NSAR24	0.25	21.90	22.00	43.70	19.40	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.70	19.00
Santa Ana River	NSAR24	0.05	495.52	621.98	577.82	279.46	277.03	28.79	19.00	19.00	20.06	27.46	213.43	307.99	235.85
Santa Ana River	NSAR24	mean	143.57	231.25	154.79	55.05	54.90	24.82	19.31	23.96	26.87	25.74	63.79	99.62	76.18
Santa Ana River	NSAR232	0.95	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Santa Ana River	NSAR232	0.75	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Santa Ana River	NSAR232	0.50	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Santa Ana River	NSAR232	0.25	18.75	18.95	39.65	16.40	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.65	16.00
Santa Ana River	NSAR232	0.05	470.04	610.05	541.18	276.46	271.79	24.66	16.00	16.00	16.91	23.84	178.80	278.25	218.20
Santa Ana River	NSAR232	mean	135.20	221.60	146.61	50.89	51.70	21.80	16.27	20.72	23.41	22.21	58.02	93.12	71.03
Santa Ana River	NSAR231	0.95	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Santa Ana River	NSAR231	0.75	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Santa Ana River	NSAR231	0.50	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Santa Ana River	NSAR231	0.25	18.75	18.95	39.65	16.40	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.65	16.00
Santa Ana River	NSAR231	0.05	470.04	610.05	541.18	276.46	271.79	24.66	16.00	16.00	16.91	23.84	178.80	278.25	218.20
Santa Ana River	NSAR231	mean	135.20	221.60	146.61	50.89	51.70	21.80	16.27	20.72	23.41	22.21	58.02	93.12	71.03
Santa Ana River	NSAR23	0.95	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Santa Ana River	NSAR23	0.75	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Santa Ana River	NSAR23	0.50	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Santa Ana River	NSAR23	0.25	18.75	18.95	39.65	16.40	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.65	16.00
Santa Ana River	NSAR23	0.05	470.04	610.05	541.18	276.46	271.79	24.66	16.00	16.00	16.91	23.84	178.80	278.25	218.20
Santa Ana River	NSAR23	mean	135.20	221.60	146.61	50.89	51.70	21.80	16.27	20.72	23.41	22.21	58.02	93.12	71.03
Santa Ana River	NSAR22	0.95	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80
Santa Ana River	NSAR22	0.75	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80
Santa Ana River	NSAR22	0.50	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80
Santa Ana River	NSAR22	0.25	22.55	22.75	43.50	20.10	19.80	19.80	19.80	19.80	19.80	19.80	19.80	20.45	19.80
Santa Ana River	NSAR22	0.05	481.14	651.10	567.53	280.86	276.19	28.46	19.80	19.80	20.67	27.71	183.06	282.65	222.50
Santa Ana River	NSAR22	mean	142.39	230.64	154.69	55.30	55.66	25.61	20.07	24.74	27.46	26.21	62.99	99.00	76.28
Santa Ana River	NSAR21	0.95	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Santa Ana River	NSAR21	0.75	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Santa Ana River	NSAR21	0.50	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Santa Ana River	NSAR21	0.25	24.20	24.88	44.80	22.30	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.55	22.00
Santa Ana River	NSAR21	0.05	461.71	658.38	563.49	283.46	278.69	30.39	22.00	22.00	22.66	29.43	172.78	261.13	220.45
Santa Ana River	NSAR21	mean	141.29	229.17	154.34	56.96	57.86	27.81	22.25	26.86	29.43	28.10	63.53	99.12	77.29
Santa Ana River	NSAR20	0.95	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60
Santa Ana River	NSAR20	0.75	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60
Santa Ana River	NSAR20	0.50	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60	33.60
Santa Ana River	NSAR20	0.25	35.80	36.28	55.10	33.90	33.60	33.60	33.60	33.60	33.60	33.60	33.60	34.05	33.60
Santa Ana River	NSAR20	0.05	471.45	705.58	600.58	293.30	292.09	42.05	33.60	33.60	34.10	39.96	164.99	250.26	222.60
Santa Ana River	NSAR20	mean	154.31	244.77	169.58	68.96	70.05	39.45	33.83	38.59	41.08	39.60	74.64	110.88	89.69
Santa Ana River	NSAR19	0.95	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90
Santa Ana River	NSAR19	0.75	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90
Santa Ana River	NSAR19	0.50	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Santa Ana River	NSAR19	0.25	8.10	8.60	27.45	6.28	5.90	5.90	5.90	5.90	5.90	5.90	5.90	6.40	5.90
Santa Ana River	NSAR19	0.05	444.04	679.65	573.98	265.70	264.49	14.40	5.90	5.90	6.46	12.29	137.39	222.66	195.05
Santa Ana River	NSAR19	mean	126.76	217.27	142.06	41.31	42.38	11.76	6.13	10.90	13.40	11.91	47.00	83.27	62.06
Santa Ana River	NSAR18	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR18	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR18	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR18	0.25	0.00	0.00	2.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR18	0.05	321.03	548.05	476.79	260.92	260.69	10.06	0.00	0.00	0.10	1.10	47.29	112.34	125.45
Santa Ana River	NSAR18	mean	101.51	189.86	118.91	31.55	35.88	5.94	0.15	4.05	5.95	4.05	28.89	61.43	48.29
Santa Ana River	NSAR17	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR17	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR17	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR17	0.25	0.00	0.00	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR17	0.05	271.05	511.85	463.21	260.76	260.69	10.11	0.00	0.00	0.10	0.43	26.12	75.89	106.15
Santa Ana River	NSAR17	mean	95.65	183.60	113.85	30.33	35.66	5.93	0.13	3.18	5.48	3.43	26.35	56.80	45.99
Santa Ana River	NSAR16	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR16	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR16	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR16	0.25	0.00	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR16	0.05	271.88	515.28	465.74	261.60	261.59	10.91	0.00	0.00	0.10	0.63	26.87	76.69	106.95
Santa Ana River	NSAR16	mean	96.07	184.25	114.48	30.53	35.83	5.99	0.14	3.21	5.53	3.49	26.54	57.10	46.22
Santa Ana River	NSAR151	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR151	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR151	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR151	0.25	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR151	0.05	232.84	511.10	456.02	262.30	262.29	11.41	0.00	0.00	0.00	0.10	5.96	58.23	97.30
Santa Ana River	NSAR151	mean	91.78	179.60	110.71	29.69	35.74	6.02	0.13	2.57	5.17	2.95	24.66	53.84	44.54
Santa Ana River	NSAR15	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR15	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR15	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR15	0.25	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR15	0.05	233.74	514.60	458.41	263.16	263.09	12.21	0.00	0.00	0.00	0.20	6.72	59.03	98.10
Santa Ana River	NSAR15	mean	92.18	180.24	111.33	29.88	35.91	6.07	0.13	2.59	5.21	2.99	24.83	54.10	44.75
Santa Ana River	NSAR14	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR14	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR14	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR14	0.25	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR14	0.05	215.91	519.20	460.06	264.26	264.29	13.21	0.00	0.00	0.00	0.00	5.67	58.68	95.60
Santa Ana River	NSAR14	mean	91.62	179.85	111.17	29.88	36.08	6.14	0.13	2.57	5.15	2.92	24.50	53.76	44.61
Santa Ana River	RNASRP	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	RNASRP	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	RNASRP	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	RNASRP	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	RNASRP	0.05	161.85	412.23	439.94	265.39	265.42	14.11	0.00	0.00	0.00	0.00	0.00	0.21	81.97
Santa Ana River	RNASRP	mean	84.42	172.06	104.98	29.30	36.11	6.19	0.00	2.40	4.74	2.71	21.87	48.83	42.12

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Santa Ana River	NSAR13	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR13	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR13	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR13	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santa Ana River	NSAR13	0.05	161.86	412.20	439.97	265.36	265.39	14.11	0.00	0.00	0.00	0.00	0.00	0.21	82.00
Santa Ana River	NSAR13	mean	84.42	172.06	104.98	29.30	36.11	6.19	0.00	2.40	4.74	2.71	21.87	48.83	42.12
Santa Ana River	US RNASRP	0.95	1.57	2.04	2.08	1.87	1.50	1.32	0.91	0.75	0.82	0.91	1.04	1.47	0.92
Santa Ana River	US RNASRP	0.75	3.34	3.58	4.01	3.09	2.15	1.63	1.14	0.91	0.94	1.04	1.41	2.40	1.45
Santa Ana River	US RNASRP	0.50	5.42	6.14	6.85	5.06	2.78	1.91	1.36	1.05	1.08	1.41	2.82	4.65	2.95
Santa Ana River	US RNASRP	0.25	12.24	14.55	57.30	19.96	7.66	3.09	1.97	1.52	2.18	2.42	6.37	9.52	7.85
Santa Ana River	US RNASRP	0.05	361.25	611.63	639.34	464.79	464.82	213.51	77.95	62.68	33.01	10.27	107.11	187.85	281.37
Santa Ana River	US RNASRP	mean	111.52	201.85	152.76	66.61	74.03	32.03	11.73	11.07	11.52	7.82	37.45	69.35	64.93
Santa Ana River	SE-74	0.95	0.05	0.08	0.11	0.13	0.13	0.12	0.11	0.09	0.08	0.07	0.06	0.05	0.07
Santa Ana River	SE-74	0.75	0.12	0.14	0.19	0.18	0.17	0.16	0.13	0.11	0.10	0.08	0.08	0.08	0.12
Santa Ana River	SE-74	0.50	0.24	0.30	0.43	0.32	0.26	0.21	0.16	0.14	0.12	0.11	0.12	0.16	0.19
Santa Ana River	SE-74	0.25	0.72	3.35	37.33	12.64	3.26	0.55	0.33	0.24	0.25	0.21	0.28	0.77	0.72
Santa Ana River	SE-74	0.05	274.75	450.26	563.92	454.16	458.84	210.24	75.43	60.64	30.34	3.48	70.70	144.64	233.76
Santa Ana River	SE-74	mean	76.27	156.05	119.50	58.11	70.06	30.01	10.35	9.07	8.88	4.65	25.31	52.11	51.14
Santa Ana River	SE-58	0.95	0.00	0.03	0.05	0.05	0.05	0.05	0.05	0.04	0.03	0.02	0.02	0.00	0.02
Santa Ana River	SE-58	0.75	0.04	0.05	0.07	0.07	0.07	0.07	0.06	0.05	0.04	0.03	0.02	0.02	0.05
Santa Ana River	SE-58	0.50	0.07	0.11	0.18	0.15	0.11	0.08	0.07	0.06	0.05	0.04	0.03	0.05	0.07
Santa Ana River	SE-58	0.25	0.35	0.78	4.04	5.65	1.77	0.29	0.15	0.11	0.10	0.07	0.09	0.20	0.34
Santa Ana River	SE-58	0.05	39.56	67.47	502.99	483.31	510.21	265.52	130.12	77.97	40.78	0.58	10.69	25.70	154.59
Santa Ana River	SE-58	mean	21.80	55.68	60.00	55.64	78.09	38.17	15.22	10.24	6.75	0.61	6.09	16.39	30.24
Santa Ana River	SE-55	0.95	0.02	0.03	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Santa Ana River	SE-55	0.75	0.05	0.06	0.09	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02	0.02	0.04
Santa Ana River	SE-55	0.50	0.09	0.15	0.18	0.17	0.11	0.07	0.05	0.04	0.04	0.03	0.04	0.04	0.07
Santa Ana River	SE-55	0.25	0.25	0.70	0.70	0.65	0.44	0.29	0.20	0.14	0.15	0.07	0.08	0.13	0.27
Santa Ana River	SE-55	0.05	1.39	5.45	43.32	242.12	452.29	224.67	149.11	123.98	55.66	0.31	0.37	0.79	79.97
Santa Ana River	SE-55	mean	0.71	29.50	23.46	26.36	50.91	27.82	17.57	14.33	7.50	0.08	0.12	6.16	16.97
Temescal Wash	NTE24	0.95	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE24	0.75	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE24	0.50	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE24	0.25	48.00	2.30	3.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE24	0.05	279.97	548.50	502.33	175.45	60.20	8.92	2.30	2.30	2.30	2.40	45.31	109.04	65.30
Temescal Wash	NTE24	mean	139.40	140.65	95.90	25.78	9.37	3.44	2.42	3.96	4.43	4.43	28.96	44.81	41.50
Temescal Wash	NTE23	0.95	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE23	0.75	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE23	0.50	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE23	0.25	48.00	2.30	3.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE23	0.05	279.97	548.50	502.33	175.45	60.20	8.92	2.30	2.30	2.30	2.40	45.31	109.04	65.30
Temescal Wash	NTE23	mean	139.40	140.65	95.90	25.78	9.37	3.44	2.42	3.96	4.43	4.43	28.96	44.81	41.50
Temescal Wash	NTE22	0.95	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE22	0.75	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE22	0.50	48.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Temescal Wash	NTE22	0.25	48.00	2.30	3.15	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Temescal Wash	NTE22	0.05	258.43	539.73	502.33	175.45	58.87	8.92	2.30	2.30	2.30	2.40	38.11	94.13	61.30
Temescal Wash	NTE22	mean	135.14	134.90	91.86	25.13	9.28	3.41	2.41	3.84	4.21	4.19	26.98	42.51	39.89
The Zanja	SE-59	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
The Zanja	SE-59	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
The Zanja	SE-59	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
The Zanja	SE-59	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
The Zanja	SE-59	0.05	6.46	8.17	5.24	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.08	1.36	0.01
The Zanja	SE-59	mean	1.09	1.85	1.00	0.17	0.03	0.00	0.00	0.08	0.10	0.12	0.46	0.78	0.47
Upper Warm Creek	SE-31	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-31	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-31	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-31	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-31	0.05	28.61	33.55	19.52	0.59	0.00	0.00	0.00	0.00	0.00	0.00	5.05	9.09	0.80
Upper Warm Creek	SE-31	mean	4.96	7.11	4.36	0.72	0.13	0.00	0.00	0.39	0.50	0.60	2.28	3.59	2.03
Upper Warm Creek	SE-20	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-20	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-20	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-20	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Warm Creek	SE-20	0.05	6.65	9.37	4.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.33	0.00
Upper Warm Creek	SE-20	mean	2.00	3.79	2.05	0.13	0.02	0.00	0.00	0.15	0.17	0.19	0.69	1.36	0.87
Warm Creek	NW-35	0.95	1.32	1.84	1.78	1.59	1.26	1.09	0.71	0.57	0.65	0.75	0.89	1.28	0.73
Warm Creek	NW-35	0.75	2.95	3.25	3.55	2.71	1.78	1.34	0.89	0.70	0.75	0.85	1.22	2.05	1.18
Warm Creek	NW-35	0.50	4.87	5.42	6.00	4.27	2.34	1.56	1.08	0.80	0.85	1.20	2.43	4.27	2.21
Warm Creek	NW-35	0.25	8.78	9.87	13.11	6.36	4.14	2.23	1.43	1.09	1.36	1.95	5.41	6.79	5.00
Warm Creek	NW-35	0.05	62.65	65.58	53.02	17.34	6.38	3.54	2.46	1.93	3.92	6.38	23.42	49.26	19.49
Warm Creek	NW-35	mean	14.70	16.73	14.50	6.55	3.29	1.88	1.26	1.74	2.10	2.78	7.66	11.69	7.03
Warm Creek	NW-34	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-34	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-34	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-34	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-34	0.05	0.00	1.78	3.44	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-34	mean	0.01	0.32	0.44	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Warm Creek	NW-33	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-33	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-33	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-33	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-33	0.05	12.53	11.97	8.66	0.65	0.00	0.00	0.00	0.00	0.00	0.02	3.36	5.49	0.91
Warm Creek	NW-33	mean	1.71	1.88	1.34	0.33	0.06	0.00	0.00	0.14	0.19	0.24	0.93	1.31	0.67
Warm Creek	NW-32	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-32	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-32	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-32	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-32	0.05	11.58	11.07	8.17	0.83	0.00	0.00	0.00	0.00	0.00	0.07	3.61	5.25	1.07
Warm Creek	NW-32	mean	1.54	1.69	1.23	0.32	0.06	0.00	0.00	0.12	0.17	0.22	0.85	1.18	0.61

			All Streamflows in Cubic Feet per Second												
Drainage	**Node**	**Exceedance**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Warm Creek	NW-31	0.95	0.03	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03
Warm Creek	NW-31	0.75	0.05	0.05	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.04	0.04	0.04
Warm Creek	NW-31	0.50	0.06	0.07	0.07	0.07	0.06	0.05	0.04	0.04	0.04	0.04	0.04	0.05	0.05
Warm Creek	NW-31	0.25	0.10	0.13	0.25	0.12	0.08	0.06	0.05	0.04	0.04	0.04	0.05	0.09	0.07
Warm Creek	NW-31	0.05	8.85	8.50	6.30	1.01	0.17	0.09	0.07	0.06	0.07	0.26	3.01	4.16	1.23
Warm Creek	NW-31	mean	1.27	1.39	1.06	0.34	0.12	0.06	0.05	0.13	0.17	0.22	0.71	0.98	0.54
Warm Creek	NW-30	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-30	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-30	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-30	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Creek	NW-30	0.05	2.29	2.35	1.17	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.29	0.02
Warm Creek	NW-30	mean	0.37	0.43	0.27	0.05	0.01	0.00	0.00	0.03	0.04	0.05	0.19	0.28	0.14
Waterman Canyon Creek	SE-12	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Waterman Canyon Creek	SE-12	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Waterman Canyon Creek	SE-12	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Waterman Canyon Creek	SE-12	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Waterman Canyon Creek	SE-12	0.05	0.00	12.87	13.45	4.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Waterman Canyon Creek	SE-12	mean	1.17	4.65	3.76	0.69	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.89
Waterman Canyon Creek	SE-11	0.95	0.07	0.26	0.76	0.41	0.23	0.14	0.09	0.07	0.06	0.05	0.05	0.06	0.07
Waterman Canyon Creek	SE-11	0.75	0.35	1.23	1.70	1.21	0.67	0.33	0.19	0.12	0.09	0.08	0.07	0.11	0.16
Waterman Canyon Creek	SE-11	0.50	2.01	2.52	3.32	2.70	1.39	0.56	0.29	0.18	0.13	0.12	0.13	0.32	0.56
Waterman Canyon Creek	SE-11	0.25	3.28	6.13	7.37	6.64	3.90	1.86	0.71	0.38	0.27	0.21	0.33	1.49	2.30
Waterman Canyon Creek	SE-11	0.05	10.00	22.99	20.62	12.57	7.60	3.98	1.78	0.88	0.92	1.08	2.76	7.30	9.48
Waterman Canyon Creek	SE-11	mean	4.16	8.40	7.79	4.39	2.52	1.22	0.54	0.33	0.30	0.27	0.71	2.14	2.70

Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Appendix D

Santa Ana River High Flow Effects Analysis

Importance of Channel Maintenance Flows

The Covered Activities will decrease the magnitude, frequency, and duration of high flow flood events in the Santa Ana River and several tributaries, primarily through diversion of stream flow into groundwater recharge basins. The alteration of low flow conditions and how it affects aquatic ecology and Santa Ana sucker habitat suitability are described elsewhere in Chapter 4 of the HCP. This analysis focuses on how the Covered Activities would affect channel maintenance flows. Channel maintenance flows are described herein as instream flows necessary to maintain the physical character of the stream channel (Schmidt and Potyondy 2004). Maintenance of the physical habitat is in turn essential for healthy aquatic and terrestrial habitat and reducing flood risk. Schmidt and Potyondy (2004) describe the following benefits of channel maintenance flows:

- Convey water and sediment from tributary areas through the stream system without aggradation (net raising) or degradation (net lowering) of the channel bed.
- Maintain the relationship between the channel and the floodplain by temporarily storing flood flows on the floodplain.
- Maintain the ability of the stream to dissipate energy on the floodplain.
- Maintain essential channel capacity to avoid increasing flood risk to adjacent and downstream facilities.
- Maintain pools, riffles, meanders, and other physical habitats necessary to sustain aquatic ecosystems.

Channel maintenance flows are also essential for maintaining healthy riparian vegetation and the numerous benefits it provides, including habitat, root cohesion to protect against excessive erosion, shading to regulate stream temperatures, and nutrient filtering. Channel maintenance flows sustain riparian vegetation by (Schmidt and Potyondy 2004):

- Providing a source of abundant moisture.
- Transporting seed and propagules.
- Depositing sediment and scouring areas of the floodplain to create and maintain regeneration sites.
- Suppressing vegetation growth and encroachment of the main channel by several mechanisms including scour and inundation.

Loss of riparian vegetation can lead to increased erosion of sediments forming channel banks and floodplains. Rapid transport and eventual deposition of this sediment downstream can cause flooding problems and degrade aquatic habitats. Furthermore, riparian vegetation stores flood water, at least temporarily, and slows the pace of the flood wave as it moves down the watershed, thereby reducing flooding levels downstream (Anderson 2006).

The upper reaches of the mainstem Santa Ana River and tributaries City Creek and Mill Creek are designated as critical habitat for the Santa Ana sucker. These reaches are not listed as critical habitat because they currently sustain Santa Ana sucker habitat, but because they are important sources of coarse sediment and transport of these sediments to lower reaches of the Santa Ana River (e.g., downstream of RIX) is essential for sustaining sucker habitat in occupied reaches. Channel maintenance flows are necessary to maintain the balance of sediment transport and deposition in the stream system, and this includes continued transport of coarse sediment from the tributaries containing a supply of coarse sediment to reaches lower in the system.

The magnitude, frequency, and duration of flood flows necessary for performing channel maintenance can vary depending on the characteristics of the channel morphology. Most of the channels affected by covered activity hydrology changes have braided morphology (Figure 3-11). The recurrence interval, also known as the return period, is the average interval of time in years for which the discharge magnitude of a given flood will be equaled or exceeded. Surian et al. (2014) present a conceptual framework that relates recurrence interval flows with channel maintenance fluvial processes in the braided rivers they studied (Figure 3-16). Braided channel processes of sediment transport in channels and on low bars, in-channel bank erosion, sudden channel shifts into new channel braids, and vegetation erosion can all occur at frequently occurring flood events with recurrence intervals of less than a 1-year return period. It can require larger recurrence interval events of up to 2.5 years for the process of sediment transport on high bars. The framework model illustrates that fluvial process occur under a range of discharges, not a single discharge, and relatively infrequent floods (recurrence intervals in the 1- to 3-year range) are important drivers of braided channel morphology (Surian et al. 2014). Flow regulations that affect frequent, low magnitude floods with recurrence intervals in the 1- to 3-year range can significantly change braided river vegetation dynamics and the transport of coarse sediment (Surian et al. 2014).

Flood events that occur one or more times per year are drivers of bank and vegetation erosion, and sediment transport in active channel branches, while larger floods can lead to widening of the active part of the river, creation of new channel braids, and complete rearrangement of the channel network that substantially modifies the distribution of terrestrial and aquatic habitat (Bertoldi and Tubino 2010).

Analysis of Channel Maintenance Flows

Methods

ICF evaluated changes in flooding and sediment transport to assess how the Covered Activities would alter high flows and channel maintenance processes. Three different analyses were performed:

1. **Change in the Flow Magnitude of the 1.25-year Flood.** The change in the flow magnitude between the baseline and with Covered Activities conditions corresponding to the 1.25-year recurrence was evaluated. As described above, the 1.25-year flood is in the range of events that have been shown to be a key driver of geomorphic processes and vegetation dynamics in braided channel systems. Understanding how the Covered Activities would alter the 1.25-year flood provides insight into the extent to which channel maintenance processes may be altered.

2. **Change in Bedload Transport for the 1.25-year Flood.** Based on the change in the flow magnitude of the 1.25-year flood, bedload transport calculations were performed to assess how altered flows translate into altered sediment transport, which is a primary channel maintenance function.
3. **Change in the Bedload Transport Over the Entire Hydrograph.** Because fluvial process occur under a range of discharges, not just the 1.25-year flood, analysis was performed at select locations to understand how altered hydrology would cumulatively affect sediment transport for all flows in the hydrograph. Bedload transport rating curves were developed to show how the Covered Activities would change sediment transport to downstream reaches for every flow – from the lowest to highest flow over the HCP 25-year hydro period.

The focus of the high flow effects analysis is on the mainstem Santa Ana River extending from near Seven Oaks Dam and downstream to near Prado, and major tributaries from Lytle Creek and further upstream. Tributaries downstream of Lytle Creek are not included in the analysis since they are: (1) not significant sources of sediment compared to the upper tributaries; (2) most of the lower tributaries are concrete conveyance channels devoid of natural geomorphic processes; and (3) are not designated as critical habitat for sediment sources.

Change in the Flow Magnitude of the 1.25-year Flood

Determination of the flow magnitude that corresponds to different recurrence intervals (e.g., the 1.25-year flood) is usually based on peak instantaneous flows. The peak instantaneous flow for a given water year is typically determined by querying USGS gage records of flow levels reported on a 15-minute interval to find the largest value that occurred in the year. Several USGS gages exist in the study area. The peak flow data was downloaded from the USGS online records for several gages on the mainstem Santa Ana River and tributaries and Bulletin 17C (England et al. 2018) methods were used to calculate flood recurrence intervals. Values for the 1.25-year flood are listed in Table D-1.

The hydrology analysis used for the effects analysis is based on modeled mean daily flows and does not include peak instantaneous flows (see Chapter 3). ICF used a procedure to correlate the peak flow recurrence interval with mean daily discharge. A flow duration curve was created from the mean daily flow records at the U.S. Geological Survey (USGS) gages and the exceedance probability (probability that a flow will be equaled or exceeded on a given day) corresponding to the 1.25-year flood was determined. See Figures D-2 through D-15 for graphs of the flow duration curves prepared for the analysis that show the baseline and with covered activity conditions. For example, for the USGS Santa Ana River at MWD crossing gage, the 1.25-year flood is 3,080 cubic feet per second (cfs), which has a mean daily exceedance probability of 0.33% (on average is equaled or exceeded 1.2 days per year). Then, flow duration curves were developed from the modeled mean daily discharges at select model node locations. The same exceedance probability determined from the USGS gage was used to determine the corresponding modeled mean daily flow. Continuing the example, a 0.33% exceedance for node NSAR 232 located near the MWD gage has a corresponding baseline mean daily flow of 2,971 cfs. This is not an exact correlation of peak flow with mean daily flow since the peak instantaneous flow duration may have been less than a day, and thus the mean flow for the entire day would be less than the peak. However, this approach uses a consistent method, and, as the results in Table D-1 show, the peak instantaneous and modeled mean daily baseline flows have similar magnitudes for most gages.

Change in Bedload Transport for the 1.25-year Flood

2D Hydraulic Modeling

Bedload transport analysis was performed using 2D hydraulic modeling and field-measured bed sediment particle size analysis. Two-dimensional hydraulic modeling was performed using the SRH-2D numerical model (Lai 2008) at 22 locations in the study area to support the HCP effects analysis. The locations of the 2D hydraulic model assessment reaches are mapped in Figure D-1.

The SRH-2D numerical model was created by the U.S. Bureau of Reclamation at its Technical Service Center in Denver, Colorado. The model is a 2D depth-averaged velocity, finite element model. The model was run using a steady state flow condition for all scenarios analyzed. All model set-up, including mesh generation and boundary condition establishment, was performed in Aquaveo's SMS software. Elevations in the model are based on LiDAR flown in 2015, with the exception of model sites located on the downstream of the Rialto and RIX effluent discharges, in which the LiDAR was supplemented with field-surveyed bathymetry (see Chapter 3 for more discussion). The resolution of the modeling mesh is typically 3 feet spacing between model nodes, which is the same resolution of the raster cell size in the LiDAR elevation surface.

As described in Chapter 3 for the Santa Ana sucker effects analysis, field-surveyed water surface elevations and discharge measurements were used to calibrate Manning's n roughness values specified in the models for model sites located downstream of the Rialto and RIX effluent discharges. For the other sites that are typically dry (and were dry when the 2015 LiDAR was flown), roughness values for the modeling mesh were not calibrated, but instead were specified. Roughness values used in the modeling sites for the channel typically ranged from 0.025 to 0.035. The specified roughness value was determined based on consideration of grain roughness (Limerinos 1970) related to particle size and surface irregularities that also provide roughness and are not already accounted for in the density of the node spacing in the mesh surface or grain size (Tonina and Jorde 2013). These 2D roughness values are lower than what was used in the 1D hydraulic model because much of the bedform roughness and other flow resistance factors (e.g., channel geometry) are accounted for in the 2D mesh. Manning's n values in vegetated areas typically ranged from 0.06 to over 0.1 depending on the vegetation density.

Upstream boundary conditions were set at locations where the flow is concentrated into one channel braid. The water surface elevations assigned to the models' downstream boundary conditions were determined from 1D calculations of discharge and water surface elevation using the Manning's equation. The parabolic turbulence coefficient was set to 0.6 in the model (Pasternack 2011). Monitoring lines and points were established on the model to monitor water surface elevations and continuity calculations during the model run. Each modeled flow was run at a time step of 1 second or less until an acceptable level of convergence was obtained in continuity, water surface elevations, and velocities.

Eleven of the 2D model sites were used in the sediment transport analysis (see Table D-2). The model reach lengths average 2,280 feet, with a range from 745 feet (SAR-USGS Reach 9 Downstream of RIX) to 3,600 feet (Cajon Wash). Model reaches are shorter where bathymetric field surveys were required (it is time intensive to survey bathymetry over long reaches) and longer where use of the LiDAR elevations alone was sufficient for the modeling. The mean daily flows for both the baseline and with Covered Activities condition at the 1.25-year flood recurrence (Table D-1) were run in the model.

Channel Bed Sediment Analysis

Sediment transport analysis requires specification of the particle size gradation of the channel bed sediment. ICF obtained field-measured channel bed particle size sediment data from 3 sources: (1) USGS unpublished data collected in 2014–2015; (2) ESA (2015); and (3) U.S. Army Corps of Engineers unpublished data collected in 2017–2018. ICF calculated cumulative frequency grain sizes for different fractions (e.g., D_{50} = median grain size for which half the sediment sampled is finer in size), sediment sorting parameters to see how well or poorly sorted the sediment is, and the percent of each sample that is in sand, gravel, cobble, or boulder size fractions based on the Wentworth scale.

Sediment Transport Equation

The Wilcock and Crowe (2003) surface-based transport model for mixed-size bed sediments was used for the analysis. The Wilcock and Crowe model is a set of equations that are commonly used to estimate the rate that sediment is transported in channels with a sand and gravel bed sediment mixture. The Wilcock and Crowe equation was developed to calculate transport for all sediment fractions found in the bed rather than just using the D_{50} as some equations do. Importantly, this equation considers the effect of relative particle size variations within the sediment mixture and how different percentages of bed sand content affect the transport of other size fractions.

Shear stress is a key input in the Wilcock and Crowe (2003) sediment model. The local shear velocity u^* (feet per second [ft/s]) related to grain-induced resistance, from which local shear stress (pounds per square feet [lb/ft^2]) was calculated, was determined from a variation of Keulegan's (1938) resistance law for rough flow presented by Wilcock (2001) as:

$$\frac{U}{u^*} = 8.1\left(\frac{h}{k_s}\right)^{0.167}$$

where U is flow velocity (ft/s), h is flow depth (ft), and k_s is the bed roughness height (ft) calculated as twice the D_{65} particle size (Wilcock 2001).

Sediment transport calculations were performed in user-created Excel spreadsheets. The hydraulic depth and velocity output for every node in the SRH-2D model was imported into Excel and used to calculate shear stress and sediment transport rates at every model node. Table D-2 shows which bed sediment sample was used for each 2D model site. From this process the sediment transport for a given flow magnitude was calculated over a continuous model reach. At the flow level that corresponds to the 1.25-year flood, sediment transport was calculated over model reaches several acres in size. Performing the analysis over continuous channel area reaches, as opposed to limited to single cross-sections employed in a 1D analysis, allows for better capture of the variability in sediment transport that occurs through the different morphologic units found within a reach. Because sediment transport values are often reported as a rate along a cross-section, the total sediment transport for the reach was divided by the reach length to calculate a reach-averaged transport rate.

Change in the Bedload Transport Over the Entire Hydrograph

Bedload transport rating curves were developed for 6 of the 11 locations assessed for the 1.25-year flood (Table D-4). The curves were used to show how the Covered Activities would change sediment transport to downstream reaches for every flow – from the lowest to highest flow over the HCP 25-year hydro period. The analysis was performed for 3 Santa Ana River locations (Greenspot Road,

upstream of East Twin Creek, and downstream of RIX) and 3 major tributaries that are important sediment sources to downstream reaches (Mill Creek, City Creek, and Lytle Creek). The same 2D hydraulic modeling and sediment transport calculation methods described above for the 1.25-year analysis were used for the curve development. Several different flows that span the range of low to maximum flows in the hydrology model hydrographs for each location were run in 2D models and the hydraulic output was used to perform the bedload calculations. The bedload transport rates determined for each flow were used to develop a curve from which an equation was fit through the points. This equation that predicts the bedload transport rate for a given flow rate was then used to calculate bedload transport for every daily flow in the hydrograph.

Results

Change in the Flow Magnitude of the 1.25-year Flood

The Covered Activities would decrease the mean daily discharge exceedance flow that corresponds to the 1.25-year flood for all locations (Table D-1). The decrease is the smallest on Mill Creek (4%) and largest on Lytle Creek upstream of Cajon Wash (77%). For the Santa Ana River locations the magnitude of the reductions progressively decrease downstream: 34% at Greenspot Road, 18% downstream of Mill Creek, and reaching a low of 7% at the E Street gage location (Node SE-74 upstream of Lytle Creek). Downstream of Lytle Creek, the Santa Ana River 1.25-year flood reductions increase again to 19%. This is attributed to the substantial flow reductions created by Covered Activities on the Lytle Creek and Cajon Wash tributaries that affect Santa Ana River flows. At the most downstream Santa Ana River location evaluated (Site 3A downstream of I-15) the reduction is 15%. Lower City Creek (just upstream of the confluence with Plunge Creek) has a 42% decrease in the 1.25-year flood reduction.

Change in Bedload Transport for the 1.25-year Flood

Particle size analysis of the channel bed sediment samples shows that most of the assessment reaches are composed of fine grained, poorly sorted, sandy sediment (Table D-2). The exceptions are steeper reaches in the upper watershed on the Santa Ana River at Greenspot Road and Mill Creek (dominant small cobble size), the Rialto Channel (dominant coarse gravel), and Santa Ana River ESA Middle Reach downstream of Highway 60 (dominant fine gravel size).

Results for the modeled sediment transport for the 11 assessment reaches are presented in Table D-3. The table lists the change between the baseline and covered activity conditions for streamflow of the 1.25-year food, change in total sediment transport, and change in fractional sediment transport. Graphs showing comparisons for transport of all the fractional sizes analyzed are presented in Figures D-16 through D-25.[1]

Under the baseline condition, Mill Creek has the largest sediment transport rate (15,781 tons/day) and is nearly 3 times greater than the second largest tributary site of Lytle Creek upstream of Cajon Wash (5,295 tons/day). Mill Creek's steep bed slope (4.1%) is the highest of all reaches assessed and a primary factor for why this tributary is the largest sediment source. A 4% reduction in Mill Creek's 1.25-year flood under the Covered Activities condition also results in a 4% reduction in sediment

[1] A fractional graph of D_i sediment sizes is not included for Mill Creek because the differences in baseline condition and covered activity condition flows at the 1.25-year flood are so minimal. However, a comparison of sand, gravel, cobble, and boulder fractions is listed in Table D-3.

transport. Lytle Creek upstream of Cajon Wash has a 75% reduction in the 1.25-year flood that results in a 72% reduction in a sediment transport. This is the largest reduction of all sites assessed. Other tributary reductions in sediment transport include 59% at Lytle Creek downstream of Cajon Wash, 48% at Cajon Wash, and 49% at lower City Creek. For the Santa Ana River assessment sites, the location at Greenspot Road has the largest reduction (41%). The other Santa Ana River locations have reductions ranging from 12% (ESA Middle Reach and upstream of East Twin Creek) up to 24% (USGS Reach 9 downstream of RIX).

In terms of the fractional size components of the total sediment load, Mill Creek is the largest supplier of gravel and cobble at the 1.2-year flood under the baseline condition (Table D-3). Under the Covered Activities, the Santa Ana River at Greenspot Road has the largest reduction in transport of gravel (1,508 tons/day; 40%) and cobble (1,004 tons/day; 42%) followed by the Santa Ana River downstream of Mill Creek (702 tons/day gravel; 26% and 436 tons/day cobble; 30%). Lytle Creek upstream of Cajon Wash also has a notable reduction in gravel transport (794 tons/day; 75%).

Change in the Bedload Transport Over the Entire Hydrograph

Results of the sediment transport analysis over the entire hydrograph are listed in Table D-4. The sediment transport rating curves that were used to determine the values in Table D-4 are presented in Figures D-26 through D-31, as well as graphical bar charts of the fractional transport rates listed in Table D-4 in Figures D-32 through D-37. Mill Creek by far has the largest total sediment load under the baseline condition of all sites at 1,184,365 tons/year, and is also the largest supplier of combined gravel and cobble to the Santa Ana River. Under the Covered Activities condition, Mill Creek's streamflow would be reduced by 3,105 acre-feet/year (22%), resulting in a sediment supply reduction of 215,357 tons/year (18%). The Santa Ana River at Greenspot Road is the location with the second largest baseline condition total sediment load at 280,296 tons/year. Under the Covered Activities, this location's streamflow would be reduced by 3,357 acre-feet/year (21%), resulting in a sediment supply reduction of 57,404 tons/year (20%). The third largest baseline condition total sediment load is the Santa Ana River USGS Reach 9 downstream of RIX at 177,376 tons/year. Under the Covered Activities, this location's streamflow would be reduced by 34,698 acre-feet/year (35%), resulting in a sediment supply reduction of -63,486 tons/year (36%). Total sediment load would be reduced by 45% at lower City Creek, 49% at Lytle Creek downstream of Cajon Wash (which is the largest percent reduction of all sites), and 18% at the Santa Ana River upstream of East Twin Creek.

In terms of the fractional size components of the total sediment load, Mill Creek is the largest supplier of gravel and cobble under the baseline condition (Table D-4). Under the Covered Activities condition, gravel transport would be reduced by 17% and cobble by 10%. The Santa Ana River at Greenspot Road is the second largest supplier of gravel and cobble, and it would experience reductions of gravel transport by 26% and cobble by 18%. On a percentage basis, Lytle Creek downstream of Cajon Wash would have the largest reduction in gravel transport (48%) and cobble transport (35%).

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Table D-1. Flow Magnitudes for the 1.25-Year Flood Determined at USGS Gages and Determination of Corresponding Mean Daily Discharge Exceedance Probabilities

Gage Number	Gage Name	1.25-yr Recurrence Interval Flow[3] (cfs)	USGS Mean Daily Discharge Annual Exceedance Probability of the 1.25-yr Flood[4] (%)	Hydrology Model Node	Exceedance Probability used for the Modeled Mean Daily Discharge Hydrology[5] (%)	Average Number Days per Year Equaled or Exceeded[6] (days)	Baseline Flow at Exceedance Probability (cfs)	Covered Activity Flow at Exceedance Probability (cfs)	Change in Flow (Baseline minus Covered Activity) (cfs)	Change in Flow (%)	2D Hydraulic Model Assessment Reach
11051500	SAR near Mentone 1891-1998 Pre-Seven Oaks Dam Construction (pre-Nov. 2009)	263	3.02	SE-55 Up SAR	3.02	11.02	259	170	89	-34%	SAR at Greenspot Rd
11051500	SAR near Mentone 1999-2017 Post-Seven Oaks Dam Construction (since Nov. 2009)	70	8.20	SE-55 Up SAR	8.20	29.93	53	26	27	-51%	
				SE-55 UP SAR +SE-56 UP Mill Crk	3.00[1]	10.95	401	328	73	-18%	SAR Downstream of Mill Creek
				SE-57 E Low City Crk III + SE-58 Mid SAR	2.73[2]	9.97	473	429	44	-9%	SAR Upstream of East Twin Creek
11059300	SAR at E St near San Bernardino	1,710	0.50	SE-74 SAR E St	0.50	1.83	1,604	1,498	106	-7%	
11066460	SAR at MWD Crossing	3,080	0.33	NSAR 20[7]	0.42	1.53	3,178	2,580	599	-19%	SAR - USGS Reach 9 Downstream of RIX
				NSAR 232[7]	0.42	1.53	2,971	2,421	550	-19%	SAR - ESA Middle Reach
				NSAR 351	0.33	1.20	5,948	5,053	896	-15%	SAR - Site 3A Downstream of I-15
11054000	Mill Creek near Yucaipa (1948-1986)	82	4.88	SE-56 UP Mill Crk	4.88	17.81	84	81	3	-4%	Mill Creek Upstream of SAR
11055800	City Creek near Highland	132	0.86	SE-39 Mid City Crk	0.86	3.14	176	102	74	-42%	Lower City Creek
				SE-49 E Low City Crk II	0.86	3.14	274	237	37	-13%	
11062000	Lytle Creek near Fontana	176	2.02	NW-20 Upper Lytle Creek	1.15[8]	4.20	100	23	77	-77%	Lytle Creek Upstream of Cajon Wash
				NW-26 Lower Lytle Creek	1.15[8]	4.20	159	72	87	-55%	Lytle Creek Downstream of Cajon Wash
11063510	Cajon Creek Below Lone Pine Creek Near Keenbrook	186	0.39	NW-18 Upper Cajon Crk	0.39	1.42	100	54	46	-46%	Cajon Wash

[1] 3% Probability used since similar to long-term SAR near Mentone gage values

[2] 2.7% Probability is a drainage area weighted average of SAR near Mentone, Mill Creek, City Creek & Plunge Creek gages

[3] Determined from Log-Pearson Type III analysis of peak instantaneous flow records

[4] Determined by finding the discharge magnitude on an annual flow duration curve of mean daily discharge values that corresponds to the 1.25-yr flood magnitude

[5] The same exceedance probability used as determined for the representative USGS gage except for some instances where interpolation was used where model nodes are located between different USGS gages

[6] Calculated as the annual exceedance probability multiplied by 365 days

[7] Calculated as the average of the E Street and MWD Crossing gages

[8] Since a value using 2.02 results in 0 cfs (and no sediment transport) for the Covered Activity flow, a value of 1.15 is used to show some level of sediment transport under a low flow condition for comparison

Table D-2. Particle Size Analysis of Channel Bed Sediment Samples

Source	Site	2D Hydraulic Model Assessment Reach & Bed Slope	D_5 (mm)	D_{10} (mm)	D_{16} (mm)	D_{50} (mm)	D_{65} (mm)	D_{84} (mm)	D_{90} (mm)	D_{95} (mm)	Folk & Ward Sorting (S_o)	Dominant Class Size (mm)	Percent in Dominant Class (%)	Finer than Sand (%)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)
USGS	SAR near Greenspot Road	SAR at Greenspot Rd (2.7%) SAR Downstream of Mill Creek (2.2%)	0.64	2.93	7.75	102.24	168.69	328.11	408.12	489.51	very poor	128.00	21.41	0.90	7.80	26.82	41.65	22.82
USGS	SAR near Orange Street		0.11	0.16	0.22	0.67	1.41	42.84	103.66	190.56	very poor	0.50	24.00	2.05	67.07	17.33	11.11	2.44
USGS	SAR near Tippecanoe Avenue	SAR Upstream of East Twin Creek (0.7%)	0.14	0.23	0.31	0.90	1.57	11.02	27.16	54.57	very poor	1.00	26.00	2.02	68.92	25.26	3.79	0.00
USGS	SAR Upstream of Rialto Drain		0.09	0.14	0.18	0.50	0.86	5.66	7.75	12.39	very poor	0.50	27.00	3.05	70.69	25.91	0.35	0.00
USGS	Mill Creek near Greenspot Road	Mill Creek Upstream of SAR (4.1%)	0.19	0.30	0.44	16.62	39.93	96.32	125.75	190.68	very poor	128.00	15.60	0.02	23.18	51.60	23.60	1.60
USGS	City Creek near 5th Street	Lower City Creek (0.7%)	0.15	0.25	0.31	0.94	1.93	5.66	7.19	11.06	poor	1.00	23.00	2.01	63.66	34.33	0.00	0.00
USGS	Lytle Creek near Hwy 66	Lytle Creek Downstream of Cajon Wash (1.1%) Lytle Creek Upstream of Cajon Wash (1.9%) Cajon Wash (2.0%)	0.10	0.15	0.21	0.59	1.47	6.62	10.75	26.91	very poor	0.50	26.00	3.03	64.33	30.95	1.68	0.00
USGS	Rialto Channel		4.50	6.68	8.85	21.88	32.10	63.52	83.76	105.68	poor	32.00	27.19	0.00	0.88	83.33	15.79	0.00
USGS	SAR Upstream of RIX	SAR - USGS Reach 9 Downstream of RIX (0.4%)	0.30	0.37	0.47	0.88	1.20	1.94	2.78	3.94	poor	1.00	40.31	0.00	85.25	14.75	0.00	0.00
USGS	SAR near Riverside Avenue		0.23	0.28	0.32	0.78	1.26	3.07	4.76	7.46	poor	0.50	27.77	0.01	77.38	22.61	0.00	0.00
USGS	SAR near Market Street		0.26	0.31	0.36	0.85	1.29	2.71	3.84	6.47	poor	1.00	29.46	0.00	78.77	21.23	0.00	0.00
ESA	ESA Upper Reach Site		0.38	0.59	1.58	19.73	32.25	53.31	60.59	67.41	very poor	50.00	25.30	0.00	17.00	75.57	7.43	0.00
ESA	ESA Riverside Site		0.34	0.47	0.73	5.05	10.75	19.31	22.73	29.34	very poor	25.00	25.50	0.00	28.50	71.50	0.00	0.00
ESA	ESA Middle Reach Site	SAR – ESA Middle Reach (0.3%)	0.30	0.36	0.46	1.90	3.31	8.37	12.12	17.36	poor	4.80	23.50	0.00	51.50	48.50	0.00	0.00
ESA	ESA Lower Reach Site		0.22	0.29	0.34	0.69	1.07	2.15	3.27	4.63	poor	0.85	17.00	0.00	83.00	17.00	0.00	0.00
Corps	SAR Downstream of I-15 (TP-17-72-1)	SAR – Site 3A (0.2%)	0.18	0.24	0.31	0.60	0.82	1.34	1.95	3.35	poor	0.60	36.00	0.00	90.37	9.63	0.00	0.00

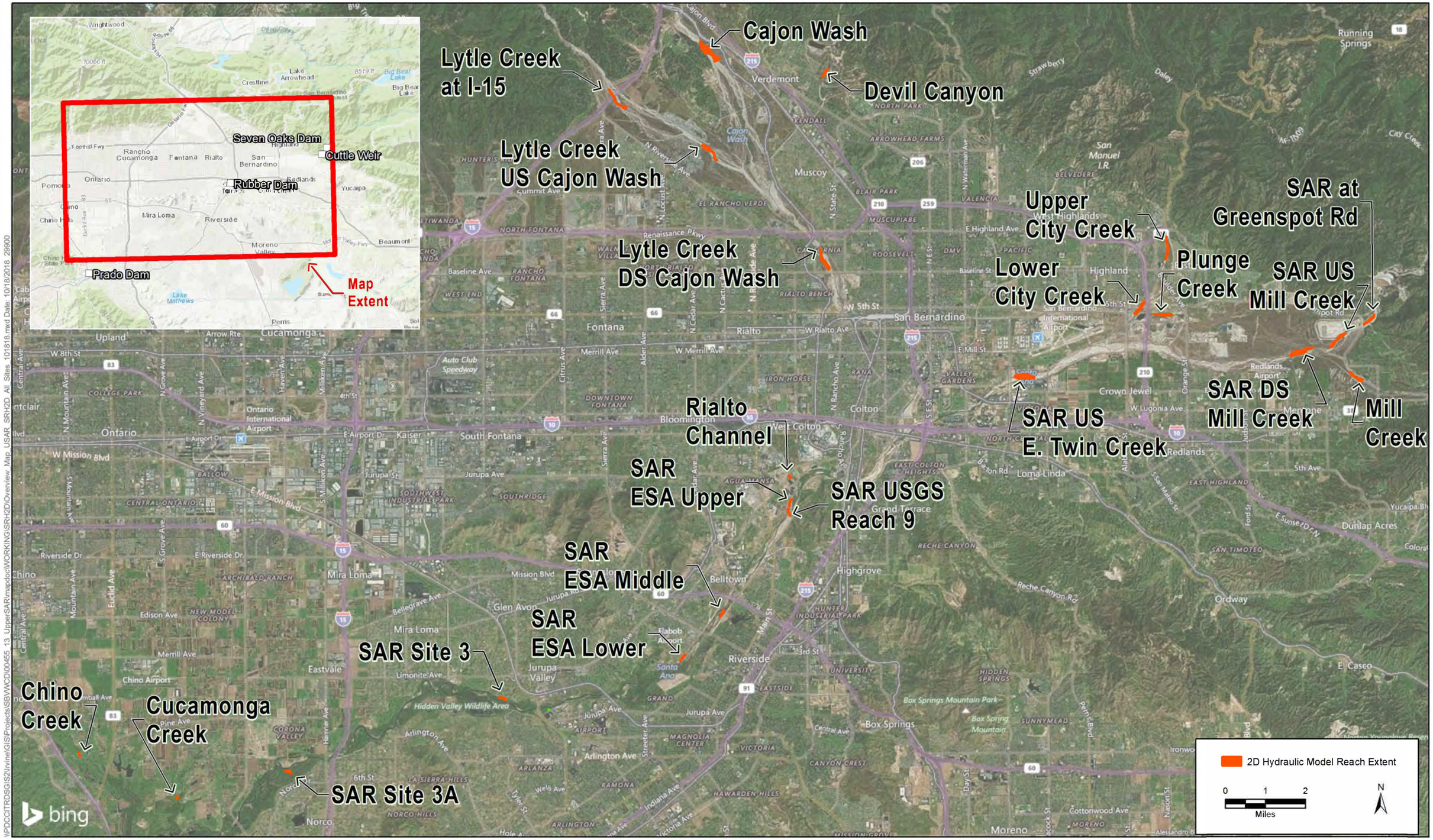
Sources: USGS unpublished sediment data collected 2014-2015; ESA 2015; Corps unpublished sediment data collected 2017-2018

Table D-3. Sediment Transport Effects From Reductions in the Mean Daily Discharge that Corresponds to the 1.25-Year Flood Recurrence Interval

	Streamflow				Total Bedload Transport				Fractional Bedload Transport															
2D Hydraulic Model Assessment Reach	Baseline (cfs)	With Cov. Act. (cfs)	Change from Baseline (cfs)	Change from Baseline (%)	Baseline (t/d)	With Cov. Act. (t/d)	Change from Baseline (t/d)	Change from Baseline (%)	Baseline Sand (t/d)	With Cov. Act. Sand (t/d)	Sand Change from Baseline (t/d)	Sand Change from Baseline (%)	Baseline Gravel (t/d)	With Cov. Act. Gravel (t/d)	Gravel Change from Baseline (t/d)	Gravel Change from Baseline (%)	Baseline Cobble (t/d)	With Cov. Act. Cobble (t/d)	Cobble Change from Baseline (t/d)	Cobble Change from Baseline (%)	Baseline Boulder (t/d)	With Cov. Act. Boulder (t/d)	Boulder Change from Baseline (t/d)	Boulder Change from Baseline (%)
Mill Creek Upstream of SAR	84	81	-3	-4%	15,781	15,139	-643	-4%	6,407	6,171	-236	-4%	8,557	8,199	-358	-4%	815	766	-49	-6%	2	2	0	-4%
Lower City Creek	176	102	-74	-42%	1,100	556	-544	-49%	904	465	-439	-49%	196	92	-105	-53%	0	0	0	0%	0	0	0	0%
Lytle Creek Upstream of Cajon Wash	100	25	-75	-75%	5,295	1,472	-3,823	-72%	4,224	1,201	-3,023	-72%	1,063	269	-794	-75%	8	2	-6	-79%	0	0	0	0%
Lytle Creek Downstream of Cajon Wash	159	72	-87	-55%	1,737	721	-1,017	-59%	1,497	633	-864	-58%	240	88	-152	-63%	0	0	0	-66%	0	0	0	0%
Cajon Wash	100	54	-46	-46%	2,167	1,117	-1,049	-48%	1,847	966	-881	-48%	319	151	-168	-53%	0	0	0	-52%	0	0	0	0%
SAR at Greenspot Rd	259	170	-89	-34%	8,201	4,872	-3,328	-41%	1,949	1,196	-753	-39%	3,747	2,240	-1,508	-40%	2,365	1,361	-1,004	-42%	140	76	-64	-46%
SAR Downstream of Mill Creek	401	328	-73	-18%	5,660	4,136	-1,524	-27%	1,482	1,120	-362	-24%	2,660	1,958	-702	-26%	1,462	1,026	-436	-30%	56	32	-24	-43%
SAR Upstream of East Twin Creek	473	429	-44	-9%	959	846	-113	-12%	877	776	-102	-12%	81	70	-11	-14%	0	0	0	-32%	0	0	0	0%
SAR - USGS Reach 9 Downstream of RIX	3,178	2,580	-598	-19%	7,626	5,790	-1,836	-24%	6,862	5,226	-1,636	-24%	764	564	-200	-26%	0	0	0	0%	0	0	0	0%
SAR - ESA Middle Reach	2,971	2,421	-550	-19%	2,490	2,197	-293	-12%	1,641	1,443	-199	-12%	849	754	-94	-11%	0	0	0	0%	0	0	0	0%
SAR - Site 3A Downstream of I-15	5,948	5,053	-895	-15%	2,157	1,806	-352	-16%	1,179	990	-190	-16%	978	816	-162	-17%	0	0	0	0%	0	0	0	0%

Table D-4. Sediment Transport Effects From Changes in Hydrology Calculated for Every Mean Daily Discharge Over the 25-Year 1966-1990 Base Hydro Period

	Streamflow				Total Bedload Transport				Fractional Bedload Transport															
	1966-1990 Annual Average				1966-1990 Annual Average				1966-1990 Annual Average															
2D Hydraulic Model Assessment Reach	Baseline (ac-ft)	With Cov. Act. (ac-ft)	Change from Baseline (ac-ft)	Change from Baseline (%)	Baseline (t/yr)	With Cov. Act. (t/yr)	Change from Baseline (t/yr)	Change from Baseline (%)	Baseline Sand (t/yr)	With Cov. Act. Sand (t/yr)	Sand Change from Baseline (t/yr)	Sand Change from Baseline (%)	Baseline Gravel (t/yr)	With Cov. Act. Gravel (t/yr)	Gravel Change from Baseline (t/yr)	Gravel Change from Baseline (%)	Baseline Cobble (t/yr)	With Cov. Act. Cobble (t/yr)	Cobble Change from Baseline (t/yr)	Cobble Change from Baseline (%)	Baseline Boulder (t/yr)	With Cov. Act. Boulder (t/yr)	Boulder Change from Baseline (t/yr)	Boulder Change from Baseline (%)
Mill Creek Upstream of SAR	14,362	11,257	-3,105	-22%	1,184,365	968,978	-215,387	-18%	466,051	370,450	-95,601	-21%	641,526	529,443	-112,083	-17%	75,564	67,955	-7,609	-10%	967	912	-55	-6%
Lower City Creek	8,275	3,585	-4,689	-57%	22,964	12,683	-10,280	-45%	18,838	10,124	-8,713	-46%	4,126	2,559	-1,567	-38%	0	0	0	0%	0	0	0	0%
Lytle Creek Downstream of Cajon Wash	9,471	4,989	-4,482	-47%	48,938	24,846	-24,092	-49%	41,864	21,154	-20,711	-49%	7,052	3,678	-3,374	-48%	23	15	-8	-35%	0	0	0	0%
SAR at Greenspot Rd	15,650	12,292	-3,357	-21%	280,296	222,892	-57,404	-20%	63,450	44,720	-18,729	-30%	125,237	93,156	-32,081	-26%	84,766	69,372	-15,394	-18%	6,340	5,153	-1,187	-19%
SAR Upstream of East Twin Creek	36,313	29,072	-7,241	-20%	39,531	32,267	-7,264	-18%	35,847	29,020	-6,827	-19%	3,668	3,131	-537	-15%	15	16	1	7%	0	0	0	0%
SAR - USGS Reach 9 Downstream of RIX	99,675	64,977	-34,698	-35%	177,376	113,891	-63,486	-36%	161,323	103,717	-57,606	-36%	16,053	10,174	-5,879	-37%	0	0	0	0%	0	0	0	0%



Upper Santa Ana River Habitat Conservation Plan

Figure D-1
Santa Ana River - Locations of 2D Hydraulic Model Assessment Reaches

Figure D-2. Geoscience Node SE-55 (Up SAR)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

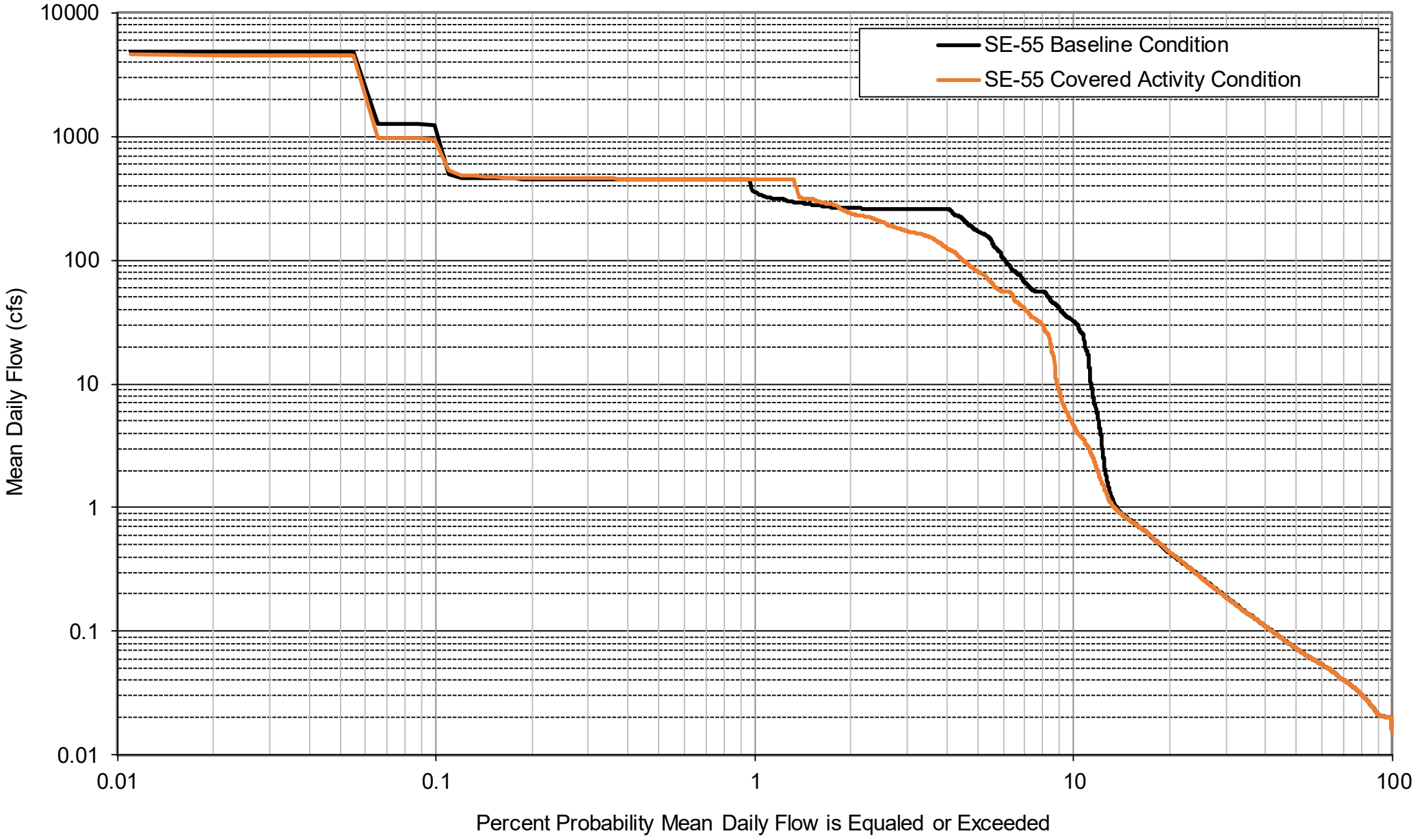


Figure D-3. Geoscience Nodes SE-55+SE-56 (UP SAR + UP Mill Crk)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

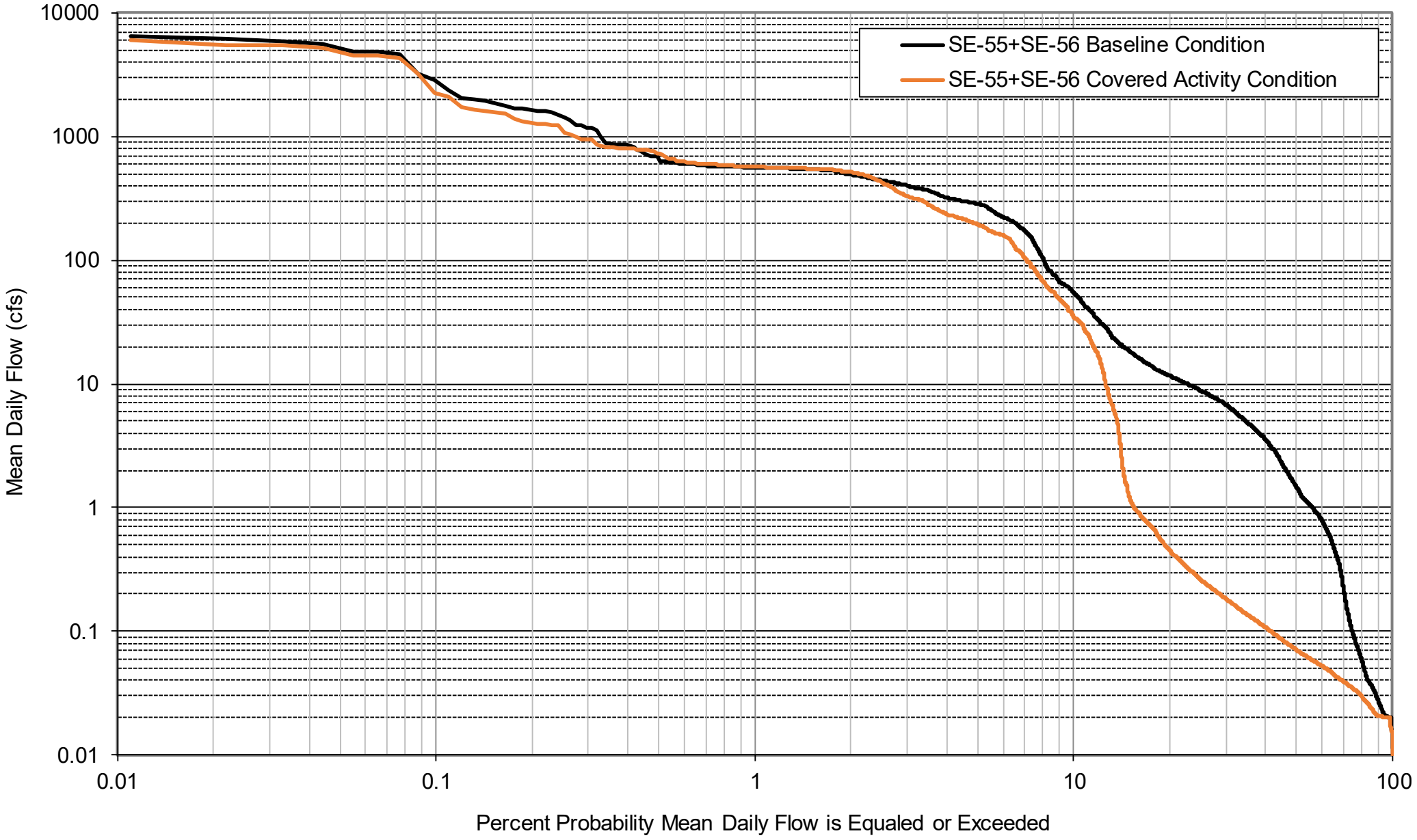


Figure D-4. Geoscience Nodes SE57+SE58 (E Low City Crk III + Mid SAR)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

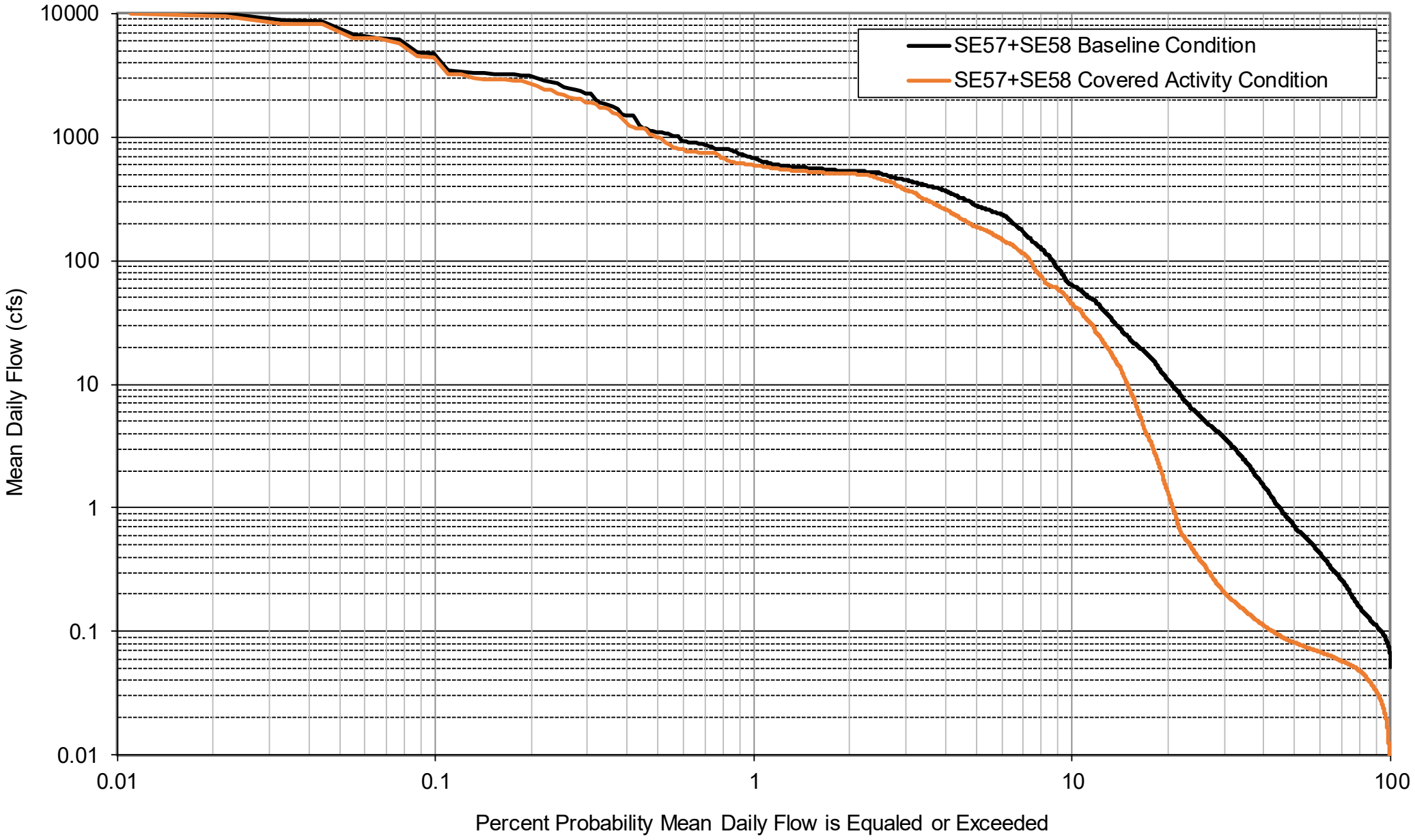


Figure D-5. Geoscience Node SE-74 (SAR E st)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

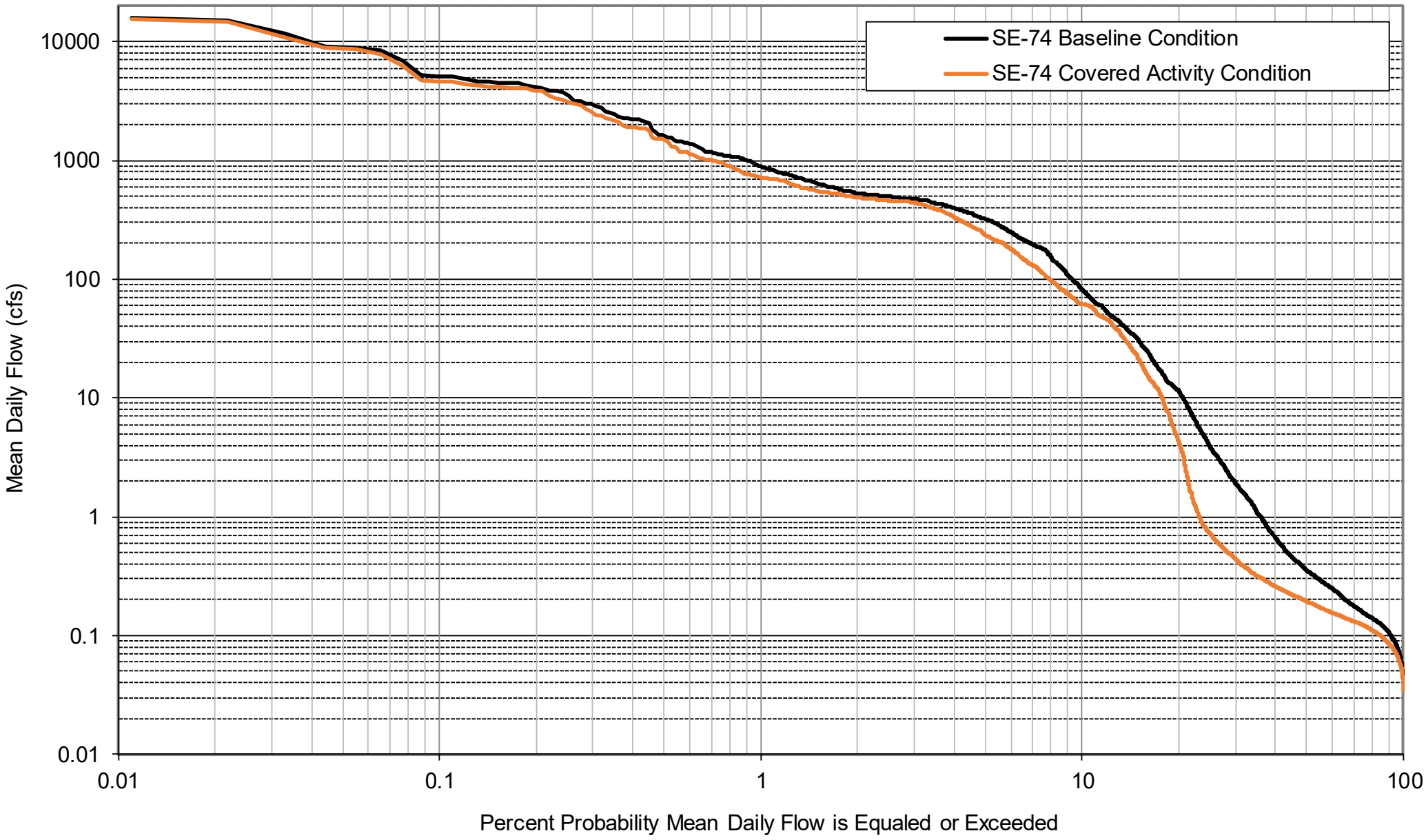


Figure D-6. Wildermuth Node NSAR20 (Santa Ana River)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

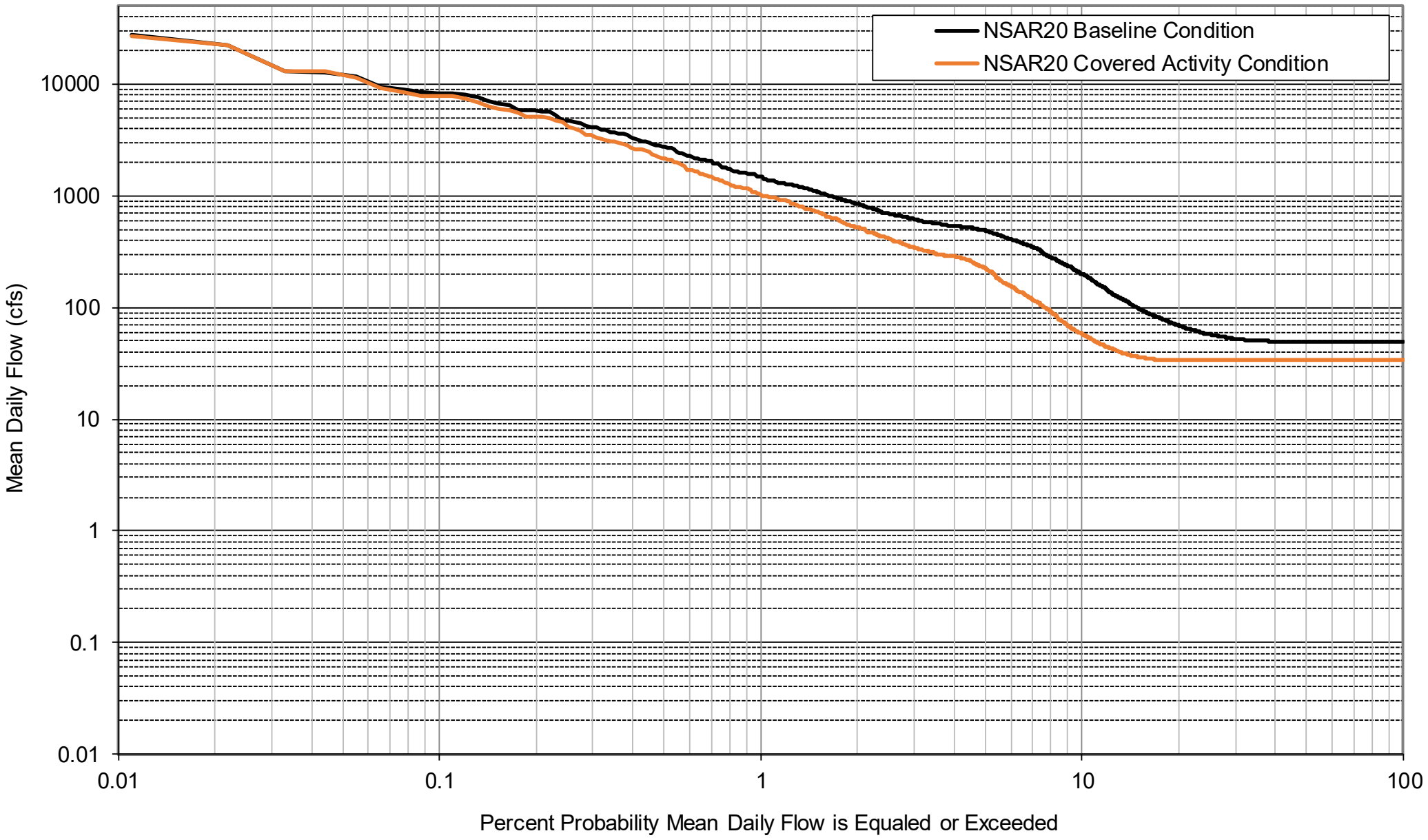


Figure D-7. Wildermuth Node NSAR232 (Santa Ana River)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

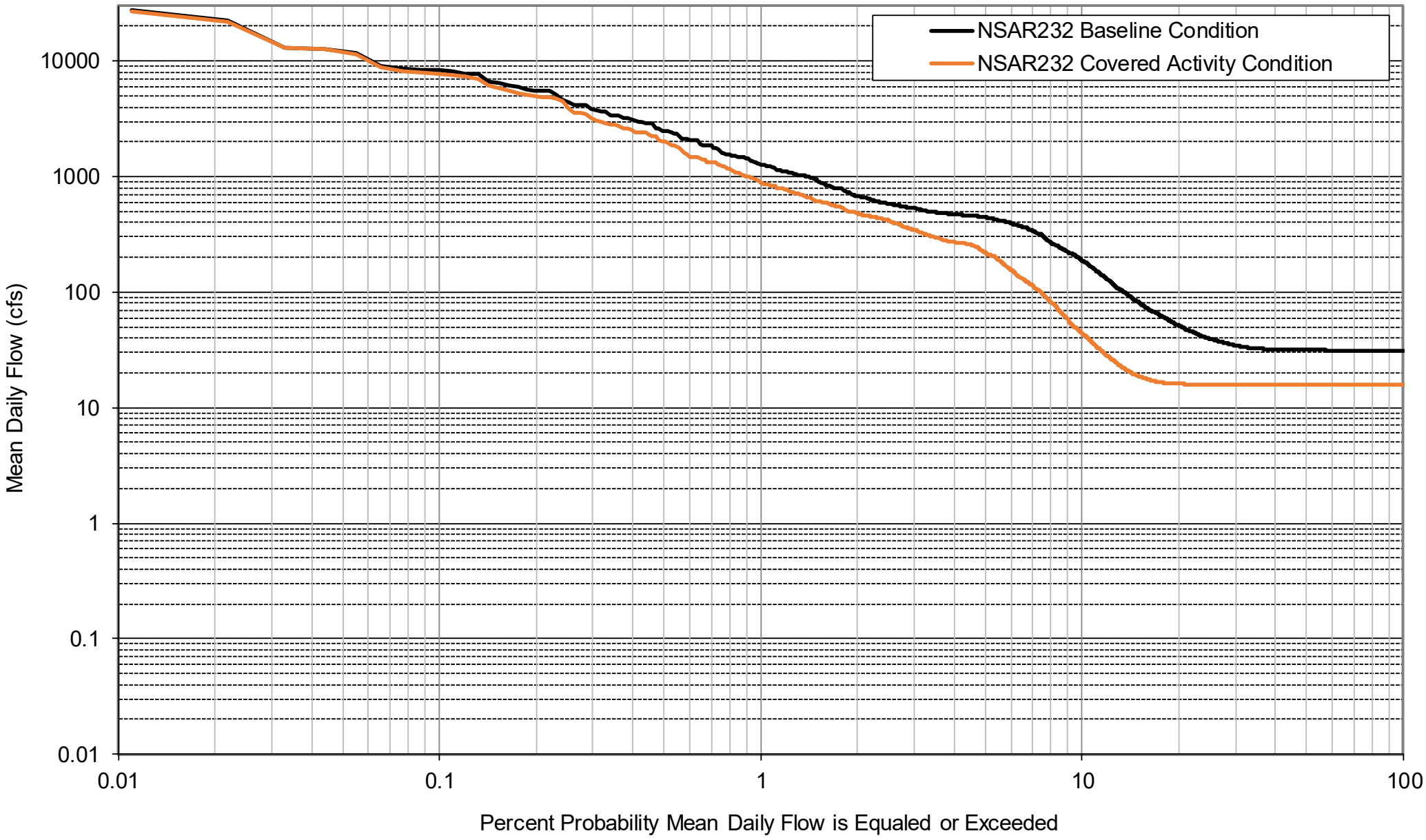


Figure D-8. Wildermuth Node NSAR351 (Santa Ana River)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

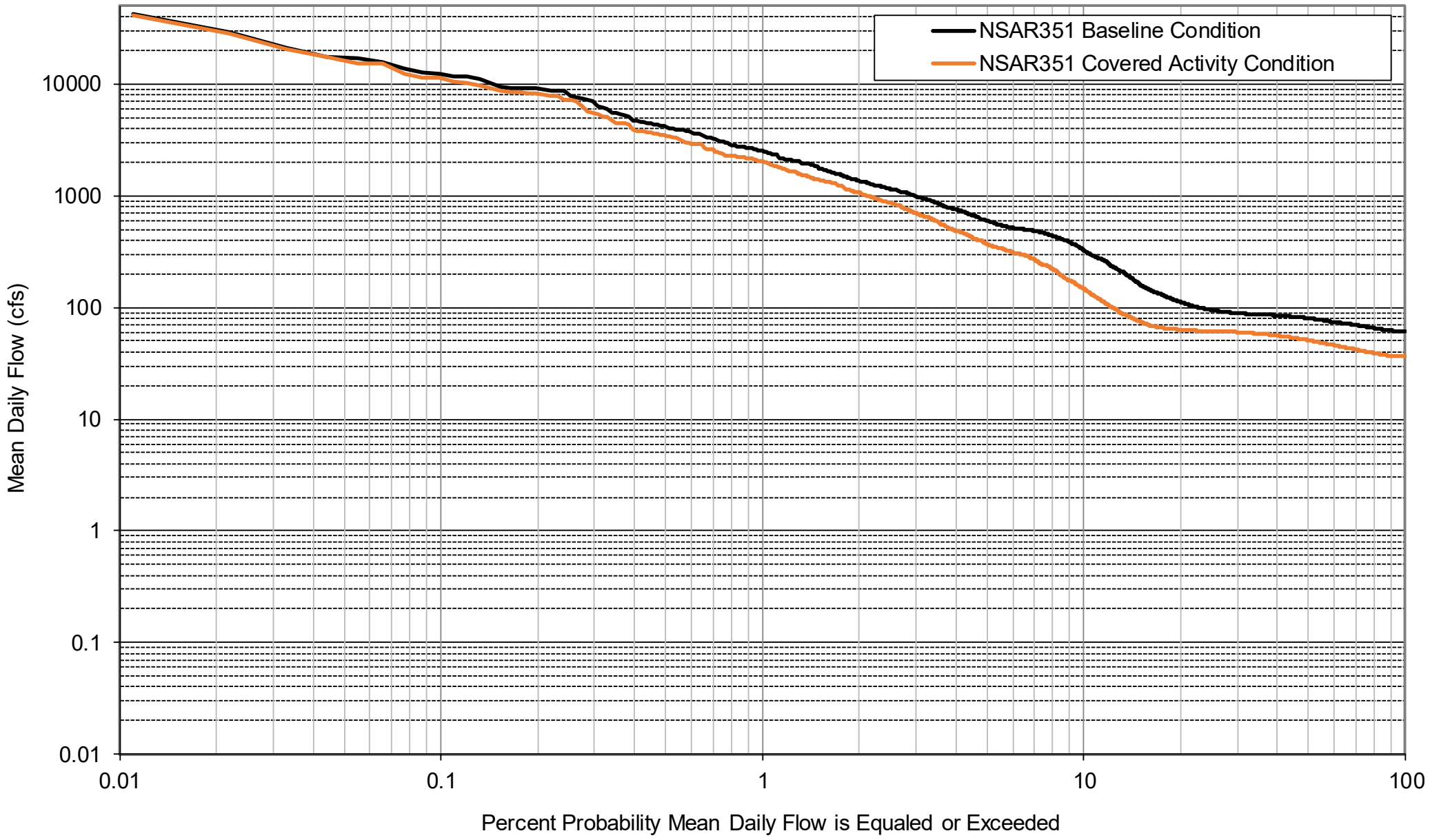


Figure D-9. Geoscience Node SE-56 (UP Mill Crk)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

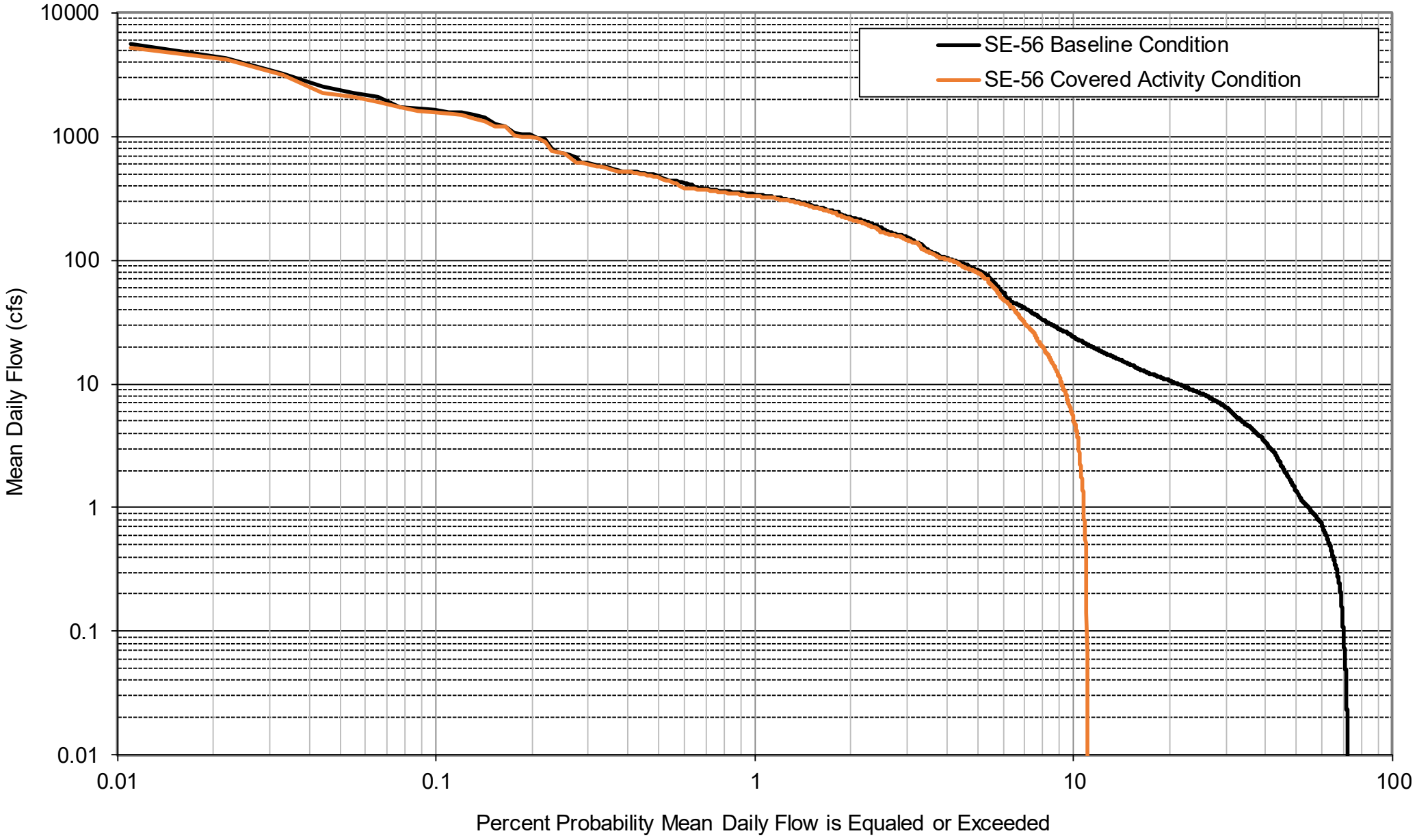


Figure D-10. Geoscience Node SE-39 (Mid City Crk)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

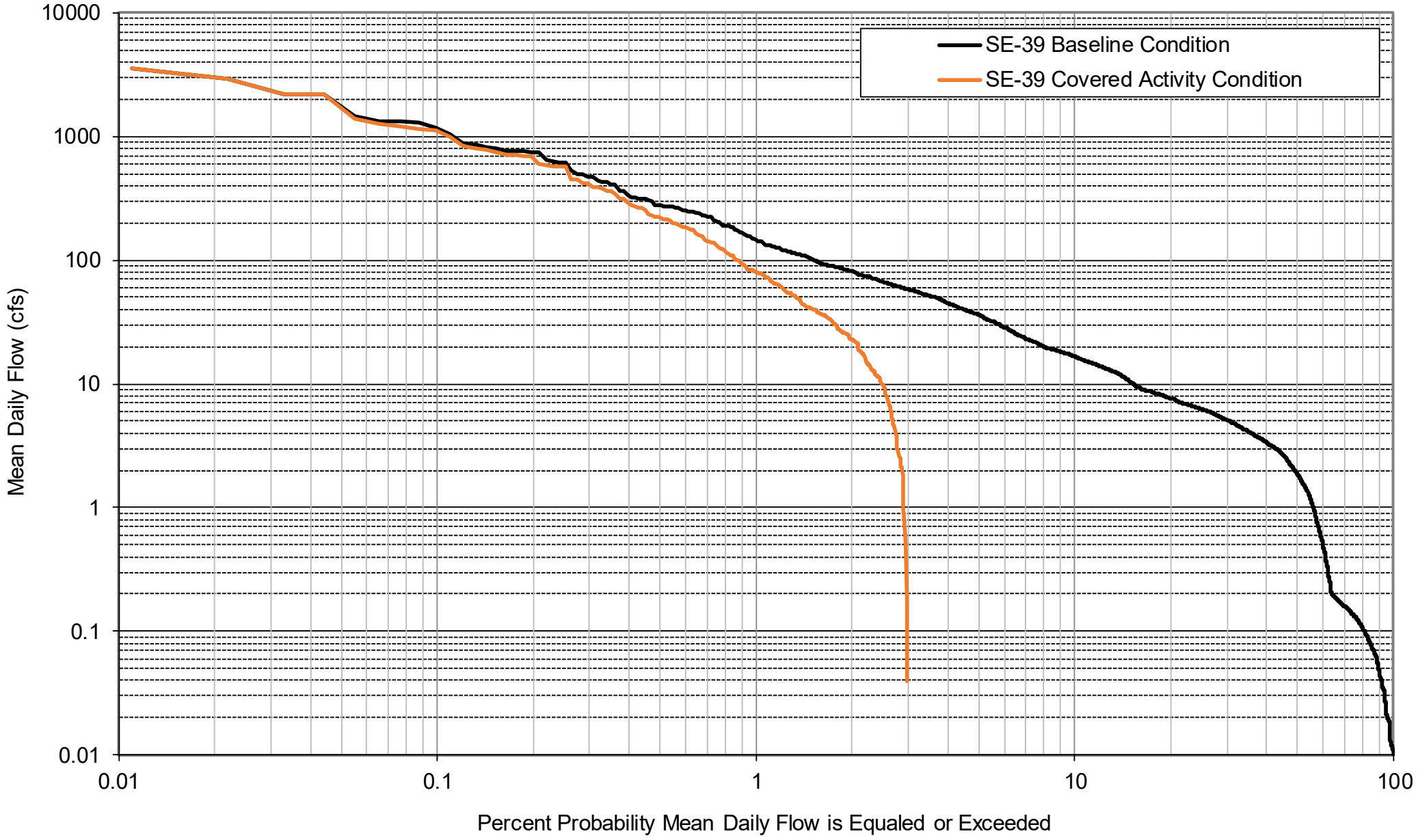


Figure D-11. Geoscience Node SE-49 (E Low City Crk II)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

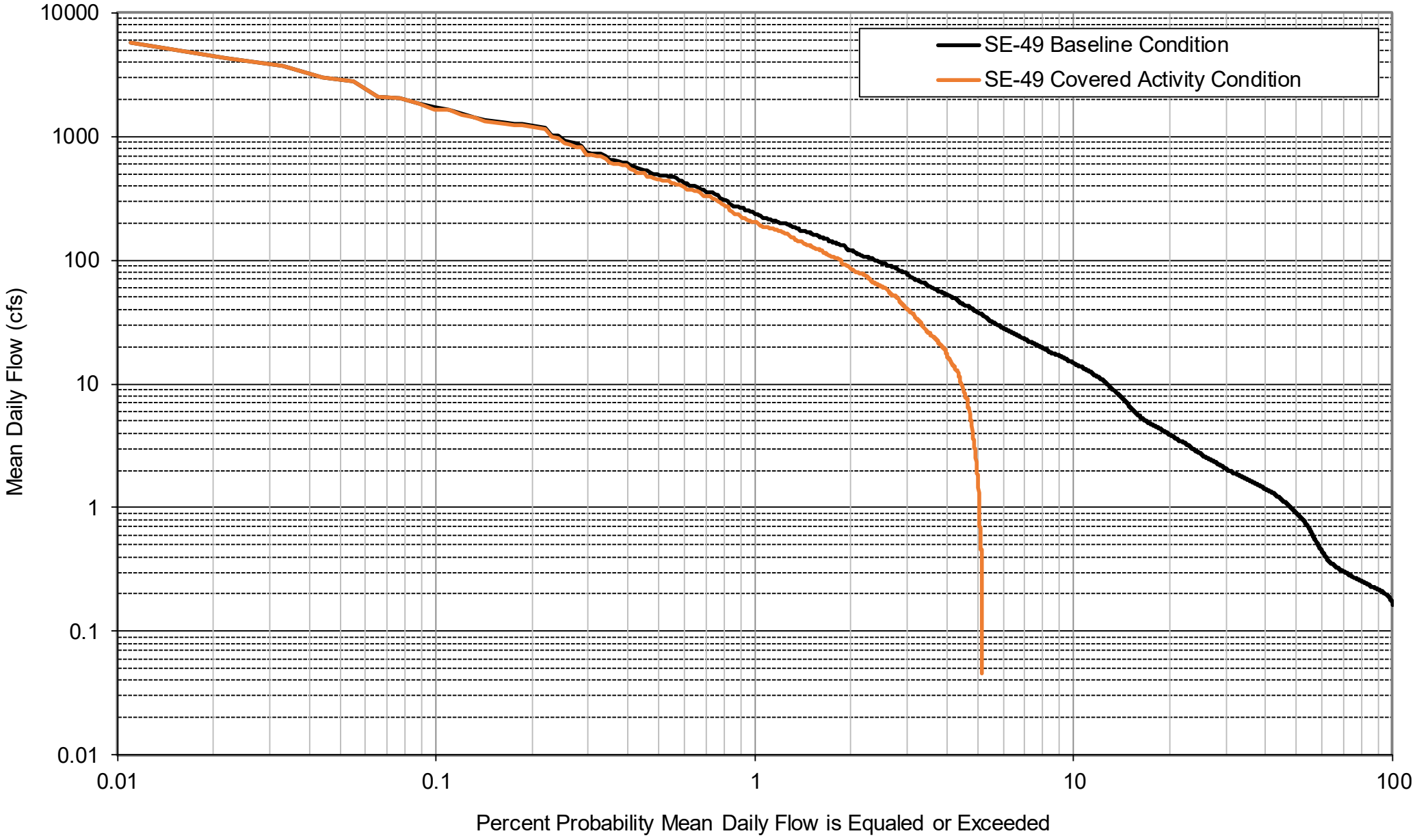


Figure D-12. Geoscience Node SE-57 (E Low City Crk III)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

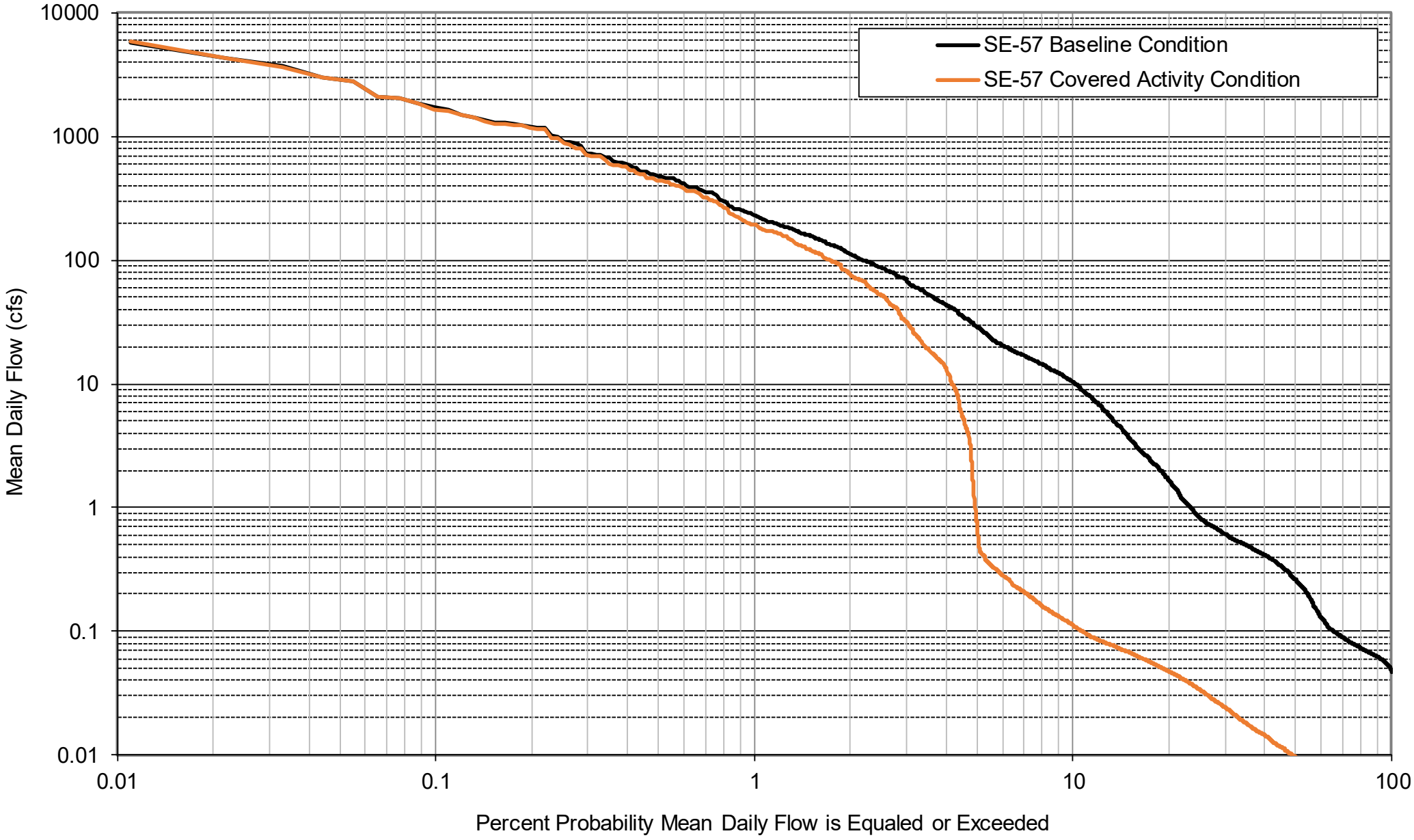


Figure D-13. Geoscience Node NW-20 (Upper Lytle Crk)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

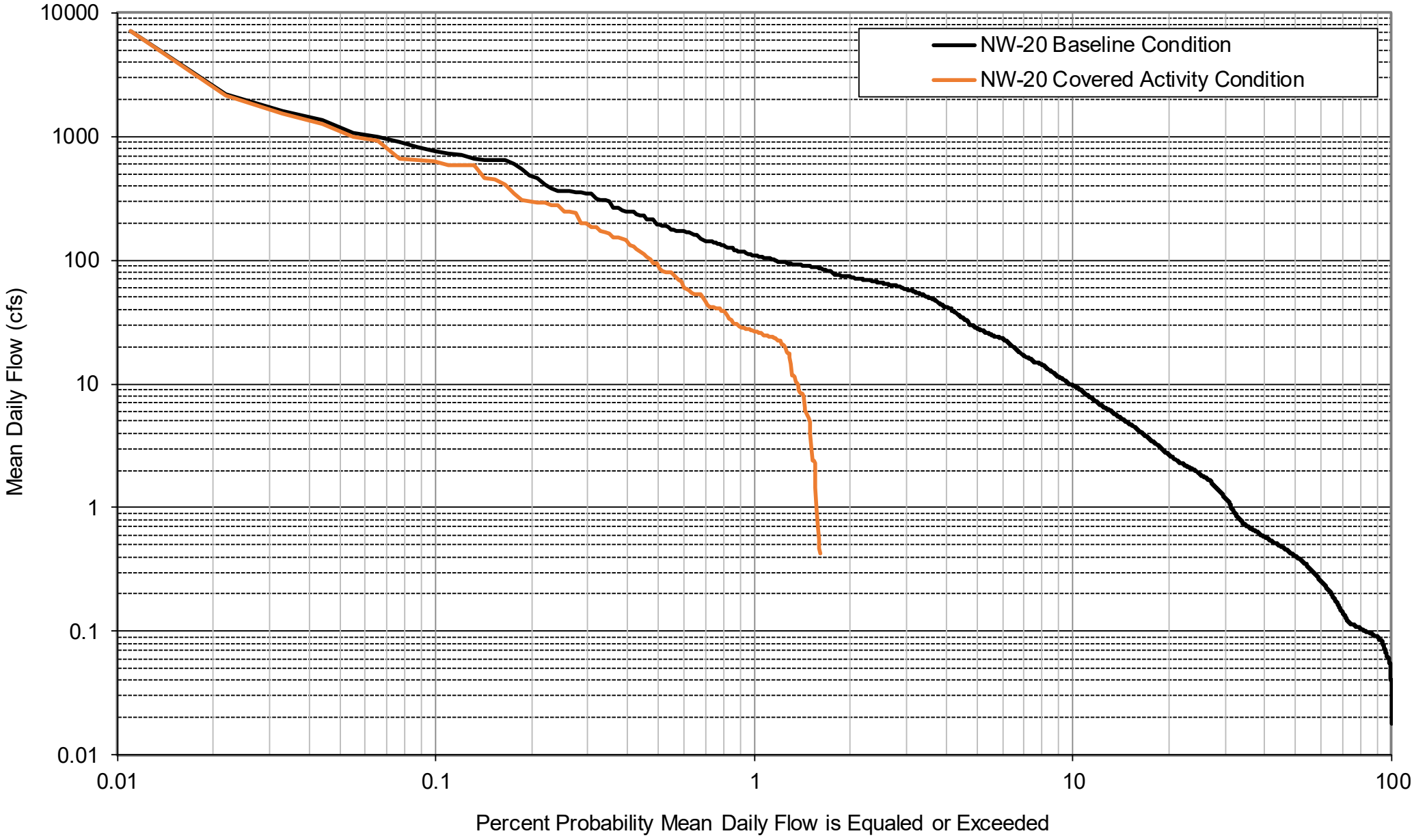


Figure D-14. Geoscience Node NW-26 (Lower Lytle Crk)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

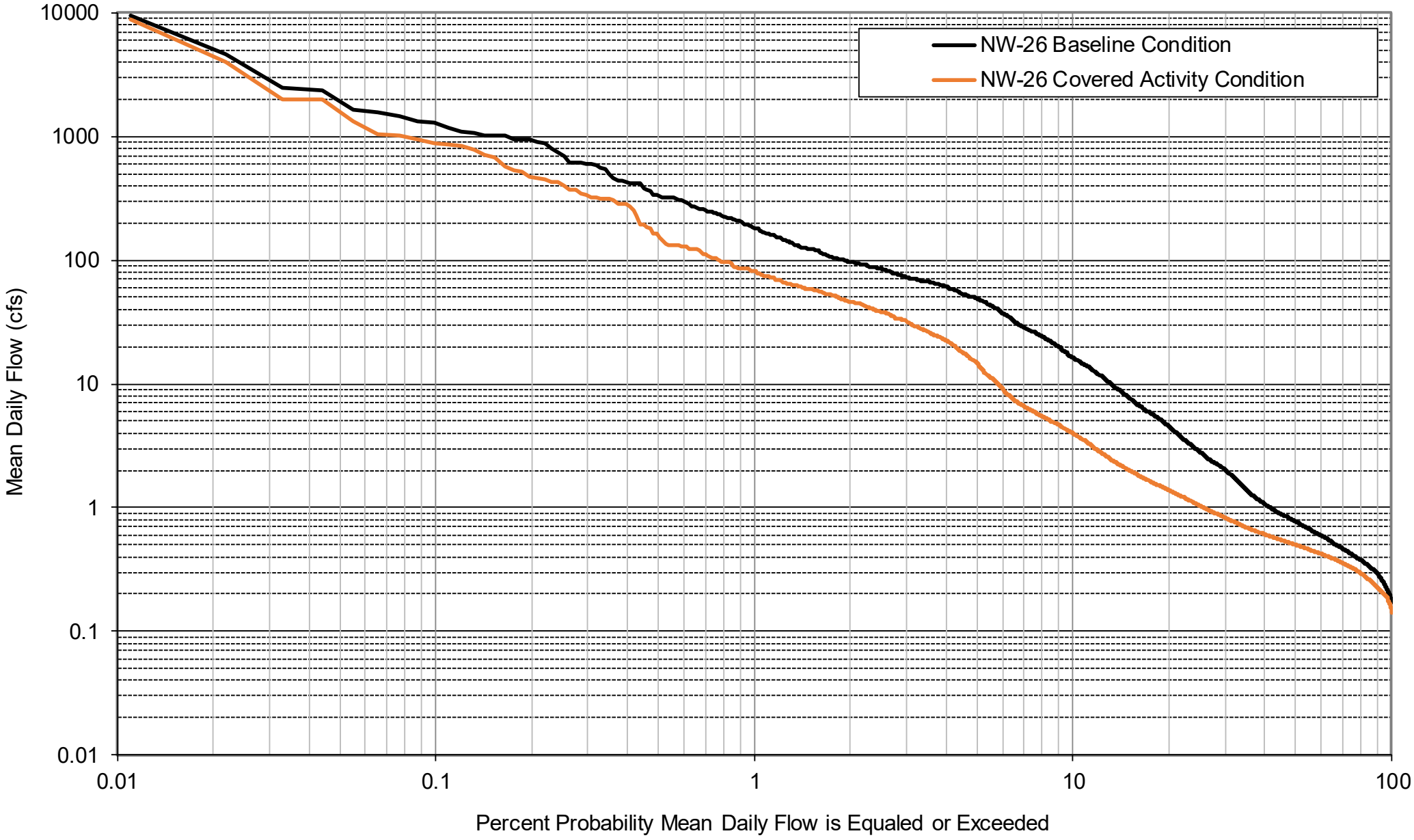


Figure D-15. Geoscience Node NW-18 (Upper Cajon Crk)

Annual Flow Duration Curve for HCP Baseline Hydrology Period 1966-1990

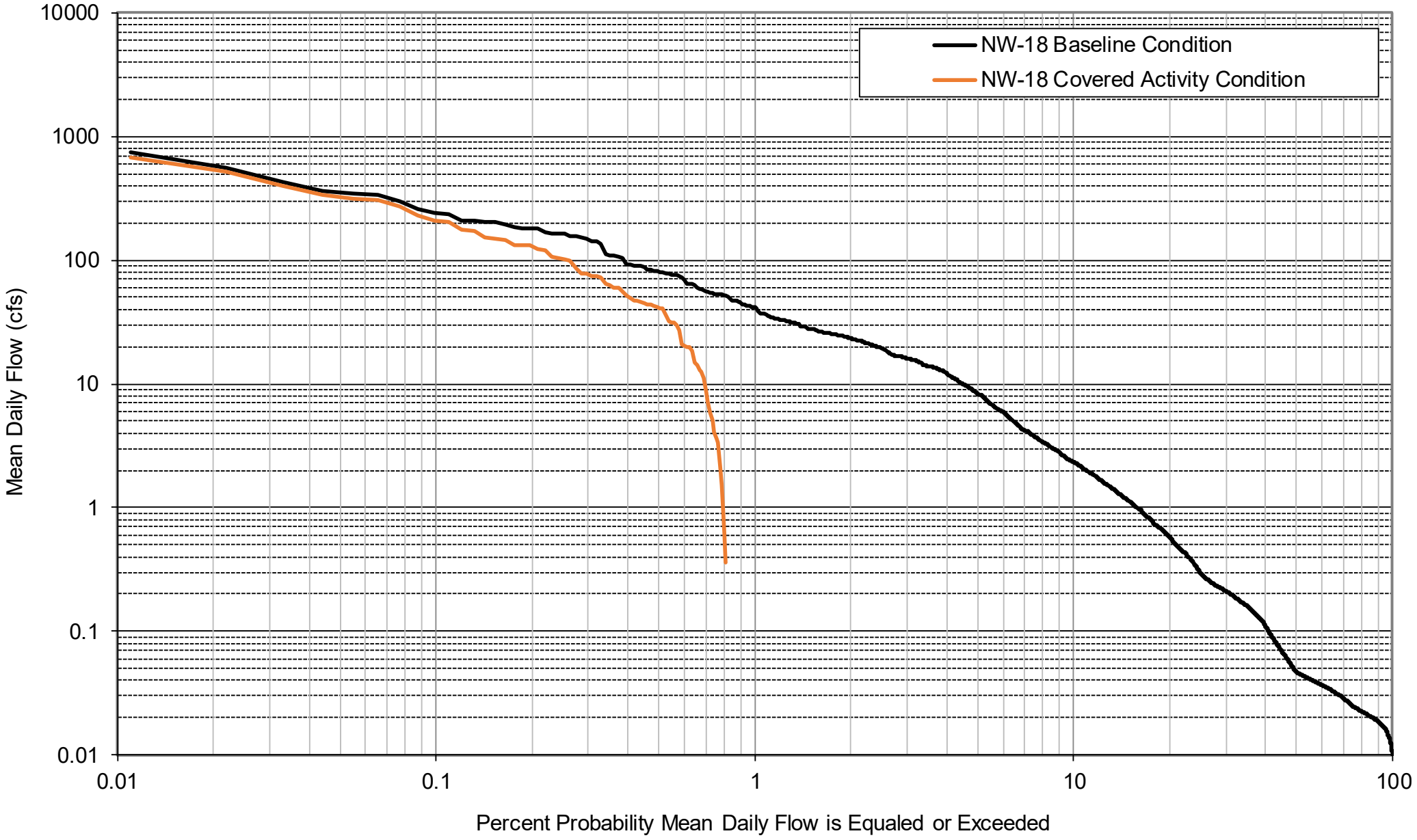


Figure D-16. Santa Ana River Upstream of Greenspot Rd

Wilcock & Crowe (2003) - Modeled Fractional Bed Load per Wetted Width

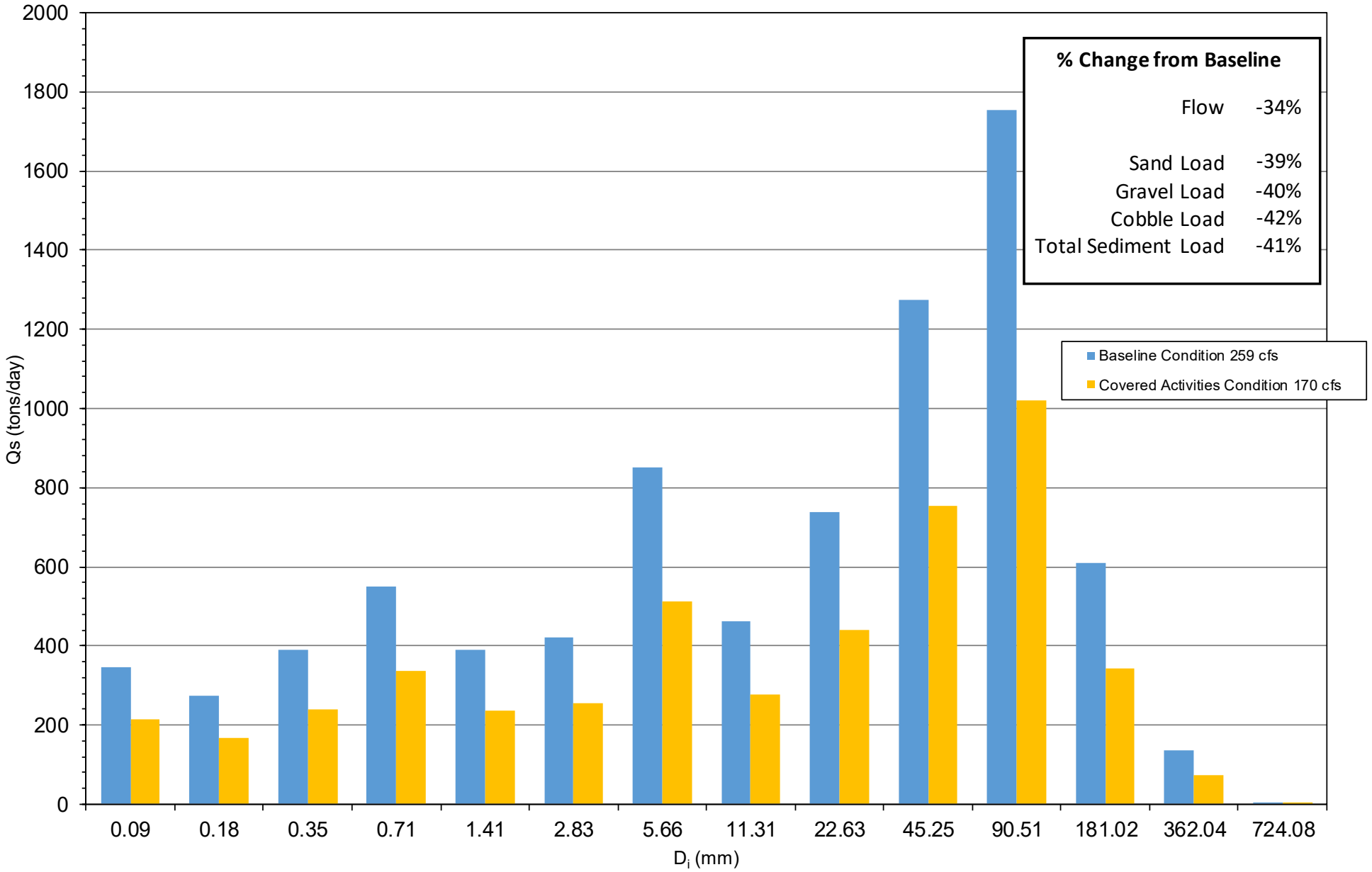


Figure D-17. Santa Ana River Downstream of Mill Creek

Wilcock & Crowe (2003) - Modeled Fractional Bed Load per Wetted Width

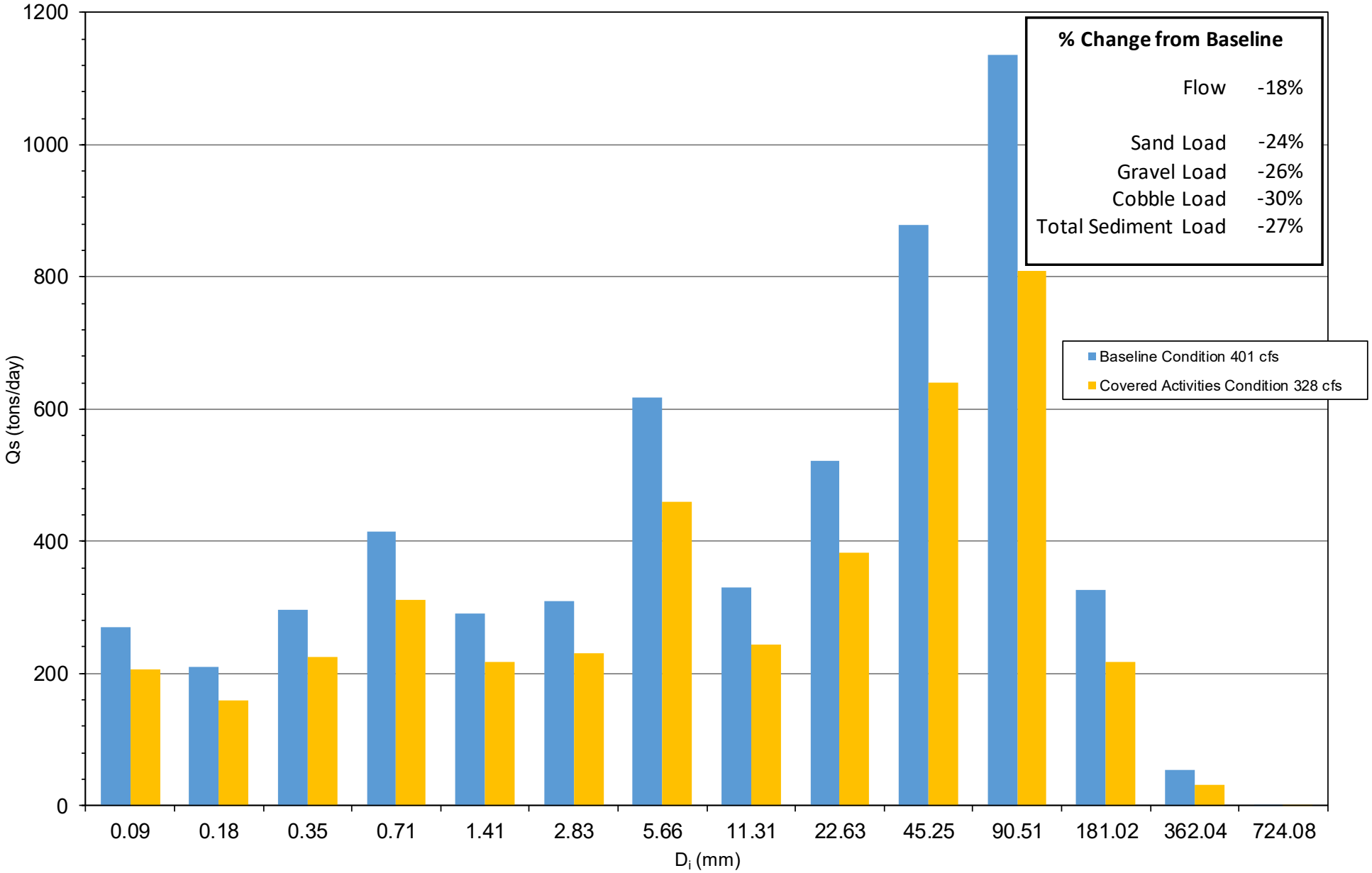


Figure D-18. Santa Ana River Upstream of East Twin Creek

Wilcock & Crowe (2003) - Modeled Fractional Bed Load per Wetted Width

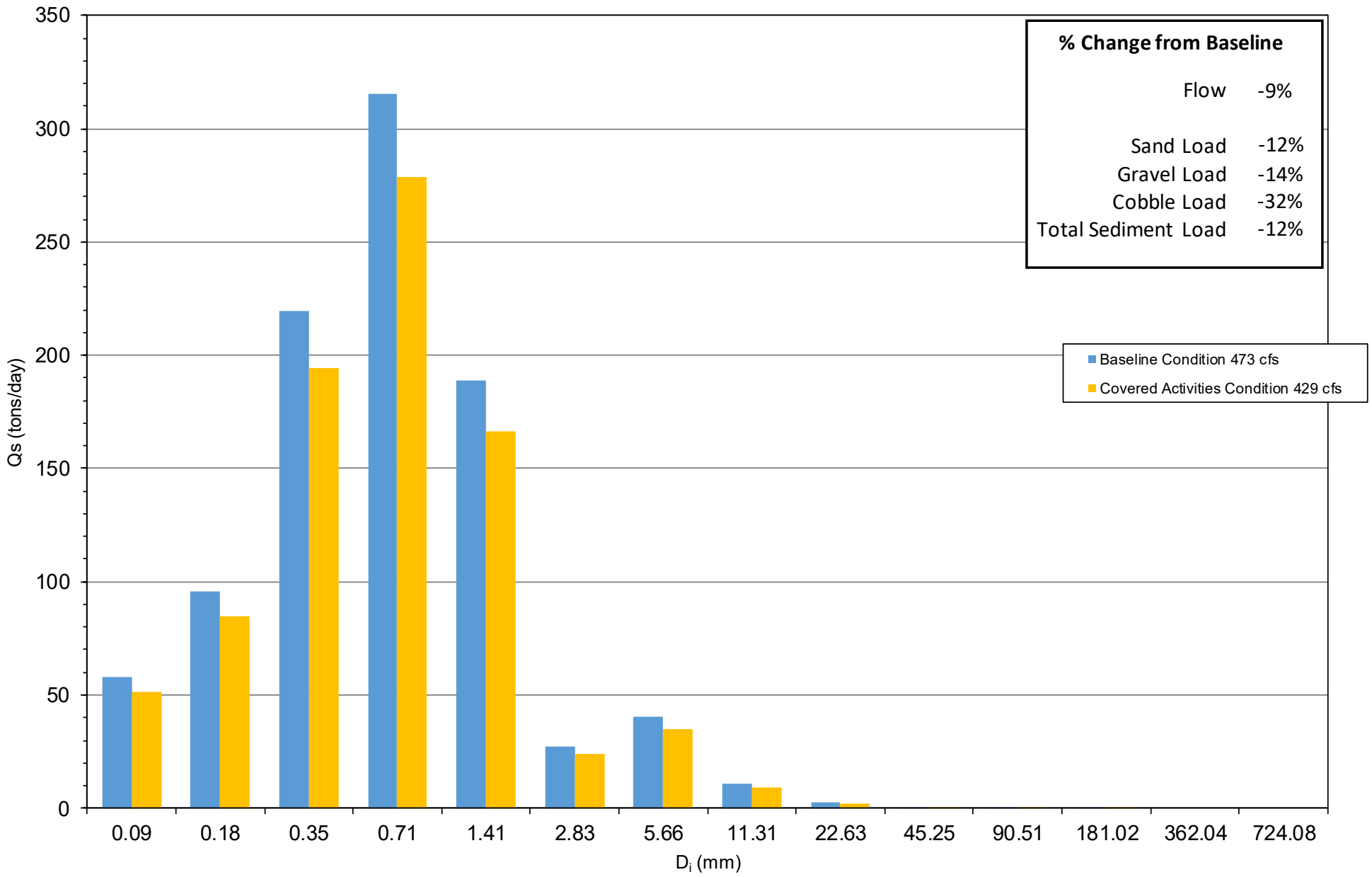


Figure D-19. Santa Ana River USGS Reach 9 Downstream of RIX

Wilcock & Crowe (2003) - Modeled Fractional Bed Load per Wetted Width

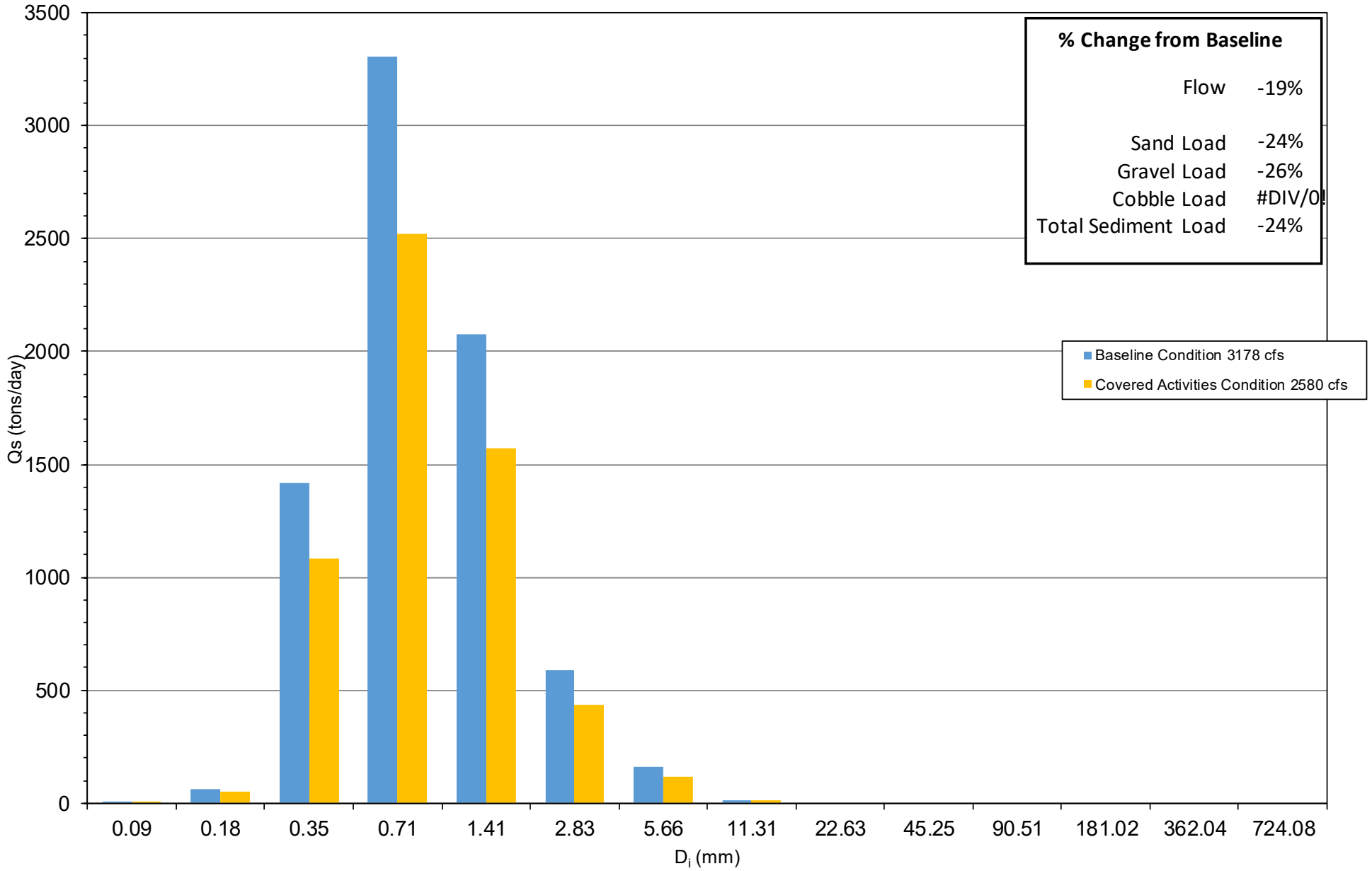


Figure D-20. ESA Middle Reach

Wilcock & Crowe (2003) - Modeled Fractional Bed Loads per Wetted Width

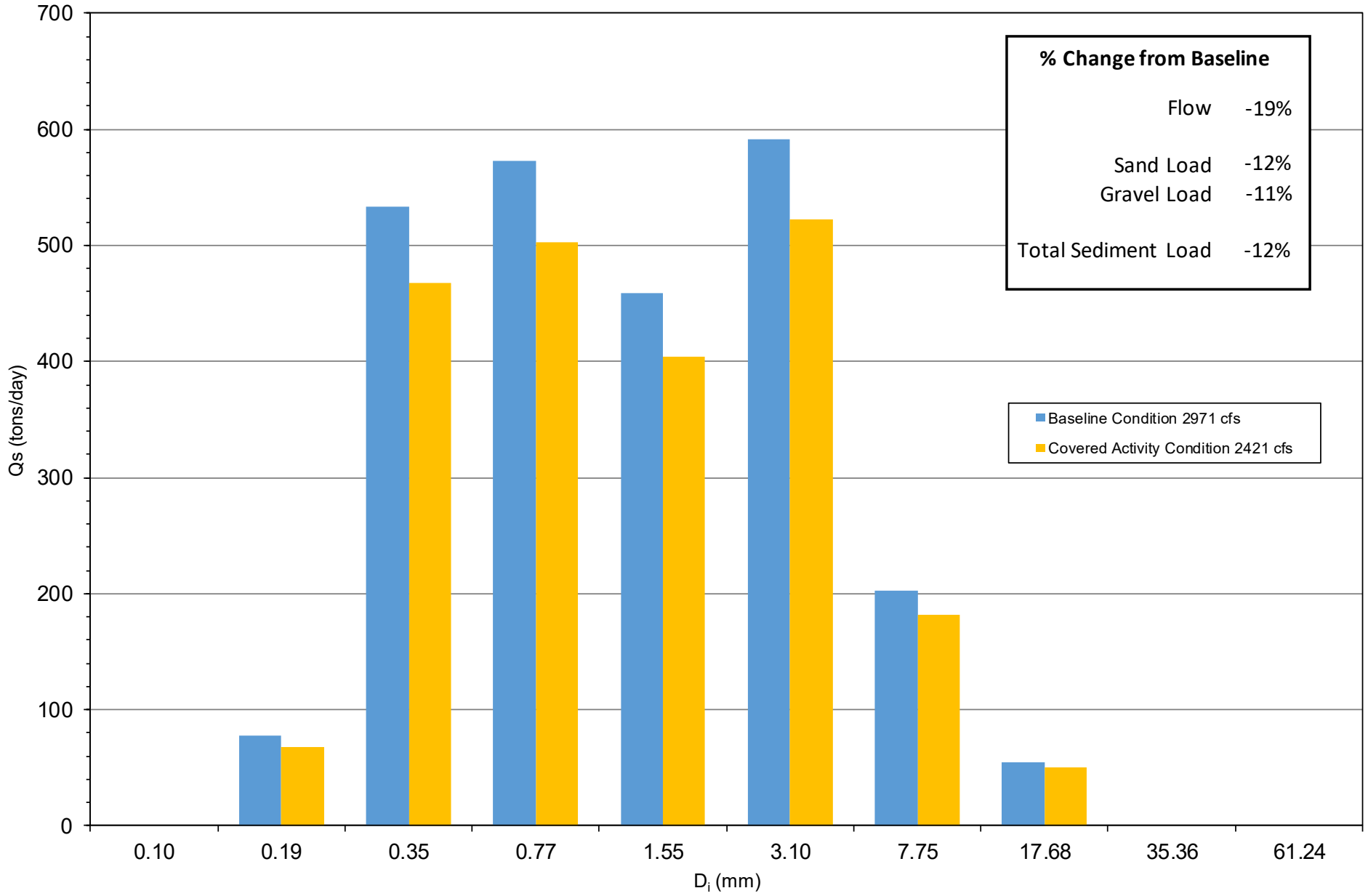


Figure D-21. Santa Ana River Site 3A Downstream of I-15

Wilcock & Crowe (2003) - Modeled Fractional Bed Load per Wetted Width

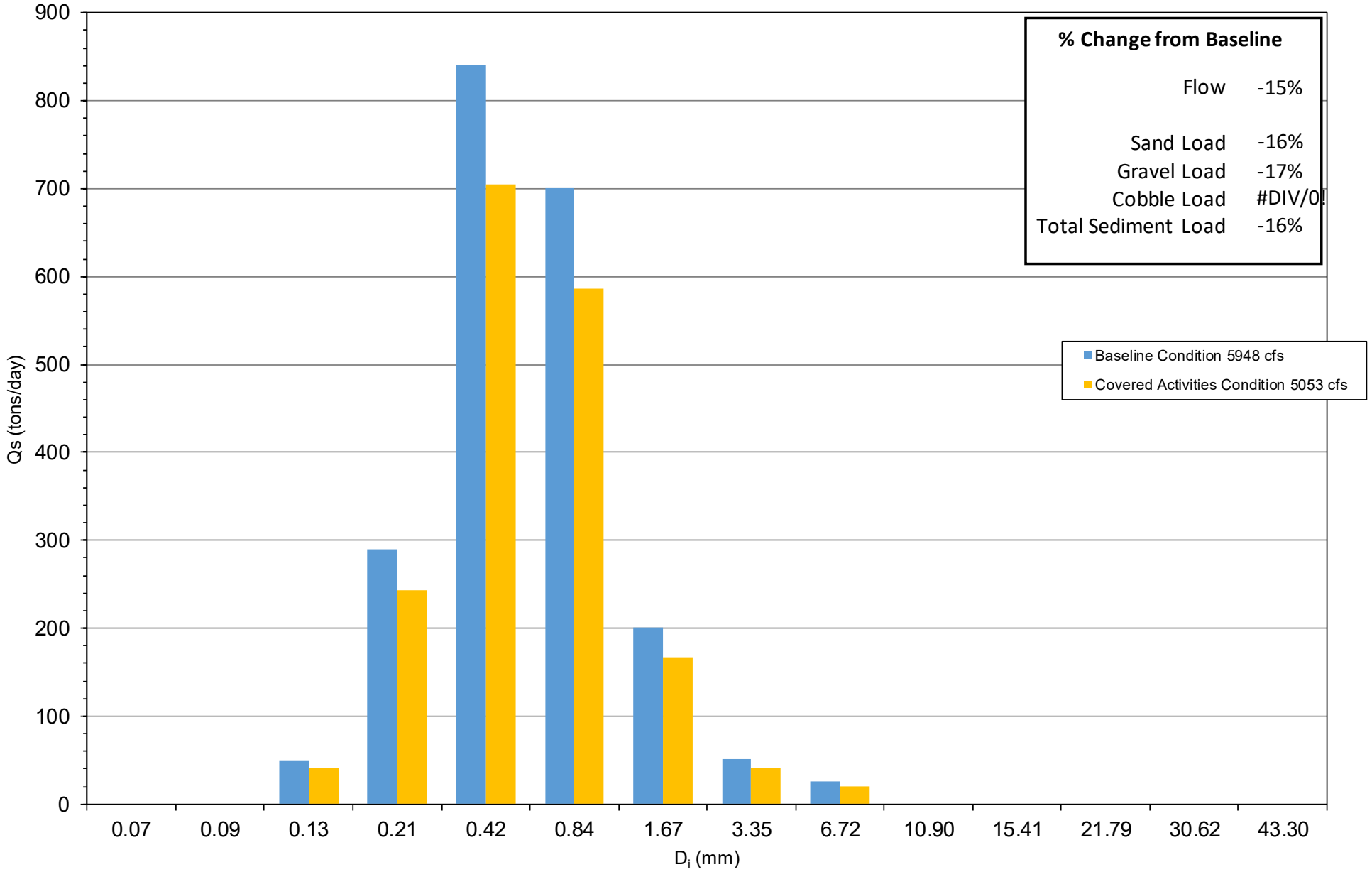


Figure D-22. Lower City Creek

Wilcock & Crowe (2003) - Modeled Fractional Bed Loads per Wetted Width

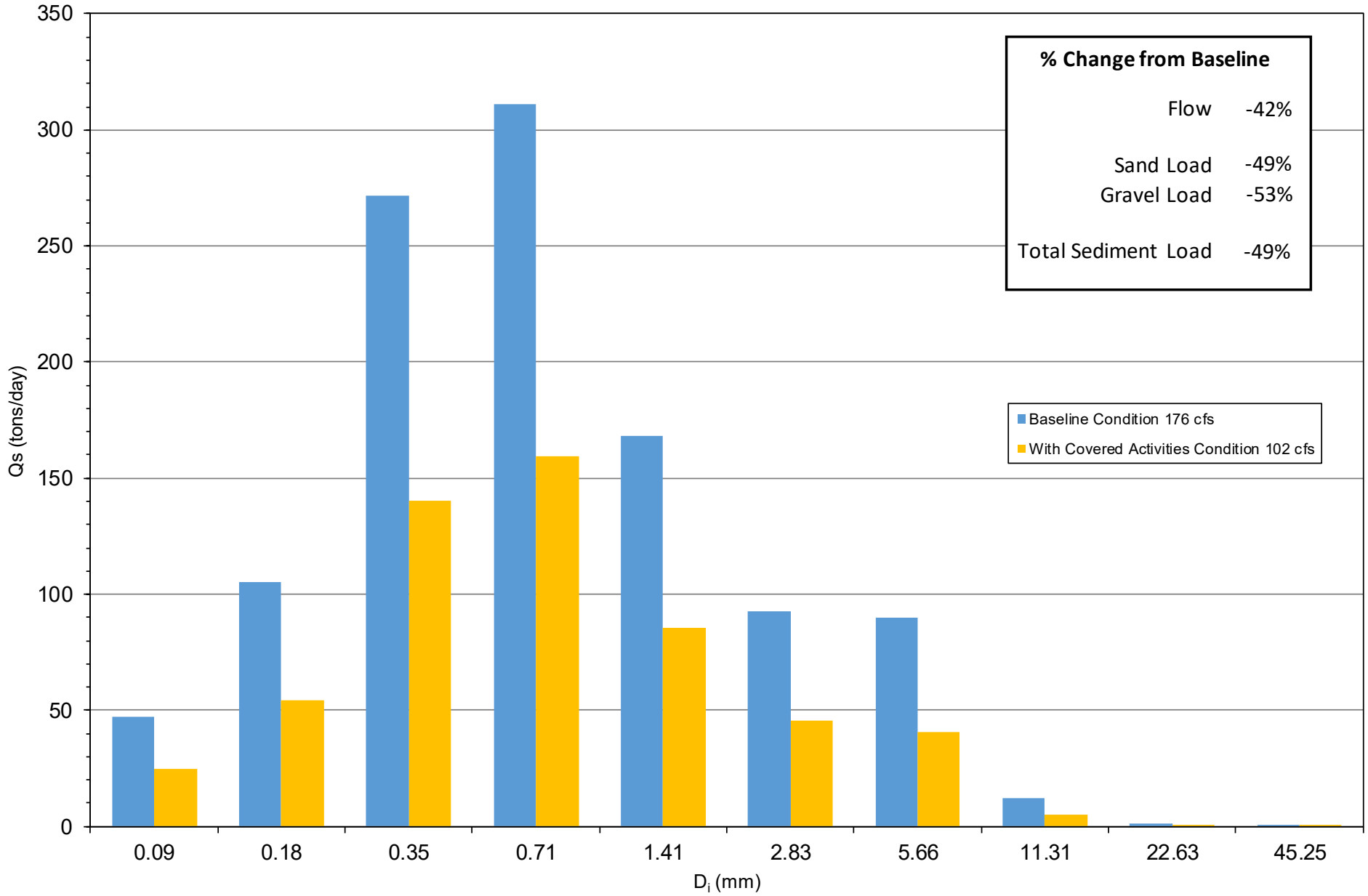


Figure D-23. Lytle Creek Upstream of Cajon Wash

Wilcock & Crowe (2003) - Modeled Fractional Bed Load per Wetted Width

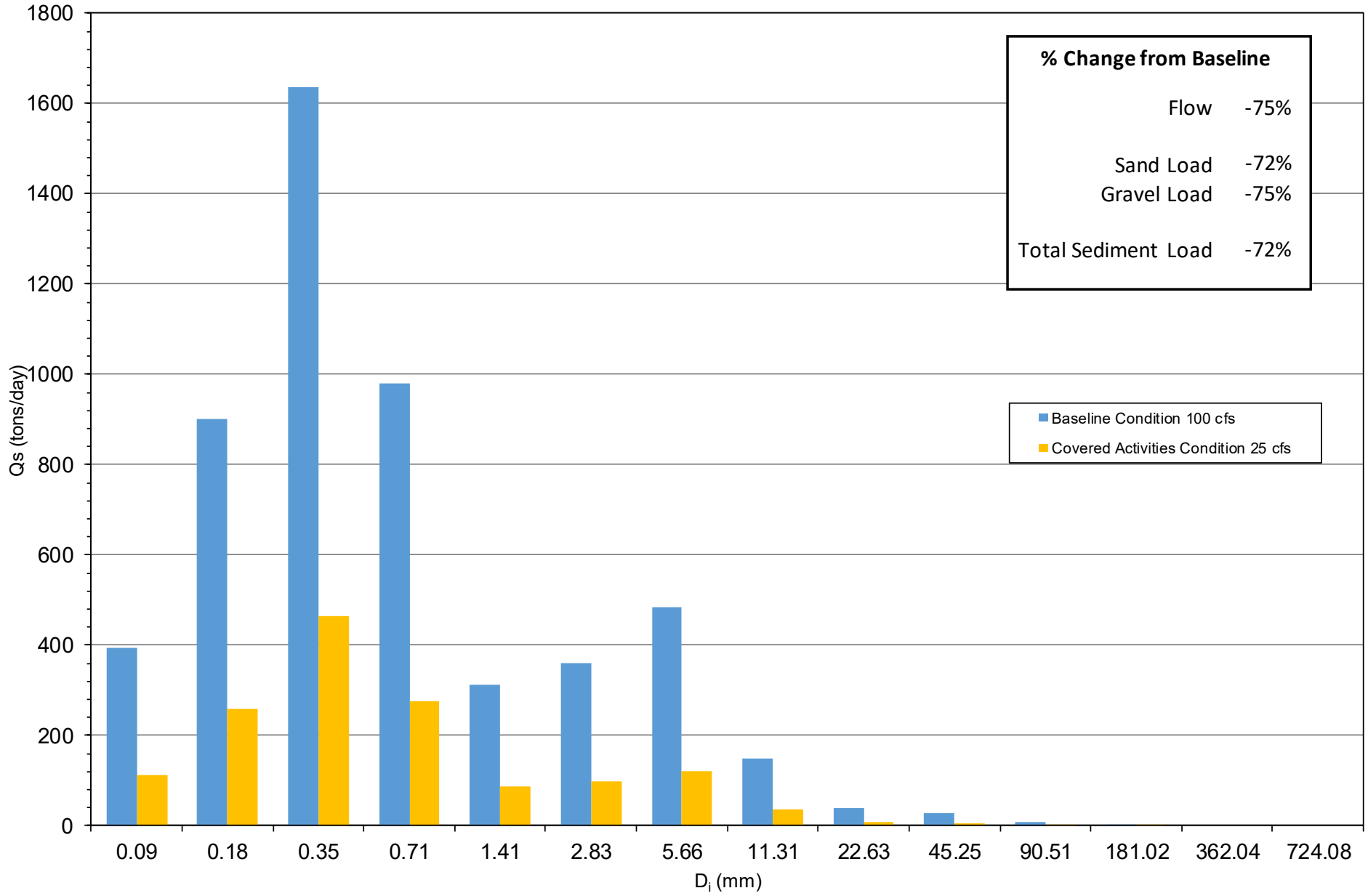


Figure D-24. Lytle Creek Upstream of Base Line St

Wilcock & Crowe (2003) - Modeled Fractional Bed Load per Wetted Width

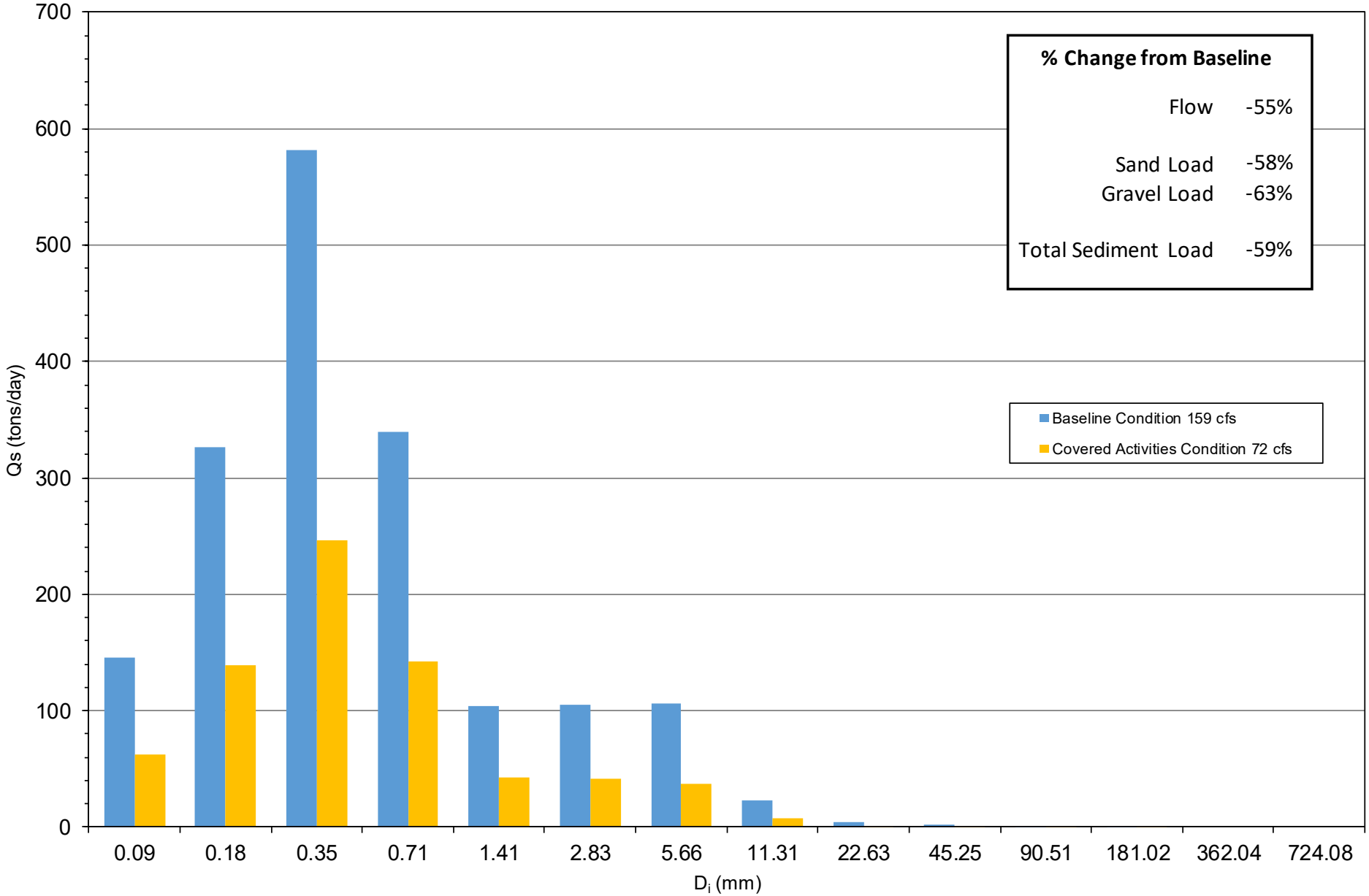


Figure D-25. Cajon Wash

Wilcock & Crowe (2003) - Modeled Fractional Bed Load per Wetted Width

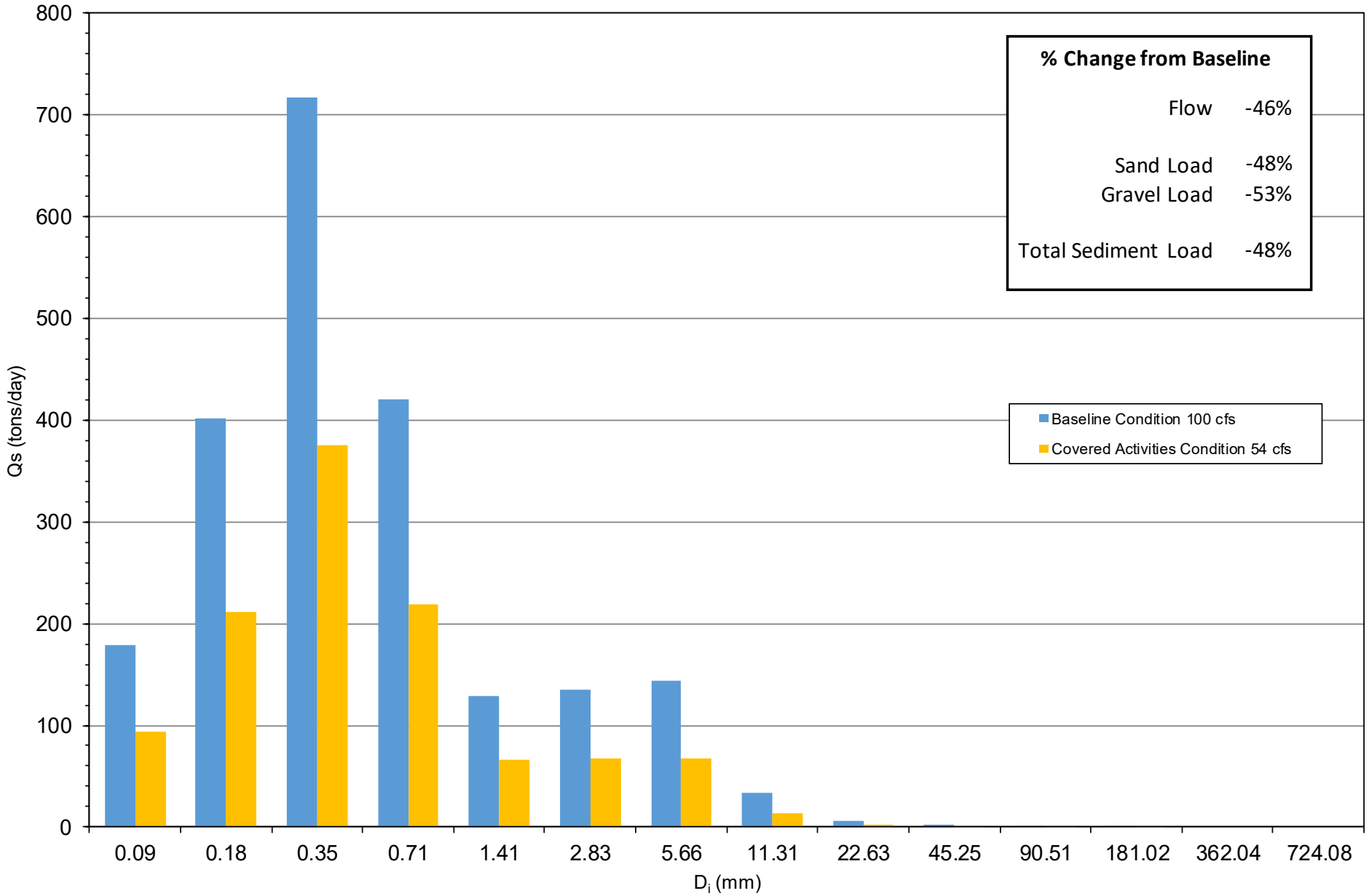


Figure D-26. Santa Ana River DS Seven Oaks Dam Modeled Bedload Transport Rating Curve

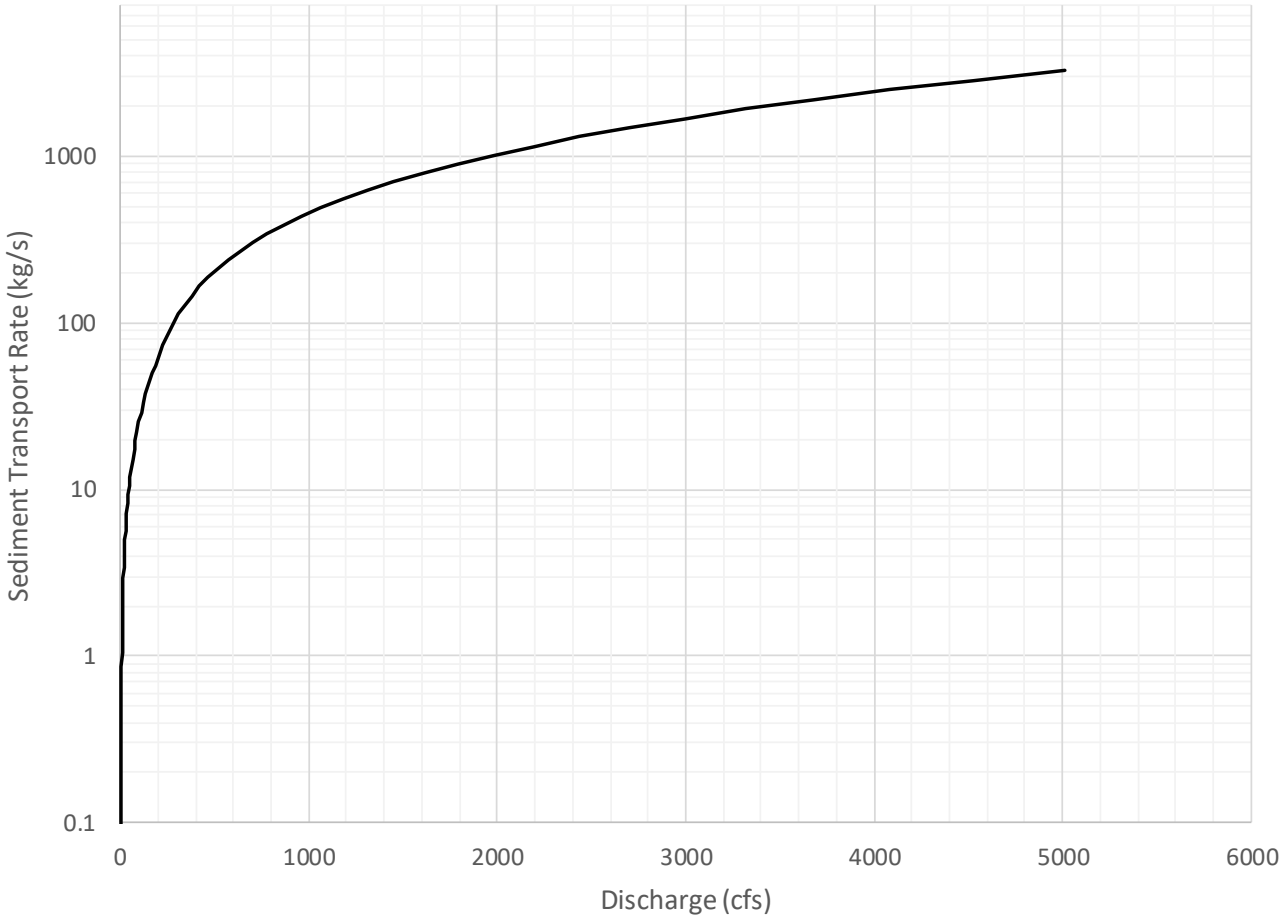


Figure D-27. Santa Ana River US East Twin Creek Modeled Bedload Transport Rating Curve

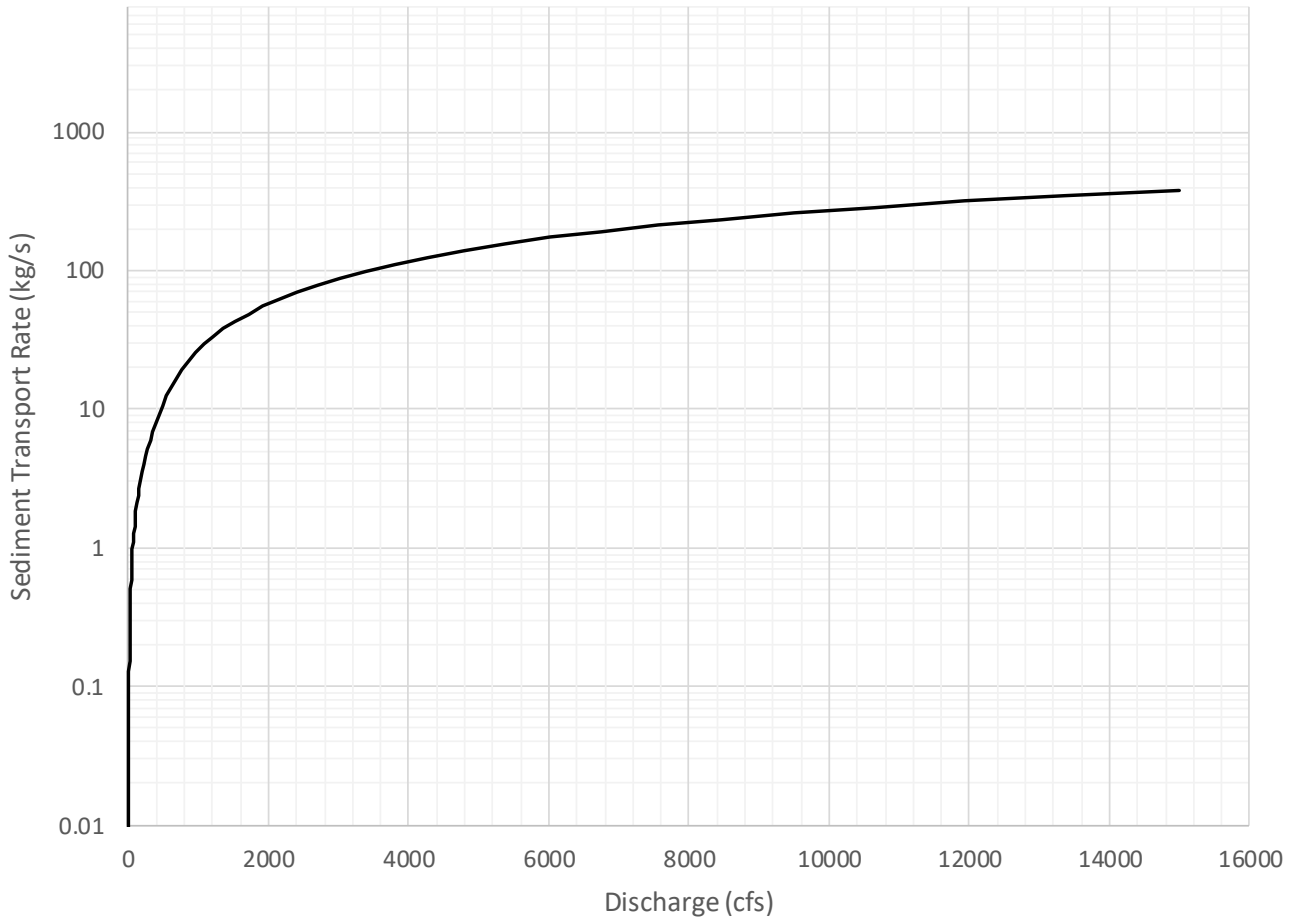


Figure D-28. Santa Ana River DS of RIX (USGS Reach 9) Modeled Bedload Transport Rating Curve

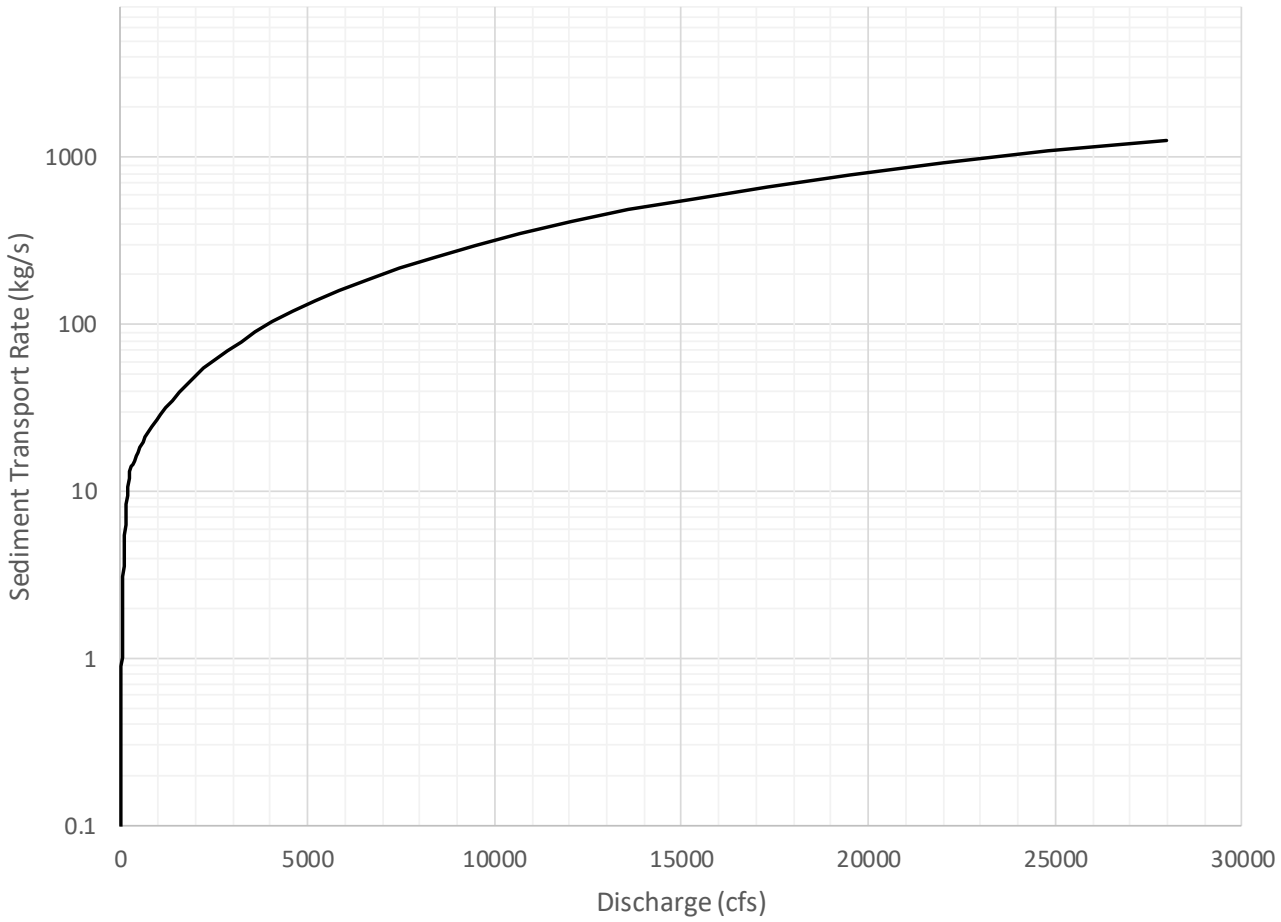


Figure D-29. Mill Creek Modeled Bedload Transport Rating Curve

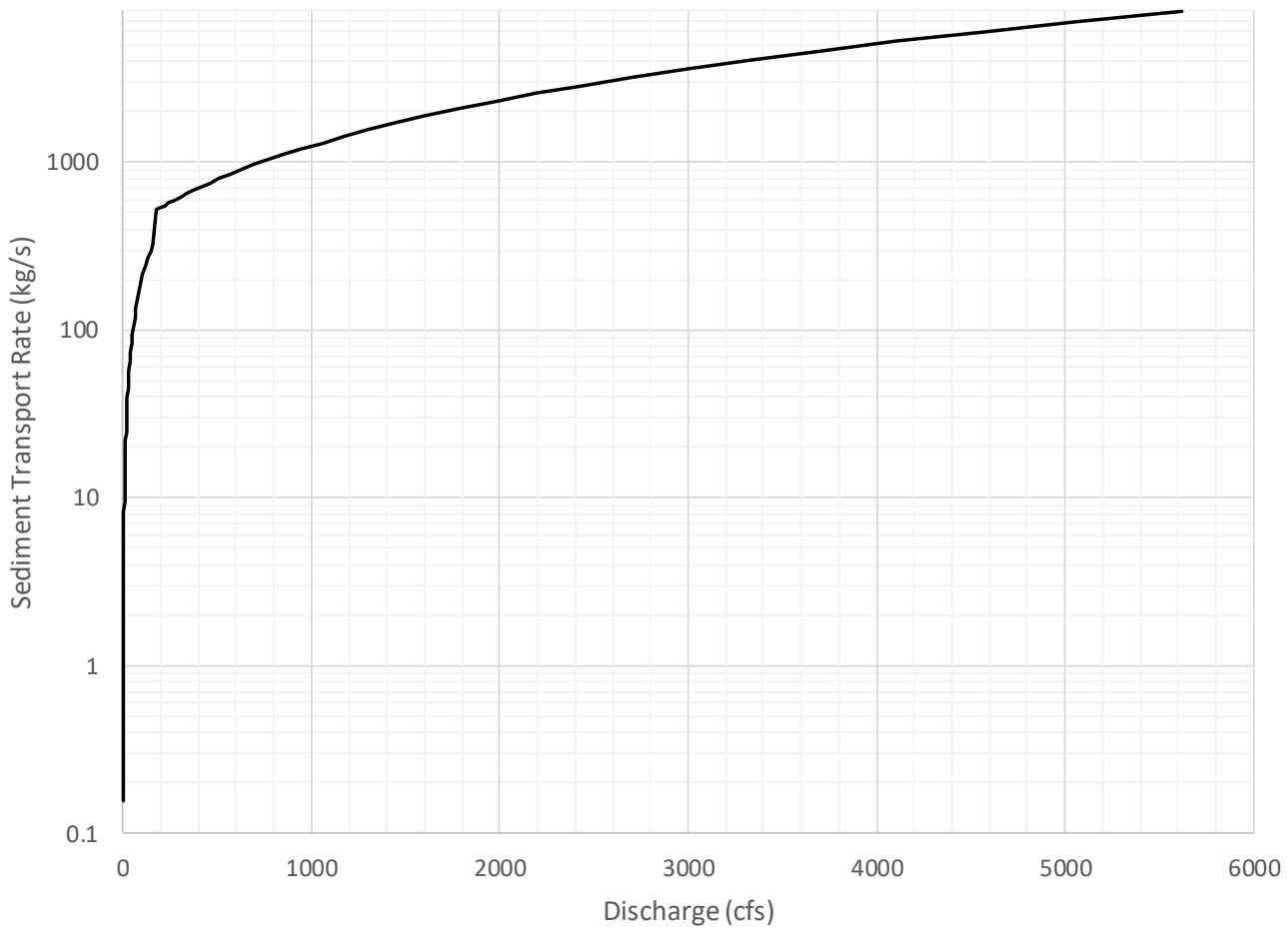


Figure D-30. Lower City Creek Modeled Bedload Transport Rating Curve

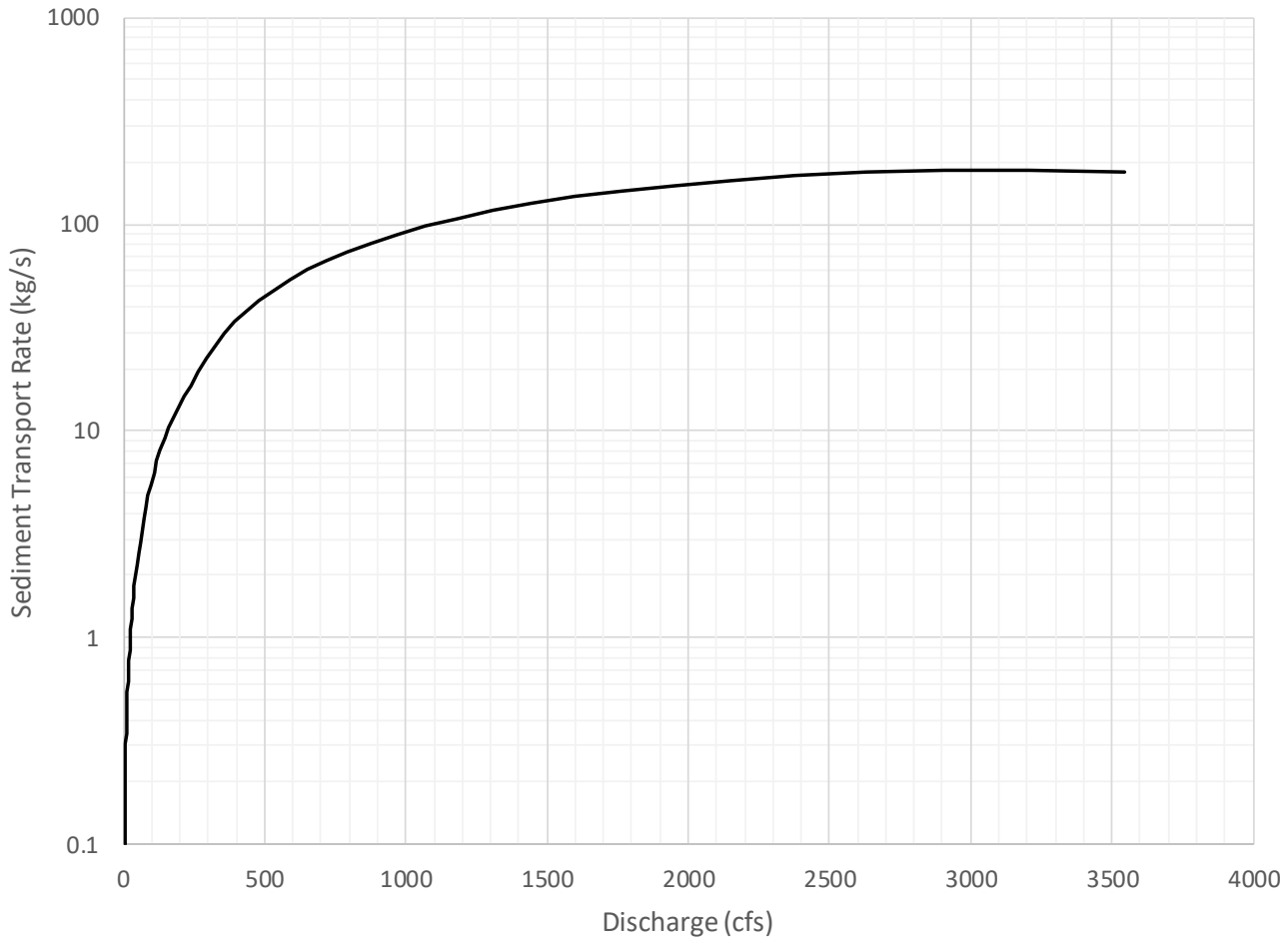
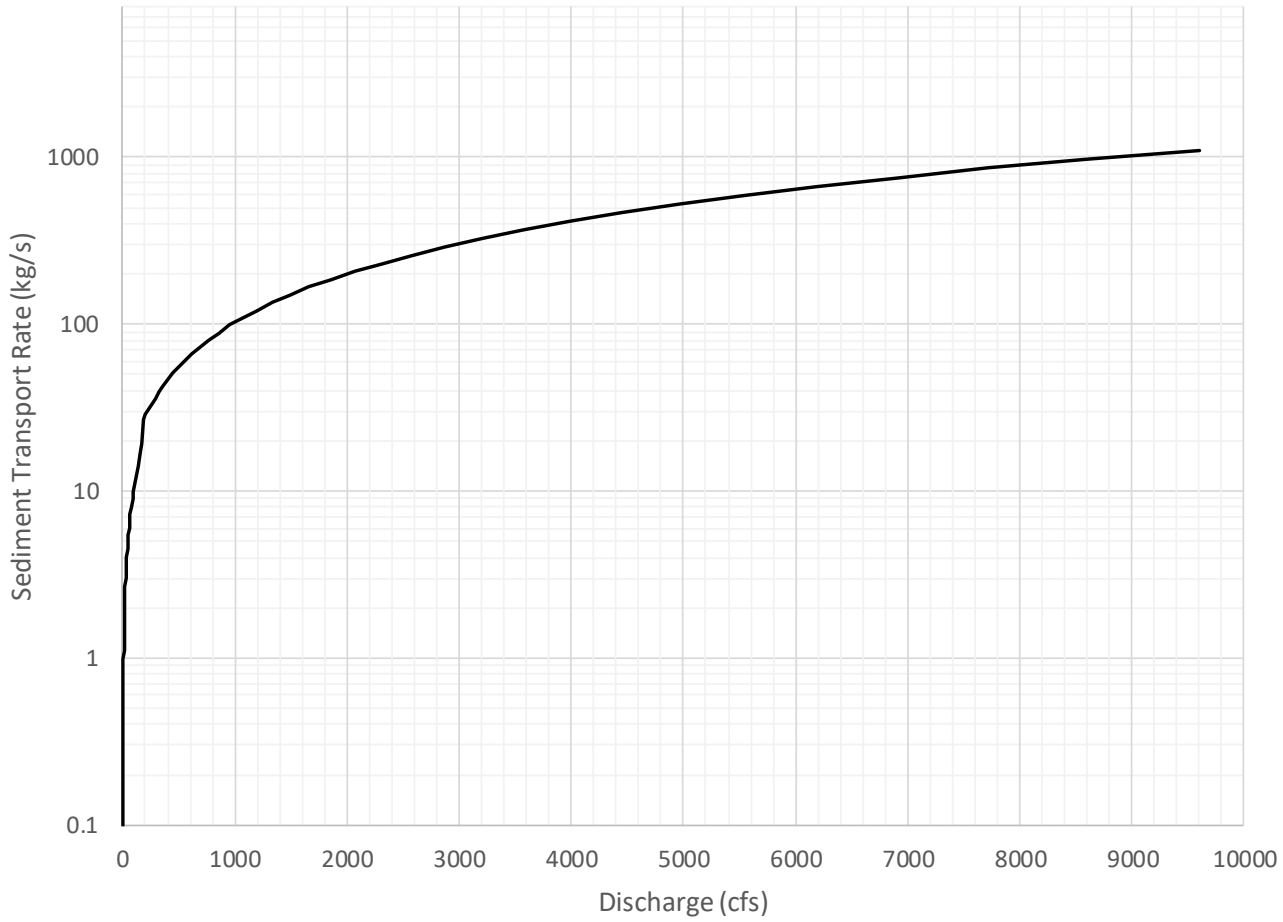


Figure D-31. Lower Lytle Creek Modeled Bedload Transport Rating Curve



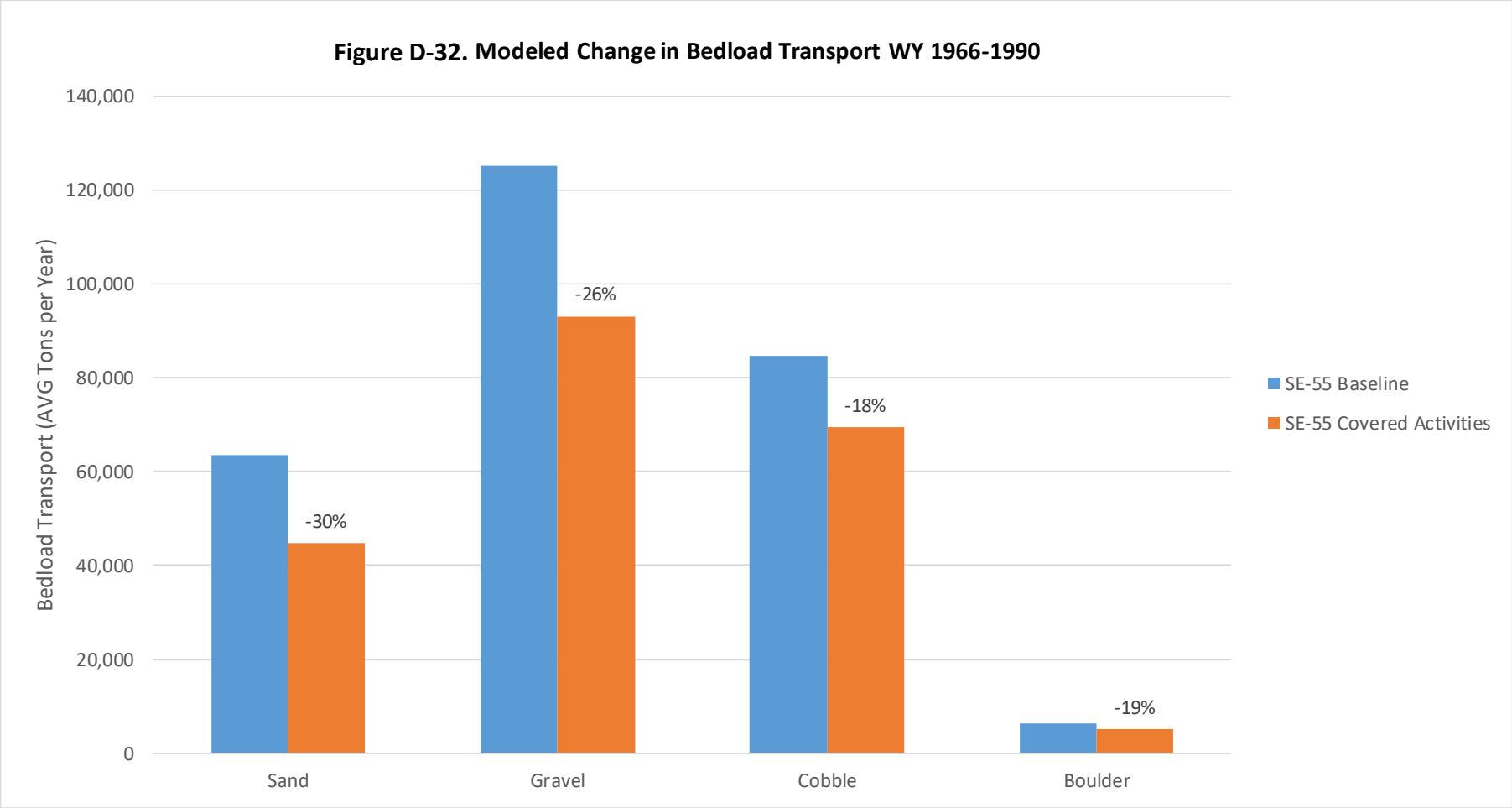


Figure D-32. Modeled Change in Bedload Transport WY 1966-1990
Bedload Transport (AVG Tons per Year)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
-30%
-26%
-18%
-19%
Sand
Gravel
Cobble
Boulder
SE-55 Baseline
SE-55 Covered Activities

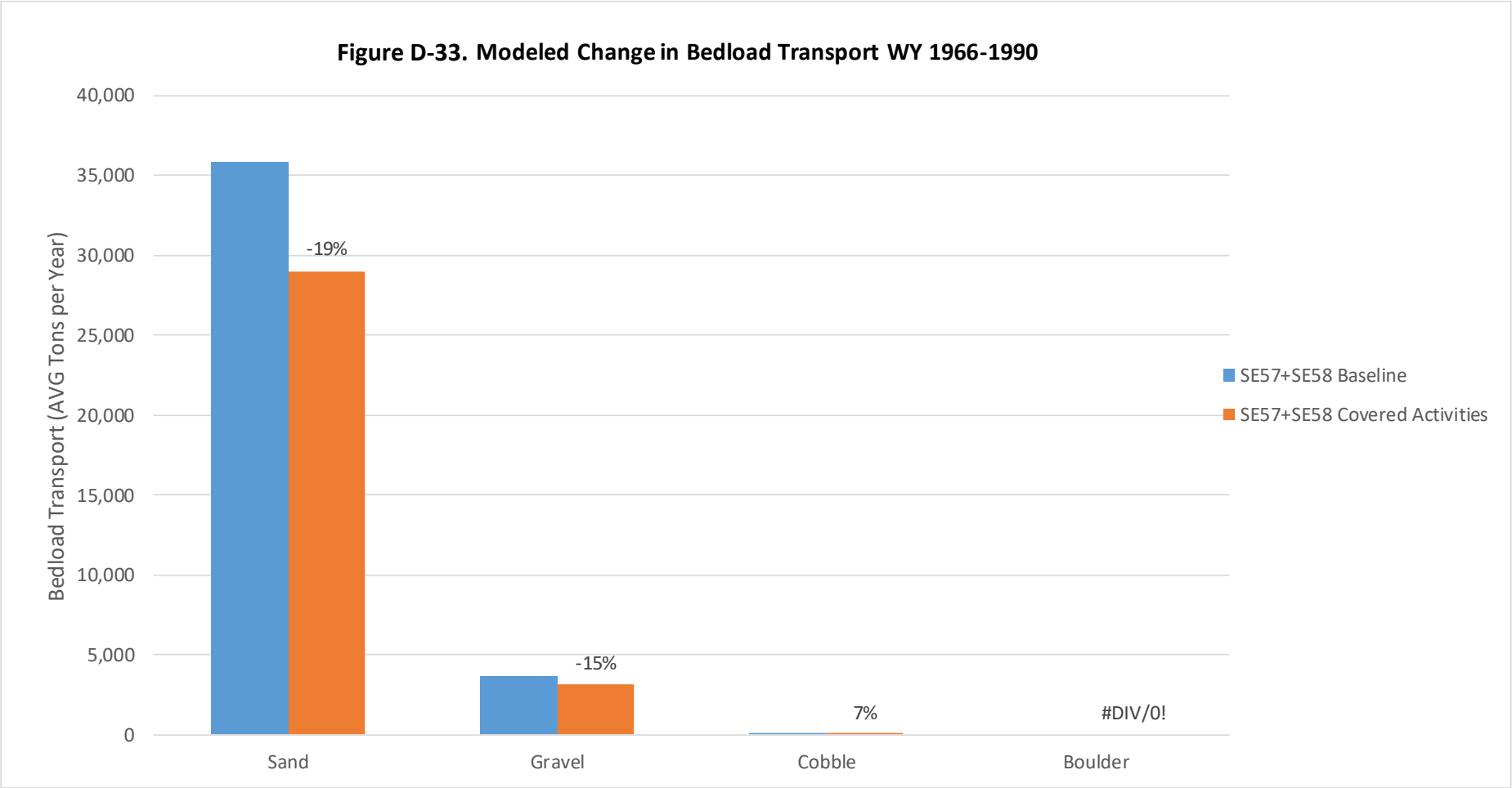


Figure D-33. Modeled Change in Bedload Transport WY 1966-1990
Bedload Transport (AVG Tons per Year)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
-19%
-15%
7%
#DIV/0!
Sand
Gravel
Cobble
Boulder
SE57+SE58 Baseline
SE57+SE58 Covered Activities

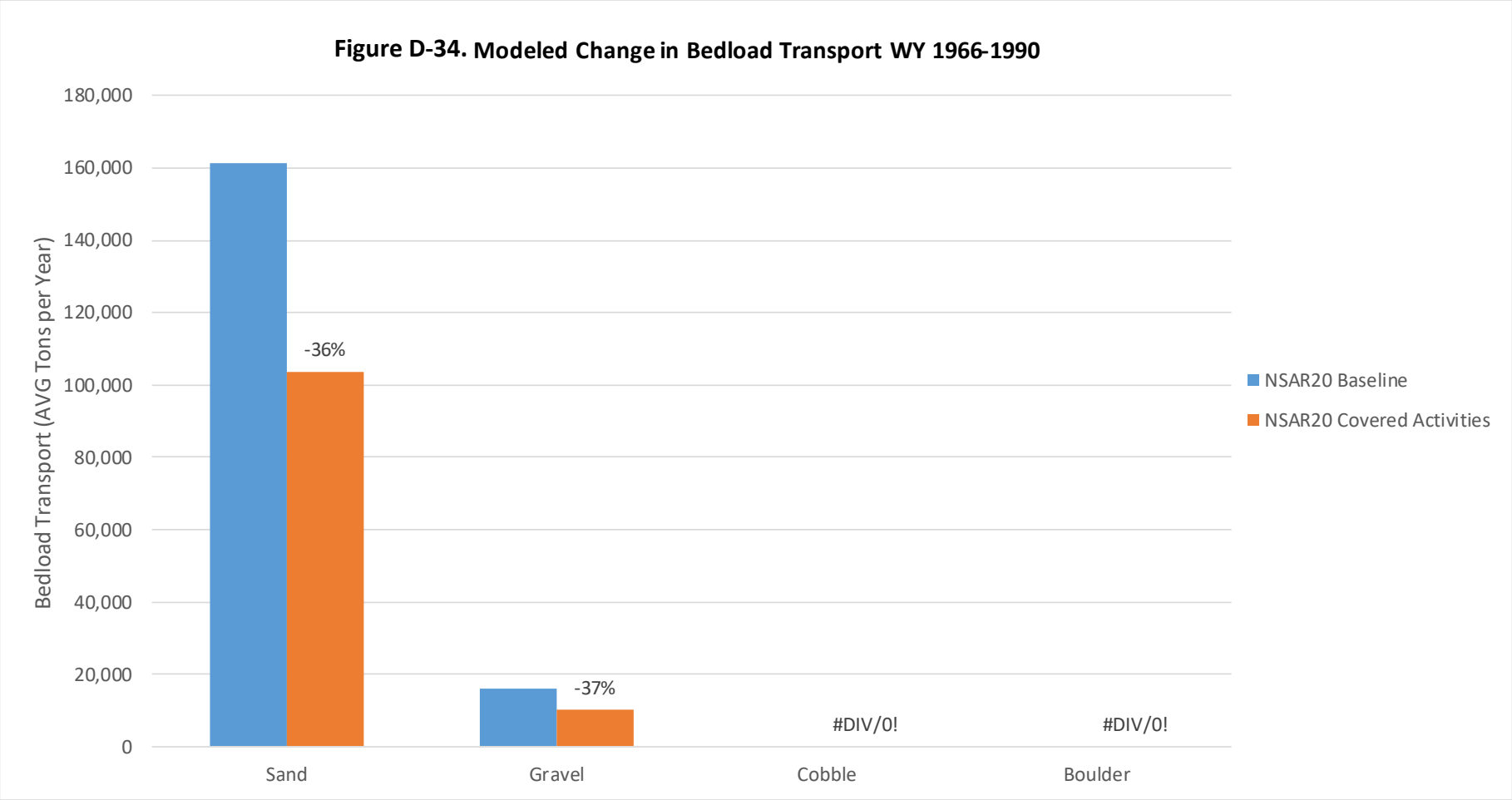


Figure D-34. Modeled Change in Bedload Transport WY 1966-1990
Bedload Transport (AVG Tons per Year)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
-36%
-37%
#DIV/0!
#DIV/0!
Sand
Gravel
Cobble
Boulder
NSAR20 Baseline
NSAR20 Covered Activities

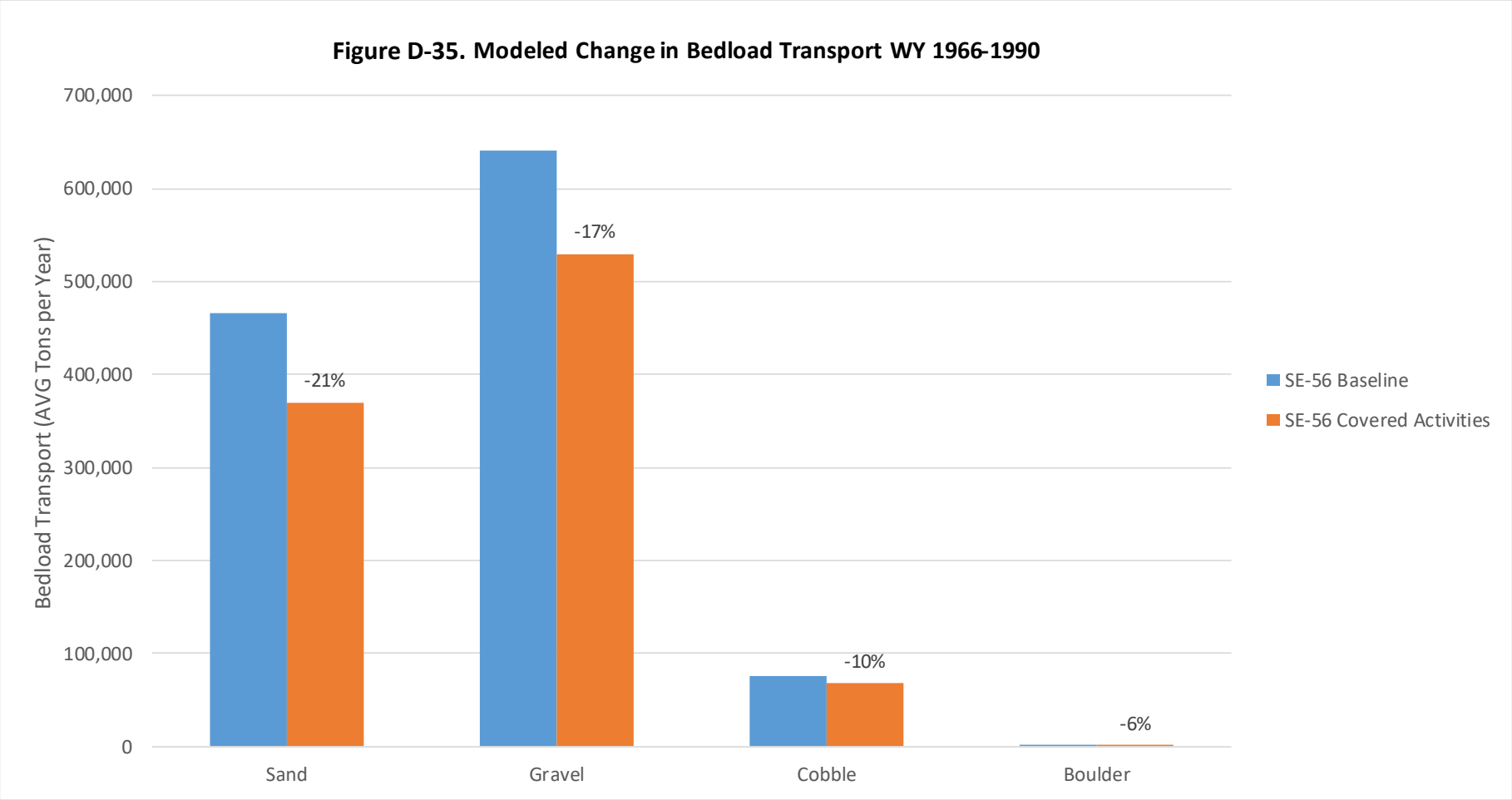


Figure D-35. Modeled Change in Bedload Transport WY 1966-1990
Bedload Transport (AVG Tons per Year)
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
-21%
-17%
-10%
-6%
Sand
Gravel
Cobble
Boulder
SE-56 Baseline
SE-56 Covered Activities

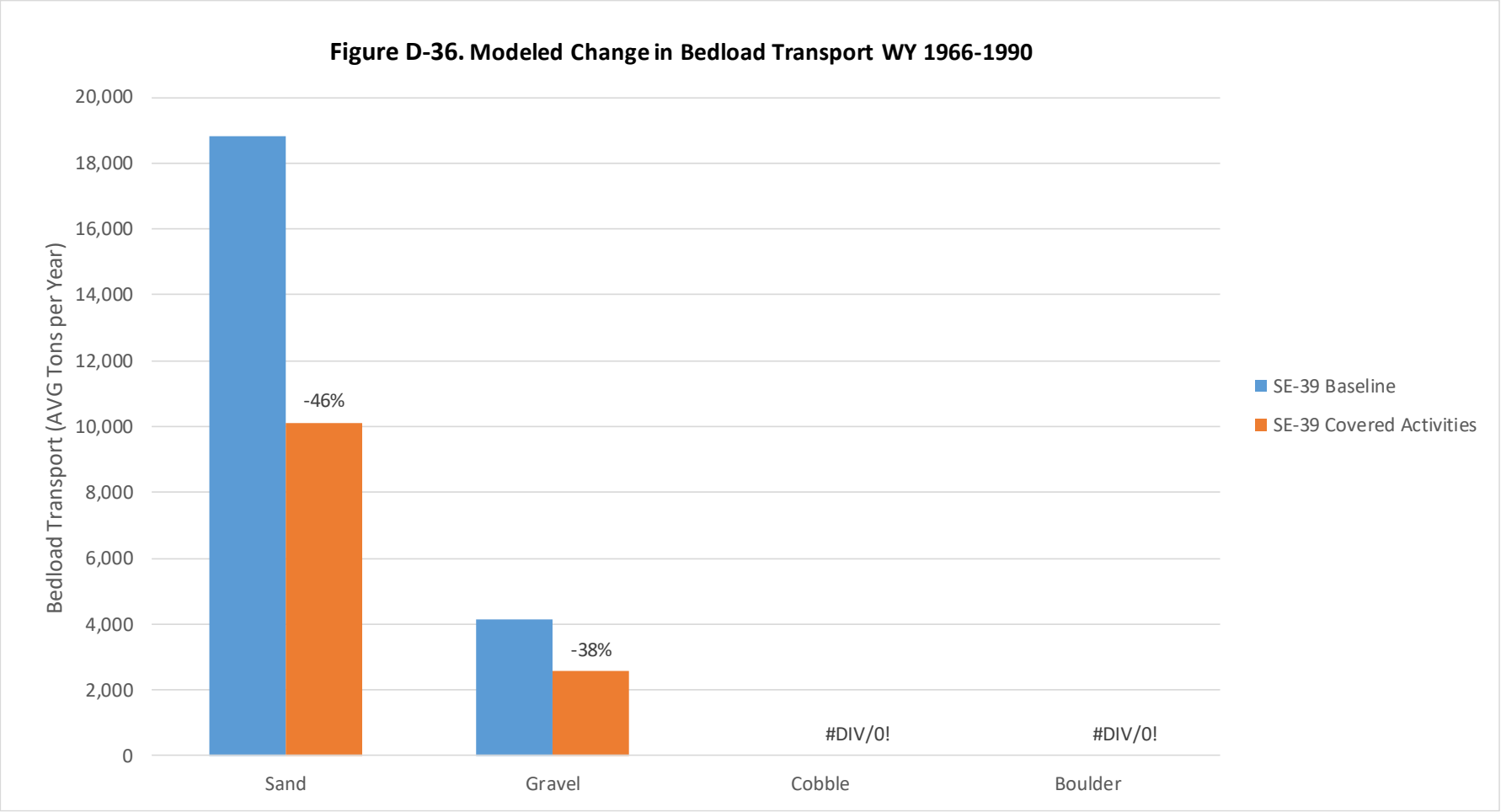


Figure D-36. Modeled Change in Bedload Transport WY 1966-1990
Bedload Transport (AVG Tons per Year)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
-46%
-38%
#DIV/0!
#DIV/0!
Sand
Gravel
Cobble
Boulder
SE-39 Baseline
SE-39 Covered Activities

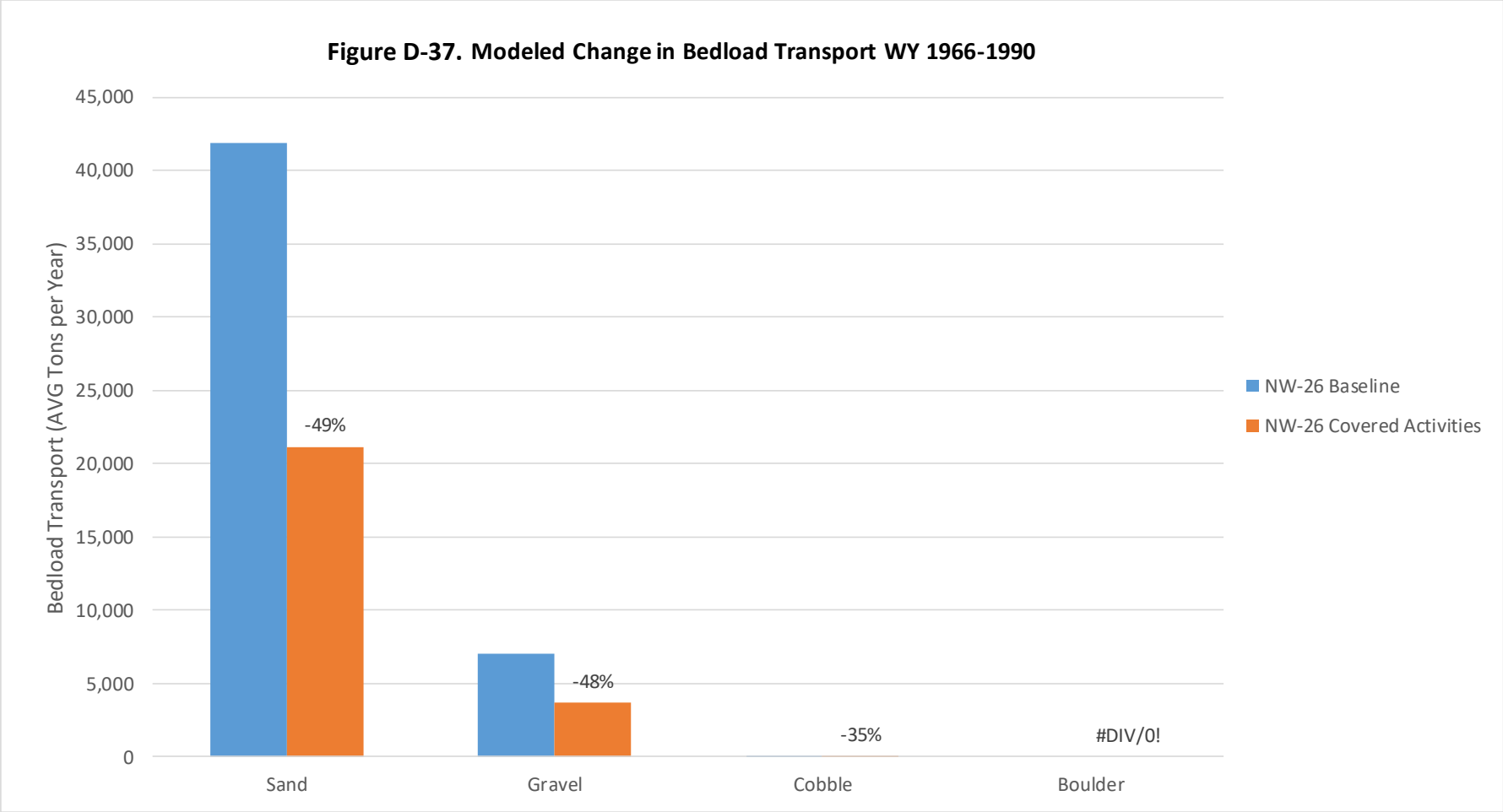


Figure D-37. Modeled Change in Bedload Transport WY 1966-1990
Bedload Transport (AVG Tons per Year)
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
-49%
-48%
-35%
#DIV/0!
Sand
Gravel
Cobble
Boulder
NW-26 Baseline
NW-26 Covered Activities

Figures throughout the document are hyperlinked. To return to your spot after viewing a figure, press Alt+Back Arrow.

Appendix E

Santa Ana Sucker Habitat Suitability Analysis

Appendix E
Santa Ana Sucker Habitat Suitability Analysis

Introduction

This appendix provides a summary of the methods used to model Santa Ana sucker (*Catostomus santaanae*) habitat preferences and assess habitat parameters. The appendix reviews recent habitat preference data for the Santa Ana sucker (SASU) for the purpose of providing SASU habitat suitability criteria. Select criteria were used to model effects on SASU habitat for the Upper Santa Ana River Habitat Conservation Plan, as well as habitat restoration activities in the upper Santa Ana River.

Various sources were used to assess habitat criteria, including peer reviewed scientific articles, unpublished technical documents, and inter-agency reports. The aim was to compare and select the most scientifically defensible estimates of SASU habitat preference. Habitat variables were ranked by importance which assisted in setting priorities in the design and creation of novel habitat for SASU.

There are limitations associated with the materials used in this study. First, the available literature on SASU habitat preference is limited, and most of the work used in this report was conducted in the last 15 years. Observations made during this time reflect the presentation of the habitat as it has been during this period, and do not offer any historical context with regards to habitat characteristics prior to the last two decades. Second, reviewed works sampled different drainages and locations, and measured habitat variables in different ways. A diversity of sample locations may be viewed both positively and negatively, but differences in methods to measure the various habitat elements impeded comparison between studies.

An additional limitation is that many of the habitat elements specified in the literature are confounded with each other. For example, discharge, water depth and velocity influence habitat type and substrate. Gradient affects velocity, and therefor habitat type and substrate which has a direct effect on cover type. This inter-connectedness complicates ranking variables by their importance, and optimal SASU preference is likely to be composed of a number of habitat elements.

Methods

Literature Review

Five studies of SASU habitat preference were collected from various sources. These include two peer reviewed publications (Saiki et al. 2007; Thompson et al. 2010) and three technical reports (Haglund et al. 2003; Aspen Environmental Group 2016; Wulff et al. 2018). This was not an exhaustive search but included the known documents for which primary measures of SASU habitat preferences were reported.

From these reports, a suite of habitat variables and their ranges were cataloged. These variables include the following: canopy cover, cover type, discharge, gradient, habitat type, substrate, velocity, and water depth. Not all sources contained measures of each type, and some sources only reported two or three.

Ranking

In compiling and ranking the various elements measured (Table E-1), preference was given to studies that reported goodness of fit values for modeled data ($R^{squared}$ values) and/or Akaiki Information Criterion (AIC) model weights. In addition, preference was given to variables for which upper and lower bounds had been observed. Lower bounds were frequently reported, but few measures also captured the upper bounds of habitat preference. Ultimately this was likely not the fault of the investigators, but more a reflection of the limited range of habitats presented during investigation.

Results

Table E-1. Ranked Habitat Variables

Variable	Rank	No# of measures	Confidence	Optimal Value	Range
Substrate	1	5	high	60% cobble	30-70%
Discharge	2	1	low	17.5-106 ft^3/s	
Velocity	3	5	moderate*	1.64 f/s	0.65-3.2
Gradient	4	1	moderate	1.75-2.20 % gradient	0.5-3.0
Habitat Type	5	2	high	80% riffle	30-100%
Water Depth	6	4	high	>1.5 ft	0.3-2.3
Canopy Cover	7	1	high	0% cover	0-20% cover
Aquatic Cover Type	8	2	high	cobble/boulder/algae	

*No upper bound for preference variable observed

Variable: Canopy cover

Aspen Environmental Group's SASU habitat preference data collected in Big Tujunga indicates a negative relationship between SASU condition factor and canopy cover (2016). Condition factors were elevated at canopy cover values less than 30%. The combined data for 2011-2013 shows a strong (but not fitted) relationship between raw abundance of SASU and % canopy cover. All observations of 50 or more animals took place at canopy cover values less than 30%, and most were at 15% or less.

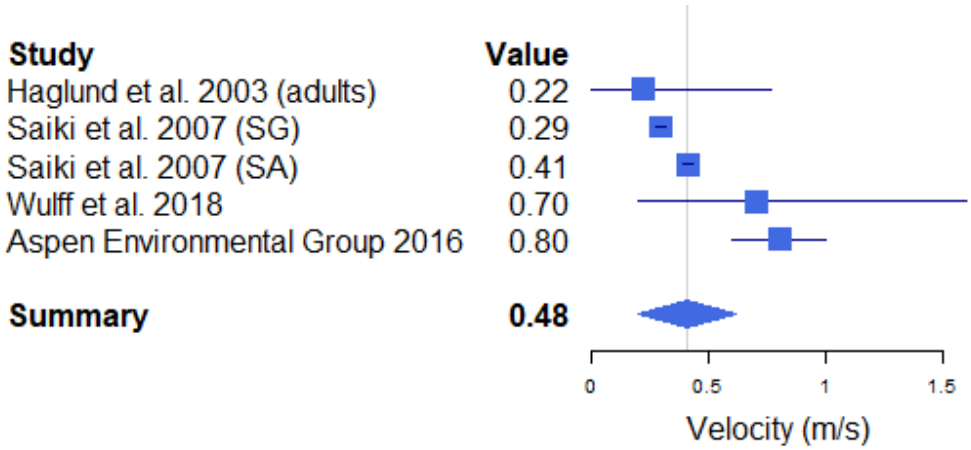
Variable: Cover type

Wulff et al. comprehensively measured cover type and found that SASU had a strong preference for both cobble/boulder cover and filamentous algae cover, using both at greater than average rates

(2018). Saiki et al. reported similar findings, indicating that fish in the San Gabriel River also used cobble and boulder for cover (2007). At the MWD crossing site in the Santa Ana river, where substrates were exclusively sand, fish utilized emergent vegetation instead. Reported rates of cover use were high at 98% for both cover types.

Variable: Discharge/Velocity

Thompson et al. (2010) suggest that Saiki et al. (2007) observed a negative correlation with higher discharge in their study. This is based on the failure to observe SASU at one of three sites. The site also had discharge measures greater than 8 m^3/s. This observation is based on correlational data, and there is currently no other evidence for an upper discharge limit on habitat preference. However, it is probable that the relationship between preference and discharge in SASU is parabolic per Thompson et al. (2010).



Notes: Values from Haglund et al. 2003 for juveniles are excluded.
SG = San Gabriel River. SA = Santa Ana River.
Values provided by Aspen Environmental are recommended, not observed.

Figure E-1. Summary of Velocity Measures by Study

Aspen Environmental provided a recommendation based on the Big Tujunga data indicating that velocities between 1.6-3.6 fps and 2.0-3.3 fps were optimal, but did not provide any observational data to support the relationship (2016).

Wulff et al.'s (2018) data indicates SASU preference for mean water column velocities of 0.7 m/s, but occupying a normal distribution of ranges from 0.1-1.6 m/s

Variable: Gradient

Aspen's Big Tujunga data indicates a gradient preference for SASU that ranges from 1.75% to 2.2%. This may represent optimum gradient preference for SASU, but it should be kept in mind that the species was present throughout the measured gradient range (0.5 to 3%) and that most observations were made at gradients between 0.5 and 1.75%.

Variable: Habitat type

The three major habitat types reviewed by the various studies are riffle, run and pool.

Aspen's Big Tujunga data indicates a strong preference by SASU to occupy reaches with greater percent riffle. Likewise there is an inverse relationship with percent pool. Reaches with less than 15% pool and greater than 60% riffle contained the highest concentrations of SASU as measured by raw abundance scores. The Aspen Environmental report is the only data presented with goodness of fit measures. The R^2 values for pools is 0.41, indicating a moderate fit for the data. The riffle R^2 value is 0.66, indicating a tighter fit and a stronger relationship. The modeled curve indicates no measured upper bound to riffle preference by SASU.

Variable: Substrate

The substrate types reviewed by the various studies are some combination of the following: silt, sand, gravel, cobble, and boulder.

Aspen's Big Tujunga data indicates strong preferences by SASU for coarser substrates. The data for percent cobble indicates a strong relationship between raw abundance and presence of cobble substrates (R^2 value 0.73). There is a corresponding negative relationship between percent silt and SASU raw abundance and the relationship is strong (R^2 value 0.65) but not as strong as the relationship with cobble. The modeled curve indicates no upper bound to cobble preference by SASU. There is some indication in the data and discussion by Aspen alluding to the relative importance of fish density in driving habitat selection for sites with greater percent cobble. At low fish densities, fish will occupy sites that have less percent cobble. Aspen only saw fish densities over 50 SASU raw abundance at sites greater than 3:1 cobble: sand values.

Wulff et al. indicate the same relationship, with SASU preferentially occupying cobble, then gravel, then sand (2016). But their data do not contain measures over silt so there was no opportunity to test the negative relationship indicated by the Aspen data. SASU occupied boulder/cobble mixes and filamentous algae surfaces preferentially over all other substrate types.

Variable: Water depth

Aspen provides a recommendation based on the Big Tujunga data indicating that depths between 24.9-59.9 cm with high water velocities (see above) are optimal, but did not provide any observational data to support the relationship.

Wulff et al. indicates a similar pattern, with animals preferentially occupying habitat with water depths greater than 25cm. The data are either bimodal or heavily skewed to observations in deeper habitat, with most observations at 45cm depth, and a long tail into the 120cm range.

Selection of Model Data

A variety of habitat parameters were initially evaluated for inclusion in modeling suitable SASU habitat. These parameters included: substrate, discharge, velocity, gradient, habitat type, water depth, canopy cover, and cover type. These variables were often co-dependent, with velocity and

gradient being linked tightly to substrate and habitat type. In reviewing available variables for model selection, discharge, velocity, gradient and water depth were singled out as being more easily modeled using existing tools than other variables such as substrate, habitat type, canopy cover and cover type.

In reviewing data on habitat type, canopy cover, and cover type, we were unable to identify any available resources for estimating these variables for the purpose of modeling SASU habitat parameters within reaches of interest (main-stem Santa Ana River). Observations on habitat type were confounded by differences in methodology between studies as well. Canopy cover was confounded with incidence of solar exposure and likely possesses a bimodal relationship with SASU habitat preference, whereby increased cover is favorable up to the point where it limits food availability in the form of algal growth. Cover type was also confounded by these problems and not uniformly observed between studies.

There are currently no available resources for comprehensive estimates of substrate type within reaches of interest for modeling purposes. To add substrate as a model element, these resources would have to be developed alongside the model. Concurrent work on substrate presentation in SASU occupied habitat indicates that sand mobilization and bed scour occur at water velocities of 1.2 fps and greater (ESA Associates 2015). For the purposes of variable selection and model building, we assume that channel velocities greater than 1.2 fps will result in bed scour and presentation of coarse substrates.

Reach vs. Individual

The majority of preference data to date (August 2020) recorded for SASU was conducted at the reach level (4 of 5 studies). Reach level habitat preference reporting generally tied SASU abundance and presence/absence data to habitat data collected at a range of river reach distances (typically 10, 25 or 100m). This reach level habitat preference data was difficult to translate into specific habitat preferences for SASU because of the lack of uniformity among reach lengths and methods between studies. One study (Wulff et al. 2018) collected SASU habitat preference data at the level of the individual through direct observation using snorkel surveys.

Data collected at the unit of the individual allows for greater confidence in estimating SASU habitat preferences at scales finer than the reach level. With well supported habitat preference data, habitat quality can be accurately modeled down to meter or even sub-meter scales. We used Wulff et al.'s 2015 and 2016 data to construct SASU habitat preference curves for depth and velocity. Using these preference curves, we modeled habitat quality over a range of discharges in the main channel of the Santa Ana River.

Data Collection

Wulff et al.'s methods and results were compiled into a report submitted to San Bernardino Valley Water Conservation District (Wulff et al. 2018). Field work continued past this date and additional preference data was compiled by USGS. Data from this report as well as from direct communications with Dr. Larry Brown was used in this analysis to construct the habitat preference model. The data consisted of two field seasons (winter 2014/2015; hereafter 2015 & winter 2015/2016; hereafter

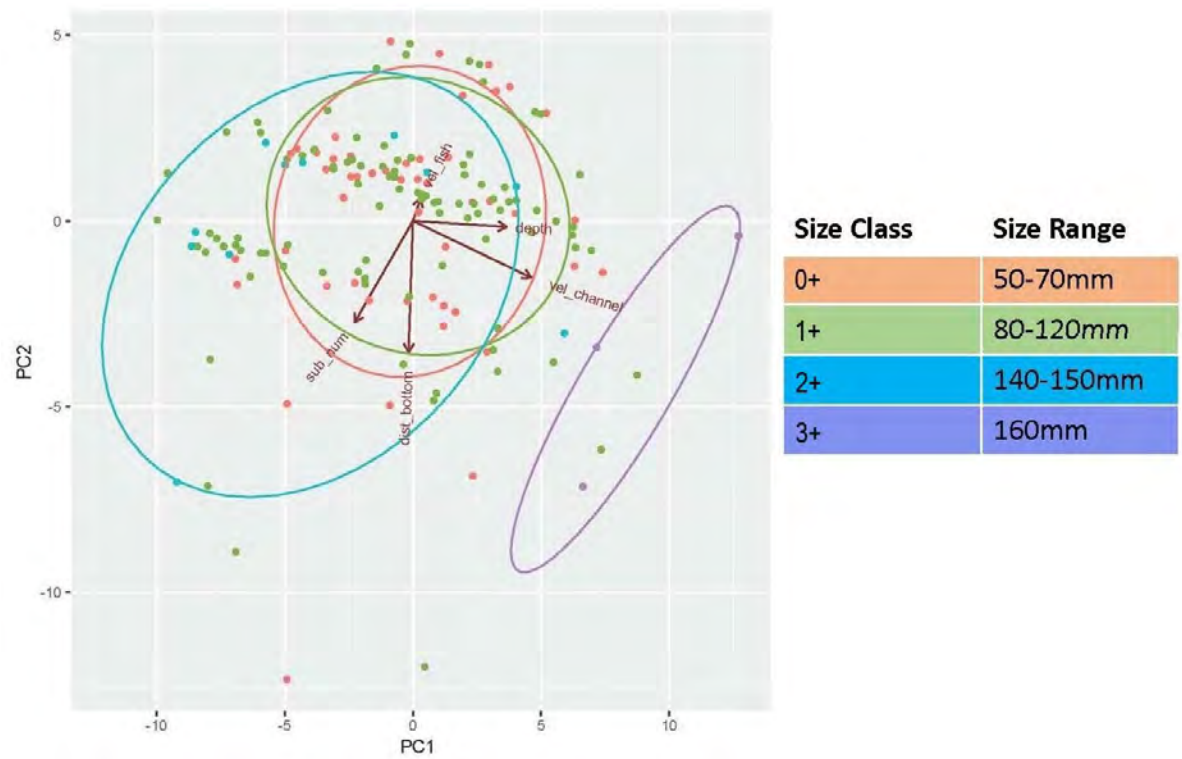
2016). For 2015, when fish were observed in groups, the number of fish observed within a group was reported (Total number of observations = 497) but preference data was taken once for the group. For 2016, records were taken for each individual, and the number of fish observed in a group was not reported (Total number of observations=330). When pooled, the data consisted of 827 SASU observations, along with the water depth, fish depth, substrate, water velocity, cover type, and distance to nearest cover for each observation.

Size Class Analysis

A potential concern associated with the data was skewing based on size class. If fish from different size classes have different habitat preferences, this may hamper modeling efforts. At worst, some size class based habitat preference might not be captured by the average preferences for the 827 observations that were made. To assess the existence of distinct habitat preferences based on size class, a cluster analysis of the observations was performed. This analysis included all recorded habitat measures including the following: water depth, water velocity at fish, water velocity in channel, distance from bottom, and substrate. Size classes were broken into four groups based on previous research indicating approximate length measurements for year-class. The size classes were as follows: 50-79mm for year 0+, 80-129mm for year 1+, 130-159mm for year 2+, and 160mm+ for year 3+. Cluster analysis was conducted in the R statistical computing environment (version 3.3.3) using the *prcomp* fuction in the base package (R Foundation for Statistical Computing 2017). The biplot of SASU habitat preference was produced using the ggbiplot package.

Cluster analysis indicated strong overlap in habitat preference for most size classes (0+ to 2+) with the exception of year 3+ animals (Figure E-2.). These year 3+ animals exhibiting a preference for deeper, faster moving water than smaller size classes. However the year 3+ cohort was comprised of three observations. With such a small sample size, it is unclear if the separation is due to sampling artifacts or truly represents differences in preference. Importantly, some year 1+ observations overlapped with the year 3+ observations, indicating that smaller animals were not excluded from these habitats. Ultimately, we concluded that the data was broadly reflective of habitat preference for all size classes of SASU and appropriate for use in the model except for larvae.

Larval habitat is typified by shallow backwater habitat with reduced water velocity and elevated temperature (Moyle 2002). An assumption of the current modeling effort is that habitat suitable for larval rearing is broadly available throughout all wetted portions of the main-stem Santa Ana River, and that when elements suitable for larger size classes are present, larval habitat will also be present.



Notes: Circles Represent the Four Size Classes

Figure E-2. Cluster Plot of SASU Habitat Preference Clusters.

Habitat Suitability Criteria

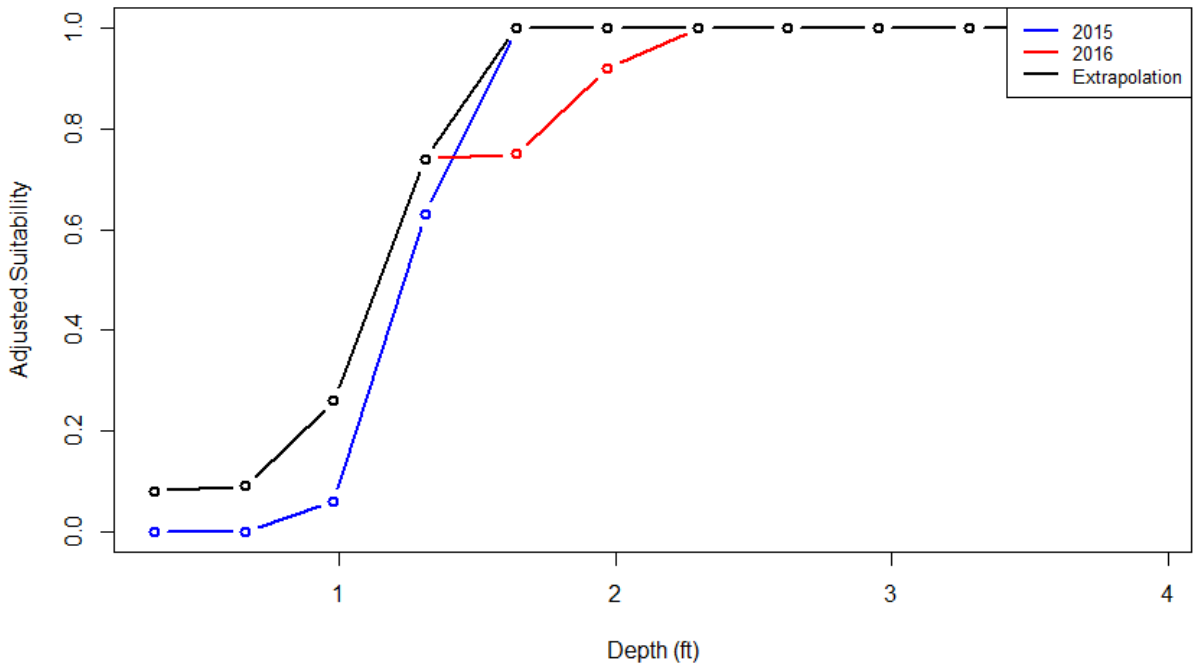
Wulff et al. utilized Ivlev's Electivity Index to calculate habitat utilization curves based on habitat availability and observed utilization by SASU (2018). The index is an equation originally developed to model feeding preference with regards to prey selection by planktonic feeding fishes. The index allows for the development of a value (range: -1 to 1) that represents the observed animal's preference for a specific prey item over other available items. In the case of this study, the index allows for calculating a fish's preference for an individual habitat type over other available habitat types. Taken from Wulff et al.

> "Ivlev's Electivity Index is calculated as, $E_i = (r_i - p_i)/(r_i + p_i)$, where r_i is the proportion of a resource utilized and p_i is the proportion of the resource in the environment. Values range from -1 (complete avoidance) to 1 (complete utilization). Like all selection indices, quantitative index values should be used with caution, especially when small sample sizes are used to calculate r_i or p_i (Lechowicz, 1982). We use the index as a general indicator of selection or avoidance."

Electivity scores were converted to habitat suitability indices by scaling observed index values for the most used category to 1.0 and least used to 0. In their report, Wulff et al. adjusted some 2015 suitability scores based on habitat availability and expert knowledge of typical fish preference. This adjustment was made for depth values only and velocity preference scores were unmodified. This adjustment was justified because available habitat deeper than 50 cm within the survey reaches was rare, skewing index values. This resulted in several depressed or even negative scores for depths

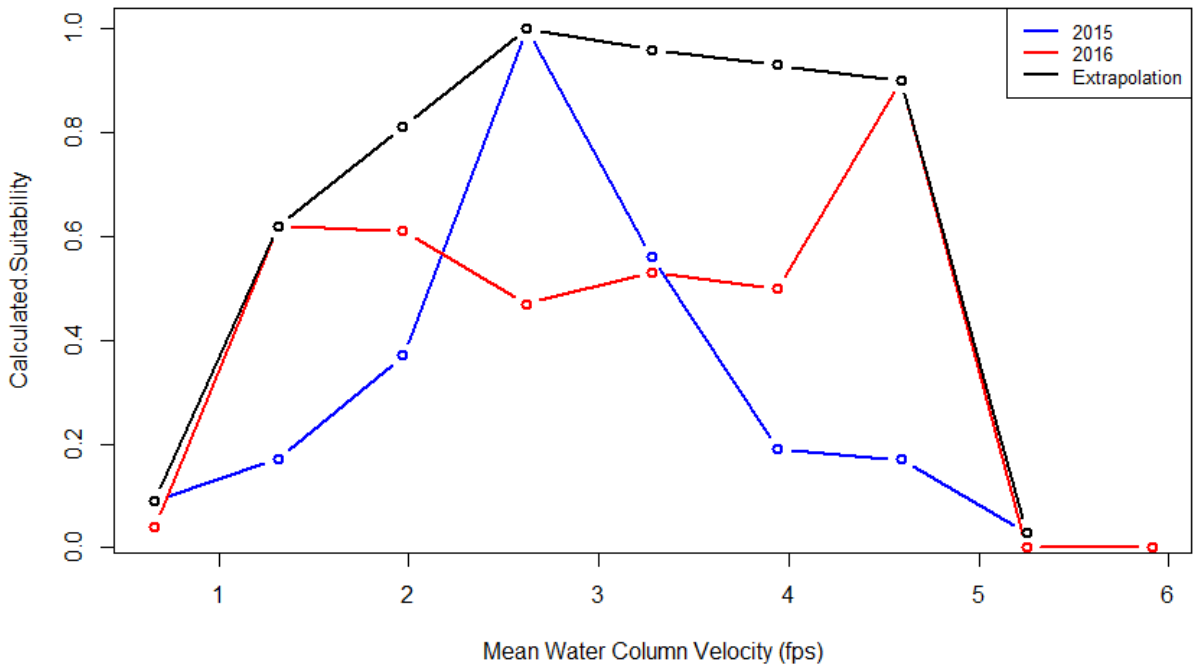
greater than 70 cm. All scores in the 2015 data at depths greater than 50 cm were adjusted to 1.0 to more accurately reflect SASU preference.

For the purposes of the current study, only the depth and water velocity preference data were utilized. Wulff et al. provided raw suitability scores for 2015 and 2016 directly to the authors. The separate suitability scores for SASU habitat preferences (depth and velocity) for the two field seasons were merged to create combined preference scores which could then be applied in the model. In composing the combined suitability index, the higher of the values for each season was used. As a result, the model may slightly over-predict suitable habitat.



Notes: Wulff et al.'s 2015 and 2016 raw data are shown in red and blue, with the extrapolated values in black.

Figure E-3. Depth Suitability Index



Notes: Wulff et al.'s 2015 and 2016 raw data are shown in red and blue, with the extrapolated values in black.

Figure E-4. Velocity Suitability Index

A habitat suitability matrix for water depth and velocity was created by multiplying the velocity suitability scores by the depth suitability scores derived from Wulff et al. 2018. Combined suitability scores greater than 0.50 were considered to represent habitat with suitable velocity and depth, while scores less than 0.50 represent unsuitable habitat, as is consistent with the IFIM/PHABSIM approach (Table E-2).

Table E-2. Santa Ana Sucker Depth by Velocity Habitat Suitability Matrix

	Velocity (feet/second)	0.66	1.31	1.97	2.62	3.28	3.94	4.59	5.25	5.91
Depth (feet)	Habitat Suitability Index	0.09	0.62	0.81	1.00	0.96	0.93	0.90	0.03	0.00
0.33	0.08	0.01	0.05	0.06	0.08	0.08	0.07	0.07	0.00	0.00
0.66	0.09	0.01	0.06	0.07	0.09	0.09	0.08	0.08	0.00	0.00
0.98	0.26	0.02	0.16	0.21	0.26	0.25	0.24	0.23	0.01	0.00
1.31	0.74	0.07	0.46	0.60	0.74	0.71	0.69	0.67	0.02	0.00
1.64	1.00	0.09	0.62	0.81	1.00	0.96	0.93	0.90	0.03	0.00
1.97	1.00	0.09	0.62	0.81	1.00	0.96	0.93	0.90	0.03	0.00
2.30	1.00	0.09	0.62	0.81	1.00	0.96	0.93	0.90	0.03	0.00
2.62	1.00	0.09	0.62	0.81	1.00	0.96	0.93	0.90	0.03	0.00
2.95	1.00	0.09	0.62	0.81	1.00	0.96	0.93	0.90	0.03	0.00
3.28	1.00	0.09	0.62	0.81	1.00	0.96	0.93	0.90	0.03	0.00
3.61	1.00	0.09	0.62	0.81	1.00	0.96	0.93	0.90	0.03	0.00
3.94	1.00	0.09	0.62	0.81	1.00	0.96	0.93	0.90	0.03	0.00

Model Implementation

Model Methods

The modeling of suitable depth and velocity conditions was performed at seven different assessment sites by applying the Santa Ana sucker habitat suitability criteria to the flow depths and flow velocities modeled in a Two-Dimensional Sedimentation and River Hydraulics model (2D hydraulic model) that was developed for the HCP. Six of the sites are located on the Santa Ana River, from just downstream of the RIX discharge outfall (site USGS Reach 9) to the most downstream site (Site 3A) located near Prado Basin Park downstream of I-15. One site is located on the Rialto Channel downstream of the Rialto discharge outfall (see mapped locations in Figure E-5). The total assessed channel length from the Rialto Channel to the downstream end of the Santa Ana River near Prado is 21.1 miles.

Flow depths and velocities were modeled for a range of discharges in the 2D hydraulic modeling software SRH-2D. The 2D hydraulic models require an elevation surface of channel and floodplain elevations. Elevations outside of the low-flow channel were obtained from 2015 LiDAR. All of the assessment sites have perennial flow, and thus required bathymetric surveys of the low-flow channel to supplement the 2015 LiDAR data since LiDAR does not capture underwater elevations. Bathymetry surveys were previously performed at four of the sites. ESA field surveyed bathymetry at the 3 ESA sites in Figure E-5 in July 2015 as part of work to evaluate potential RIX facility flow reductions on sucker habitat (ESA 2015). The USGS also field surveyed bathymetry in 2015 in "USGS Reach 9" just downstream of the RIX facility. ICF used the USGS and ESA bathymetry data for this study. ICF added 3 new assessment sites for this study. Site 3 and Site 3A in Figure E-5 were added to assess sucker habitat at locations further downstream of the Santa Ana River, and a site was added on the Rialto Channel. New field surveys of bathymetry for these 3 sites were performed in December 2017. Model elevation surfaces made from the combined bathymetry and LiDAR sources have nodes spaced typically around 3 feet from each other.

The Manning's n roughness values in the 2D model created for each site were calibrated with field measurements. The n values calibrated with measurements of water levels and velocity measurements made as part of the ESA (2015) study were also used in this study. Water surface elevations were surveyed at all the other sites and through correlation with discharge readings at the time of the surveys were used to calibrate n values until a best fit was obtained between modeled and measured water surfaces. The Santa Ana River modeled reaches range in low-flow channel length from 975 feet to 1,200 feet and the Rialto Channel model reach is 500 feet long. Details on model reach lengths, bed slopes, and channel widths are listed in Table E-3. A series of flows was modeled for each site that span the range of low flows that typically occur at the sites. The model output for each model node along the continuous 2D modeling surface was queried to assess the combination of depth and velocity at each node. For each modeled flow, calculations were performed to determine the percentage of wetted area in which the combination of depth and velocity values are within the sucker habitat "suitable" range shown in the habitat suitability matrix in Table E-2 above.

Table E-3. Summary of Hydrologic Model Characteristics by Santa Ana Sucker Habitat Modeling Site (Upstream to Downstream)

Hydrologic Model Characteristic	Rialto Channel	ESA Upper	USGS Reach 9	ESA Middle	ESA Lower	SAR Site 3	SAR Site 3a
Low Flow Channel Length (feet)	507	1,132	975	1,195	1,048	1,032	1,099
Reach Average Bed Slope (percent)	0.77	0.32	0.39	0.36	0.38	0.25	0.24
Existing Condition Aug–Oct 95% Exceedance Flow (cfs)	9.2	49.0	49.0	31.1	31.1	87.4	63.6
Average Modeled Wetted Channel Width under Existing Condition Aug–Oct 95% Exceedance Flow (feet)	14	26	35	24	40	84	81
Area of Suitable Depth and Velocity under Existing Condition Aug–Oct 95% Exceedance Flow (acres)	0.006	0.202	0.110	0.071	0.012	0.107	0.045
Unit Area of Suitable Depth and Velocity under Existing Condition Aug–Oct 95% Exceedance Flow (acres/1,000 feet of channel length)	0.011	0.179	0.112	0.059	0.011	0.103	0.041
Suitable Depth and Velocity as percent of Total Channel Wetted Area under Existing Condition Aug–Oct 95% Exceedance Flow (percent)	3.3	30.3	14.2	11.0	1.2	5.3	2.2

Model Results

Table E-3 summarizes the amount of suitable habitat determined for all 7 of the 2D assessment sites. The table lists the August through October 95% exceedance flow (i.e., statistically the flow in the channel is equal to or greater than this magnitude 95% of the time from August through October) for the existing hydrology condition. The months of August through October were selected because these are typically the 3 months of the year with the lowest flows and thus allow for habitat assessment under limiting flow conditions when habitat suitability is likely the lowest it will be for the year. The amount of existing conditions suitable habitat (in acres, acres per 1000 feet of channel, and as a percent of the total wetted area) is shown in Table E-3.

Figures E-6 through E-12 are graphs showing several outputs important for the sucker effects analysis. A graph prepared for each model reach shows the following:

- A curve (red squares) showing the total wetted area in acres for a modeled flow
- A curve (black circles) showing the preferred habitat in acres for the modeled flow
- A curve (blue X's) showing the percent of a modeled flow's wetted area that is preferred habitat

- The two vertical black lines show the average August through October 95% exceedance flow for both the existing conditions and with HCP covered activity conditions.

The curves show how sucker habitat suitability would change due to flow changes at 7 specific locations. For the HCP effects analysis it is necessary to understand how suitability would change for the entire 21.1 mile long study reach (starting at the Rialto Outfall and extending down the Rialto Channel and then down the Santa Ana River to Prado). The following process was used to take the output from the curves and extrapolate for the non-2D model reaches.

Hydrology models that calculate mean daily flows were developed for the HCP to show how streamflows would change due to the covered activities. The hydrology models use a base hydrology period that is considered representative of the distribution of dry, average, and wet water year types experienced in the study area. The details of the hydrology modeling are discussed in more detail in Section 3.6.3, Hydrologic Modeling as the Foundation for Hydrologic Analysis. The hydrology models provide mean daily flow values at 31 model nodes located between the Rialto Channel and Prado (see Figure E-13 for a map of the hydrology nodes). The nodes are generally located at locations where flows change, such as wastewater treatment plant outfalls or channel confluences. A map of August through October 95% exceedance flows for the existing conditions is shown in Figure E-14 and for the covered activity condition in Figure E-15.

Table E-4 shows the results of the process to assess sucker suitability continuously throughout the study area. A description of the columns in this table will aid understanding of the steps involved in the calculations:

1. The **Reach Description** column describes geographic boundaries between the reaches. Reaches were created between each of the 31 nodes since flow changes occur at these locations from flow inputs (effluent discharges or tributaries) or losses (streambed infiltration).
2. **Reach Length** is the distance of the reach between the hydrology model nodes.
3. **Hydro Model Node(s) Used** lists the node used for the mean daily flow value. Note that a reach uses the hydrology corresponding to the node at the upstream end of the reach.
4. **Existing Conditions Aug-Oct 95% Exceedance Flow (cfs)** is from the hydrology model node. These values are also mapped in Figure E-14.
5. **Covered Activity Aug-Oct 95% Exceedance Flow (cfs)** is from the hydrology model node. These values are also mapped in Figure E-15.
6. **Existing Conditions minus Covered Activity Aug-Oct 95% Exceedance Flow (cfs)** shows how implementation of the covered activities would change the flow in the reach.
7. **Sucker Habitat Curve Used** identifies which of the 7 curves in Figures E-6 through E-12 were used for the specific reach calculations.
8. **Existing Conditions Preferred Habitat as % Wetted Area** is determined from the sucker habitat curve. The value is the percent of the total wetted area that meets the suitable habitat criteria and it is calculated from the location on the curve that corresponds to the flow magnitude from Step 4.

9. **Covered Activity Preferred Habitat as % Wetted Area** is defined the same as Step 8 but it uses the location on the curve that corresponds to the flow magnitude from Step 5.
10. **Existing Conditions Preferred Habitat (acres)** is the area within a reach that meets suitable habitat criteria under the existing conditions flow condition. The unit suitable area calculated for the 2D model reach (i.e., acres per 1,000 feet of channel length) and the actual reach length (Step 2) were used to calculate the actual suitable habitat in the reach.
11. **Covered Activity Preferred Habitat (acres)** is defined the same as Step 10 except it uses the unit suitable habitat area under the covered activity flow condition.
12. **Change in Preferred Habitat from Existing Condition (acres)** shows how implementation of the covered activities would change suitable habitat area in the reach. These values are also mapped in Figure E-16.
13. **Change in Preferred Habitat from Existing Condition (%)** shows the percent change in suitable habitat that implementation of the covered activities would create in the reach. These values are also mapped in Figure E-17.
14. **Notes on Existing Condition Hydrology** identifies key hydrology changes that occur with the reaches. This includes assumptions used in the hydrology model for effluent discharges and Riverside Narrows upwelling.
15. **Notes on Covered Activity Condition Hydrology** identifies key hydrology changes that occur with the reaches due to implementation of the covered activities. This includes assumptions used in the hydrology model for reductions in effluent discharges at Rialto and RIX, and for redistribution of existing conditions effluent discharges at the Regional Water Quality Control Plant into planned tributary restoration sites and for use in public parks. Reductions in flows from San Sevaine Creek and Day Creek due to IEUA covered activities are also identified.

The sum of all the suitable habitat for the reaches in Table E-4 is 6.05 acres for the existing conditions and 2.17 acres for the covered activity conditions. Implementation of the covered activities would decrease suitable habitat by 3.86 acres, or 64%.

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Table E-4. Model Results

Drainage	Reach Description	Channel Type	Reach Length (ft)	Hydro Model Node(s) Used	Existing Conditions Aug-Oct 95% Exceedance Flow (cfs)	Covered Activity Aug-Oct 95% Exceedance Flow (cfs)	Existing Conditions minus Covered Activity Aug-Oct 95% Exceedance Flow (cfs)	Sucker Habitat Curve Used	Existing Conditions Preferred Habitat as % Wetted Area	Covered Activity Preferred Habitat as % Wetted Area	Existing Conditions Preferred Habitat (acres)	Covered Activity Preferred Habitat (acres)	Change in Preferred Habitat from Existing Condition (acres)	Change in Preferred Habitat from Existing Condition (%)	Notes on Existing Condition Hydrology	Notes on Covered Activity Condition Hydrology
Rialto Channel	Rialto Channel DS of Rialto outfall	Straight Channelized Slope < 2% WD < 50	1,705	NFRC06	9.2	7.0	2.2	Rialto Channel	3.3%	1.3%	0.019	0.007	0.012	-62.6%		
Santa Ana River	SAR DS Rialto Channel & US RIX outfall	Braided/Braided Channelized Slope < 2% WD > 175	1,141	NSAR19	8.1	5.9	2.2	Average ESA Upper Reach & USGS Reach 9	0.0%	0.0%	0.000	0.000	0.000	#DIV/0!	Rialto existing conditions effluent: 9.3 cfs	Rialto covered activity effluent: 7.0 cfs
Santa Ana River	SAR DS RIX outfall & US Riverside Ave (@ ESA Upper model site)	Braided/Braided Channelized Slope < 2% WD > 175	6,865	NSAR20	49.0	33.6	15.4	Average ESA Upper Reach & USGS Reach 9	22.2%	12.9%	0.910	0.501	0.409	-44.9%	RIX existing conditions effluent: 41.2 cfs	RIX covered activity effluent: 28.0 cfs
Santa Ana River	SAR DS Riverside Ave & US node NSAR 22	Braided/Braided Channelized Slope < 2% WD > 175	3,242	NSAR21	37.2	22.0	15.2	Average ESA Upper Reach & USGS Reach 9	15.0%	6.6%	0.279	0.112	0.167	-59.8%		
Santa Ana River	SAR DS node NSAR 22 & US Market St	Braided/Braided Channelized Slope < 2% WD 50-175	5,624	NSAR22	35.0	19.8	15.2	ESA Middle Reach	13.8%	4.6%	0.425	0.122	0.303	-71.3%		
Santa Ana River	SAR DS Market St & US Hwy 60	Braided/Braided Channelized Slope < 2% WD 50-175	1,576	NSAR23	31.1	16.0	15.1	ESA Middle Reach	11.0%	3.1%	0.093	0.021	0.071	-76.9%		
Santa Ana River	SAR DS Hwy 60 and US node NSAR 232	Braided/Braided Channelized Slope < 2% WD 50-175	1,804	NSAR231	31.1	16.0	15.1	ESA Middle Reach	11.0%	3.1%	0.106	0.025	0.082	-76.9%		
Santa Ana River	SAR DS Hwy 60 & US Mission Blvd (@ ESA Middle model site)	Braided/Braided Channelized Slope < 2% WD 50-175	4,000	NSAR232	31.1	16.0	15.1	ESA Middle Reach	11.0%	3.1%	0.236	0.055	0.182	-76.9%		
Santa Ana River	SAR DS Mission Blvd & US node NSAR 241 (@ ESA Lower model site)	Braided/Braided Channelized Slope < 2% WD 50-175	5,679	NSAR24	31.1	19.0	12.1	ESA Lower Reach	1.2%	0.2%	0.064	0.010	0.054	-84.3%		3 cfs input at Evans Lake from Purple Pipe
Santa Ana River	SAR DS node NSAR 241 & US node NSAR 242 (Tequesquite Arroyo reach)	Low Gradient Meandering Slope < 2% WD 50-175	7,883	NSAR241	31.1	20.0	11.1	Santa Ana River Site 3	0.1%	0.0%	0.016	0.000	0.016	-100.0%		1 cfs input at Tequesquite Arroyo from Purple Pipe
Santa Ana River	SAR DS node NSAR 242 & US node NSAR 243	Low Gradient Meandering Slope < 2% WD 50-175	1,842	NSAR242	31.1	20.0	11.1	Santa Ana River Site 3	0.1%	0.0%	0.004	0.000	0.004	-100.0%		

Drainage	Reach Description	Channel Type	Reach Length (ft)	Hydro Model Node(s) Used	Existing Conditions Aug-Oct 95% Exceedance Flow (cfs)	Covered Activity Aug-Oct 95% Exceedance Flow (cfs)	Existing Conditions minus Covered Activity Aug-Oct 95% Exceedance Flow (cfs)	Sucker Habitat Curve Used	Existing Conditions Preferred Habitat as % Wetted Area	Covered Activity Preferred Habitat as % Wetted Area	Existing Conditions Preferred Habitat (acres)	Covered Activity Preferred Habitat (acres)	Change in Preferred Habitat from Existing Condition (acres)	Change in Preferred Habitat from Existing Condition (%)	Notes on Existing Condition Hydrology	Notes on Covered Activity Condition Hydrology
Santa Ana River	SAR Anza Creek reach	Low Gradient Meandering Slope < 2% WD 50-175	1,826	NSAR243	31.1	20.0	11.1	Santa Ana River Site 3	0.1%	0.0%	0.004	0.000	0.004	-100.0%		
Santa Ana River	SAR DS of Anza Creek/railroad bridge & US pipeline crossing	Low Gradient Meandering Slope < 2% WD 50-175	3,703	NSAR244	31.1	23.0	8.1	Santa Ana River Site 3	0.1%	0.0%	0.008	0.000	0.008	-100.0%		3 cfs input at Anza Creek/Old Ranch Creek from Purple Pipe
Santa Ana River	SAR DS of pipeline crossing & US RWQCP	Low Gradient Meandering Slope < 2% WD 50-175	4,700	NSAR25	51.2	43.0	8.2	Santa Ana River Site 3	1.3%	0.7%	0.114	0.062	0.052	-45.4%	Riverside Narrows upwelling of ~20 cfs	Riverside Narrows upwelling of ~20 cfs
Santa Ana River	SAR DS of RWQCP & US of Van Buren Blvd	Low Gradient Meandering Slope < 2% WD 50-175	1,305	NSAR26	45.8	37.6	8.1	Santa Ana River Site 3	0.9%	0.4%	0.022	0.010	0.012	-55.5%		
Santa Ana River	SAR DS Van Buren Blvd (Hole Creek reach)	Low Gradient Meandering Slope < 2% WD 50-175	1,647	NSAR27	91.9	59.2	32.7	Santa Ana River Site 3	6.0%	2.0%	0.190	0.062	0.128	-67.5%	RWQCP existing conditions effluent of 47 cfs	RWQCP covered activity effluent of 23 cfs
Santa Ana River	SAR DS node NSAR 28 & US node NSAR 29	Low Gradient Meandering Slope < 2% WD 50-175	1,777	NSAR28	90.3	60.7	29.6	Santa Ana River Site 3	5.7%	2.1%	0.197	0.072	0.125	-63.6%		3 cfs input at Hole Creek from Purple Pipe
Santa Ana River	SAR DS node NSAR 29 & US node NSAR 30	Low Gradient Meandering Slope < 2% WD 50-175	1,010	NSAR29	88.5	59.0	29.5	Santa Ana River Site 3	5.4%	2.0%	0.107	0.038	0.069	-64.8%		
Santa Ana River	SAR DS node NSAR 30 & US node NSAR 301	Low Gradient Meandering Slope < 2% WD 50-175	2,990	NSAR30	87.4	57.9	29.5	Santa Ana River Site 3	5.3%	1.9%	0.306	0.105	0.201	-65.7%		
Santa Ana River	SAR DS node NSAR 301 & US node NSAR 31	Low Gradient Meandering Slope < 2% WD 50-175	7,793	NSAR301	84.7	58.4	26.3	Santa Ana River Site 3	4.9%	1.9%	0.741	0.281	0.459	-62.0%		3 cfs input at Hidden Valley Creek from Purple Pipe
Santa Ana River	SAR DS node NSAR 31 & US node NSAR 311 (San Antonio Creek reach)	Low Gradient Meandering Slope < 2% WD 50-175	1,493	NSAR31	78.7	52.4	26.2	Santa Ana River Site 3	4.1%	1.4%	0.119	0.039	0.080	-67.2%		
Santa Ana River	SAR DS node NSAR 311 & US node NSAR 32	Low Gradient Meandering Slope < 2% WD 50-175	1,900	NSAR311	76.4	50.2	26.2	Santa Ana River Site 3	3.8%	1.2%	0.140	0.043	0.097	-69.2%		
Santa Ana River	SAR DS node NSAR 32 & US node NSAR 321	Low Gradient Meandering Slope < 2% WD 50-175	4,855	NSAR32	75.0	47.3	27.7	Santa Ana River Site 3	3.7%	1.0%	0.342	0.091	0.252	-73.5%		1.3 cfs flow reduction from San Sevaine Creek

Drainage	Reach Description	Channel Type	Reach Length (ft)	Hydro Model Node(s) Used	Existing Conditions Aug-Oct 95% Exceedance Flow (cfs)	Covered Activity Aug-Oct 95% Exceedance Flow (cfs)	Existing Conditions minus Covered Activity Aug-Oct 95% Exceedance Flow (cfs)	Sucker Habitat Curve Used	Existing Conditions Preferred Habitat as % Wetted Area	Covered Activity Preferred Habitat as % Wetted Area	Existing Conditions Preferred Habitat (acres)	Covered Activity Preferred Habitat (acres)	Change in Preferred Habitat from Existing Condition (acres)	Change in Preferred Habitat from Existing Condition (%)	Notes on Existing Condition Hydrology	Notes on Covered Activity Condition Hydrology
																covered activities
Santa Ana River	SAR DS node NSAR 321 & US node NSAR 33 (Day Creek reach)	Low Gradient Meandering Slope < 2% WD 50-175	2,968	NSAR321	72.9	47.6	25.3	Santa Ana River Site 3	3.4%	1.0%	0.195	0.057	0.138	-71.0%		2.3 cfs input at from Hidden Valley Ponds outfall from Purple Pipe
Santa Ana River	SAR DS node NSAR 33 & US node NSAR 331	Low Gradient Meandering Slope < 2% WD 50-175	4,953	NSAR33	70.8	45.3	25.5	Santa Ana River Site 3A	2.8%	1.1%	0.261	0.097	0.164	-62.9%		0.7 cfs flow reduction from Day Creek covered activities
Santa Ana River	SAR DS node NSAR 331 & US node NSAR 332	Low Gradient Meandering Slope < 2% WD 50-175	3,354	NSAR331	66.5	41.1	25.5	Santa Ana River Site 3A	2.4%	0.9%	0.154	0.052	0.102	-66.3%		
Santa Ana River	SAR DS node NSAR 332 & US node NSAR 34 (I-15)	Low Gradient Meandering Slope < 2% WD 50-175	1,724	NSAR332	64.7	39.3	25.4	Santa Ana River Site 3A	2.3%	0.8%	0.074	0.024	0.050	-67.8%		
Santa Ana River	SAR DS node NSAR 34 (I-15) & US node NSAR 35	Low Gradient Meandering Slope < 2% WD 50-175	1,388	NSAR34	63.6	38.2	25.4	Santa Ana River Site 3A	2.2%	0.7%	0.058	0.018	0.040	-68.7%		
Santa Ana River	SAR DS node NSAR 35 & US node NSAR 351	Low Gradient Meandering Slope < 2% WD 50-175	2,064	NSAR35	63.6	38.2	25.4	Santa Ana River Site 3A	2.2%	0.7%	0.086	0.027	0.059	-68.7%		
Santa Ana River	SAR DS node NSAR 351 & US node NSAR 352	Low Gradient Meandering Slope < 2% WD 50-175	11,399	NSAR351	63.6	38.2	25.4	Santa Ana River Site 3A	2.2%	0.7%	0.474	0.148	0.326	-68.7%		
Santa Ana River	SAR DS node NSAR 352 & US node NSAR 36 (entrance into Prado)	Low Gradient Meandering Slope < 2% WD 50-175	7,293	NSAR352	63.6	38.2	25.4	Santa Ana River Site 3A	2.2%	0.7%	0.303	0.095	0.209	-68.7%		

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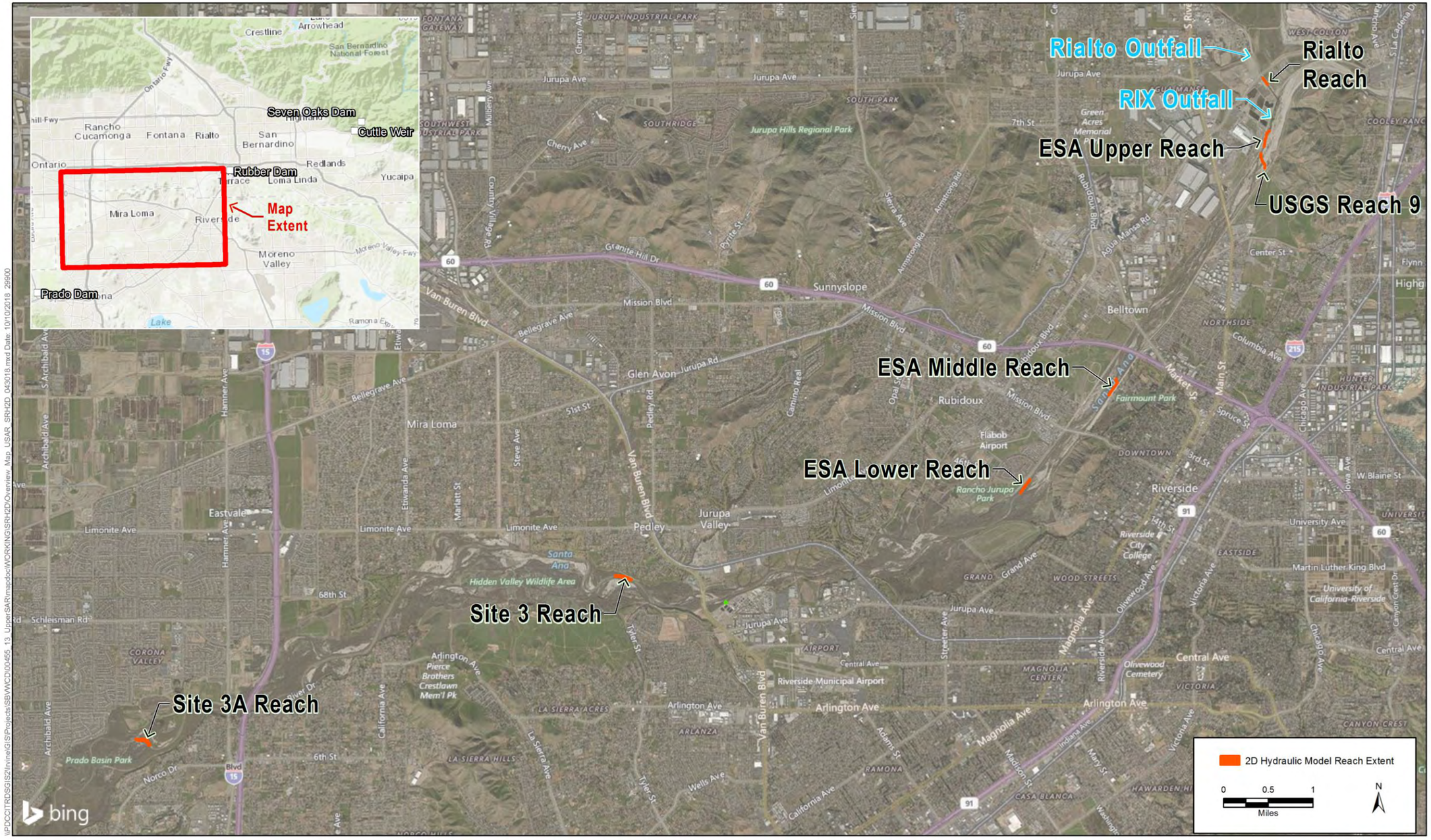

Figure E-5. Santa Ana River Hydraulic & Habitat Modeling Reaches Downstream of Rialto

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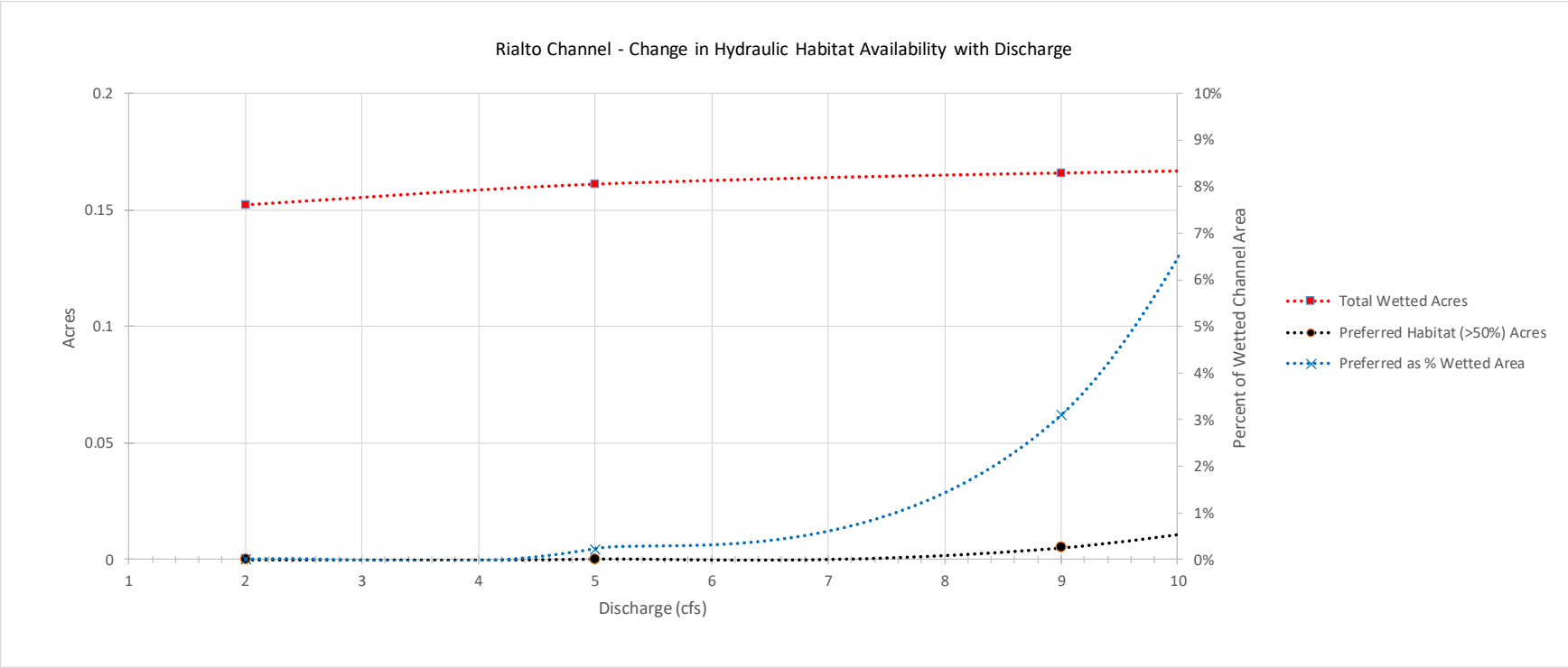

Figure E-6. Rialto Channel – Change in Hydraulic Habitat Availability with Discharge

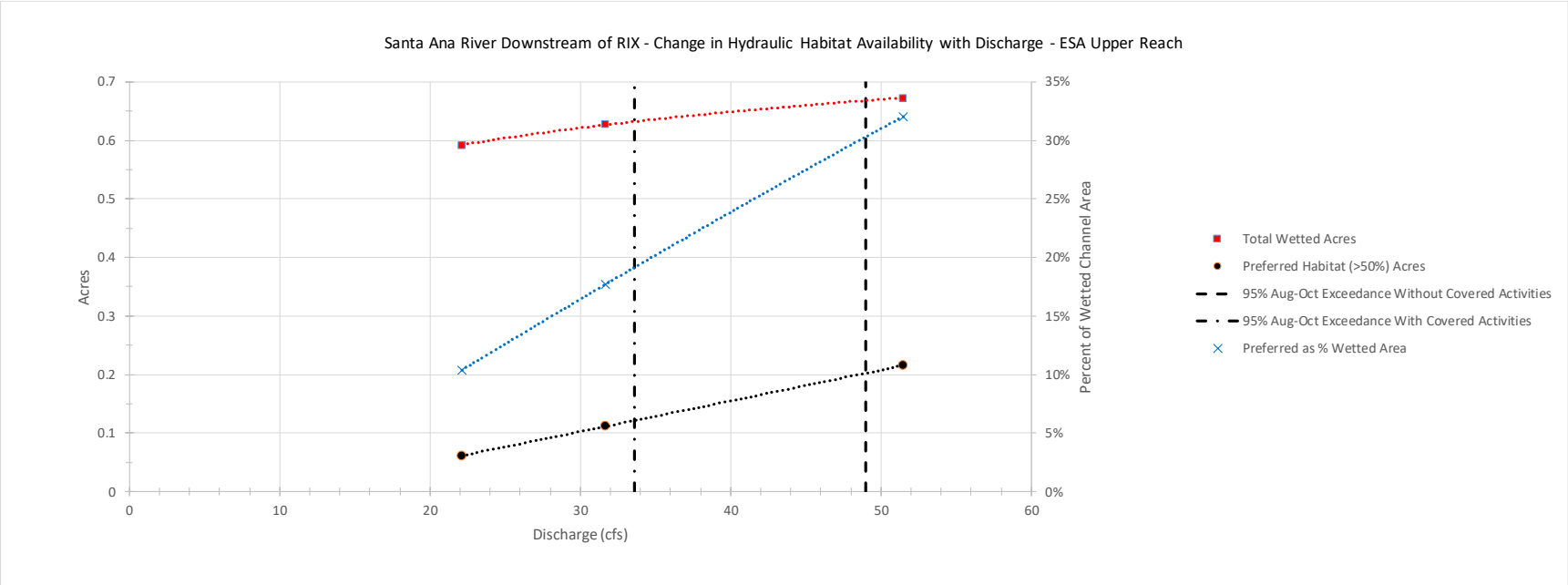

Figure E-7. Santa Ana River Downstream of RIX – ESA Upper Reach – Change in Hydraulic Habitat Availability with Discharge

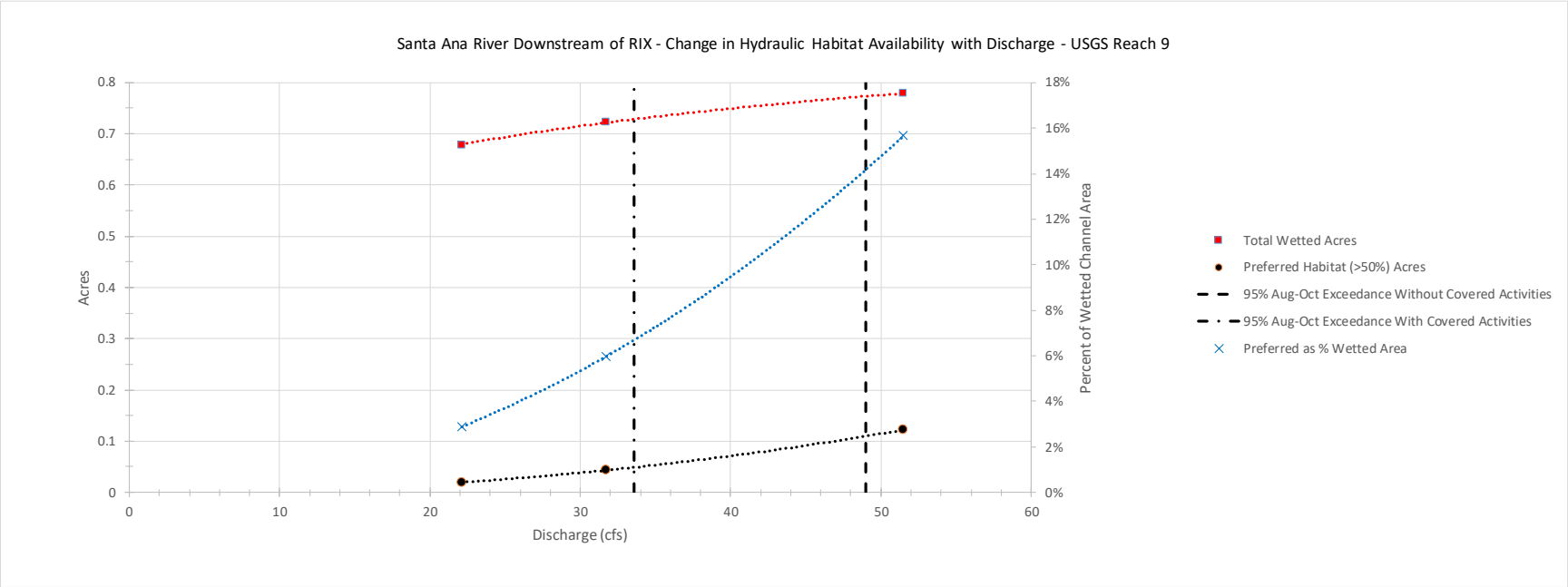

Figure E-8. Santa Ana River Downstream of RIX – USGS Reach 9 – Change in Hydraulic Habitat Availability with Discharge

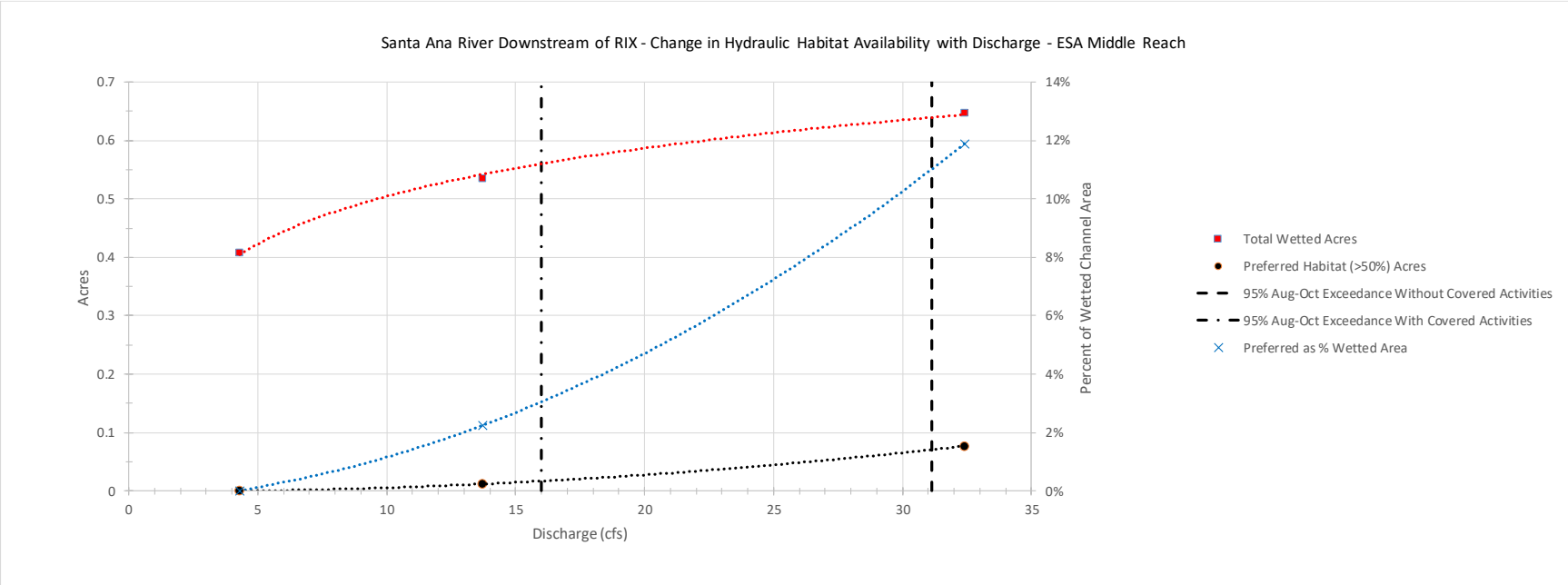

Figure E-9. Santa Ana River Downstream of RIX – ESA Middle Reach – Change in Hydraulic Habitat Availability with Discharge

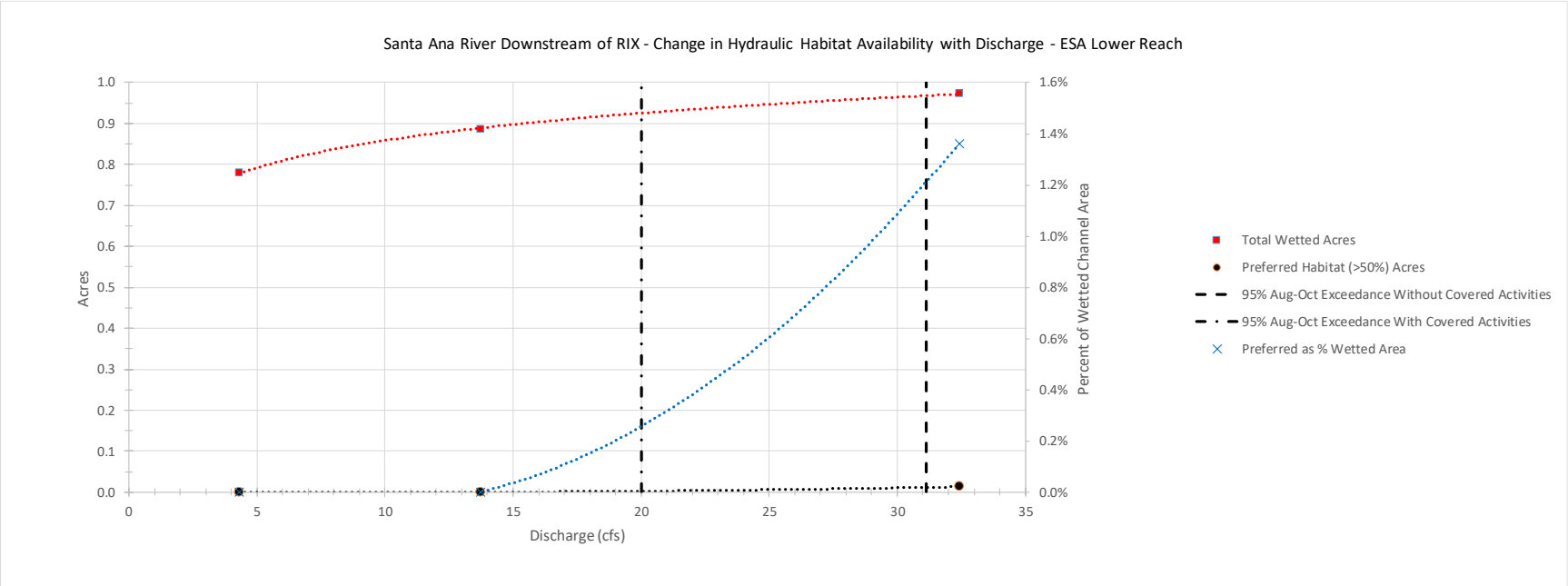

Figure E-10. Santa Ana River Downstream of RIX – ESA Lower Reach – Change in Hydraulic Habitat Availability with Discharge

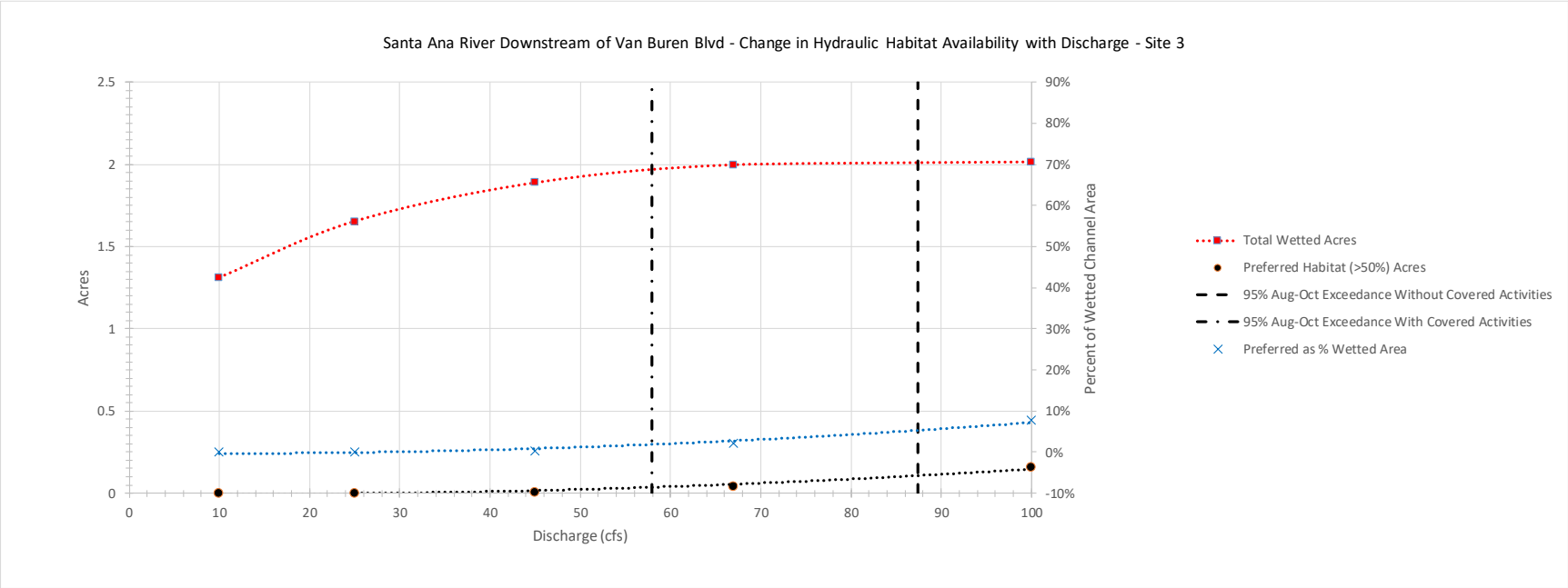

Figure E-11. Santa Ana River Downstream of Van Buren Blvd – Site 3 – Change in Hydraulic Habitat Availability with Discharge

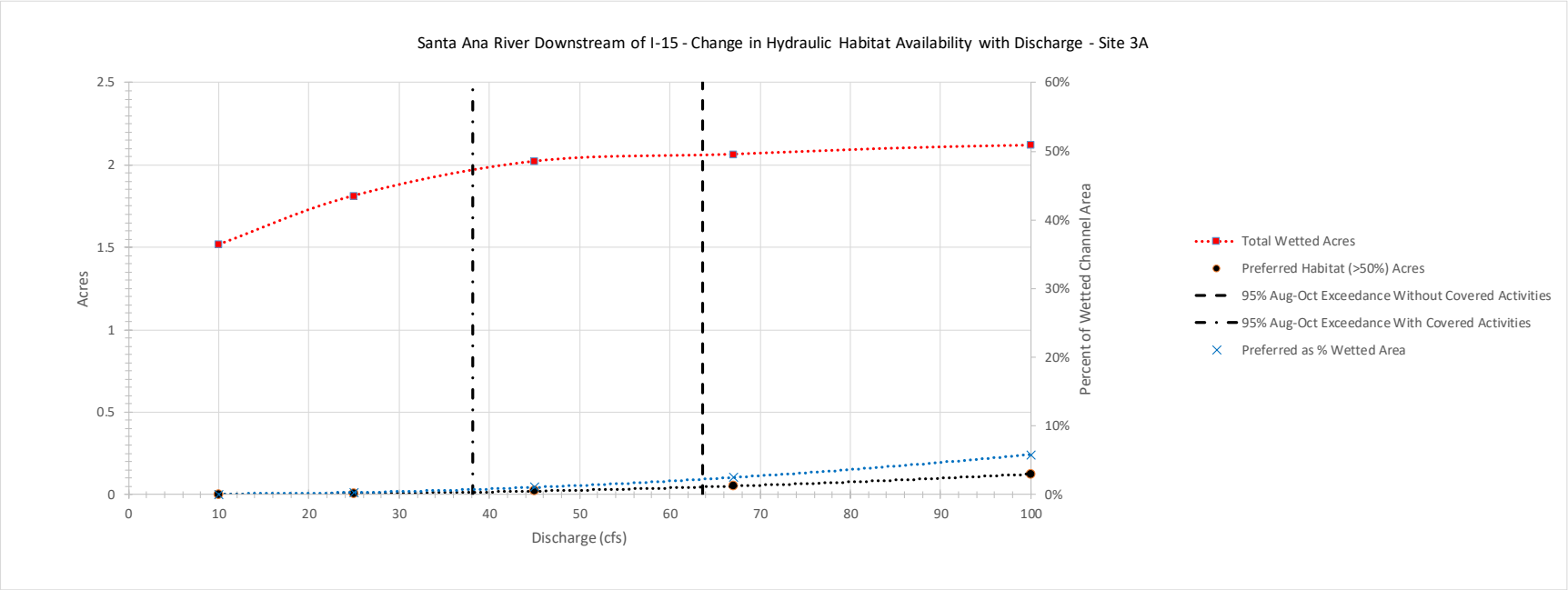

Figure E-12. Santa Ana River Downstream of I-15 – Site 3A – Change in Hydraulic Habitat Availability with Discharge

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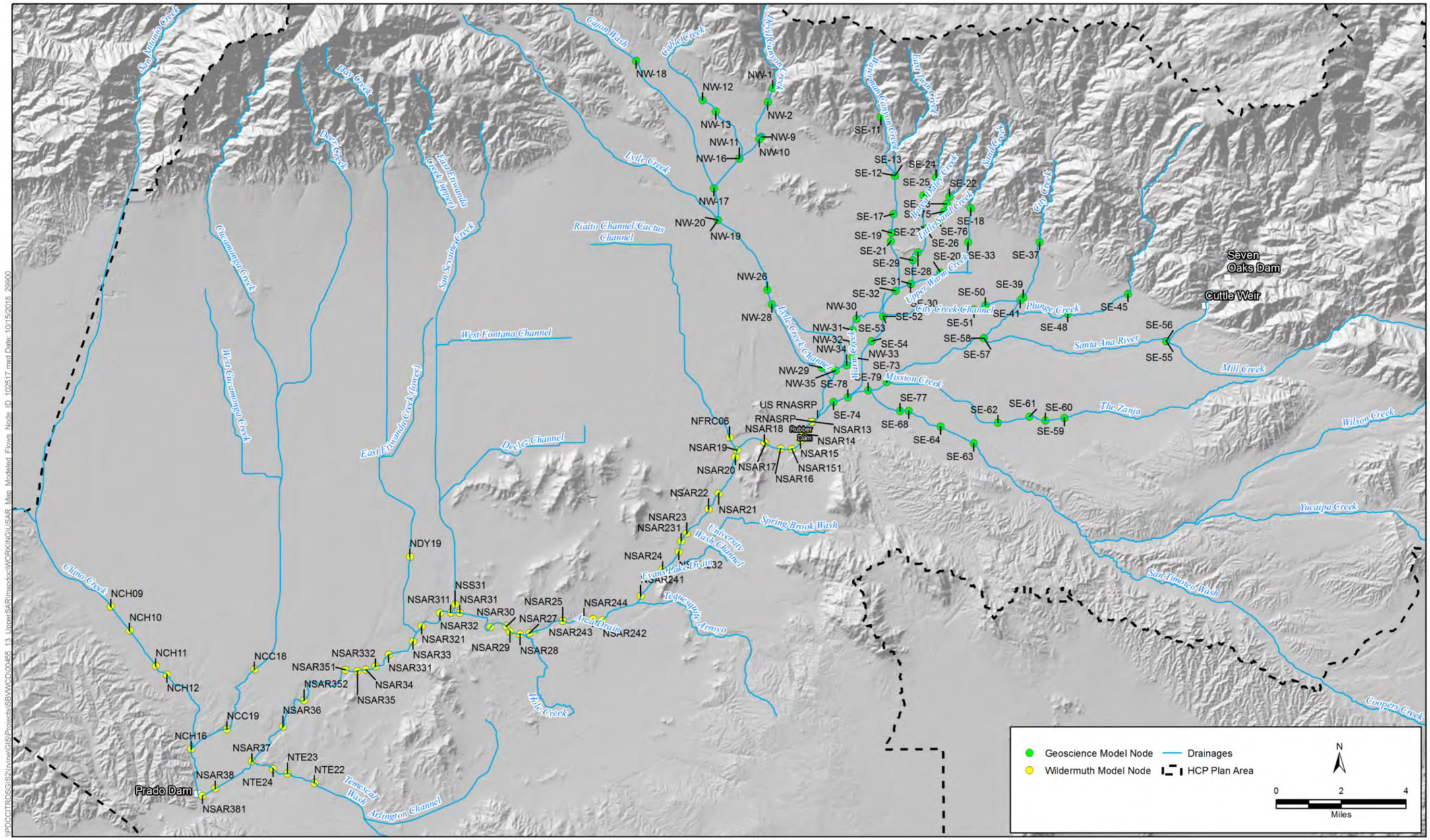

Figure E-13. Node Locations of Upper Santa Ana River HCP Hydrology Models

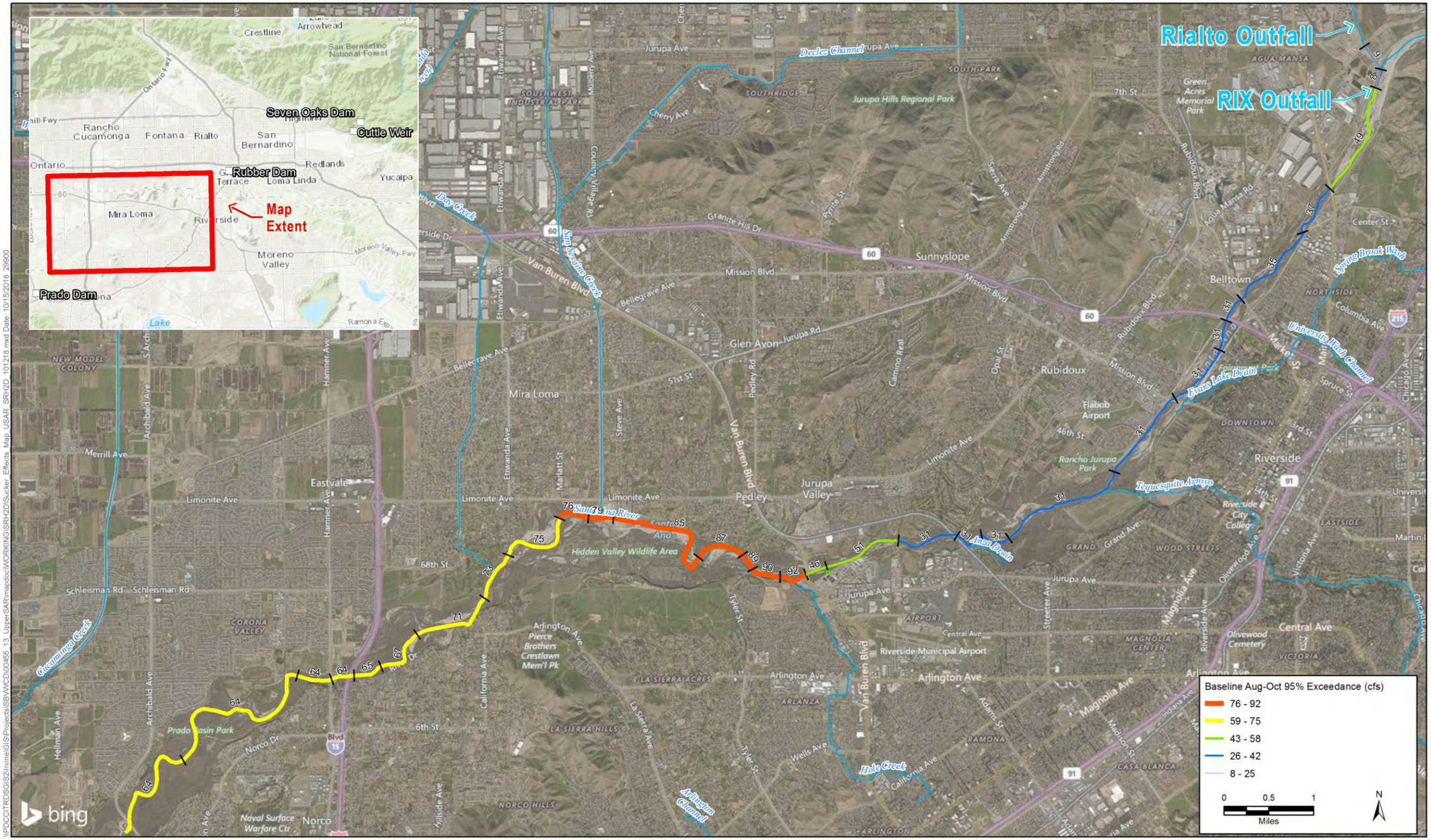

Figure E-14. Average August-October 95% Exceedance Flow (cfs) for the Baseline Condition

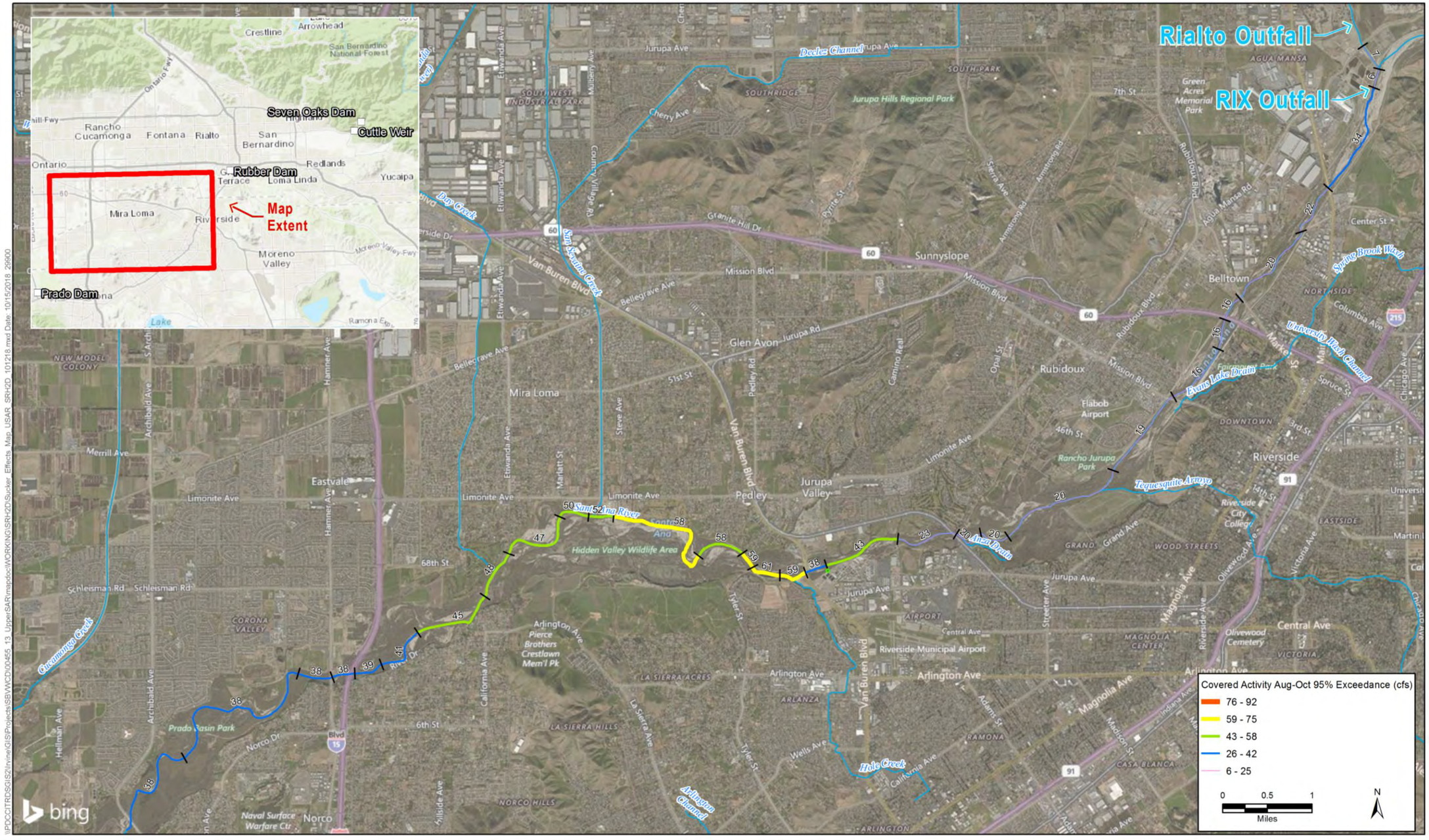

Figure E-15. Average August-October 95% Exceedance Flow (cfs) for the Covered Activity Condition

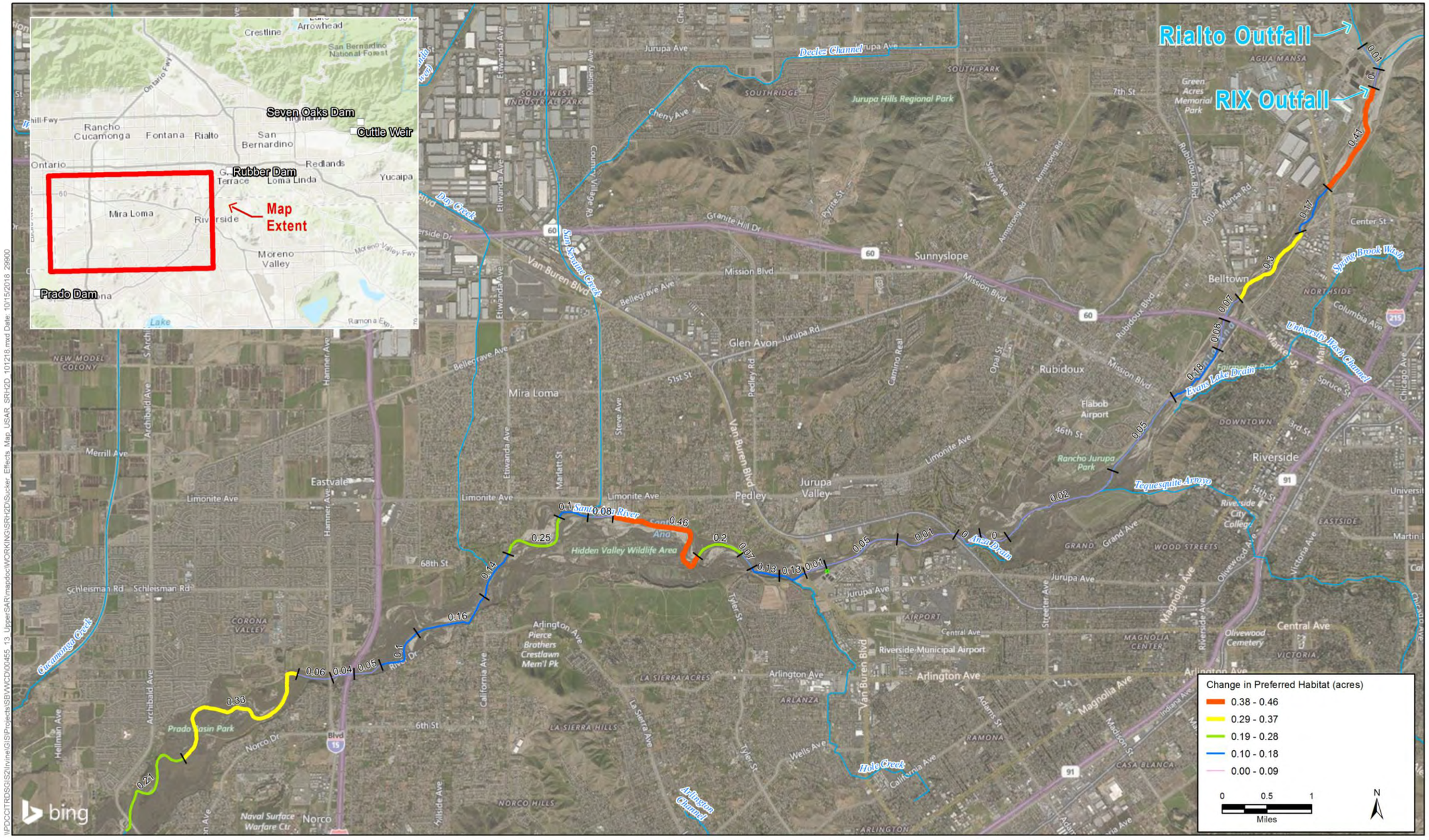

Figure E-16. Change in Preferred Habitat (acres) for the Santa Ana Sucker between Baseline and with Covered Activities Conditions

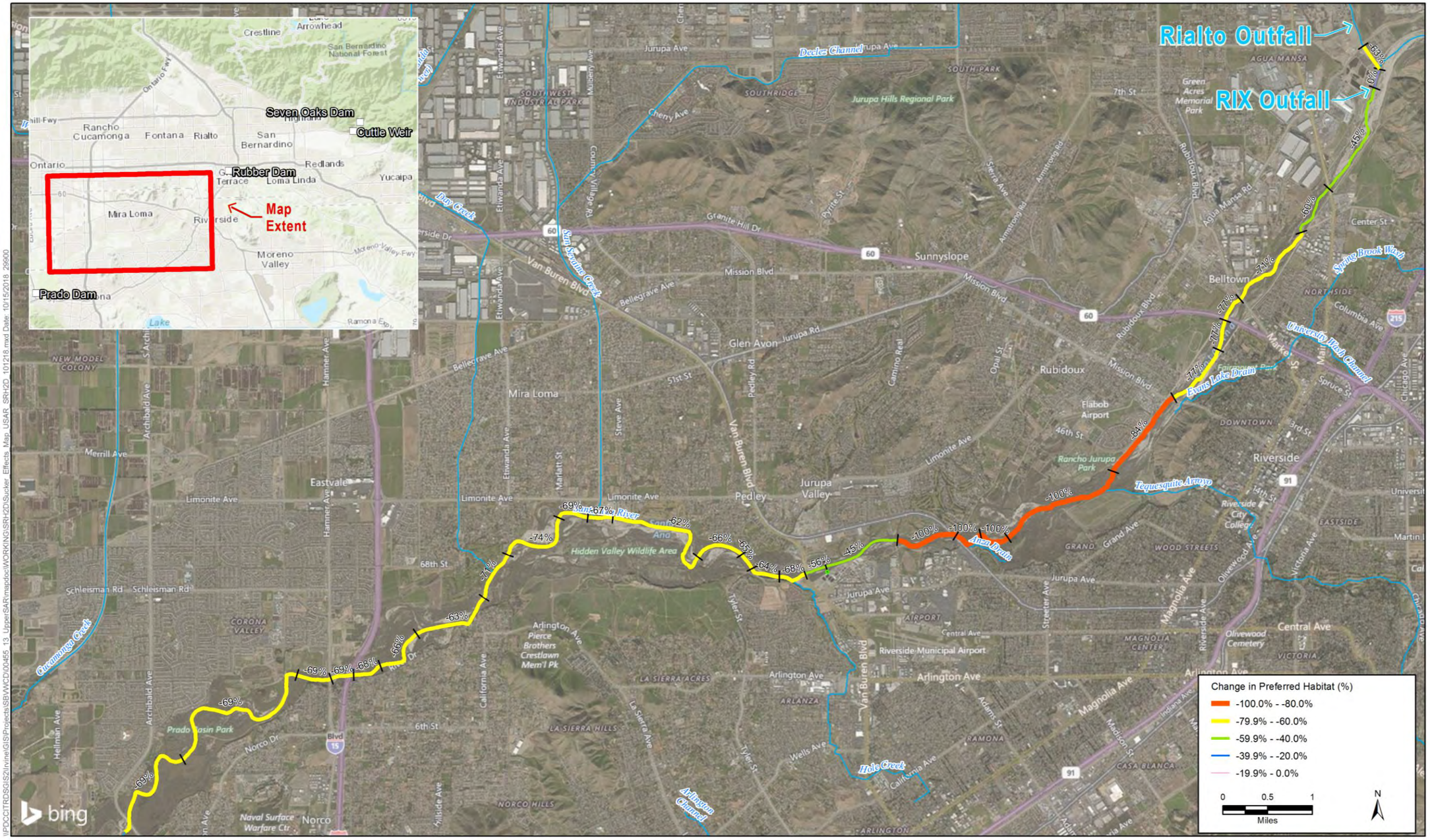

Figure E-17. Change in Preferred Habitat (%) for the Santa Ana Sucker between Baseline and with Covered Activities Conditions

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Appendix F

Covered Activity Impacts

SPECIES MODELS IMPACTS

Western Municipal Water District of Riverside County (Western)

Acres Impacted Permanent (Temporary) Species and Model Category	Groundwater Recharge West.06	Wells and Water Conveyance Infrastructure West.01	West.02	West.03	West.04	West.07	West.08	West.09	West.10	Western Total
Plants										
Slender-horned spineflower										
Current Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat	-- (--)	4.7 (50.1)	-- (5.1)	-- (--)	-- (0.4)	4.9 (0.9)	-- (--)	-- (0.7)	15.6 (--)	25.2 (57.2)
Santa Ana River woolly-star										
Potentially Suitable Habitat	-- (--)	0.1 (1.2)	-- (0.1)	-- (--)	-- (0.1)	-- (0.1)	-- (--)	-- (--)	-- (--)	0.1 (1.5)
Invertebrates										
Delhi sands flower-loving fly										
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat (Extirpated)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Amphibians and Reptiles										
Arroyo toad										
Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Upland Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Mountain yellow-legged frog										
Potentially Suitable Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Refugia/Foraging/Dispersal Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western spadefoot										
Potentially Suitable Habitat	-- (--)	4.5 (45.8)	-- (4.6)	-- (--)	-- (0.5)	1.4 (1.3)	-- (--)	-- (0.1)	0.4 (--)	6.3 (52.3)
California glossy snake										
Potentially Suitable Habitat	-- (--)	5.6 (59.2)	-- (5.9)	-- (--)	-- (0.6)	5.1 (2.4)	-- (0.1)	-- (0.2)	15.6 (--)	26.3 (68.4)
South coast garter snake										
Potentially Suitable Habitat	-- (--)	0.1 (1.1)	-- (0.1)	-- (--)	-- (--)	-- (0.9)	-- (--)	-- (--)	-- (--)	0.1 (2.1)
Western pond turtle										
Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (0.1)
Potentially Suitable Upland Habitat	-- (--)	0.3 (3.1)	-- (0.3)	-- (--)	-- (--)	-- (1.1)	-- (--)	-- (--)	-- (--)	0.3 (4.5)
Birds										
Tricolored blackbird										
Suitable Colony Habitat	1.0 (--)	-- (0.5)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	1.0 (0.7)
Breeding Season Foraging - Natural	-- (--)	2.4 (24.6)	-- (2.5)	-- (--)	-- (0.2)	-- (0.7)	-- (--)	-- (--)	-- (--)	2.4 (28.0)
Breeding Season Foraging - Agriculture	2.0 (--)	7.3 (75.1)	-- (--)	0.7 (--)	-- (--)	25.6 (14.4)	-- (2.4)	-- (--)	11.4 (--)	47.0 (91.9)
Non-Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Season Foraging - Agriculture	-- (--)	0.1 (0.6)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (0.6)
Burrowing owl										
Potentially Suitable Habitat	2.0 (--)	11.8 (124.8)	-- (7.1)	0.7 (--)	-- (0.9)	50.2 (17.8)	-- (3.4)	-- (0.4)	6.6 (--)	71.3 (154.4)
Cactus wren										
Known Suitable Nesting	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potential Nesting and Foraging Habitat	-- (--)	7.6 (80.4)	-- (8.1)	-- (--)	-- (0.9)	5.1 (2.8)	-- (0.1)	-- (0.7)	12.7 (--)	25.4 (93.0)

SPECIES MODELS IMPACTS

Western Municipal Water District of Riverside County (Western)

Acres Impacted Permanent (Temporary) Species and Model Category	Groundwater Recharge West.06	Wells and Water Conveyance Infrastructure West.01	West.02	West.03	West.04	West.07	West.08	West.09	West.10	Western Total
Recently Burned (2008-2018)	-- (--)	0.4 (4.0)	-- (0.4)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.4 (4.4)
Yellow-breasted chat										
Potentially Suitable Habitat	1.0 (--)	1.0 (12.1)	-- (1.0)	-- (--)	-- (--)	-- (0.8)	-- (4.8)	-- (--)	-- (--)	2.0 (18.7)
Yellow-billed cuckoo										
High Value Breeding Habitat	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
Other Potentially Suitable Breeding Habitat	-- (--)	0.1 (1.7)	-- (0.1)	-- (--)	-- (--)	-- (0.4)	-- (2.2)	-- (--)	-- (--)	0.1 (4.4)
Southwestern willow flycatcher										
Core Southwestern Willow Flycatcher Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Very High Value Habitat	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (0.1)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Habitat	1.0 (--)	1.0 (12.1)	-- (1.0)	-- (--)	-- (--)	-- (0.8)	-- (4.8)	-- (--)	-- (--)	2.0 (18.7)
Coastal California gnatcatcher										
Very High Value Habitat	-- (--)	0.1 (0.5)	-- (0.1)	-- (--)	-- (--)	0.7 (--)	-- (--)	-- (--)	-- (--)	0.8 (0.6)
High Value Habitat	-- (--)	0.3 (3.6)	-- (0.4)	-- (--)	-- (--)	4.2 (0.1)	-- (--)	-- (--)	1.0 (--)	5.5 (4.1)
Moderate Value Habitat	-- (--)	1.0 (10.7)	-- (1.1)	-- (--)	-- (0.1)	-- (0.3)	-- (--)	-- (--)	3.6 (--)	4.6 (12.2)
Low Value Habitat	-- (--)	3.1 (33.3)	-- (3.4)	-- (--)	-- (0.2)	-- (0.4)	-- (--)	-- (0.6)	5.0 (--)	8.1 (37.9)
Other Suitable Habitat	-- (--)	0.1 (1.5)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (1.6)
Least Bells vireo										
Core Breeding Habitat	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (0.5)	-- (--)	-- (--)	-- (--)	-- (0.7)
Other Breeding Habitat	1.0 (--)	1.0 (12.0)	-- (1.0)	-- (--)	-- (--)	-- (0.4)	-- (4.8)	-- (--)	-- (--)	2.0 (18.2)
Mammals										
Los Angeles little pocket mouse										
Potentially Suitable Habitat	-- (--)	5.3 (55.3)	-- (5.6)	-- (--)	-- (0.6)	5.1 (2.4)	-- (0.1)	-- (0.2)	5.5 (--)	15.9 (64.2)
San Bernardino Merriams kangaroo rat										
High	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Medium	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Low	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Very Low Quality	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Ecological Process Area	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Suitable Habitat	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)

SPECIES MODELS IMPACTS
West Valley Water District (West Valley)

Acres Impacted Permanent (Temporary) Species and Model Category	Water Reuse Projects WV.4	Groundwater Recharge WV.1	Wells and Water Conveyance Infrastructure WV.2	WV.3	WV.5	WV.6	West Valley Total
Plants							
Slender-horned spineflower							
Current Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat	-- (--)	-- (--)	-- (0.2)	-- (--)	0.2 (--)	-- (4.2)	0.2 (4.4)
Santa Ana River woolly-star							
Potentially Suitable Habitat	0.1 (--)	-- (--)	-- (0.3)	-- (--)	0.2 (--)	-- (4.0)	0.3 (4.3)
Invertebrates							
Delhi sands flower-loving fly							
Potentially Suitable Habitat	-- (--)	-- (--)	-- (0.3)	-- (--)	-- (--)	-- (1.1)	-- (1.4)
Potentially Suitable Habitat (Extirpated)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Amphibians and Reptiles							
Arroyo toad							
Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Upland Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Mountain yellow-legged frog							
Potentially Suitable Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Refugia/Foraging/Dispersal Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (4.7)	-- (4.7)
Western spadefoot							
Potentially Suitable Habitat	0.1 (--)	7.7 (--)	-- (0.3)	-- (--)	0.1 (--)	-- (5.2)	7.9 (5.5)
California glossy snake							
Potentially Suitable Habitat	0.1 (--)	7.8 (--)	-- (0.6)	-- (--)	0.2 (--)	-- (11.1)	8.1 (11.7)
South coast garter snake							
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (0.1)
Western pond turtle							
Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Upland Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (0.2)
Birds							
Tricolored blackbird							
Suitable Colony Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (0.3)	-- (--)	-- (--)	-- (2.7)	-- (3.0)
Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.6)	-- (0.6)
Non-Breeding Season Foraging - Natural	0.1 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.3)	0.1 (0.3)
Non-Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Burrowing owl							
Potentially Suitable Habitat	0.1 (--)	4.0 (--)	-- (0.7)	-- (--)	0.2 (--)	-- (8.0)	4.3 (8.7)

SPECIES MODELS IMPACTS
West Valley Water District (West Valley)

Acres Impacted Permanent (Temporary) Species and Model Category	Water Reuse Projects WV.4	Groundwater Recharge WV.1	Wells and Water Conveyance Infrastructure WV.2	WV.3	WV.5	WV.6	West Valley Total
Cactus wren							
Known Suitable Nesting	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potential Nesting and Foraging Habitat	0.1 (--)	4.0 (--)	-- (0.6)	-- (--)	0.2 (--)	-- (8.5)	4.3 (9.1)
Recently Burned (2008 - 2018)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (0.2)
Yellow-breasted chat							
Potentially Suitable Habitat	-- (--)	3.2 (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	3.2 (0.2)
Yellow-billed cuckoo							
High Value Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Southwestern willow flycatcher							
Core Southwestern Willow Flycatcher Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (0.1)
Very High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Habitat	-- (--)	3.2 (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	3.2 (0.1)
Coastal California gnatcatcher							
Very High Value Habitat	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (0.3)	-- (0.4)
High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.3)	-- (0.3)
Moderate Value Habitat	-- (--)	1.2 (--)	-- (0.1)	-- (--)	0.1 (--)	-- (0.3)	1.3 (0.4)
Low Value Habitat	-- (--)	1.3 (--)	-- (0.1)	-- (--)	0.1 (--)	-- (2.0)	1.4 (2.1)
Other Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (1.0)	-- (1.0)
Least Bells vireo							
Core Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Breeding Habitat	-- (--)	3.2 (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	3.2 (0.2)
Mammals							
Los Angeles little pocket mouse							
Potentially Suitable Habitat	0.1 (--)	4.0 (--)	-- (0.7)	-- (--)	0.2 (--)	-- (8.0)	4.3 (8.7)
San Bernardino Merriams kangaroo rat							
High	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Medium	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (0.1)
Low	-- (--)	0.8 (--)	-- (--)	-- (--)	-- (--)	-- (0.5)	0.8 (0.5)
Very Low Quality	-- (--)	10.4 (--)	-- (0.1)	-- (--)	0.2 (--)	-- (1.1)	10.6 (1.2)
Ecological Process Area	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (0.2)
Suitable Habitat	-- (--)	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (1.6)	-- (1.8)

SPECIES MODELS IMPACTS

San Bernardino Municipal Water Department (Water Department)

Acres Impacted Permanent (Temporary) Species and Model Category	Water Reuse Projects WD.1	Groundwater Recharge WD.4	Wells and Water Conveyance Infrastructure WD.2	WD.3	WD.5	Water Dept Total
Plants						
Slender-horned spineflower						
Current Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat	0.3 (1.9)	-- (0.8)	-- (0.1)	-- (0.9)	-- (2.9)	0.3 (6.6)
Santa Ana River woolly-star						
Potentially Suitable Habitat	0.4 (2.6)	-- (0.8)	-- (1.9)	-- (--)	-- (1.8)	0.4 (7.1)
Invertebrates						
Delhi sands flower-loving fly						
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat (Extirpated)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Amphibians and Reptiles						
Arroyo toad						
Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (0.6)	0.1 (0.2)	0.1 (0.8)
Non-Breeding Upland Habitat	-- (--)	-- (--)	-- (--)	0.4 (0.9)	0.1 (0.6)	0.5 (1.5)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (--)	-- (--)	-- (1.1)	0.2 (0.4)	0.2 (1.5)
Mountain yellow-legged frog						
Potentially Suitable Aquatic Habitat	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)
Refugia/Foraging/Dispersal Habitat	0.7 (1.5)	-- (--)	-- (--)	0.4 (0.8)	0.1 (1.5)	1.2 (3.8)
Western spadefoot						
Potentially Suitable Habitat	0.5 (2.2)	-- (0.8)	-- (1.2)	-- (0.7)	-- (2.8)	0.5 (7.7)
California glossy snake						
Potentially Suitable Habitat	0.5 (3.2)	-- (0.8)	-- (3.2)	0.4 (1.2)	-- (5.5)	0.9 (13.9)
South coast garter snake						
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western pond turtle						
Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Upland Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Birds						
Tricolored blackbird						
Suitable Colony Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Breeding Season Foraging - Natural	-- (0.7)	-- (--)	-- (--)	-- (--)	-- (0.5)	-- (1.2)
Breeding Season Foraging - Agriculture	-- (0.6)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.6)
Non-Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)

SPECIES MODELS IMPACTS

San Bernardino Municipal Water Department (Water Department)

Acres Impacted Permanent (Temporary) Species and Model Category	Water Reuse Projects WD.1	Groundwater Recharge WD.4	Wells and Water Conveyance Infrastructure WD.2	WD.3	WD.5	Water Dept Total
Non-Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Burrowing owl						
Potentially Suitable Habitat	0.3 (3.2)	-- (0.8)	-- (0.2)	-- (--)	-- (3.6)	0.3 (7.8)
Cactus wren						
Known Suitable Nesting	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potential Nesting and Foraging Habitat	0.5 (3.1)	-- (0.8)	-- (0.2)	-- (0.9)	-- (4.5)	0.5 (9.5)
Recently Burned (2008 - 2018)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Yellow-breasted chat						
Potentially Suitable Habitat	0.9 (0.7)	-- (--)	-- (1.1)	-- (--)	-- (0.2)	0.9 (2.0)
Yellow-billed cuckoo						
High Value Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Southwestern willow flycatcher						
Core Southwestern Willow Flycatcher Habitat	-- (0.2)	-- (--)	-- (0.8)	-- (--)	-- (0.1)	-- (1.1)
Very High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Habitat	0.9 (0.5)	-- (--)	-- (0.2)	-- (--)	-- (--)	0.9 (0.7)
Coastal California gnatcatcher						
Very High Value Habitat	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (0.3)
High Value Habitat	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (0.3)
Moderate Value Habitat	-- (0.6)	-- (0.1)	-- (--)	-- (--)	-- (0.2)	-- (0.9)
Low Value Habitat	0.3 (0.9)	-- (0.7)	-- (0.1)	-- (--)	-- (1.7)	0.3 (3.4)
Other Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (0.9)	-- (0.7)	-- (1.6)
Least Bells vireo						
Core Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Breeding Habitat	0.9 (0.7)	-- (--)	-- (1.1)	-- (--)	-- (0.2)	0.9 (2.0)
Mammals						
Los Angeles little pocket mouse						
Potentially Suitable Habitat	0.5 (3.1)	-- (0.8)	-- (0.2)	-- (0.3)	-- (4.2)	0.5 (8.6)
San Bernardino Merriams kangaroo rat						
High	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Medium	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Low	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (0.1)
Very Low Quality	-- (0.2)	-- (--)	-- (--)	-- (--)	0.1 (0.3)	0.1 (0.5)
Ecological Process Area	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Suitable Habitat	0.3 (2.7)	-- (0.3)	-- (1.6)	-- (1.0)	-- (2.1)	0.3 (7.7)

SPECIES MODELS IMPACTS

San Bernardino Valley Municipal Water District (Valley District)

Acres Impacted Permanent (Temporary)	Groundwater Recharge														Wells & Water Conveyance Infrastructure	Habitat Enhancement, Management, and Monitoring															Valley
Species and Model Category	**VD.1**	**VD.2.02**	**VD.2.03**	**VD.2.05**	**VD.2.06**	**VD.2.07**	**VD.2.08**	**VD.2.09**	**VD.2.10**	**VD.2.11**	**VD.2.12**	**VD.2.13**	**VD.2.14**	**VD.3**	**VD.4**	**Rest.01**	**Rest.02**	**Rest.03**	**Rest.04**	**Rest.05**	**Rest.06**	**Rest.07**	**Rest.08**	**Rest.09**	**Rest.10**	**Rest.11**	**Rest.12**	**Rest.13**	**Rest.14**	**Rest.15**	**District Total**
Plants																															
Slender-horned spineflower																															
Current Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat	-- (--)	69.5 (--)	10.6 (--)	39.3 (--)	2.1 (--)	0.5 (--)	32.9 (--)	7.4 (--)	1.9 (--)	-- (--)	0.6 (--)	-- (--)	-- (--)	-- (11.0)	-- (15.3)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	165.6 (26.3)
Santa Ana River woolly-star																															
Potentially Suitable Habitat	-- (--)	77.4 (--)	62.4 (--)	51.1 (--)	11.4 (--)	0.5 (--)	23.1 (--)	89.3 (--)	8.0 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (11.1)	-- (11.0)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	323.8 (22.1)
Invertebrates																															
Delhi sands flower-loving fly																															
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat (Extirpated)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Amphibians and Reptiles																															
Arroyo toad																															
Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Upland Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Mountain yellow-legged frog																															
Potentially Suitable Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	1.7 (--)	1.7 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	3.4 (--)
Refugia/Foraging/Dispersal Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	3.0 (--)	92.1 (--)	-- (--)	-- (--)	-- (1.3)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	95.1 (1.3)
Western spadefoot																															
Potentially Suitable Habitat	-- (--)	68.6 (--)	7.2 (--)	44.5 (--)	-- (--)	0.5 (--)	42.9 (--)	4.4 (--)	0.6 (--)	16.4 (--)	0.8 (--)	98.6 (--)	2.0 (--)	0.1 (11.5)	-- (15.0)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	287.4 (26.5)
California glossy snake																															
Potentially Suitable Habitat	-- (--)	73.0 (--)	40.5 (--)	58.3 (--)	3.9 (--)	0.5 (--)	43.2 (--)	80.8 (--)	4.3 (--)	14.7 (--)	1.0 (--)	5.0 (--)	0.3 (--)	-- (12.4)	-- (23.7)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	326.4 (36.1)
South coast garter snake																															
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western pond turtle																															
Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Upland Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Birds																															
Tricolored blackbird																															
Suitable Colony Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (--)	-- (--)	0.5 (--)	-- (--)	0.5 (--)	0.1 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.5)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	1.1 (0.5)
Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (2.2)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (2.2)
Non-Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)
Burrowing owl																															
Potentially Suitable Habitat	-- (--)	72.8 (--)	10.6 (--)	17.3 (--)	2.6 (--)	0.5 (--)	33.4 (--)	7.4 (--)	2.6 (--)	14.7 (--)	1.0 (--)	-- (--)	0.3 (--)	-- (11.5)	-- (15.0)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	163.7 (26.5)
Cactus wren																															
Known Suitable Nesting	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.3)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.2 (0.3)
Potential Nesting and Foraging Habitat	-- (--)	73.0 (--)	10.6 (--)	47.3 (--)	2.6 (--)	0.5 (--)	33.4 (--)	7.2 (--)	2.6 (--)	14.7 (--)	1.0 (--)	4.8 (--)	0.3 (--)	-- (11.5)	-- (15.5)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	198.8 (27.0)
Recently Burned (2008 - 2018)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (1.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (1.1)
Yellow-breasted chat																															
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (--)	14.6 (--)	0.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.4)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	14.9 (0.4)
Yellow-billed cuckoo																															
High Value Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
Southwestern willow flycatcher																															
Core Southwestern Willow Flycatcher Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Very High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (--)	14.6 (--)	0.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.4)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	14.9 (0.4)
Coastal California gnatcatcher																															
Very High Value Habitat	-- (--)	-- (--)	-- (--)	5.8 (--)	0.1 (--)	-- (--)	0.1 (--)	1.2 (--)	-- (--)	-- (--)	-- (--)	0.9 (--)	-- (--)	-- (1.6)	-- (1.4)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	8.1 (3.0)
High Value Habitat	-- (--)	-- (--)	-- (--)	18.3 (--)	0.9 (--)	-- (--)	9.8 (--)	4.7 (--)	-- (--)	-- (--)	0.6 (--)	0.4 (--)	-- (--)	-- (8.6)	-- (1.9)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	35.2 (10.5)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)	4.0 (--)	-- (--)	-- (--)	9.7 (--)	0.5 (--)	0.3 (--)	-- (--)	-- (--)	0.2 (--)	-- (--)	-- (1.2)	-- (2.9)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	15.0 (4.1)
Low Value Habitat	-- (--)	0.6 (--)	9.8 (--)	11.2 (--)	1.1 (--)	0.5 (--)	3.5 (--)	1.0 (--)	1.5 (--)	13.5 (--)	0.2 (--)	0.4 (--)	0.3 (--)	-- (0.1)	-- (8.7)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	43.6 (8.8)
Other Suitable Habitat	-- (--)	68.5 (--)	0.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	69.3 (0.1)
Least Bells vireo																															
Core Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)

SPECIES MODELS IMPACTS

San Bernardino Valley Municipal Water District (Valley District)

Acres Impacted Permanent (Temporary)	Groundwater Recharge													Wells & Water Conveyance Infrastructure	Habitat Enhancement, Management, and Monitoring															Valley
Species and Model Category	**VD.1**	**VD.2.02**	**VD.2.03**	**VD.2.05**	**VD.2.06**	**VD.2.07**	**VD.2.08**	**VD.2.09**	**VD.2.10**	**VD.2.11**	**VD.2.12**	**VD.2.13**	**VD.2.14**	**VD.3**	**VD.4**	**Rest.01**	**Rest.02**	**Rest.03**	**Rest.04**	**Rest.05**	**Rest.06**	**Rest.07**	**Rest.08**	**Rest.09**	**Rest.10**	**Rest.11**	**Rest.12**	**Rest.13**	**Rest.14**	**Rest.15**	**District Total**
Other Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (--)	14.6 (--)	0.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.4)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	14.9 (0.4)
Mammals																														
Los Angeles little pocket mouse																														
Potentially Suitable Habitat	-- (--)	72.5 (--)	10.6 (--)	47.3 (--)	2.6 (--)	0.5 (--)	33.4 (--)	7.3 (--)	2.6 (--)	14.7 (--)	0.9 (--)	4.8 (--)	0.3 (--)	-- (11.2)	-- (18.7)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	198.3 (29.9)
San Bernardino Merriams kangaroo rat																														
High	-- (--)	-- (--)	-- (--)	-- (--)	0.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.6 (--)
Medium	-- (--)	-- (--)	-- (--)	-- (--)	1.3 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	1.3 (0.1)
Low	-- (--)	-- (--)	19.2 (--)	-- (--)	2.9 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (1.2)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	22.1 (1.2)
Very Low Quality	-- (--)	-- (--)	2.6 (--)	-- (--)	0.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.7 (--)	101.5 (--)	-- (--)	-- (11.9)	-- (3.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	105.0 (15.0)
Ecological Process Area	-- (--)	-- (--)	47.0 (--)	0.4 (--)	3.3 (--)	-- (--)	-- (--)	33.6 (--)	1.9 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	86.2 (0.2)
Suitable Habitat	-- (--)	17.6 (--)	-- (--)	50.0 (--)	-- (--)	0.5 (--)	-- (--)	50.4 (--)	-- (--)	17.4 (--)	0.8 (--)	-- (--)	-- (--)	-- (0.4)	-- (10.9)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	137.7 (11.3)

SPECIES MODELS IMPACTS
Riverside Public Utilities (RPU)

Acres Impacted Permanent (Temporary) Species and Model Category	Water Reuse Projects RPU.09	Groundwater Recharge RPU.05	RPU.08	Wells and Water Conveyance Infrastructure RPU.01	RPU.02	RPU.03	RPU.04	RPU.06	RPU.07	RPU.10	RPU.12	RPU.13	RPU.14	RPU.15	Solar Energy Development RPU.11	RPU Total
Plants																
Slender-horned spineflower																
Current Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (2.2)	-- (0.2)	-- (--)	-- (0.8)	-- (0.1)	-- (2.9)	40.5 (--)	-- (--)	-- (0.1)	-- (0.4)	5.5 (--)	46.0 (6.9)
Santa Ana River woolly-star																
Potentially Suitable Habitat	-- (--)	5.0 (--)	-- (--)	-- (0.8)	-- (3.2)	-- (2.6)	-- (--)	-- (0.8)	-- (1.0)	-- (0.5)	42.2 (--)	-- (--)	-- (0.4)	-- (0.2)	5.5 (--)	52.7 (9.5)
Invertebrates																
Delhi sands flower-loving fly																
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
Potentially Suitable Habitat (Extirpated)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Amphibians and Reptiles																
Arroyo toad																
Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Upland Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Mountain yellow-legged frog																
Potentially Suitable Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Refugia/Foraging/Dispersal Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western spadefoot																
Potentially Suitable Habitat	2.5 (--)	57.5 (--)	-- (--)	-- (--)	-- (4.5)	-- (0.3)	-- (--)	-- (0.2)	-- (0.7)	-- (--)	117.7 (--)	0.9 (--)	-- (0.3)	-- (0.8)	15.3 (--)	193.9 (6.8)
California glossy snake																
Potentially Suitable Habitat	2.5 (--)	94.1 (--)	13.2 (--)	-- (3.4)	-- (5.8)	-- (3.5)	-- (--)	-- (0.8)	-- (1.1)	-- (5.4)	138.4 (--)	1.0 (--)	-- (1.0)	-- (2.1)	15.7 (--)	264.9 (23.1)
South coast garter snake																
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (3.9)	11.7 (--)	-- (--)	-- (--)	-- (0.2)	-- (--)	11.7 (4.1)
Western pond turtle																
Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (0.4)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.2 (--)	-- (--)	-- (--)	-- (0.2)	-- (--)	0.2 (0.6)
Potentially Suitable Upland Habitat	-- (--)	-- (--)	-- (--)	-- (2.1)	-- (--)	-- (--)	0.7 (--)	-- (--)	-- (--)	-- (5.5)	11.2 (--)	-- (--)	-- (--)	-- (0.5)	-- (--)	11.9 (8.1)
Birds																
Tricolored blackbird																
Suitable Colony Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (0.2)	2.9 (--)	-- (--)	-- (--)	-- (--)	-- (--)	2.9 (0.4)
Breeding Season Foraging - Natural	-- (--)	51.2 (--)	6.9 (--)	-- (0.9)	-- (0.7)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.3)	39.8 (--)	0.9 (--)	-- (--)	-- (0.9)	5.6 (--)	104.4 (2.8)
Breeding Season Foraging - Agriculture	-- (--)	-- (--)	4.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (1.7)	-- (--)	4.8 (1.7)
Non-Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Burrowing owl																
Potentially Suitable Habitat	2.5 (--)	52.5 (--)	0.7 (--)	-- (1.2)	-- (4.6)	-- (0.2)	-- (--)	-- (0.8)	-- (0.2)	-- (7.3)	136.5 (--)	0.9 (--)	-- (0.1)	-- (3.6)	15.7 (--)	208.8 (18.0)
Cactus wren																
Known Suitable Nesting	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potential Nesting and Foraging Habitat	2.5 (--)	52.5 (--)	13.2 (--)	-- (1.2)	-- (4.6)	-- (0.2)	-- (--)	-- (0.8)	-- (0.2)	-- (8.7)	136.4 (--)	0.9 (--)	-- (0.1)	-- (2.2)	15.7 (--)	221.2 (18.0)

SPECIES MODELS IMPACTS
Riverside Public Utilities (RPU)

Acres Impacted Permanent (Temporary)	Water Reuse Projects	Groundwater Recharge		Wells and Water Conveyance Infrastructure											Solar Energy Development	
Species and Model Category	**RPU.09**	**RPU.05**	**RPU.08**	**RPU.01**	**RPU.02**	**RPU.03**	**RPU.04**	**RPU.06**	**RPU.07**	**RPU.10**	**RPU.12**	**RPU.13**	**RPU.14**	**RPU.15**	**RPU.11**	**RPU Total**
Recently Burned (2008 - 2018)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Yellow-breasted chat																
Potentially Suitable Habitat	-- (--)	6.0 (--)	1.3 (--)	-- (1.1)	-- (0.3)	-- (0.3)	0.7 (--)	-- (--)	-- (0.6)	-- (4.4)	27.7 (--)	-- (--)	-- (0.4)	-- (0.5)	-- (--)	35.7 (7.6)
Yellow-billed cuckoo																
High Value Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.3 (--)	-- (--)	-- (--)	-- (3.6)	8.3 (--)	-- (--)	-- (--)	-- (0.2)	-- (--)	8.6 (3.8)
Southwestern willow flycatcher																
Core Southwestern Willow Flycatcher Habitat	-- (--)	6.0 (--)	-- (--)	-- (1.1)	-- (--)	-- (0.2)	0.4 (--)	-- (--)	-- (--)	-- (--)	9.1 (--)	-- (--)	-- (0.4)	-- (0.1)	-- (--)	15.5 (1.8)
Very High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Habitat	-- (--)	-- (--)	1.3 (--)	-- (--)	-- (0.3)	-- (--)	0.3 (--)	-- (--)	-- (0.6)	-- (4.3)	18.6 (--)	-- (--)	-- (--)	-- (0.4)	-- (--)	20.2 (5.6)
Coastal California gnatcatcher																
Very High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.6)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	6.7 (--)	-- (--)	-- (--)	-- (--)	0.7 (--)	7.4 (0.6)
High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.8)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	2.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	2.2 (0.8)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.4)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (0.3)	2.7 (--)	-- (--)	-- (0.1)	-- (0.1)	-- (--)	2.7 (1.1)
Low Value Habitat	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (1.8)	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (2.4)	33.1 (--)	-- (--)	-- (--)	-- (0.2)	4.8 (--)	37.9 (4.8)
Other Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
Least Bells vireo																
Core Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (1.0)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (1.1)
Other Breeding Habitat	-- (--)	6.0 (--)	1.3 (--)	-- (1.1)	-- (0.3)	-- (0.3)	0.7 (--)	-- (--)	-- (0.6)	-- (3.5)	27.7 (--)	-- (--)	-- (0.4)	-- (0.3)	-- (--)	35.7 (6.5)
Mammals																
Los Angeles little pocket mouse																
Potentially Suitable Habitat	2.5 (--)	52.5 (--)	13.2 (--)	-- (1.1)	-- (4.6)	-- (0.2)	-- (--)	-- (0.8)	-- (0.2)	-- (5.4)	136.4 (--)	0.9 (--)	-- (0.1)	-- (1.8)	15.7 (--)	221.2 (14.2)
San Bernardino Merriams kangaroo rat																
High	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Medium	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Low	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Very Low Quality	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Ecological Process Area	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Suitable Habitat	-- (--)	5.0 (--)	-- (--)	-- (0.8)	-- (2.1)	-- (2.6)	-- (--)	-- (--)	-- (0.3)	-- (--)	9.7 (--)	-- (--)	-- (0.4)	-- (0.1)	3.0 (--)	17.7 (6.3)

SPECIES MODELS IMPACTS
•Orange County Water District (OCWD)

Acres Impacted Permanent (Temporary) Species and Model Category	Wells and Water Conveyance Infrastructure OCWD.1	OCWD Total
Plants		
Slender-horned spineflower		
Current Occupied Habitat	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)
Potentially Suitable Habitat	-- (--)	-- (--)
Santa Ana River woolly-star		
Potentially Suitable Habitat	-- (--)	-- (--)
Invertebrates		
Delhi sands flower-loving fly		
Potentially Suitable Habitat	-- (--)	-- (--)
Potentially Suitable Habitat (Extirpated)	-- (--)	-- (--)
Amphibians and Reptiles		
Arroyo toad		
Suitable Breeding Habitat	-- (--)	-- (--)
Non-Breeding Upland Habitat	-- (--)	-- (--)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (--)
Mountain yellow-legged frog		
Potentially Suitable Aquatic Habitat	-- (--)	-- (--)
Refugia/Foraging/Dispersal Habitat	-- (--)	-- (--)
Western spadefoot		
Potentially Suitable Habitat	-- (--)	-- (--)
California glossy snake		
Potentially Suitable Habitat	-- (--)	-- (--)
South coast garter snake		
Potentially Suitable Habitat	-- (--)	-- (--)
Western pond turtle		
Aquatic Habitat	-- (--)	-- (--)
Potentially Suitable Upland Habitat	-- (--)	-- (--)
Birds		
Tricolored blackbird		
Suitable Colony Habitat	-- (--)	-- (--)
Breeding Season Foraging - Natural	-- (--)	-- (--)
Breeding Season Foraging - Agriculture	-- (--)	-- (--)
Non-Breeding Season Foraging - Natural	-- (--)	-- (--)
Non-Breeding Season Foraging - Agriculture	-- (--)	-- (--)
Burrowing owl		
Potentially Suitable Habitat	-- (--)	-- (--)
Cactus wren		
Known Suitable Nesting	-- (--)	-- (--)
Potential Nesting and Foraging Habitat	-- (--)	-- (--)
Recently Burned (2008 - 2018)	-- (--)	-- (--)
Yellow-breasted chat		
Potentially Suitable Habitat	-- (--)	-- (--)
Yellow-billed cuckoo		
High Value Breeding Habitat	-- (--)	-- (--)
Other Potentially Suitable Breeding Habitat	-- (--)	-- (--)
Southwestern willow flycatcher		
Core Southwestern Willow Flycatcher Habitat	-- (--)	-- (--)
Very High Value Habitat	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)
Other Potentially Suitable Habitat	-- (--)	-- (--)

SPECIES MODELS IMPACTS
•Orange County Water District (OCWD)

Acres Impacted Permanent (Temporary) Species and Model Category	Wells and Water Conveyance Infrastructure OCWD.1	OCWD Total
Coastal California gnatcatcher		
Very High Value Habitat	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)
Low Value Habitat	-- (--)	-- (--)
Other Suitable Habitat	-- (--)	-- (--)
Least Bells vireo		
Core Breeding Habitat	-- (--)	-- (--)
Other Breeding Habitat	-- (--)	-- (--)
Mammals		
Los Angeles little pocket mouse		
Potentially Suitable Habitat	-- (--)	-- (--)
San Bernardino Merriams kangaroo rat		
High	-- (--)	-- (--)
Medium	-- (--)	-- (--)
Low	-- (--)	-- (--)
Very Low Quality	-- (--)	-- (--)
Ecological Process Area	-- (--)	-- (--)
Suitable Habitat	-- (--)	-- (--)

SPECIES MODELS IMPACTS

Metropolitan Water District of Southern California (Metropolitan)

Acres Impacted Permanent (Temporary)	Wells and Water Conveyance Infrastructure			
Species and Model Category	**Met.1**	**Met.2**	**Met.3**	**Metropolitan Total**
Plants				
Slender-horned spineflower				
Current Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat	-- (--)	-- (12.4)	29.2 (--)	29.2 (12.4)
Santa Ana River woolly-star				
Potentially Suitable Habitat	-- (--)	-- (4.6)	9.5 (--)	9.5 (4.6)
Invertebrates				
Delhi sands flower-loving fly				
Potentially Suitable Habitat	-- (--)	-- (--)	0.2 (--)	0.2 (--)
Potentially Suitable Habitat (Extirpated)	-- (--)	-- (0.1)	0.1 (--)	0.1 (0.1)
Amphibians and Reptiles				
Arroyo toad				
Suitable Breeding Habitat	-- (--)	-- (0.1)	0.3 (--)	0.3 (0.1)
Non-Breeding Upland Habitat	-- (--)	-- (1.0)	0.9 (--)	0.9 (1.0)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (2.1)	3.4 (--)	3.4 (2.1)
Mountain yellow-legged frog				
Potentially Suitable Aquatic Habitat	-- (--)	-- (--)	0.5 (--)	0.5 (--)
Refugia/Foraging/Dispersal Habitat	-- (--)	-- (5.3)	11.7 (--)	11.7 (5.3)
Western spadefoot				
Potentially Suitable Habitat	-- (--)	-- (9.6)	19.7 (--)	19.7 (9.6)
California glossy snake				
Potentially Suitable Habitat	0.1 (--)	-- (18.2)	38.5 (--)	38.6 (18.2)
South coast garter snake				
Potentially Suitable Habitat	0.1 (--)	-- (0.4)	2.7 (--)	2.8 (0.4)
Western pond turtle				
Aquatic Habitat	-- (--)	-- (--)	0.6 (--)	0.6 (--)
Potentially Suitable Upland Habitat	0.1 (--)	-- (1.3)	6.1 (--)	6.2 (1.3)
Birds				
Tricolored blackbird				
Suitable Colony Habitat	-- (--)	-- (0.1)	0.4 (--)	0.4 (0.1)
Breeding Season Foraging - Natural	-- (--)	-- (7.0)	15.7 (--)	15.7 (7.0)
Breeding Season Foraging - Agriculture	-- (--)	-- (4.1)	15.1 (--)	15.1 (4.1)
Non-Breeding Season Foraging - Natural	-- (--)	-- (0.1)	0.3 (--)	0.3 (0.1)
Non-Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)
Burrowing owl				
Potentially Suitable Habitat	0.1 (--)	-- (23.8)	63.5 (--)	63.6 (23.8)
Cactus wren				
Known Suitable Nesting	-- (--)	-- (0.1)	0.1 (--)	0.1 (0.1)
Potential Nesting and Foraging Habitat	0.1 (--)	-- (20.6)	48.9 (--)	49.0 (20.6)
Recently Burned (2008 - 2018)	-- (--)	-- (0.7)	1.1 (--)	1.1 (0.7)
Yellow-breasted chat				
Potentially Suitable Habitat	-- (--)	-- (0.6)	3.0 (--)	3.0 (0.6)
Yellow-billed cuckoo				
High Value Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Breeding Habitat	-- (--)	-- (--)	0.1 (--)	0.1 (--)
Southwestern willow flycatcher				
Core Southwestern Willow Flycatcher Habitat	-- (--)	-- (--)	-- (--)	-- (--)
Very High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Habitat	-- (--)	-- (0.6)	3.0 (--)	3.0 (0.6)

SPECIES MODELS IMPACTS

Metropolitan Water District of Southern California (Metropolitan)

Acres Impacted Permanent (Temporary)	Wells and Water Conveyance Infrastructure			
Species and Model Category	**Met.1**	**Met.2**	**Met.3**	**Metropolitan Total**
Coastal California gnatcatcher				
Very High Value Habitat	-- (--)	-- (1.2)	1.9 (--)	1.9 (1.2)
High Value Habitat	-- (--)	-- (0.9)	2.3 (--)	2.3 (0.9)
Moderate Value Habitat	-- (--)	-- (1.8)	5.7 (--)	5.7 (1.8)
Low Value Habitat	-- (--)	-- (6.9)	14.2 (--)	14.2 (6.9)
Other Suitable Habitat	-- (--)	-- (0.2)	0.8 (--)	0.8 (0.2)
Least Bells vireo				
Core Breeding Habitat	-- (--)	-- (--)	0.2 (--)	0.2 (--)
Other Breeding Habitat	-- (--)	-- (0.5)	2.8 (--)	2.8 (0.5)
Mammals				
Los Angeles little pocket mouse				
Potentially Suitable Habitat	0.1 (--)	-- (16.0)	32.0 (--)	32.1 (16.0)
San Bernardino Merriams kangaroo rat				
High	-- (--)	-- (--)	-- (--)	-- (--)
Medium	-- (--)	-- (--)	0.1 (--)	0.1 (--)
Low	-- (--)	-- (0.5)	2.3 (--)	2.3 (0.5)
Very Low Quality	-- (--)	-- (1.3)	4.0 (--)	4.0 (1.3)
Ecological Process Area	-- (--)	-- (0.1)	0.2 (--)	0.2 (0.1)
Suitable Habitat	-- (--)	-- (4.9)	3.6 (--)	3.6 (4.9)

SPECIES MODELS IMPACTS
Inland Empire Utilities Agency (IEUA)

Acres Impacted Permanent (Temporary) Species and Model Category	Water Reuse Projects IEUA.4	Groundwater Recharge IEUA.1.01	IEUA.1.02	IEUA.1.03	IEUA.1.05	IEUA.1.07	IEUA.1.09	IEUA.1.10	IEUA.1.11	IEUA.1.12	IEUA.2.01	IEUA.2.03	IEUA.2.04	IEUA.2.05	IEUA.2.06	IEUA.2.08	IEUA.3.01	IEUA.3.02	IEUA.3.04	Habitat Enhancement, Management, and Monitoring IEUA.1.13	IEUA Total
Plants																					
Slender-horned spineflower																					
Current Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	13.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	13.6 (0.1)
Santa Ana River woolly-star																					
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	3.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	3.2 (--)
Invertebrates																					
Delhi sands flower-loving fly																					
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat (Extirpated)	-- (--)	63.4 (--)	-- (--)	-- (--)	-- (--)	22.0 (--)	-- (--)	-- (--)	-- (--)	14.3 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	99.7 (--)
Amphibians and Reptiles																					
Arroyo toad																					
Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Upland Habitat	-- (--)	-- (--)	-- (--)	5.7 (0.3)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	5.7 (0.3)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (--)	-- (--)	61.9 (1.9)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	61.9 (1.9)
Mountain yellow-legged frog																					
Potentially Suitable Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Refugia/Foraging/Dispersal Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western spadefoot																					
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	63.2 (0.3)	-- (--)	11.9 (--)	-- (--)	6.7 (--)	-- (--)	12.1 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	93.9 (0.3)
California glossy snake																					
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	16.4 (0.3)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	13.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	30.0 (0.3)
South coast garter snake																					
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western pond turtle																					
Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Upland Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Birds																					
Tricolored blackbird																					
Suitable Colony Habitat	-- (--)	28.1 (--)	0.2 (--)	-- (--)	-- (--)	-- (--)	2.8 (--)	-- (--)	3.3 (--)	-- (--)	6.0 (--)	-- (--)	-- (--)	-- (--)	7.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	48.0 (--)
Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	7.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	7.6 (--)
Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Burrowing owl																					
Potentially Suitable Habitat	-- (--)	-- (--)	15.1 (--)	40.0 (0.3)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	13.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	7.6 (--)	14.1 (--)	-- (--)	-- (--)	-- (--)	-- (--)	90.4 (0.3)
Cactus wren																					
Known Suitable Nesting	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potential Nesting and Foraging Habitat	-- (--)	-- (--)	15.1 (--)	40.0 (0.3)	1.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	13.6 (--)	0.1 (--)	8.2 (--)	-- (--)	-- (--)	7.6 (--)	14.1 (--)	-- (--)	-- (--)	-- (--)	-- (--)	100.5 (0.3)
Recently Burned (2008 - 2018)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Yellow-breasted chat																					
Potentially Suitable Habitat	-- (--)	25.4 (--)	0.2 (--)	14.0 (--)	-- (--)	1.1 (--)	2.1 (--)	-- (--)	2.8 (--)	-- (--)	6.0 (--)	-- (--)	-- (--)	-- (--)	7.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	59.2 (--)
Yellow-billed cuckoo																					
High Value Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Southwestern willow flycatcher																					
Core Southwestern Willow Flycatcher Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Very High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Habitat	-- (--)	25.4 (--)	0.2 (--)	14.0 (--)	-- (--)	1.1 (--)	2.1 (--)	-- (--)	2.8 (--)	-- (--)	6.0 (--)	-- (--)	-- (--)	-- (--)	7.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	59.2 (--)
Coastal California gnatcatcher																					
Very High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)	0.7 (--)	0.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	1.5 (--)
Moderate Value Habitat	-- (--)	-- (--)	4.0 (--)	3.9 (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	4.9 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	12.8 (0.1)

SPECIES MODELS IMPACTS
Inland Empire Utilities Agency (IEUA)

Acres Impacted Permanent (Temporary) Species and Model Category	Water Reuse Projects IEUA.4	Groundwater Recharge IEUA.1.01	IEUA.1.02	IEUA.1.03	IEUA.1.05	IEUA.1.07	IEUA.1.09	IEUA.1.10	IEUA.1.11	IEUA.1.12	IEUA.2.01	IEUA.2.03	IEUA.2.04	IEUA.2.05	IEUA.2.06	IEUA.2.08	IEUA.3.01	IEUA.3.02	IEUA.3.04	Habitat Enhancement, Management, and Monitoring IEUA.1.13	IEUA Total
Low Value Habitat	-- (--)	-- (--)	6.6 (--)	7.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	8.7 (--)	-- (--)	2.7 (--)	4.8 (--)	-- (--)	-- (--)	12.9 (--)	-- (--)	-- (--)	-- (--)	-- (--)	43.5 (--)
Other Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Least Bells vireo																					
Core Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Breeding Habitat	-- (--)	25.4 (--)	0.2 (--)	14.0 (--)	-- (--)	1.1 (--)	2.1 (--)	-- (--)	2.8 (--)	-- (--)	6.0 (--)	-- (--)	-- (--)	-- (--)	7.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	59.2 (--)
Mammals																					
Los Angeles little pocket mouse																					
Potentially Suitable Habitat	-- (--)	-- (--)	15.1 (--)	40.0 (0.3)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	13.6 (--)	0.1 (--)	8.2 (--)	-- (--)	-- (--)	7.6 (--)	14.1 (--)	-- (--)	-- (--)	-- (--)	-- (--)	98.7 (0.3)
San Bernardino Merriams kangaroo rat																					
High	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Medium	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Low	-- (--)	-- (--)	-- (--)	68.7 (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	68.7 (0.1)
Very Low Quality	-- (--)	-- (--)	31.5 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	31.5 (--)
Ecological Process Area	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)

SPECIES MODELS IMPACTS
East Valley Water District (East Valley)

Acres Impacted Permanent (Temporary)		Water Reuse Projects			Wells & Water Conveyance Infrastructure			East Valley
Species and Model Category	**EV.1**	**EV.4.01**	**EV.4.02**	**EV.4.03**	**EV.2**	**EV.3**	**EV.5**	**Total**
Plants								
Slender-horned spineflower								
Current Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat	0.1 (--)	-- (--)	-- (0.6)	-- (--)	-- (1.5)	2.1 (--)	0.8 (0.2)	3.0 (2.3)
Santa Ana River woolly-star								
Potentially Suitable Habitat	-- (--)	-- (--)	-- (2.6)	-- (--)	-- (0.9)	2.1 (--)	0.3 (0.2)	2.4 (3.7)
Invertebrates								
Delhi sands flower-loving fly								
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat (Extirpated)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Amphibians and Reptiles								
Arroyo toad								
Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Upland Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Mountain yellow-legged frog								
Potentially Suitable Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Refugia/Foraging/Dispersal Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	0.5 (--)	0.3 (--)	0.8 (0.1)
Western spadefoot								
Potentially Suitable Habitat	0.1 (--)	-- (--)	-- (0.6)	-- (--)	-- (0.7)	1.7 (--)	0.4 (0.2)	2.2 (1.5)
California glossy snake								
Potentially Suitable Habitat	0.1 (--)	17.0 (--)	-- (4.0)	-- (--)	-- (2.4)	4.9 (--)	1.2 (0.2)	23.2 (6.6)
South coast garter snake								
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western pond turtle								
Aquatic Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Potentially Suitable Upland Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Birds								
Tricolored blackbird								
Suitable Colony Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Breeding Season Foraging - Natural	-- (--)	17.0 (--)	-- (0.9)	-- (--)	-- (0.3)	2.1 (--)	-- (--)	19.1 (1.2)
Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (0.1)
Non-Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Non-Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Burrowing owl								
Potentially Suitable Habitat	-- (--)	17.0 (--)	-- (1.5)	-- (--)	-- (2.3)	4.6 (--)	0.9 (0.3)	22.5 (4.1)
Cactus wren								
Known Suitable Nesting	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (--)	0.1 (--)
Potential Nesting and Foraging Habitat	-- (--)	17.0 (--)	-- (1.5)	-- (--)	-- (2.3)	4.6 (--)	0.8 (0.3)	22.4 (4.1)

SPECIES MODELS IMPACTS
East Valley Water District (East Valley)

Acres Impacted Permanent (Temporary)		Water Reuse Projects			Wells & Water Conveyance Infrastructure			East Valley
Species and Model Category	**EV.1**	**EV.4.01**	**EV.4.02**	**EV.4.03**	**EV.2**	**EV.3**	**EV.5**	**Total**
Recently Burned (2008 - 2018)	0.1 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (--)
Yellow-breasted chat								
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	0.1 (--)	-- (--)	0.1 (0.1)
Yellow-billed cuckoo								
High Value Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Southwestern willow flycatcher								
Core Southwestern Willow Flycatcher Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Very High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	0.1 (--)	-- (--)	0.1 (0.1)
Coastal California gnatcatcher								
Very High Value Habitat	-- (--)	-- (--)	-- (0.2)	-- (--)	-- (0.2)	0.2 (--)	-- (0.1)	0.2 (0.5)
High Value Habitat	-- (--)	-- (--)	-- (0.2)	-- (--)	-- (0.3)	1.0 (--)	0.3 (--)	1.3 (0.5)
Moderate Value Habitat	0.1 (--)	-- (--)	-- (--)	-- (--)	-- (0.3)	0.6 (--)	-- (0.2)	0.7 (0.5)
Low Value Habitat	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (0.4)	0.1 (--)	0.4 (--)	0.5 (0.5)
Other Suitable Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Least Bells vireo								
Core Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Other Breeding Habitat	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	0.1 (--)	-- (--)	0.1 (0.1)
Mammals								
Los Angeles little pocket mouse								
Potentially Suitable Habitat	0.1 (--)	17.0 (--)	-- (1.5)	-- (--)	-- (1.8)	4.4 (--)	0.6 (0.2)	22.1 (3.5)
San Bernardino Merriams kangaroo rat								
High	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Medium	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Low	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Very Low Quality	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	2.2 (--)	0.7 (0.3)	2.9 (0.4)
Ecological Process Area	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Suitable Habitat	-- (--)	-- (--)	-- (0.7)	-- (--)	-- (0.6)	0.2 (--)	-- (--)	0.2 (1.3)

SPECIES MODELS IMPACTS

San Bernardino Valley Water Conservation District (Conservation District)

Acres Impacted Permanent (Temporary) Species and Model Category	Groundwater Recharge Groundwater	 CD.2	Conservation District Total
Plants			
Slender-horned spineflower			
Current Occupied Habitat	-- (--)	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat	0.1 (--)	-- (--)	0.1 (--)
Santa Ana River woolly-star			
Potentially Suitable Habitat	0.2 (--)	0.1 (--)	0.3 (--)
Invertebrates			
Delhi sands flower-loving fly			
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)
Potentially Suitable Habitat (Extirpated)	-- (--)	-- (--)	-- (--)
Amphibians and Reptiles			
Arroyo toad			
Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)
Non-Breeding Upland Habitat	-- (--)	-- (--)	-- (--)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (--)	-- (--)
Mountain yellow-legged frog			
Potentially Suitable Aquatic Habitat	-- (--)	-- (--)	-- (--)
Refugia/Foraging/Dispersal Habitat	-- (--)	-- (--)	-- (--)
Western spadefoot			
Potentially Suitable Habitat	0.1 (--)	0.1 (--)	0.2 (--)
California glossy snake			
Potentially Suitable Habitat	0.3 (--)	-- (--)	0.3 (--)
South coast garter snake			
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)
Western pond turtle			
Aquatic Habitat	-- (--)	-- (--)	-- (--)
Potentially Suitable Upland Habitat	-- (--)	-- (--)	-- (--)
Birds			
Tricolored blackbird			
Suitable Colony Habitat	-- (--)	-- (--)	-- (--)
Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (--)
Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)
Non-Breeding Season Foraging - Natural	-- (--)	-- (--)	-- (--)
Non-Breeding Season Foraging - Agriculture	-- (--)	-- (--)	-- (--)
Burrowing owl			
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)
Cactus wren			
Known Suitable Nesting	-- (--)	-- (--)	-- (--)
Potential Nesting and Foraging Habitat	0.1 (--)	-- (--)	0.1 (--)
Recently Burned (2008 - 2018)	-- (--)	-- (--)	-- (--)
Yellow-breasted chat			
Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)
Yellow-billed cuckoo			
High Value Breeding Habitat	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Breeding Habitat	-- (--)	-- (--)	-- (--)
Southwestern willow flycatcher			
Core Southwestern Willow Flycatcher Habitat	-- (--)	-- (--)	-- (--)
Very High Value Habitat	-- (--)	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)	-- (--)
Other Potentially Suitable Habitat	-- (--)	-- (--)	-- (--)
Coastal California gnatcatcher			
Very High Value Habitat	-- (--)	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)	-- (--)
Moderate Value Habitat	0.1 (--)	-- (--)	0.1 (--)
Low Value Habitat	-- (--)	-- (--)	-- (--)

SPECIES MODELS IMPACTS

San Bernardino Valley Water Conservation District (Conservation District)

Acres Impacted Permanent (Temporary) **Species and Model Category**	**Groundwater Recharge** **Groundwater**	 **CD.2**	**Conservation District** **Total**
Other Suitable Habitat	-- (--)	-- (--)	-- (--)
Least Bells vireo			
Core Breeding Habitat	-- (--)	-- (--)	-- (--)
Other Breeding Habitat	-- (--)	-- (--)	-- (--)
Mammals			
Los Angeles little pocket mouse			
Potentially Suitable Habitat	0.1 (--)	-- (--)	0.1 (--)
San Bernardino Merriams kangaroo rat			
High	-- (--)	-- (--)	-- (--)
Medium	-- (--)	-- (--)	-- (--)
Low	-- (--)	-- (--)	-- (--)
Very Low Quality	-- (--)	-- (--)	-- (--)
Ecological Process Area	-- (--)	-- (--)	-- (--)
Suitable Habitat	0.3 (--)	0.1 (--)	0.4 (--)

SPECIES MODELS IMPACTS
City of Rialto Public Works (Rialto)

Acres Impacted Permanent (Temporary) Species and Model Category	Water Reuse Projects Rial.1	City of Rialto Total
Plants		
Slender-horned spineflower		
Current Occupied Habitat	-- (--)	-- (--)
Historic Occupied Habitat	-- (--)	-- (--)
Potentially Suitable Habitat	-- (--)	-- (--)
Santa Ana River woolly-star		
Potentially Suitable Habitat	-- (--)	-- (--)
Invertebrates		
Delhi sands flower-loving fly		
Potentially Suitable Habitat	-- (--)	-- (--)
Potentially Suitable Habitat (Extirpated)	-- (--)	-- (--)
Amphibians and Reptiles		
Arroyo toad		
Suitable Breeding Habitat	-- (--)	-- (--)
Non-Breeding Upland Habitat	-- (--)	-- (--)
Permeable Movement Area (Developed, Agriculture, Disturbed)	-- (--)	-- (--)
Mountain yellow-legged frog		
Potentially Suitable Aquatic Habitat	-- (--)	-- (--)
Refugia/Foraging/Dispersal Habitat	-- (--)	-- (--)
Western spadefoot		
Potentially Suitable Habitat	-- (0.2)	-- (0.2)
California glossy snake		
Potentially Suitable Habitat	-- (--)	-- (--)
South coast garter snake		
Potentially Suitable Habitat	-- (--)	-- (--)
Western pond turtle		
Aquatic Habitat	-- (--)	-- (--)
Potentially Suitable Upland Habitat	-- (--)	-- (--)
Birds		
Tricolored blackbird		
Suitable Colony Habitat	-- (--)	-- (--)
Breeding Season Foraging - Natural	7.8 (--)	7.8 (--)
Breeding Season Foraging - Agriculture	-- (--)	-- (--)
Non-Breeding Season Foraging - Natural	-- (--)	-- (--)
Non-Breeding Season Foraging - Agriculture	-- (--)	-- (--)
Burrowing owl		
Potentially Suitable Habitat	7.8 (0.2)	7.8 (0.2)
Cactus wren		
Known Suitable Nesting	-- (--)	-- (--)
Potential Nesting and Foraging Habitat	7.8 (0.2)	7.8 (0.2)
Recently Burned (2008 - 2018)	-- (--)	-- (--)
Yellow-breasted chat		
Potentially Suitable Habitat	1.2 (--)	1.2 (--)
Yellow-billed cuckoo		
High Value Breeding Habitat	-- (--)	-- (--)
Other Potentially Suitable Breeding Habitat	-- (--)	-- (--)
Southwestern willow flycatcher		
Core Southwestern Willow Flycatcher Habitat	-- (--)	-- (--)
Very High Value Habitat	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)
Other Potentially Suitable Habitat	1.2 (--)	1.2 (--)
Coastal California gnatcatcher		
Very High Value Habitat	-- (--)	-- (--)
High Value Habitat	-- (--)	-- (--)
Moderate Value Habitat	-- (--)	-- (--)
Low Value Habitat	-- (--)	-- (--)

SPECIES MODELS IMPACTS
City of Rialto Public Works (Rialto)

Acres Impacted Permanent (Temporary) **Species and Model Category**	**Water Reuse Projects** **Rial.1**	**City of Rialto Total**
Other Suitable Habitat	-- (--)	-- (--)
Least Bells vireo		
Core Breeding Habitat	-- (--)	-- (--)
Other Breeding Habitat	1.2 (--)	1.2 (--)
Mammals		
Los Angeles little pocket mouse		
Potentially Suitable Habitat	-- (0.2)	-- (0.2)
San Bernardino Merriams kangaroo rat		
High	-- (--)	-- (--)
Medium	-- (--)	-- (--)
Low	-- (--)	-- (--)
Very Low Quality	-- (--)	-- (--)
Ecological Process Area	-- (--)	-- (--)
Suitable Habitat	-- (--)	-- (--)

VEGETATION IMPACTS
Western Municipal Water District of Riverside County (Western)

Acres Impacted Permanent (Temporary) Vegetation Communities	Water Reuse Projects West.05	Groundwater Recharge West.06	Wells and Water Conveyance Infrastructure West.01	West.02	West.03	West.04	West.07	West.08	West.09	West.10	Western Total
Riparian											
Interior Warm and Cool Desert Riparian Forest	-- (--)	-- (--)	1.0 (11.9)	-- (1.0)	-- (--)	-- (--)	-- (0.9)	-- (4.5)	-- (--)	-- (--)	1.0 (18.3)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	0.2 (2.2)	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (0.9)	-- (--)	-- (--)	0.2 (3.3)
Wetlands											
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Freshwater Aquatic Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	1.0 (--)	0.1 (0.8)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (0.3)	-- (--)	-- (--)	1.1 (1.2)
Water											
Dry Channel/Shrubland	0.3 (--)	0.2 (--)	0.4 (3.9)	-- (0.4)	-- (--)	-- (--)	-- (0.3)	-- (0.1)	-- (0.1)	-- (--)	0.9 (4.8)
Permanent Water	1.4 (--)	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (0.1)	-- (0.1)	-- (0.1)	-- (--)	-- (--)	1.4 (0.5)
Water in Existing Basins	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Shrublands											
Californian Chaparral	-- (--)	-- (--)	0.1 (1.5)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	2.8 (--)	2.9 (1.6)
Californian Coastal Scrub	-- (--)	-- (--)	4.7 (50.0)	-- (5.0)	-- (--)	-- (0.4)	4.9 (0.9)	-- (--)	-- (0.7)	12.7 (--)	22.3 (57.0)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	-- (--)	0.1 (0.6)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (0.7)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	-- (--)	0.1 (0.5)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (0.6)
Grasslands											
Californian Annual and Perennial Grassland	-- (--)	-- (--)	3.2 (33.2)	-- (3.3)	-- (--)	-- (0.5)	0.2 (1.9)	-- (0.1)	-- (--)	-- (--)	3.4 (39.0)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Woodlands											
Californian Disturbed Forest	-- (--)	-- (--)	0.1 (1.0)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (1.1)
Californian Forest and Woodland	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)	0.1 (0.5)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (0.5)
Rock Outcrops											
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Agriculture											
Herbaceous Agricultural Vegetation	-- (--)	2.0 (--)	8.3 (85.6)	-- (--)	0.7 (--)	-- (--)	45.0 (15.3)	-- (3.3)	-- (--)	11.6 (--)	67.6 (104.2)
Woody Agricultural Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (0.2)

VEGETATION IMPACTS
West Valley Water District (West Valley)

Acres Impacted Permanent (Temporary) Vegetation Communities	Water Reuse Projects WV.4	Groundwater Recharge WV.1	Wells and Water Conveyance Infrastructure WV.2	WV.3	WV.5	WV.6	West Valley Total
Riparian							
Interior Warm and Cool Desert Riparian Forest	-- (--)	1.9 (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	1.9 (0.2)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Wetlands							
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Freshwater Aquatic Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	1.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	1.2 (--)
Water							
Dry Channel/Shrubland	0.3 (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (1.4)	0.3 (1.5)
Permanent Water	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (0.1)
Water in Existing Basins	-- (--)	7.5 (--)	-- (--)	-- (--)	-- (--)	-- (--)	7.5 (--)
Shrublands							
Californian Chaparral	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (2.6)	-- (2.6)
Californian Coastal Scrub	-- (--)	2.3 (--)	-- (0.1)	-- (--)	0.1 (--)	-- (3.2)	2.4 (3.3)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	0.2 (--)	-- (0.1)	-- (--)	0.1 (--)	-- (0.8)	0.3 (0.9)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (0.1)
Grasslands							
Californian Annual and Perennial Grassland	0.1 (--)	1.4 (--)	-- (0.4)	-- (--)	-- (--)	-- (4.6)	1.5 (5.0)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Woodlands							
Californian Disturbed Forest	0.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.2 (--)
Californian Forest and Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Rock Outcrops							
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	0.7 (--)	-- (0.1)	-- (--)	-- (--)	-- (0.1)	0.7 (0.2)
Agriculture							
Herbaceous Agricultural Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.7)	-- (0.7)
Woody Agricultural Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (0.1)

VEGETATION IMPACTS

San Bernardino Municipal Water Department (Water Department)

Acres Impacted Permanent (Temporary) Vegetation Communities	Groundwater Recharge WD.4	Water Reuse Projects WD.1	Wells and Water Conveyance WD.2	 WD.3	 WD.5	Water Dept Total
Riparian						
Interior Warm and Cool Desert Riparian Forest	-- (--)	-- (0.7)	-- (1.1)	-- (--)	-- (0.2)	-- (2.0)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (0.1)
Wetlands						
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Freshwater Aquatic Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	0.9 (--)	-- (--)	-- (--)	-- (--)	0.9 (--)
Water						
Dry Channel/Shrubland	-- (--)	0.3 (2.4)	-- (1.8)	-- (0.3)	0.1 (1.0)	0.4 (5.5)
Permanent Water	-- (--)	0.4 (0.3)	-- (0.6)	-- (--)	-- (0.4)	0.4 (1.3)
Water in Existing Basins	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (0.2)
Shrublands						
Californian Chaparral	-- (--)	-- (--)	-- (--)	0.4 (0.3)	-- (0.5)	0.4 (0.8)
Californian Coastal Scrub	-- (0.8)	0.3 (0.9)	-- (0.1)	-- (0.9)	-- (2.7)	0.3 (5.4)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	-- (1.0)	-- (--)	-- (--)	-- (0.1)	-- (1.1)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (0.2)	-- (0.3)
Grasslands						
Californian Annual and Perennial Grassland	-- (--)	0.2 (1.2)	-- (0.1)	-- (--)	-- (1.6)	0.2 (2.9)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Woodlands						
Californian Disturbed Forest	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Californian Forest and Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Rock Outcrops						
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	-- (0.1)	-- (0.2)	-- (--)	-- (0.2)	-- (0.5)
Agriculture						
Herbaceous Agricultural Vegetation	-- (--)	-- (0.6)	-- (--)	-- (--)	-- (0.1)	-- (0.7)
Woody Agricultural Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)

VEGETATION IMPACTS
San Bernardino Valley Municipal Water District (Valley District)

Acres Impacted Permanent (Temporary)	Groundwater Recharge															Wells and Water Conveyance Infrastructure	Habitat Enhancement, Management, and Monitoring															Valley District
Vegetation Communities	**VD.1**	**VD.2.02**	**VD.2.03**	**VD.2.04**	**VD.2.05**	**VD.2.06**	**VD.2.07**	**VD.2.08**	**VD.2.09**	**VD.2.10**	**VD.2.11**	**VD.2.12**	**VD.2.13**	**VD.2.14**	**VD.3**	**VD.4**	**Rest.01**	**Rest.02**	**Rest.03**	**Rest.04**	**Rest.05**	**Rest.06**	**Rest.07**	**Rest.08**	**Rest.09**	**Rest.10**	**Rest.11**	**Rest.12**	**Rest.13**	**Rest.14**	**Rest.15**	**Total**
Riparian																																
Interior Warm and Cool Desert Riparian Forest	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (--)	11.7 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.4)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	11.8 (0.4)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Wetlands																																
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Freshwater Aquatic Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	2.9 (--)	0.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	3.1 (--)
Water																																
Dry Channel/Shrubland	-- (--)	7.9 (--)	66.7 (--)	0.2 (--)	14.8 (--)	9.4 (--)	-- (--)	-- (--)	82.8 (--)	6.2 (--)	-- (--)	1.0 (--)	-- (--)	-- (--)	0.3 (--)	-- (2.9)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	189.3 (2.9)
Permanent Water	-- (--)	-- (--)	-- (--)	-- (--)	0.3 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	2.5 (--)	-- (--)	-- (--)	-- (--)	-- (0.5)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	2.8 (0.5)
Water in Existing Basins	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	5.8 (--)	-- (--)	107.1 (--)	2.7 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	115.6 (--)
Shrublands																																
Californian Chaparral	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	9.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (2.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	9.8 (2.1)
Californian Coastal Scrub	-- (--)	64.5 (--)	2.9 (--)	0.8 (--)	32.4 (--)	0.2 (--)	0.5 (--)	23.1 (--)	1.1 (--)	-- (--)	13.5 (--)	1.0 (--)	0.7 (--)	0.3 (--)	-- (1.0)	-- (14.6)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	141.0 (15.6)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	2.5 (--)	3.4 (--)	-- (--)	0.3 (--)	-- (--)	-- (--)	-- (--)	2.8 (--)	0.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (1.5)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	9.8 (1.5)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	2.5 (--)	4.3 (--)	-- (--)	6.6 (--)	1.9 (--)	-- (--)	-- (--)	3.4 (--)	1.1 (--)	-- (--)	-- (--)	1.2 (--)	-- (--)	-- (13.1)	-- (2.0)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	21.0 (15.1)
Grasslands																																
Californian Annual and Perennial Grassland	-- (--)	3.5 (--)	-- (--)	-- (--)	8.0 (--)	0.5 (--)	-- (--)	10.3 (--)	0.1 (--)	0.7 (--)	1.2 (--)	-- (--)	2.9 (--)	-- (--)	-- (--)	-- (1.9)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	27.2 (1.9)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Woodlands																																
Californian Disturbed Forest	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (--)
Californian Forest and Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Rock Outcrops																																
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	-- (--)	0.1 (--)	-- (--)	-- (--)	1.2 (--)	-- (--)	-- (--)	0.6 (--)	-- (--)	-- (--)	-- (--)	0.2 (--)	-- (--)	-- (1.0)	-- (1.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	2.1 (2.1)
Agriculture																																
Herbaceous Agricultural Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (3.6)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (3.6)
Woody Agricultural Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (1.7)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (1.8)

Acres Impacted Permanent (Temporary) Vegetation Communities	Water Reuse Projects	Groundwater Recharge		Wells and Water Conveyance Infrastructure												Solar Energy Development	
	RPU.09	RPU.05	RPU.08	RPU.01	RPU.02	RPU.03	RPU.04	RPU.06	RPU.07	RPU.10	RPU.12	RPU.13	RPU.14	RPU.15	RPU.11	RPU Total
Riparian																
Interior Warm and Cool Desert Riparian Forest	-- (--)	5.0 (--)	1.1 (--)	-- (1.1)	-- (0.2)	-- (0.2)	0.7 (--)	-- (--)	-- (0.5)	-- (4.3)	22.8 (--)	-- (--)	-- (0.3)	-- (0.4)	-- (--)	29.6 (7.0)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)
Wetlands																
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	2.9 (--)	-- (--)	-- (--)	-- (--)	-- (--)	2.9 (0.2)
Western North American Freshwater Aquatic Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	0.9 (--)	0.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	1.1 (0.1)
Water																
Dry Channel/Shrubland	-- (--)	5.8 (--)	10.0 (--)	-- (0.7)	-- (1.1)	-- (2.4)	-- (--)	-- (--)	-- (0.8)	-- (0.2)	2.6 (--)	-- (--)	-- (0.3)	-- (0.6)	-- (--)	18.4 (6.1)
Permanent Water	-- (--)	22.0 (--)	-- (--)	-- (0.4)	-- (0.1)	-- (0.6)	-- (--)	-- (--)	-- (0.1)	-- (--)	0.2 (--)	-- (--)	-- (0.1)	-- (0.6)	-- (--)	22.2 (1.9)
Water in Existing Basins	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Shrublands																
Californian Chaparral	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Californian Coastal Scrub	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (2.2)	-- (--)	-- (--)	-- (0.8)	-- (0.1)	-- (2.1)	40.7 (--)	-- (--)	-- (--)	-- (0.4)	5.5 (--)	46.2 (5.8)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (0.3)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.8)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.8)
Grasslands																
Californian Annual and Perennial Grassland	2.5 (--)	52.5 (--)	13.2 (--)	-- (0.9)	-- (2.4)	-- (--)	-- (--)	-- (--)	-- (--)	-- (5.9)	95.4 (--)	0.9 (--)	-- (--)	-- (1.7)	10.2 (--)	174.7 (10.9)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (0.1)
Woodlands																
Californian Disturbed Forest	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.4)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.4)
Californian Forest and Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Rock Outcrops																
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	9.1 (--)	-- (--)	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	0.1 (--)	-- (--)	-- (0.1)	-- (0.1)	-- (--)	9.2 (0.5)
Agriculture																
Herbaceous Agricultural Vegetation	-- (--)	-- (--)	4.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (--)	-- (--)	-- (2.1)	-- (--)	4.8 (2.2)
Woody Agricultural Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)

VEGETATION IMPACTS
Orange County Water District (OCWD)

Acres Impacted Permanent (Temporary) Vegetation Communities	Wells and Water Conveyance Infrastructure OCWD.1	OCWD Total
Riparian		
Interior Warm and Cool Desert Riparian Forest	-- (--)	-- (--)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)
Wetlands		
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)
Western North American Freshwater Aquatic Vegetation	-- (--)	-- (--)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)
Water		
Dry Channel/Shrubland	-- (--)	-- (--)
Permanent Water	-- (--)	-- (--)
Water in Existing Basins	-- (--)	-- (--)
Shrublands		
Californian Chaparral	-- (--)	-- (--)
Californian Coastal Scrub	-- (--)	-- (--)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	-- (--)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	-- (--)
Grasslands		
Californian Annual and Perennial Grassland	-- (--)	-- (--)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)
Woodlands		
Californian Disturbed Forest	-- (--)	-- (--)
Californian Forest and Woodland	-- (--)	-- (--)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)
Rock Outcrops		
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	-- (--)
Agriculture		
Herbaceous Agricultural Vegetation	-- (--)	-- (--)
Woody Agricultural Vegetation	-- (--)	-- (--)

VEGETATION IMPACTS

Metropolitan Water District of Southern California (Metropolitan)

Acres Impacted Permanent (Temporary) Vegetation Communities	Wells and Water Conveyance Infrastructure			Metropolitan
	Met.1	Met.2	Met.3	Total
Riparian				
Interior Warm and Cool Desert Riparian Forest	-- (--)	-- (0.5)	2.6 (--)	2.6 (0.5)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (0.2)	0.8 (--)	0.8 (0.2)
Wetlands				
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Freshwater Aquatic Vegetation	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (0.1)	0.2 (--)	0.2 (0.1)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (0.1)	0.4 (--)	0.4 (0.1)
Water				
Dry Channel/Shrubland	-- (--)	-- (2.4)	5.8 (--)	5.8 (2.4)
Permanent Water	-- (--)	-- (1.0)	4.8 (--)	4.8 (1.0)
Water in Existing Basins	-- (--)	-- (--)	-- (--)	-- (--)
Shrublands				
Californian Chaparral	-- (--)	-- (6.3)	11.2 (--)	11.2 (6.3)
Californian Coastal Scrub	-- (--)	-- (10.1)	25.1 (--)	25.1 (10.1)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	-- (1.3)	2.3 (--)	2.3 (1.3)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	-- (0.9)	1.1 (--)	1.1 (0.9)
Grasslands				
Californian Annual and Perennial Grassland	0.1 (--)	-- (9.6)	22.4 (--)	22.5 (9.6)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)	-- (--)	-- (--)
Woodlands				
Californian Disturbed Forest	-- (--)	-- (--)	0.3 (--)	0.3 (--)
Californian Forest and Woodland	-- (--)	-- (0.5)	1.4 (--)	1.4 (0.5)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)	-- (--)	-- (--)
Rock Outcrops				
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	-- (0.3)	0.4 (--)	0.4 (0.3)
Agriculture				
Herbaceous Agricultural Vegetation	-- (--)	-- (4.9)	17.1 (--)	17.1 (4.9)
Woody Agricultural Vegetation	-- (--)	-- (0.2)	0.3 (--)	0.3 (0.2)

VEGETATION IMPACTS
Inland Empire Utilities Agency (IEUA)

Acres Impacted Permanent (Temporary) Vegetation Communities	Water Reuse Projects	Groundwater Recharge																			Groundwater Recharge (cont.)							Habitat Enhancement, Management, and Monitoring	IEUA
	IEUA.4	IEUA.1.01	IEUA.1.02	IEUA.1.03	IEUA.1.04	IEUA.1.05	IEUA.1.06	IEUA.1.07	IEUA.1.08	IEUA.1.09	IEUA.1.10	IEUA.1.11	IEUA.1.12	IEUA.2.01	IEUA.2.02	IEUA.2.03	IEUA.2.04	IEUA.2.05	IEUA.2.06	IEUA.2.07	IEUA.2.08	IEUA.3.01	IEUA.3.02	IEUA.3.03	IEUA.3.04	IEUA.3.05	IEUA.3.06	IEUA.1.13	Total
Riparian																													
Interior Warm and Cool Desert Riparian Forest	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Wetlands																													
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Freshwater Aquatic Vegetation	-- (--)	2.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.7 (--)	-- (--)	0.4 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	3.9 (--)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	25.4 (--)	0.2 (--)	14.0 (--)	-- (--)	-- (--)	-- (--)	1.1 (--)	-- (--)	2.1 (--)	-- (--)	2.8 (--)	-- (--)	6.0 (--)	-- (--)	-- (--)	-- (--)	-- (--)	7.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	59.2 (--)
Water																													
Dry Channel/Shrubland	-- (--)	-- (--)	-- (--)	0.4 (0.1)	0.1 (--)	0.2 (--)	-- (--)	1.6 (--)	2.6 (--)	11.2 (--)	-- (--)	0.2 (--)	0.9 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	17.2 (0.1)
Permanent Water	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.9 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.9 (--)
Water in Existing Basins	-- (--)	35.3 (--)	17.0 (--)	115.1 (--)	25.5 (--)	35.5 (--)	61.5 (--)	19.6 (--)	1.9 (--)	18.5 (--)	29.8 (--)	39.2 (--)	-- (--)	23.1 (--)	10.2 (--)	8.1 (--)	21.9 (--)	-- (--)	2.2 (--)	15.2 (--)	15.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	495.4 (--)
Shrublands																													
Californian Chaparral	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Californian Coastal Scrub	-- (--)	-- (--)	15.1 (--)	33.9 (0.2)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	13.6 (--)	-- (--)	-- (--)	8.2 (--)	-- (--)	-- (--)	-- (--)	-- (--)	7.6 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	78.4 (0.2)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	-- (--)	-- (--)	6.1 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	6.1 (--)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Grasslands																													
Californian Annual and Perennial Grassland	-- (--)	-- (--)	-- (--)	-- (0.1)	-- (--)	1.8 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.1 (--)	-- (--)	-- (--)	-- (--)	-- (--)	7.6 (--)	-- (--)	6.5 (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	16.0 (0.1)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Woodlands																													
Californian Disturbed Forest	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Californian Forest and Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Rock Outcrops																													
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Agriculture																													
Herbaceous Agricultural Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Woody Agricultural Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)

VEGETATION IMPACTS
East Valley Water District (East Valley)

Acres Impacted Permanent (Temporary) Vegetation Communities	Water Reuse Projects				Wells and Water Conveyance Infrastructure			East Valley Total
	EV.1	EV.4.01	EV.4.02	EV.4.03	EV.2	EV.3	EV.5	
Riparian								
Interior Warm and Cool Desert Riparian Forest	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	0.1 (--)	-- (--)	0.1 (0.1)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Wetlands								
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Freshwater Aquatic Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Water								
Dry Channel/Shrubland	-- (--)	-- (--)	-- (2.0)	-- (--)	-- (0.4)	0.3 (--)	-- (--)	0.3 (2.4)
Permanent Water	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	0.2 (--)	-- (--)	0.2 (--)
Water in Existing Basins	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Shrublands								
Californian Chaparral	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	0.1 (--)	0.4 (--)	0.5 (0.2)
Californian Coastal Scrub	0.1 (--)	-- (--)	-- (0.5)	-- (--)	-- (0.8)	0.3 (--)	0.2 (--)	0.6 (1.3)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.6)	0.1 (--)	0.4 (--)	0.5 (0.6)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	-- (--)	-- (0.1)	-- (--)	-- (0.2)	2.5 (--)	0.8 (0.3)	3.3 (0.6)
Grasslands								
Californian Annual and Perennial Grassland	-- (--)	17.0 (--)	-- (0.9)	-- (--)	-- (0.8)	2.5 (--)	0.1 (--)	19.6 (1.7)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Woodlands								
Californian Disturbed Forest	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Californian Forest and Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (0.2)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Rock Outcrops								
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	-- (--)	-- (0.5)	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.5)
Agriculture								
Herbaceous Agricultural Vegetation	-- (--)	-- (--)	-- (--)	-- (--)	-- (0.2)	-- (--)	-- (--)	-- (0.2)
Woody Agricultural Vegetation	1.4 (--)	-- (--)	-- (--)	-- (--)	-- (0.1)	0.6 (--)	-- (--)	2.0 (0.1)

VEGETATION IMPACTS

San Bernardino Valley Water Conservation District (Conservation District)

Acres Impacted Permanent (Temporary) Vegetation Communities	Groundwater Recharge CD.1	 CD.2	Conservation District Total
Riparian			
Interior Warm and Cool Desert Riparian Forest	-- (--)	-- (--)	-- (--)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)
Wetlands			
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)
Western North American Freshwater Aquatic Vegetation	-- (--)	-- (--)	-- (--)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)	-- (--)
Water			
Dry Channel/Shrubland	0.2 (--)	0.2 (--)	0.4 (--)
Permanent Water	-- (--)	-- (--)	-- (--)
Water in Existing Basins	-- (--)	-- (--)	-- (--)
Shrublands			
Californian Chaparral	-- (--)	-- (--)	-- (--)
Californian Coastal Scrub	0.1 (--)	-- (--)	0.1 (--)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	-- (--)	-- (--)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	-- (--)	-- (--)
Grasslands			
Californian Annual and Perennial Grassland	-- (--)	-- (--)	-- (--)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)	-- (--)
Woodlands			
Californian Disturbed Forest	-- (--)	-- (--)	-- (--)
Californian Forest and Woodland	-- (--)	-- (--)	-- (--)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)	-- (--)
Rock Outcrops			
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	-- (--)	-- (--)
Agriculture			
Herbaceous Agricultural Vegetation	-- (--)	-- (--)	-- (--)
Woody Agricultural Vegetation	-- (--)	-- (--)	-- (--)

VEGETATION IMPACTS
City of Rialto Public Works (Rialto)

Acres Impacted Permanent (Temporary) Vegetation Communities	Water Reuse Projects Rial.1	City of Rialto Total
Riparian		
Interior Warm and Cool Desert Riparian Forest	1.2 (--)	1.2 (--)
Warm Desert Lowland Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)
Wetlands		
Western North American Disturbed Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)
Western North American Freshwater Aquatic Vegetation	-- (--)	-- (--)
Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)
Western North American Temperate and Boreal Freshwater Marsh, Wet Meadow, and Shrubland	-- (--)	-- (--)
Water		
Dry Channel/Shrubland	4.5 (--)	4.5 (--)
Permanent Water	1.3 (--)	1.3 (--)
Water in Existing Basins	-- (--)	-- (--)
Shrublands		
Californian Chaparral	-- (--)	-- (--)
Californian Coastal Scrub	-- (--)	-- (--)
Great Basin-Intermountain Xeric-Riparian Scrub	-- (--)	-- (--)
North American Warm-Desert Xeric-Riparian Scrub	-- (--)	-- (--)
Grasslands		
Californian Annual and Perennial Grassland	7.8 (0.2)	7.8 (0.2)
Californian Disturbed Grassland, Meadow, and Scrub	-- (--)	-- (--)
Woodlands		
Californian Disturbed Forest	-- (--)	-- (--)
Californian Forest and Woodland	-- (--)	-- (--)
Intermountain Singleleaf Pinyon-Utah Juniper-Western Juniper Woodland	-- (--)	-- (--)
Rock Outcrops		
Western North American Cliff, Scree, and Rock Vegetation	-- (--)	-- (--)
Agriculture		
Herbaceous Agricultural Vegetation	-- (--)	-- (--)
Woody Agricultural Vegetation	-- (--)	-- (--)

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Appendix G

Covered Activity AMMs

Covered Activity ID	All Covered Activities (AMM 1-19)	Riparian Area and Aquatic Habitat Protection (AMM 20-27)	Alluvial Fan Sage Scrub Protection (AMM 28-xx)	Special Status Fish and Other Aquatic Species Protection (AMM xx-xx)	Migratory Bird Protection (AMM xx-xx)	ARTO AM 1-4	DSFF AM 1-4	SHSP AMM- 1-4	SARW AMM- 1-3	SAS AMM- 1-3	SASD AMM-1	MYLF AMM 1	WESP AMM 1-2	TRBL AMM-1	BUOW AMM-1	WYBC AMM-1	SWFL AMM-1	CAGN AMM-1	LBV AMM-1	LAPM AMM	SBKR AMM 1-7
CD.1	•		•	•	•			•	•	•			•		•			•		•	•
CD.2	•	•	•	•	•			•	•	•			•		•		•	•	•	•	•
EV.1	•		•		•			•					•		•			•		•	•
EV.2	•	•	•		•			•	•			•	•	•	•		•	•	•	•	•
EV.3	•	•	•		•			•	•			•	•	•	•		•	•	•	•	•
EV.4.01 – 4.03	•	•	•	•	•			•	•	•	•		•	•	•		•	•	•	•	•
EV.5	•	•	•		•			•	•			•	•		•		•	•	•	•	•
IEUA.1.01 – 1.13	•	•	•	•	•	•	•	•	•	•			•	•	•		•	•	•	•	•
IEUA.2	•	•	•	•	•	•				•			•	•	•		•	•	•	•	•
IEUA.3.01 – 3.06	•		•	•	•		•		•	•											
IEUA.4	•	•		•	•					•			•				•		•		
Met.1	•	•	•	•	•			•	•	•					•		•	•	•	•	•
Met.2	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•
Met.3	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•
OCWD.1	•	•	•	•	•		•		•	•				•	•	•	•	•	•	•	•
Rial.1	•	•	•	•	•		•			•	•		•	•	•		•	•	•	•	•
RPU.1	•	•	•	•	•			•	•	•				•	•		•	•	•	•	•
RPU.2	•	•	•		•			•	•				•	•	•		•	•	•	•	•
RPU.3	•	•	•		•			•	•				•	•	•		•	•	•	•	•
RPU.4	•	•		•	•					•				•		•	•		•		
RPU.5	•	•	•		•				•				•	•	•		•		•	•	•
RPU.6	•		•		•			•	•				•		•			•		•	•
RPU.7	•	•	•		•			•	•				•	•	•		•	•	•	•	•
RPU.8	•	•	•		•									•	•		•		•	•	•
RPU.9	•		•		•								•		•					•	•
RPU.10	•	•	•	•	•		•	•	•	•				•	•	•	•	•	•	•	•
RPU.11	•	•	•		•			•	•				•	•	•		•	•	•	•	•
RPU.12	•	•	•	•	•			•	•	•			•	•	•	•	•	•	•	•	•
RPU.13	•	•	•		•								•	•	•					•	•
RPU.14	•	•	•		•			•	•				•	•	•		•	•	•	•	•
RPU.15	•	•	•	•	•				•	•			•	•	•	•	•	•	•	•	•
Rest.1	•	•	•	•	•				•	•				•	•	•	•	•	•	•	•
Rest.2	•	•	•	•	•			•	•	•				•	•		•	•	•	•	•
Rest.3	•	•	•	•	•				•	•				•	•		•	•	•	•	•
Rest.4	•	•	•	•	•			•	•	•				•	•		•	•	•	•	•

Covered Activity ID	All Covered Activities (AMM 1-19)	Riparian Area and Aquatic Habitat Protection (AMM 20-27)	Alluvial Fan Sage Scrub Protection (AMM 28-xx)	Special Status Fish and Other Aquatic Species Protection (AMM xx-xx)	Migratory Bird Protection (AMM xx-xx)	ARTO AM 1-4	DSFF AM 1-4	SHSP AMM- 1-4	SARW AMM- 1-3	SAS AMM- 1-3	SASD AMM-1	MYLF AMM 1	WESP AMM 1-2	TRBL AMM-1	BUOW AMM-1	WYBC AMM-1	SWFL AMM-1	CAGN AMM-1	LBV AMM-1	LAPM AMM	SBKR AMM 1-7
Rest.5	•	•	•	•	•		•	•	•	•				•	•	•	•	•	•	•	•
Rest.6	•	•	•	•	•				•	•				•	•	•	•		•	•	•
Rest.7	•	•	•	•	•		•		•	•				•	•	•	•		•	•	•
Rest.8	•	•	•	•	•					•	•			•	•	•	•		•		
Rest.9	•	•	•		•									•	•		•		•	•	•
Rest.10	•	•	•	•	•		•		•	•				•	•	•	•	•	•	•	•
Rest.11	•	•	•	•	•		•		•	•					•	•	•		•		
Rest.12	•		•		•			•	•		•		•		•			•		•	•
Rest.13	•		•		•			•	•				•		•			•		•	•
Rest.14	•		•		•			•	•				•		•			•		•	•
Rest.15	•	•	•		•								•	•	•					•	•
VD.1	•	•	•	•	•					•					•		•	•	•	•	•
VD.2.02 – 2.14	•	•	•	•	•			•	•	•		•	•	•	•		•	•	•	•	•
VD.3	•	•	•	•	•			•	•	•			•		•			•		•	•
VD.4	•	•	•	•	•			•	•	•		•	•	•	•	•	•	•	•	•	•
WD.1	•	•	•	•	•			•	•	•	•	•	•	•	•		•	•	•	•	•
WD.2	•	•	•	•	•			•	•	•			•		•		•	•	•	•	•
WD.3	•	•	•		•	•		•				•	•					•		•	•
WD.4	•		•		•			•	•				•		•			•		•	•
WD.5	•	•	•	•	•	•	•	•	•	•		•	•	•	•		•	•	•	•	•
West.1	•	•	•	•	•			•	•	•			•	•	•	•	•	•	•	•	•
West.2	•	•	•	•	•			•	•	•			•	•	•	•	•	•	•	•	•
West.3	•	•	•		•									•	•		•		•		
West.4	•	•	•	•	•			•	•	•			•	•	•			•		•	•
West.5	•	•		•	•					•											
West.6	•	•	•		•									•	•		•		•		
West.7	•	•	•	•	•		•	•	•	•			•	•	•	•	•	•	•	•	•
West.8	•	•	•	•	•					•				•	•	•	•		•	•	•
West.9	•	•	•	•	•			•		•			•		•		•	•	•	•	•
West.10	•		•	•	•			•		•			•	•	•			•		•	•
WV.1	•	•	•	•	•					•			•		•		•	•	•	•	•
WV.2	•		•	•	•		•	•	•	•			•	•	•			•		•	•
WV.3	•	•	•		•							•									
WV.4	•		•	•	•			•	•	•	•		•	•	•			•		•	•
WV.5	•	•	•	•	•			•	•	•			•	•	•		•	•	•	•	•
WV.6	•	•	•	•	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•

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Appendix H

Cost Summary

Upper Santa Ana River HCP Cost Summary

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Restoration Contingency	15%
Land Acquisition Contingency	10%
Remaining Contingency	3%

1000s

Table 7-1

Total Operating Costs	Pre-Permit Costs	5-Yr Cost by Plan Period										Undiscounted Total Cost
		Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Land Costs												
Restoration	$0	$3,065	$6,963	$922	$922	$922	$4,040	$4,040	$4,040	$4,040	$4,040	**$32,993**
SAR Fish Translocation	$0	$1,108	$849	$547	$547	$547	$547	$547	$547	$547	$547	**$6,337**
Management and Maintenance	$0	$2,978	$3,237	$3,773	$3,781	$3,781	$3,781	$3,781	$3,781	$3,781	$3,781	**$36,459**
Monitoring and Reporting	$0	$1,744	$1,744	$1,964	$1,964	$1,964	$1,964	$1,964	$1,836	$1,964	$1,836	**$18,946**
Program Administration	$0	$2,340	$2,340	$2,212	$2,212	$2,212	$2,212	$2,212	$2,212	$2,212	$2,212	**$22,376**
Subtotal	$ -	**$11,236**	**$15,134**	**$9,419**	**$9,427**	**$9,427**	**$12,545**	**$12,545**	**$12,417**	**$12,545**	**$12,417**	**$117,111**
Average Annual Cost:	NA	$ 2,247	$ 3,027	$ 1,884	$ 1,885	$ 1,885	$ 2,509	$ 2,509	$ 2,483	$ 2,509	$ 2,483	
Endowment Fund	$0	$1,561	$1,561	$1,561	$1,561	$1,561	$1,561	$1,561	$1,561	$1,561	$1,561	**$15,613**
Restoration Changed Circumstance	$0	$460	$1,044	$138	$138	$138	$606	$606	$606	$606	$606	**$4,949**
Remaining Changed Circumstance	$0	$156	$148	$142	$142	$142	$142	$142	$138	$142	$138	**$1,430**
Total Changed Circumstance Reserve	$0	$616	$1,192	$280	$280	$280	$748	$748	$744	$748	$744	**$6,379**
Total	$0	$13,412	$17,887	$11,260	$11,268	$11,268	$14,854	$14,854	$14,722	$14,854	$14,722	**$139,103**

Staffing & Program Overhead Costs	Pre-Permit Costs	5-Yr Cost by Plan Period										Undiscounted Total Cost
		Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Land costs												
Restoration	$ -	$ 965	$ 965	$ 699	$ 699	$ 699	$ 699	$ 699	$ 699	$ 699	$ 699	$ 7,522
SAR Fish Translocation	$ -	$ 727	$ 727	$ 475	$ 475	$ 475	$ 475	$ 475	$ 475	$ 475	$ 475	$ 5,258
Management and Maintenance	$ -	$ 1,190	$ 1,190	$ 1,488	$ 1,488	$ 1,488	$ 1,488	$ 1,488	$ 1,488	$ 1,488	$ 1,488	$ 14,286
Monitoring and Reporting	$ -	$ 1,022	$ 1,022	$ 1,242	$ 1,242	$ 1,242	$ 1,242	$ 1,242	$ 1,242	$ 1,242	$ 1,242	$ 11,983
Program Administration	$ -	$ 1,512	$ 1,512	$ 1,385	$ 1,385	$ 1,385	$ 1,385	$ 1,385	$ 1,385	$ 1,385	$ 1,385	$ 14,101
Subtotal Staffing & Overhead:	**$ -**	**$ 5,417**	**$ 5,417**	**$ 5,289**	**$ 5,289**	**$ 5,289**	**$ 5,289**	**$ 5,289**	**$ 5,289**	**$ 5,289**	**$ 5,289**	**$ 53,150**
Average Annual Cost:	NA	$ 1,083	$ 1,083	$ 1,058	$ 1,058	$ 1,058	$ 1,058	$ 1,058	$ 1,058	$ 1,058	$ 1,058	

Other Operating Costs	Pre-Permit Costs	5-Yr Cost by Plan Period										Undiscounted Total Cost
		Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Land Costs												
Restoration	$0	$2,100	$5,998	$223	$223	$223	$3,341	$3,341	$3,341	$3,341	$3,341	$25,471
SAR Fish Translocation	$0	$381	$122	$72	$72	$72	$72	$72	$72	$72	$72	$1,079
Monitoring and Reporting	$0	$722	$722	$722	$722	$722	$722	$722	$594	$722	$594	$6,963
Management and Maintenance	$0	$1,788	$2,047	$2,285	$2,293	$2,293	$2,293	$2,293	$2,293	$2,293	$2,293	$22,173
Program Administration	$0	$828	$828	$828	$828	$828	$828	$828	$828	$828	$828	$8,275
Subtotal Other Operating Costs:	**$ -**	**$5,818**	**$9,716**	**$4,129**	**$4,138**	**$4,138**	**$7,255**	**$7,255**	**$7,128**	**$7,255**	**$7,128**	**$ 63,961**
Average Annual Cost:	NA	$ 1,164	$ 1,943	$ 826	$ 828	$ 828	$ 1,451	$ 1,451	$ 1,426	$ 1,451	$ 1,426	

HCP Cost Summary

Table 7-2

Non-Recurring Capital Costs	Pre-Permit Costs	5-Yr Cost by Plan Period										Undiscounted Total Cost
		Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Land Costs		$26,387	$6,843	$0	$0	$0	$0	$0	$0	$0	$0	**$33,230**
Restoration	$24,350	$3,711	$1,550	$750	$0	$0	$0	$0	$0	$0	$0	**$30,361**
SAR Fish Translocation	$255	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$255**
Management and Maintenance	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
Monitoring and Reporting	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
Program Administration	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
Subtotal Non-Recurring Capital Costs:	**$24,605**	**$30,098**	**$8,393**	**$750**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$63,847**
Average Annual Cost:	NA	$ 6,020	$ 1,679	$ 150	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Restoration Changed Circumstance	$3,653	$557	$233	$113	$0	$0	$0	$0	$0	$0	$0	**$4,554**
Land Acquisition Changed Circumstance	$0	$2,639	$684	$0	$0	$0	$0	$0	$0	$0	$0	$3,323
Remaining Changed Circumstance	$8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$8**
Total Changed Circumstance Reserve	$3,660	$3,195	$917	$113	$0	$0	$0	$0	$0	$0	$0	**$7,885**
Total	$28,266	$33,293	$9,310	$863	$0	$0	$0	$0	$0	$0	$0	**$71,731**

Table 7-1

Total Program Costs	Pre-Permit Costs	5-Yr Cost by Plan Period										Undiscounted Total Cost
		Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Land Costs	$0	$26,387	$6,843	$0	$0	$0	$0	$0	$0	$0	$0	**$33,230**
Restoration	$24,350	$5,811	$7,548	$973	$223	$223	$3,341	$3,341	$3,341	$3,341	$3,341	**$55,833**
SAR Fish Translocation	$255	$381	$122	$72	$72	$72	$72	$72	$72	$72	$72	**$1,334**
Management and Maintenance	$0	$722	$722	$722	$722	$722	$722	$722	$594	$722	$594	**$6,964**
Monitoring and Reporting	$0	$1,788	$2,047	$2,285	$2,293	$2,293	$2,293	$2,293	$2,293	$2,293	$2,293	**$22,171**
Staffing and Program Administration	$0	$6,245	$6,245	$6,117	$6,117	$6,117	$6,117	$6,117	$6,117	$6,117	$6,117	**$61,426**
Grand Total Program Costs:	**$24,605**	**$41,334**	**$23,527**	**$10,169**	**$9,427**	**$9,427**	**$12,545**	**$12,545**	**$12,417**	**$12,545**	**$12,417**	**$180,958**
Average Annual Cost:	NA	$ 8,267	$ 4,705	$ 2,034	$ 1,885	$ 1,885	$ 2,509	$ 2,509	$ 2,483	$ 2,509	$ 2,483	
Endowment Fund	$0	$1,561	$1,561	$1,561	$1,561	$1,561	$1,561	$1,561	$1,561	$1,561	$1,561	**$15,613**
Restoration Changed Circumstance	$3,653	$1,016	$1,277	$251	$138	$138	$606	$606	$606	$606	$606	**$9,503**
Land Acquisition Changed Circumstance	$0	$2,639	$684	$0	$0	$0	$0	$0	$0	$0	$0	$3,323
Remaining Changed Circumstance	$8	$156	$148	$142	$142	$142	$142	$142	$138	$142	$138	**$1,437**
Total Changed Circumstance Reserve	$3,660	$3,811	$2,109	$392	$280	$280	$748	$748	$744	$748	$744	**$14,263**
Total	$28,265	$46,706	$27,197	$12,122	$11,268	$11,268	$14,854	$14,854	$14,722	$14,854	$14,722	**$210,834**

Program Administration Costs

Capital Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead													$0
Vehicle/Mileage Allowance													$0
Travel													$0
Legal & Accounting													$0
Public Relations/Outreach													$0
Capital Subtotal:	**Per Period**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Per Year	NA	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	

Operational Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead			$1,512,312	$1,512,312	$1,384,542	$1,384,542	$1,384,542	$1,384,542	$1,384,542	$1,384,542	$1,384,542	$1,384,542	$14,100,962
Vehicle/Mileage Allowance			$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$75,000
Travel			$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$300,000
Legal & Accounting			$665,000	$665,000	$665,000	$665,000	$665,000	$665,000	$665,000	$665,000	$665,000	$665,000	$6,650,000
Public Relations/Outreach			$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$1,250,000
Operational Subtotal:	**Per Period**	**$0**	**$2,339,812**	**$2,339,812**	**$2,212,042**	**$2,212,042**	**$2,212,042**	**$2,212,042**	**$2,212,042**	**$2,212,042**	**$2,212,042**	**$2,212,042**	
	Per Year	NA	**$467,962**	**$467,962**	**$442,408**	**$442,408**	**$442,408**	**$442,408**	**$442,408**	**$442,408**	**$442,408**	**$442,408**	

Total Program Administration Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead			$1,512,312	$1,512,312	$1,384,542	$1,384,542	$1,384,542	$1,384,542	$1,384,542	$1,384,542	$1,384,542	$1,384,542	$14,100,962
Vehicle/Mileage Allowance			$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$75,000
Travel			$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$300,000
Legal & Accounting			$665,000	$665,000	$665,000	$665,000	$665,000	$665,000	$665,000	$665,000	$665,000	$665,000	$6,650,000
Public Relations/Outreach			$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$1,250,000
Program Administration Total:	**Per Period**	**$0**	**$2,339,812**	**$2,339,812**	**$2,212,042**	**$2,212,042**	**$2,212,042**	**$2,212,042**	**$2,212,042**	**$2,212,042**	**$2,212,042**	**$2,212,042**	
	Per Year	NA	**$467,962**	**$467,962**	**$442,408**	**$442,408**	**$442,408**	**$442,408**	**$442,408**	**$442,408**	**$442,408**	**$442,408**	
			$302,462.49										

Staff and Overhead	Fully Burdened Annual Cost per FTE	Pre-Permit Costs	Number of FTEs by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Executive Director/Principal Scientist	$261,175		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
HCP Program Manager/Lead Biologist	$217,270		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
Preserve Manager	$217,270		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
Senior Environmental Scientist	$159,995		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Associate Environmental Scientist	$126,545		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
GIS Analyst/Database Manager	$127,789		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
Budget Analyst/Accountant	$102,216		0.75	0.75	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Empty	$0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Empty	$0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total FTE	**0.00**	**1.75**	**1.75**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	
	Cost per period	**$0**	**$1,512,312**	**$1,512,312**	**$1,384,542**	**$1,384,542**	**$1,384,542**	**$1,384,542**	**$1,384,542**	**$1,384,542**	**$1,384,542**	**$1,384,542**	**$14,100,962**
	Cost per year	**$0**	**$302,462**	**$302,462**	**$276,908**	**$276,908**	**$276,908**	**$276,908**	**$276,908**	**$276,908**	**$276,908**	**$276,908**	

Notes:

Fully burdened annual cost per FTE includes salary and benefits and allowances for salaries and benefits of support staff (e.g. secretaries, IT support) and associated overhead, including space and utility costs, office furniture, equipement, and supplies.

Program Administration Costs

Other Administrative Costs

Vehicle/Mileage Allowance		Pre-Permit	Total Cost Per 5-Year Period										Undiscounted
Assumptions:	Cost per period	Costs	Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	Total Cost
annual mileage allowance ($/yr)	$1,500		$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$75,000
	annual cost based on actual ECCC HCP experience through 2016												

Travel		Pre-Permit	Total Cost Per 5-Year Period										Undiscounted
Assumptions:	Cost per period	Costs	Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	Total Cost
annual travel expense ($/yr)	$6,000		$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$300,000
	annual cost based on actual ECCC HCP experience through 2016												

Legal & Accounting		Pre-Permit	Total Cost Per 5-Year Period										Undiscounted
Assumptions:	Cost per period	Costs	Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	Total Cost
annual cost for legal assistance	$100,000		$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$5,000,000
annual cost for financial assistance	$13,000		$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$650,000
annual cost for financial audits	$20,000		$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$1,000,000
	annual cost assumption used in ECCC HCP												

Public Relations/Outreach		Pre-Permit	Total Cost Per 5-Year Period										Undiscounted
Assumptions:	Cost per period	Costs	Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	Total Cost
annual cost for published materials	$5,000		$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$250,000
annual cost for public events	$10,000		$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$500,000
annual cost for web development	$10,000		$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$500,000
	annual cost assumption used in ECCC HCP												

Land Acquisition/Easements

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Capital Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead													$0
Design/Enviro/Permitting		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Land Acquisition		$0	$26,387,000	$6,843,000	$0	$0	$0	$0	$0	$0	$0	$0	$33,230,000
Construction		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M													$0
Capital Subtotal:	**Per Period**	**$0**	**$26,387,000**	**$6,843,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$33,230,000**
	Per Year	NA	**$5,277,400**	**$1,368,600**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	

Operational Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead		$0	$965,138	$965,138	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$7,521,589
Design/Enviro/Permitting													$0
Land Acquisition													$0
Construction													$0
O&M		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operational Subtotal:	**Per Period**	**$0**	**$965,138**	**$965,138**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$7,521,589**
	Per Year	NA	**$193,028**	**$193,028**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	

Total Tributaries Restoration Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead		$0	$965,138	$965,138	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$7,521,589
Design/Enviro/Permitting		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Land Acquisition		$0	$26,387,000	$6,843,000	$0	$0	$0	$0	$0	$0	$0	$0	$33,230,000
Construction		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
SAR Tributaries Restoration Total:	**Per Period**	**$0**	**$27,352,138**	**$7,808,138**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$40,751,589**
	Per Year	NA	**$5,470,428**	**$1,561,628**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	

Staff and Overhead	Fully Burdened Cost per FTE	Pre-Permit Costs	Number of FTEs by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Executive Director/Principal Scientist	261174.73	0	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
HCP Program Manager/Lead Biologist	217270.48	0	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Preserve Manager	217270.48	0	0.15	0.15	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Senior Environmental Scientist	159995.06	0	0.25	0.25	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
Associate Environmental Scientist	126544.92	0	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
GIS Analyst/Database Manager	127788.75	0	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
Budget Analyst/Accountant	102216.19	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Empty	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Empty	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total FTE	**0.00**	**1.10**	**1.10**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	
	Cost per period	**$0**	**$965,138**	**$965,138**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$7,521,589**
	Cost per year	**$0**	**$193,028**	**$193,028**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	

Notes:

Fully burdened annual cost per FTE includes salary and benefits and allowances for salaries and benefits of support staff (e.g. secretaries, IT support) and associated overhead, including space and utility costs, office furniture, equipement, and supplies.

Land Acquisition/Easements

Sum of Tributaries Restoration Project Costs

	Cost Type	Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Design/Enviro/Permitting	Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Land Acquisition	Capital	$0	$26,387,000	$6,843,000	$0	$0	$0	$0	$0	$0	$0	$0	$33,230,000
Construction	Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M	Operational	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Capital		$0	$26,387,000	$6,843,000	$0	$0	$0	$0	$0	$0	$0	$0	$33,230,000
Total Operational		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Cost estimates of individual restoration projects

Anza Creek and Old Ranch (14 acres, 1.3 strea acres 25.80 292.0416342

		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Restoration lands	Land Acquisition	$0	$26,167,000	$5,671,000	$0	$0							$31,838,000
Conservation lands	Land Acquisition	$0	$0	$1,172,000	$0	$0							$1,172,000
Restoration easement transaction cost	Land Acquisition	$0	$60,000										$60,000
Conservation easement transaction cost	Land Acquisition	$0	$160,000										$160,000

Restoration

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Capital Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead													$0
Design/Enviro/Permitting		$0	$227,308	$0	$0	$0	$0	$0	$0	$0	$0	$0	$227,308
Land Acquisition		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction		$0	$3,483,800	$1,550,000	$750,000	$0	$0	$0	$0	$0	$0	$0	$5,783,800
O&M													$0
Supplemental Water Supply		$24,350,000											$24,350,000
Empty													$0
Empty													$0
Empty													$0
Capital Subtotal:	**Per Period**	**$24,350,000**	**$3,711,108**	**$1,550,000**	**$750,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$30,361,108**
	Per Year	NA	**$742,222**	**$310,000**	**$150,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	

Operational Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead		$0	$965,138	$965,138	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$7,521,589
Design/Enviro/Permitting													$0
Land Acquisition													$0
Construction													$0
O&M		$0	$2,100,000	$5,997,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$9,881,700
Supplemental Water Supply			$0	$0	$0	$0	$0	$3,117,855	$3,117,855	$3,117,855	$3,117,855	$3,117,855	$15,589,275
Operational Subtotal:	**Per Period**	**$0**	**$3,065,138**	**$6,963,105**	**$921,881**	**$921,881**	**$921,881**	**$4,039,736**	**$4,039,736**	**$4,039,736**	**$4,039,736**	**$4,039,736**	**$32,992,564**
	Per Year	NA	**$613,028**	**$1,392,621**	**$184,376**	**$184,376**	**$184,376**	**$807,947**	**$807,947**	**$807,947**	**$807,947**	**$807,947**	

Total Tributaries Restoration Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead		$0	$965,138	$965,138	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$698,914	$7,521,589
Design/Enviro/Permitting		$0	$227,308	$0	$0	$0	$0	$0	$0	$0	$0	$0	$227,308
Land Acquisition		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction		$0	$3,483,800	$1,550,000	$750,000	$0	$0	$0	$0	$0	$0	$0	$5,783,800
O&M		$0	$2,100,000	$5,997,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$9,881,700
Supplemental Water Supply		$24,350,000	$0	$0	$0	$0	$0	$3,117,855	$3,117,855	$3,117,855	$3,117,855	$3,117,855	$39,939,275
SAR Tributaries Restoration Total:	**Per Period**	**$24,350,000**	**$6,776,246**	**$8,513,105**	**$1,671,881**	**$921,881**	**$921,881**	**$4,039,736**	**$4,039,736**	**$4,039,736**	**$4,039,736**	**$4,039,736**	**$63,353,672**
	Per Year	NA	**$1,355,249**	**$1,702,621**	**$334,376**	**$184,376**	**$184,376**	**$807,947**	**$807,947**	**$807,947**	**$807,947**	**$807,947**	

Staff and Overhead	Fully Burdened Cost per FTE	Pre-Permit Costs	Number of FTEs by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Executive Director/Principal Scientist	261174.73	0	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
HCP Program Manager/Lead Biologist	217270.48	0	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Preserve Manager	217270.48	0	0.15	0.15	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Senior Environmental Scientist	159995.06	0	0.25	0.25	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
Associate Environmental Scientist	126544.92	0	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
GIS Analyst/Database Manager	127788.75	0	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
Budget Analyst/Accountant	102216.19	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Empty	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Empty	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total FTE	**0.00**	**1.10**	**1.10**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	
	Cost per period	**$0**	**$965,138**	**$965,138**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$698,914**	**$7,521,589**
	Cost per year	**$0**	**$193,028**	**$193,028**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	**$139,783**	

Notes:

Fully burdened annual cost per FTE includes salary and benefits and allowances for salaries and benefits of support staff (e.g. secretaries, IT support) and associated overhead, including space and utility costs, office furniture, equipement, and supplies.

Restoration

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Sum of Tributaries Restoration Project Costs

	Cost Type	Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Design/Enviro/Permitting	Capital	$0	$227,308	$0	$0	$0	$0	$0	$0	$0	$0	$0	$227,308
Land Acquisition	Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction	Capital	$0	$3,483,800	$1,550,000	$750,000	$0	$0	$0	$0	$0	$0	$0	$5,783,800
O&M	Operational	$0	$2,100,000	$5,997,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$9,881,700
Supplemental Water	Capital	$24,350,000	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$24,350,000
Supplemental Water	Operational	$0	-	-	-	-	-	3,117,855	3,117,855	3,117,855	3,117,855	3,117,855	$15,589,275
Total Capital		$0	$3,711,108	$1,550,000	$750,000	$0	$0	$0	$0	$0	$0	$0	$6,011,108
Total Operational		$0	$2,100,000	$5,997,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$9,881,700
Supplemental Streamflow--Capital		$24,350,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$24,350,000
Supplemental Streamflow--Operational		$0	$0	$0	$0	$0	$0	$3,117,855	$3,117,855	$3,117,855	$3,117,855	$3,117,855	$15,589,275

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Cost estimates of individual restoration projects v 2. HCP Conservation Cost Breakdown

All restoration projects acres 25.80 292.0416342

		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Restoration implementation	Construction	$0	$0	$1,550,000	$750,000								$2,300,000
HMMP	O&M	$0	$2,100,000	$5,775,000	$0								$7,875,000
Land Acquisition	Land Acquisition	$0	$0	$0									$0
Construction	Construction	$0											$0
Site Maintenance (5 yrs, weeding, irrigation, etc.)	O&M	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Microhabitat Creation

		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Design	Design/Enviro/Pe	$0	$67,308										$67,308
CEQA	Design/Enviro/Pe	$0	$80,000										$80,000
Permitting	Design/Enviro/Pe	$0	$80,000										$80,000
Construction Nodes - Elevated Invert (4 no	Construction	$0	$1,059,200										$1,059,200
Construction Nodes - Open Water Runner	Construction	$0	$1,509,600										$1,509,600
Construction Nodes - Partially Submerged	Construction	$0	$915,000										$915,000
Construction Nodes - Boulder Array	Construction	$0	$0										$0
Replacement of Nodes 1/	O&M	$0	$0	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$222,967	$2,006,700

1/ Assumes a node has to be re-built once every five years; assumes cost is average for individual node projects (see v2.HCP Micro worksheet)

SAR Fish Translocation

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Capital Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead													$0
Design/Enviro/Permitting		$255,476	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$255,476
Land Acquisition		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M													$0
Empty													$0
Empty													$0
Empty													$0
Empty													$0
Capital Subtotal:	**Per Period**	**$255,476**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$255,476**
	Per Year	**$51,095**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	

Operational Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead		$0	$727,315	$727,315	$475,410	$475,410	$475,410	$475,410	$475,410	$475,410	$475,410	$475,410	$5,257,907
Design/Enviro/Permitting													$0
Land Acquisition													$0
Construction													$0
O&M		$0	$381,000	$122,000	$72,000	$72,000	$72,000	$72,000	$72,000	$72,000	$72,000	$72,000	$1,079,000
Empty													$0
Empty													$0
Empty													$0
Empty													$0
Operational Subtotal:	**Per Period**	**$0**	**$1,108,315**	**$849,315**	**$547,410**	**$547,410**	**$547,410**	**$547,410**	**$547,410**	**$547,410**	**$547,410**	**$547,410**	**$6,336,907**
	Per Year	**$0**	**$221,663**	**$169,863**	**$109,482**	**$109,482**	**$109,482**	**$109,482**	**$109,482**	**$109,482**	**$109,482**	**$109,482**	

Total Fish Translocation Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead		$0	$727,315	$727,315	$475,410	$475,410	$475,410	$475,410	$475,410	$475,410	$475,410	$475,410	$5,257,907
Design/Enviro/Permitting		$255,476	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$255,476
Land Acquisition		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M		$0	$381,000	$122,000	$72,000	$72,000	$72,000	$72,000	$72,000	$72,000	$72,000	$72,000	$1,079,000
Fish Translocation Total:	**Per Period**	**$255,476**	**$1,108,315**	**$849,315**	**$547,410**	**$547,410**	**$547,410**	**$547,410**	**$547,410**	**$547,410**	**$547,410**	**$547,410**	**$6,592,384**
	Per Year	**$51,095**	**$221,663**	**$169,863**	**$109,482**	**$109,482**	**$109,482**	**$109,482**	**$109,482**	**$109,482**	**$109,482**	**$109,482**	

Staff and Overhead	Fully Burdened Cost per FTE	Pre-Permit Costs	Number of FTEs by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Executive Director/Principal Scientist	$261,175	0	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
HCP Program Manager/Lead Biologist	$217,270	0	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Preserve Manager	$217,270	0	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
Senior Environmental Scientist	$159,995	0	0.25	0.25	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
Associate Environmental Scientist	$126,545	0	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
GIS Analyst/Database Manager	$127,789	0	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Budget Analyst/Accountant	$102,216	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total FTE	**0.00**	**0.85**	**0.85**	**0.55**	**0.55**	**0.55**	**0.55**	**0.55**	**0.55**	**0.55**	**0.55**	
	Cost per period	**$0**	**$727,315**	**$727,315**	**$475,410**	**$475,410**	**$475,410**	**$475,410**	**$475,410**	**$475,410**	**$475,410**	**$475,410**	**$5,257,907**
	Cost per year	**$0**	**$145,463**	**$145,463**	**$95,082**	**$95,082**	**$95,082**	**$95,082**	**$95,082**	**$95,082**	**$95,082**	**$95,082**	

Notes:

Fully burdened annual cost per FTE includes salary and benefits and allowances for salaries and benefits of support staff (e.g. secretaries, IT support) and associated overhead, including space and utility costs, office furniture, equipement, and supplies.

SAR Fish Translocation

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Sum Translocation Project Costs

	Cost Type	Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Design/Enviro/Permitting	Capital	$255,476	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$255,476
Land Acquisition	Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction	Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M	Operational	$0	$381,000	$122,000	$72,000	$72,000	$72,000	$72,000	$72,000	$72,000	$72,000	$72,000	$1,079,000
empty		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
empty		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
empty		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Cost estimates of individual translocation projects

Translocation costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Translocation Plan Development	Design/Enviro/I	$255,476											$255,476
Translocation Contractor Costs 1/	O&M	$0	$56,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$119,000
Captive Propagation Facility O&M	O&M	$0	$325,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$910,000
Fish Translocation Mgt Agree w/ USFS	O&M		$0	$50,000	$0	$0	$0	$0	$0	$0	$0	$0	$50,000

1/ For Yrs 1 & 2 assumes contract with licensed biologist for 4 streams per year @ $7,000 per stream. For Yrs 6-50, assumes 1 stream translocation every 5 years @ $7,000 for periodic replacement of fish stock

Preserve Management/Maintenance/Protection

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Capital Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead													
Design/Enviro/Permitting													$0
Land Acquisition													$0
Construction													$0
O&M													$0
Empty													$0
Empty													$0
Empty													$0
Empty													$0
Capital Subtotal:	**Per Period**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Per Year		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	

Operational Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead		$0	$1,190,312	$1,190,312	$1,488,173	$1,488,173	$1,488,173	$1,488,173	$1,488,173	$1,488,173	$1,488,173	$1,488,173	$14,286,004
Design/Enviro/Permitting													$0
Land Acquisition													$0
Construction													$0
O&M		$0	$1,788,039	$2,047,115	$2,285,021	$2,293,266	$2,293,266	$2,293,266	$2,293,266	$2,293,266	$2,293,266	$2,293,266	$22,173,038
Operational Subtotal:	**Per Period**		**$2,978,351**	**$3,237,427**	**$3,773,194**	**$3,781,439**	**$3,781,439**	**$3,781,439**	**$3,781,439**	**$3,781,439**	**$3,781,439**	**$3,781,439**	**$36,459,042**
	Per Year		**$595,670**	**$647,485**	**$754,639**	**$756,288**	**$756,288**	**$756,288**	**$756,288**	**$756,288**	**$756,288**	**$756,288**	

Total Preserve Management Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead			$1,190,312	$1,190,312	$1,488,173	$1,488,173	$1,488,173	$1,488,173	$1,488,173	$1,488,173	$1,488,173	$1,488,173	$14,286,004
Design/Enviro/Permitting			$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Land Acquisition			$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction			$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M			$1,788,039	$2,047,115	$2,285,021	$2,293,266	$2,293,266	$2,293,266	$2,293,266	$2,293,266	$2,293,266	$2,293,266	$22,173,038
Preserve Management Total:	**Per Period**		**$2,978,351**	**$3,237,427**	**$3,773,194**	**$3,781,439**	**$3,781,439**	**$3,781,439**	**$3,781,439**	**$3,781,439**	**$3,781,439**	**$3,781,439**	**$36,459,042**
	Per Year		**$595,670**	**$647,485**	**$754,639**	**$756,288**	**$756,288**	**$756,288**	**$756,288**	**$756,288**	**$756,288**	**$756,288**	

Staff and Overhead	Fully Burdened Annual Cost per FTE	Pre-Permit Costs	Number of FTEs by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Executive Director/Principal Scientist	$261,175		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
HCP Program Manager/Lead Biologist	$217,270		0.25	0.25	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
Preserve Manager	$217,270		0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
Senior Environmental Scientist	$159,995		0.00	0.00	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
Associate Environmental Scientist	$126,545		0.10	0.10	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
GIS Analyst/Database Manager	$127,789		0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Budget Analyst/Accountant	$102,216		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Empty	$0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Empty	$0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total FTE	**0.00**	**1.20**	**1.20**	**1.55**	**1.55**	**1.55**	**1.55**	**1.55**	**1.55**	**1.55**	**1.55**	
	Cost per period	**$0**	**$1,190,312**	**$1,190,312**	**$1,488,173**	**$1,488,173**	**$1,488,173**	**$1,488,173**	**$1,488,173**	**$1,488,173**	**$1,488,173**	**$1,488,173**	**$14,286,004**
	Cost per year	**$0**	**$238,062**	**$238,062**	**$297,635**	**$297,635**	**$297,635**	**$297,635**	**$297,635**	**$297,635**	**$297,635**	**$297,635**	

Notes:

Fully burdened annual cost per FTE includes salary and benefits and allowances for salaries and benefits of support staff (e.g. secretaries, IT support) and associated overhead, including space and utility costs, office furniture, equipement, and supplies.

Preserve Management/Maintenance/Protection

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Other Preserve Management Costs

Site Patrols (Contractors)

Assumptions:	Cost per period	Pre-Permit	Cost by Plan Period										Undiscounted
County Ranger II annual contract ($/yr)	$131,600		Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	Total Cost
County Ranger I annual contract ($/yr)	$122,200		$1,269,000	$1,269,000	$1,269,000	$1,269,000	$1,269,000	$1,269,000	$1,269,000	$1,269,000	$1,269,000	$1,269,000	$12,690,000
		County Fully-burdened labor rate is $70/hr, per May 3, 2018 email from Dustin McClain (DMcLain@RIVCO.ORG); 1.0 FTE, 1880 direct labor hours per year											
		County Fully-burdened labor rate is $65/hr, per May 3, 2018 email from Dustin McClain (DMcLain@RIVCO.ORG); 1.0 FTE, 1880 direct labor hours per year											

Maintenance & Repairs (Contractors)

Assumptions:	Cost per period	Pre-Permit Costs	Cost by Plan Period										Undiscounted
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	Total Cost
Maintenance Annual Contract	$30,550		$152,750	$152,750	$152,750	$152,750	$152,750	$152,750	$152,750	$152,750	$152,750	$152,750	$1,527,500
		County Fully-burdened labor rate is $65/hr, per May 3, 2018 email from Dustin McClain (DMcLain@RIVCO.ORG); 0.25 FTE, 470 direct labor hours per year											

Habitat Management

Assumptions:	Cost per acre	Pre-Permit Costs	Cost by Plan Period										Undiscounted
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	Total Cost
trash removal	11.36		$366,289	$625,365	$863,271	$871,516	$871,516	$871,516	$871,516	$871,516	$871,516	$871,516	$7,955,538
Thinning	13		$63,187	$107,879	$148,919	$150,341	$150,341	$150,341	$150,341	$150,341	$150,341	$150,341	$1,372,372
Invasive plant control--herbicide	46		$223,584	$381,725	$526,944	$531,976	$531,976	$531,976	$531,976	$531,976	$531,976	$531,976	$4,856,087
Invasive plant control--grazing	5		$24,303	$41,492	$57,276	$57,824	$57,824	$57,824	$57,824	$57,824	$57,824	$57,824	$527,836
spineflower habitat management	0		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			phase 1	phase 2	phase 3	phase 4							
Total acres by phase			972	1,660	2,291	2,313	2,313	2,313	2,313	2,313	2,313	2,313	
Conservation acres			972	1,274	1,274	1,274	1,274	1,274	1,274	1,274	1,274	1,274	
Post-Restoration acres			-	386	1,017	1,039	1,039	1,039	1,039	1,039	1,039	1,039	

Monitoring and Reporting

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Capital Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead													
Vegetation mapping													$0
Travel													$0
Field Monitoring (Contractors)													$0
Directed Research (contractors)													$0
Adaptive Management													$0
Empty													$0
Empty													$0
Empty													$0
Capital Subtotal:	**Per Period**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Per Year		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	

Operational Costs		Pre-Permit Costs	Cost by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead		$0	$1,022,099	$1,022,099	$1,242,368	$1,242,368	$1,242,368	$1,242,368	$1,242,368	$1,242,368	$1,242,368	$1,242,368	$11,983,142
Vegetation mapping		$127,875	$127,875	$127,875	$127,875	$127,875	$127,875	$127,875	$127,875	$0	$127,875	$0	$1,150,875
Field Monitoring (Contractors)		$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$5,940,000
Empty													$0
Empty													$0
Empty													$0
Operational Subtotal:	**Per Period**		**$1,743,974**	**$1,743,974**	**$1,964,243**	**$1,964,243**	**$1,964,243**	**$1,964,243**	**$1,964,243**	**$1,836,368**	**$1,964,243**	**$1,836,368**	**$18,946,142**
	Per Year		**$348,795**	**$348,795**	**$392,849**	**$392,849**	**$392,849**	**$392,849**	**$392,849**	**$367,274**	**$392,849**	**$367,274**	

Total Compliance, Permitting, Monitoring Costs		Pre-Permit Costs	5	5	5	5	5	5	5	5	5	5	Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Staff and Overhead			$1,022,099	$1,022,099	$1,242,368	$1,242,368	$1,242,368	$1,242,368	$1,242,368	$1,242,368	$1,242,368	$1,242,368	$11,983,142
Vegetation mapping		$127,875	$127,875	$127,875	$127,875	$127,875	$127,875	$127,875	$127,875	$0	$127,875	$0	$1,023,000
Field Monitoring (Contractors)			$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$594,000	$5,940,000
USFS Coordingating Agreement													
ompliance, Permitting, Monitoring Total:	**Per Period**		**$1,743,974**	**$1,743,974**	**$1,964,243**	**$1,964,243**	**$1,964,243**	**$1,964,243**	**$1,964,243**	**$1,836,368**	**$1,964,243**	**$1,836,368**	**$18,946,142**
	Per Year		**$348,795**	**$348,795**	**$392,849**	**$392,849**	**$392,849**	**$392,849**	**$392,849**	**$367,274**	**$392,849**	**$367,274**	

Staff and Overhead	Fully Burdened Cost per FTE	Pre-Permit Costs	Number of FTEs by Plan Period										Undiscounted Total Cost
			Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	
Executive Director/Principal Scientist	$261,175		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
HCP Program Manager/Lead Biologist	$217,270		0.20	0.20	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
GIS Analyst/Database Manager	$127,789		0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
Preserve Manager	$217,270		0.20	0.20	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Budget Analyst/Accountant	$102,216		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Senior Environmental Scientist	$159,995		0.25	0.25	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	
Associate Environmental Scientist	$126,545		0.00	0.00	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
	Total FTE	**0.00**	**1.10**	**1.10**	**1.35**	**1.35**	**1.35**	**1.35**	**1.35**	**1.35**	**1.35**	**1.35**	
	Cost per period	**$0**	**$1,022,099**	**$1,022,099**	**$1,242,368**	**$1,242,368**	**$1,242,368**	**$1,242,368**	**$1,242,368**	**$1,242,368**	**$1,242,368**	**$1,242,368**	**$11,983,142**
	Cost per year	**$0**	**$204,420**	**$204,420**	**$248,474**	**$248,474**	**$248,474**	**$248,474**	**$248,474**	**$248,474**	**$248,474**	**$248,474**	

Notes:

Fully burdened annual cost per FTE includes salary and benefits and allowances for salaries and benefits of support staff (e.g. secretaries, IT support) and associated overhead, including space and utility costs, office furniture, equipement, and supplies.

Monitoring and Reporting

Other Compliance/Monitoring/Permitting Costs

Vegetation Mapping	8.47	Pre-Permit	Cost by Plan Period										Undiscounted
		Costs	Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	Total Cost
LiDAR	O&M	$44,875	$44,875	$44,875	$44,875	$44,875	$44,875	$44,875	$44,875		$44,875		$403,875
imagery	O&M	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000		$33,000		$297,000
Labor Costs	O&M	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000		$50,000		$450,000
	Cost per year	**$127,875**	**$127,875**	**$127,875**	**$127,875**	**$127,875**	**$127,875**	**$127,875**	**$127,875**	**$0**	**$127,875**	**$0**	

Notes:

		Pre-Permit	Cost by Plan Period										Undiscounted
Field Monitoring (Contractors)		Costs	Yrs 1-5	Yrs 6-10	Yrs 11-15	Yrs 16-20	Yrs 21-25	Yrs 26-30	Yrs 31-35	Yrs 36-40	Yrs 41-45	Yrs 46-50	Total Cost
Amphibians and Reptiles	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000	$1,980,000
Rare plant species	$16,000	$16,000	$16,000	$16,000	$16,000	$16,000	$16,000	$16,000	$16,000	$16,000	$16,000	$16,000	$176,000
SBKR, Pocketmouse	$94,000	$94,000	$94,000	$94,000	$94,000	$94,000	$94,000	$94,000	$94,000	$94,000	$94,000	$94,000	$1,034,000
All bird species, riparian habitat	$304,000	$304,000	$304,000	$304,000	$304,000	$304,000	$304,000	$304,000	$304,000	$304,000	$304,000	$304,000	$3,344,000
Fish species	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Delhi Sands Fly	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Cost per period	**$594,000**	**$594,000**	**$594,000**	**$594,000**	**$594,000**	**$594,000**	**$594,000**	**$594,000**	**$594,000**	**$594,000**	**$594,000**	**$5,940,000**
	Cost per year	**NA**	**$118,800**	**$118,800**	**$118,800**	**$118,800**	**$118,800**	**$118,800**	**$118,800**	**$118,800**	**$118,800**	**$118,800**	

Notes:

1/ For Yrs 6-10 assumes USGS survey of 1 stream per year @ $138,000 per survey; Yrs 11-50 USGS survey of 1 stream every 2 years @ $138,000 per survey

2/ Assumes $25,000/year for monitoring Mountain Yellow Legged Frog habitat starting in Yr 1

Endowment Fund **Page 1 of 2**

Nominal Rate of Return	4.0%
Inflation Rate	2.0%
Real Rate of Return	4.0%
Post-Permit Withdrawal %	3.8%
Post Permit Annual Expenditure in 2018 $	$623,000
Post Permit Annual Expenditure (w contingency)	$641,690
Post Permit Annual Expenditure (w contingency) accounting for 2% inflation	**$1,906,930**
Initial Year of HCP	2023

target value at 50 year mark
$49,580,176
annual payment to meet target value
$312,269
$312,000

Endowment Funding Assumes Contributions and Withdrawals occur at beginning of each period.

Plan Year	Beginning Balance	Contributions	Withdrawals	Investment Return	Ending Balance			
1	$0	$312,269	$0	$12,491	$324,760			
2	$324,760	$312,269	$0	$25,481	$662,511			
3	$662,511	$312,269	$0	$38,991	$1,013,771			
4	$1,013,771	$312,269	$0	$53,042	$1,379,082			
5	$1,379,082	$312,269	$0	$67,654	$1,759,005			
6	$1,759,005	$312,269	$0	$82,851	$2,154,126			
7	$2,154,126	$312,269	$0	$98,656	$2,565,051			
8	$2,565,051	$312,269	$0	$115,093	$2,992,413			
9	$2,992,413	$312,269	$0	$132,187	$3,436,870			
10	$3,436,870	$312,269	$0	$149,966	$3,899,104			
11	$3,899,104	$312,269	$0	$168,455	$4,379,829			
12	$4,379,829	$312,269	$0	$187,684	$4,879,782			
13	$4,879,782	$312,269	$0	$207,682	$5,399,733			
14	$5,399,733	$312,269	$0	$228,480	$5,940,483			
15	$5,940,483	$312,269	$0	$250,110	$6,502,862			
16	$6,502,862	$312,269	$0	$272,605	$7,087,737			
17	$7,087,737	$312,269	$0	$296,000	$7,696,006			
18	$7,696,006	$312,269	$0	$320,331	$8,328,607			
19	$8,328,607	$312,269	$0	$345,635	$8,986,511			
20	$8,986,511	$312,269	$0	$371,951	$9,670,732			
21	$9,670,732	$312,269	$0	$399,320	$10,382,321			
22	$10,382,321	$312,269	$0	$427,784	$11,122,374			
23	$11,122,374	$312,269	$0	$457,386	$11,892,029			
24	$11,892,029	$312,269	$0	$488,172	$12,692,470			
25	$12,692,470	$312,269	$0	$520,190	$13,524,929			
26	$13,524,929	$312,269	$0	$553,488	$14,390,686			
27	$14,390,686	$312,269	$0	$588,118	$15,291,074			
28	$15,291,074	$312,269	$0	$624,134	$16,227,477			
29	$16,227,477	$312,269	$0	$661,590	$17,201,336			
30	$17,201,336	$312,269	$0	$700,544	$18,214,150			
31	$18,214,150	$312,269	$0	$741,057	$19,267,476			
32	$19,267,476	$312,269	$0	$783,190	$20,362,935			
33	$20,362,935	$312,269	$0	$827,008	$21,502,212			
34	$21,502,212	$312,269	$0	$872,579	$22,687,061			
35	$22,687,061	$312,269	$0	$919,973	$23,919,303			
36	$23,919,303	$312,269	$0	$969,263	$25,200,836			
37	$25,200,836	$312,269	$0	$1,020,524	$26,533,629			
38	$26,533,629	$312,269	$0	$1,073,836	$27,919,734			
39	$27,919,734	$312,269	$0	$1,129,280	$29,361,284			
40	$29,361,284	$312,269	$0	$1,186,942	$30,860,495			
41	$30,860,495	$312,269	$0	$1,246,911	$32,419,675			
42	$32,419,675	$312,269	$0	$1,309,278	$34,041,222			
43	$34,041,222	$312,269	$0	$1,374,140	$35,727,631			
44	$35,727,631	$312,269	$0	$1,441,596	$37,481,497			
45	$37,481,497	$312,269	$0	$1,511,751	$39,305,517			
46	$39,305,517	$312,269	$0	$1,584,711	$41,202,497			
47	$41,202,497	$312,269	$0	$1,660,591	$43,175,357		Annual % Change in	
48	$43,175,357	$312,269	$0	$1,739,505	$45,227,132			
49	$45,227,132	$312,269	$0	$1,821,576	$47,360,977			Endowment
50	$47,360,977	$312,269	$0	$1,906,930	$49,580,176	<< End of Permit	Withdraw	Ending

Endowment Fund **Page 2 of 2**

Plan Year	Beginning Balance	Contributions	Withdrawals	Investment Return	Ending Balance			
						<< Begin of Post-Permit	Amount	Balance
51	$49,580,176	$0	$1,906,930	$2,059,484	$53,546,590		0.0000%	7.7037%
52	$53,546,590	$0	$1,906,930	$2,218,141	$57,671,661		0.0000%	7.4388%
53	$57,671,661	$0	$1,906,930	$2,383,144	$61,961,734		0.0000%	7.2007%
54	$61,961,734	$0	$1,906,930	$2,554,747	$66,423,411		0.0000%	6.9857%
55	$66,423,411	$0	$1,906,930	$2,733,214	$71,063,554		0.0000%	6.7908%
56	$71,063,554	$0	$1,906,930	$2,918,819	$75,889,304		0.0000%	6.6133%
57	$75,889,304	$0	$1,906,930	$3,111,849	$80,908,083		0.0000%	6.4512%
58	$80,908,083	$0	$1,906,930	$3,312,601	$86,127,613		0.0000%	6.3026%
59	$86,127,613	$0	$1,906,930	$3,521,382	$91,555,925		0.0000%	6.1661%
60	$91,555,925	$0	$1,906,930	$3,738,514	$97,201,369		0.0000%	6.0403%
61	$97,201,369	$0	$1,906,930	$3,964,332	$103,072,631		0.0000%	5.9241%
62	$103,072,631	$0	$1,906,930	$4,199,182	$109,178,743		0.0000%	5.8165%
63	$109,178,743	$0	$1,906,930	$4,443,427	$115,529,100		0.0000%	5.7166%
64	$115,529,100	$0	$1,906,930	$4,697,441	$122,133,471		0.0000%	5.6238%
65	$122,133,471	$0	$1,906,930	$4,961,616	$129,002,017		0.0000%	5.5373%
66	$129,002,017	$0	$1,906,930	$5,236,358	$136,145,304		0.0000%	5.4567%
67	$136,145,304	$0	$1,906,930	$5,522,089	$143,574,324		0.0000%	5.3813%
68	$143,574,324	$0	$1,906,930	$5,819,250	$151,300,503		0.0000%	5.3108%
69	$151,300,503	$0	$1,906,930	$6,128,297	$159,335,731		0.0000%	5.2447%
70	$159,335,731	$0	$1,906,930	$6,449,706	$167,692,367		0.0000%	5.1826%
71	$167,692,367	$0	$1,906,930	$6,783,972	$176,383,269		0.0000%	5.1244%
72	$176,383,269	$0	$1,906,930	$7,131,608	$185,421,806		0.0000%	5.0696%
73	$185,421,806	$0	$1,906,930	$7,493,149	$194,821,886		0.0000%	5.0180%
74	$194,821,886	$0	$1,906,930	$7,869,153	$204,597,968		0.0000%	4.9693%
75	$204,597,968	$0	$1,906,930	$8,260,196	$214,765,094		0.0000%	4.9234%
76	$214,765,094	$0	$1,906,930	$8,666,881	$225,338,905		0.0000%	4.8801%
77	$225,338,905	$0	$1,906,930	$9,089,833	$236,335,668		0.0000%	4.8391%
78	$236,335,668	$0	$1,906,930	$9,529,704	$247,772,302		0.0000%	4.8004%
79	$247,772,302	$0	$1,906,930	$9,987,169	$259,666,401		0.0000%	4.7638%
80	$259,666,401	$0	$1,906,930	$10,462,933	$272,036,264		0.0000%	4.7290%
81	$272,036,264	$0	$1,906,930	$10,957,728	$284,900,922		0.0000%	4.6961%
82	$284,900,922	$0	$1,906,930	$11,472,314	$298,280,166		0.0000%	4.6649%
83	$298,280,166	$0	$1,906,930	$12,007,484	$312,194,579		0.0000%	4.6352%
84	$312,194,579	$0	$1,906,930	$12,564,060	$326,665,570		0.0000%	4.6071%
85	$326,665,570	$0	$1,906,930	$13,142,900	$341,715,399		0.0000%	4.5804%
86	$341,715,399	$0	$1,906,930	$13,744,893	$357,367,222		0.0000%	4.5549%
87	$357,367,222	$0	$1,906,930	$14,370,966	$373,645,118		0.0000%	4.5308%
88	$373,645,118	$0	$1,906,930	$15,022,082	$390,574,130		0.0000%	4.5078%
89	$390,574,130	$0	$1,906,930	$15,699,242	$408,180,302		0.0000%	4.4859%
90	$408,180,302	$0	$1,906,930	$16,403,489	$426,490,722		0.0000%	4.4650%
91	$426,490,722	$0	$1,906,930	$17,135,906	$445,533,557		0.0000%	4.4451%
92	$445,533,557	$0	$1,906,930	$17,897,619	$465,338,107		0.0000%	4.4262%
93	$465,338,107	$0	$1,906,930	$18,689,801	$485,934,838		0.0000%	4.4081%
94	$485,934,838	$0	$1,906,930	$19,513,671	$507,355,439		0.0000%	4.3909%
95	$507,355,439	$0	$1,906,930	$20,370,495	$529,632,863		0.0000%	4.3744%
96	$529,632,863	$0	$1,906,930	$21,261,592	$552,801,385		0.0000%	4.3588%
97	$552,801,385	$0	$1,906,930	$22,188,333	$576,896,647		0.0000%	4.3438%
98	$576,896,647	$0	$1,906,930	$23,152,143	$601,955,720		0.0000%	4.3295%
99	$601,955,720	$0	$1,906,930	$24,154,506	$628,017,156		0.0000%	4.3158%
100	$628,017,156	$0	$1,906,930	$25,196,963	$655,121,049		0.0000%	

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