California **Water Plan**
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South Coast

INTEGRATED WATER MANAGEMENT

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Southern Region Office

The Division of Integrated Regional Water Management assists public and private agencies and the general public with water issues throughout the state. Four regional offices are located throughout California to maintain close contact with local interests to facilitate communication and to work on water-related matters. The offices are:

- Northern Region in Red Bluff,
- North Central Region in West Sacramento,
- South Central Region in Fresno, and
- Southern Region in Glendale.

Each of the regional offices offers technical guidance and assistance in water resource engineering, project management, hydrology, groundwater, water quality, environmental analysis and restoration, surveying, mapping, water conservation, and other related areas within the boundaries of their offices. Because of the regional offices' close ties with local interests, DWR regional coordinators in each office facilitate overall communication between DWR divisions and local partners to ensure coordinated efforts throughout all DWR programs and projects.

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	1	2	3
4	5	6	

Cover Photos:

1. 5. Along Pacific Coast Highway at Malibu
2. 3. Downtown Los Angeles
4. Avocado orchard (San Diego County)
6. Santa Monica Pier

Contents

South Coast Hydrological Region SC-3
Setting SC-3
Watersheds SC-3
Ecosystems SC-12
Climate SC-15
Population SC-15
Economic Drivers SC-17
Land Use Patterns SC-17
Regional Water Conditions SC-19
Environmental Water SC-19
Water Supplies SC-20
Water Uses SC-24
Water Balance Summary SC-25
Water Quality SC-26
Project Operations SC-31
Water Governance SC-33
Flood Management SC-35
Flood Hazards SC-35
Historic Floods SC-35
Flood Governance SC-36
Flood Risk Management SC-37
Relationship with Other Regions SC-42
Sacramento-San Joaquin Delta SC-43
Colorado River System SC-43
Owens Valley and Mono Basin SC-44
Other Water Storage and Transfers SC-44
Regional Water and Flood Planning and Management SC-45
Integrated Regional Water Management SC-45
Accomplishments SC-48
Challenges SC-49
Drought and Flood Planning SC-53
Looking to the Future SC-55
Climate Change SC-57
Future Scenarios SC-58
Appendix A. Flood Management SCA-1
Historic Floods SCA-1
Flood Governance SCA-3
Flood Risk Management SCA-4
Integrated Regional Water Management SCA-7
Appendix B. Water Quality SCB-1
Water Supplies SCB-1
State Water Project SCB-1
Colorado River System SCB-1
Local Surface Water SCB-2

Groundwater....SCB-3
Recycled Water....SCB-5
Desalination....SCB-6
Urban Water Conservation....SCB-7
Appendix C. Selected References SCC-1

Figures

Figure SC-1 South Coast Hydrologic Region....SC-4
Figure SC-2 Watersheds of the South Coast region....SC-5
Figure SC-3 Wetlands and critical habitat in the South Coast Region....SC-14
Figure SC-4 South Coast Hydrologic Region water balance summary, 1998-2005....SC-25
Figure SC-5 Impaired water bodies in South Coast Hydrologic Region....SC-28
Figure SC-6 Statewide project operations....SC-32
Figure SC-7 FEMA floodplains in the South Coast region....SC-36
Figure SC-9 Water demand changes by scenario, South Coast Hydrologic Region....SC-59
Figure SCA-1 Los Angeles County Drainage Area Project....SCA-6
Figure SCA-2 Santa Ana River Basin and Orange County projects....SCA-8

Tables

Table SC-1 Representative climate data for South Coast planning areas....SC-15
Table SC-2 Tribal lands with acreage, South Coast Hydrologic Region....SC-18
Table SC-3 South Coast Hydrologic Region water balance for 1998-2005 (thousand acre-feet)....SC-27
Table SC-4 Key elements of the Law of the Colorado River....SC-34
Table SCA-1 Record floods for selected streams, South Coast Hydrologic Region....SCA-2
Table SCA-2 Flood management participants, South Coast Hydrologic Region....SCA-5
Table SCA-3 Flood control facilities, South Coast Hydrologic Region....SCA-9
Table SCA-4 Flood emergency responders....SCA-12
Table SCA-5 Advanced Hydrologic Prediction Service stream forecast points....SCA-12
Table SCB-1 Water Suppliers in the South Coast Hydrologic Region....SCB-9

Boxes

Box SC-1 Acronyms and Abbreviations Used in This Report....SC-6
Box SC-2 California Native American Tribal Information, South Coast Hydrologic Region....SC-16
Box SC-3 Flood Management Agencies....SC-37
Box SC-4 Scenario Descriptions....SC-58
Box SCA-1 Selection Criteria....SCA-1

South Coast Hydrological Region

Within the South Coast Hydrologic Region, wholesale and retail water agencies, groundwater agencies, and watershed managers are working together to meet current and future demands of municipal, industrial, and agricultural users and the environment and to sustain the region's economy. To achieve this they are planning and implementing large and diverse water supply and water quality projects and water use efficiency projects. Cooperation between agencies and organizations and use of integrated resources planning have improved the flexibility and diversity of the region's water supplies.

Setting

The South Coast Hydrologic Region is California's most urbanized and populous region. More than half of the state's population resides in the region (54 percent), which covers 11,000 square miles or 7 percent of the state's total land. It extends from the Pacific Ocean east to the Transverse and Peninsular Ranges, and from the Ventura-Santa Barbara County line south to the international border with Mexico. The region includes all of Orange County and portions of Ventura, Los Angeles, San Bernardino, Riverside, and Sana Diego counties (see Figure SC-1).

Topographically, most of the South Coast region is composed of several large, undulating coastal and interior plains. Several prominent mountain ranges comprise its northern and eastern boundaries and include the San Gabriel and San Bernardino mountains. Most of the region's rivers drain into the Pacific Ocean, and many terminate in lagoons or wetland areas that serve as important coastal habitat. Many river segments on the coastal plain, however, have been concrete-lined and in other ways modified for flood control operations.

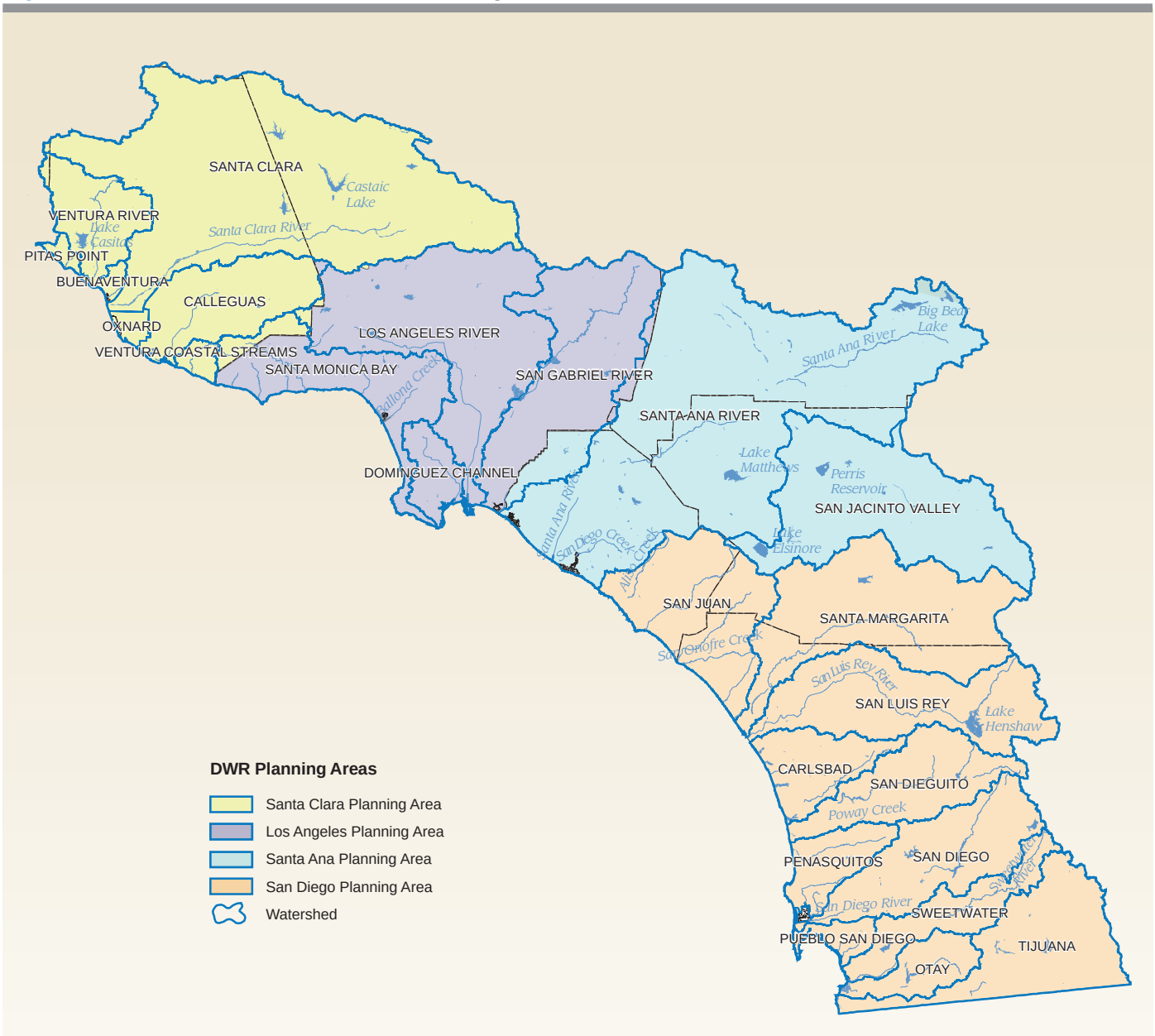
Although much of the land is used for either urban or agricultural land uses, all or portions of several national and State parks are located in the South Coast region. They are the Los Padres, Angeles, San Bernardino, and Cleveland national forests and Cuyamaca-Rancho and Chino Hills State parks.

Watersheds

There are 19 major rivers and watersheds in the South Coast region (Figure SC-2). Many of these watersheds have densely urbanized lowlands with concrete-lined channels and dams controlling floodflows. The headwaters for many rivers, however, are within coastal mountain ranges and have remained largely undeveloped.

Figure SC-1 South Coast Hydrologic Region

Figure SC-2 **Watersheds of the South Coast region**



Santa Clara Planning Area Watersheds

The watersheds of the Santa Clara Planning Area provide important habitat and water resources within Ventura County and northern Los Angeles County. They are not heavily urbanized and efforts are under way to protect remaining ecosystems and water supplies while providing flood protection to existing developments. The major watersheds are the Ventura River, Santa Clara River, and Calleguas Creek (including Oxnard Plain). Watershed scale planning efforts include the Ventura River Watershed Protection Plan, Santa Clara River Enhancement and Management Plan, and the Calleguas Creek Watershed Management Plan.

Box SC-1 Acronyms and Abbreviations Used in This Report

af	acre-feet
AHPS	Advanced Hydrologic Prediction Service
ALERT	Automated Local Evaluation in Real Time
API	antecedent precipitation index
BDCP	Bay-Delta Conservation Plan
BMPs	best management practices
Cal Fire	California Department of Forestry and Fire Protection
Cal EMA	California Emergency Management Agency
CCP	Conservation Credits Program
CDEC	California Data Exchange Center
CRA	Colorado River Aqueduct
CRS	Community Rating System
DFG	California Department of Fish and Game
cfs	cubic feet per second
CLWA	Castaic Lake Water Agency
CRA	Colorado River Aqueduct
CRS	Community Rating System
CUWCC	California Urban Water Conservation Council
CVWD	Coachella Valley Water District
Delta	Sacramento-San Joaquin Delta
DFG	California Department of Fish and Game
DWR	California Department of Water Resources
EOCWD	East Orange County Water District
FACC	funding area coordinating committee
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GMA	Groundwater Management Agency
IEUA	Inland Empire Utilities Agency
IID	Imperial Irrigation District
IPR	indirect potable reuse
IRWD	Irvine Ranch Water District
IRWM	Integrated Regional Water Management
LAA	Los Angeles Aqueduct
LACDA	Los Angeles County Drainage Area
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
LADWP	Los Angeles Department of Water and Power
LID	Low Impact Development
Metropolitan	Metropolitan Water District of Southern California
MGD	million gallons per day
MSCP	Multiple Species Conservation Plan
MWC	Mutual Water Company
MWD	Municipal Water District
MWDOC	Municipal Water District of Orange County
NFIP	National Flood Insurance Program
NIMS	National Incident Management System
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
NRCS	Natural Resources Conservation Service
OCWD	Orange County Water District
OES	Office of Emergency Services
ppm	parts per million
PUD	Public Utilities District
QSA	Federal Quantification Settlement Agreement 2003
RAP	regional acceptance process
Regional Water Board	Regional Water Quality Control Board
RWMG	Regional Watershed Management Group
SARI	Santa Ana Regional Interceptor
SAROC	Santa Ana River and Orange County
SAWPA	Santa Ana Watershed Project Authority
SC	South Coast
SDCWA	San Diego County Water Authority
SEMS	Standardized Emergency Management System
SGPWA	San Gorgonio Pass Water Agency
SMP	Salinity Management Project
SWP	State Water Project
State Water Board	State Water Resources Control Board
TDS	total dissolved solids
TMDLs	Total Maximum Daily Loads
USACE	US Army Corps of Engineers
USBR	US Bureau of Reclamation
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
VCWPD	Ventura County Watershed Protection District
WRD	Water Replenishment District of Southern California
WSD	Water Storage District
WWTP	wastewater treatment plant

The 228-square mile Ventura River watershed extends from the upper slopes of the Transverse Ranges southward to an estuary north of the City of Ventura. Drainage is provided by the Ventura River and its tributaries which include the Matilija, North Fork Matilija, and San Antonio creeks. The watershed also has one major reservoir, Lake Casitas, which provides water supplies downstream for local urban and agricultural users. The upper portion of the watershed is minimally developed and provides excellent aquatic habitat. Water quality issues from point and nonpoint pollution sources are present in the lower portion.

The 1,600-square mile Santa Clara River watershed extends from the northern slope of the San Gabriel Mountains in Los Angeles County westward to the City of Oxnard in Ventura County. Drainage is provided by the Santa Clara River and its tributaries which include Piru, Sespe, San Francisquito, Castaic, and Santa Paula creeks. The Santa Clara is the largest river in Southern California that remains in a relatively natural state. The upper watershed (portion in Los Angeles County) consists of approximately 680 square mile of mostly undeveloped land. The only urban development in the upper portion is in the Santa Clarita Valley. Agricultural and urban land use activities are more extensive in the lower portion of the watershed. Although the Santa Clara River typically has an intermittent flow regime in the main stem, flows can increase rapidly in response to high intensity rainfall with the potential for severe flooding. Controlled releases of water from Lake Piru supplement surface flows in Ventura County.

The 343-square mile Calleguas Creek watershed drains the Oxnard Plain in Ventura County. Drainage is provided by Calleguas Creek and its tributaries Conejo Creek and Arroyo Santa Rosa. Calleguas Creek begins on the eastern Ventura County, meanders through the cities of Simi Valley, Moorpark, and Camarillo, and drains into the Pacific Ocean at Mugu Lagoon. Along the way it is also known as Arroyo Simi and Arroyo Las Posas. Groundwater supplies are quite extensive in the alluvial aquifers beneath the plain. Urban, industrial, and agricultural land use activities within the watershed have resulted in the degradation of water resources, loss of sensitive ecosystems, flooding, and erosion and sedimentation. Nutrients and other dissolved constituents in irrigation return-flows are seeping into shallow aquifers and degrading groundwater in this basin.

Metropolitan Los Angeles Planning Area Watersheds

The watersheds of the Metropolitan Los Angeles Planning Area have been subjected to some of the densest urbanization in California and have issues associated with urban runoff, groundwater contamination, and the loss of major historical ecosystems. The planning area has four major watersheds: Santa Monica Bay, Los Angeles River, Dominguez Channel, and San Gabriel River. These watersheds begin in the surrounding Santa Monica and San Gabriel Mountains and flow south across the coastal plains into the Pacific Ocean. Extensive watershed scale planning has taken place, including Santa Monica Bay Restoration Plan, Malibu Creek Watershed Management Plan, Los Angeles River Master Plan, Arroyo Seco Watershed Restoration Feasibility Study, Dominguez Watershed Management Master Plan, and San Gabriel River Master Plan.

The 200-square mile North Santa Monica Bay watershed is in the northwest corner of Los Angeles County and comprises several smaller subwatersheds, including Malibu and Topanga creeks. The topography of the watershed is a combination of steep-slope mountains, coastal sand dunes, and several broad, gently sloping alluvial valleys. The coastal margin and portions interior valleys are urbanized. Healthy riparian habitats continue to exist because many of the mountainous canyons remain undeveloped. Malibu Creek drains the southern Simi Hills, western San Fernando Valley, and the western Santa Monica mountains, entering the Pacific Ocean at Malibu Lagoon.

The 130-square mile Ballona Creek watershed extends from downtown Los Angeles westward to the Pacific Ocean. It is bounded to the north by the Santa Monica Mountains and the south by the Baldwin Hills. Drainage is provided by Ballona Creek and two small tributaries. The watershed is heavily urbanized and includes the cities of Beverly Hills, Culver City, and West Hollywood and portions of the cities of Inglewood, Los Angeles, and Santa Monica. Several environmental sites are located in the western margin of the watershed. These are the Ballona Wetlands, Ballona Lagoon, and Oxford Lagoon. Water quality issues in Ballona Creek are caused by industrial effluent, illegal dumping, and nonpoint source pollutants. Upgrades of the Hyperion Sewage Treatment Plant have eliminated the outflow of untreated sewage during storm events.

The 834-square mile Los Angeles River watershed is shaped by the Los Angeles River, which flows from its headwaters in the Santa Monica Mountains, through the San Fernando Valley, south through the Glendale Narrows and across the coastal plain into San Pedro Bay. The river's major tributaries are the Arroyo Calabasas and Bell Creek (at the river's origin), Brown's Canyon Wash, the Burbank Western Channel, Tujunga Wash, Arroyo Seco, Rio Hondo, and Compton Creek. The watershed contains 22 lakes and flood control reservoirs, as well as a number of spreading grounds. The Los Angeles River is hydraulically connected to the San Gabriel River through the Whittier Narrows Reservoir, although this occurs primarily during large storm events. The Los Angeles River, which once flowed freely over the coastal plain, was channelized between 1914 and 1970 to control the runoff and reduce the impacts of major flood events in the region. Today, over 90 percent of the Los Angeles River is concrete-lined. The watershed has impaired water quality in the middle and lower portions of the basin due to urban runoff from dense urbanization.

The 110-square mile Dominguez Channel watershed is in southern Los Angeles County and defined by a complex network of storm drains and smaller flood control channels. The Dominguez Channel extends from the Los Angeles International Airport to the Los Angeles Harbor and drains a large portion, if not all, of the cities of Inglewood, Hawthorne, El Segundo, Gardena, Lawndale, Redondo Beach, Torrance, Carson, and Los Angeles.

The 640-square mile San Gabriel River watershed is in the eastern portion of Los Angeles County and extends from the San Gabriel Mountains to the Pacific Ocean at the City of Seal Beach. Drainage is provided by the San Gabriel River and its

tributaries, which include Coyote Creek. Although the watershed contains portions of 37 incorporated cities, only 26 percent of its total land area is developed. Flows in the San Gabriel River are diverted into four different spreading grounds and impounded behind several rubber dams in order to control flow for groundwater recharge.

Santa Ana Planning Area Watersheds

The Santa Ana Planning Area has experienced some of the most rapid urbanization in the state over the past 10 to 15 years, which has created numerous challenges in balancing growth with water supplies, flood protection, and ecosystem preservation. The planning area consists of one major watershed, the Santa Ana River watershed, and a few subwatershed areas including the San Diego Creek subwatershed and the San Jacinto River subwatershed. Watershed scale planning is provided by the Santa Ana Watershed Project Authority Santa Ana (One Water One Watershed) Integrated Water Resources Management Plan. This plan was supported by a number of subwatershed integrated plans including Central Orange County Integrated Regional and Coastal Watershed Management Plan, North Orange County Integrated Regional and Coastal Watershed Management Plan, Integrated Regional Management Plan for San Jacinto River Watershed, Upper Santa Ana River Watershed Integrated Regional Water Management Plan, and Western Municipal Water District Integrated Regional Water Management Plan.

The 2,800-square mile Santa Ana River watershed is the largest coastal stream system in Southern Ca1ifornia including parts of Orange, Riverside, San Bernardino, and Los Angeles counties. The principle river in the watershed is 96-mile long Santa Ana River. The river has its headwaters in the San Bernardino Mountains, and it meanders through the San Bernardino Valley, Chino Basin, and the coastal plain of Orange County before it drains into the Pacific Ocean near the City of Newport Beach. Most of the river channel in Orange County has been altered for flood management purposes including a section that has been concrete-lined. Upstream, the river is in its natural state. Flows in the river are perennial. The watershed also contains several human-made water storage facilities, including Lake Perris, Lake Mathews, and Big Bear Lake. Other flood control facilities along the river are Prado and Seven Oaks dams. Most of the watershed has both urban and agricultural land use activities. In the upper portion of the watershed, urbanization is a factor in the degradation of sensitive aquatic and riparian habitats and has impacted local water quality. The watershed continues to have riparian, wetland, and other wildlife habitat.

The 112-square mile San Diego Creek subwatershed is in central Orange County, and drains a portion of the area into Upper Newport Bay. It is a subwatershed to the Santa Ana River watershed. Erosion of the creek channels in the watershed have resulted in the sedimentation of the bay and channel basins. For years there have been concerns about declining water quality from sediments, nutrients, pathogens, and toxics. Habitats for many wildlife species are being isolated by new construction that cuts off long-used wildlife corridors.

The 765-square mile San Jacinto River subwatershed is in western Riverside County and is a subwatershed to the Santa Ana River watershed. It extends from the San Bernardino National Forest in the San Jacinto Mountains to Lake Elsinore in the west. Drainage is provided by the San Jacinto River. The lower portion of the watershed is being urbanized while the upper portion is a mixture of high- and low-density urbanization, agriculture, and undeveloped lands.

San Diego Planning Area Watersheds

The watersheds of the San Diego Planning Area are generally smaller than in other areas of the South Coast Hydrologic region. These watersheds are being urbanized, resulting in local water quality issues and loss of ecosystems. Local water supplies are limited in these watersheds. The planning area has nine major watersheds: San Juan, Santa Margarita, San Luis Rey, Carlsbad, San Dieguito, San Diego River, Sweetwater, Otay, and Tijuana. These watersheds generally flow east to west, a majority discharging into lagoons that been designated as ecological reserves. Watershed-scale planning efforts include Santa Margarita Watershed Management Plan, San Dieguito Watershed Management Plan, San Diego River Watershed Management Plan, Otay River Watershed Management Plan, and Tijuana River Bi-national Vision.

The 134-square mile San Juan Creek watershed extends from the Cleveland National Forest in the Santa Ana Mountains of eastern Orange County to the lagoon at the Pacific Ocean near the City of Dana Point. Drainage is provided by San Juan Creek and its tributaries, which include Trabuco and Oso creeks. Modifications have been made for flood control. Urbanization of the watershed is more extensive on the lower end of the watershed. Issues include channelization and poor surface water quality from urban runoff, loss of floodplain and riparian habitat, decline of water supply and flows, invasive species, and erosion.

The 750-square mile Santa Margarita River watershed resides in both Riverside and San Diego counties. It extends southwestward from the confluence of Temecula and Murrieta creeks in southern Riverside County to the Pacific Ocean at the US Marine Corps Base Camp Pendleton, north of the City of Oceanside. The lower portion of the watershed and estuary has largely escaped the development typical of the South Coast and are, therefore, able to support a relative abundance of functional habitats and wildlife. The upper portion is one of the fastest growing areas in California. Issues that have arisen include excessive nutrient inputs, erosion and sedimentation, groundwater degradation and contamination with nitrates and other salts, habitat loss, channelization, and flooding.

The 562-square mile San Luis Rey River watershed is in San Diego County and extends westward from the Palomar and Hot Springs Mountains in the Cleveland National Forest to the Pacific Ocean near the City of Oceanside. Drainage is provided by the San Luis Rey River and its tributaries. Most of the river channel remains in its natural state. The river is generally dry but can carry floodflows during winter storms. The other major water feature in the watershed is Lake Henshaw, which impounds water on the San Luis

Rey River near its headwater. Water supplies from the dam are used downstream for urban uses in the City of Escondido and Vista Irrigation District. The eastern portion of the watershed is owned and managed by governmental agencies, local districts, and Native American Tribes. Urban and agricultural land uses occur throughout much of the watershed, with the urban uses concentrated in the lower portion. Agricultural and livestock operations, urban runoff, and sand mining operations, and septic tanks are among the factors in local surface water quality issues. They include high chloride, total dissolved solids (TDS), and bacteria levels.

The 210-square mile Carlsbad watershed is in the coastal margin of San Diego County and has six smaller watersheds that all drain separately to the Pacific Ocean. The watershed is extensively urbanized and includes the cities of Oceanside, Carlsbad, Encinitas, Solana Beach, Vista, San Marcos, Rancho Santa Fe, and Escondido. Water quality issues include toxic substances, nutrients, bacteria and pathogens, and sedimentation. The Agua Hedionda, Buena Vista, and San Elijo lagoons are experiencing excessive coliform bacteria and sediment loading from upstream sources.

The 346-square mile San Dieguito River watershed extends westward from the Volcan Mountains to its outlet to the Pacific Ocean, San Dieguito Lagoon near the City of Del Mar. Drainage is provided by the San Dieguito River and its tributaries which include Santa Ysabel and Santa Maria creeks. Over half of the watershed is vacant or undeveloped; however, much of this is zoned for future residential development. There are several important natural areas within the watershed that sustain a number of threatened and endangered species. Among these are the 55-mile-long, 80,000-acre San Dieguito River Park, the 150-acre San Dieguito Lagoon, and five water storage reservoirs including Lake Hodges, Lake Sutherland, and Lake Poway. The San Dieguito Lagoon is especially sensitive to the effects of pollutants and oxygen depletion from restricted or intermittent tidal flushing.

The 440-square mile San Diego River watershed extends westward from the Volcan and Cuyamaca Mountains through the San Diego urban area to the Pacific Ocean at Ocean Beach. Drainage is provided by the San Diego River and its tributaries which include San Vicente and Boulder creeks. There are four imported-water storage reservoirs within the watershed: El Capitan, San Vicente, Lake Jennings, and Cuyamaca. Famosa Slough is a tidal salt water marsh, which receives water via the San Diego River Flood Control Channel. Beach postings and closures from elevated levels of coliform bacteria were common in the last 10 years due to urban runoff and sewage spills. Excessive groundwater extraction, increasing TDS, and MTBE contamination threatens this limited resource.

The 230-square mile Sweetwater River watershed extends westward from the Cuyamaca Mountains to the San Diego Bay. Drainage is provided by the Sweetwater River. The San Diego Bay, which constitutes the largest estuary along the San Diego coastline, has been extensively developed with port facilities. Similar to other major bays of the region, 90 percent of the original salt marshes have been filled or dredged. Construction of Loveland and Sweetwater reservoirs, as well as extensive local groundwater

pumping, has substantially reduced freshwater input to San Diego Bay. Storm water outfalls provide some flows and nutrients to the bay, but not with natural seasonality, timing, frequency, or content.

The 160-square mile Otay River watershed extends westward from the San Miguel Mountains to San Diego Bay. Drainage is provided by the Otay River which flows through the Upper and Lower Otay lakes. These lakes provide water supply, wildlife habitat, and recreational opportunities. Approximately 36 square mile of the watershed are part of the San Diego Multiple Species Conservation Plan (MSCP) effort that provides habitat for endangered plant and animal species. Other important conservation areas include the San Diego National Wildlife Refuge, Rancho Jamul Ecological Reserve, and vernal pools. Water quality concerns include elevated coliform bacteria in the Pacific Ocean receiving waters near Coronado.

The 1,700-square mile Tijuana River watershed is a bi-national watershed (455 square miles in the United States and 1,245 square miles in Mexico) on the westernmost portion of the US/Mexico border. The watershed contains three surface water reservoirs, various flood control works, and a National Estuarine Sanctuary. Major drainages include Cottonwood and Campo creeks in the United States, and the Rio Las Palmas system in Mexico. Cottonwood Creek begins about 20 miles north of the international boundary in the Laguna Mountains. Numerous tributaries come together near Barrett Lake, where the creek continues, entering Mexico west of Tecate. The main river returns to the United States near San Ysidro and joins the Pacific Ocean south of Imperial Beach. Poor water quality is a major issue in the Tijuana River watershed. Although discharges from the Tijuana River account for only a small percentage of total gaged runoff to the ocean, it contains the highest concentrations of suspended solids and heavy metals among the eight largest creeks and rivers in Southern California. Surface water quality has been affected by urban runoff from Mexico, and groundwater contamination has occurred as a result of seawater intrusion and waste discharges.

Ecosystems

Ecosystems in the South Coast region are host to a wide diversity of special status plants and wildlife. Despite their exceptional value, many of the region's ecosystems have suffered from over 100 years of human development activities. Rivers, streams, and wetlands have been diked, ditched, filled, and channelized. Dams and flood control channels have been built to contain and direct waterways, fundamentally altering their natural processes. Various flood, vector, and fire districts frequently enter streambeds, wetlands, or riparian buffers to remove vegetation from channels and adjacent habitats. Riparian vegetation is not only important for raptor nesting and other bird species, but vegetation within streambeds and along the edge of streams provides essential cover for aquatic species and fish fry. Removal of riparian vegetation eliminates essential habitat, degrades water quality, causes scour and erosion, and affects the natural flow regime. Loss of vernal pools, seasonally flooded depressions found on hardpan soils, has been extensive; the largest remnant patch in San Diego County occurs on the US Marine Corps Air Station Miramar (Bauder and McMillan 1998). Much of the historical coastal

dunes, wetlands, and estuary ecosystems in the region have also been degraded by declines in water quality and ecosystem functionality. The introduction of invasive Quagga mussels in Lake Havasu, the Colorado River Aqueduct (CRA), and multiple San Diego reservoirs threatens to both disrupt the food chain within those aquatic ecosystems and impede the flow of water supply to users. Finally, invasive plant species, such as *Arundo donax*, have further impaired local ecosystems by choking out native plants and competing with other plant and animal species for limited available water.

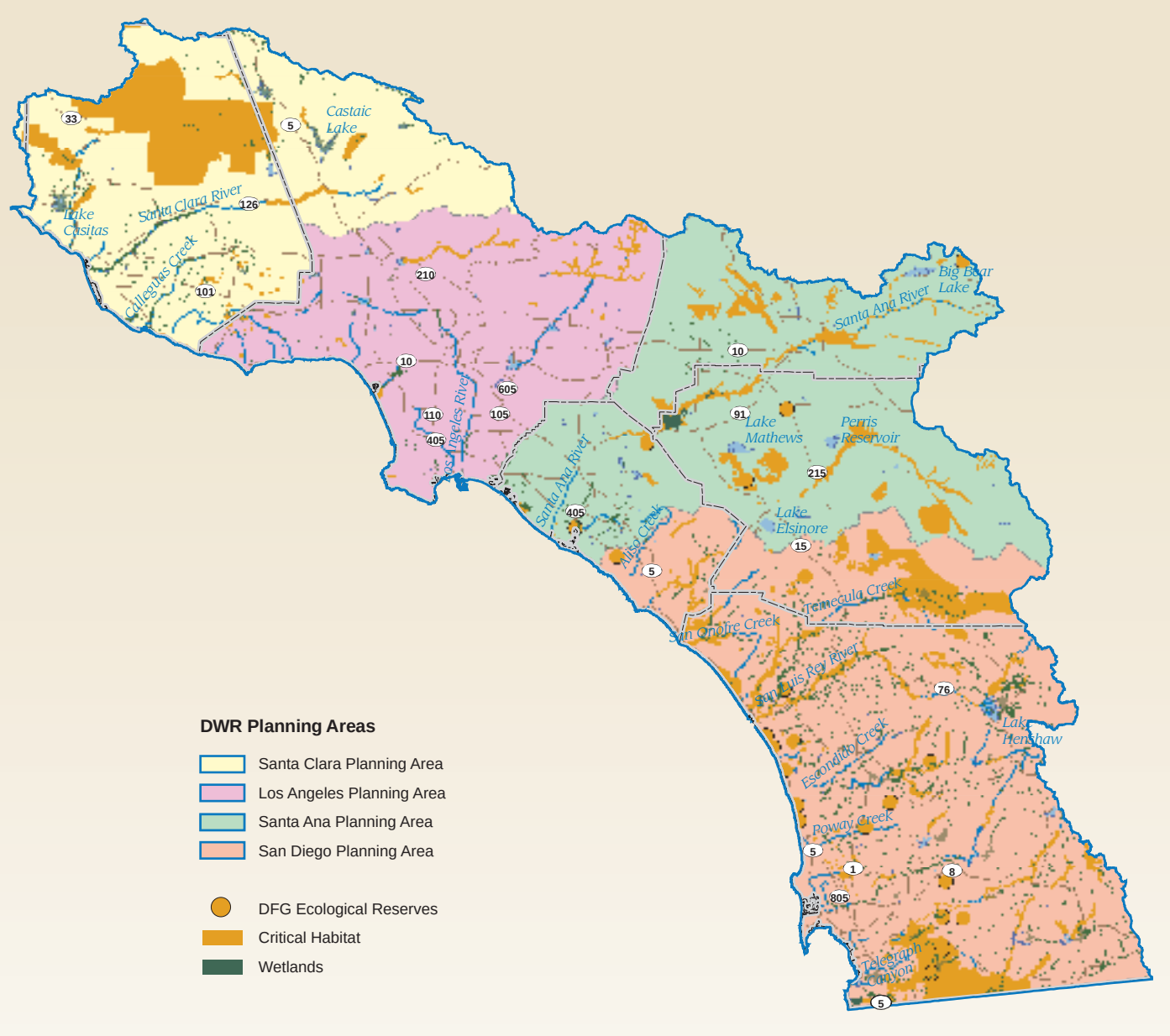
In recent decades, however, concerted planning efforts and technologies have emerged to restore function and productivity to degraded or destroyed ecosystems. Additionally, important ecological areas have been set aside and designated for protection including Significant Ecological Areas by county governments; Environmentally Sensitive Habitat Areas by the Coastal Commission; State Water Quality Protected Areas (formerly Areas of Special Biological Significance) by the State Water Resources Control Board (State Water Board); Ecological Reserves by the California Department of Fish and Game (DFG); and Critical Habitat by the US Fish and Wildlife Service (USFWS). See Figure SC-3 Wetlands and critical habitat in the South Coast Region.

Key ecosystems in the Santa Clara Planning Area include the aquatic and riparian habitats along Ventura and Santa Clara rivers and their tributaries and estuaries. The primary goal of the Watersheds Coalition of Ventura County is to bring together stakeholders to develop integrated watershed management strategies and coordinate ecosystem restoration efforts to achieve long term sustainability of local water resources. Ongoing projects and programs include land acquisition for protection and restoration of habitat areas; ecosystem restoration projects to remove barriers to steelhead passage, restore sediment transport and natural hydrologic regimes on the river, and restore riparian and wetland habitats; and remove the invasive giant reed (*Arundo donax*) from local rivers and tributaries.

Key ecosystems in the Metropolitan Los Angeles Planning Area include intermittent canyons in the inland San Gabriel Mountains and coastal Santa Monica Mountains. Because of extensive development in the Los Angeles area, the physical and hydrologic landscape has been irreversibly altered. Nevertheless, opportunities for aquatic and riparian restoration, wetlands enhancement, and habitat creation are being actively pursued. Ecosystem protection efforts are under way in the San Gabriel River headwaters in Angeles National Forest.

Key ecosystems in the Santa Ana Planning Area include the upper Newport Bay and the constructed wetlands behind Prado Dam. Seven Oaks Dam, and Hemet/San Jacinto. The Santa Ana Watershed Project Authority (SAWPA) is responsible for many impressive projects underway or under development within the Santa Ana watershed, including its 93-mile Santa Ana Regional Interceptor (SARI) pipeline designed to convey non-reclaimable, high-saline brine out of the watershed, non-native plant removal program, constructed wetlands, wetland expansion, habitat restoration, and wildlife conservation and enhancement. Environmental groups such as the Orange County Coastkeeper are working to restore ecosystem function and improve water quality within coastal

Figure SC-3 **Wetlands and critical habitat in the South Coast Region**



marshes. In Orange County's developed watersheds, restoration activities include the removal of debris and trash, reversion to natural channel configuration, revegetation with native species, and a regional invasive species removal program. Many projects contain a public education component intended to integrate public outreach and education of outlying neighborhoods, as well as of visitors to the restoration site.

Key ecosystems in the San Diego Planning Area include the coastal lagoons and wetlands, protected reservoir lands, and the San Dieguito River Park area. The San Diego area's vegetation communities support a wide array of wildlife species and are

Table SC-1 Representative climate data for South Coast planning areas

	Planning areas			
	Santa Clara	Metropolitan LA	Santa Ana	San Diego
Rainfall (inches per year)[1]	10 to 46	12 to 47	10 to 53	8 to 38
Minimum Temperature (°F)[1]	29 to 54	35 to 55	23 to 54	37 to 54
Maximum Temperature (°F)[1]	55 to 78	52 to 79	48 to 81	63 to 81
Average Eto (feet per year)[2]	4.6	4.3	4.4	4.5

1. PRISM Group 2008. Averages calculated from 1971 to 2000.
2. California Irrigation Management Irrigation System 2008. Reference Evapotranspiration.

home to hundreds of native plant species. However, invasive species are a major threat to native species in the area. The San Diego County MSCP effort is implementing comprehensive programs to protect these resources.

Climate

The coastal and interior valleys of the South Coast region feature Mediterranean climates characterized by mild, wet winters and warm, dry summers. See Table SC-1 for climate data by planning area. The bordering mountains have climates that range from Mediterranean to subtropical steppe, with a greater range of maximum and minimum temperatures and higher precipitation amounts for all seasons. Most of the region's precipitation (75 percent) falls between December and March. Average precipitation can vary greatly along the South Coast, ranging from over 40 inches annually in the mountains to less than 10 inches annually in the valleys. Although generally dry, the eastern and southern portions of the region may be impacted in the late summer by monsoonal thunderstorms which result from low pressure cells in the Southwest. The region generally experiences substantial climactic variability, with periods of higher than normal precipitation followed by lower than normal precipitation. Periodic drought conditions present a challenge to water providers throughout the region as they attempt to meet growing demands for water.

Precipitation extremes were experienced in the South Coast region between 2000 and 2005. Very dry conditions were experienced in 2002 in the region. At the Los Angeles Civic Center, 4.4 inches was recorded in water year 2002, which was 30 percent of normal. At the San Diego Airport, 3.3 inches was recorded, which is 33 percent of normal. Above average precipitation was recorded in 2005. At the Los Angeles Civic Center, 37.5 inches was recorded in water year 2005, which was 254 percent of normal. At the San Diego Airport, 22.6 inches was recorded, which is 222 percent of normal.

Population

In 2005, South Coast Hydrologic Region had the largest population of the state's 10 hydrologic regions with 19.6 million people. About 54 percent of the state's total

Box SC-2 California Native American Tribal Information, South Coast Hydrologic Region

- Demographics: Tribes with historic or cultural ties to the Central Cost region are primarily the Cahuilla, Cupeno, Diegueno, Gabrieleno, Kumeyaay, Luiseno, Serrano, and Tongva (previously referred to collectively as the Mission Indians).
  - Currently, Tribal landholdings located in this region include the Barona, Campo, Capitan Grande, Highland (Serrano), Inaja-Cosmit, Jamul, La Jolla, La Posta, Mesa Grande, Pechanga, Pala, Pauma-Yuima, Poway (San Luis Rey), Ramona, Rincon, Riverside (Sherman Indian Museum), San Fernando (Fernando Tataviam), San Manuel, San Pasqual, Santa Ana (Juaneno/ Acjachemem), Santa Ysabel, Soboba, Sycuan, and Viejas reservations, rancherias, and communities. On the boundary with the Colorado River region are the Cahuilla, Ewiiaapaayp (Cuyapaipe), Los Coyotes, Manzanita, and Santa Rosa reservations.
- Collaborative Efforts:
  - Through an agreement with the US Bureau of Reclamation, the La Jolla Band of Luiseno Mission Indians received funding to support fire suppression, increased storage, and the development a drought contingency plan.
  - Pechanga established a full response fire department and has mutual and autoaid agreements with the City of Temecula and the California Department of Forestry, including access to Pechanga's two artificial lakes for supplying aerial water drops in fighting wild fires.
  - The Pala Band, San Luis Rey Indian Water Authority, and the Native American Environmental Protection Coalition participate on the San Luis Rey Watershed Council, working with local jurisdictions, water districts, and non-profit organizations.
- Concerns and Priorities:
  - Tribal water rights are often "paper water" and are not linked to actual water deliveries or supplies.
  - Water quality for surface and groundwater resources along the Mexico border.
- Accomplishments:
  - The San Luis Rey Indian Water Authority is close to completing a 40-year effort to restore and perfect senior water rights that were bypassed in 1895 with the diversion of San Luis Rey River waters into the Escondido Canal. A 1969 lawsuit led to the 1988 San Luis Rey Indian Water Rights Settlement Act. The lining of the All-American Canal, completed in May of 2009, and the settlement agreement provides the necessary supplemental water. Funding options are currently being explored for construction of a pipeline, an important component of actual water deliveries to the reservations. At present, the final settlement agreement is in a period of review by the parties.

NOTE: Above information was gathered from Tribal input at the California Water Plan Update regional workshops and the Tribal water plenary sessions that are supporting the California Tribal Water Summit.

population lives in this region, and 88 percent of the region's population lives in incorporated cities. Between 2000 and 2005, the region grew by 1,414,691 people, a growth of 8 percent over the 5-year period. For historical population data, 1960–2005, see Volume 5, The Technical Guide.

In Water Plan Update 2009, we project population growth based on the assumptions of future scenarios. Discussion of the three scenarios used in this Water Plan and how the region's population may change through 2050 can be found later in this report under Looking to the Future.

Senate Bill 18 (Chapter 905, Statutes of 2004) requires cities and counties to consult with Native American Indian Tribes during the adoption or amendment of local general plans or specific plans. A contact list of appropriate Tribes and representatives within a region is maintained by the Native American Heritage Commission. Box SC-2 lists information about regional Tribal concerns.

Economic Drivers

Historically dominated by the aerospace and defense industries, the South Coast region has diversified into multiple technological fields. Research and development activities are concentrated within the region's universities, including UC Los Angeles, University of Southern California, Caltech, UC Irvine, UC Riverside, and UC San Diego, and their associated research institutes, as well as countless technology-based companies. The top industries in the South Coast, according to the US Census Bureau (2006), are: manufacturing (computers and electronics, transportation equipment, metal fabrication, food, and apparel); healthcare and social assistance; professional, scientific and technical services (legal, accounting, architectural/engineering services); and wholesale trade (grocery, professional and commercial equipment, apparel, machinery).

The tourism industry, which is supported by coastal and beach ecosystems, is a key economic driver in the South Coast region. The region also includes the largest port complex in the United States, the adjacent 7,500-acre Port of Los Angeles and 3,200-acre Port of Long Beach, as well as several smaller ports and harbors. In 2003, merchandise trade passing through the Port of Long Beach was valued at $96 billion: 12 percent of the value of total US international waterborne trade. Coastal and channel erosion, polluted runoff, and sea level rise are all water resources issues that affect these important industries.

Though not as high in value as the above industries, the agricultural industry still plays an important role in the South Coast economy. The top agricultural products in 2005 include: strawberries, assorted nursery products, and citrus.

Land Use Patterns

With over half of the State's population, urbanization and its associated impacts are key challenges to future land use and water resources planning. The mild climate and gentle hillscapes in the South Coast region have encouraged growth since the first great development boom of the late 1880s. Typical land use patterns include urban development in the coastal plains and interior valleys, with open space maintained in the mountains. Nearly 40 percent of the South Coast's land area is urban and suburban use, which has led to fragmentation of wildlife habitats by urban sprawl and freeways. Recent urban development has occurred on the coastal plains, valleys, and hillsides of Ventura, Orange, and San Diego counties and on the remaining undeveloped land in the Inland Empire. Managed wetlands, reservoirs, and riparian corridors provide pockets of open space within the urban grid. Historical agricultural areas are giving way to urbanization. There are numerous Native American reservations in the South Coast region. See Table SC-2 for information on Tribal lands.

Agricultural land uses remain important in the South Coast region. Important agricultural areas are the Oxnard Plain and Santa Clara River and Santa Rosa valleys in Ventura County and several coastal and interior valleys of San Diego County. Other notable locations include the Chino, Perris, and San Jacinto valleys and near the

Table SC-2 Tribal lands with acreage, South Coast Hydrologic Region

Federal Trust Lands	Acres	Tribal owners
Campo Reservation (Splits with CR Region, but mostly in SC)	16,512	Kumeyaay (Diegueño) Indians
La Posta Reservation	3,556	Kumeyaay (Diegueño) Indians
Manzanita Reservation (Splits with CR Region, but mostly in CR)	See CR Region for acres	
Cuyapaipe Reservation (Splits with CR Region, but mostly in CR)	See CR Region for acres	
Santa Ysabel Reservation (Splits with CR Region, but almost entirely in SC Region)	15,526	Diegueño Indians
Los Coyotes Reservation (Splits with CR Region, but mostly in SC Region)	25,050	Cahuilla and Cupeño Indians
Pala Reservation (2 separate locations – one large and one really small a distance away).	11,893	Cupeño and Luiseño
Cabazon Reservation	1,706	Cahuilla Indians of the Cabazon Reservation.
Santa Rosa Reservation (Splits with CR Region, but almost entirely in CR Region)	See CR Region for acres	
Morongo Reservation (Splits with CR Region, but is almost entirely in CR Region except for one small parcel)	See CR Region for acres	
San Manuel Reservation	658	Serrano Indians
Soboba Reservation	5,915	Luiseño Indians
Ramona Reservation	560	Cahuilla Indians
Pechanga Reservation	4,394	Luiseño Indians
Pauma-Yuima Reservation	5,877	Luiseño Indians
La Jolla Reservation	8,541	Luiseño Indians
Reservation Rincon	4,275	Luiseño Indians
San Pasqual Reservation	1,380	Kumeyaay (Diegueño) Indians
Mesa Grande Reservation	1,803	Diegueño Indians
Inaja - Cosmit Reservation	880	Diegueño Indians
Barona Reservation	5,903	Barona Band of Mission Indians
Capitan Grande Reservation	15,753	Today, the Capitan Grande Reservation is owned by Viejas, Barona, and other non-reservation groups.
Reservation Viejas	1,609	Kumeyaay (Diegueño) Indians
Sycuan Reservation	640	Kumeyaay (Diegueño) Indians
Jamul Village	Unknown at this time	

*Data taken from the San Diego State University's online library and information access (http://infodome.sdsu.edu/research/guides/calindians/calinddict.shtml#a)

cities of Irvine, Redlands, and Riverside. Total crop acres in 2005 for the region was 242,000 acres; a decrease from 2000 when 280,000 acres was harvested.

In the major agricultural areas, the emphasis was on growing high market value crops. The Oxnard Plain is still recognized for fresh market vegetables. Citrus and subtropical fruits are produced in the Santa Clara River Valley and the interior valleys of San Diego County. Forage crops are still grown in the Chino, Perris, and San Jacinto Valleys in support of the dairy industry in Chino.

The South Coast's watersheds typically do not resemble their natural state due to urbanization and agricultural practices that have modified waterways and surrounding habitats. Numerous waterways have been impacted by hydromodification and channelization. Many streambeds have been lined with concrete to facilitate flood management, thereby decreasing groundwater recharge. This is a particular problem for those groundwater basins which have historically been over-pumped, such as in the Los Angeles River watershed. Bridges and other structures over channelized streams can slow flow velocity and cause adjacent flood damage, as seen in the Calleguas Creek watershed. Due to intense urbanization and loss of natural habitat, there is a focus on conserving the natural areas that remain within the region.

Concern over effective land use planning for reducing wildfire risk and ensuring rapid response strategies have become more urgent as development continues to move into urban interface areas. Brush fires in San Diego County in October 2003 burned about 265,000 acres (Cal Fire 2003). Not only was the loss to wildlands severe during this nightmare, including devastating nearly all of Cuyamaca Rancho State Park, but more than 5,000 homes and other structures were damaged or completely destroyed. San Diego County burned again in October 2007, losing 347,000 acres and damaging 2,600 structures (Cal Fire 2007). In 2009, a brush fire in the Angeles National Forest in Los Angeles County burned over 160,000 acres and damaged 89 structures. Fires have always been a component of life in California, but the likelihood of fire causing profound damage for local residents has increased with ongoing urbanization. Planners and legislators are increasingly looking to understand and manage the South Coast landscape to reduce such losses.

Regional Water Conditions

The region has developed a diverse mix of local and imported water supply sources, available in differing amounts throughout the South Coast region. The following sections provide an overview of regional water conditions.

Environmental Water

Given the arid nature of the region and the flashy nature of storm events, the native South Coast environment is generally very sensitive to water. Although numerous structures have been built to alter the natural flows of local water bodies, many efforts

are under way to restore these damaged environments, protect existing ones, and develop new ones to replace those that have been lost.

Water supply dedicated to environmental management includes instream flows for fisheries, aquatic vegetation, and water quality protection. Although environmental water use is limited in the South Coast region, local agencies have developed beneficial reuse programs for reclaimed water. Managed wetlands—e.g., Balboa Lake in the Sepulveda Basin area of Los Angeles County, Hemet/San Jacinto Multi-Purpose Constructed Wetlands in Riverside County, San Jacinto Wildlife Area in Riverside County, San Joaquin Marsh along San Diego Creek in Orange County, and Santee Lakes in San Diego—are maintained through discharge of reclaimed water supplies. Discharges from upstream wastewater treatment plants (WWTPs) contribute inflows to many of the region's coastal lagoons and estuaries. Constructed wetlands along the Santa Ana River, including lands behind Prado Dam, have effectively demonstrated the ability to reduce nitrogen levels and recharge the groundwater aquifer. These managed wetlands, fed by Santa Ana River flows, provide for migratory and resident waterfowl and shorebird habitat, wildlife diversity, and public education and recreation opportunities. The source of the wetland flows is assured by the Santa Ana River Stipulated Judgment (overseen by the Santa Ana River Watermaster) which requires minimum average annual flows and guaranteed TDS concentrations within the river.

A 31-mile section of Sespe Creek in the Los Padres National Forest (Ventura County) was designated by USFWS as a Wild and Scenic River in 1992. Unusual geologic formations, gorges, and riparian vegetation provide excellent scenic diversity and recreation opportunities. This stream is considered a rainbow trout fishery and provides critical habitat for the endangered California condor. Sespe Creek and Bear Creek/Bear Valley Dam (impounding Big Bear Lake) are both designated as "wild trout waters" by DFG and are further regulated to maintain appropriate instream habitat conditions (DFG 2008). These South Coast fisheries are limited by diversions and dams that have cut off important spawning areas through diminished flows and poor water quality.

Water Supplies

To meet current and growing demands for water, the South Coast region is leveraging all available water resources: imported water, water transfers, conservation, captured surface water, groundwater, recycled water, and desalination. Given the level of uncertainty about water supply from the Delta and Colorado River, local agencies have emphasized diversification. Local water agencies now utilize a diverse mixture of local and imported sources and water management strategies to adequately meet urban and agricultural demands each year. For example, San Diego is projected to produce approximately 185,000 acre-feet per year of local supplies through water recycling, desalination, groundwater, and surface storage programs by 2030. By 2021, the area will receive an additional 277,000 acre-feet per year due to San Diego County Water Authority-Imperial Irrigation District (SDCWA-IID) water conservation, transfer, and canal-lining programs. This diverse mix of sources provides flexibility in managing resources in wet and dry years.

Imported Water

Water is brought into the South Coast region from three major sources: the Sacramento-San Joaquin Delta, Colorado River, and Owens Valley/Mono Basin. All three are facing water supply cutbacks due to climate change and environmental issues. Although historically imported water served to help the South Coast region grow, it is today relied upon to sustain the existing population and economy. As such, parties in the South Coast region are working closely with other regions, the State, and federal agencies to address the challenges facing these imported supplies. Meanwhile, the South Coast region is working to develop new local supplies to meet the needs of future population and economic growth.

State Water Project

The State Water Project (SWP) is an important source of water for the South Coast region wholesale and retail suppliers. SWP contractors in the region take delivery of and convey the supplies to regional wholesalers and retailers. Contractors in the region are the Metropolitan Water District of Southern California (Metropolitan), Castaic Lake Water Agency (CLWA), San Bernardino Valley Municipal Water District (MWD), Ventura County Watershed Protection District (VCWPD) (formerly Ventura County Flood Control District), San Gorgonio Pass Water Agency (SGPWA), and San Gabriel Valley Municipal Water District. Metropolitan's contract with the California Department of Water Resources (DWR) is for 1.91 million acre-feet annually—about half the total project (see more discussion in Appendix B).

Colorado River System

Another key imported water supply source for the South Coast region is the Colorado River. California water agencies are entitled to 4.4 million acre-feet annually of Colorado River water. Of this amount, 3.85 million acre-feet are assigned in aggregate to agricultural users; 550,000 acre-feet is Metropolitan's annual entitlement. Until a few years ago, Metropolitan routinely had access to 1.2 million acre-feet annually because Arizona and Nevada had not been using their full entitlement and the Colorado River flow was often adequate enough to yield surplus water. Metropolitan delivers the available water via the 242-mile CRA and the regional conveyance system. (See more discussion in Appendix B.)

Owens Valley/Mono Basin

High-quality water from the Mono Basin and Owens Valley is delivered through the Los Angeles Aqueduct (LAA) to the City of Los Angeles. Construction of the original 233-mile aqueduct from the Owens Valley was completed in 1913, with a second aqueduct completed in 1970 to increase capacity. Approximately 480,000 acre-feet per year of water can be delivered to the City of Los Angeles each year; however the amount the aqueducts deliver varies from year to year due to fluctuating precipitation in the Sierra Nevada Mountains and mandatory instream flow requirements.

For more information on Water Supply and Suppliers in the South Coast Region, see Appendix B.

Diversion of water from Mono Lake has been reduced following State Water Board Decision 1631 and exportation of water from the Owens Valley is limited by the Inyo-Los Angeles Long Term Water Agreement (and related MOU) and the Great Basin Air Pollution Control District/City of Los Angeles MOU (to reduce particulate matter air pollution from the Owens Lake bed).

Other Water Transfers

Prior to 1991, water transfers within the South Coast region had been limited to transfers of annual groundwater basin rights (which continue to occur). Recently, municipal population growth and the need for water supply reliability have resulted in the growth of water transfer agreements. Metropolitan participates in multiple water exchange and storage programs, including agreements with Semitropic Water Storage District (WSD), Arvin-Edison WSD, San Bernardino Valley MWD, Kern-Delta Water District, Mojave Water District, and the Governor's Water Bank. CLWA has executed long-term transfer agreements with the Buena Vista and Rosedale-Rio Bravo WSDs (see Section, Relationship with Other Regions).

In 1998, SDCWA entered into a transfer agreement with Imperial Irrigation District (IID) to purchase conserved agricultural water. Through the agreement, SDCWA received 50,000 acre-feet in 2007. This quantity will increase in 10,000 acre-feet increments annually up to 200,000 acre-feet per year in 2021 and then remain fixed for the duration of the 75-year agreement. Metropolitan conveys the transfer water to SDCWA via an exchange agreement.

The Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003 (QSA) has resulted in the movement of supplies between the Colorado River and South Coast regions.

Local Surface Water

Local surface capture plays an important water resource role in the South Coast region. More than 75 impound structures are used to capture local runoff for direct use or groundwater recharge, operational or emergency storage for imported supplies, or flood protection. While precipitation contributes most of the annual volume of streamflow to the region's waterways, urban runoff, wastewater discharges, agricultural tailwater, and surfacing groundwater are the prime sources of surface flow during non-storm periods. The South Coast has experienced a trend of increasing dry weather flows during the past 30 years as the region has developed, due to increased imported water use and associated urban runoff. (See more discussion in Appendix B.)

Groundwater

During the first half of the 20th century, groundwater was important factor in the expansion of the urban and agricultural sectors in the South Coast region. Today,

it remains important for the Santa Clara, Metropolitan Los Angeles and Santa Ana planning areas, but only a small source for San Diego. Court adjudications, recharge operations, and other management programs are helping to maintain the supplies available from many of the region's groundwater basins. Since the 1950s, conjunctive management and groundwater storage has been utilized to increase the reliability of supplies, particularly during droughts. Using the region's other water resources, groundwater basins are being recharged through spreading basins and injection wells. During water shortages of the imported supplies, more groundwater would be extracted to make up the difference. Water quality issues have impacted the reliability of supplies from some basins. However, major efforts are underway to address the problems and increase supplies for these basins. (See more discussion in Appendix B.)

Recycled Water

In the South Coast region, recycled water is becoming increasingly valuable given its reliability and cost-effectiveness as compared to tapping other water supplies. In addition to extending conveyance systems to deliver recycled water for non-potable uses (i.e., purple pipe), the region is leading implementation of groundwater recharge and reservoir augmentation with recycled water (i.e., indirect potable reuse, IPR). (See more discussion in Appendix B.)

Desalination

Desalination is being implemented in the South Coast region not only to help meet local water supply needs, but also to manage salinity levels and associated impacts on the environment. In the Santa Clara and Santa Ana planning areas, desalination is focused on brackish groundwater treatment. Large-scale seawater desalination facilities are moving through the approval process in the Santa Ana Planning Area. A large-scale seawater desalination facility has recently been approved in the San Diego Planning Area, and seawater desalination is being pursued in earnest in the Metropolitan Los Angeles Planning Area. (See more discussion in Appendix B.)

Urban Water Conservation

Water conservation is a fundamental component of the South Coast region's water management planning. Water agencies in the South Coast have been aggressively implementing water conservation since the 1990s. Many local water agencies are signatories to the California Urban Water Conservation Council (CUWCC) Memorandum of Understanding (MOU) for urban water conservation and also have adopted Urban Water Management Plans to ensure water supply reliability during normal, dry, and multiple dry years. These agencies implement the best management practices (BMPs) and demand management measures contained in those documents. The backbone of Metropolitan's conservation program is the Conservation Credits Program (CCP), initiated in 1988, that contributes $195 per acre-foot of water conserved to assist member agencies in pursuing urban BMPs and other demand management

opportunities. All of the region's water suppliers have water conservation programs for their customers which feature residential and commercial water saving tips, rebates for water efficient purchases (e.g., low-flow toilets, high-efficiency clothes washers, weather-based irrigation controllers), and tools for implementing landscape/garden improvements. Local agencies are also developing water conservation master plans and conservation rate structures as well as working closely through Integrated Regional Water Management (IRWM) planning efforts to develop coordinated water efficiency programs. (See more discussion in Appendix B.)

Water Uses

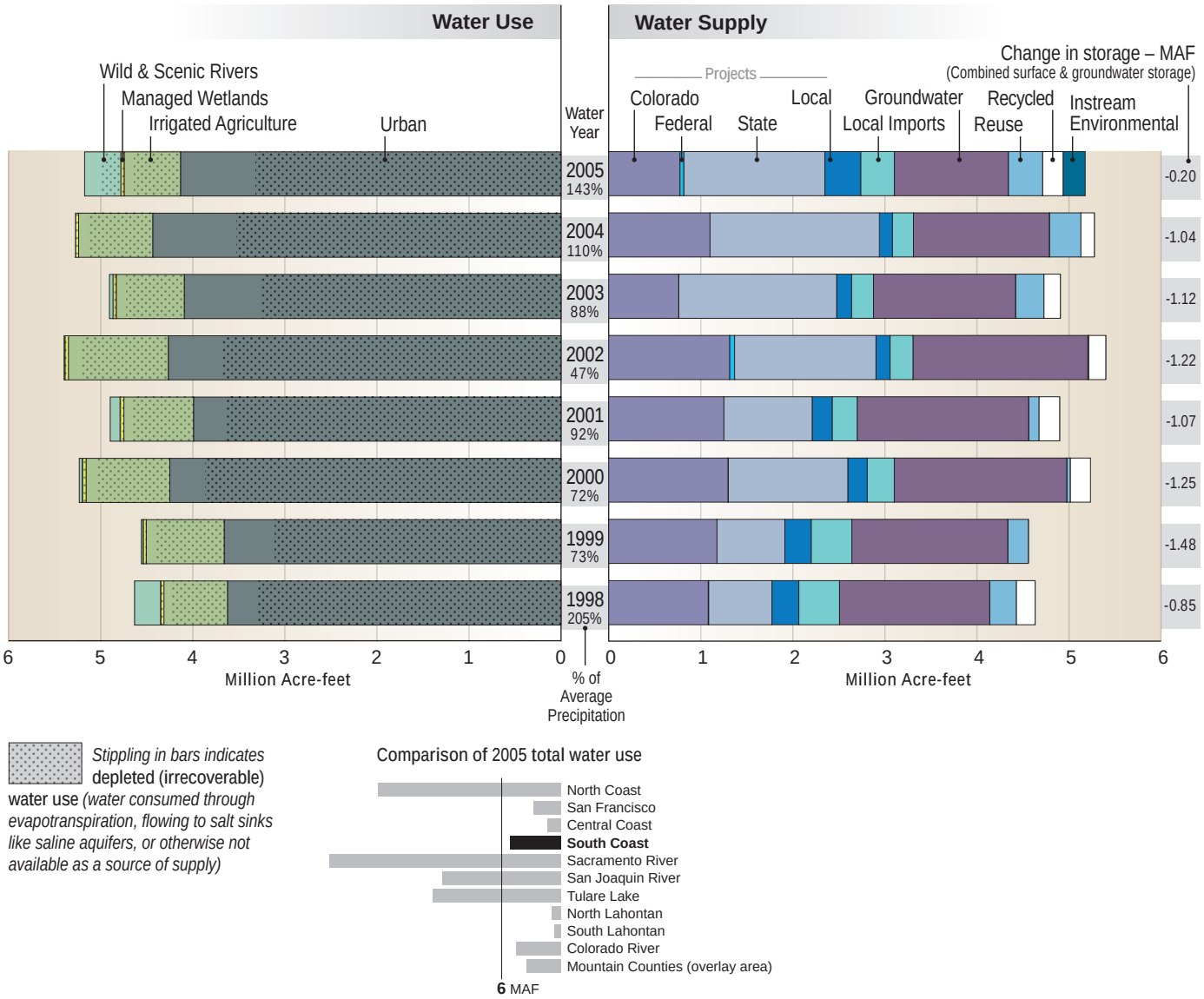
Urban Water Use

The South Coast Hydrologic Region is the most populous and urbanized region in California. In some portions of the region, water users consume more water than is locally available, which has resulted in an overdraft of groundwater resources and increasing dependence on imported water supplies. The distribution of water uses, however, varies dramatically across the South Coast's planning areas. As a result of recent droughts, South Coast water users have generally become more water efficient. Municipal water agencies are engaged in aggressive water conservation and efficiency programs to reduce per capita water demand. As a result of changes in plumbing codes, energy and water efficiency innovations in appliances, and trends toward more water efficient landscaping practices, urban water demand has become more efficient. (Read about the region's urban water conservation above under Water Supply and in Appendix B.)

Agricultural Water Use

Despite vast urbanization within the South Coast, about 240,000 acres of irrigated crops were harvested in 2005. Agricultural activities accounted for approximately 12 percent of the overall use in the region. In the main agricultural areas on the South Coast, growers are very conscious about the amount of water needed to produce a marketable crop and strive to be as efficient as possible. The largest area of concentrated row crops (35,000 acres of harvest produce) is in Ventura County. Although sprinkler and furrow irrigation is still used on several truck crops (celery, cabbage and broccoli), drip irrigation is used almost exclusively for other kinds of vegetable crops (lettuce, peppers, and tomatoes). In recent years, improvements in surface drip technology have permitted growers to use drip tape for consecutive years without a decrease in effectiveness. Additionally, many of the large-scale citrus and avocado operations in Ventura and San Diego counties are irrigated with micro-sprinkler systems. Improved technology has allowed growers to more accurately distribute water to the individual trees; pressure compensating valves and emitters have enabled growers to irrigate on steep slopes with better precision. Maximizing agricultural irrigation systems lowers the growers' irrigation demands.

Figure SC-4 **South Coast Hydrologic Region water balance summary, 1998-2005**



Water Balance Summary

Figure SC-4 summarizes the total developed water supplies and distribution of the dedicated water uses within this hydrologic region for the eight years from 1998 through 2005. As indicated by the variation in the horizontal bars for wet (1998) and dry (2002) years, the distribution of the dedicated supply sources (right side of Figure SC-4) can change significantly based on the wetness or dryness of the water year. The more detailed numerical information about the developed water supplies and uses is presented in Volume 5 Technical Guide, which provides a breakdown of the components of developed supplies used for agricultural, urban, and environmental purposes and Water Portfolio data.

For the South Coast region, urban water uses are the largest component of the developed water supply, while agricultural water use is a smaller but significant portion of the total. There is very little dedicated water required for instream flows within this region. The water supply portion of Figure SC-4 also indicates that imported water supplies and groundwater are the major components of the water supply for this region, with minor supplies from local surface waters and recycled water.

Table SC-3 presents information about the total water supply available to this region for the eight years from 1998 through 2005, and the estimated distribution of these water supplies to all uses. The annual change in the region's surface and groundwater storage is also estimated, as part of the balance between supplies and uses. In wetter water years, water will usually be added to storage, while during drier water years storage volumes may be reduced. Of the total water supply to the region, more than half is either used by native vegetation; evaporates to the atmosphere; provides some of the water for agricultural crops and managed wetlands (effective precipitation); or flows to other states, the Pacific Ocean, and salt sinks like saline groundwater aquifers. The remaining portion, identified as consumptive use of applied water, is distributed among urban and agricultural uses and for diversions to managed wetlands. For some of the data values presented in Table SC-3, the numerical values were developed by estimation techniques, because actual measured data are not available for all categories of water supply and use.

Water Quality

Water quality is a key issue in the South Coast region. Population and economic growth not only affect water demand, but add contamination challenges from increases in wastewater and industrial discharges, urban runoff, agricultural chemical usage, livestock operations, and seawater intrusion. Urban and agricultural runoff can contribute to local surface water sediment from disturbed areas; oil, grease, and toxic chemicals from automobiles; nutrients and pesticides from turf and crop management; viruses and bacteria from failing septic systems and animal waste; road salts; and heavy metals. Three areas that are receiving intense interest are nonpoint source (NPS) pollution control, salinity management, and emerging contaminants.

Three Regional Water Quality Control Boards (Regional Water Boards) have jurisdiction in the South Coast: Los Angeles (Region 4), Santa Ana (Region 8), and San Diego (Region 9). Each Regional Water Board identifies impaired water bodies, establishes priorities for the protection of water quality, issues waste discharge requirements, and takes appropriate enforcement actions within in its jurisdiction (Figure SC-5). Specific water quality issues within the South Coast include beach closures, contaminated sediments, agricultural discharges, salinity management, and port and harbor discharges. Outside the region, high salinity levels and perchlorate contamination contribute to degraded Colorado River supplies, while seawater intrusion and agricultural drainage threaten SWP supplies.

Table SC-3 South Coast Hydrologic Region water balance for 1998-2005 (thousand acre-feet)

South Coast	Water Year (Percent of Normal Precipitation)							
	1998 (205%)	1999 (73%)	2000 (72%)	2001 (92%)	2002 (47%)	2003 (88%)	2004 (110%)	2005 (143%)
Water Entering the Region								
Precipitation*	20,873	7,803	7,522	9,327	5,034	9,468	11,807	15,344
Inflow from Oregon/Mexico	0	0	0	0	0	0	0	0
Inflow from Colorado River	1,081	1,176	1,296	1,250	1,313	760	1,100	773
Imports from Other Regions	1,286	2,361	1,695	1,255	3,093	2,740	3,137	2,331
Total	**23,240**	**11,340**	**10,513**	**11,832**	**9,440**	**12,968**	**16,044**	**18,448**
Water Leaving the Region								
Consumptive Use of Applied Water ** (Ag, M&I, Wetlands)	1,468	1,585	1,819	1,628	1,887	1,651	1,739	1,515
Outflow to Oregon/Nevada/Mexico	0	0	0	0	0	0	0	0
Exports to Other Regions	0	0	0	0	0	0	0	0
Statutory Required Outflow to Salt Sink	0	0	0	0	0	0	0	202
Additional Outflow to Salt Sink	2,110	2,153	2,498	2,325	2,617	2,101	2,347	2,128
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	20,514	9,086	7,441	8,947	6,160	10,333	12,994	14,803
Total	**24,092**	**12,823**	**11,758**	**12,900**	**10,664**	**14,085**	**17,080**	**18,648**
Storage Changes in the Region [+] Water added to storage [–] Water removed from storage								
Change in Surface Reservoir Storage	372	-237	128	332	53	-81	-102	509
Change in Groundwater Storage ***	-1,224	-1,246	-1,373	-1,400	-1,276	-1,035	-934	-709
Total	**-852**	**-1,483**	**-1,245**	**-1,068**	**-1,223**	**-1,116**	**-1,036**	**-200**
Applied Water ** (compare with Consumptive Use).	4,184	4,386	5,041	4,633	5,173	4,676	5,068	4,564

* The percent precipitation is based upon a running 30 year average of precipitation for the region and discrepancies can occur between information calculated for Update 2009 and earlier published data.

** Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows

*** Change in Groundwater Storage is based upon best available information. Basins in the north part of the state (North Coast, San Francisco, Sacramento River and North Lahontan regions and parts of Central Coast and San Joaquin River Regions) were modeled - spring 1997 to spring 1998 for the 1998 water year and spring 1999 to spring 2000 for the 2000 water year. All other regions and years were calculated using the following equation:

GW change in storage = intentional recharge + deep percolation of applied water + conveyance deep percolation and seepage - withdrawals

This equation does not include the unknown factors such as natural recharge and subsurface inflow and outflow.

Figure SC-5 Impaired water bodies in South Coast Hydrologic Region

Nonpoint Source Pollution Control

All NPS pollution is currently regulated through either the National Pollutant Discharge Elimination System (NPDES) Permitting Program or the Coastal Non-point Pollution Control Program. All three Regional Water Boards issue municipal, industrial, and construction NPDES permits with the goal of reducing or eliminating the discharge of pollutants into the storm water conveyance system. The coastal program requires the US Environmental Protection Agency and National Oceanic and Atmospheric Administration to develop and implement enforceable BMPs to control non-point source pollution in coastal waters. Further, the Los Angeles and San Diego Regional Water Boards have adopted conditional waivers for discharges from irrigated agricultural lands, which require farmers to measure and control discharges from their property.

South Coast agencies have recently begun to implement Low Impact Development (LID) as a way of improving water quality through sustainable urban runoff management. LID practices include: bioretention and rain gardens, rooftop gardens, vegetated swales and buffers, roof disconnection, rain barrels and cisterns, permeable pavers, soil amendments, impervious surface reduction, and pollution prevention (SWRCB 2008). The Los Angeles and San Diego Regional Water Boards have both incorporated LID language into Standard Urban Storm Water Mitigation Plan requirements for municipal NPDES permits.

Salinity Management

Surface and groundwater salinity is an ongoing challenge for South Coast water supply agencies. Higher levels of treatment are needed following long-range import of water supplies, as TDS levels are increased during conveyance. Salinity sources in local supplies include concentration from agricultural irrigation, seawater intrusion, discharge of treated wastewater, and recycled water. Metropolitan depends on blending the higher salinity CRA supply at Parker Dam with the lower salinity SWP supply to maintain 500 milligrams per liter (mg/L) TDS or lower. The City of San Diego 2006 Water Quality Report shows average TDS for three water treatment plants using blended supplies ranging from 442 to 465 parts per million (ppm). Further, seawater intrusion and agricultural drainage threatens to increase the salinity of SWP supplies. Reduced surface water quality would require additional or upgraded demineralization facilities. Increased salinity also reduces the life of plumbing fixtures and consequently increases replacement costs to customers.

Groundwater quality has also been degraded by a long history of groundwater overdrafting and subsequent seawater intrusion. Orange County Water District (OCWD), Water Replenishment District of Southern California (WRD), and Los Angeles County Department of Public Works (LACDPW) operate groundwater injection programs to form hydraulic barriers that protect aquifers from seawater intrusion. Brackish groundwater treatment occurs throughout the Santa Clara and Santa Ana planning areas. Various local agencies have developed salinity and nutrient management plans to reduce salt loading. For example, the Chino Basin Watermaster developed an Optimum Basin Management Plan (1999) to develop the maximum yield of the basin while protecting water quality. Further development of IPR/groundwater recharge programs within the South Coast may exacerbate groundwater salinity and require additional technological advances in desalination.

Potential Contaminants

Chemical and microbial constituents that have not historically been considered as contaminants are increasingly present in the environment due to municipal, agricultural, and industrial wastewater sources and pathways. Established and emerging contaminants of concern to the region's drinking water supplies include pharmaceuticals and personal care products; disinfection byproducts; those associated with the production of rocket fuel, such as perchlorate and nitrosodimethylamine; those that occur naturally, such

as arsenic; those associated with industrial processes, such as hexavalent chromium; and methyl tertiary butyl ether (MTBE), a gasoline additive. WWTPs are not currently designed to remove these emerging contaminants. However, Metropolitan, the National Water Resources Institute, and OCWD are studying the occurrence of emerging constituents in the Santa Ana River, SWP, and Colorado River water. Also, SAWPA is facilitating a task force of watershed stakeholders that is investigating emerging constituents as part of a voluntary cooperative agreement with the Santa Ana Regional Water Quality Control Board.

Planning Area Impairments

Water quality issues within the Santa Clara and Metropolitan Los Angeles planning areas (Los Angeles Regional Water Board) stem from a range of sources, including industrial and municipal operations, flow diversion, channelization, introduction of non-native species, sand and gravel operations, natural oil seeps, dredging, spills from ships, transient camps, and illegal dumping. Over time, these practices have resulted in the bioaccumulation of toxic compounds in fish and other aquatic life, instream toxicity, eutrophication, beach closures, and a number of Clean Water Act 303(d) listings. Water bodies within this planning area have been listed for metals, pesticides, nitrates, trash, salinity, and pH. The Regional Water Board is developing Total Maximum Daily Loads (TMDLs) for nutrients, pathogens, trash, toxic organic compounds, and metals (Los Angeles Regional Water Board 1994; 2007).

Key issues within the Santa Ana Planning Area (Santa Ana Regional Water Board) include: nitrogen/TDS due to flow diversion; nitrogen/TDS associated with past agricultural activities and dairies in the Chino Basin; and pathogen issues from urbanization impacting river and coastal beaches, and past contamination of groundwater basins from perchlorate which is related to rocket fuel disposal and fertilizer use. Water bodies within this planning area typically have nutrient issues, including organic enrichment, low dissolved oxygen, and algal blooms. These are particular problems in Big Bear Lake and Lake Elsinore. Water quality issues also include pathogens, metals, and toxic organic compounds in the lower watershed due to urbanization and agricultural activities. TMDLs have been developed throughout the Santa Ana River and San Jacinto River watersheds for nutrients and pathogens. Along the Newport coast, TMDLs are in place for metals, nutrients, pathogens, pesticides/priority organics, and siltation (Santa Ana Regional Water Board 1994; 2001).

The Chino Basin maintains a large concentration of dairy operations along with livestock. Runoff from the dairies contributes nitrate, salts, and microorganisms to both surface water and groundwater. Since 1972, the Santa Ana Regional Water Board has issued waste discharge requirements to the dairies in this basin. Groundwater quality in this basin is integrally related to the surface water quality downstream in the Santa Ana River, which in turn serves as a source for groundwater recharge in Orange County.

The San Diego Planning Area (San Diego Regional Water Board) is primarily concerned with the quality of coastal water bodies. Agricultural operations, urban runoff, marinas

and boating, and hydromodification all pose a threat to coastal water quality. Several shorelines within this region are Clean Water Act 303(d) listed for pathogens, and a number of estuaries and lagoons are listed for nutrients, sediments, pathogens, and metals. TMDLs are under development for several lagoons for nutrients/eutrophication, sedimentation/siltation, TDS, and bacteria. A shoreline TMDL is being created for indicator bacteria as well. The bays and harbors in the region are Clean Water Act 303(d) listed for sediment toxicity, pathogens, pesticides, benthic community effects, copper, lead, and toxic organics. As with the rest of the South Coast, the lakes and reservoirs within the region are affected by nutrients, metals and pH, and rivers are streams are commonly listed for nutrients, pathogens, metals, pesticides, toxic organics, and salinity (San Diego Regional Water Board 1994; 2002).

The Tijuana River watershed poses a unique challenge water quality control as the upper watershed lies within Mexico. Urban runoff and untreated wastewater discharges from Mexico have created significant water quality impacts within the lower watershed. The river and its estuary have issues with nutrients, debris, bacteria, low dissolved oxygen, synthetic organics, pesticides, and metals. The Tijuana River Bi-national Vision is a project meant to identify these water quality issues and define ways to bring the watershed to an ideal state.

Project Operations

The South Coast region maintains one of the most far-reaching systems of water management in the world. This includes facilities to convey imported water to the region; capture, store, and treat water supplies within the region; and deliver water throughout the region. The following paragraphs describe major water supply infrastructure that deliver imported water to the South Coast region (Figure SC-6). Protection of this infrastructure from earthquakes and other major catastrophes is an essential component of water management.

The California Aqueduct is 444 miles long, owned and operated by DWR, and carries SWP supplies to water agencies throughout California. The aqueduct begins at the Delta and flows by gravity south through the Central Valley to the Edmonston Pumping Plant, where it is pumped 1,926 feet over the Tehachapi Mountains. Once it has crossed the Tehachapis, the aqueduct divides into two branches—the West and the East. The East Branch feeds Lake Palmdale, Lake Perris, and the San Gorgonio Pass area, and the West Branch heads toward Pyramid Lake and Castaic Lake in the Angeles National Forest to supply the western Los Angeles basin. The SWP consists of pumping and power plants (6.5 billion KWh generated annually); 21 reservoirs (5.8 million acre-feet capacity); storage tanks; and canals, tunnels, and pipelines (DWR 2008b).

The CRA is 242 miles long, owned and operated by Metropolitan, and conveys Colorado River water to Southern California. The CRA diverts water from the Colorado River at Lake Havasu on the California-Arizona border and conveys it west across the Mojave and Colorado deserts to Lake Mathews in western Riverside County. The CRA

Figure SC-6 **Statewide project operations**

was constructed between 1933 and 1941 to ensure a steady supply of drinking water to Los Angeles. The aqueduct consists of 2 reservoirs, 5 pumping plants, 63 miles of canals, 92 miles of tunnels, and 84 miles of buried conduit and siphons.

The Los Angeles Aqueducts comprise two aqueducts. The first LAA (or the Owens Valley aqueduct) was completed 1913 and the second LAA was completed 1970. The first LAA was designed to deliver water from the Owens River near Independence to the City of Los Angeles. The second LAA, which added transport capacity in order to exhaust the city's water rights from the Mono Basin, starts at the Haiwee Reservoir just south of Owens Lake. Running roughly parallel to the first aqueduct, it carries water 137 miles to the City of Los Angeles.

The San Diego Aqueducts, with two branch lines, make up the backbone of the SDCWA system. The five pipelines in the two aqueducts have a combined capacity of 826 cubic

feet per second (cfs). The first aqueduct (Pipelines 1 and 2) extends 70 miles from the CRA near San Jacinto to San Vicente Reservoir. Constructed by the Navy Department and US Bureau of Reclamation (USBR) from 1945 to 1954, the two pipelines share common tunnels and inverted siphons. The 94-mile second aqueduct (Pipelines 3 and 4) were constructed from 1957 to 1979 and are operated separately. Pipeline 3 extends from the CRA to Lower Otay Reservoir, and Pipeline 4 terminates at San Diego's Alvarado Treatment Plant near Lake Murray. Metropolitan owns and operates the northern portions of the pipelines; the delivery point to SDCWA is located six miles south of the San Diego-Riverside county line (USBR 2008a).

Water Governance

Water governance is undertaken by various federal and State agencies, the courts, and sanctioned regional organizations to manage critical imported water and groundwater supplies, as well as coordinate flood management. As described in this report, there are hundreds of water supply agencies within the South Coast region. In addition, regional partnerships have been established by South Coast agencies to further collaborate on strategic water resources planning and implementation.

DWR administers long-term imported water supply contracts with 29 agencies for SWP supplies. In return for State financing, operation, and maintenance of SWP facilities, the agencies contractually agree to repay all associated capital and operating costs. The Colorado River is managed and operated by USBR under numerous compacts, federal laws, court decisions and decrees, contracts, and regulatory guidelines collectively known as the “Law of the River” (Table SC-4). This collection of documents apportions the water and regulates the use and management of the Colorado River among the seven basin states and Mexico. LADWP owns and operates the LAAs for conveyance of imported water from the Owens Valley to the City of Los Angeles. Metropolitan, the largest SWP contractor and primary South Coast wholesaler, delivers an average of 1.4 million acre-feet or more of SWP and CRA supplies (depending on the availability of surplus water) to its 26 cities, water districts, and a county authority. In fiscal year 2007-2008, SDCWA, the largest of Metropolitan’s members, purchased about 593,500 acre-feet, or about 25 percent of Metropolitan’s deliveries.

Groundwater adjudication limits the amount of groundwater that can be extracted by all parties based on a court-determined safe yield of the basin. A watermaster is then appointed by the court to administer the judgment. There are 13 court adjudications for groundwater basins in the South Coast, including Central Basin, Chino Basin, Cucamonga Basin, Goleta Basin, Main San Gabriel Basin, Puente Basin, Raymond Basin, San Bernardino Basin Area, Santa Margarita River watershed, Santa Paula Basin, Six Basins, Upper Los Angeles River, and the West Coast Basin.

Three Regional Water Boards manage water quality for the region by setting standards, issuing waste discharge requirements, determining compliance with those requirements, and taking appropriate enforcement actions. Each Regional Water Board

Table SC-4 Key elements of the Law of the Colorado River

Document	Date	Main Purpose
Colorado River Compact	1922	The Upper and Lower Basin are each provided a basic apportionment of 7.5 MAF annually of consumptive use. The Lower Basin is given the right to increase its consumptive use by an additional 1.0 MAF annually.
Boulder Canyon Project Act	1928	Authorized USBR to construct Hoover Dam and the All-American Canal (including the Coachella Canal), and gave congressional consent to the Colorado River Compact. Apportioned the Lower Basin's 7.5 MAF among the states of Arizona (2.8 MAF), California (4.4 MAF), and Nevada (0.3 MAF). Provided that all users of Colorado River water stored in Lake Mead must enter into a contract with USBR for use of the water.
California Limitation Act	1929	Confirmed California's share of the 7.5 MAF Lower Basin allocation to 4.4 MAF annually, plus no more than half of any surplus waters.
California Seven-Party Agreement	1931	An agreement among seven California water agencies/districts to recommend to the Secretary of Interior how to divide use of California's apportionment among the California water users.
US-Mexican Water Treaty	1944	Apportions Mexico a supply of 1.5 MAF annually of Colorado River water, except under surplus or extraordinary drought conditions.
US Supreme Court Decree in Arizona v. California, et al.	1964, supplemented 1979	Rejected California's argument that Arizona's use of water from the Gila River, a Colorado River tributary, constituted use of its Colorado River apportionment. Ruled that Lower Basin states have a right to appropriate and use tributary flows before the tributary co-mingles with the Colorado River. Mandated the preparation of annual reports documenting the uses of water in the three Lower Basin states. Quantifies tribal water rights for specified tribes, including 131,400 afy for diversion in California. Quantified Colorado River mainstream present perfected rights in the Lower Basin states.
Colorado River Basin Project Act	1968	Authorized construction of the Central Arizona Project. Requires Secretary of the Interior to prepare long-range operating criteria for major Colorado River reservoirs.
Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs	1970, amended 2005	Provided for the coordinated operation of reservoirs in the Upper and Lower Basins and set conditions for water releases from Lake Powell and Lake Mead.
Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003	2003	Complex package of agreements that, in addition to many other important issues, further quantifies priorities established in the 1931 California Seven-Party Agreement and enables specified water transfers (such as the water conserved through lining of the All-American and Coachella canals to SDCWA) in California.

Source: Adapted from USBR 2008c

identifies impaired water bodies and establishes priorities for the protection of surface water quality.

Regional planning has been advanced by IRWM introduced by DWR and the State Water Board. Regional planning efforts bring together water supply, wastewater, flood control, and environmental stakeholders to identify water management challenges, reduce conflicts, and develop the region's diversified water management portfolios.

Flood Management

Flood Hazards

Flooding in the South Coast region is predominately from winter storms. Precipitation over short periods can produce large amounts of water in the steep upper watersheds, often leading to very sudden and severe flooding of developed lowland areas. Debris flows are also a common occurrence during the winter months. Seasonal fires denude the watersheds of their vegetation, and can leave steep terrain vulnerable to winter storms. Thunderstorms are infrequent in the region and typically only occur at lower elevations during the winter months. Very little snow makes its way into this region and therefore has a marginal impact on flood events.

Representative hazards currently facing the region are listed below (for specific instances, see Challenges).

- Some existing culverts and channels do not have sufficient capacity to carry flow resulting from the event having 1 percent probability of occurrence in any year.
- Flood infrastructure is aging, leading to deterioration and costly maintenance.
- Population growth and the ensuing development increase the area of impervious surface without sufficient mitigation, increasing peak runoff.
- Development occurs in the floodplain of the 1 percent event without sufficient mitigation, causing increased flood damage risk.
- Development has resulted in poorly placed, flood-vulnerable structures.
- Unmanaged vegetation has reduced flood flow capacity at some locations.
- Clogged rivers, channels, and conveyance structures exacerbate flood risk.
- Existing properties are vulnerable to uncontrolled hillside sheet flow.
- Reservoir siltation has reduced flood storage capacity.
- Some debris basins do not have adequate capacity to capture the anticipated mudflows.
- Some dams do not meet current State seismic, spillway or other structural requirements.
- Wildfires may denude steep slopes, which are then vulnerable to increased runoff and debris flow during ensuing storms.

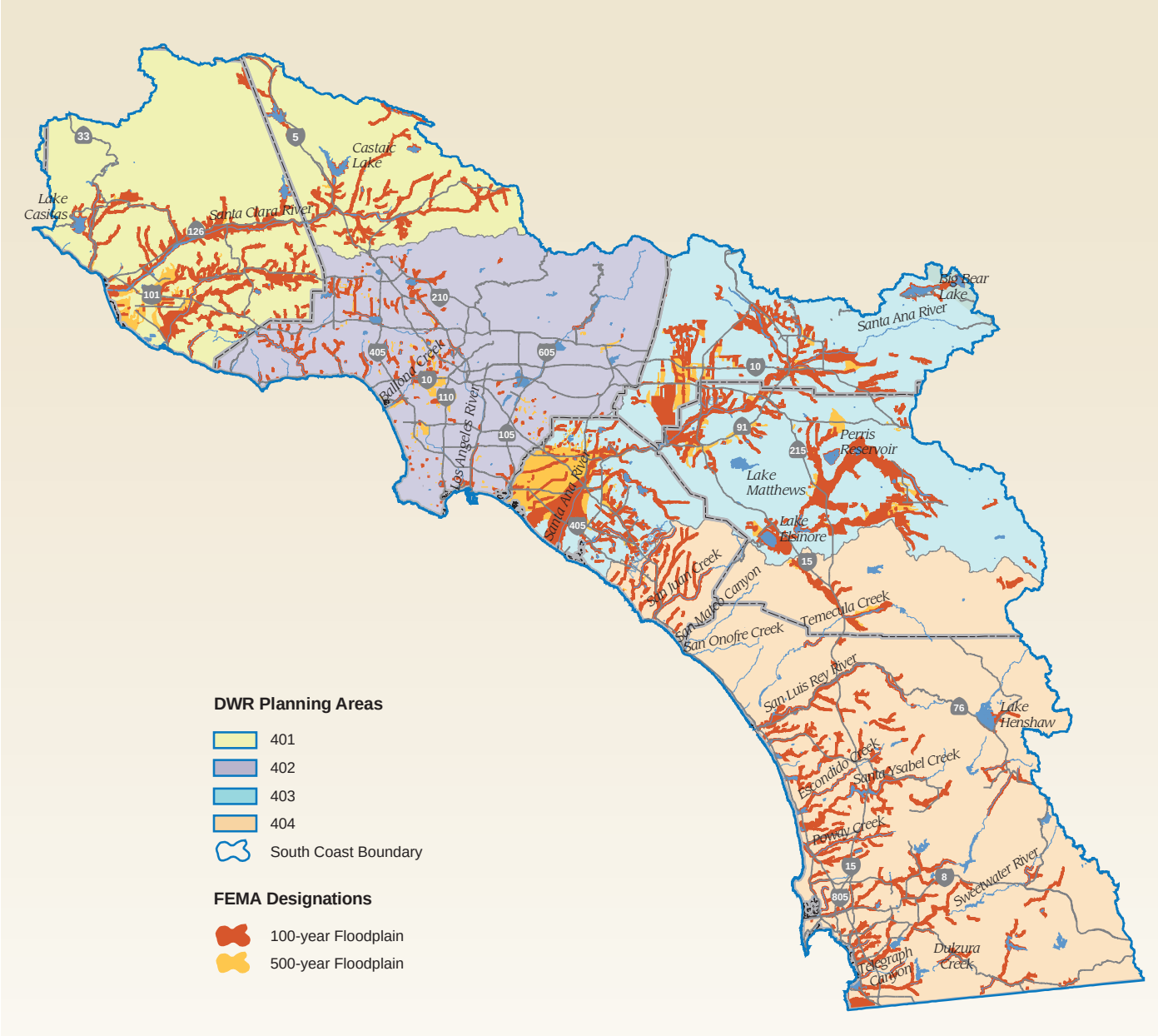
Figure SC-7 illustrates the 100- and 500-year floodplains identified by the Federal Emergency Management Agency (FEMA).

Historic Floods

The South Coast region has experienced many floods over the past 200 years. Significant floods occurred in 1810, 1861-62, 1884, 1914, 1916, 1925, 1928, 1938, 1969, 1978, 1980, and 1992.

The highest storm discharges on record have occurred on the Los Angeles River at Long Beach (128,700 cfs), the Santa Clara River at Montalvo (165,000 cfs), the Santa Ana River at Prado Dam (100,000 cfs), the San Diego River at Fashion Valley (75,000 cfs), and Sespe Creek near Fillmore (85,300 cfs).

Figure SC-7 FEMA floodplains in the South Coast region



For more information on these floods see Appendix A, Flood Management. Flood records for selected flood-producing streams are listed in Appendix A in Table SCA-1, Record floods for selected streams.

Flood Governance

Flood management is a cooperative effort in which federal, tribal, state, and local governments all play significant parts. The principal participants are listed in Box SC-3 Flood Management Agencies. For more information on the agencies' roles, see Table SCA-2, Flood management participants, in Appendix A.

Box SC-3 Flood Management Agencies

Federal

- Federal Emergency Management Agency
- National Weather Service
- Natural Resources Conservation Service
- US Geological Survey
- US Army Corps of Engineers

Tribal

- Tribal governments of the region

State

- California Conservation Corps
- California Emergency Management Agency
- Department of Corrections
- Department of Forestry and Fire Protection
- Department of Water Resources

Local

- Los Angeles County Department of Public Works—Watershed Management Division
- Los Angeles County Flood Control District
- Orange County Flood Control District
- Riverside County Flood Control and Water Conservation District
- San Bernardino County Flood Control District
- San Diego County Flood Control District
- Ventura County Watershed Protection District
- County and city emergency services units
- County and city planning departments
- County and city building departments
- Local flood maintenance organizations
- Local conservation corps
- Local emergency response agencies
- Local initial responders to emergencies

Flood Risk Management

Flood risk management includes a wide variety of projects and programs, which may be grouped as Structural Approaches (constructed facilities, coordination and reservoir operations, maintenance), Land Use Management (regulation, flood insurance), and Disaster Preparedness, Response, and Recovery (information and education, event management).

Structural Approaches

Constructed Facilities. The urban development that supports the South Coast's vast population produces many challenges for local flood control agencies. Flood control projects accommodate changing conditions by protecting life, property, public infrastructure, and watercourses from potential damage associated with storm flows and floods. County flood control districts in each of the six counties accomplish these goals through floodplain management, construction of flood control infrastructure, mapping, and development of flood control ordinances. Replenishment of local groundwater aquifers is also a major activity of the flood management agencies. Federal support for these efforts comes through project financing and construction by the US Army Corps of Engineers (USACE). Smaller watershed-related projects often have the support of Natural Resources Conservation Service (NRCS).

The South Coast region has one of the highest densities of flood control and water conservation structures in the state. Channels have been modified and realigned on many of the waterways to provide improved conveyance for floodflows. There is an extensive network of flood storage facilities throughout the region. Debris basins along many of the waterways provide protection against sedimentation, a major cause of flood damage. Many miles of levees provide flood protection to areas historically inundated by floodwaters.

The USACE Santa Clara River Project in the Santa Clara Planning Area includes levees on the Santa Clara River protecting Oxnard and Port Hueneme, and an improved channel on Santa Paula Creek at Santa Paula. Other USACE projects include levees on the Ventura River at Ventura and a debris basin and channel on Stewart Creek near Ojai. NRCS has provided construction funding for projects including a debris basin, spillways and channel work at Beardsley Wash and channel improvements on Revolon Slough, both in the Oxnard Plain and owned by Ventura County Watershed Management District; and sediment basins, debris dams, levees, channels, and spillways on Calleguas and Conejo creeks, Arroyo Simi, Arroyo Las Posas, and tributaries near Camarillo, Somis, Moorpark, and Simi Valley, all part of another project of Ventura County Watershed Management District.

In the Metropolitan Los Angeles Planning Area, the LACDPW, in cooperation with USACE, constructed one of the largest flood control projects ever built for a metropolitan area. The Los Angeles County Drainage Area Project includes 20 reservoirs, 90 debris basins, 458 miles of improved channels, and 1,424 separate storm drains. Included in the Los Angeles County Drainage Area (LACDA) project are the Sepulveda Dam on the Los Angeles River, Hansen Dam on Tujunga Wash, Santa Fe Dam on the San Gabriel River, Lopez Dam on Pacoima Wash, and the Whittier Narrows Dam on the San Gabriel River and Rio Hondo. Apart from LACDA, LACDPW also operates and maintains Big Dalton, Santa Anita, Big Tujunga, Cogswell, Devil's Gate, Live Oak, Eaton Wash, Pacoima, San Dimas, Puddingstone, Puddingstone Diversion, San Gabriel, and Thompson Creek reservoirs, all providing flood protection for the greater Los Angeles area.

USACE constructed conduit and channel at Kenter Canyon near Santa Monica. NRCS provided construction funding for many LADPW channel projects in the San Fernando Valley, including Aliso Creek, Arroyo Calabasas, Bell Creek, Browns Creek, Bull Creek, Limekiln Creek, Lower East Canyon, Santa Susana Creek, Upper East Canyon, and Wilbur Creek.

The USACE collaborated with the Orange County Flood Control District to develop major flood protection systems collectively called the Santa Ana River Basin and Orange County (SAROC) projects in the Santa Ana Planning Area. The SAROC projects include seven dams, one dam enlargement, ten channel modifications, three new channels, levees on five waterways, and bank protection. Dams include Brea and Fullerton protecting Fullerton, Prado and Seven Oaks protecting urban Orange County, and Carbon Canyon protecting Anaheim and Los Alamitos. USACE also constructed

San Antonio Dam, protecting the Ontario-Pomona area, and Orange County Flood Control District built Villa Park Dam for Orange County urban areas. SAROC also includes levees, improved channels, bypasses, debris basins, detention basins, groins, revetment, bank stabilization and floodplain management. Separately from SAROC, Riverside County Flood Control and Water Conservation District constructed, operates and maintains Allesandro, Box Springs, Harrison Street, Prenda, Sycamore, and Woodcrest dams to reduce flood risk in Riverside; and Pigeon Pass Dam to protect Moreno Valley. The City of Riverside contributed Mockingbird Dam. At Lake Elsinore, USACE constructed facilities to increase flood control storage in the lake.

USACE also constructed improved channels and a storage basin on Santiago Creek at Santa Ana and levees, an improved channel, and revetment on City Creek at San Bernardino.

In the San Diego Planning Area there is substantial investment in non-storage flood control projects. USACE has constructed levees or improved channels on the San Diego River, the Sweetwater River, and Rose Creek at San Diego, the San Luis Rey River in the San Luis Rey Valley, Los Coches Creek at Lakeside, and Telegraph Canyon Creek at Chula Vista. Internationally, a USACE project on the Tijuana River in the San Diego area protects property in Tijuana, Mexico. NRCS has provided construction funds for City of Vista channel improvements on Buena Vista Creek near Vista and a City of Escondido flood control reservoir and channels on Escondido Creek near Escondido.

Local sponsors and descriptions for reservoirs and non-storage flood control facilities in the region are listed in Appendix A in Table SCA-3, Flood control facilities. Also in Appendix A, Figure SCA-1 is a schematic of the LACDA project, and Figure SCA-2 depicts the SAROC projects.

Coordination and Reservoir Operations. There are no formal overall agreements for operation of flood protection facilities in the region. However, major drainage areas often drain separately to the ocean and are served by coordinated systems developed by USACE and a single local flood control entity. LADPW and USACE coordinate closely on the operation of the LACDA project and upstream reservoirs. Orange County Flood Control District and USACE also coordinate closely for operation of the SAROC system. In Riverside County, most flood control reservoirs are operated by a single agency, Riverside County Flood Control and Water Conservation District.

For most larger flood control reservoirs in California, USACE has participated with a federal contribution to the cost of the flood control space. Whether federally financed or not, the reserved space in multipurpose reservoirs is most often defined by a trapezoidal diagram of volume required versus date, modified by conditions in the latter part of flood season. Generally, the diagrams require a flood space reservation increasing from zero from the beginning of the flood season, invariant with date during mid-season, and decreasing to zero again at season's end. Superimposed on these diagrams are modifications based on either an antecedent precipitation index (API) or a runoff forecast. The index-controlled diagrams are usually decreased from the trapezoid and

shortened in time during drier years, beginning in mid-season. The runoff-controlled diagrams increase the trapezoid and extend it in time for the greater runoff forecasts. Single-purpose flood control reservoirs are kept as low as possible. For any reservoir, there are usually downstream controls of various kinds on evacuation rates.

For more information on flood control reservoirs, see Table SCA-3, Flood control facilities, in Appendix A.

Maintenance. Maintenance of flood control works is a critical activity which preserves the integrity of the facilities, ensuring continued protection for the public. This effort is made more difficult by two factors: (1) Lack of adequate financing for many installations is the result of tax-management efforts of the late 20th century that have placed controls on former sources of revenue, and (2) Heightened public awareness of the environment has resulted in new regulations making the permitting process lengthy and expensive. Compounding the problem, deferred maintenance can cause establishment of new habitat which then must be protected.

Maintenance of flood control facilities is usually the responsibility of the local maintaining agency, which is usually the local sponsor; or if there is none, the constructing agency. Most USACE projects are maintained by the sponsoring local maintenance agency, but dams in particular may be exceptions. In this region, Hansen Dam, Lopez Dam, Santa Fe Dam, Sepulveda Dam, Whittier Narrows Dam, Prado Dam, Carbon Canyon Dam, San Antonio Dam, and the international Tijuana River levees and channel improvements are maintained directly by the USACE. NRCS projects follow a pattern of close cooperation with a local sponsor, with NRCS providing maintenance standards and the local sponsor performing the maintenance. The local constructing agency maintains non-federal projects in this region.

Land Use Management

Regulation. Counties are the main agencies responsible for designating and regulating floodways. Land development within the floodplains of the South Coast is primarily regulated by local building codes, subdivision regulations, and zoning ordinances. These ordinances regulate development and construction within flood-prone areas to minimize losses due to flood events. Floodplain ordinances are one of the key legislative tools used to regulate development within floodplains in the South Coast region. All counties and many cities have adopted such ordinances to protect their communities from flood hazards. All local land use jurisdictions must adopt a floodplain management ordinance identifying 1 percent floodplains and floodways, in order to qualify for FEMA flood insurance.

Flood Insurance. The National Flood Insurance Program is administered by FEMA. It enables property owners in participating communities to purchase insurance as protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. About 97 percent of California communities participate in the National Flood Insurance Program. Of

those, approximately 12 percent participate in the Community Rating System (CRS) Program, which encourages communities to go beyond minimum program requirements in return for reduced insurance rates. Quality mapping is critical to administering an effective flood insurance program, developing hydrologic and hydraulic information for determining floodplain boundaries, and allocating flood protection project funds.

FEMA has provided Flood Insurance Rate Maps (FIRMs) for all areas within the region. CRS rates communities from 1 to 10 on the effectiveness of flood protection activities. The lower ratings bring larger discounts on flood insurance. Of the six counties and 179 cities in the hydrologic region, 5 counties and 17 cities participate in CRS. As of May 2009, Orange County, Huntington Beach, Long Beach, and Los Angeles are in Class 7; Los Angeles County, San Diego County, Anaheim, Fountain Valley, Irvine, Moreno Valley, Newport Beach, Oceanside, Poway, and San Juan Capistrano, Class 8; and Mission Viejo, Murrieta, Orange, Redlands, Santa Clarita, and Simi Valley, Class 9. See http://www.fema.gov/business/nfip/crs.shtm for more information on the CRS system.

Disaster Preparedness, Response, and Recovery

Information and Education. The California Data Exchange Center (CDEC) provides real-time and historical hydrometeorological data for hundreds of stations statewide, as well as real-time data on releases, spill rates, and elevations of many reservoirs. For this region, CDEC provides gage data from several federal, State, and local agencies, a total of 186 gages, and real-time flow and stage data for the Santa Clara, San Luis Rey, and San Diego rivers and Piru Creek. For access to CDEC data, see http://cdec.water.ca.gov.

The US Geological Survey maintains and publishes statistics for stream gages nationwide. USGS gages are the source of data for 28 of the 32 stations listed in Appendix A, Table SCA-1, Flood parameters for principal streams. For access to USGS gage data, see http://waterdata.usgs.gov/nwis.

DWR's Awareness Floodplain Mapping program provides an easy-to-use computer interface for viewing areas vulnerable to flooding by the flood event having a 1 percent probability of occurrence. The program applies to areas not already covered by FEMA Flood Insurance Rate Maps. For this region, maps have been drawn for all counties, but coverage of some areas may have been deferred. By 2015, all areas expected to develop over the next 25 years will have mapped floodplains.

Accurate hydrologic and hydraulic models inform the design of effective flood control structures and emergency actions before, during, and after floods. The National Weather Service's Advanced Hydrologic Prediction Service uses historical hydrologic data, current river and watershed conditions, and near-term meteorological outlooks to forecast river flows. The service is publicly available for certain streams of the South Coast region. Locations are given in Appendix A, Table SCA-5, AHPS stream forecast points.

Event Management. Under the Standardized Emergency Management System (SEMS) and the National Incident Management System (NIMS), initial flood emergency response is made by the responsible party at the site. When its resources are exhausted, the county emergency management organization (Operational Area) provides support. If necessary, additional support is coordinated by Southern Region or Inland Region of the California Emergency Management Agency (Cal EMA), formerly California Office of Emergency Services. Through the Cal EMA region and Cal EMA headquarters, help can be obtained from any State agency. Cal EMA coordinates with federal agencies and private organizations as well. The State-federal Flood Operations Center (a joint facility of DWR and the Sacramento Weather Office and California-Nevada River Forecast Center, both units of National Weather Service) is normally called early in the event to provide weather and river forecasts, facilitate information flow, provide field situation analysis, and give flood fight expertise. Severe situations that require Cal EMA involvement may also require emergency response by USACE, which is obtained by request of DWR. Table SCA-4, Flood emergency response organizations, in Appendix A, is a listing of specific response organizations.

Recovery after a flood event may involve the funding and construction services of USACE if the facilities are parts of federal projects. Availability of resources to repair local and private facilities; remove flood waters; and restore housing, businesses, and infrastructure often depends on the severity of the event and the allocation of event-specific federal or State funds.

Flood preparedness and mitigation efforts are promoted and funded by many organizations, including city and county governments, Cal EMA, DWR, National Weather Service, and USACE.

Relationship with Other Regions

The South Coast region is a major importer of water supplies from other regions both within and outside of the state. Because these supplies are vital to sustaining the South Coast region, local representatives work closely with other regions to ensure that their local resource needs are met while ensuring the reliability of supply to the South Coast region.

Within this region, water supply agencies have undertaken strategic regional planning to increase the reliability of local water supplies during normal and dry hydrologic conditions. This effort has resulted in the preparation and execution of water transfer and banking agreements both within and outside of the region. Outside of the South Coast region, environmental and water resource management in the Delta, Colorado River, and Owens River systems affect imported water supply reliability and quality. However, these inter-regional and inter-state linkages go well beyond direct water use. The overall planning direction (i.e., land use development patterns, economic drivers, agricultural production) established in other regions effect water resources available to the South

Coast. As a region dependent on others, the South Coast agencies recognize the need to invest in water management strategies in these other regions in order to provide coordinated benefits.

Sacramento-San Joaquin Delta

SWP contractors in the South Coast region—including Metropolitan, CLWA, San Bernardino Valley MWD, VCWPD, SGPWA, and San Gabriel Valley MWD—work with DWR to coordinate delivery of SWP supplies. Due to a series of short-term ecosystem collapses in 2007, including declines in native species and significant loss of habitat, Metropolitan also participates with DWR and other State, federal, and local agencies and environmental organizations in the development of the Bay-Delta Conservation Plan (BDCP). Metropolitan further maintains individual relationships with each of its 26 member agencies for sale and conveyance of SWP supplies, as well as adjacent agencies with which it has storage and transfer agreements (see discussion below).

Significant restrictions were placed on SWP pumping in accordance with the December 2007 federal court imposed interim rules to protect the Delta smelt (*Hypomesus transpacificus*). Additionally, the inherent annual variability in location, timing, and amount of precipitation in California introduces uncertainty to the availability of future SWP deliveries. In June 2008, the Governor issued Executive Order S-06-08 declaring a statewide drought, which directed State agencies and departments to take immediate action to address serious drought conditions and water delivery reductions. Solutions developed to address environmental and drought-related concerns, including conservation and restoration efforts associated with the BDCP, will continue to impact future SWP exports. Other important factors that impact supply reliability include the vulnerability of Delta levees to failure due to floods and earthquakes, as well as long-term management and maintenance of SWP conveyance infrastructure. As the regional SWP wholesaler, Metropolitan is continuing to develop closer relationships with DWR and other State agencies to deal with fundamental Delta issues including environmental protection and levee rehabilitation.

Colorado River System

Metropolitan and USBR have been working together for many decades to manage Colorado River deliveries, including drought allocation planning and salinity management. Allocations and diversions of Colorado River water function within the legal and administrative rules known as the "Law of the River" (see Table SC-4). With full implementation of the programs identified in the QSA, Metropolitan expects to be able to annually divert 852,000 acre-feet of Colorado River water plus any unused agricultural water that may be available. With continuation of the current drought, however, the South Coast's reliance on diversions of excess Colorado River water (such as wet-year flows and allocated but unused supplies) will place substantial pressure on regional water availability.

Metropolitan will continue to collaborate with USBR to ensure the reliability and quality of Colorado River supplies. Although agricultural water conservation and transfer agreements (described below) will increase the volume of water available to the South Coast region via the CRA, further development of local supplies will be necessary to defend against future shortages.

Owens Valley and Mono Basin

In 1991, LADWP entered into the Inyo/Los Angeles Long Term Water Agreement to address impacts from groundwater pumping in the Owens Valley. In 1994, the State Water Board ruled on decision 1631, restricting exports from the Mono Basin to protect the basin and the tributaries feeding into Mono Lake. As a result of these measures and other commitments to protecting and enhancing the environment, approximately half of the historical average annual LAA supplies are being diverted for environmental enhancement projects.

The Lower Owens River Project, considered one of the most ambitious river restoration projects in the West, is in operation with 62 miles of the Lower Owens River having been rewatered. LADWP is working with Inyo County and other stakeholders on numerous restoration projects, including instream flow management in Rush, Lee Vining, Walker, and Parker creeks, restoration of Mono Lake water surface elevation, riparian restoration on the Upper Owens River, Convict, Mammoth, and McGee creeks, and dust mitigation measures on the Owens Lake bed.

Other Water Storage and Transfers

South Coast agencies continue to build relationships with other areas of the state via various storage and transfer programs. Under many of the storage and exchange agreements, imported water supplies are banked in groundwater aquifers in neighboring regions. These agreements are an essential component of the region's overall strategic planning to meet peak demand during the dry season.

Metropolitan has agreements with the Semitropic and Arvin-Edison Water Storage Districts which can result in the delivery of 197,000 acre-feet to Metropolitan over a 10-month period. Metropolitan can store portions of its SWP entitlements in the groundwater basins managed by these agencies during wet hydrologic conditions and retrieve the supplies when conditions are dry. Metropolitan's program with the San Bernardino Valley MWD yields between 20,000-80,000 acre-feet during dry years and permits Metropolitan to store up to 50,000 acre-feet of transfer water supplies in its groundwater basin. Metropolitan's programs with the Kern-Delta Water District and Mojave Water District operate in a similar manner. Dry-year yields for Metropolitan are 50,000 acre-feet and 35,000 acre-feet, respectively.

Some excess floodwater can be routed into the California Aqueduct through the Kern River Intertie. This water is transported from the Tulare Lake Hydrologic Region to the

South Coast Hydrologic Region for water supply. Quantities are limited by the flow capability of the aqueduct and by available space in the SWP reservoirs in Southern California.

In addition to exchange agreements, Metropolitan is partnering with the Coachella Valley Water District (CVWD) and Desert Water Agency on an advance delivery agreement. The agreement allows Metropolitan to deliver exchange water in advance of receiving CVWD's and Desert Water Agency's SWP water. Metropolitan releases Colorado River water into the Whitewater River in Riverside which flows into the Coachella Valley and deep percolates in the groundwater basin. During dry hydrologic conditions, Metropolitan can take the CRA and SWP supplies for its partners until the banked water supplies are used. Through 2004, 177,400 acre-feet was banked in the groundwater basin.

CLWA has executed a long-term transfer agreement for 11,000 acre-feet per year with the Buena Vista and Rosedale-Rio Bravo water storage districts (WSD). These two districts, both in Kern County, joined to develop a program that provides a firm water supply and a water banking component. The supply is based on existing long-standing Kern River water rights, which would be delivered by exchange of SWP supplies.

In 1998, SDCWA entered into a transfer agreement with IID to purchase conserved agricultural water. Through the agreement, SDCWA will receive an annually increasing volume up to 200,000 acre-feet by 2021. The volume then remains fixed for the duration of the 75-year agreement.

In 2003, the QSA resulted in the movement of supplies between the Colorado River and South Coast regions. SDCWA was assigned rights to 77,000 acre-feet per year of water that will be conserved through lining of the All-American and Coachella canals in Imperial County. Another 16,000 acre-feet per year of water conserved with the lining of the All-American Canal will go the San Luis Rey Indian Water Rights Settlement Parties.

Regional Water and Flood Planning and Management

Integrated Regional Water Management

The IRWM Planning Act, signed by the Governor as part of SB 1 in 2008 (CWC Sec 10530 et seq), provides a general definition of an IRWM plan as well as guidance to DWR as to what IRWM program guidelines must contain. The Act states that the guidelines shall include standards for identifying a region for the purposes of developing or modifying an IRWM plan. The first regional acceptance process (RAP) spanned 2008-2009. Final decisions were released in fall 2009. The region acceptance process is used to evaluate and accept an IRWM region into the IRWM grant program. See

Figure SC-8 for map for regions in the South Coast Hydrologic Region's three funding areas: Los Angeles-Ventura, Santa Ana, and San Diego. Find more information on the DWR IRWM Web site: http://www.water.ca.gov/irwm/integregio_rap_summary2.cfm.

See Appendix A for discussion of flood control in the region's IRWM plans. The South Coast region implements to some extent nearly all of the resource management strategies in the Water Plan's Volume 2. Some regional projects in the South Coast region are highlighted here.

Los Angeles Subregion

Calleguas Regional Salinity Management Project. The Calleguas Regional Salinity Management Project (SMP) is a regional pipeline that will collect salty water generated by groundwater desalting facilities and excess recycled water and convey that water for reuse elsewhere. Any unused salty water will be safely discharged to the ocean, where natural salt levels are much higher. The SMP will improve water supply reliability by facilitating the development of up to 40,000 acre feet of new, local water supplies each year and expanding the distribution and use of recycled water from areas with abundant supplies to areas of need.

***Arundo* Removal.** *Arundo* (giant reed) removal projects have been completed in several watersheds in Ventura County and in the San Gabriel Valley of Los Angeles County. The objectives of removing the non-native invasive giant reed are to restore biological habitat, reduce flood hazards, reduce fire risks, improve water quality, and enhance water supply reliability and groundwater recharge.

Las Virgenes Creek Restoration. More than 1,500 tons of concrete and other non-native material were removed from a portion of the creek between Highway 101 and the Agoura Road Bridge. Native vegetation was planted where litter used to accumulate on concrete, and a walkway and gazebo were built along the creek's bank.

Joint Water Pollution Control Plant Marshland Enhancement (Bixby Marshland). Marshland conditions before restoration and enhancement included stagnant water pools and an abundance of non-native plants. A viewing and educational area was added to the marshland to provide the public with the opportunity to enjoy this green gem set amidst an industrial area. Open water pools were added to the marshland, which is located on the Pacific Flyway, to increase the habitat value for birds.

Santa Ana Subregion

Arlington Desalter. The Arlington Desalter, operated by Western Municipal Water District and constructed by the Santa Ana Watershed Project Authority in 1989, was the first operating groundwater desalter in the Upper Santa Ana River Watershed.

Orange County Groundwater Replenishment System. Orange County Groundwater Replenishment System produces 70 million gallons per day (MGD) of highly treated wastewater for groundwater recharge and a seawater intrusion barrier. Located in the lower Santa Ana River Watershed, it is one of the largest water reclamation facilities west of the Mississippi River.

Solar Array at RP-5 WWTP. The solar array at RP-5 WWTP, operated by Inland Empire Utilities Agency, produces 1 megawatt of power and is an example of sustainability efforts in the Santa Ana River Watershed.

San Diego Subregion

Tri-County Funding Area Coordinating Committee. The Upper Santa Margarita Regional Watershed Management Group (RWMG), San Diego RWMG, and South Orange County RWMG collaborate in the San Diego Funding Area through a joint Memorandum of Understanding that established the inter-regional body known as the Tri-County Funding Area Coordinating Committee (Tri- County FACC). The group is enthusiastically working together on common and long-term water quality issues and aim to improve planning across regional boundaries and identify opportunities to support common goals and projects. One example of this partnership is the Stormwater Monitoring Coalition, which enables the Tri-County FACC members to jointly address water quality concerns.

El Monte Valley Groundwater Recharge and River Restoration Project. The El Monte Valley Groundwater Recharge and River Restoration Project will recharge the El Monte Valley Basin using highly treated recycled water, raise the groundwater level to support habitat restoration, and subsequently withdraw up to 2,240 AFY of groundwater to supply the R.M. Levy Water Treatment Plant.

Carlsbad Desalination Project Local Conveyance. The Carlsbad Desalination Project Local Conveyance project will provide 56,000 acre-feet per year of new water supply for the San Diego region through the design and construction of pipelines and facilities to serve local desalinated water from the Carlsbad Desalination Plant to Water Authority member agencies, including Carlsbad Municipal Water District, City of Oceanside, Olivenhain Municipal Water District, Vallecitos Water District, Vista Irrigation District, and Santa Fe Irrigation District.

Santa Margarita Conjunctive Use Project. The Santa Margarita Conjunctive Use Project provides for enhanced recharge of the groundwater basin underlying US Marine Corps Base Camp Pendleton in northern San Diego County. The project also includes a seawater intrusion barrier using recycled water, a distribution system, and advanced water treatment facilities. This project will provide a water supply for both Camp Pendleton and Fallbrook as resolution of a long-standing water rights dispute.

Accomplishments

The South Coast has a long history of regional water management and planning that has helped form the backbone of its current system. As the state's water resources continue to become more precious, the South Coast has continued to make significant regional accomplishments. These include the following.

Integrating Water Management Efforts. Recent developments in IRWM planning and collaboration have expanded the development of strategic, multi-benefit projects that meet regional water demands, improve water quality, and enhance environmental functions. Coordination of numerous stakeholders in development of the IRWM plans has been one of the biggest successes in the region. As a result, South Coast agencies acquired $135 million in Proposition 50 grant funding for local water resources projects.

Diversifying Supplies. The South Coast has succeeded in diversifying its water supply sources over the last decade. Environmental and drought concerns have reduced imported water supplies, while local agencies have expanded local groundwater production, water recycling, and surface storage. Water transfers, banking, and conservation programs have further contributed to supply reliability.

Reducing Water Demands. DWR, State Water Board, and USBR are making major statewide investments in urban and agricultural water conservation programs, which regional and local agencies leverage with their own investments to reduce demands. Metropolitan and its member agencies have developed a robust interregional water conservation and efficiency program, and the CCP further assists member agencies in pursuing urban BMPs and other demand management opportunities. The 2007 Blueprint for Water Conservation was a San Diego regional partnership for increasing conservation. In tandem with these urban conservation efforts, Metropolitan and IID entered into an agricultural water savings program. In August 2008, the City of Los Angeles amended its conservation ordinance by expanding the prohibited uses of water and curtailing outdoor irrigation in conservation phases based on reduced water supply conditions.

Increasing Local Surface Storage. South Coast agencies are developing partnerships for reservoir construction, reoperation, and maintenance in order to meet water demands. The Carryover Storage and San Vicente Dam Raise project is a joint project by SDCWA and the City of San Diego to raise the existing dam at San Vicente Reservoir to provide additional capacity.

Replenishing Groundwater. A groundwater conjunctive use program is a storage program to provide dry-year yield. Fourteen conjunctive use programs are implemented by local water agencies. Metropolitan has 10 conjunctive use programs within its service area.

Eleven dams were constructed as part of the San Gabriel River and Montebello Forebay water conservation system to impound storm water runoff for groundwater

recharge. The Vern Freeman Diversion and Pumping Trough Pipeline in Ventura County provides a means to capture high flows in the Santa Clara River and provide recharge to groundwater basins on the Oxnard Plain.

Desalting Brackish Supplies. Nineteen brackish groundwater recovery programs are being implemented in the region. Some of these programs have multiple facilities in operations. The Calleguas MWD Salinity Management Project is a 35-mile brine pipeline that provides disposal of tertiary treated effluent for five WWTPs and brine disposal for seven groundwater desalters. SAWPA's 30-MGD capacity SARI pipeline conveys desalter brine to Orange County Sanitation District for treatment and then discharges to the ocean. Further, several agencies within the South Coast are pursuing design, engineering, and environmental review for seawater desalination facilities.

Recycling Water. Progress continues on the start-up or augmentation of water recycling programs in the region. The Inland Empire Utilities Agency (IEUA) has completed and is on track in implementing a five-year business plan to expand the use of recycled water supplies within its service area to 50,000 acre-feet per year by 2015 (70,000 acre-feet per year by 2025). West Basin MWD's Edward Little Water Recycling Facility in El Segundo recently completed its Phase IV Expansion, which increased production of recycled water. LADWP has begun development of a Recycled Water Master Plan to expand its existing recycled water deliveries for an estimated $1 billion in construction cost. Irvine Ranch Water District (IRWD) is planning for expansion of its recycled water treatment and delivery system to meet expected recycled water demand at buildout. Further, IPR is being pioneered through various groundwater recharge and reservoir augmentation projects—the San Diego City Council recently authorized a demonstration IPR/reservoir augmentation project.

Controlling NPS Pollution. Local agencies are continuing to collaborate with Regional Water Boards on NPS pollution prevention, including development of public outreach campaigns to reduce pollutant loading as well as LID for more sustainable storm water management.

Hazard Mitigation Plans. The federal Disaster Mitigation Act of 2000 amended existing law with regards to hazard mitigation planning. The Act emphasizes pre-disaster mitigation and mitigation planning. In order to receive federal hazard mitigation funds in the future, all local jurisdictions must now adopt a hazard mitigation plan identifying hazards, risks, mitigation actions and priority and providing technical support for those efforts. Between 2004 and 2007, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, and Ventura counties adopted hazard mitigation plans and subsequently received Cal EMA approval.

Challenges

With the South Coast region, population growth, water supply availability and reliability, water quality, and drought will continue to be key issues for the future.

Resource Development. Water districts throughout the South Coast are engaged in integrated urban water management and groundwater planning. Decisions regarding development and expansion of other water supplies, such as recycled water and ocean desalination, will require more rigorous analysis of costs and tradeoffs between options.

Drought. Drought is a constant concern for water districts in the South Coast region. A drought simulation developed by Harding et al. (1995) indicated that, under current management practices, a severe sustained drought would heavily impact the Colorado River. In some months, stretches of river would be completely dry in order to maintain reservoir storage elsewhere in the system. Potential repercussions of drought on imported water supply reliability have led to an emphasis on the development of local supplies and implementation of demand management strategies. Further, given the uncertainty of water imports in the future, local agencies are aggressively developing local alternatives and transfer agreements.

Climate Change. Climate change is expected to impact the South Coast region through changes in Statewide precipitation and surface runoff volume. More extreme storm events may exceed reservoir storage capacity and therefore result in allocated water supplies discharged to the ocean. Sea level rise may impact local aquifers and Delta water quality through seawater intrusion, as well as impact local coastal water and wastewater infrastructure. All of these uncertainties related to climate change could potentially reduce delivery of imported supplies and the ability of local agencies to meet South Coast water demand.

Sustainability. With the recognition that water resources management is a major component to sustainable development for the State, an overarching emphasis must be placed on the concept of integration in all water resource planning efforts. As water supply development is considered, the energy and greenhouse gas emission impacts must be addressed to assure that proposed water development projects are sustainable for the future.

Environmental Concerns in Delta. Uncertainty about the availability of imported water supplies from the Delta through the SWP is of primary concern to the South Coast region. A federal court found that a 2004 biological opinion by the USFWS does not adequately protect sensitive fish populations when authorizing long-term operations of the State and federal water projects. Further, significant restrictions were placed on SWP and Central Valley Project pumping in accordance with the December 2007 federal court imposed interim rules to protect the Delta smelt (*Hypomesus transpacificus*). Metropolitan and other stakeholders are reviewing the impact of the ruling and possible future solutions.

Groundwater Overdraft. Groundwater overdraft and lower groundwater levels are further water supply challenges to the region. Historically, agricultural, industrial, and urban development has led to increased groundwater pumping from many of the region's basins. Natural recharge is typically insufficient to maintain basin water levels

and current pumping levels due to the extent of impervious surfaces and the presence of clay soils. In some basins, over-extraction of groundwater has caused lowering of groundwater tables and seawater intrusion, contributed to land subsidence, and resulted in legal solutions, adjudication, to resolve disputes over pumping rights within specific basins.

Runoff Management. Surface water quality issues in the region are dominated by storm water and urban runoff, which contribute contaminants to local creeks and rivers, lagoons, beaches, and bays. Shipping can also influence water quality, especially in San Diego Bay and the Long Beach and Los Angeles harbors, where there are toxic sediment hot spots. The Chino Basin faces substantial nutrient loading impacts from dairy farming, thereby impacting groundwater quality and downstream Santa Ana River quality.

Salinity. Salinity in both local and imported supplies will continue to be a challenge for local water agencies. Salinity sources in local groundwater supplies include concentration from agricultural tailwater, imported water, seawater intrusion, discharge of treated wastewater, and recycled water. Higher levels of treatment are also needed following long-range import of water supplies, as TDS levels are increased during conveyance. High salinity levels and perchlorate contamination contribute to degraded Colorado River supplies. Seawater intrusion and agricultural drainage threatens to increase the salinity of SWP supplies. The long-term salt balance of the region's groundwater basins is an increasingly critical management issue. Abandoned groundwater basins, due to high salinity levels, have only recently been restored through brackish water desalting projects.

Water Recycling. With its expansion of water recycling programs, the region continues to work to address issues related to TDS levels and constituents of emerging concern like pharmaceuticals, household products, and other products in treated wastewater that are not known to be harmful or are not regulated. The high salinity of imported Colorado River water limits the number of times water can be reused and wastewater can only be discharged to the ocean. Additionally, some inland water districts that use recycled water also have salt accumulation problems in their groundwater basins because they lack an ocean outfall or stream discharge.

Flood Control Infrastructure. Major challenges include maintenance of 100-year flood protection where it has been provided throughout the South Coast in light of continued urbanization and climate change. Major flood control projects in the Los Angeles, San Gabriel, and Santa Ana areas are threatened as urbanization in the upper watersheds adds to storm volumes. Local funding for flood maintenance and construction projects has become less effective in recent years because of several factors: Laws enacted in response to heightened public awareness of the need to protect the environment have increased the cost of upkeep and improvement; concern for endangered species has made scheduling more complex; both environmental and endangered species conditions have made permits more difficult to obtain; measures to reduce taxation, especially

on property, have rendered revenue increases difficult to achieve, and inflation has increased costs. Meeting the requirements of these new restraints has become a high-profile local challenge. Concerns related to funding include invasive species, sediment in channels and reservoirs, decreasing levels of protection as runoff rates increase with urbanization and climate change, aging infrastructure, structural deficiencies of dams, and debris basins that are too small. Finally, adequate evaluation is needed of the long-term secondary impacts of environmental enhancements proposed for integration into flood control projects.

Water Costs. SWP contractors pay for the cost of constructing and operating facilities which store and convey SWP water supply, plus a transportation charge which covers the cost of delivery facilities. Thus, contractors in the South Coast pay higher transportation charges than those near the Delta. Metropolitan's 2009 Tier 1 rates for treated water total $579 per acre-foot and recovers the costs of purchasing, pumping, and delivering SWP and CRA supplies, as well as a surcharge for purchase of additional water transfers.

Local Flooding Impacts. Recurrent flooding is a problem in many places in the South Coast region. At many locations, lives, homes, business, farm lands, and infrastructure are frequently at risk. Providing better protection for lives and property remains the definitive flood management challenge. Solutions may range from governmental regulation of occupancy and building in flood-prone areas through local or watershed-based non-structural measures to infrastructure such as levees and reservoirs, constructed with consideration of environmental needs. Development of a discharge-based standard, such as protection from the flood having a 0.5 percent, 1 percent, or 2 percent probability of occurrence (or such a standard in conjunction with land use type or other pertinent factor) would facilitate equitable distribution of State and federal support funding.

San Jacinto River. Excessive sedimentation in the San Jacinto River causes breaching onto agricultural lands in the "gap" area of the river. There are many challenges in the Upper San Jacinto Watershed area with flooding along the San Jacinto gap area. Initial feasibility studies have been completed. Additional studies will be needed to resolve this major flooding issue.

Effects of Urbanization. Throughout the state, including this region, urbanization continues. It brings greater runoff due to increases of impervious area making retention of flood protection levels a challenging issue. Urbanization often causes increases in erosion and sedimentation. Construction of flood infrastructure or changes in land use may cause subsequent undesirable vegetation growth, whether of native or invasive species. Regulation of occupancy and land use is critical for reducing the number and severity of flood damage occurrences in an era of population growth. In this region, hillside flooding and flooding of developed low areas are special concerns, as is flooding in disadvantaged communities. Increased agricultural activity, an adjunct of population growth, may also increase erosion. Another particular concern in this region is flash flooding from steep watersheds, which has increasing impact as the population grows.

Preparedness for and Response to Flood Events. Effective preparedness for flood events depends on accurate evaluation of the risk, adequate measures for mitigation of flood damage, sufficient preparation for response and recovery activities and coordination among local, State, and federal agencies. Completion of floodplain mapping, both the FEMA Flood Insurance Rate Maps and the State's complementary Awareness Floodplain Mapping, will provide much needed information for evaluating flood risk. Mitigation may take many forms, including restriction of use, floodproofing, or structural protection of vulnerable sites. Some actions that help meet the challenge of response and recovery preparedness are organization for emergency management, formal agreement on responsibilities for emergency actions and funding, and use of warning systems.

Debris Flows. Wildfires may denude steep erodible slopes in canyons and upland areas above urban development below. Ensuing winter rains may threaten these areas not only with high water, but also with debris flows. In these situations, flooding may cause greatly increased damages to structures and other installations and may leave large amounts of sediment and other detritus.

Storm Water Capture. The region's flood control systems are designed to quickly move storm flow through to the ocean. Managing these systems to retain flows to recharge aquifers where soft channel bottoms exist or diverting flow to off channel recharge basins provides an opportunity to enhance the supply of local water.

Invasive Species. Invasive species disrupt natural ecosystems by competing with native flora for limited resources and generally providing poor quality habitat for native fauna. The removal of Arundo and other invasive species offers numerous direct and indirect benefits to landowners, land managers, public agencies, and other Watershed residents. These benefits include reduction in risk of flooding and fire, improvements in water quality, increased water conservation, and restoration of habitat for native species, including several threatened and endangered species.

Drought and Flood Planning

The South Coast region is subject to severe repercussions from extreme weather events. Drought conditions both within and outside of the region can substantially limit water availability to urban and agricultural users. In contrast, extreme precipitation events can result in sudden and severe flooding and mud flows. This unusual paradox of concurrent drought and flooding is being addressed by the South Coast region's integrated regional planning efforts.

Drought Planning

Drought planning in the South Coast region is being conducted in coordination with State agencies, per the Governor's Executive Order S-06-08 declaring a statewide drought. Metropolitan's Water Supply Allocation Plan (2007) provides a formula and implementation plan for equitable regional allocation of water supplies during times

of shortage. The objectives, mechanics, and policy aspects of the Allocation Plan were developed in coordination with member agencies.

In 2007, SDCWA adopted a Drought Management Plan that outlined a series of potential actions to take when faced with a shortage of imported water supplies from Metropolitan due to drought conditions. Further, SDCWA adopted a model Drought Response Ordinance in March 2008. A Drought Management Committee has been formed in the Upper Santa Clara watershed to address the need to comprehensively respond to the current drought. Water agencies and cities within Ventura County are working together to coordinate their disaster and drought preparedness efforts.

In 2008, LADWP developed a Water Supply Action Plan for creating sustainable sources of water for the future demands of Los Angeles. As a result of water shortages, Los Angeles implemented Phase III of its Emergency Water Conservation Plan Ordinance, which added restrictions on outdoor water use to existing prohibitions on water waste.

Flood Planning

Most flood control districts in the South Coast region incorporate flood planning as a component in their flood management strategy. As described above, regional flood protection is sustained through an extensive network of flood control reservoirs, debris basins, flood channels, and levees; land use regulations, flood forecasting, and SEMS; and flood insurance. All counties in the region use the Automated Local Evaluation in Real Time (ALERT) system to notify the public of impending flood hazards. The Disaster Mitigation Act of 2000 required development of Hazard Mitigation Plans, which emphasize community partnerships in planning for and responding to disasters; assessing strategies for reducing risks; and identifying capabilities and resources for addressing various hazards. Each county in the South Coast region has an adopted Hazard Mitigation Plan.

Several other groups in the South Coast are addressing flood management programs and issues at the local level. VCWPD staff is looking into an integrated surface water and groundwater model of the entire county as an element of the IRWM Plan. The model would facilitate implementation of real-time flood forecasting, alert emergency personnel on impending floodflows, and calculate the water budget for all of the county's rivers/creeks and aquifers.

All counties in this region have adopted hazard mitigation plans. For more information, see "Challenges" in this report.

FloodSAFE is a DWR strategic initiative that seeks a sustainable integrated flood management and emergency response system throughout California that improves public safety, protects and enhances environmental and cultural resources, and supports economic growth by reducing the probability of destructive floods, promoting beneficial floodplain processes, and lowering the damages caused by flooding. FloodSAFE is

guiding development of regional flood management plans. These plans will encourage regional cooperation in identifying and addressing flood hazards, and will include flood-hazard identification, risk analyses, review of existing measures, and identification of potential projects and funding strategies. The plans will emphasize multiple objectives, system resiliency, and compatibility with State goals and IRWM plans.

Looking to the Future

With a growing population, drought conditions in many parts of the West, and an aging infrastructure system, water resource managers will be focusing on three important areas: protection of imported water supplies; increased development of local water resources; and creation of integrated flood control projects.

Protection of Imported Supplies. Protection of imported water supplies is essential for South Coast agencies. Continued partnerships with DWR, USBR, and other State and regional agencies are necessary to ensure that the Delta, Colorado River basin, and Owens Valley ecosystems are managed in such a way that allows for successful allocation of water supplies. Effective salinity and water quality management will also be necessary to ensure that imported supplies are usable. Further, South Coast agencies are moving forward with plans to operate conjunctive use programs in local groundwater basins. South Coast water agencies are storing discount-priced imported water during winter months into groundwater basins and increasing their groundwater use during summer and drought periods.

Development of Local Supplies. Due to uncertainties related to imported supplies, South Coast agencies are also aggressively pursuing development of local supplies. In 2002 and again in 2006, California's voters approved water bond packages to help address the state's water crisis and ensure clean, safe water for generations to come. Funding from these bonds will support a variety of local water management efforts including implementation of water conservation programs, expansion of water reclamation plants and conveyance systems, construction of desalination facilities, and restoration of streams, wetlands, and lagoons. Metropolitan and five member agencies are planning for the potential development of up to 300 MGD of desalinated seawater. Further, the Southern California Water Recycling Initiative—a joint effort by DWR, USBR, and 10 local agencies—will continue a multi-year planning study that evaluates the feasibility of a regional water-recycling plan and identifies short-term projects to increase recycled water supplies. The initiative projects recycled water demand to increase between 615,700 acre-feet in moderate reuse conditions and 1.0 million acre-feet under maximum reuse conditions by 2040.

Desalination Projects. Brackish groundwater and ocean desalination will likely serve an important role in the solution to southern California's water supply shortfall. In the Santa Clara Planning Area, the Calleguas MWD Salinity Management Project serves as a regional conveyance facility that moves saline water from areas where it is a nuisance

to areas where it can be an asset for salt tolerant crops and wetlands restoration (see earlier discussion under Integrated Regional Water Management).

There are proposals for a number of desalination projects in the Metropolitan Los Angeles Planning Area. West Basin MWD is proposing to co-locate a 20 MGD desalination plant at the El Segundo Power Plant in El Segundo. The district has operated a 40 gallons-per-minute pilot plant and was awarded Proposition 50 grant funding to build a 0.5 MGD demonstration facility in May 2005 (WBMWD 2005). The Long Beach Water Department is considering a 9 MGD seawater desalination plant in Long Beach. The department, in partnership with LADWP and USBR, began operating a 0.30 MGD prototype plant at the Haynes Generating Station in early 2006. Operation of the full-scale facility is expected to commence no earlier than 2015 if the project proves to be economically, technically, and environmentally feasible (LBWD 2005b).

Poseidon Resources is proposing to co-locate a 50 MGD seawater desalination plant with the AES Power Plant in Huntington Beach. Municipal Water District of Orange County (MWDOC) is also considering building a 25 MGD seawater desalination plant in Dana Point.

SDCWA and MWDOC are considering building a 50- to 100-MGD seawater desalination plant at Camp Pendleton, using the intake and outfall structure from Unit 1 of the San Onofre Nuclear Generating Station, which is being decommissioned. A public-private partnership between the City of Carlsbad and Poseidon Resources, the 50-MGD seawater desalination plant at the Encina Power Station in Carlsbad will begin construction in 2009 and be on line by 2011. Nine water agencies have entered into long-term water purchase agreements with the Carlsbad desalination plant (Poseidon Resources 2008).

Creation of Integrated Flood Control Projects. The South Coast will continue pursuing development of integrated projects that achieve flood management, improve runoff water quality, and protect environmental resources. Flood control reservoirs are becoming valuable for their potential to provide all three benefits, as well as water supply benefits through reoperation to enhance groundwater recharge. LACDPW is completing a study, in cooperation with the USACE, to reauthorize four USACE flood control facilities in Los Angeles County for the purpose of capturing storm water and then slowly releasing the water to downstream groundwater recharge facilities after storm events. The Water Augmentation Study is a long-term research project led by the Los Angeles and San Gabriel Rivers Watershed Council to explore the challenge of capturing storm water for infiltration, in terms of groundwater quality and quantity.

Most of the South Coast's future supply projects will be designed to improve water quality as the means to develop new water supplies. These include watershed protection activities, groundwater desalination, use of highly treated recycled water, reduction of sewage spills and storm water runoff through water conservation, and surface and groundwater storage projects that implement blending and treatment strategies to reduce

contaminants in treated drinking water supplies. Ground and surface water treatment and reuse are the future of water management in the South Coast.

Climate Change

Climate change is expected to impact the South Coast region through changes in statewide precipitation and surface runoff volumes, and therefore availability of local surface and imported water supplies. Additionally, sea level rise is expected to degrade Delta water quality and impact coastal water and wastewater infrastructure, requiring substantial capital investments by local agencies. All of these uncertainties related to climate change could potentially reduce the ability of local agencies to meet South Coast water demand.

Model simulations using the Intergovernmental Panel on Climate Change's 21st century climate scenarios suggest increasing temperatures in California, with greater increases in the summer (Cayan 2008). Changes in annual precipitation across California may result in changes to surface runoff timing, volume, and form. By the end of the century, the Sierra Nevada snowpack is expected to decline as warmer temperatures raise the elevation of snow levels, reduce spring snowmelt, and increase winter runoff. Locally, climate change is expected to result in hotter summer months and more extreme winter storms. Winter runoff may result in flashier flood hazards, with flows potentially exceeding reservoir storage capacity and resulting in discharges to the ocean. Higher flow volumes may scour stream and flood control channels, degrading aquatic and riparian habitats already impacted by shifts in climate. Further, hotter summer temperatures would increase wildfire hazards in the arid South Coast region. Additionally, changes in climate and runoff patterns may create competition between sectors. The agricultural industry's demand could increase due to higher evapotranspiration rates caused by increased temperatures. Environmental water supplies would need to be retained in reservoirs for management of instream flows necessary to maintain habitat for aquatic species throughout the dry season. For the South Coast, this would likely result in reduced supplies available for import through the SWP during the non-winter months (California Climate Change Portal 2008; Cayan 2008; Hayhoe 2004).

LADWP has initiated a climate change study to evaluate the effects of climate change on the LAA watershed. This study will identify possible adaptation measures that can be implemented to mitigate the potential negative effects of climate change on the hydrology of the region as well as the potential negative impact to water quality.

Impacts resulting from extreme sea levels associated with tides, winter storms, and other episodic events would be superimposed on the higher sea level. This rise could heavily impact the South Coast through inundation of low lying areas, causing severe coastal flooding and erosion, increased salinity in the Delta, damage to coastal structures, and damage to coastal marshes and wildlife reserves (Cayan 2008; California Climate Change Portal 2008). Additionally, higher sea levels would exacerbate current seawater

Box SC-4 Scenario Descriptions

Update 2009 uses three baseline scenarios to better understand the implications of future conditions on water management decisions. The scenarios are referred to as baseline because they represent changes that are plausible and could occur without additional management intervention beyond those currently planned. Each scenario affects water demands and supplies differently.

- **Scenario 1 – Current Trends.** For this scenario, recent trends are assumed to continue into the future. In 2050, nearly 60 million people live in California. Affordable housing has drawn families to the interior valleys. Commuters take longer trips in distance and time. In some areas where urban development and natural resources restoration has increased, irrigated crop land has decreased. The state continues to face lawsuits: from flood damages to water quality and endangered species protections. Regulations are not comprehensive or coordinated, creating uncertainty for local planners and water managers.
- **Scenario 2 – Slow & Strategic Growth.** Private, public, and governmental institutions form alliances to provide for more efficient planning and development that is less resources intensive than current conditions. Population growth is slower than currently projected—about 45 million people live here. Compact urban development has eased commuter travel. Californians embrace water and energy conservation. Conversion of agricultural land to urban development has slowed and occurs mostly for environmental restoration and flood protection. State government implements comprehensive and coordinated regulatory programs to improve water quality, protect fish and wildlife, and protect communities from flooding.
- **Scenario 3 – Expansive Growth.** Future conditions are more resource intensive than existing conditions. Population growth is faster than currently projected with 70 million people living in California in 2050. Families prefer low-density housing, and many seek rural residential properties, expanding urban areas. Some water and energy conservation programs are offered but at a slower rate than trends in the early century. Irrigated crop land has decreased significantly where urban development and natural restoration have increased. Protection of water quality and endangered species is driven mostly by lawsuits, creating uncertainty.

intrusion issues in South Coast groundwater aquifers. A USGS study on the vulnerability of the West Coast to sea level rise shows the South Coast area as being in the moderate to very high vulnerability range (Thieler 2001).

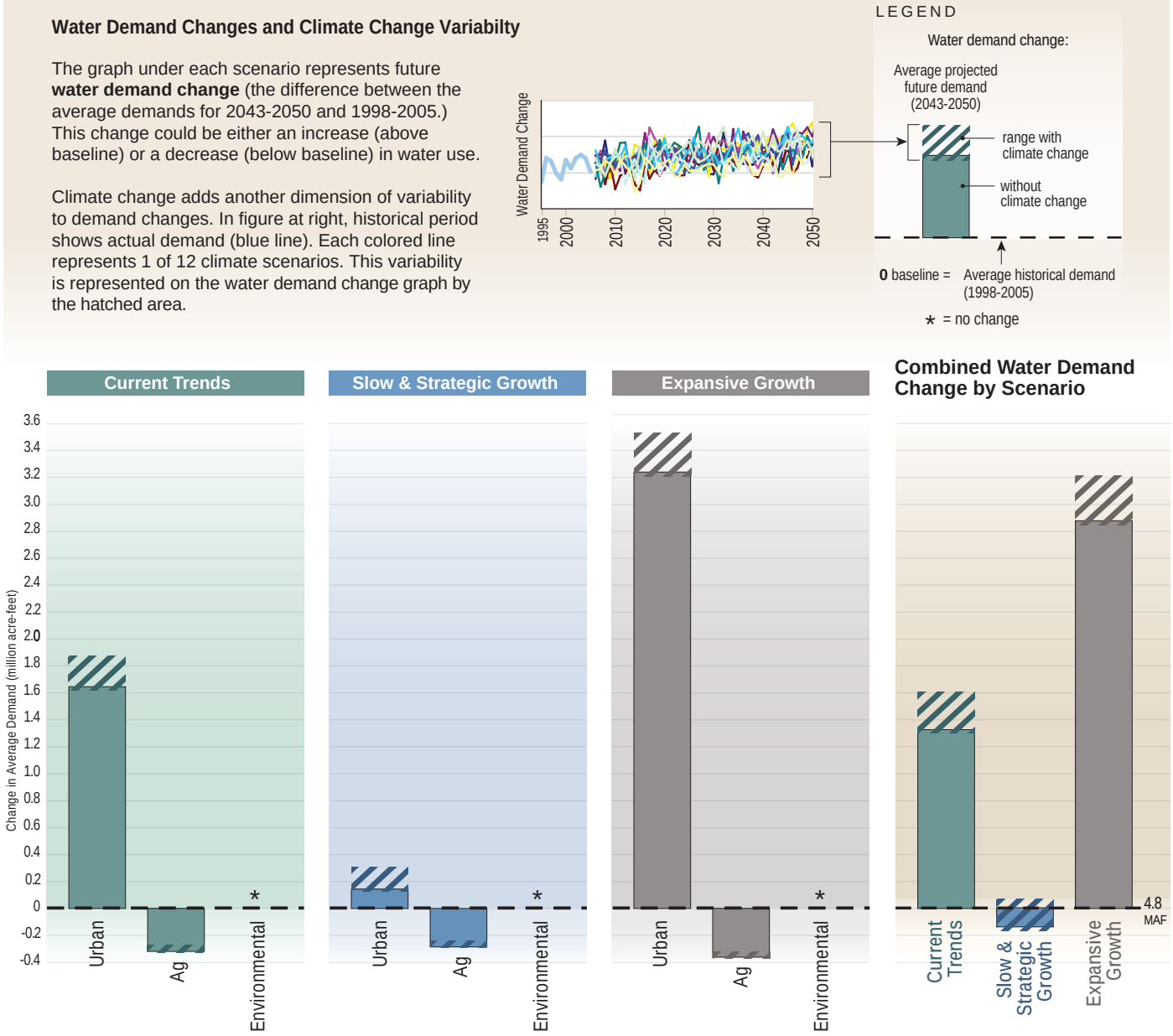
Future Scenarios

For Update 2009, we evaluated different ways of managing water in California depending on alternative future conditions and different regions of the state. The ultimate goal is to evaluate how different regional response packages, or combinations of resource management strategies from Volume 2, perform under alternative possible future conditions. The alternative future conditions are described as future scenarios. Together the response packages and future scenarios show what management options could provide for sustainability of resources and ways to manage uncertainty and risk at a regional level. See Box SC-4 scenario descriptions.

Total Demand

Change in total water demand in the South Coast Hydrologic Region for the three scenarios, Current Trends, Slow & Strategic Growth and Expansive Growth is shown in Figure SC-9. The change in water demand is based on the difference between the historical average (1998-2005) and future average (2043-2050) water demands. Future demand is shown with and without climate change. The change in water demand

Figure SC-9 **Water demand changes by scenario, South Coast Hydrologic Region**



without climate change is shown with solid bars and those with climate change is shown with hatched bars. As shown in the figure, there is considerable variation in the magnitude in demand increases across the three scenarios. Equally noticeable, Slow & Strategic Growth shows a dramatic reduction in demand when compared with Current Trends; from 1,325 thousand acre-feet down to a reduction of 140 thousand acre-feet. Considering 12 climate change alternatives (hatched bar), pronounced range of water demand change are observed under all three scenarios.

Urban Demand Change

Figure SC-9 shows urban water demand change in the South Coast region with and without climate under the Current Trends, Slow & Strategic Growth, and Expansive Growth scenarios. Without climate change, all three scenarios show an increase in urban water demand. Expansive Growth, however, shows marked increase in water demand when compared with Current Trends; an increase from 1,645 thousand acre-feet with Current Trends to 3,240 thousand acre-feet with Expansive Growth scenario. This shows urban growth and expansion in the South Coast area dramatically increases demand for water. The Slow & Strategic Growth scenario, however, shows a smaller relative increase in water demand (145 thousand acre-feet). When climate change is considered, all three scenarios showed an increase in urban water demand across most future climate sequences.

Agricultural Demand Change

Change in agricultural water demand in the South Coast region is shown in Figure SC-9. Future agricultural water demand is generally reduced due to reduction in irrigated acreage from urbanization and increased background water conservation. Without climate change (solid bar), Expansive Growth shows a slightly larger reduction (360 thousand acre-feet), followed by Current Trends scenario (320 thousand acre-feet). Under the Slow & Strategic Growth scenario, however, agricultural demand shows a slightly lower reduction of about 285 thousand acre-feet. When climate change is considered (hatched bar), water demand reductions are the same or less than demand reductions without climate change.

Environmental Demand Change

Figure SC-9 shows a base environmental water demand of about 130 thousand acre-feet in South Coast region. No additional environmental water demands are assumed for the South Coast beyond current commitments.

Appendix A. Flood Management

Historic Floods

Flood Parameters

Table SCA-1, Record floods for selected streams, is based on US Geological Survey records. The stations were selected from all USGS gaging stations in the hydrologic region, according to the criteria in Box SCA-1. (The table is supplemented with four additional sites. See Table note 6.)

Box SCA-1 Selection Criteria

- The watercourse must be a natural stream with a watershed of at least 100 square miles.
- The station must have a reasonably continuous record of discharge from 1996 to the present.
- The station must be far enough from other stations on the same river to reasonably represent a separate condition.
- Stations in well defined watercourse locations such as deep canyons are omitted, unless particularly important to the overall flood situation.

Flood Descriptions

Early Floods. The South Coast region has seen many floods over the past 198 years. One of the earliest recorded floods occurred along the Santa Ana River in 1810 and washed away adobes.

One of the more prominent floods in California history was the “Great Flood” of 1861-62. Heavy flooding during this event inundated large areas of the west coast and transformed much of Orange County into an inland sea. This flood event was unusual in that it occurred during the severe drought of 1856-64 and floodwaters did not recede for 20 days.

In 1884 the region experienced an unusually long wet season, receiving rains well into June and more than doubling the seasonal average. The second of two floods that occurred inundated the towns of Santa Ana and Orange, and caused the Santa Ana River to cut a new channel to the sea.

Two floods occurring in 1914 and 1916 provided significant insight on the relationship between urban development in the Los Angeles Basin and the flood damage potential of the surrounding rivers. In 1914 floodwaters caused over $10 million in damages and took the lives of many people. In 1916 a similar flood event caused significant damage to the Los Angeles area when inadequately sized bridges acted as debris plugs. Following these floods in 1920 the Los Angeles County Flood Control District built Devil's Gate Dam, the first flood control dam in Los Angeles County.

Another significant flood in 1925 was so severe that it altered the course of both the Santa Ana and Los Angeles rivers.

In 1928, the St. Francis Dam, located 40 miles northwest of Los Angeles, catastrophically failed and the resulting flood killed more than 600 people. The collapse of the St. Francis Dam remains the second-greatest loss of life in California's history, after the 1906 San Francisco earthquake and fire. The concrete dam was part of the Los Angeles Aqueduct system.

Table SCA-1 Record floods for selected streams, South Coast Hydrologic Region

Stream	Location	Mean annual runoff (taf)	Peak stage of record (ft)	Peak discharge of record (cfs)
Cottonwood Cr.	above Tecate Creek, near Dulzura[5]	11	11.2	11,700
San Diego R.	at Fashion Valley, at San Diego	28[2]	13.5	9,430
San Diego R.	at Mast Road, near Santee	18	18.1	45,400
Santa Ysabel Cr.	near Ramona	8	14.3	28,400
San Luis Rey R.	at Oceanside	26	21.7	25,700
Santa Margarita R.	at Ysidora	45[2]	20.5	44,000
Santa Margarita R.	near Temecula	21[2]	22.5	31,000
Temecula Cr.	near Aguanga	6	14.6	8,100
Murrieta Cr.	at Temecula	15[2]	17.2	25,000
San Juan Cr.	at La Novia Street Bridge, at San Juan Capistrano	16	20.7[1]	28,500
Santa Ana R.	at Santa Ana	57[2]	9.0	31,700
Temescal Cr.	above Main Street, at Corona	24[2]	6.7	4,720
San Jacinto R.	near Elsinore	12	11.8	16,000
Salt Cr.	at Murrieta Road, near Sun City	2	11.23[1]	4,120
San Jacinto R.	near San Jacinto	14	5.3[1]	45,000
Santa Ana R.	at MWD Crossing, near Arlington	115[2]	16.6	47,800
Lytle Cr.	at Colton	6	14.8	17,500
San Timoteo Cr.	near Loma Linda	3	8.2	15,000
San Gabriel R.	below Santa Fe Dam, near Baldwin Park	47	22.2	30,900
Rio Hondo	below Whittier Narrows Dam	125	13.8	38,800
Rio Hondo	at South Gate[6]	38	15.4	48,100
Big Tujunga Cr.	below Hansen Dam	18[2]	7.6	15,200
Los Angeles R.	at Long Beach[6]	194	18.3	128,700
Los Angeles R.	at Sepulveda Dam	39	12.1[1]	14,700
Ballona Cr.	at Culver City[6]	36	16.0	32,500
Malibu Cr.	at Malibu Canyon[6]	21	21.4	33,800
Calleguas Cr.	near Camarillo	37	10.5[1]	25,900
Santa Clara R.	at Montalvo[3]	122	17.4	165,000
Sespe Cr.	near Fillmore	93	25.0[1,4]	85,300
Piru Cr.	above Frenchmans Flat	31	n/a	36,000
Santa Clara R.	near Piru	55	12.7[1]	32,000
Ventura R.	near Ventura	51[2]	29.3[1]	63,600

Note: taf = thousand acre-feet; ft = feet; cfs = cubic feet per second

1 Different date than peak discharge

2 Most recent but less than period of record

3 Gage discontinued 2004

4 Resulting from a debris wave

5 Gage discontinued 2007

6 Data source not USGS

In 1938 a flood inundating over 250,000 acres in Orange, Riverside, San Bernardino, Los Angeles, and Ventura Counties caused an estimated $78.5 million in damages and killed 87 people.

1969. Flooding in 1969 took the lives of 103 people and caused more than $160.1 million in damages to the South Coast Hydrologic Region. Due to increased development, the 1969 flood was the worst on record for the counties of Ventura, Orange, San Bernardino, and Riverside.

1978. In 1978 intense storms combined with inadequate drainage systems caused widespread street flooding and forced the evacuation of homes and businesses residing in lower elevations in Ventura, Los Angeles, Orange, San Bernardino, and Riverside counties. Damages caused by this event were estimated to be $86 million.

1980. In 1980 a powerful series of storms left the region with destroyed homes, washed out bridges and roads, and disrupted utilities. Thousands of people were evacuated from the area, and 29 people lost their lives. Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties were declared disaster areas by President Carter.

1992. A heavy downpour led to spill at the Las Llajas Dam near Simi Valley, resulting in considerable erosion on Las Llajas Creek and bridge damage in Moorpark.

Flood Governance

Many federal, State, and local agencies have responsibilities in the overall effort to manage floods. The principal participants in the South Coast Hydrologic Region and their activities are listed in Table SCA-2, Flood management participants. Most listed activities are self-explanatory. Descriptions of some are:

- **Flood project development.** Performing feasibility studies, planning, and design of constructed facilities.
- **Encroachment control.** Establishing, financing, and operating a system of permitting and enforcing permits to encroach on constructed facilities.
- **Floodplain conservation or restoration.** Any overt activity causing part of a floodplain to remain in effect or to be reinstated as a watercourse overflow area.
- **Flood insurance administration or participation.** Contribution to the management of or acting as a sponsor and cooperator in the National Flood Insurance Program including the Community Rating System.
- **Hydrologic analysis.** Hydrologic or statistical analysis of collected hydrometeorological data.
- **Flood education.** Informing the general public about any aspect of flood management; publishing or broadcasting collected hydrometeorological data or other flood-related material.
- **Recovery operations.** Financing or performing any activity intended to return flood-impacted facilities or persons to normal status.

- **Event management system administration.** Oversight of the National Incident Management System/Standardized Emergency Management System (NIMS/SEMS) as applied to California.

In the Santa Clara, the Ventura County Watershed Protection District provides flood management to 1,670 square miles. The agency divides the county into four zones; each zone is managed separately to protect aquatic ecosystems, human life and health, and other natural resources.

In the Metropolitan Los Angeles Planning Area, the Los Angeles County Flood Control District (LACFCD) was created in 1915 to provide for the control and conservation of flood, storm, and other waste waters. LACDPW's Watershed Management Division was created in 2000 to evaluate and address flood control needs from an integrated watershed management approach taking into account flood protection, water quality and conservation, and enhancement of habitat, open space, and recreational opportunities.

In the Santa Ana Planning Area, the Orange County Flood Control District manages 790 square miles and more than 350 miles of flood channels, dams, pump stations, flood control basins and other infrastructure. The San Bernardino County Flood Control District is responsible for providing flood protection, water conservation, and storm drain construction. The district is divided into six planning zones that cover an area of 21,105 square miles; each zone functions independently. The Riverside County Flood Control and Water Conservation District provides flood management to 2,700 square miles in the western region of the county. The district divides its jurisdiction into seven management zones; each zone is managed separately.

In the San Diego Planning Area, the San Diego County Flood Control District is responsible for flood management in 4,200 square miles of unincorporated San Diego County. Individual municipalities are responsible for flood management within their jurisdictions. Although flood management is a top priority, the agency's other responsibilities include water supply, watershed-based recreation, water quality enforcement, and watershed rehabilitation.

Flood Risk Management

Structural Approaches

Construction of several major flood control projects in the South Coast region has been the responsibility of US Army Corps of Engineers with the Natural Resources Conservation Service and other public agencies participating on a much smaller scale. Maintenance of these flood control facilities is primarily left to local agencies, with the exception of a few structures under the purview of the USACE.

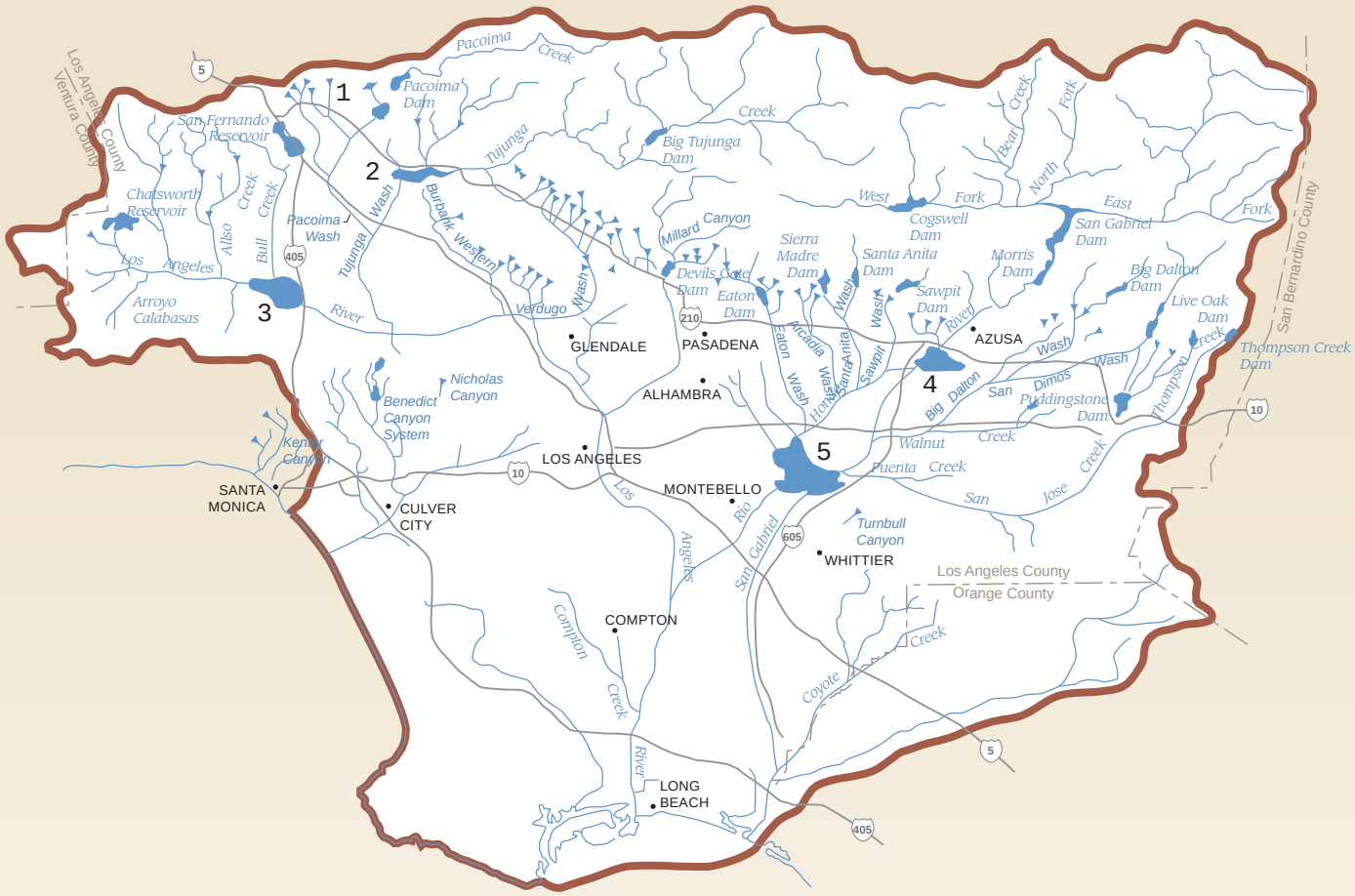
Two of the most extensive individual flood control systems in California are found in the region. These are:

- The Los Angeles County Drainage Area Project, principally in the watersheds of Los Angeles and San Gabriel Rivers and the Rio Hondo. The local sponsor is the

Table SCA-2 Flood management participants, South Coast Hydrologic Region

	Structural approaches														Land use management																Preparedness, response and recovery						
	Flood projects						Floodplains			Flood insurance			Regulation		Data management				Event management																		
	Financing	Development	Construction	Operation	Encroachment control	Maintenance	Conservation	Restoration	Delineation	Administration	Participation	FIRM mapping	Building permits	Designated floodways	Data collection	Hydrologic analysis	Data station maintenance	Flood education	Preparedness	Response management	Response personnel	System administration	Recovery funding	Recovery operations	Mitigation
Federal agencies																																					
Federal Emergency Management Agency										●		●											●		●
National Weather Service															●	●	●	●	●	●	●				
Natural Resources Conservation Service	●	●	●															●							
US Geological Survey															●	●	●								
US Army Corps of Engineers	●	●	●	●	●	●									●	●	●	●	●	●	●		●	●	●
State agencies																																					
California Conservation Corps																				●	●				
Department of Corrections																					●				
Department of Forestry and Fire Protection																				●					
Department of Water Resources	●	●	●	●	●	●			●	●		●			●	●	●	●	●	●	●		●	●	
Office of Emergency Services																			●	●	●	●	●		●
Local agencies																																					
County emergency services units																			●	●	●				
County planning departments														●											
County building departments													●												
Local flood maintenance organizations				●	●	●																			
Local conservation corps																				●	●				
Local initial responders to emergencies																			●	●	●				
Los Angeles County Flood Control District	●	●	●	●	●	●	●	●	●			●													
Orange County Flood Control District	●	●	●	●	●	●	●	●	●			●													
Riverside County Flood Control and Water Conservation District	●	●	●	●	●	●	●	●	●			●													
San Bernardino County Flood Control District	●	●	●	●	●	●	●	●	●			●													
San Diego County Flood Control District	●	●	●	●	●	●	●	●	●			●													
Ventura County Watershed Protection District	●	●	●	●	●	●	●	●	●		●	●							●	●					

Figure SCA-1 Los Angeles County Drainage Area Project



Multipurpose Projects

1 Lopez Dam

2 Hansen Dam

3 Sepulveda Dam

4 Santa Fe Dam

5 Whittier Narrows

Drainage area boundary

Debris basin

Los Angeles County Flood Control District (LACFCD). The project, depicted in Figure SCA-1, Los Angeles County Drainage Area Project, includes 20 dams, 90 debris basins, and 458 miles of improved channels.

- The Santa Ana River Project and Santa Ana Main Stem Project, implemented successively on the Santa Ana River, also include multiple dams and many miles of new or improved channels. Figure SCA-2, Santa Ana River Basin and Orange County projects, illustrates these facilities.

The principal reservoirs and non-storage facilities contributing to flood control are listed in Table SCA-3, Flood control facilities.

Disaster Preparedness, Response, and Recovery

Management of flood emergencies is the responsibility of many organizations and individuals. Response is required by law to conform to the Standardized Emergency Management System, under which action is taken by levels of organization. It is begun by the person or organization on the site. That entity resists personal injury and property damage to the best of its ability, only calling on the next level when its resources become insufficient, and succeeding levels follow the same procedure. Table SCA-4, Flood emergency responders indicates the responsible entities at successive levels of response.

Table SCA-5, Advanced Hydrologic Prediction Service stream forecast points, is a list of forecast points that can be used in the Advanced Hydrologic Prediction Service of NWS.

Integrated Regional Water Management

The South Coast Region has a high density of integrated regional water management plans covering the hydrologic region. Of 14 plans, five have incorporated flood control and/or floodplain management components. The San Diego IRWMP discusses the integration of floodplain management into the plan, but does not elaborate on specific projects. The Central Orange County IRWMP discusses the Orange County Flood Control District and the role it serves as a participating flood control entity in the plan. The Watersheds Coalition of Ventura County IRWMP is coordinated with the Integrated Watershed Protection Program, allowing for county-wide planning of flood reduction measures over a 20 year horizon. For example, in the Calleguas Creek basin, which is a 341 square mile watershed, one of the ongoing projects is the Calleguas Creek IWPP Phase II Management Strategy Study. This project will provide multi-purpose outcomes including flood control, sedimentation balance and control, water quality improvement, land use management, groundwater recharge, ecosystem mitigation and restoration, and recreational opportunities. When and where opportunities become available, projects of this type will be proposed, planned, and implemented on a collaborative basis in all four zones within Ventura County. The San Jacinto River Watershed Management Plan discusses a strategy that incorporates multi-objective projects for storm water and flood management. The RCWD/Upper Santa Margarita plan discusses floodplain management and the important role it plays in protecting public and private property.

Figure SCA-2 Santa Ana River Basin and Orange County projects

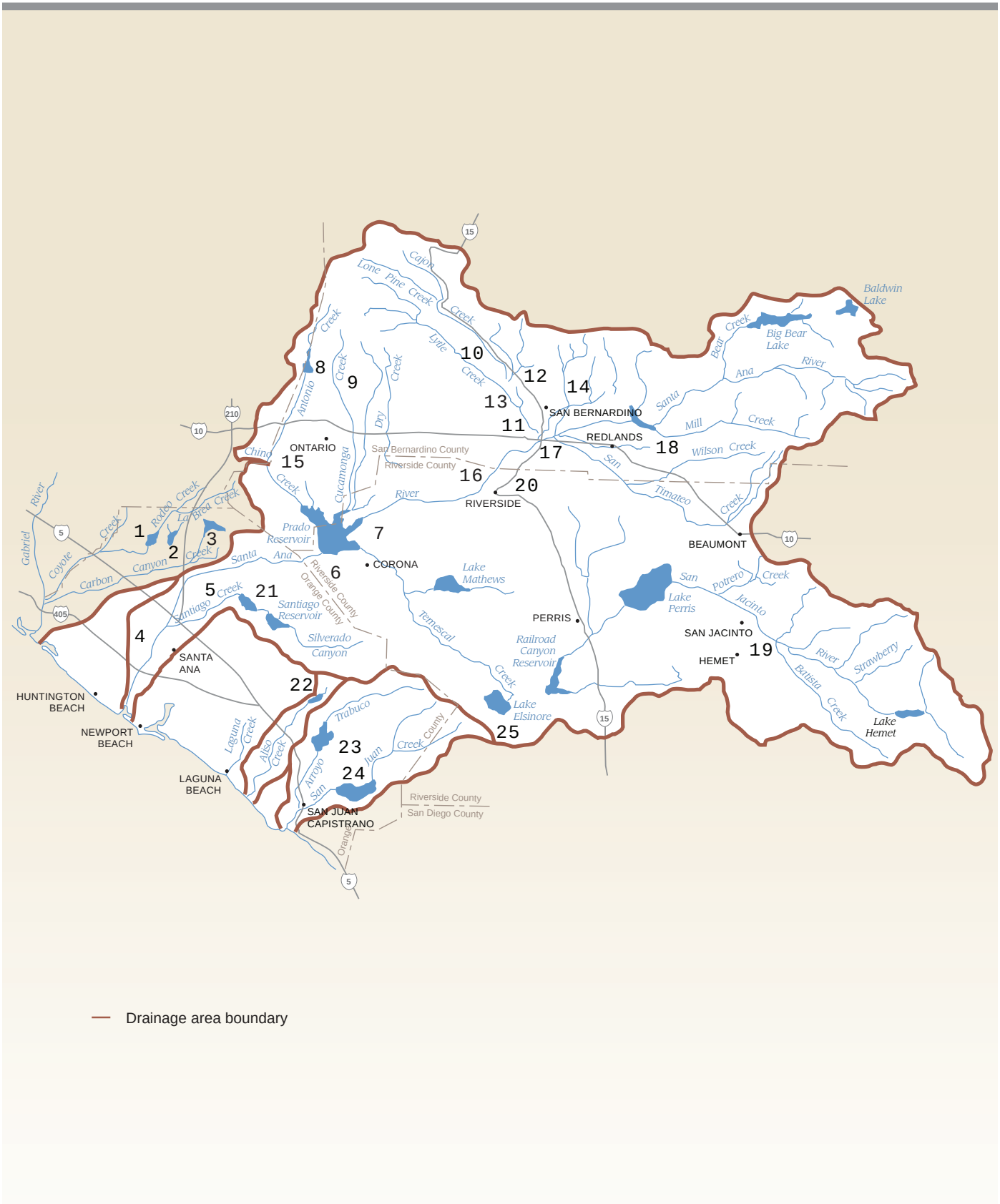


Table SCA-3 Flood control facilities, South Coast Hydrologic Region

Facility	Stream	Owner (Sponsor)	Description	Protects
RESERVOIRS AND LAKES				
Big Dalton Res.	Big Dalton Cr.	LA Co. DPW	1,000 AF flood control	Cities of eastern Los Angeles Co.
Santa Anita Res.	Trib. Rio Hondo	LA Co. DPW	800 AF	Cities of eastern Los Angeles Co.
Big Tujunga Res.	Big Tujunga Cr.	LA Co. DPW	6,000 AF flood control	Urban areas in Tujunga Canyon
Cogswell Res.	W. Fork San Gabriel R.	LA Co. DPW	11,100 AF flood control	Urban areas in W. Fork San Gabriel R.
Devils Gate Res.	Arroyo Seco	LA Co. DPW	1600 AF flood control	Pasadena, Alhambra & E. Los Angeles
Live Oak Res.	Live Oak Cr.	LA Co. DPW	200 AF flood control	Cities of E. Los Angeles Co.
Eaton Wash Res.	Eaton Wash	LA Co. DPW	900 AF flood control	Pasadena. ther cities of metro Los Angeles
Pacoima Res.	Pacoima Cr.	LA Co. DPW	3,600 AF flood control	Cities of San Fernando Valley
San Dimas Res.	San Dimas Wash	LA Co. DPW	1,300 AF flood control	Cities of eastern Los Angeles Co.
Puddingstone Diversion Res.	San Dimas Wash	LA Co. DPW	200 AF flood control	Cities of eastern Los Angeles Co.
Puddingstone Res.	Walnut Cr.	LA Co. DPW	16,400 AF flood control	Cities of eastern Los Angeles Co.
San Gabriel Res.	San Gabriel R.	LA Co. DPW	43,600 AF flood control	Cities of eastern Los Angeles Co.
Thompson Creek Res.	Thompson Cr.	LA Co. DPW	500 AF flood control	Cities of eastern Los Angeles Co.
Hansen Dam (LACDA project)	Tujunga Wash	USACE	29,700 AF flood control	Lower Part of San Fernando Valley & City of Los Angeles
Sepulveda Dam (LACDA project)	Los Angeles R.	USACE	17,300 AF flood control	Cities in western Los Angeles Co.
Lopez Dam (LACDA project)	Pacoima Wash	USACE	200 AF flood control	Cities in San Fernando Valley
Santa Fe Dam (LACDA project)	San Gabriel R.	USACE	32,600 AF flood control	Cities of eastern Los Angeles Co.
Whittier Narrows Dam (LACDA project)	Rio Hondo San Gabriel R.	USACE	36,200 AF flood control	Cities in central Los Angeles metro area
Alessandro Dam	Alessandro Cr.	RCFCWCD	400 AF flood control	City of Riverside
Box Springs Dam	Box Springs Cr.	RCFCWCD	400 AF flood control	City of Riverside
Harrison Street Dam	Harrison Cr.	RCFCWCD	200 AF flood control	City of Riverside
Pigeon Pass Dam	Pigeon Pass Cr.	RCFCWCD	1,400 AF flood control	City of Moreno Valley
Prenda Dam	Prenda Cr.	RCFCWCD	200 AF flood control	City of Riverside
Sycamore Dam	Sycamore Cyn.	RCFCWCD	900 AF flood control	City of Riverside
Woodcrest Dam	Woodcrest Cr.	RCFCWCD	400 AF flood control	City of Riverside
Mockingbird Dam	Mockingbird Cyn.	City of Riverside	1,000 AF flood control	City of Riverside
Lake Elsinore Res.	L. Elsinore	USACE (EVMWD)	61,200 AF flood control	City of Lake Elsinore
Brea Dam (SAROC projects)	Brea Cr.	USACE (OCFCD)	4,000 AF flood control	Fullerton & Buena Park
Fullerton Dam (SAROC projects)	East Fullerton Cr.	USACE (OCFCD)	800 AF flood control	Fullerton, Buena Park, and La Palma
Prado Dam (SAROC projects)	Santa Ana R.	USACE	196 taf flood control	Urban areas in Lower Orange County

Table SCA-3 Flood control facilities, South Coast Hydrologic Region (continued)

Facility	Stream	Owner (Sponsor)	Description	Protects
Villa Park Dam (SAROC projects)	Santiago Cr.	OCFCD	15,600 AF flood control	Cities of Orange, Santa Ana and other urban areas of Orange County
Seven Oaks Dam (SAROC projects)	Santa Ana R.	OCFCD, RCFCWCD, SBCFCD, USACE	146 taf flood control	Urban Orange County
Carbon Canyon Dam (SAROC projects)	Carbon Canyon Cr.	USACE	6,600 AF flood control	Anaheim, Los Alamitos, Placentia Naval Air Station
San Antonio Dam (SAROC projects)	San Antonio Cr.	USACE	7,600 AF flood control	Pomona, Claremont, Chino, Ontario & Upland
Beardsley Wash	Beardsley Wash	Ventura Co. Watershed Mgmt. Dist. (NRCS)	Debris basin, drop spillways, channels	Oxnard plain
NON-STORAGE FLOOD CONTROL FACILITIES				
Los Angeles County Drainage Area (LACDA) project	Los Angeles R., San Gabriel R., Rio Hondo, Ballona Cr., and tributaries	USACE (LA Co. DPW)	Improved channels	Los Angeles metropolitan area, San Fernando Valley
Santa Ana River Basin and Orange County (SAROC) projects	Santa Ana R., San Jacinto R., Carbon Cr., Cucamonga Cr. and tributaries, Devil Cr., East Twin Cr., Warm Cr., Lytle Cr., Cajon Cr., Mill Cr., Chino Cr., San Antonio Cr., Bautista Cr.	USACE (OCFCD, SBCFCD, RCFCWCD)	Levees, improved channels, bypasses, debris basins, detention basins, revetment, groins, floodplain management, bank stabilization	Anaheim, Los Alamitos, Upland, Ontario, Cucamonga, Alta Loma, San Antonio Heights, San Bernardino and vicinity, Rialto, Bloomington, Colton, Redlands, Mentone, Corona, Rubidoux, Pomona, Claremont, Chino, San Jacinto, Hemet, Valle Vista
Kenter Canyon Conduit and Channel	Local drainage	USACE (LA Co. DPW)	Conduit and channel	Los Angeles, Santa Monica
San Diego River	San Diego R.	USACE (City of San Diego)	Levee, channel improvements	San Diego
Santa Clara River Basin	Santa Clara R., Santa Paula Cr.	USACE (Ventura Co. WPD)	Levees, improved channel	Oxnard, Port Hueneme, Santa Paula
Stewart Canyon	Stewart Cr.	USACE (Ventura Co. WPD)	Debris basin, channel	Ojai
Sweetwater River	Sweetwater R.	USACE (Caltrans, San Diego Co. FCD)	Improved channel	San Diego, Chula Vista, National City
Tijuana River	Tijuana R.	USACE	Levees, Improved channel	Tijuana, Mexico
Ventura River	Ventura R.	USACE (Ventura Co. WPD)	Levee	Ventura and vicinity
San Luis Rey River	San Luis Rey R.	USACE (San Diego Co. FCD)	Levee	San Luis Rey River valley
Santiago Creek	Santiago Cr.	USACE (OCFCD)	Improved channel, storage basin	Santa Ana
City Creek	City Cr.	USACE (SBCFCD)	Levee, revetment, improved channel	San Bernardino
Los Coches Creek	Los Coches Cr.	USACE (San Diego Co. FCD)	Channel	Lakeside

Table SCA-3 Flood control facilities, South Coast Hydrologic Region (continued)

Facility	Stream	Owner (Sponsor)	Description	Protects
Rose Creek	Rose Cr.	USACE San Diego Co. FCD)	Improved channel	San Diego
Telegraph Canyon Creek	Telegraph Canyon Cr.	USACE (San Diego Co. FCD)	Channels, culverts	Chula Vista
Aliso Creek	Aliso Cr.	Los Angeles CO. DPW (NRCS)	Channels	San Fernando Valley
Arroyo Calabasas	Arroyo Calabasas	Los Angeles CO. DPW (NRCS)	Channels	San Fernando Valley
Bell Creek	Bell Cr.	Los Angeles CO. DPW (NRCS)	Channels	San Fernando Valley
Browns Creek	Browns Cr.	Los Angeles CO. DPW (NRCS)	Channels	San Fernando Valley
Bull Creek	Bull Cr.	Los Angeles CO. DPW (NRCS)	Channels	San Fernando Valley
Limekiln Creek	Limekiln Cr.	Los Angeles CO. DPW (NRCS)	Channels	San Fernando Valley
Lower East Canyon	Lower East Canyon	Los Angeles CO. DPW (NRCS)	Channels	San Fernando Valley
Santa Susana Creek	Santa Susana Cr.	Los Angeles CO. DPW (NRCS)	Channels	San Fernando Valley
Upper East Canyon	Upper East Canyon	Los Angeles CO. DPW (NRCS)	Channels	San Fernando Valley
Wilbur Creek	Wilbur Cr.	Los Angeles CO. DPW (NRCS)	Channels	San Fernando Valley
Main Street Canyon	Main Street Canyon	Riverside Co. FCWCD (NRCS)	Small flood control project	Riverside Co.
Buena Vista Creek	Buena Vista Cr.	City of Vista (NRCS)	Channels	Vista
Beardsley Wash	Beardsley Wash	Ventura Co. Watershed Mgmt. Dist. (NRCS)	Debris basin, drop spillways, channels	Oxnard plain
Revolon Slough	Revolon Slough	Ventura Co. Watershed Mgmt. Dist. (NRCS)	Channels	Oxnard Plain

taf = thousand acre-feet

Table SCA-4 Flood emergency responders

Responder	Level	Comment
Person(s) or organization(s) on the site	0	Any emergency
Emergency services units of the 179 cities in the region	1	Any emergency
Emergency services units of the eight counties in the region	1 or 2	Any emergency, and by request from Level 1 responders
Department of Water Resources	2	Flood Operations Center, flood fight and Corps liaison
Office of Emergency Services, Inland Region	3	Any emergency, Kern County, by request of county (operational area)
Office of Emergency Services, Southern Region	3	Any emergency, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, and Ventura Counties, by request of county (operational area)
U. S. Army Corps of Engineers	3	Specified water-related emergencies, by request of DWR
California Conservation Corps	3	Personnel and equipment for flood fight
Department of Forestry and Fire Protection	3	Personnel and equipment for flood fight
Office of Emergency Services Headquarters	4	All emergencies, entire hydrologic region, by request of OES Region

Table SCA-5 Advanced Hydrologic Prediction Service stream forecast points

River Basin	Stream	Location
Calleguas Creek	Calleguas Creek	CSU Channel Islands
San Diego River	San Diego River	El Capitan Reservoir
San Luis Rey River	San Luis Rey River	Lake Henshaw
San Luis Rey River	San Luis Rey River	Oceanside
San Diego River	San Vicente Creek	San Vicente Reservoir
Santa Ana River	Santa Ana River	Seven Oaks Reservoir
Santa Clara River	Santa Clara River	Freeman Diversion
Santa Clara River	Santa Clara River	Piru
Santa Margarita River	Santa Margarita River	Ysidora
Santa Clara River	Sespe Creek	Fillmore
Ventura River	Ventura River	Foster Park

Appendix B. Water Quality

Water Supplies

State Water Project

Legal decisions regarding environmental concerns in the Delta, however, have recently limited the volume of water that can be delivered south of the Sacramento-San Joaquin Bay Delta through the State Water Project (SWP). The potential impact of further declines in ecological indicators in the Delta system on SWP water deliveries is unclear. Additionally, the SWP is subject to extreme variability in hydrology due to a lack of storage, with full deliveries in only the wettest years. Other obstacles that must be overcome in importing water through the SWP include limitations on the movement of water across the Delta system, constraints related to water quality, and the cost of the water. The Governor's Delta Vision Strategic Plan (2008) recently recommended two co-equal goals and associated actions: (1) restore the Delta ecosystem and (2) create a reliable water supply for California. The plan recommends improving the existing channel through the Delta, developing a second conveyance channel, increasing storage capacity, and expanding local supplies to reduce dependence on imports. The Bay-Delta Conservation Plan, under development by a collaboration of State, federal, and local water agencies, will further address the recovery of endangered and sensitive fisheries in the Delta.

Colorado River System

The Metropolitan Water District of Southern California (Metropolitan) diverts Colorado River supplies based on the agreements in the 1931 California Seven-Party Agreement and the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003 (QSA), which further quantifies priorities established in the 1931 document. Metropolitan's diversions, although within its legal entitlements, are less now than they were in the early 2000s. Surplus supplies which existed then have been reduced as other states increased their diversions in accord with their authorized entitlements. Since 2003, Metropolitan's annual deliveries have varied from a low of 633,000 acre-feet in 2006 to a high of 897,000 acre-feet in 2005. The QSA also identifies measures to conserve and transfer water through the lining of existing earthen canals. The San Diego County Water Authority has further developed conservation and transfer agreements with Imperial Irrigation District to augment its Colorado River Aqueduct supply. With full implementation of the programs identified in the QSA, Metropolitan plans to divert 852,000 acre-feet per year of Colorado River water annually plus any unused agricultural water that may be available. Additional conjunctive use agreements that Metropolitan have in operation to manage its Colorado River Aqueduct supply include the Hayfield, Chuckwalla, and Lower Coachella Valley groundwater storage programs.

Local Surface Water

Surface water in the Santa Clara Planning Area is obtained from Lake Casitas (254,000 acre-feet), Lake Piru (100,000 acre-feet), and from diversion projects along the Santa Clara River, Ventura River, Santa Paula Creek, Piru Creek, Sespe Creek, and Conejo Creek. Natural surface flows from these diversions are also directed to spreading basins to replenish local aquifers. Local surface water provides approximately 8.5 percent of the total water utilized in Ventura County. The most southern reservoir on the West Branch of the SWP California Aqueduct is Castaic Lake (320,000 acre-feet). Metropolitan and CLWA both receive water from Castaic Lake and distribute it to retail water purveyors following treatment. Bouquet Reservoir (33,000 acre-feet) is a part of the Los Angeles Aqueduct (LAA) system built by the City of Los Angeles in 1934.

Originally, the Los Angeles River was the primary water source for the Metropolitan Los Angeles Planning Area. Following several catastrophic floods, the U.S. Army Corps of Engineers (USACE) lined most of the riverbed with concrete and constructed several dams to manage storm flows. The USACE continues to oversee Hansen, Lopez, and Sepulveda Dams in the Los Angeles River watershed, as well as Santa Fe and Whittier Narrows Dams in the San Gabriel River watershed. LACDPW oversees several surface water storage facilities, including Big Tujunga and Pacoima dams, which further improve flood protection and store runoff for subsequent diversion to 27 groundwater spreading basins. Eleven dams were constructed as part of the San Gabriel River and Montebello Forebay water conservation system to impound runoff for groundwater recharge. Three dams in San Gabriel Canyon (Cogswell, San Gabriel, and Morris dams) capture runoff for diversion to the Santa Fe, Rio Hondo, or San Gabriel Coastal Basin spreading grounds. Las Virgenes MWD uses Las Virgenes Reservoir (9,800 acre-feet) to store treated water it has purchased from Metropolitan. The Los Angeles Reservoir (10,000 acre-feet), operated by the LADWP, is a primary water source of the San Fernando Valley area.

The Santa Ana Planning Area has water storage reservoirs, including Lake Perris (124,000 acre-feet), which stores State Water Project water Lake Mathews (182,000 acre-feet) which stores Colorado River water, and Big Bear Lake (74,000 acre-feet). Additionally, several flood control projects, including Prado Dam (383,500 acre-feet) and Seven Oaks Dam (145,600 acre-feet) have been created to retain surface water during storm season. Although not a drinking water supply, Lake Elsinore is the only natural freshwater lake in the watershed with a surface area of five square miles. Surface water accounts for approximately five-percent of the total water supply to serve demands in the Santa Ana watershed.

In the San Diego Planning Area, a total of 25 reservoirs with a combined capacity of 594,000 acre-feet are located within the SDCWA's service territory. Major supply reservoirs include San Vicente (90,200 acre-feet), El Capitan (112,800 acre-feet), Lake Henshaw (50,000 acre-feet), and Lake Morena (50,200 acre-feet). Seventeen (17) of these reservoirs are connected to the SDCWA's aqueduct system. SDCWA plans to raise the existing dam at San Vicente Reservoir from 220 feet to 337 feet to provide an additional 100,000 acre-feet capacity for carryover storage (63 feet per Carryover

Storage Project) and 52,000 acre-feet capacity for emergency storage (54 feet per Emergency Storage Project). The increased reservoir capacity will also require construction of two auxiliary saddle dams and a three-year reservoir draw down. RCWD's surface storage system is comprised of Vail Lake (51,000 acre-feet). RCWD meets Temecula Gorge flow requirements of 2,500 acre-feet per year, as set by the Cooperative Water Resource Management Agreement between Camp Pendleton and RCWD, by discharging untreated imported water into Murrieta Creek, a tributary of the Santa Margarita River. Metropolitan owns and operates Diamond Valley Lake (800,000 acre-feet) and Lake Skinner (44,000 acre-feet) within the planning area.

Groundwater

In the South Coast region, natural recharge is typically insufficient to maintain groundwater basin water levels and current pumping levels due to the extent of impervious surfaces and the presence of clay soils. In some groundwater basins, as the demand for groundwater exceeded supply, landowners and other parties have turned to the courts to determine how much groundwater can rightfully be extracted. Most basin adjudications have resulted in either a reduction or no increase in the amount of groundwater extracted. Watermasters are further recognizing that they must also manage groundwater extraction to protect water quality and/or to prevent the spread of contaminants in groundwater. Adjudicated groundwater basins include: Central, Chino, Cucamonga, Main San Gabriel, Puente, Raymond, San Bernardino, Santa Margarita River, Santa Paula, Six Basins, Upper Los Angeles River, and the West Coast. Additional management of groundwater has been afforded through legislation to: Fox Canyon Groundwater Management Agency (GMA), Ojai GMA, Water Replenishment District of Southern California (WRD), and OCWD.

Groundwater production within the greater Metropolitan service area is estimated at 1.6 million acre-feet annually, employing nearly 5,000 acres of spreading basins and 36 injection wells (Metropolitan 2007). The discussion below provides examples of the larger basins, as there are too many small groundwater basins to name.

Groundwater is the largest single source of water in the Santa Clara Planning Area. The 66,200-acre Upper Santa Clara River Valley basin is comprised of two aquifers (an alluvial aquifer and a Saugus Formation aquifer) totaling approximately 1.9 million acre-feet of storage capacity. Due to extensive pumping by private well owners and by a majority of the 166 public water purveyors within Ventura County, overdraft and seawater intrusion problems were occurring to local groundwater basins. Established in 1982 by State legislation, the Fox Canyon GMA now manages some of the basins and is implementing actions to mitigate these issues. The 125,300-acre Lower Santa Clara River Valley basin is subdivided into five smaller basins: Oxnard, Mound, Santa Paula, Fillmore, and Piru. The largest of the sub-basins is the 58,000-acre Oxnard basin, which contains approximately 7.1 million acre-feet of storage capacity and is managed by the Fox Canyon GMA. Conjunctive use projects underway in Ventura County include Calleguas Conjunctive Use Program (North Las Posas Basin).

Many agencies in the Metropolitan Los Angeles Planning Area rely on artificial recharge, by diverting local supplies from rivers or creeks when flow conditions are optimal, to spreading grounds (or basins) which typically contain sandy soils that promote infiltration. LADWP, in partnership with the Los Angeles County Flood Control District, is moving forward with several storm water capture projects with the goal of increasing long-term groundwater recharge by a minimum 20,000 acre-feet per year. In addition, recycled water is infiltrated in spreading grounds and injected (along with imported water) along the coast to form barriers to seawater intrusion at three locations (the Alamitos, Dominguez Gap, and West Coast barriers). The 310,900-acre Coastal Plain of Los Angeles County basin is subdivided into 4 sub-basins: Santa Monica, Hollywood, Central, and West Coast. The Central and West Coast sub-basins represent almost 90 percent of the storage of the Coastal Plain basin and are both adjudicated for allowed pumping of up to 281,000 acre-feet per year. These sub-basins have a combined total storage capacity estimated at 20.3 million acre-feet and up to 450,000 acre-feet set aside for the development of future conjunctive use projects. Conjunctive use projects underway in Los Angeles County include Long Beach Conjunctive Use Storage Project (Central Basin).

Groundwater continues to be the primary water supply source in the Santa Ana Planning Area. Groundwater production is supported by incidental and artificial recharge of recycled water, imported water, and storm water supplies. On average, about 80,000 acre-feet per year of imported supplies from Metropolitan are recharged each year to support groundwater production. The 466,900-acre Upper Santa Ana Valley basin has nine sub-basins: Chino, Cucamonga, Rialto-Colton, Riverside-Arlington, Cajon, Bunker Hill, Yucaipa, San Timoteo, and Temescal. Total combined storage of the sub-basins is estimated at 21 million acre-feet. Groundwater pumping operations in the Chino, Bunker Hill, and Rialto-Colton sub-basins are managed under adjudication judgments. The 224,000-acre Coastal Plain of Orange County basin has a storage capacity of 37.7 million acre-feet. The Orange County groundwater basin, managed by OCWD, provides a majority of the water used by north and central Orange County cities. Conjunctive use of surface water and groundwater is a long-standing practice in the region, with numerous spreading grounds developed to recharge the basins. Phase I construction has been completed for OCWD and Orange County Sanitation District's Groundwater Replenishment System, which purifies 72,000 acre-feet per year of wastewater for groundwater storage either by injection along the seawater barrier or by percolation near the Santa Ana River. Conjunctive use programs underway in San Bernardino County include IEUA Cyclic Storage Agreement (Chino Basin) and Three Valley Municipal Water District Cyclic Storage Agreement (Main San Gabriel Basin).

Groundwater production in the San Diego Planning Area is limited by lack of storage capacity in local aquifers, availability of groundwater recharge, and degraded water quality. RCWD stores local runoff in Vail Lake via a surface water storage permit (up to 40,000 acre-feet from November 1 to April 30) and then releases available water to spreading basins for groundwater recharge. SDCWA does not utilize groundwater extraction to meet member agency needs. The proposed El Monte Valley Groundwater Recharge project, a joint effort between Padre Dam MWD and Helix WD in San Diego

County, would recharge the El Monte Valley Basin using highly treated recycled water. The Santa Margarita Conjunctive Use Project, by the Fallbrook PUD, provides for recharge of the groundwater basin underlying Camp Pendleton through diversions from the Santa Margarita River.

Recycled Water

Within Metropolitan's service area, there are approximately 355,000 acre-feet of planned and permitted uses of recycled water supplies. Actual use is approximately 209,000 acre-feet, which includes golf course, landscape, and cropland irrigation; industrial uses; construction applications; and groundwater recharge, including maintenance of seawater barriers in coastal aquifers. Metropolitan projects the development of 500,000 acre-feet of recycled water supplies (including groundwater recovery) by 2025 (Metropolitan 2004). A necessary component of water recycling is providing a means of disposal or storage for excess recycled water supplies during wet weather periods (other than discharge via regional ocean outfalls). Discharge of treated wastewater flows into streams and rivers can help satisfy environmental water demands and provide for incidental groundwater recharge. IPR through release of recycled water to groundwater spreading basins or surface storage reservoirs can further augment local drinking water supplies. By utilizing reclaimed water, agencies can more efficiently allocate their potable water and increase the reliability of water supplies in the region.

Recycled water in the Santa Clara Planning Area holds great potential as an alternative water source and a means to improve water supply reliability, particularly for agricultural irrigation. Four WWTPs in Ventura County currently reclaim a portion of their effluent. The Camrosa Water District recycles water from its own facilities, the City of Thousand Oaks' Hill Canyon WWTP, and Camarillo Sanitary District for agricultural and landscape irrigation demands. In the upper watershed, Santa Clarita Valley Sanitation District owns and operates two water reclamation plants (Saugus and Valencia) within the CLWA service area. A third reclamation plant is proposed as part of the Newhall Ranch project. Accordingly, CLWA has constructed an initial phase (Phase 1A) of the recycled water system and proposes to construct an additional phase in the near future.

Current average annual recycled water production in the Metropolitan Los Angeles Planning Area is approximately 225 million gallons per day (MGD), which represents approximately 25 percent of the current average annual effluent flows. WRD is permitted to recharge up to 50,000 acre-feet per year (45 MGD) of Title 22 recycled water from CSDLAC for replenishment of the Central sub-basin through use of the Montebello Forebay spreading grounds. West Basin MWD's Edward Little Water Recycling Facility in El Segundo, which produced approximately 24,500 acre-feet in 2004-2005, recently completed its Phase IV Expansion Project. Approximately 12,500 acre-feet per year of the water produced at this facility is purchased by WRD and injected into the West Coast Barrier by LACDPW. The use of recycled water by LADWP is projected to be approximately 50,000 acre-feet per year by 2019.

Recycled water currently represents approximately 4 percent of the total water demands in the Santa Ana Planning Area. Eastern MWD recycles effluent from four WWTPs. EMWD is reusing the majority of the treated wastewater. EMWD is also investigating the feasibility of indirect potable reuse through groundwater recharge, The Irvine Ranch Water District (IRWD) has developed an extensive recycled water treatment and delivery system and will expand capacity through 2013 to meet expected recycled water demand at buildout. Inland Empire Utilities Agency (IEUA) is expanding its water recycling with a goal of meeting 20 percent of their demand or 50,000 acre-feet with recycled water. The Western Water Recycling Facility, owned and operated by Western Municipal Water District, is currently being upgraded and expanded. Eastern Municipal Water District has Perris Valley and Moreno Valley Water Reclamation Facilities and recycled water is available through the OCWD's Green Acres Project and the El Toro Water District. As infrastructure is further developed, recycled water is projected to surpass surface water as a water supply source for the planning area. OCWD and Orange County Sanitation District's Groundwater Replenishment System provides 72,000 acre-feet per year of recycled water for groundwater recharge and injection along the seawater barrier.

The San Diego Planning Area contains a number of recycled water facilities. In Riverside County, water reclamation facilities include Santa Rosa and Temecula Valley which provide non-potable supplies for local use. Seventeen recycled water tertiary treatment facilities are located within San Diego County. The use of tertiary treated recycled water within the San Diego area is projected to increase from 11,500 acre-feet per year in 2005 to 47,600 acre-feet per year in 2030 (SDCWA 2007). In September 2008, the City of San Diego approved funding for an IPR demonstration project that releases advanced treated wastewater to San Vicente Reservoir for blending and subsequent additional treatment prior to redistribution.

Desalination

In the Metropolitan Los Angeles Planning Area, the 3 MGD Goldsworthy Desalter, owned and operated by WRD, provides brackish groundwater desalination for the dual purposes of remediation of a saline plume located within the West Coast sub-basin and provision of a reliable local water source to Torrance.

The potential for groundwater banking in the Santa Ana Planning Area is substantial, but the volume of clean water that can be stored may be hindered by high salt concentrations in the existing groundwater. In the Santa Ana watershed, three groundwater desalination plants have been constructed by SAWPA (in the Arlington and Chino areas) and are producing a total of 24 MGD. The Arlington Desalter is now owned and operated by Western Municipal Water District. The Temescal plant, constructed and operated by the City of Corona, has a capacity of 15 MGD. The Menifee and Perris Desalters, owned and operated by Eastern MWD, are producing 7 MGD. A third desalter (Perris II with a 5 MGD capacity is in design. The Chino Basin Desalter Authority operates Chino 1 and Chino II Desalters, which are producing 24 MGD (26,000 acre-feet per year).

The Irvine Desalter Project, a joint groundwater quality restoration project by IRWD and OCWD, yields 7,700 acre-feet per year of potable drinking water and 3,900 acre-feet per year of non-potable water. The Tustin Seventeenth Street Desalter, owned and operated by the City of Tustin yields approximately 2,100 acre-feet per year. The Arlington Desalter, managed by Western MWD, delivers approximately 6,400 acre-feet of treated groundwater annually to the City of Norco. Brine from local desalters is effectively transported from the watershed by SAWPA's 30 MGD capacity Santa Ana Regional Interceptor (SARI) brine pipeline to OCSD for treatment and then discharge to the ocean. As described above, groundwater extraction is limited in the San Diego Planning Area. Brackish groundwater desalination facilities in the planning area include the City of Oceanside's Mission Basin Desalter (6.37 MGD) and Sweetwater Authority's Reynolds Groundwater Desalination Facility (4 MGD).

Urban Water Conservation

Water conservation programs are coordinated in the Santa Clara Planning Area by a variety of agencies. Calleguas MWD, the local wholesaler of SWP supplies, administers programs with its member agencies in the southeastern portion of Ventura County. A regional agricultural interest group, the Ventura County Farm Water Coalition, was recently formed to collaborate on implementation of agricultural efficient water management practices. CLWA acts as the information clearinghouse for water conservation efforts in the upper watershed by purchasing advertising time in all media types and funding conservation programs by its member water retailers.

In the Metropolitan Los Angeles Planning Area, Metropolitan assists member agencies with implementation of water conservation programs. Additionally, LADWP implements public outreach and school education programs to encourage conservation ethics; seasonal water rates that are approximately 20 percent greater during the summer high use period; and free water conservation kits. As a result of these conservation efforts by LADWP, the water demand for Los Angeles is about the same as it was 25 years ago, despite a population increase of more than 1 million people. LADWP projects an additional savings of at least 50,000 acre-feet per year by 2030 through additional water conservation programs. The Central and West Basin MWDs recently completed water conservation master plans to coordinate and prioritize conservation efforts and identify enforcement protocols.

OCWD implements several water use efficiency programs in the Santa Ana Planning Area, including a hotel/motel water conservation program, an annual Children's Water Festival and a Water Heroes program and water saving tips and tools. Eastern Municipal Water District has a strategic goal to reduce per capita water use and has several programs to replace existing inefficient water devices and encourage water efficiency in new development. IEUA provides multiple rebate programs, including turf removal and water efficient fixtures, and has established the Inland Empire Landscape Alliance to promote the use of water efficiency landscaping by its cities and retail agencies. Western Municipal Water District operates the preeminent water conservation demonstration

center in the southland, Landscapes Southern California Style, which has been educating the public about water efficient planting and irrigation for over 15 years.

In the San Diego Planning Area, significant SDCWA and member agency funding has been directed toward implementing water conservation programs. Major programs include water efficient purchase incentives, efficiency standards, residential surveys, residential retrofits, landscape/irrigation improvements, and commercial/industrial/institutional retrofits. These programs resulted in 53,400 acre-feet of water savings during 2005; water savings are projected to annually exceed 100,000 acre-feet by year 2025. Numerous partnerships have also been developed to implement retail agency projects supported by external funding. For example, the 2007 Blueprint for Water Conservation is a partnership of SDCWA, member agencies, Cuyamaca College's Water Conservation Garden, and private stakeholders dedicated to increasing regional water conservation to 80,000 acre-feet per year by 2010 and further to 108,000 acre-feet per year by 2030.

Table SCB-1 Water Suppliers in the South Coast Hydrologic Region

Entity	Local Supply				Imported	Imported Supplier
	Surface	Groundwater	Desalination	Recycle		
Metropolitan Water District of Southern California (MWDSC)					•	SWP
Calleguas Municipal Water District (MWD)		•	•	•	•	MWDSC
Academy MWC, Arroyo Las Posas MWC, Balcolm Bixby MWA, Berylwood Heights MWC, Brandeis-Bardin MWC, Butler Ranch MWC, California Water Service Company, California-American Water Company, City of Camarillo, Camrosa Water District, Crestview MWC, Golden State Water Company, Del Norte MWC, Epworth MWC, Fuller Falls MWC, La Loma Ranch MWC, Lake Sherwood CSD, Las Lomas Water System, Mesa Water Co., Oak Park Water Service, City of Oxnard, Pleasant Valley MWC, Rancho Canada Water Company, Thermic MWC, City of Simi Valley, Solano Verde MWC, City of Thousand Oaks, Ventura County Waterworks District No. 1, Ventura County Waterworks District No. 8, Ventura County Waterworks District No. 17, Ventura County Waterworks District No. 19, Zone MWC	•	•	•	•	•	Calleguas MWD, United Water Conservation District
Central Basin MWD		•		•	•	MWDSC
City of Bell Gardens, City of Downey, City of Montebello, City of Norwalk, City of Vernon, City of La Habra Heights, City of La Mirada, City of Pico Rivera, City of Santa Fe Springs, City of Whittier, City of Bell, City of Commerce, City of Huntington Park, City of Maywood, City of Walnut Park, City of Lynwood, City of South Gate, City of Florence-Graham, City of Willowbrook, City of Artesia, City of Bellflower, City of Cerritos, City of Hawaiian Gardens, City of Lakewood, City of Paramount, City of Signal Hill, Water Replenishment District of Southern California (WRD)						Central Basin MWD
Eastern MWD		•		•	•	MWDSC
City of Hemet, City of Perris, City of San Jacinto, City of Menifee, Nuevo MWC, Moreno Valley MWC, Lake Hemet MWD, Rancho California Water District	•	•		•	•	Eastern MWD, Western MWD
Foothill MWD	•	•			•	MWDSC
Crescenta Valley Water District, La Canada Irrigation District, Mesa Crest Water Company, Valley Water Company, Las Flores Water Company, Lincoln Avenue Water Company, Rubio Canon Land and Water Association, Kinneloa Irrigation District		•			•	Foothill MWD
Inland Empire Utilities Agency (IEUA)				•	•	MWDSC
City of Chino, City of Chino Hills, City of Upland, Cucamonga Valley Water District, City of Fontana, City of Montclair, City of Ontario, City of Upland, Monte Vista Water District, Fontana Water Co., San Antonio Water Co.,	•	•		•	•	IEUA
Las Virgenes MWD					•	MWDSC
Municipal Water District of Orange County (MWDOC)		•			•	MWDSC
City of Brea, City Buena Park, East Orange County Water District (EOCWD), City of Fountain Valley, City Garden Grove, Golden State Water Co-Orange County District, City of Huntington Beach, City of La Habra, City of La Palma, Mesa Consolidated Water District, City of Orange, Orange County Water District (OCWD), City of Newport Beach, Santa Margarita Water District, City of Seal Beach, Serrano Water District, City of Tustin, City of Westminster, Yorba Linda Water District, El Toro Water District, Emerald Bay Service District, Irvine Ranch Water District (IRWD), Laguna Beach County Water District, Moulton Niguel Water District, City of San Clemente, South Coast Water District, City of San Juan Capistrano, Trabuco Canyon Water District, City of Laguna Beach	•	•	•	•	•	MWDOC, OCWA, EOCWD, IRWD, Cal Domestic
San Diego County Water Authority (SDCWA)	•	•	•	•	•	MWDSC, IID Transfer, Canal Lining
Carlsbad MWD, City of Del Mar, City of Escondido, Fallbrook PUD, Helix Water District, Lakeside Water District, City of Oceanside, Olivenhain MWD, Otay Water District, Padre Dam MWD, Camp Pendleton, City of Poway, Rainbow MWD, Ramona MWD, Rincon Del Diablo MWD, City of San Diego, San Dieguito Water District, Santa Fe Irrigation District, Sweetwater Authority (incl City of National City, South Bay Irrigation District), Vallecitos Water District, Valley Center MWD, Vista Irrigation District, Yuima MWD	•	•	•	•	•	SDCWA

Table SCB-1 Water Suppliers in the South Coast Hydrologic Region (continued)

Entity	Local Supply				Imported	Imported Supplier
	Surface	Groundwater	Desalination	Recycle		
Three Valleys MWD		●		●	●	MWDSC
City of La Verne, City of Covina, City of Glendora, City of Pamona, Southern California Water Co, Rowland Water District, Walnut Valley Water District, California State Polytechnic University-Pamona, Mount San Antonio College, Boy Scouts of America-Firestone Reservation	●	●		●	●	Three Valleys MWD, Covina Irrigating Co
Upper San Gabriel Valley MWD		●			●	MWDSC
Golden State Water Company, City of South Pasadena, Main San Gabriel Basin Watermaster, Suburban Water Systems, City of Alhambra, City of Arcadia, City of Monrovia, City of Azusa, Valley County Water District	●	●			●	Upper San Gabriel Valley MWD, Covina Irrigating Co, Cal Domestic
West Basin MWD	●	●	●	●	●	MWDSC
City of El Segundo, City of Inglewood, City of Lomita, City of Los Angeles, City of Manhattan Beach, City of Torrance, Water Replenishment District of Southern California, Los Angeles County Waterworks District #29, California American Water Company, California Water Service Company, Golden State Water Company		●	●	●	●	MET, West Basin MWD, LADWP
Western MWD		●			●	MWDSC
Box Springs MWC, City of Corona, City of Norco, City of Riverside, City of Wildomar, Eagle Valley MWC, Elsinore Valley MWD, Lee Lake Water District, Rancho California Water District	●	●		●	●	Eastern MWD, Western MWD
City of Anaheim		●			●	MWDSC
City of Beverly Hills		●			●	MWDSC
City of Burbank		●		●	●	MWDSC
City of Compton		●			●	MWDSC
City of Fullerton		●			●	MWDSC
City of Glendale		●		●	●	MWDSC
City of Long Beach		●		●	●	MWDSC
City of Pasadena		●			●	MWDSC
City of San Fernando		●			●	MWDSC
City of San Marino		●			●	Cal-American, City of Pasadena
City of Santa Monica		●		●	●	MWDSC
City of Torrance		●		●	●	MWDSC, WBMWD
Castaic Lake Water Agency (CLWA)	●	●		●	●	SWP, Buena Vista WSD, Rosedale-Rio Bravo WSD
Los Angeles County Water District #36, Newhall County Water District, Santa Clarita Water Division, Valencia Water Company	●	●		●	●	CLWA
San Bernardino Valley MWD		●			●	SWP
City of Redlands, City of Rialto, City of Colton, City of Loma Linda, City of San Bernardino, Terrace Water Co.,Western Heights Co, Marygold Mutual Water Co. Riverside Highland Water Co. Muscoy Mutual Water Co. East Valley Water District, Fontana Water Co., Yucaipa Valley Water District, West Valley Water District	●	●			●	
San Gorgonio Pass Water Agency (SGPWA)		●			●	SWP
City of Banning, Beaumont-Cherry Valley Water District, Yucaipa Valley Water District, South Mesa Water Company		●			●	SGPWA

Table SCB-1 Water Suppliers in the South Coast Hydrologic Region (continued)

Entity	Local Supply				Imported	Imported Supplier
	Surface	Groundwater	Desalination	Recycle		
San Gabriel Valley MWD						SWP
Casitas MWD	•	•			•	SWP (Ventura County allocation)
Casitas MWC, City of Buenaventura, Dennison Park Water System, Gridley Road Water Group, Hermitage MWC, Meiners Oaks CWD, North Fork Springs MWC, Ojala, Old Creek Road MWC, Oviatt Water Association, Rancho del Cielo MWC, Rancho Matilija MWC, Rincon Water and Roadworks, Ojai Water Conservation District, Senior Canyon MWC, Siete Robles MWC, Sisar MWC, Golden State Water Company, Sulphur Mountain Road Water Association, Tico MWC, Tres Condados, Ventura River CWD, Villanova Road Water Well Association	•	•			•	Casitas MWD
City of Ventura	•	•		•	•	SWP (Ventura County allocation)
United Water Conservation District	•	•			•	SWP (Ventura County allocation)
Aliso MWC, Alta MWC, Beedy Street Well, Brownstone MWC, Camarillo Airport Utility, Channel Islands Beach CSD, City of Fillmore, City of Port Hueneme, Cloverdale MWC, Community MWC, Cypress MWC, Dempsey Road MWC, Seacoast Cooling, Elkins Ranch Co., Farmer's Irrigation Co., Fillmore Irrigation Co., Goodenough MWC, Hailwood Inc., CB South, Poinsettia Stock Farm, Lake Piru Recreation Area, Limoneira Assoc., Middle Road MWC, Montalvo MWC, Nyeland Acres NWC, Oxnard Lemon MWC, Pleasant Valley CWD, Rio Manor MWC, Rio Plaza Water Company, San Cayetand MWC, City of Santa Paula, Saviers Road MWC, South Mountain MWC, Storkel MWC, Strickland MWC, Thermal Belt MWC, Timber Canyon MWC, Tobock Rock MWC, USNAS Point Mugu, USNCBC Port Hueneme, United MWC, Ventura County Waterworks District #16, Vineyard Avenue Acres MWC, Vineyard MWC, Warring Water Service, Piro MWC, Hardscrabble MWC, Sespe Agricultural Water, Guadalasca MWC, Citrus MWC, Lloyd-Butler MWC, Onard MWC, Toland Road Water System, Thornhill MWC	•	•			•	United Water Conservation District

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