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SOUTH COAST HYDROLOGIC REGION

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2



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Acronyms and Abbreviations Used in This Report

µg/L	micrograms per liter
AB	Assembly Bill
ACWA	Association of California Water Agencies
af	acre-feet
af/yr.	acre-feet per year
ALERT	Automatic Local Evaluation on Real Time Flood Detections System
AVEK	Antelope Valley-East Kern Water Agency
BMP	best management practices
CASGEM	California Statewide Groundwater Elevation Monitoring
CCP	Conservation Credits Program
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CLWA	Castaic Lake Water Agency
cm	centimeters
CPA	community planning area
CRA	Colorado River Aqueduct
CRWDA	Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003
CWA	Clean Water Act
CWC	California Water Code
DAC	disadvantaged community
DAMP	drainage area management plan
DBCP	dibromochloropropane
DDT	dichloro-diphenyl-trichloroethane
Delta	Sacramento-San Joaquin Delta
DFW	California Department of Fish and Wildlife

DWR	California Department of Water Resources
EI	energy intensity
EMWD	Eastern Municipal Water District
ENSO	El Niño Southern Oscillation
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GAMA	Groundwater Ambient Monitoring and Assessment
GCM	global climate model
GHG	greenhouse gas
GLAC	Greater Los Angeles County
gpcd	gallons per capita per day
gpm	gallons per minute
GWMA	Gateway Water Management Authority
GWMP	groundwater management plan
GWRS	groundwater replenishment system
HIP	high population scenario
IID	Imperial Irrigation District
IEUA	Inland Empire Utilities Agency
IRWM	integrated regional water management
IWRAP	Integrated Wetlands Regional Assessment Program
IRWD	Irvine Ranch Water District
kWh/af	kilowatt hours per acre foot
LAA	Los Angeles Aqueduct
LACFCD	Los Angeles County Flood Control District
LADPW	Los Angeles County Department of Public Works
LARC	Los Angeles Regional Collaborative for Climate Action and Sustainability
LC	leadership committee
LOP	low-population growth scenario
MCL	maximum contaminant level

MHI	median household income
MOU	memorandum of understanding
MTBE	methyl tertiary butyl ether
MWD	Metropolitan Water District of Southern California
mg/L	milligrams per liter
maf	million acre-feet
mgd	million gallons per day
MS4	municipal separate storm sewer system
MWDOC	Municipal Water District of Orange County
NAHC	Native American Heritage Commission
NPDES	National Pollutant Discharge Elimination System
OCWD	Orange County Water District
OVOV	One Valley One Vision
OWOW	One Water One Watershed
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
RAC	regional advisory committee
RWQCB	regional water quality control board
SAR	Santa Ana River
SARP	Santa Ana River Mainstem Project
SAWPA	Santa Ana Watershed Project Authority
SB	Senate Bill
SBVMWD	San Bernardino Valley Municipal Water District
SCREMP	Santa Clara River Enhancement and Management Plan
SDCWA	San Diego County Water Authority
SEWRF	San Elijo Water Recreation Facility
SGPWA	San Geronio Pass Water Agency
SJHU	San Juan Hydrologic Unit

SOCWMA	South Orange County Watershed Management Area
SNWA	Southern Nevada Water Agency
SUSMP	standard urban stormwater mitigation plan
SWOT	strength, weaknesses, opportunities, and threats
SWRCB	State Water Resources Control Board
taf	thousand acre-feet
taf/yr.	thousand acre-feet per year
TCE	trichloroethylene
TDS	total dissolved solids
TMDL	total maximum daily load
Tri-FACC	Tri-County Funding Area Coordination Committee
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
Update 2009	California Water Plan Update 2009
Update 2013	California Water Plan Update 2013
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
UWMP	urban water management plan
VOC	volatile organic compound
VCWPD	Ventura County Watershed Protection District
WBMWD	West Basin Municipal Water District
WCVC	Watersheds Coalition of Ventura County
WDR	Waste Discharge Requirement
WMWD	Western Municipal Water District
WRCC	Western Regional Climate Center
WRD	Water Replenishment District of Southern California
WRP	Southern California Wetlands Recovery Project
WSD	water storage district
WWTP	wastewater treatment plant



San Diego, CA. This aerial view near San Diego shows the varied terrain and the reach of development, where rural areas and more urbanized areas come together. The South Coast region is home to the largest concentration of population in the state and continues to be a vibrant center for both industry and agriculture.

South Coast Hydrologic Region

South Coast Hydrologic Region Summary

The South Coast Hydrologic Region is the most urbanized and populous region in the state and very dependent on supplemental water supplies. The supplies not only come from the Colorado River, the State Water Project (SWP), and the Eastern Sierra but also from vast groundwater basins within the region, and some recycled water and desalinated water. The region's mild climate, employment opportunities, and recreational venues have resulted in the rapid growth that has occurred within the 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 goal, they have developed and implemented large and diverse water supply, water quality, and water use efficiency projects. Through the emphasis on water conservation and efficiency practices, the total use within the region has not increased nearly as rapidly as would otherwise be expected from the population growth that has occurred. Cooperation between agencies and organizations, including tribal communities and disadvantaged communities and use of integrated resources planning has improved the flexibility and diversity of the region's water supplies.

Current State of the Region

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, which covers 11,000 square miles or 7 percent of the state's total area. The region extends from the Pacific Ocean east to mountains of the Transverse and Peninsular ranges, and from the Ventura-Santa Barbara County line south to the international border with Mexico. It includes all of Orange County and portions of Ventura, Los Angeles, San Bernardino, Riverside, and San Diego counties (see Figure SC-1).

The topography of the South Coast Hydrologic Region, excluding the mountainous portions, provides the ideal conditions to accommodate the steady expansion of the residential, commercial, and industrial developments throughout. Yet there remains sufficient land to sustain the important agricultural operations in Ventura and San Diego counties and the Chino and San Jacinto valleys. The coastal zone encompasses the Oxnard Plain (or the Ventura Basin), the Los Angeles Basin, and the Coastal Plain of Orange County. These alluvial basins are heavily utilized for urban, agricultural, or a combination of both uses. These same uses are also occurring in the South Coast region's warmer interior basins. They are often separated from their coastal counterparts by hills (Chino Hills) and small to moderately sized mountain ranges (Santa Ana and the Santa Monica mountains).

Prominent mountain ranges provide the northern and eastern boundaries of the region. In the north, there are the San Gabriel Mountains and several mountain ranges known collectively as the Ventura County Mountains, which includes the Topatopa Mountains. To the east, there are the San Bernardino, San Jacinto, Borrego, and Vallecito mountains.

Figure SC-1 South Coast Hydrologic Region



Although much of the land in the region is urbanized or is part of agriculture, all or portions of several national and State parks are located in the South Coast Hydrologic Region. They are the Santa Monica Mountains Recreational Area, Los Padres, Angeles, San Bernardino, and Cleveland national forests and Cuyamaca-Rancho, Malibu State, 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 flood flows. The headwaters for many rivers, however, are within coastal mountain ranges and have remained largely undeveloped.

Santa Clara River Planning Area Watersheds

The watersheds of the Santa Clara River planning area provide important habitat and water resources within Ventura and Los Angeles counties. Strategic planning continues 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 the Oxnard Plain).

Ventura River Watershed

The Ventura River watershed covers an area of 227 square miles in the mountains of the western Transverse Range. It is located to the north of the cities of Oxnard and San Buenaventura and includes the scenic Ojai Valley. Drainage is provided by the Ventura River, the northernmost major river system in the region, and its tributaries, which include Matilija and San Antonio creeks. One major reservoir, Lake Casitas, is located in the watershed and provides water supplies downstream for local urban and agricultural users. The watershed provides habitat for a number of sensitive aquatic species, several of which are endangered or threatened — such as steelhead trout. In 2012, the draft Ventura River Watershed Protection Plan was released. It provides guidance on the kinds of environmental data and programs required for a comprehensive plan for the watershed.

Santa Clara River Watershed

The Santa Clara River watershed covers an area of 1,643 square miles. The portion of the watershed in Los Angeles County is also identified as the Upper Santa Clara River watershed, which is about 654 square miles in size. Within Ventura County, the watershed is also known as the Lower Watershed. The upper portion is bounded by the San Gabriel Mountains to the south and southeast, the Santa Susana Mountains to the southwest, and the Liebre Mountains to the northeast and northwest — all of which are part of the Transverse Ranges — and extends westward to the Ventura County line. The main hydrologic feature in the watershed is the Santa Clara River, which is the largest river system in Southern California that remains in a relatively natural state, although it has control channels that help protect communities from flooding and its tributaries have in-stream facilities for water storage like Bouquet and Castaic reservoir and. The river is about 100 miles long and originates in the northern slope of the San Gabriel Mountains in Los Angeles County. From its headwaters, the river travels west, crossing both Los Angeles and Ventura counties before it eventually enters the Pacific Ocean midway between the cities of San Buenaventura and Oxnard. The watershed supports many sensitive aquatic

Figure SC-2 South Coast Hydrologic Region Watersheds



species, including steelhead trout. One of the largest tributaries, Sespe Creek, contains most of the river's remnant, but restorable, run of the steelhead trout. Sespe Creek has been designated as a "Wild Trout Stream" by the State of California and supports significant steelhead spawning and rearing habitat. Additionally, the federal Los Padres Wilderness Act of 1992 permanently set aside portions of the creek for steelhead trout protection and designated Sespe Creek as a wild and scenic river. Urban and some agricultural land use in the watershed exists primarily on the floor of the Santa Clarita Valley. From there, the watershed has a combination of urban and agricultural uses. To meet the water demands, a combination of groundwater, imported water (SWP supplies), and some recycled water supplies are used. The Santa Clara River Enhancement and Management Plan provided guidance to local stakeholders about the kinds of actions and programs that can help sustain and improve the watershed conditions. SCREMP has been replaced by the Watersheds Coalition of Ventura County (WCVC) Integrated Regional Water Management (IRWM) Plan and it continues to provide guidance to help improve the watershed conditions. Additional input is provided by the Santa Clara River IRWM Plan 2013 update.

Additional descriptions of Los Angeles County's significant ecological area designations can be found in Technical Appendix E (Santa Susana Mountains-Simi Hills) of the Los Angeles County Draft General Plan 2035 online at: <http://planning.lacounty.gov/generalplan>.

Calleguas Creek Watershed

The Calleguas Creek watershed covers an area of 343 square miles. Most of the watershed is on the Oxnard Plain; however, it does extend eastward into Los Angeles County, just to the east of Simi Valley city. Its main hydrologic feature is Calleguas Creek, whose headwaters lie near the city of Simi Valley. Arroyo Simi, Arroyo Conejo, and Arroyo Santa Rosa are important tributaries. Much of the western portion of the watershed has intense agricultural land-use activities. Farther east, the agricultural land uses decrease, and urban land uses become more prominent. Some undeveloped areas exist throughout the watershed. The creek flows into Mugu Lagoon, one of Southern California's few remaining large wetlands that support a rich diversity of fish and wildlife. Ventura County has designated the wetland habitat at Mugu as a significant biological resource. The lagoon is adjacent to an area of special biological significance, which also supports a great diversity of wildlife, including several endangered birds and one endangered plant species. Natural water flows in Calleguas Creek are intermittent; however, discharges of treated urban and agricultural wastewaters increase the flows. Unfortunately, the increased flows have resulted in sedimentation in the lagoon. The presence of pesticide residues (dichloro-diphenyl-trichloroethane [DDT]), polychlorinated biphenyls (PCBs), and some metals have had impacts on the aquatic life in both the lagoon and the inland streams. One of the most critical water quality challenges in the watershed is salinity, primarily in surface water supplies. High levels of minerals (particularly salts) and nitrates are also common the groundwater beneath the watershed.

Los Angeles Planning Area Watersheds

The watersheds of the Metropolitan Los Angeles planning area are heavily urbanized and have issues with urban runoff and the loss of ecosystems. This planning area has six major watersheds: Santa Monica Bay, Los Angeles River, Malibu Creek, Ballona Creek, Dominguez Channel, and San Gabriel River. These watersheds begin in the surrounding Santa Monica and San Gabriel mountains and extend 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.

Santa Monica Bay Watershed

The 200-square-mile North Santa Monica Bay watershed is in the Santa Monica Mountains and includes the southwest Los Angeles County and the southeast Ventura County. Much of the watershed remains undeveloped. Urban developments are on the northern margin (cities of Calabasas and Hidden Hills in Los Angeles County and Agoura Hills and Westlake Village in Ventura County) and on the southern margin (unincorporated Los Angeles County and city of Malibu). Agricultural uses are minimal. Riparian habitats continue to exist because many of the mountainous canyons remain undeveloped.

Malibu Creek Watershed

The Malibu Creek watershed covers 109 square miles in Los Angeles and Ventura counties. Most of the watershed lies within the Santa Monica Mountains National Recreation Area, which is managed by the National Park Service. The main hydrologic feature is Malibu Creek, whose headwaters are in the Simi Hills. Tributaries include Las Virgenes Creek and Medea Creek. The Southern California steelhead trout continue to spawn in relatively large numbers in the upper portions of the creek despite Rindge Dam, a major barrier to upstream migration. Near the coast, the creek flows into Malibu Lagoon, which supports two important plant communities — the coastal salt marsh and coastal strand. The lagoon serves as a refuge for migrating birds (over 200 species of birds have been observed). Oak and riparian woodlands are supported in the Malibu Canyon area. Pollutants of concern, many of which are discharged from non-point-sources, include excess nutrients, sediment, and bacteria.

Ballona Creek Watershed

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 to 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, as well as 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. The California Department of Fish and Wildlife (DFW) (formerly the California Department of Fish and Game), State Coastal Conservancy, and California State Lands Commission are developing a restoration plan for the wetlands. DFW issued a notice of preparation for an environmental impact report on the plan. Ideas for consideration include repositioning existing levees for flood protection of the urban area around wetlands, helping to restore native habitat, and establishing facilities for walking and bird watching.

Los Angeles River Watershed

The 834-square-mile Los Angeles River watershed is shaped by the Los Angeles River, which flows from its headwaters in the San Gabriel 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. Today, more than 90 percent of the Los Angeles River is concrete-lined to control surface runoff and reduce the impacts from major flood events. The Los Angeles River Revitalization Master Plan was approved by the City of Los Angeles City Council in 2007. The plan has more than 200 proposed projects to rehabilitate the riparian vegetation in certain sections of the river and establish or refurbish landscape areas/parks, bikeways, and pedestrian walkways along the river and in adjoining neighborhoods. Before the plan can be implemented, results are needed from several feasibility studies either under way or planned. One such study is being conducted by the U.S. Army Corps of Engineers (USACE) to determine the feasibility of re-establishing riparian vegetation along the Los Angeles River at different locations.

Dominguez Channel Watershed

The 110-square-mile Dominguez Channel watershed in southern Los Angeles County is 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 Dominguez Watershed Advisory Council was formed and is working on a management plan for the watershed. The plan will provide an overview of the conditions, problems, and issues in the watershed. It also will establish targets or goals and provide recommendations on how to achieve them.

San Gabriel River Watershed

The San Gabriel River watershed covers an area of 640 square miles and is in eastern Los Angeles County. The watershed extends to the coast and is a prominent member of the Transverse Ranges geologic zone. The watershed's main hydrologic feature is the San Gabriel River, which flows from north to south. Upper areas of the watershed are undeveloped. Large areas of undisturbed riparian and woodland habitats exist, although flood control dams are on the river to protect the communities below the mountains and capture stormwater for the communities' water supply. In this part of the watershed, the San Gabriel River has a West Fork and an East Fork. Most of this part of the river's watershed is set aside as a wilderness area. Descending from the mountains, large spreading grounds for groundwater recharge are in operation. The river in the lower part of the watershed has a concrete-lined channel for the protection of people and property in this heavily urbanized sector. The river is once again unlined before entering the Pacific Ocean at the city of Long Beach. The lower watershed encompasses an area that historically consisted of extensive wetlands. A study is under way by the National Park Service to examine the recreational and open space needs for the San Gabriel River watershed. Also, the study will identify strategies to protect and enhance the natural resources and environmental habitat. The study is titled San Gabriel Watershed and Mountains Special Resource Study and is authorized under Public Law 108-042.

Santa Ana Planning Area Watersheds and Subwatersheds

Urban development in the Santa Ana area was occurring at a steady pace until the years preceding the 2008 financial recession. Open space and agricultural lands were used to accommodate the growth. Although many challenges in the Santa Ana planning area are related

to urban development, other challenges include 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. Through its watershed-scale planning process known as One Water One Watershed, the Santa Ana Watershed Project Authority (SAWPA) has developed an IRWM plan.

Santa Ana River Watershed

The Santa Ana River (SAR) watershed (Figure SC-3) drains a 2,650 square-mile area. The watershed is home to more than 6 million people and includes portions of the major population centers of Orange, Riverside, and San Bernardino counties, as well as a small portion of Los Angeles County.

The SAR flows more than 100 miles and drains the largest coastal stream system in Southern California. It discharges into the Pacific Ocean at the city of Huntington Beach. The total length of the SAR and its major tributaries is about 700 miles.

Today, only 20 percent of the SAR is a concrete channel, mostly near its mouth. Discharges from publicly owned wastewater treatment facilities along the river have altered the natural surface flows in the river. The discharges help in providing year-round river flow. As populations have increased, urban runoff and wastewater flows have increased. Between 1970 and 2000, the total average volume rose from less than 50,000 acre-feet per year (af/yr.) to more than 146,000 af/yr., as measured at the Prado Dam. Since 2004, however, baseflow has decreased every year from a high of 154,000 acre-feet (af) to 93,000 af for the year ending on September 30, 2012.

Operation of Prado Dam has altered natural sediment transport in the Santa Ana River. Sediment accumulates behind the dam resulting in loss of sediment in river water below the dam, which causes erosion and armoring in the riverbed downstream of the dam. In addition, rapid urbanization has artificially increased the rate of sedimentation and loss of habitat in this part of the watershed. Water quality and wildlife habitat are being negatively affected.

In the southern portion of the watershed, the regional boundary divides the Santa Margarita River drainage area, which is not part of the watershed, from that of the San Jacinto River. The San Jacinto River, which is part of the watershed, flows from the San Jacinto Mountains westerly through Canyon Lake and ends in Lake Elsinore. In wet years, the San Jacinto River will overflow the lake and connect with the SAR through the Temescal Wash.

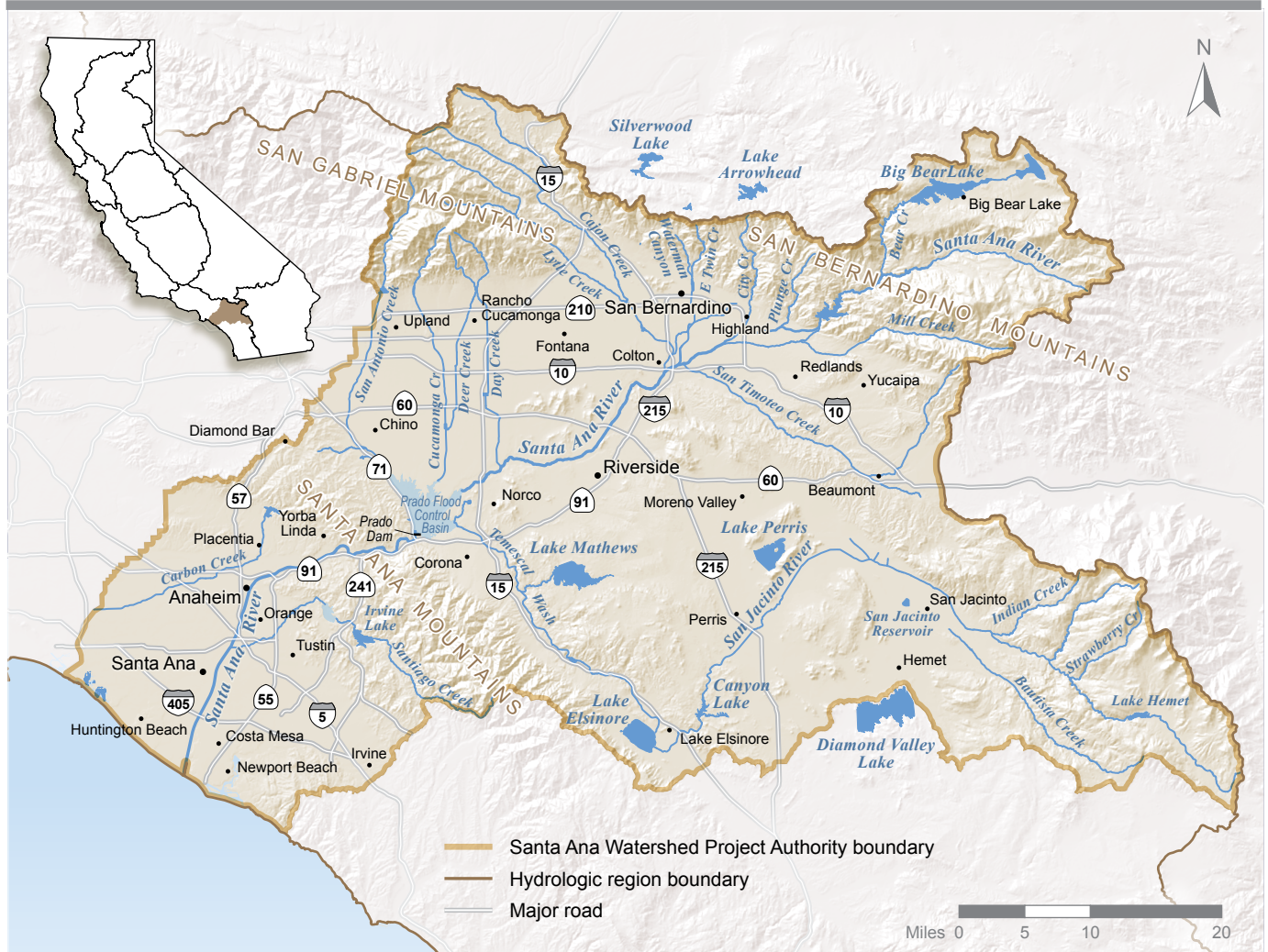
The watershed also contains several human-made water storage facilities, including Diamond Valley Reservoir, Lake Mathews, Lake Perris, and Big Bear Lake. Other flood control facilities along the river are Prado and Seven Oaks dams. The watershed is heavily urbanized, though some agricultural uses and undeveloped areas remain today. In the upper portion of the

watershed, urbanization is a factor in the degradation of sensitive aquatic and riparian habitats and has affected local water quality. The watershed continues to have riparian, wetland, and other wildlife habitat. A visual “fly-through” of the Santa Ana Watershed is available online at: <http://www.youtube.com/watch?v=HXDQCXKP6IM>.



Orange County. Prado constructed wetlands provide both ecosystem and water quality improvements.

Figure SC-3 Santa Ana River Watershed



San Diego Creek Subwatershed

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 tributary to the SAR watershed. Erosion of the creek channels in the subwatershed 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.

San Jacinto River Subwatershed

The 765-square-mile San Jacinto River subwatershed is in western Riverside County and is a tributary to the SAR 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.

San Juan Creek Watershed

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. The watershed is drained 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.

San Margarita River Watershed

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 U.S. 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 thus is able to support a relative abundance of functional habitats and wildlife. The upper portion is one of the fastest growing areas in California. Issues include excessive nutrient inputs, erosion and sedimentation, groundwater degradation and contamination with nitrates and other salts, habitat loss, channelization, and flooding.

San Luis Rey Watershed

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 flood flows 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 headwaters. Water supplies from the dam are used downstream for urban uses in the city of Escondido and the 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, 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.

Carlsbad Watershed

The 210-square-mile Carlsbad watershed is in the coastal margin of San Diego County and has six smaller watersheds that 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.

San Dieguito River Watershed

The 346-square-mile San Dieguito River watershed extends westward from the Volcan Mountains to San Dieguito Lagoon near the City of Del Mar, its outlet to the Pacific Ocean. 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.

San Diego River Watershed

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 as a result of urban runoff and sewage spills. Excessive groundwater extraction, increasing TDS, and methyl tertiary butyl ether (MTBE) contamination threatens this limited resource.

Sweetwater River Watershed

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. Stormwater outfalls provide some flows and nutrients to the bay but not with natural seasonality, timing, frequency, or content.

Otay River Watershed

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 miles of this watershed are covered by the San Diego Multiple Species Conservation Plan, which 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.

Tijuana River Watershed

The 1,700-square-mile Tijuana River watershed is a bi-national watershed on the westernmost portion of the U.S./Mexico border (455 square miles in the United States and 1,245 square miles in Mexico). 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 gauged 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.

Groundwater Aquifers and Wells

Groundwater resources in the South Coast Hydrologic Region are supplied by alluvial and fractured rock aquifers. Alluvial aquifers are composed of sand and gravel or finer grained sediments, with groundwater stored within the voids, or pore space, between the alluvial sediments. Fractured-rock aquifers consist of impermeable granitic, metamorphic, volcanic, and hard sedimentary rocks, with groundwater being stored within cracks, fractures, or other void spaces. The distribution and extent of alluvial and fractured-rock aquifers and water wells vary within the region. A brief description of the aquifers in the region is provided below.

Alluvial Aquifers

The South Coast Hydrologic Region contains 73 alluvial groundwater basins and subbasins that are recognized in *Bulletin 118-2003* and underlie approximately 3,500 square miles, or 32 percent, of the region (California Department of Water Resources 2003). The majority of the groundwater in the region is stored in alluvial aquifers.

Figure SC-4 shows the location of the alluvial groundwater basins and subbasins, and Table SC-1 lists the associated names and numbers. Most of the groundwater used in the South Coast region is derived from alluvial aquifers. The most heavily extracted groundwater basins in the region are the Coastal Plain of Los Angeles, Coastal Plain of Orange County, the Upper Santa Ana Valley, and the Santa Clara River Valley groundwater basins.

Fractured-Rock Aquifers

Fractured-rock aquifers are typically found in the mountain and foothill areas adjacent to alluvial groundwater basins. Owing to the highly variable nature of the void spaces within fractured-rock aquifers, wells drawing from fractured-rock aquifers tend to have less capacity and less reliability than wells drawing from alluvial aquifers. On average, wells drawing from fractured-

Figure SC-4 Alluvial Groundwater Basins and Subbasins within the South Coast Hydrologic Region



Table SC-1 Alluvial Groundwater Basins and Subbasins within the South Coast Hydrologic Region

Basin/Subbasin		Basin Name	Basin/Subbasin		Basin Name
4-1		Upper Ojai Valley		8-2.07	Yucaipa
4-2		Ojai Valley		8-2.08	San Timoteo
4-3		Ventura River Valley		8-2.09	Temescal
	4-3.01	Upper Ventura River	8-4		Elsinore
	4-3.02	Lower Ventura River	8-5		San Jacinto
4-4		Santa Clara River Valley	8-6		Hemet Lake Valley
	4-4.02	Oxnard	8-7		Big Meadows Valley
	4-4.03	Mound	8-8		Seven Oaks Valley
	4-4.04	Santa Paula	8-9		Bear Valley
	4-4.05	Fillmore	9-1		San Juan Valley
	4-4.06	Piru	9-2		San Mateo Valley
	4-4.07	Santa Clara River Valley East	9-3		San Onofre Valley
4-5		Acton Valley	9-4		Santa Margarita Valley
4-6		Pleasant Valley	9-5		Temecula Valley
4-7		Arroyo Santa Rosa Valley	9-6		Cahuilla Valley
4-8		Las Posas Valley	9-7		San Luis Rey Valley
4-9		Simi Valley	9-8		Warner Valley
4-10		Conejo Valley	9-9		Escondido Valley
4-11		Coastal Plain Of Los Angeles	9-10		San Pasqual Valley
	4-11.01	Santa Monica	9-11		Santa Maria Valley
	4-11.02	Hollywood	9-12		San Dieguito Creek
	4-11.03	West Coast	9-13		Poway Valley
	4-11.04	Central	9-14		Mission Valley

Basin/Subbasin		Basin Name	Basin/Subbasin		Basin Name
4-12		San Fernando Valley	9-15		San Diego River Valley
4-13		San Gabriel Valley	9-16		El Cajon Valley
4-15		Tierra Rejada	9-17		Sweetwater Valley
4-16		Hidden Valley	9-18		Otay Valley
4-17		Lockwood Valley	9-19		Tia Juana
4-18		Hungry Valley	9-22		Batiquitos Lagoon Valley
4-19		Thousand Oaks Area	9-23		San Elijo Valley
4-20		Russell Valley	9-24		Pamo Valley
4-22		Malibu Valley	9-25		Ranchita Town Area
4-23		Raymond	9-27		Cottonwood Valley
8-1		Coastal Plain Of Orange County	9-28		Campo Valley
8-2		Upper Santa Ana Valley	9-29		Potrero Valley
	8-2.01	Chino	9-32		San Marcos Area
	8-2.02	Cucamonga			
	8-2.03	Riverside-Arlington			
	8-2.04	Rialto-Colton			
	8-2.05	Cajon			
	8-2.06	Bunker Hill			

rock aquifers yield 10 gallons per minute (gpm) or less. Although fractured-rock aquifers are less productive compared with alluvial aquifers, they commonly serve as the sole source of water and a critically important water supply for many communities.

More detailed information regarding the aquifers in the South Coast Hydrologic Region is available online from *California Water Plan Update 2013* (Update 2013), Volume 4, *Reference Guide*, the article, “California’s Groundwater Update 2013” and in California Department of Water Resources (DWR) *Bulletin 118-2003* (2003).

Well Infrastructure and Distribution

Well logs submitted to DWR for water supply wells completed from 1977 to 2010 were used to evaluate the distribution of water wells and the uses of groundwater in the South Coast region. Many wells could have been drilled prior to 1977 or without submitted well logs. As a result, the total number wells in the region is probably higher than what is reported here. DWR does not have well logs for all the wells drilled in the region; and for some well logs, information regarding well location or use is inaccurate, incomplete, ambiguous, or missing. Hence, some well logs could not be used in the current assessment. However, for a regional-scale evaluation of well installation and distribution, the quality of the data is considered adequate and informative.

The number and distribution of wells in the region are grouped according to their location by county and according to six most common well-use types — domestic, irrigation, public supply, industrial, monitoring, and other. Public supply wells include all wells identified in the well completion report as municipal or public. Wells identified as “other” include a combination of the less common well types, such as stock wells, test wells, or unidentified wells (no information listed on the well log).

Well log data for counties that fall within multiple hydrologic regions were assigned to the hydrologic region containing the majority of alluvial groundwater basins within the county. Well log information listed in Table SC-2 and illustrated in Figure SC-5 show that the distribution and number of wells vary widely by county and by use.

The total number of wells installed in the region between 1977 and 2010 is approximately 37,000 and ranges from a high of about 15,000 in San Diego County to fewer than 3,000 in Ventura County. In most counties, monitoring wells make up the majority of well logs — 7,600 in Los Angeles County, followed by about 3,900 in Orange County. San Diego County also has a relatively high number of monitoring wells (3,300), but the number of domestic wells there (6,800) is more than double the number of monitoring wells. A high percentage of monitoring wells compared with other well types in a community may indicate the presence of groundwater quality monitoring to help characterize groundwater quality issues.

Figure SC-6 shows that domestic wells make up nearly 30 percent of well logs for the region, while irrigation wells account for about 10 percent of well logs. Monitoring wells comprise more than 40 percent of well logs.

Figure SC-7 shows a cyclic pattern of well installation for the region, with new well construction ranging from about 100 to 2,100 wells per year. The average number of new wells constructed is about 1,100 wells per year.

The fluctuation in domestic well drilling is likely associated with population booms and residential housing construction. The increase in the number of domestic wells drilled during the late 1980s and early 1990s as well as early through mid-2000s is likely due to growth in housing construction. Similarly, the decrease in the number of domestic wells drilled from 2007 to 2010 is likely due to declining economic conditions and the related drop in housing construction. A portion of the lower number of well logs recorded for 2009 and 2010 could also be due to delays in receiving and processing well drillers logs.

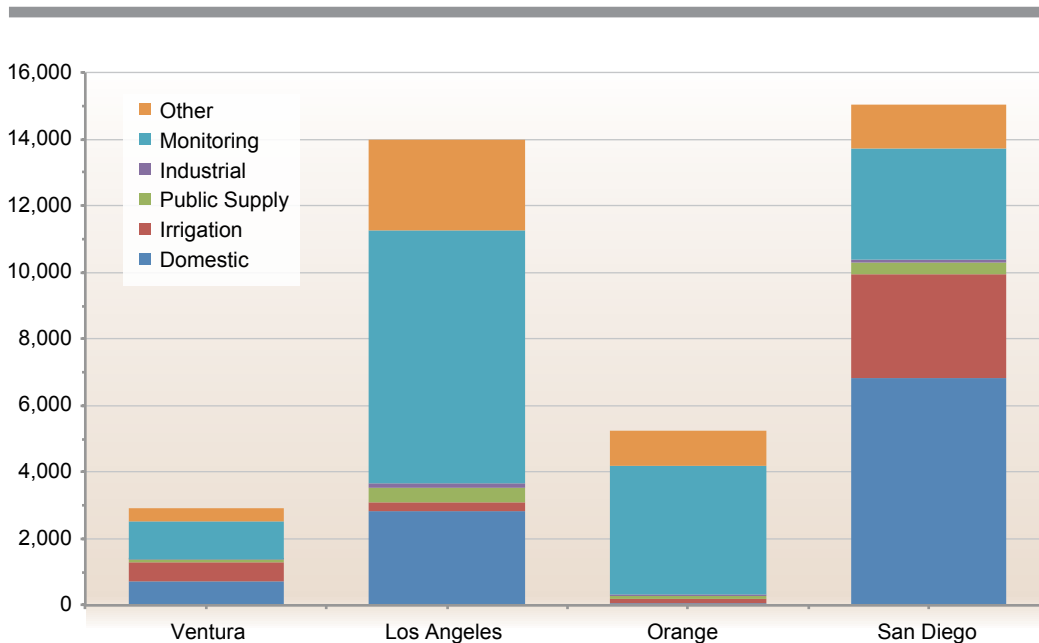
The onset of monitoring well installation in the mid to late 1980s is likely associated with federal underground storage tank programs signed into law in the mid-1980s. Information on the well

Table SC-2 Number of Well Logs by County and Use for the South Coast Hydrologic Region (1977-2010)

County	Total Number of Well Logs by Well Use						Total Well Records
	Domestic	Irrigation	Public Supply	Industrial	Monitoring	Other	
Ventura	707	571	95	21	1,148	356	2,898
Los Angeles	2,820	283	425	128	7,611	2,705	13,972
Orange	59	114	125	23	3,863	1,054	5,238
San Diego	6,828	3,099	384	88	3,313	1,329	15,041
Total Well Records	10,414	4,067	1,029	260	15,935	5,444	37,149

Note: Table represents well log data as of July 2012.

Figure SC-5 Number of Well Logs by County and Use for the South Coast Hydrologic Region (1977-2010)



logs supports a conclusion that the majority of the monitoring wells were installed for use in environmental assessments and remediation projects related to leaking underground storage tanks, waste disposal sites, and hazardous chemical spills.

Irrigation well installation tends to closely follow changes in hydrology, cropping patterns, and the availability of surface water supply. Figure SC-7 shows a relatively steady number (100-200) of irrigation wells installed annually, with the exception of 1991. In 1991, more than 500

irrigation wells were installed in the region, perhaps in response to the drought of 1987-1992.

More detailed information regarding assumptions and methods of reporting well log information is available online from Update 2013, Volume 4, *Reference Guide*, the article, “California’s Groundwater Update 2013.”

South Coast Hydrologic Region Groundwater Monitoring Efforts

Groundwater resource monitoring and evaluation are keys to understanding groundwater conditions, identifying effective resource management strategies, and implementing sustainable resource management practices. The California Water Code (CWC) Section 10753.7 requires local agencies seeking State funds administered by DWR to prepare and implement groundwater management plans that include monitoring of groundwater levels, groundwater quality degradation, inelastic land subsidence, and changes in surface water flow and quality that directly affect groundwater levels or quality. This section summarizes some of the groundwater level, groundwater quality, and land subsidence monitoring efforts within the South Coast Hydrologic Region. Information included is only from active monitoring wells, which have been measured since January 1, 2010.

Additional information regarding the methods, assumptions, and data availability associated with the groundwater monitoring is available online from Update 2013, Volume 4, *Reference Guide*, the article, “California’s Groundwater Update 2013.”

Groundwater Level Monitoring

To strengthen existing groundwater level monitoring in the state by DWR, the U.S. Geological Survey (USGS), U.S. Bureau of Reclamation (USBR), local agencies, and communities, the California Legislature passed Senate Bill (SB) X7 6 in 2009. This law requires that groundwater elevation data be collected in a systematic manner on a statewide basis and be made readily and widely available to the public. DWR was charged with administering the program, which is now known as California Statewide Groundwater Elevation Monitoring (CASGEM).

The locations of monitoring wells by monitoring entity and monitoring well type in the South Coast region are shown in Figure SC-8. Observation wells, other wells, irrigation wells, public supply wells, and domestic wells account for 35, 29, 19, 13, and 4 percent of the monitoring wells in the region, respectively.

A list of the number of monitoring wells in the region by monitoring agencies, cooperators, and CASGEM monitoring entities is provided in Table SC-3. Groundwater levels have been actively monitored in 1,727 wells in the region since 2010. DWR monitors 250 wells in three basins within the region, but only 17 can be shown because data from all wells are not publicly available due to privacy agreements with well owners or operators. The USGS monitors 339 wells in 15

Figure SC-6 Percentage of Well Logs by Use for the South Coast Hydrologic Region (1977-2010)

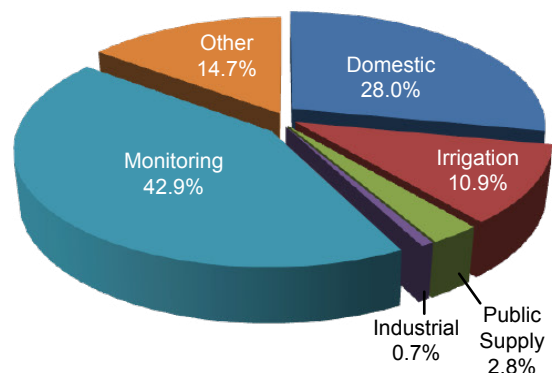
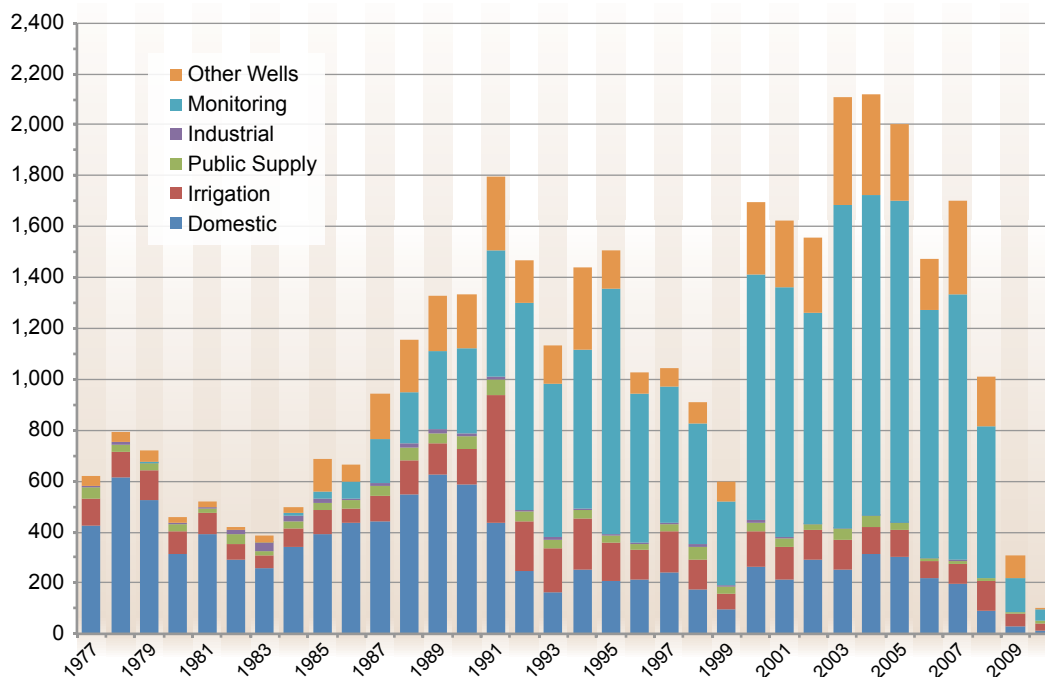


Figure SC-7 Number of Well Logs Filed per Year by Use for the South Coast Hydrologic Region (1977-2010)



basins and subbasins; and 15 designated CASGEM-monitoring entities monitor the remaining 1,332 wells in 34 basins and subbasins. Additional 60 wells, not included in Table SC-3 and not shown in Figure SC-8, monitor Santa Clara River Valley East Subbasin. The associated monitoring entities include the Castaic Lake Water Agency, Los Angeles County Waterworks District 36, Santa Clarita Water Division, Valencia Water Company, Whittaker Bermite, Wayside Honor Rancho, and private well owners.

CASGEM Basin Prioritization

Figure SC-9 shows the groundwater basin prioritization for the South Coast region. Of the 73 basins and subbasins within the region, 14 were identified as high priority, 22 as medium priority, 5 as low priority, and the remaining 32 as very low priority. Table SC-4 lists the high and medium CASGEM priority groundwater basins for the region. The 36 basins and subbasins designated as high or medium priority include 94 percent of the population and account for 96 percent of groundwater supply in the region. Basin prioritization could be a valuable tool to help evaluate, focus, and align limited resources for effective groundwater management and reliable and sustainable groundwater resources.

More detailed information on groundwater basin prioritization is available at http://www.water.ca.gov/groundwater/casgem/basin_prioritization.cfm.

Figure SC-8 Monitoring Well Location by Agency, Monitoring Cooperator, and CASGEM Monitoring Entity in the South Coast Hydrologic Region

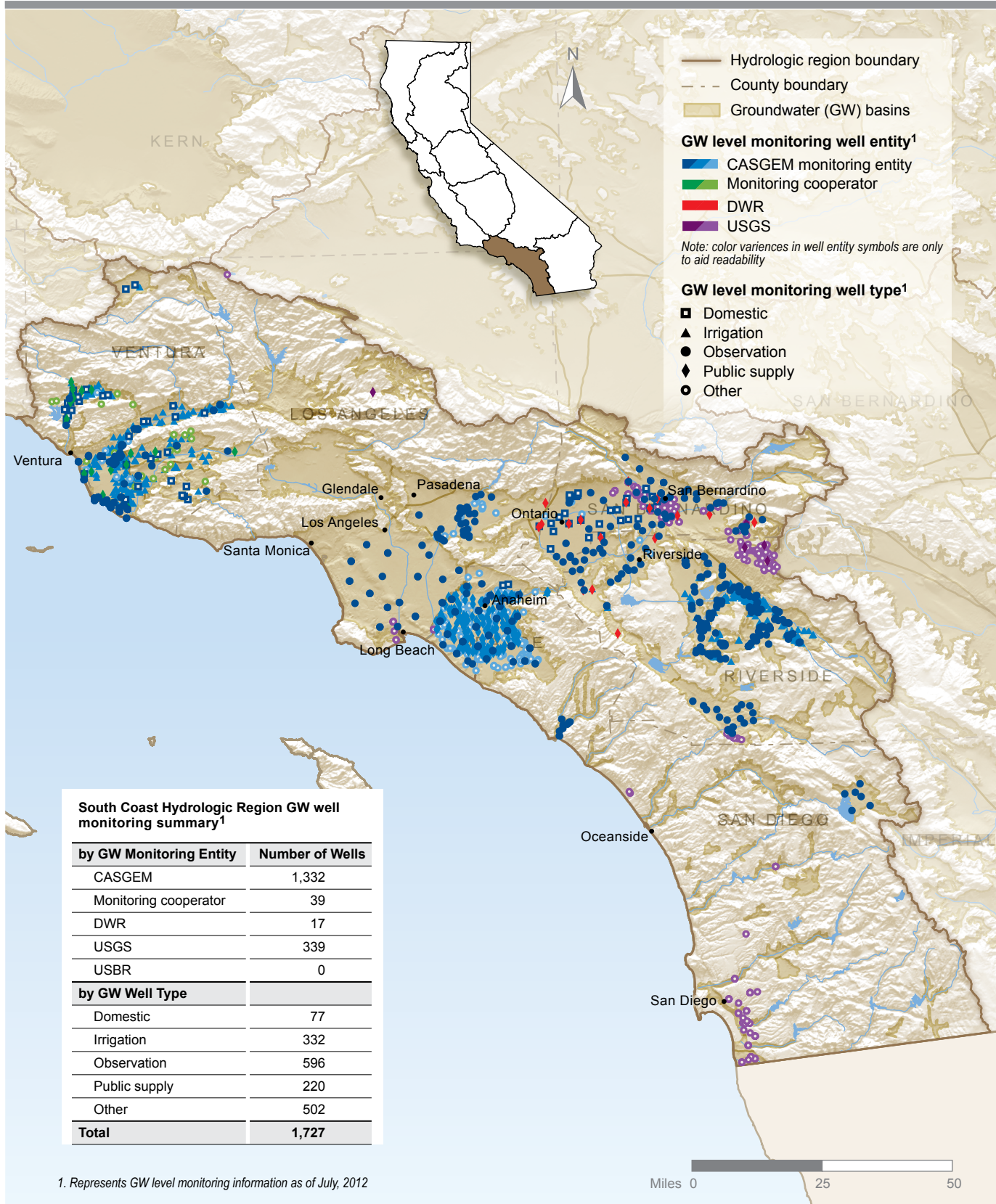


Table SC-3 Groundwater Level Monitoring Wells by Monitoring Entity in the South Coast Hydrologic Region

State and Federal Agencies	Number of Wells
California Department of Water Resources (DWR)	17 (see note)
U.S. Geological Survey	339
Total State and Federal Wells:	356
Monitoring Cooperators	Number of Wells
Ventura County Flood Control District (see note)	39
Total Cooperator Wells:	39
CASGEM Monitoring Entities	Number of Wells
Chino Basin Watermaster	46
County of Ventura, Watershed Protection District	362
Eastern Municipal Water District	312
Main San Gabriel Basin Watermaster	42
Orange County Water District	372
Puente Basin Watermaster	13
Rancho California Water District	25
Raymond Basin Management Board	24
San Bernardino Valley Municipal Water District	43
San Geronio Pass Water Agency	14
San Juan Basin Authority	9
Six Basins Watermaster	12
Vista Irrigation District	6
Water Replenishment District of Southern California	28
Western Municipal Water District	24
Total CASGEM Monitoring Wells:	1,332
Grand Total:	1,727

Notes: CASGEM = California Statewide Groundwater Elevation Monitoring.

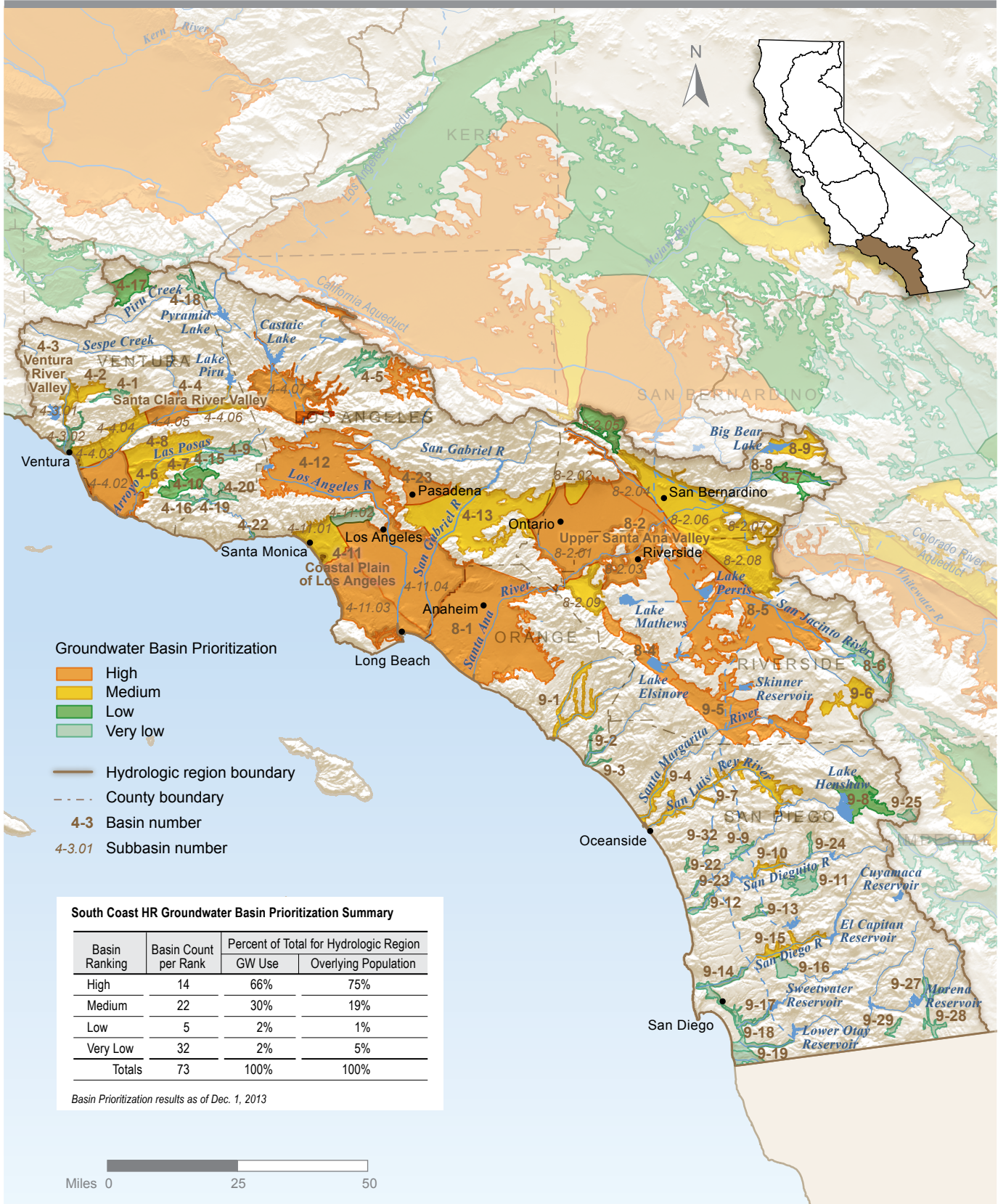
Table includes groundwater level monitoring wells having publicly available online data. DWR currently monitors 250 wells in the South Coast Hydrologic Region; however, not all of these data are publicly available due to privacy agreements with well owners or operators.

The Ventura County Flood Control District is now referred to as the County of Ventura, Watershed Protection District.

Additional 60 wells monitor Santa Clara River Valley East subbasin. The associated monitoring entities include the Castaic Lake Water Agency, Los Angeles County Waterworks District 36, Santa Clarita Water Division, Valencia Water Company, Whittaker Bermite, Wayside Honor Rancho, and private well owners.

Table represents monitoring information as of July 2012.

Figure SC-9 CASGEM Groundwater Basin Prioritization for the South Coast Hydrologic Region



Groundwater Quality Monitoring

Groundwater quality monitoring is an important aspect of effective groundwater basin management and is one of the components required to be included in groundwater management planning so that local agencies may be eligible for State funds. Numerous State, federal, and local agencies participate in groundwater quality monitoring efforts throughout California. Regional and statewide groundwater quality monitoring information and data are available on the State Water Resources Control Board's (SWRCB's) Groundwater Ambient Monitoring and Assessment (GAMA) Web site and the GeoTracker GAMA groundwater information system developed as part of the Groundwater Quality Monitoring Act of 2001. The GAMA Web site describes GAMA program and provides links to all published GAMA and related reports. The GeoTracker GAMA groundwater information system geographically displays information and includes analytical tools and reporting features to assess groundwater quality. This system currently includes groundwater data from the SWRCB, regional water quality control boards (RWQCBs), California Department of Public Health (CDPH), Department of Pesticide Regulation, DWR, USGS, and Lawrence Livermore National Laboratory. In addition to groundwater quality data, GeoTracker GAMA has more than 2.5-million depth-to-groundwater measurements from the RWQCBs and DWR and oil and gas hydraulically fractured well information from the California Division of Oil, Gas, and Geothermal Resources. Table SC-5 provides agency-specific groundwater quality information.

Land Subsidence Monitoring

Land subsidence occurs in areas experiencing significant declines in groundwater levels. When groundwater is extracted from aquifers in sufficient quantity, the groundwater level is lowered; and the water pressure, which supports the sediment grains structure, decreases. In unconsolidated deposits, as aquifer pressures decrease, the increased weight from overlying sediments may compact the fine-grained sediments and permanently decrease the porosity of the aquifer and the ability of the aquifer to store water. Elastic land subsidence is the reversible and temporary fluctuation of earth's surface in response to seasonal groundwater extraction and recharge. Inelastic land subsidence is the irreversible and permanent decline in the earth's surface due to the collapse or compaction of the pore structure within the fine-grained portions of an aquifer system (U.S. Geological Survey 1999). Land subsidence thus results in irreversible compaction of the aquifer and permanent loss of aquifer storage capacity, and has serious effects on groundwater supply and development. Land subsidence due to aquifer compaction causes costly damage to the gradient and flood capacity of conveyance channels, to water system infrastructure (including wells), and to farming operations.

In the South Coast region, land subsidence associated with groundwater withdrawal has been documented in the Chino, Coastal Plain of Orange County, Oxnard, and San Jacinto groundwater basins. Results associated with the subsidence monitoring are provided under the "Land Subsidence" section later in this report.

Ecosystems

Diversity in topography, soils, and microclimates of the region supports a corresponding variety of plant and animal communities. Native vegetation in the region can be categorized into a number of general plant communities, including grasslands, coastal sage scrub, chaparral, oak woodland, riparian, pinyon-juniper, and timber-conifer.

Table SC-4 CASGEM Groundwater Basin Prioritization for the South Coast Hydrologic Region

Basin Prioritization	Count	Basin/Subbasin Number	Basin Name	Subbasin Name	2010 Census Population
High	1	4-11.04	Coastal Plain of Los Angeles	Central	3,052,303
High	2	9-5	Temecula Valley		219,431
High	3	4-4.02	Santa Clara River Valley	Oxnard	235,973
High	4	8-2.01	Upper Santa Ana Valley	Chino	898,653
High	5	4-4.07	Santa Clara River Valley	Santa Clara River Valley East	221,204
High	6	8-2.03	Upper Santa Ana Valley	Riverside-Arlington	336,884
High	7	8-2.04	Upper Santa Ana Valley	Rialto-Colton	145,832
High	8	4-12	San Fernando Valley		1,745,338
High	9	4-23	Raymond		223,100
High	10	4-4.05	Santa Clara River Valley	Fillmore	16,417
High	11	8-4	Elsinore		60,946
High	12	4-11.03	Coastal Plain of Los Angeles	West Coast	1,195,195
High	13	8-1	Coastal Plain of Orange County		2,309,966
High	14	8-5	San Jacinto		474,317
Medium	1	8-2.07	Upper Santa Ana Valley	Yucaipa	65,180
Medium	2	4-4.04	Santa Clara River Valley	Santa Paula	46,816
Medium	3	4-13	San Gabriel Valley		1,275,187
Medium	4	8-2.08	Upper Santa Ana Valley	San Timoteo	54,169
Medium	5	9-7	San Luis Rey Valley		43,942
Medium	6	4-11.01	Coastal Plain of Los Angeles	Santa Monica	465,606
Medium	7	8-2.02	Upper Santa Ana Valley	Cucamonga	51,001
Medium	8	4-4.06	Santa Clara River Valley	Piru	2,666
Medium	9	4-6	Pleasant Valley		69,392
Medium	10	9-10	San Pasqual Valley		968
Medium	11	8-2.06	Upper Santa Ana Valley	Bunker Hill	363,394
Medium	12	8-2.09	Upper Santa Ana Valley	Temescal	141,436
Medium	13	9-4	Santa Margarita Valley		4,121
Medium	14	4-8	Las Posas Valley		39,835

Basin Prioritization	Count	Basin/Subbasin Number	Basin Name	Subbasin Name	2010 Census Population
Medium	15	4-7	Arroyo Santa Rosa Valley		2,211
Medium	16	9-6	Cahuilla Valley		1,993
Medium	17	9-15	San Diego River Valley		45,800
Medium	18	4-3.01	Ventura River Valley	Upper Ventura River	15,961
Medium	19	8-9	Bear Valley		16,866
Medium	20	4-4.03	Santa Clara River Valley	Mound	77,886
Medium	21	4-2	Ojai Valley		8,268
Medium	22	9-1	San Juan River Valley		61,131
Low	5	See <i>California Water Plan Update 2013, Volume 4 Reference Guide</i> , the article "California's Groundwater Update 2013."			
Very Low	32	See <i>California Water Plan Update 2013, Volume 4 Reference Guide</i> , the article "California's Groundwater Update 2013."			
Totals:	73	Population of groundwater basin area: 14,849,557			
Notes:					
Senate Bill X7 6 (SB X7 6; Part 2.11 to Division 6 of the California Water Code Sections 10920 et seq.) requires, as part of the CASGEM program, DWR to prioritize groundwater basins to help identify, evaluate, and determine the need for additional groundwater level monitoring by considering available data that include the population overlying the basin, the rate of current and projected growth of the population overlying the basin, the number of public supply wells that draw from the basin, the total number of wells that draw from the basin, the irrigated acreage overlying the basin, the degree to which persons overlying the basin rely on groundwater as their primary source of water, any documented impacts on the groundwater within the basin, including overdraft, subsidence, saline intrusion, and other water quality degradation, and any other information determined to be relevant by the DWR.					
Using groundwater reliance as the leading indicator of basin priority, DWR evaluated California's 515 alluvial groundwater basins and categorized them into five groups - very high, high, medium, low, and very low.					

Chaparral is the most common type of vegetation association in the region. It is generally located on steeper slopes and has characteristics that make it highly flammable. Large expanses of chaparral are found in the Santa Monica Mountains, Simi Hills, Santa Susanna Mountains, Verdugo Hills, and San Gabriel Mountains. Oak woodland is dominant in Thousand Oaks, Lake Casitas, Hidden Valley, Santa Clarita Valley, and elsewhere in the Transverse Ranges. Grasslands occur in Point Mugu State Park and on the hillsides and in the valleys of northern Los Angeles.

Riparian vegetation, found along most of the rivers and creeks, consists of sycamores, willows, cottonwoods, and alders. Extensive riparian corridors occur along Piru, Sespe, Santa Paula, Malibu, and Las Virgenes creeks and the Santa Clara and Ventura rivers, as well as along other rivers and creeks of the Los Padres and Angeles national forests. The riparian vegetation provides essential habitat and transportation corridors for wildlife, supporting a great abundance and diversity of species.

Sandy beaches are the most prominent and dominant habitat along the shoreline. Beaches support species of macroinvertebrates, such as sand crabs and Pismo clams. They also support surf fish,

Table SC-5 Sources of Groundwater Quality Information

Agency	Links to Information
<p>State Water Resources Control Board http://www.waterboards.ca.gov/</p>	<p>Groundwater http://www.waterboards.ca.gov/water_issues/programs/#groundwater</p> <ul style="list-style-type: none"> • Communities that Rely on a Contaminated Groundwater Source for Drinking Water http://www.waterboards.ca.gov/water_issues/programs/gama/ab2222/index.shtml • Nitrate in Groundwater: Pilot Projects in Tulare Lake Basin/Salinas Valley http://www.waterboards.ca.gov/water_issues/programs/nitrate_project/index.shtml • Hydrogeologically Vulnerable Areas http://www.waterboards.ca.gov/gama/docs/hva_map_table.pdf • Aquifer Storage and Recovery http://www.waterboards.ca.gov/water_issues/programs/asr/index.shtml • Central Valley Salinity Alternatives for Long-Term Sustainability (CV-Salts) http://www.waterboards.ca.gov/centralvalley/water_issues/salinity/ <p>GAMA http://www.waterboards.ca.gov/gama/index.shtml</p> <ul style="list-style-type: none"> • GeoTracker GAMA (Monitoring Data) http://www.waterboards.ca.gov/gama/geotracker_gama.shtml • Domestic Well Project http://www.waterboards.ca.gov/gama/domestic_well.shtml • Priority Basin Project http://www.waterboards.ca.gov/water_issues/programs/gama/sw_basin_assesmt.shtml • Special Studies Project http://www.waterboards.ca.gov/water_issues/programs/gama/special_studies.shtml • California Aquifer Susceptibility Project http://www.waterboards.ca.gov/water_issues/programs/gama/cas.shtml <p>Contaminant sites</p> <ul style="list-style-type: none"> • Land Disposal Program http://www.waterboards.ca.gov/water_issues/programs/land_disposal/ • Department of Defense Program http://www.waterboards.ca.gov/water_issues/programs/dept_of_defense/ • Underground Storage Tank Program http://www.waterboards.ca.gov/ust/index.shtml • Brownfields http://www.waterboards.ca.gov/water_issues/programs/brownfields/
<p>California Department of Toxic Substance Control http://www.dtsc.ca.gov/</p>	<p>EnviroStor http://www.envirostor.dtsc.ca.gov/public/</p>
<p>California Department of Pesticide Regulation http://www.cdpr.ca.gov/</p>	<p>Groundwater Protection Program http://www.cdpr.ca.gov/docs/emon/grndwtr/index.htm</p> <ul style="list-style-type: none"> • Well Sampling Database http://www.cdpr.ca.gov/docs/emon/grndwtr/gwp_sampling.htm • Groundwater Protection Area Maps http://www.cdpr.ca.gov/docs/emon/grndwtr/gwpa_maps.htm

Agency	Links to Information
California Department of Public Health http://www.cdph.ca.gov/Pages/DEFAULT.aspx	Division of Drinking Water and Environmental Management http://www.cdph.ca.gov/programs/Pages/DDWEM.aspx <ul style="list-style-type: none"> • Drinking Water Source Assessment and Protection (DWSAP) Program http://www.cdph.ca.gov/certlic/drinkingwater/Pages/DWSAP.aspx • Chemicals and Contaminants in Drinking Water http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Chemicalcontaminants.aspx • Chromium-6 http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Chromium6.aspx • Groundwater Replenishment with Recycled Water http://www.cdph.ca.gov/HealthInfo/environhealth/water/Pages/Waterrecycling.aspx
California Department of Water Resources http://www.water.ca.gov/	Groundwater Information Center http://www.water.ca.gov/groundwater/index.cfm <ul style="list-style-type: none"> • Bulletin 118 Groundwater Basins http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm • California Statewide Groundwater Elevation Monitoring (CASGEM) http://www.water.ca.gov/groundwater/casgem/ • Groundwater Level Monitoring http://www.water.ca.gov/groundwater/data_and_monitoring/gw_level_monitoring.cfm • Groundwater Quality Monitoring http://www.water.ca.gov/groundwater/data_and_monitoring/gw_quality_monitoring.cfm • Well Construction Standards http://www.water.ca.gov/groundwater/well_info_and_other/well_standards.cfm • Well Completion Reports http://www.water.ca.gov/groundwater/well_info_and_other/well_completion_reports.cfm
U.S. Environmental Protection Agency http://www.epa.gov/safewater/	EPA STORET Environmental Data System http://www.epa.gov/storet/
U.S. Geological Survey http://ca.water.usgs.gov/	USGS Water Data for the Nation http://waterdata.usgs.gov/nwis

such as California corbina, barred surfperch, and shovelnose guitarfish. Many sandy beaches are important spawning grounds for California grunion. Intertidal zones include mud flats, tide pools, sandy beaches, and wave-swept rocks. They provide important habitat and breeding grounds for a variety of plants, such as marine algae, fish such as grunion, and many invertebrates. Both beaches and other intertidal zones are important nesting and feeding grounds for migratory waterfowl and shore birds.

Because of the existence of off-shore kelp beds, tide pools, and significant ecological diversity, the nearshore areas between the Ventura County line and Latigo Point was designated by the SWRCB as an area of special biological significance, which is afforded special protection for

marine life to the extent that waste discharge is prohibited within the areas. Additionally, both Ventura and Los Angeles counties have officially designated unique inland habitat areas, which are described in detail in the counties' respective general plans.

Urbanization and development have resulted in the loss of habitat and a decline in biological diversity. As a result, several native flora and fauna species have been listed as rare, endangered, or threatened. Representative examples of endangered species include California condor, American peregrine falcon, California least tern, tidewater goby, unarmored threespine stickleback, Mohave ground squirrel, conejo buckwheat, many-stemmed Dudleya, least Bell's vireo, and slender-horned spine flower.

Key ecosystems in the Santa Clara planning area include the aquatic and riparian habitats along the Ventura and Santa Clara rivers and their tributaries and estuaries.

The major or significant ecosystems found within the Upper Santa Clara River watershed include the Santa Clara River, Aliso Canyon, Soledad Canyon, the Santa Clarita Valley, Castaic Valley, San Francisquito Canyon, Bouquet Canyon, Placerita Canyon, and Hasley Canyon. This complex topography provides a natural setting that supports a diverse assemblage of biotic communities. As one of the last free-flowing natural riparian systems remaining in Southern California, the Santa Clara River provides breeding sites, traveling routes, and other essential resources for wildlife, thereby contributing to the great diversity and abundance of organisms in the region. The Upper Santa Clara River region is home to a range of endangered, threatened, and rare species, including such fish species such as unarmored threespine stickleback (*Gasterosteus aculeatuswilliamsoni*).

Key ecosystems in the Metropolitan Los Angeles planning area include intermittent streams 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 SAWPA is responsible for many projects under way or under development within the Santa Ana watershed, including its 93-mile Inland Empire Brine Line — previously referred to as the Santa Ana Regional Interceptor 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. Groups such as the Orange County Coastkeeper and the Santa Ana Watershed Association are working to restore ecosystem function and improve water quality within coastal 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 and visitors to the restoration site.

Key ecosystems in the San Diego planning area include coastal lagoons and wetlands, perennial rivers and streams, upland scrub, native grasslands, and native woodlands. San Diego's vegetation communities support a wide array of wildlife species and are home to

dozens of sensitive plant species, many of them endemic to the region. Ongoing, large-scale habitat conservation efforts by federal, State, and local agencies have resulted in the permanent protection of many thousands of acres of these ecosystems. Land acquisition and management to preserve biologically sensitive resource areas (including watershed buffers around reservoirs for source water protection and wildlife corridors) are under way throughout the San Diego area. These preservation efforts are being coupled with conservation agreements that provide protections for sensitive habitats and species well in advance of anticipated impacts from future development. Frequently, large-scale land preservation results in regional public recreational amenities, such as the San Dieguito River Park or the Elfin Forest Recreational Reserve, which also provide watershed protection benefits. However, invasive species (such as the quagga mussel, giant reed, and *caulerpa* algae) remain a major threat to native species. Local environmental organizations, in concert with public agencies, continue to work to identify and restore infested areas.

Flood

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 (including human-made) 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. Little snow falls in this region and thus has a marginal impact on flood events.

Since 2000, the South Coast region has had several significant brush fire events, including two in the San Bernardino Mountains (Old and Cedar) and one in the San Gabriel Mountains (Station). These include the Padua Fire in 2003, the Santa Anita, Merek, and Sayre fires in 2008. The loss of many acres of native trees and shrubs posed a significant problem for debris basins. This has prompted both State and local governments to request assistance from the Federal Emergency Management Agency (FEMA) for large-scale debris basin cleanout operations and from the Natural Resources Conservation Service under its Emergency Watershed Program to temporary post-fire debris basins to handle the post-fire debris potential.

Climate

The coastal and interior sections of the South Coast region feature Mediterranean climates characterized by mild, wet winters and warm, dry summers. The bordering mountains have climates that range from Mediterranean to subtropical steppe, with greater ranges 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. A geographic variability does exist in the region for both temperature and precipitation. Because of topography and distance from the ocean, the interior basins are often much warmer in the summer and cooler during the winter than the coastal basins. Annual rainfall totals in the coastal and interior basins generally decrease from north to south, though higher totals occur in the mountains. The eastern and southern sections can be affected in the late summer by monsoonal thunderstorms. 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.

Table SC-6 was compiled from data collected by California Irrigation Management Information System (CIMIS) weather stations to compare annual maximum and minimum temperatures and annual precipitation amounts between 2005 and 2010. The average maximum and minimum temperatures remained fairly stable during the period. However, the period was bookended by years of above-average rainfall. Dry years occurred in 2007 and especially 2009.

Demographics

Population

In 2010, the population in the South Coast Hydrologic Region was 19,579,208. The population in the region represents about 53 percent of the total population of the state, a total of more than the next five most populated hydrologic regions combined. In 2010, about 47 percent (9,165,000) of the regional population lived in the Metropolitan Los Angeles planning area and about 28 percent (5,421,000) lived in the Santa Ana planning area. Since 2000, the net growth in the region has been 1.4 million people. Table SC-7 presents the population estimates and projections for the South Coast region.

The South Coast region has both the state's largest and smallest cities. In 2010, the City of Los Angeles, the state's largest city, had a population of about 3,793,000, whereas the City of Vernon had a population of 112.

The financial recession affected population growth. Although many cities in the region experienced growth between 2008 and 2010, some cities remained relatively stable while several lost population.

Tribal Communities

There are 25 federally recognized Native American tribes within the South Coast Hydrologic Region (see Box SC-2 in the *South Coast Regional Report in California Water Plan Update 2009* [Update 2009]), all of which are located in the Santa Ana and San Diego PAs.

Land uses on these reservations include agriculture, urban development, industrial, and culturally sensitive areas. Climate change, land use development (within or adjacent to reservations), agricultural activities, environmental regulations, increasingly stringent water quality objectives, and potential catastrophic events such as earthquakes, extreme drought conditions, and floods are challenging to tribes as they face numerous uncertainties and challenges to provide reliable water supplies to their lands. Also, the desire to protect the high-quality groundwater resources for domestic use and to control the pollution of surface water resources is paramount.

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 Hydrologic Region are the Cahuilla, Ewiiapaayp (Cuyapaipe), Los Coyotes, Manzanita, and Santa Rosa reservations.

Table SC-6 South Coast Hydrologic Region Yearly Regional Temperature and Precipitation

Year	Avg. Temps Maximum (°F)	Avg. Temps Minimum (°F)	Avg. Daily Temperatures (°F)	Avg. Precipitation (in)	Avg. ETo (in)
2005	73.84	50.16	60.97	17.48	51.16
2006	75.35	49.53	61.43	9.91	50.72
2007	74.60	48.99	60.72	6.24	52.95
2008	75.77	50.28	60.11	10.07	51.76
2009	75.77	50.01	61.89	5.25	51.48
2010	73.25	48.89	59.80	19.12	51.24

Source: California Irrigation Management Information System.

Note: ETo = reference evapotranspiration

Table SC-7 Population Growth Trends for the South Coast Hydrologic Region

County	Estimates ^a			Projections ^b			
	1990	2000	2010	2020	2030	2040	2050
Los Angeles	8,635,406	9,228,961	9,448,213	10,043,688	10,608,199	10,885,680	10,988,583
Orange	2,410,668	2,846,289	3,010,232	3,220,788	3,385,762	3,509,352	3,565,648
Riverside	896,273	1,172,748	1,708,076	1,976,635	2,277,684	2,585,942	2,825,283
San Bernardino	1,084,173	1,305,451	1,501,645	1,665,137	1,850,874	2,031,440	2,186,409
San Diego	2,492,837	2,807,672	3,088,040	3,383,005	3,655,063	3,879,719	4,066,513
Santa Barbara	0	0	0	0	0	0	0
Ventura	668,770	752,973	823,002	884,826	955,920	1,025,255	1,085,410
Totals	16,188,127	18,144,094	19,579,208	21,174,079	22,733,502	23,917,388	24,717,846

Source: California Department of Finance 2010.

Notes:

Values represent population in the South Coast Hydrologic Region.

^a Estimates are for April of each year.

^b Projections are for July of each year.

Disadvantaged Communities

Many communities in the South Coast region are considered disadvantaged communities (DACs). These are communities where the median household income (MHI) is less than 80 percent of the statewide MHI, which in 2010 was \$60,883. Therefore, a DAC MHI is less than \$48,706 (California Department of Finance 2012). Table SC-8 lists the communities with a

Table SC-8 Disadvantaged Communities within the South Coast Hydrologic Region

Community	Type	Population	MHI	Households
Anza	CDP	2,789	44,112	1,021
Banning	City	29,030	38,979	11,871
Bell	City	35,648	38,473	9,000
Bell Gardens	City	42,408	39,167	10,040
Big Bear City	CDP	11,937	40,765	4,540
Big Bear Lake	City	5,171	32,299	2,091
Bloomington	CDP	24,982	44,464	5,566
Bostonia	CDP	14,515	45,300	5,240
Camp Pendleton North	CDP	10,104	38,718	1,809
Colton	City	52,187	43,373	15,205
Compton	City	95,761	43,201	23,442
Cudahy	City	23,854	41,805	5,597
East Los Angeles	CDP	123,136	37,128	31,044
East Rancho Dominguez	CDP	13,599	46,409	2,993
El Cajon	City	97,932	47,048	32,916
El Monte	City	113,888	42,750	27,590
Florence-Graham	CDP	60,834	35,851	13,857
Gardena	City	58,668	46,837	21,043
Glen Avon	CDP	19,587	45,369	5,885
Good Hope	CDP	8,112	36,100	2,084
Hawthorne	City	84,195	44,469	28,471
Hemet	City	76,403	35,306	29,834
Highgrove	CDP	4,302	42,694	1,217
Homeland	CDP	7,004	37,023	2,112
Huntington Park	City	58,642	37,224	14,427
Idyllwild-Pine Cove	CDP	2,193	45,833	1,028
Imperial Beach	City	26,254	45,418	9,159
Inglewood	City	110,053	43,460	36,476
Laguna Woods	City	16,295	34,192	11,470
Lake San Marcos	CDP	4,532	45,055	2,590
Lawndale	City	32,552	48,357	9,842
Lennox	CDP	21,594	36,311	5,307

Community	Type	Population	MHI	Households
Lynwood	City	69,806	43,654	15,079
Maywood	City	27,515	38,740	6,611
Mead Valley	CDP	17,616	43,314	4,182
Meadowbrook	CDP	2,731	34,107	829
Midway City	CDP	7,804	48,403	2,451
Muscoy	CDP	11,294	46,188	2,442
National City	City	57,343	36,280	16,325
Paramount	City	54,187	41,333	14,524
Pinon Hills	CDP	5,391	32,903	2,130
Rosemead	City	53,670	46,706	14,464
San Bernardino	City	209,174	39,895	60,956
San Jacinto	City	41,203	45,567	12,954
South El Monte	City	20,240	46,037	4,655
South Gate	City	94,683	43,268	23,828
Valle Vista	CDP	13,957	41,804	5,417
Walnut Park	CDP	16,686	40,401	3,650
West Athens	CDP	8,307	41,087	2,576
West Rancho Dominguez	CDP	5,761	46,716	1,568
Westmont	CDP	31,301	32,973	9,876
Willowbrook	CDP	35,174	37,465	9,001

Source: DWR Web site: <http://www.water.ca.gov/irwm/grants/resourceslinks.cfm>. Disadvantaged Communities (DAC) Mapping Tool — GIS Files — Census Places.

Notes:

CDP = Census-Designated Place, MHI = median household income.

Table only includes communities that have a population of 2,000 or more.

population of 2,000 or more that are considered DACs. An online mapping tool is available at <http://www.water.ca.gov/irwm/grants/resourceslinks.cfm>.

Land Use Patterns

Urban development continues to encroach on one of the most productive agricultural areas in the nation. The expansion of urban land uses is focused in the Inland Empire (western sections of Riverside and San Bernardino counties) and on the coastal and interior basins of Orange, Ventura, and San Diego counties. Preservation of open space in the region's urban environment is still important; and local governments have taken actions to create and manage wetlands, reservoir

sites, regional parks, and riparian corridors. Maintenance of preserved open space in the region's interior mountains continues to be a priority as well. In addition, some of the agricultural lands in the region have been set aside as preserves; however, these preserves are under constant pressure by encroachment of surrounding urban lands.

As remaining acres of buildable land decrease in Los Angeles and Orange counties, developers have increasingly turned their attention to the other counties in the region. Demand for homes by a burgeoning pool of prospective buyers, with an eye on the difficult economy, has forced more development to occur in the interior portions of the region than ever before. Although the Inland Empire and the interior basins and valleys of Ventura, Orange, and San Diego counties have experienced continued conversion of agricultural land and undeveloped land to urban uses, the rapid changes of the first decade of the 21st century have slowed because of the recession. However, the pace of urbanization will undoubtedly pick up again in the future, and impacts on the environment and quality of life will once more present significant challenges to land use and water resources planning in the South Coast region.

With regard to South Coast agricultural uses, major crops include citrus and subtropical varieties, with almost 120,000 acres of orchards in production in 2010, while miscellaneous vegetables and truck crops accounted for 78,000 acres in the same year. Planted and harvested acres of irrigated crops are decreasing slowly in the region. Between 2006 and 2010, the planted acres went from 242,000 to 232,000 acres, a decline of approximately 4 percent. Although agricultural land use activities have declined to just a fraction of what they used to be in Los Angeles and Orange counties, they remain robust in Ventura, Riverside, San Bernardino, and San Diego counties, albeit on the decline. On the Oxnard Plain and on the floodplain of the Santa Clara River Valley, within the Santa Clara planning area, 111,000 acres of crops were planted and harvested in 2010. This includes more than 48,000 acres of tomatoes, lettuce, kale, and other miscellaneous vegetable and truck crops and more than 58,000 acres of citrus and subtropical fruit, including lemons and avocados (California Department of Food and Agriculture 2013). Table SC-9 shows the major crops grown in the South Coast region.

The state's most important center for avocado production is located in the hills of the San Diego area, around the cities of Escondido and Fallbrook. In 2010, 48,000 acres of citrus and subtropical orchards were in production, including avocados. In addition, more than 15,000 acres of tomatoes and other miscellaneous vegetable and truck crops were planted in several coastal and valley locations. The wine industry cultivated more than 2,000 acres of vineyards, mostly near the city of Temecula.

The region also has a very robust nursery industry. San Diego County is the state's leading producer of both flowers and foliage, having slightly more than a 50-percent share of total gross sales. The county also has more than 27 percent of the state's nursery products.

In the Santa Ana planning area, the production of citrus and subtropical orchards, with over 13,000 acres in production in 2010, and the planting and harvesting of vegetables and nursery crops, with almost 11,000 acres for the same year, are scattered throughout the region. Large orchards of oranges and grapefruit are in production near the cities of Corona, Irvine, Redlands, Riverside, and Hemet. Also near Hemet, the San Jacinto Valley remains an important agricultural area with its production of potatoes and other vegetable crops. The dairy industry remains strong near the cities of Chino, Norco, and Ontario, with alfalfa, grains, and other forage crops being planted and harvested in the fields adjacent to the dairying facilities. In 2010, more than 5,300

Table SC-9 South Coast Hydrologic Region Top Crops 2010 (in acres)

Crop	Acres
Citrus and Subtropical ^a	120,000
Nursery and Cut Flowers	19,700
Pasture and Turf	12,100
Celery	11,900
Pasture and Turf Grass	11,500
Wheat and Small Grains	6,200
Asian Specialty Vegetables	6,100

Source: Department of Water Resources and County Agricultural Commissioner Annual Reports.

^a Includes avocados.

acres of alfalfa and 6,000 acres of pasture grass were in production in addition to almost 4,700 acres of grains.

The South Coast's watersheds typically do not resemble their natural state because of urbanization and agricultural practices that have modified waterways and surrounding habitats. Numerous waterways have been impacted by the hydro-modification and channelization. Bridges and other structures over channelized streams can slow flow velocity and cause adjacent flood damage, as seen in the Calleguas Creek watershed. Because of intense urbanization and loss of natural habitat, the focus is now on conserving the natural areas that remain within the region.

Concern over effective land use planning aimed at reducing wildfire risk and ensuring rapid response strategies has become more urgent as development continues to move into urban areas. 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. Since 2005, the region has been subjected to many brush fires. Most have been minor, but several major events have occurred as well. In 2007, a major event occurred in San Diego County that burned 347,000 acres and damaged 2,600 structures (California Department of Forestry and Fire Protection 2007). In 2009, a brush fire in the Angeles National Forest in Los Angeles County burned more than 160,000 acres and damaged 89 structures. The Eagle Fire, again in San Diego County, burned more than 14,000 acres near the community of Warner Springs in 2011; and the Highland Fire burned about 22,000 acres in Riverside County in 2012.

Regional Resource Management Conditions

Water in the Environment

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 — 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 SAR, including lands behind Prado Dam, have effectively demonstrated the ability to reduce nitrogen levels and recharge the groundwater aquifer. These managed wetlands, fed by SAR 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 SAR Stipulated Judgment (overseen by the SAR Watermaster), which requires minimum average annual flows and guaranteed TDS concentrations within the river.

Water Supplies

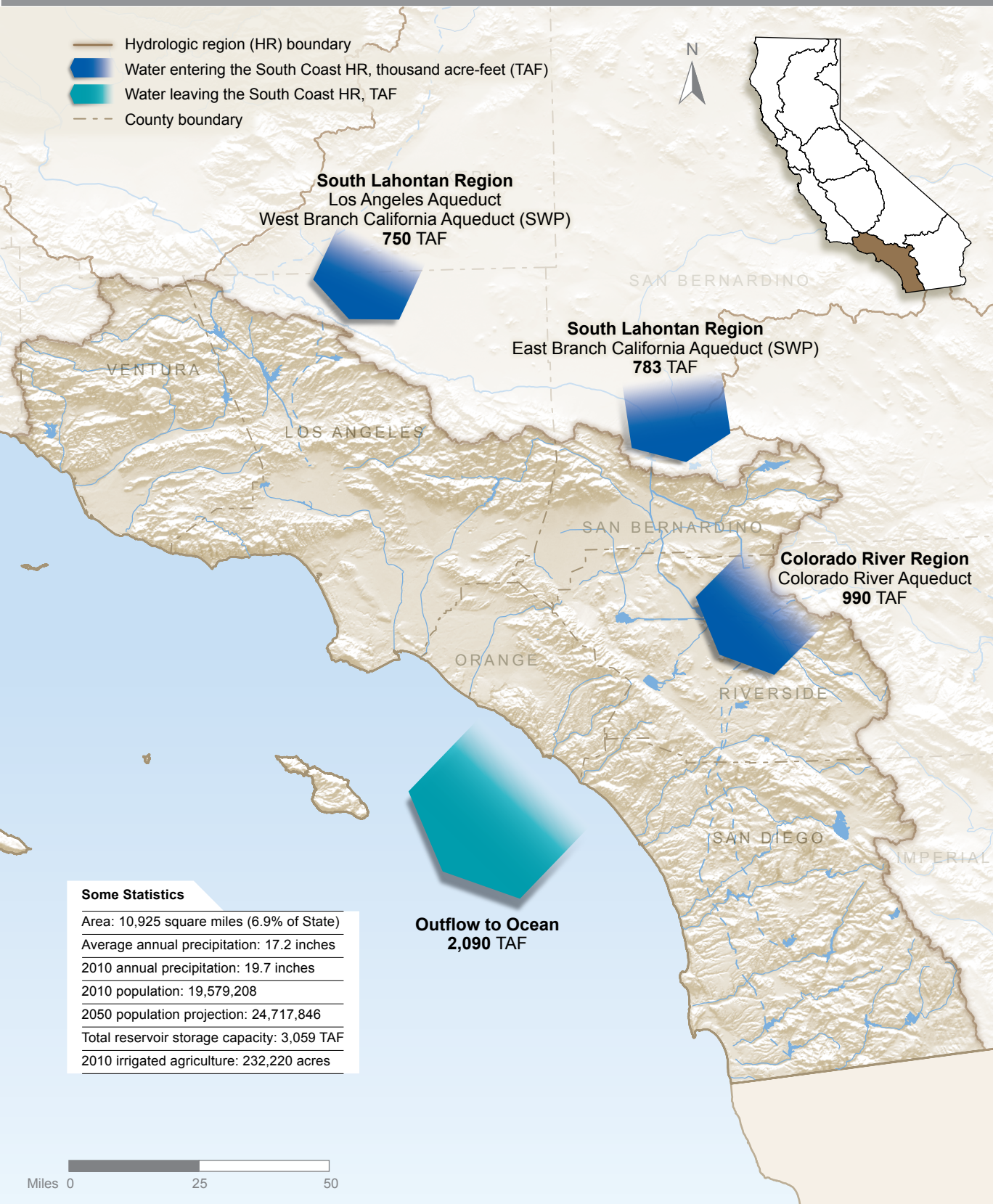
To meet current and growing demands for water, the South Coast region is leveraging all available water resources: imported water, water transfers, conservation, local surface water, groundwater, recycled water, and desalination. Given the level of uncertainty about water supply from the Sacramento-San Joaquin Delta (Delta) and Colorado River, local agencies have emphasized diversification. Local water agencies have always utilized a mixture of local and imported waters and water management strategies to adequately meet urban and agricultural demands each year. For example, by 2030 San Diego is projected to produce approximately 180,000 af/yr. of local supplies through water recycling, desalination, groundwater, and surface storage programs. By 2021, the area will receive an additional 277,700 af/yr. because of the San Diego County Water Authority-Imperial Irrigation District water conservation, transfer, and canal-lining programs. This diverse mix of sources provides flexibility in managing resources in wet and dry years. For an overview of the region's flow of water, see Figure SC-10.

Surface Water

Reservoirs in the South Coast Hydrologic Region provide storage for surface runoff and imported supplies. Flood control structures capture local runoff, and some direct it to groundwater recharge facilities.

In the Santa Clara River planning area, surface water supplies come from Lake Casitas (254,000 af), Lake Piru (100,000 af), 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. The southernmost reservoir on the West Branch of the SWP California Aqueduct is Castaic Lake. Bouquet Reservoir, built in 1934, is a part of the Los Angeles Aqueduct (LAA) system built by the City of Los Angeles in 1913.

Figure SC-10 South Coast Hydrologic Region Inflows and Outflows in 2010



In the Metropolitan Los Angeles area, flood control dams, operated by the Los Angeles County Department of Public Works (LADPW) on the Los Angeles and San Gabriel rivers, have dual uses. They protect life and property along each river and store runoff from the storms for groundwater recharge. The Los Angeles Reservoir is operated by the LADPW and stores the imported water supplies from the LAA. Las Virgenes Municipal Water District uses Las Virgenes Reservoir to store treated water it has purchased from the Metropolitan Water District of Southern California (MWD).

Several water storage reservoirs are in the Santa Ana planning area. This includes the terminus reservoir for the SWP, Lake Perris, and the MWD-owned Lake Mathews and Diamond Valley reservoirs. Big Bear Lake, Canyon Lake, and Lake Irvine are smaller facilities, though just as important. They impound the surface runoff from their respective watersheds and are used to meet local urban water demands. Lake Elsinore is used exclusively for recreation; it is not used as a potable water supply.

The San Diego planning area has a total of 25 reservoirs, with 17 connected to the San Diego Aqueduct. Major supply reservoirs include San Vicente, El Capitan, Lake Henshaw, and Lake Morena, with the latter two facilities receiving their supplies from surface runoff from the surrounding watersheds. Vail Lake is owned and operated by the Rancho California Water District. Water supplies are used for groundwater replenishment.

Groundwater

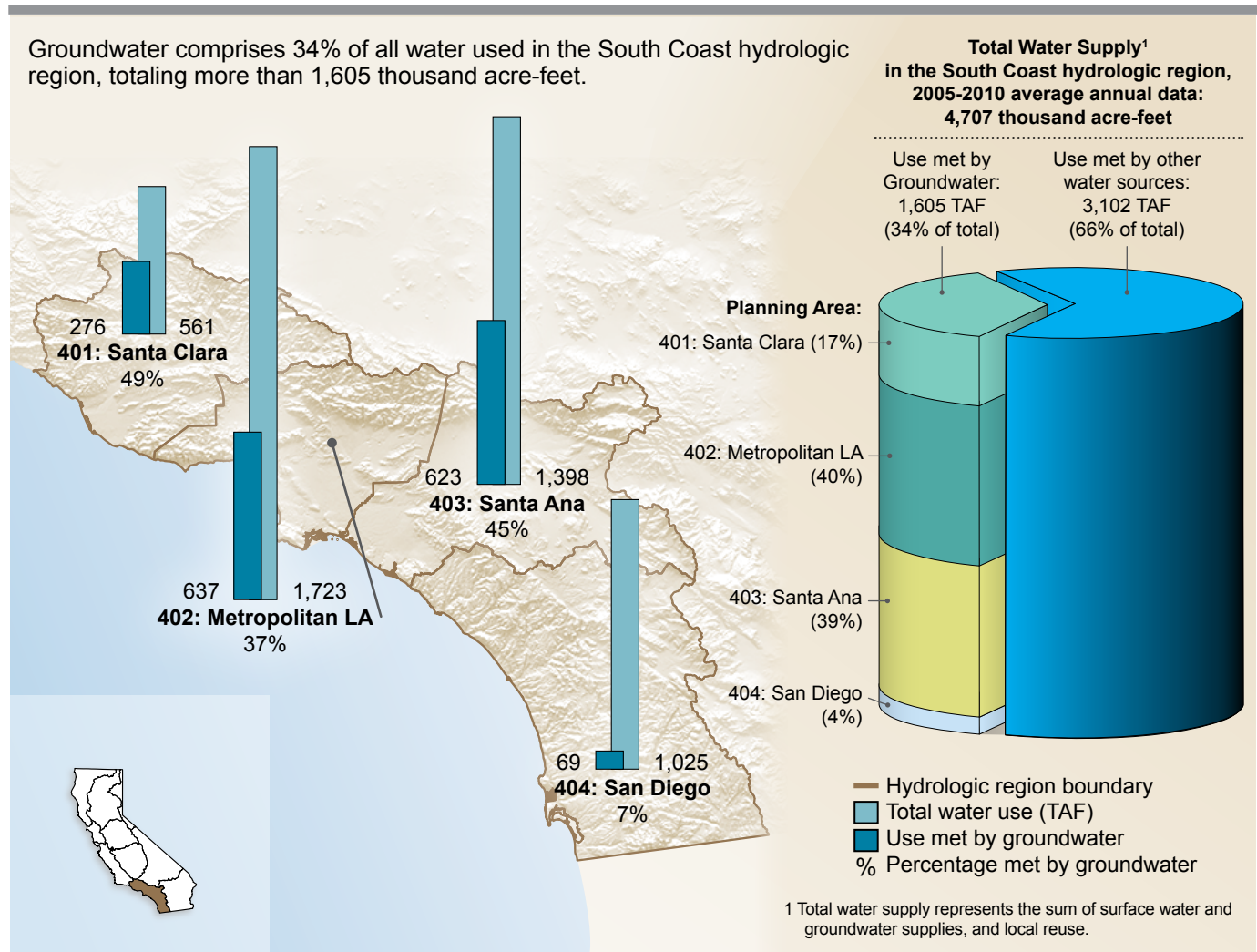
Groundwater supply estimates are based on water supply and balance information derived from DWR land use surveys and from groundwater supply information that water purveyors or other State agencies voluntarily provide to DWR. Groundwater supply is reported by water year (October 1 through September 30) and is categorized according to agriculture, urban, and managed wetlands uses. The groundwater information is presented by planning area and type of use. Although groundwater accounts for about 34 percent of the region's total water supply, the majority of groundwater supplies (about 76 percent) are used to meet urban use while the rest goes to agricultural use. No groundwater supply is used to meet managed wetlands use.

Figure SC-11 depicts the planning area locations and the associated 2005-2010 groundwater supply in the region. The estimated average annual 2005-2010 total water supply for the region is about 4.7 million acre-feet (maf), of which 1.6 maf is from groundwater supply (34 percent). (Reference to total water supply represents the sum of surface water and groundwater supplies in the region and local reuse.) The figure also shows that Metropolitan Los Angeles and Santa Ana planning areas are the largest users of groundwater in the region, being supplied with an average annual groundwater supply of 637 and 623 thousand acre-feet (taf), respectively. These two planning areas each accounts for about 40 percent of the total groundwater supply for the region.

Table SC-10 provides the 2005-2010 average annual groundwater supply by planning area and by type of use. Although groundwater extraction in the region accounts for 10 percent of California's 2005-2010 average annual groundwater supply, groundwater supplies meet 54 percent (385 taf) of the overall agricultural water use and 31 percent (1,220 taf) of the overall urban water use in the region. However, no groundwater resources are used for meeting managed wetlands uses.

Major groundwater basins in the Metropolitan Los Angeles planning area serve the intensely urbanized and industrialized inland areas of Los Angeles County, as well as the heavily urbanized

Figure SC-11 Contribution of Groundwater to the South Coast Hydrologic Region Water Supply by Planning Area (2005-2010)



coastal portions of Los Angeles County. A substantial portion of the water supply needed by the residents, businesses, and industries in the coastal areas comes from groundwater pumping. Similarly, major groundwater basins in the Santa Ana planning area serve the urbanized areas within it. Much of the pumping operations in the groundwater basins in these planning areas are limited by the courts via adjudication of water rights. And often, spreading basins are used to artificially replenish many of these groundwater basins.

As shown in Table SC-10, although the Metropolitan Los Angeles and the Santa Ana planning areas rely on groundwater supplies for 37 and 45 percent, respectively, of their overall water uses, about 99 and 80 percent of that supply, respectively, goes to urban water use. In contrast, although the Santa Clara planning area relies on groundwater supplies for 49 percent of its overall water uses, about 80 percent of that supply goes to agricultural water use.

Changes in annual groundwater supply and type of use may be related to a number of factors, such as changes in surface water availability, urban and agricultural growth, market fluctuations,

Table SC-10 South Coast Hydrologic Region Average Annual Groundwater Supply by Planning Area (PA) and by Type of Use (2005-2010)

South Coast Hydrologic Region		Agriculture Use Met by Groundwater		Urban Use Met by Groundwater		Managed Wetlands Use Met by Groundwater		Total Water Use Met by Groundwater	
PA NUMBER	PA NAME	TAF	PERCENT	TAF	PERCENT	TAF	PERCENT	TAF	PERCENT
401	Santa Clara	218.0	73	57.8	22	0	0	275.9	49
402	Metropolitan LA	3.0	53	633.7	37	0	0	636.7	37
403	Santa Ana	130.5	86	492.8	40	0	0	623.3	45 ^a
404	San Diego	33.9	13	35.3	5	0	0	69.2	7
2005-10 annual average region total		385.4	54	1,219.6	31	0	0	1,605.0	34

Notes:

TAF = thousand acre-feet

Percent use is the percent of the total water supply that is met by groundwater, by type of use.

2005-10 precipitation equals 91% of the 30-year average for the South Coast Hydrologic Region.

^a Based on the Santa Ana Water Project Authority's One Water One Watershed (OWOW) report, 58% of the total water use is met by groundwater in the Santa Ana planning area. the discrepancy between Water Plan and OWOW percentages will need to be addressed in the next *California Water Plan Update*.

and water use efficiency practices. Figures SC-12 and SC-13 summarize the 2002 through 2010 groundwater supply trends for the region.

The right side of Figure SC-12 illustrates the annual amount of groundwater versus other water supplies, while the left side identifies the percentage of the overall water supply provided by groundwater relative to other water supplies. The center column in the figure identifies the water year along with the corresponding amount of precipitation, as a percentage of the 30-year running average for the region. The figure indicates that between 2002 and 2010, the annual water supply for the region has fluctuated between 4.1 maf and 5.2 maf depending on annual precipitation amounts. The annual groundwater supply has fluctuated between 1.2 maf and 1.9 maf, providing between 27 and 38 percent of the total water supply.

Figure SC-13 shows the annual amount and percentage of groundwater supply trends for meeting urban, agricultural, and managed wetland uses. The figure indicates that about 72 to 90 percent of the annual groundwater supply met urban use, while about 10 to 28 percent of the annual groundwater supply met agricultural use. Groundwater was not used for meeting any managed wetlands use.

Figure SC-12 South Coast Hydrologic Region Annual Groundwater Supply Trend (2002-2010)

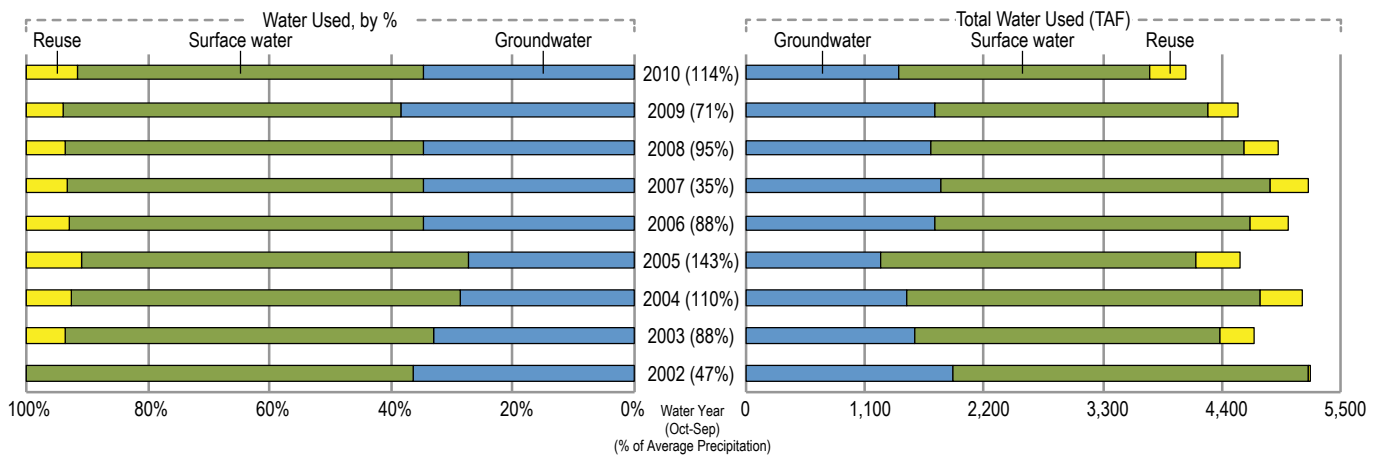
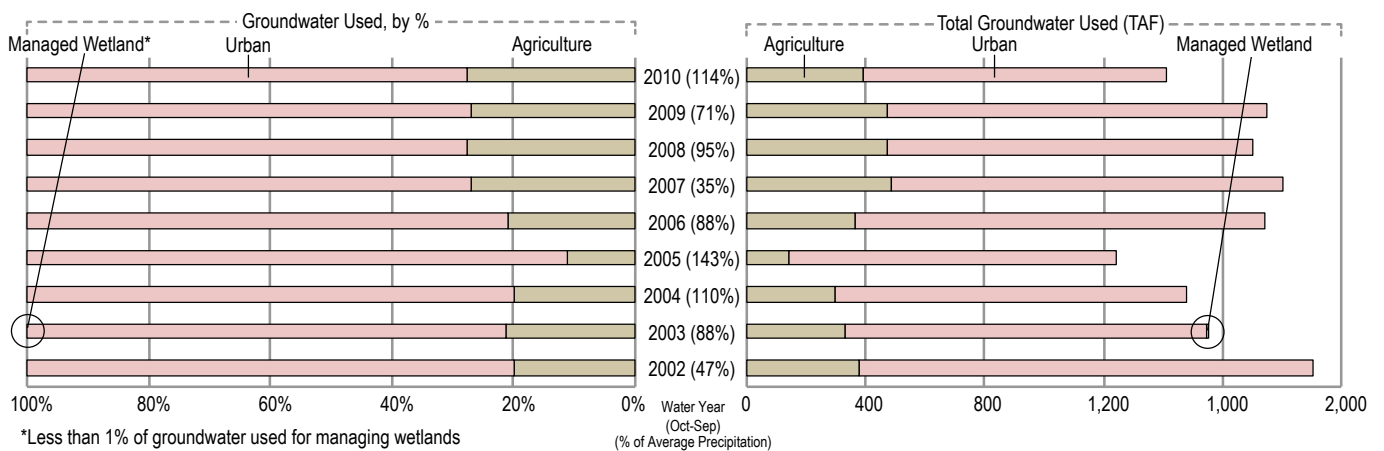


Figure SC-13 South Coast Hydrologic Region Annual Groundwater Supply Trend by Type of Use (2002-2010)



More detailed information regarding groundwater water supply and use analysis is available online from Update 2013, Volume 4, *Reference Guide*, the article “California’s Groundwater Update 2013.”

Imported Water

Water is brought into the South Coast region from three major sources: the Delta, Colorado River, and Owens Valley/Mono Basin. All three are facing water supply cutbacks because of climate change and environmental issues. Although imported water supplies historically served to help the South Coast region grow, imported supplies are now relied on to sustain the existing population and economy. As such, parties in the South Coast region are working closely with other regions, the State, and various 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.

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 LADWP owns and operates the LAA for conveyance of imported water from the Owens Valley to Los Angeles.

The Colorado River is managed and operated by the USBR under numerous compacts, federal laws, court decisions and decrees, contracts, and regulatory guidelines collectively known as the “Law of the River” (Table SC-11). This collection of documents gives entitlements to the water and regulates the use and management of the Colorado River among the seven basin states and Mexico. The MWD, the largest SWP contractor and primary South Coast region wholesaler, delivers an average of 1.4 maf of SWP and Colorado River Aqueduct (CRA) supplies (depending on the availability of surplus water) to its 26 cities and member agencies.

Imported water supplies through the Colorado River are based on the agreements in the 1931 California Seven-Party Agreement and the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003 (Tables SC-12 and SC-13).

Legal decisions regarding environmental concerns in the Delta have recently limited the volume of water that can be delivered south of the Delta through the SWP.

State Water Project

The SWP is an important source of water for the South Coast region’s 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 MWD, Castaic Lake Water Agency (CLWA), San Bernardino Valley Municipal Water District (SBVMWD), Ventura County Watershed Protection District (VCWPD) (formerly Ventura County Flood Control District), San Geronio Pass Water Agency (SGPWA), and San Gabriel Valley Municipal Water District. The MWD contract with DWR is for 1.91 maf annually, about half the total project.

Legal decisions regarding environmental concerns in the Delta, however, have recently limited the volume of water that can be delivered south of the Delta through the 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 owing 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 Delta Vision Strategic Plan* (Delta Vision Blue Ribbon Task Force 2008) recommends two coequal 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. A Bay Delta Conservation Plan is under development by a collaboration of federal, State, and local water agencies, and further addresses the recovery of endangered and sensitive fisheries in the Delta.

Table SC-11 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 U.S. Secretary of Interior how to divide use of California's apportionment among the California water users.
U.S. - Mexican Water Treaty	1944	Apportions Mexico a supply of 1.5 maf annually of Colorado River water, except under surplus or extraordinary drought conditions.
U.S. Supreme Court Decree in <i>Arizona v. California, et al.</i>	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 af/yr. 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 U.S. 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 San Diego County Water Authority) in California.

Source: Adapted from U.S. Bureau of Reclamation Web site, The Law of the River, Updated March 2008.

<http://www.usbr.gov/lc/region/g1000/lawofrvr.html>.

Notes:

maf = million acre-feet, af/yr. = acre-feet per year, USBR = U.S. Bureau of Reclamation

Table SC-12 Quantification and Annual Approved Net Consumptive Use of Colorado River Water by California Agricultural Agencies

	Quantified Amount (taf)	Quantified Net Consumptive Use, 2010 (taf)	Actual Net Consumptive Use, 2010 (taf)	Quantified Annual Net Consumptive Use, 2026–2047 (taf)
Priority 1, 2, and 3 ^b . Based on historical average use; deliveries above this amount in a given year will be deducted from MWD’s diversion (order) for the next year; as agreed by MWD, IID, CVWD, and Secretary of the Interior (PVID and the Yuma Project are not signatories to the federal QSA.)	420	420	312.2 ^d	420
Priority 3 ^a Coachella Valley Water District	330	333	306.1	424
Priority 3 ^a Imperial Irrigation District	3,100	2733.8	2545.6 ^b	2,607.8
Total California Agricultural Use	3,850	3,486.8	3,163.9	3,451.8
IID CRWDA Exhibit C Payback		19	0 ^b	0
CVWD CRWDA Exhibit C Payback		9.2	0 ^b	0
Total Priority 1-3 Use	3,850	3515	3163.9	3,446.3
Remainder of 3.85 maf for use by MWD (and SDCWA and 14.5 taf Misc. PPRs) through priority rights and transfer agreements.	0	335 ^c	686.1 ^c	403.7 ^c

Data Sources:

Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement for the purposes of Section 5(b) of Interim surplus Guidelines, Exhibits A, B and C, approved by the Secretary of the Interior on October 10 2003, <http://www.usbr.gov/lc/region/g4000/QSA/crwda.pdf>.

Colorado River Accounting and Water User Report: Arizona, California, and Nevada, Calendar Year 2010, U.S. Department of the Interior, Bureau of Reclamation Lower Colorado Region, pp 37, <http://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2010/2010.pdf>.

Notes:

CVWD = Coachella Valley Water District, IID = Imperial Irrigation District, MWD = Metropolitan Water District of Southern California, PVID = Palo Verde Irrigation District, QSA = Quantification Settlement Agreement, CRWDA = 2003 Colorado River Water Delivery Agreement, SDCWA = San Diego County Water Authority, taf = thousand acre-feet, maf = million acre-feet, PPRs = present perfected rights

^a Consumptive use is defined in the federal QSA as “the diversion of water from the main stream of the Colorado River, including water drawn from the main stream by underground pumping, net of measured and unmeasured return flows.”

^b Exhibit C obligations were fully extinguished in 2009 (IID and USBR disagree on the calculation of this value; it will be finalized upon resolution of this issue).

^c Includes miscellaneous present perfected rights, federal rights reserved, and decreed rights.

^d Includes Palo Verde Irrigation District, Yuma Project Reservation Division, and Yuma Island Pumpers.

Table SC-13 Annual Intrastate Apportionment of Water from the Colorado River Mainstream within California under the Seven Party Agreement^a

Priority Number ^{d, e}	Apportionment
Priority 1	Palo Verde Irrigation District (based on area of 104,500 acres).
Priority 2	Lands in California within USBR's Yuma Project (not to exceed 25,000 acres).
Priority 3	Imperial Irrigation District and lands served from the All American Canal in Imperial and Coachella Valleys, and Palo Verde Irrigation District for use on 16,000 acres in the Lower Palo Verde Mesa.
Priority 4	MWD for coastal plain of Southern California-550,000 af/yr.
Priority 5	An additional 550,000 af/yr. to MWD, and 112,000 af/yr. for the City and County of San Diego. ^{b, c}
Priority 6	Imperial Irrigation District and lands served from the All American Canal in Imperial and Coachella valleys, and Palo Verde Irrigation District for use on 16,000 acres in the Lower Palo Verde Mesa, for a total not to exceed 300 taf/yr.
Priority 7	All remaining water available for use in California, for agricultural use in California's Colorado River Basin.

Notes:

af = acre-feet, taf = thousand acre-feet, maf = million acre-feet, af/yr. = acre-feet per year, USBR = U.S. Bureau of Reclamation, MWD = Metropolitan Water District of Southern California, SDCWA = San Diego County Water Authority

Amounts represent consumptive use.

^a Indian tribes and miscellaneous present perfected right holders that are not encompassed in California's Seven Party Agreement have the right to divert up to approximately 90 taf /yr. (equating to about 50 taf/yr. of consumptive use) within California's 4.4 maf basic apportionment. Present consumptive use under these miscellaneous and tribal present perfected rights is approximately 15 taf/yr.

^b Subsequent to execution of the Seven Party Agreement, MWD, SDCWA, and the city of San Diego executed a separate agreement transferring its apportionment to MWD.

^c Under the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003, MWD (and SDCWA) gained access to water that may be available under Priorities 6 and 7.

^d Priorities 1 through 3 collectively are not to exceed 3.85 maf/yr. The Seven Party Agreement did not quantify the division of this volume among the three parties. Priorities 1-3 were further defined in the 2003 Quantification Settlement Agreement.

^e Total of Priorities 1 through 6 is 5.362 maf/yr.

Colorado River System

Another imported water supply source for the region is the Colorado River. California water agencies have a legal entitlement of 4.4 maf annually of Colorado River water. Of this amount, 3.85 maf are assigned in aggregate to agricultural users; MWD's annual entitlement is 550,000. MWD is the fourth priority for Colorado River supplies. The MWD 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 (CRWDA), which further quantifies priorities established in the 1931 document (see the "Imported Water" section, above). The MWD diversions, within its legal entitlements, are less now than they were in the early 2000s. Surplus supplies, which existed on the river then, have

been reduced as other states have increased their diversions in accord with their authorized entitlements. Since 2003, MWD's annual deliveries have varied from a high of 897,000 af in 2005 to a low of 633,000 af in 2006. The CRWDA also identifies measures to conserve and transfer water through the lining of existing earthen canals. The San Diego County Water Authority (SDCWA) has further developed conservation and transfer agreements with the Imperial Irrigation District (IID) to augment its CRA supply. With full implementation of the programs identified in the CRWDA, the MWD plans to divert 852,000 af/yr. of Colorado River water annually, plus any unused agricultural water that may be available. Additional conjunctive-use agreements that the MWD has in operation to manage its CRA supply include the Hayfield Groundwater Storage and the Desert Water Agency\Coachella Valley Water District Advance Delivery programs.

In 1998, the SDCWA entered into a transfer agreement with the IID to purchase conserved agricultural water. The agreement is an important element of the CRWDA. In 2011, SDCWA received 75,000 taf. The quantity will increase in 10-taf increments annually, up to 200 taf per year (taf/yr.) in 2021, and then remain fixed for the duration of the 75-year agreement. The MWD conveys the transfer water to the SDCWA via an exchange agreement.

The CRWDA of 2003 resulted in the concrete lining of the Coachella Canal and All-American Canal. The water supply savings from both projects, 77 taf/yr. for 75-year term are being transported to the SDCWA with 16 taf allocated to several bands of Mission Indians in northern San Diego County.

To facilitate water transfers, LADWP is constructing the Neenach Pumping Station, an interconnection between the LAA and the SWP's California Aqueduct, located where the two aqueducts intersect in the Antelope Valley. The interconnection will allow for water transfer from the East Branch of the SWP to the LAA system. Construction of the Neenach Pumping Station required a four-way agreement between DWR, MWD, LADWP, and the Antelope Valley-East Kern Water Agency (AVEK). When completed, the Neenach Pumping Station facility will be owned by DWR but will be designated as an AVEK interconnection. The Neenach Pumping Station will be operated on behalf of the LADWP. The MWD is in the agreement to provide consent for the transferred water to enter its service territory. Construction of the Neenach Pumping Station is estimated to be completed by fall 2014. When completed, LADWP's goal is to transfer up to 40,000 af/yr. through the interconnection.

Owens Valley/Mono Basin

High-quality water from the Mono Basin and Owens Valley is delivered through the 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 from 485 cubic feet per second to 775 cfs annually; however, the amount the aqueducts deliver varies from year to year because of fluctuating precipitation in the Sierra Nevada and mandatory instream flow requirements.

Diversion of water from streams flowing into Mono Lake has been reduced following SWRCB's State Water Board Decision 1631. LADWP is also utilizing aqueduct water supplies for projects in the Inyo-Los Angeles Long Term Water Agreement (and related memorandum of understanding) and the Great Basin Air Pollution Control District/City of Los Angeles MOU (to reduce particulate matter air pollution from the Owens Lake bed).

Water Transfers, Groundwater Storage, and Land Fallowing

Dry-year imported water supply concerns are prompting water agencies in the South Coast region to maintain and establish new water supply agreements with agencies within and outside of the region. MWD participates in multiple groundwater storage and water supply transfer programs to increase the reliability of supplies from the SWP. The partnering agencies include the Semitropic Water Storage District (WSD), Arvin-Edison WSD, San Bernardino Valley Municipal Water District, Kern-Delta Water District, Mojave Water District, Yuba County Water District, and the Governor's Water Bank. To increase its supplies from the Colorado, MWD entered into long-term agreements with the Palo Verde Irrigation District and Southern Nevada Water Agency. The CLWA, to augment its imported water supplies, entered into agreements with several water agencies in the San Joaquin Valley. The agreements with the Buena Vista WSD and Rosedale-Rio Bravo WSD are long term. The CLWA also has a limited-term agreement with the Semitropic WSD through the year 2020.

Recycled Water

Recycled water has been successfully used in the South Coast Hydrologic Region since the 1960s. Although it meets only a small fraction of the overall demands in the South Coast region, recycled water supplies are being used in the region's four PAs. Key factors in the continued increases in use include the upgrades of existing and construction of new wastewater treatment facilities with the latest technology to treat and produce these supplies and the continued expansion of the local infrastructures to store and convey the supplies to potential users, primarily for landscape irrigation. In Los Angeles County, recycled water is also recharged into the Central and West Coast basins via the county flood control district's spreading grounds and injection wells that form the district's seawater barrier projects.

Additionally, the Los Angeles RWQCB adopted Non-Irrigation General Water Reuse (Order No. R4-2009-0049) General Waste Discharge and Water Recycling Requirements for Title 22 Recycled Water for Non-Irrigation Uses over the Groundwater Basins Underlying the Coastal Watersheds of Los Angeles and Ventura Counties. The purpose of this General Waste Discharge Requirement (WDR) is to serve as a region-wide general permit for non-irrigation uses of recycled water, such as industrial cooling or dust control during construction.

Recycled water use in the South Coast region (354,000 af) was determined by the 2009 Recycled Water Survey. This accounts for more than 7.5 percent of the total applied water (4.7 maf) in the South Coast region. Almost one-third of the recycled water is used to augment or protect the South Coast's groundwater resources either by spreading basins for groundwater recharge or coastline injection to act as a barrier to saltwater intrusion. Landscape irrigation, agricultural irrigation, and industrial use are also significant uses of recycled water in the South Coast region.

Recycled water is produced and used by dozens of cities and agencies throughout the South Coast region, with the primary producers being the Sanitation Districts of Los Angeles County, the City of Los Angeles, and Orange County Water District (OCWD). These producers, as well as other recycled water producers in the region, are continuing to expand capacity and planning for uses of existing supplies. Several specific projects are briefly discussed in the "Regional Water Planning and Management" section later in this regional report.

Additional information on statewide municipal recycled water is included in Volume 3, *Resource Management Strategies*, Chapter 12, "Recycled Municipal Water," and information on specific

recycled water uses in the South Coast Hydrologic Region can be found in Volume 4, *Reference Guide*.

Desalination

Several groundwater desalination facilities are in operation in the South Coast region. In the Santa Ana planning area, the Chino Desalter Authority operates the Chino I and Chino II facilities; Eastern Municipal Water District (EMWD) operates Menifee and Perris I; the city of Riverside has the Arlington; and the city of Corona has Temescal. The Irvine Desalter is a joint project between the Irvine Ranch Water District (IRWD) and OCWD; and the 17th Street Desalter is a project between the city of Tustin, OCWD, and MWD.

In Metropolitan Los Angeles, there is the West Basin Municipal Water District's Goldworthy Desalter. In San Diego, the Oceanside operates the Mission Basin. The Sweetwater Authority operates the Reynold's Groundwater Desalination Facility; and Southwest Water operates the facility near San Juan Capistrano.

Seawater desalination projects are moving forward in the South Coast region. The Carlsbad Desalination Plant in San Diego County and the conveyance system needed to deliver the desalted water to consumers are under construction by Poseidon Resources, a private company. This facility will be able to produce up to 50 million gallons per day (mgd) of potable water supplies to SDCWA member water agencies. SDCWA is also evaluating the costs and feasibility of two other potential seawater desalination projects: one would be located at U.S. Marine Corps Base Camp Pendleton, and the other would be a bi-national facility in Baja California, Mexico. The City of Long Beach in coordination with the USBR, LADWP, and DWR operated a seawater desalination research and development facility until 2010. Other facilities are being proposed for Dana Point and Huntington Beach in Orange County and by the West Basin Municipal Water District in Los Angeles County.

Water Uses

Applied water demands are reflective of the South Coast Hydrologic Region being the most populous and urbanized area in the state. Urban water users require more than 80 percent of the total water use in the region. For the period 2006 through 2010, urban demand ranged from a high of 5,254 taf in 2007 to a low of 4,157 taf in 2010. The 22 percent reduction in urban demand from the peak uses in 2007 to 2010 reflected the hard work undertaken by the local water agencies and their respective customers to decrease demands in response to unusually dry hydrologic conditions that affected the state in 2008 and 2009. Table SC-14 shows the downward trend in urban water uses by each planning area in the South Coast region.

Almost 75 percent of the urban water uses occurred in the Metropolitan Los Angeles and Santa Ana areas, with slightly more than 40 percent occurring in Metropolitan Los Angeles.

From 2006 through 2010, environmental water demands in the South Coast region averaged a little more than 32 taf annually. For instream flow requirements, Piru Creek in the Santa Clara River area averaged about 3.6 taf annually for the same period. In 2010, Sespe Creek in the Santa Clara River area received slightly less than 96 taf of water for its wild and scenic flow requirement. Before 2010, it was receiving a little more than 40 taf.

Table SC-14 Average Annual Water Use per Capita in Gallons per Day by Planning Area, South Coast Hydrologic Region (2006-2010)

Planning Area	Average Annual Water Use per Capita in Gallons per Day				
	2006	2007	2008	2009	2010
Santa Clara	189	183	195	204	181
Metropolitan Los Angeles	164	166	157	147	133
Santa Ana	227	227	208	200	176
San Diego	193	210	210	157	136

Source: Bulletin 160-2013 Regional Water Balances (Preliminary).

Does not include water supplies for energy production or groundwater recharge.

Drinking Water

The region has an estimated 439 community drinking water systems. In contrast to other regions of the state, where the majority of the community drinking water systems are small water systems, more than half of the community drinking water systems in the region are medium or large water systems. These water systems deliver drinking water to more than 95 percent of the region's population (Table SC-15). In addition, there are 19 water systems that primarily provide wholesale drinking water to retail water purveyors.

A community water system is considered small if it serves fewer than 3,300 people. In this region, there are an estimated 182 small community water systems with the majority of these systems actually serving fewer than 500 people (see Table SC-15). Note that this total does not include small water systems that generally serve fewer than 25 people. Small water systems face unique financial and operational challenges in providing safe drinking water. Given their small customer base, many small water systems cannot develop or access the technical, managerial, or financial resources needed to comply with new and existing regulations. These water systems may be geographically isolated, and their staff often lacks the time or expertise to make needed infrastructure repairs; install or operate treatment; or develop comprehensive source water protection plans, financial plans, or asset management plans (U.S. Environmental Protection Agency 2012).

Agricultural Water

Agriculture water uses followed the same general trend as urban water uses in the region. After peaking in 2007, annual water uses have gradually declined. Total applied water uses ranged from a high of 822 taf in 2007 to a low of 632 taf in 2010. The decline is attributable to the dry hydrologic conditions statewide, the cutbacks of imported water supplies, and the recession. Although it was not significant, some acres of citrus and subtropical trees were taken out of production in response to cutbacks in the imported supplies. Stumping or actual removal occurred in Riverside and San Diego counties.

With concerns about costs and supply reliability, farmers in the South Coast region are employing the most appropriate irrigation technology and integrating the necessary practices in order to

Table SC-15 Summary of Large, Medium, Small, and Very Small Community Drinking Water System Size in the South Coast Hydrologic Region

Water System Size by Population	Community Water Systems (CWS)		Population Served	
	SYSTEMS	PERCENT	POPULATION	PERCENT
Large > 10,000	181	41	19,456,617	97.6
Medium 3,301 - 10,000	57	13	358,422	1.8
Small 500 - 3,300	66	15	94,231	0.5
Very Small < 500 people	116	26	19,437	0.1
CWS that primarily provide wholesale water	19	4	---	---
Total	439	99	19,928,707	100

Source: California Department of Public Health Permits, Inspection, Compliance, Monitoring, and Enforcement database as of June 2012.

Notes:

Running Springs Water District's (System No. 3610062) service area is in both the South Lahontan and South Coast regions. To avoid duplication, it is only included in the South Lahontan Region.

Julian Community Services District's (System No. 3700909) service area is in both the Colorado River and South Coast regions. To avoid duplication, it is only included in the Colorado River Region.

irrigate their crops as efficiently as possible. Vegetables and other row crops on the Oxnard Plain in Ventura County, in the coastal valleys of San Diego County, and in western Riverside and San Bernardino counties are now being irrigated with a combination of sprinklers and buried pressurized drip irrigation systems. Sprinklers are often used in the early stages of growth for the crop, with drip emitters or drip tape handling the remainder of the growth until harvest. This has been a growing trend for the past decade. This combination has been used to irrigate vegetables and nursery crops with low and high evapotranspiration requirements, such as strawberries and celery. Most citrus and subtropical fruit orchards grown in the region are irrigated with micro-jet sprinklers, a strategy that originated back in the 1980s.

Water Conservation Act of 2009 (SB X7-7) Implementation and Issues

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 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 the MWD conservation program is the Conservation Credits Program (CCP) initiated in 1988. The CCP contributes up to \$195 per af 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 that 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 IRWM planning efforts, to develop coordinated water efficiency programs.

The Water Conservation Act of 2009 (SB X7-7) requires each urban retail agency to establish in its urban water management plan (UWMP) goals to reduce daily per capita water use 20 percent by 2020.

SB X7-7 requires urban water suppliers to calculate baseline water use and set 2015 and 2020 water use targets. One hundred fifty-seven South Coast urban water suppliers have submitted 2010 UWMPs to DWR. The UWMPs indicate the South Coast Hydrologic Region had a population-weighted baseline average water use of 188 gallons per capita per day (gpcd) with an average population-weighted 2020 target of 159 gpcd. The Baseline and Target Data for individual South Coast urban water suppliers is available on the DWR Urban Water Use Efficiency Web site <http://www.water.ca.gov/wateruseefficiency/>.

SB X7-7 also requires agricultural water suppliers with over 25,000 irrigated acres to adopt and submit an agricultural water management plan to DWR. The South Coast agricultural water suppliers are smaller and tend to be under the acreage threshold. One South Coast agricultural water supplier has submitted an agricultural water management plan.

Water Balance Summary

Table SC-16 provides a hydrologic water balance summary for the South Coast region. Figure SC-14 illustrates a water balance for dedicated and developed supply by year. For more information on the water balances and portfolios, go to Volume 5, *Technical Guide*.

For the period of 2006-2010, hydrologic conditions in the state and in the Colorado River watershed were major factors in the water supply requirements for the South Coast region. Water supplies required for the combined urban, agriculture, and managed wetlands demands ranged from a high of 5,364 taf in 2007 to a low of 4,259 taf in 2010. Above-average precipitation occurred throughout the state in water years 2005 and 2006, and resulted in ample deliveries of SWP supplies into the region: 1,473 taf in 2006 and 1,599 taf in 2007. Water supplies from local imports (LAA deliveries) and local reservoirs were also quite high in 2006. The LAA imported slightly less than 381 taf, and contributions from local reservoirs totaled 231 taf.

Nonetheless, within a matter of a few years, these supplies were noticeably affected by several consecutive dry years. This period began in the winter of 2007-2008 and lasted through early 2010, with the winters of 2009 and 2010 being unusually dry. Deliveries by the SWP, local imports, and local reservoirs were all affected. Coupled with legal decisions on Delta diversions, SWP deliveries in 2009 and 2010 were reduced to 989 taf and 910 taf, respectively. Deliveries from the LAA were 126 taf in 2009, but they more than doubled in 2010 to 269 taf. Local reservoirs contributed 180 taf and 235 taf for the same years. Contingency plans for water supply shortages were implemented region-wide, which included the utilization of emergency supplies and enactment of mandatory water-use efficiency policies and programs.

Although operating under the CRWDA and experiencing dry conditions, imports from the Colorado River into the South Coast region during the 2006-2010 period peaked at 1,257 taf in 2008 but declined in 2009 and 2010 to 1,219 taf and 990 taf, respectively.

Table SC-16 South Coast Hydrologic Region Water Balance for 2001-2010 (in taf)

South Coast (taf)	Water Year (Percent of Normal Precipitation)									
	2001 (92%)	2002 (47%)	2003 (88%)	2004 (110%)	2005 (143%)	2006 (88%)	2007 (35%)	2008 (95%)	2009 (71%)	2010 (114%)
WATER ENTERING THE REGION										
Precipitation	9,327	5,034	9,468	11,807	15,344	8,830	3,548	9,547	7,120	11,472
Inflow from Oregon/Mexico	0	0	0	0	0	0	0	0	0	0
Inflow from Colorado River	1,251	1,313	760	1,100	773	808	1,082	1,257	1,219	990
Imports from Other Regions	1,255	1,786	2,009	2,037	1,673	1,786	1,940	1,199	1,136	1,533
Total	11,833	8,133	12,237	14,944	17,790	11,424	6,570	12,003	9,474	13,995
WATER LEAVING THE REGION										
Consumptive use of applied water^a (Ag, M&I, Wetlands)	1,998	2,044	1,810	1,899	1,678	1,733	1,886	1,807	1,684	1,514
Outflow to Oregon/Nevada/Mexico	0	0	0	0	0	0	0	0	0	0
Exports to other regions	0	0	0	0	0	0	0	0	0	0
Statutory required outflow to salt sink	0	0	0	0	202	0	0	0	0	0
Additional outflow to salt sink	2,192	2,542	2,411	2,440	3,763	2,412	2,310	2,386	2,059	2,059
Evaporation, evapotranspiration of native vegetation, groundwater subsurface outflows, natural and incidental runoff, ag effective precipitation & other outflows	8,711	4,770	9,132	11,641	12,347	8,314	3,694	9,071	7,073	11,177
Total	12,901	9,356	13,353	15,980	17,990	12,459	7,890	13,264	10,816	14,750
CHANGE IN SUPPLY										
[+] Water added to storage										
[-] Water removed from storage										
Surface reservoirs	332	53	-81	-102	509	-70	-243	-188	-231	116
Groundwater ^b	-1400	-1276	-1035	-934	-709	-965	-1077	-1073	-1111	-871
Total	-1068	-1223	-1116	-1036	-200	-1035	-1320	-1261	-1342	-755
Applied water^a (ag, urban, wetlands) (compare with consumptive use)	4,786	5,385	4,861	5,272	4,776	5,154	5,363	5,085	4,731	4,218

Notes:

taf = thousand acre-feet, M&I = municipal and industrial

^a Definition: 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.^b Definition: Change in Supply: Groundwater – The difference between water extracted from and water recharged into groundwater basins in a region. All regions and years were calculated using the following equation: change in supply: groundwater = intentional recharge + deep percolation of applied water + conveyance deep percolation and seepage - withdrawals.This equation does not include unknown factors such as natural recharge and subsurface inflow and outflow. For further details, refer to Volume 4, *Reference Guide*, the article "California's Groundwater Update 2013" and Volume 5, *Technical Guide*.

The utilization of groundwater supplies remained fairly steady during the period. Peak use of groundwater occurred in 2007 at 2,146 taf; a low of 1,649 taf was reached in 2010.

The South Coast Hydrologic Region consists of four PAs. The instream environmental use (instream and wild and scenic requirements) for the region is limited to the Santa Clara planning area. There is an instream requirement in San Diego planning area, but it rarely has measurable flow. Managed wetland environmental use occurs in three PAs. (See Table SC-16 and Figure SC-14.)

The Santa Clara planning area urban applied water averaged about 250 taf/yr. for water years 2006-2010, which was down a bit from previous years. Agricultural water use varied depending on rainfall, from about 240 to 350 taf/yr. Instream use was fairly constant at about 4 taf/yr., while the wild and scenic flows varied from about 10 taf to about 400 taf. Most of this flow was reused downstream.

Primary supply for Santa Clara planning area was a near equal mix of groundwater, SWP water, and local supplies (including reuse of instream environmental applied water). There is also about 4 taf/yr. of recycled wastewater being applied.

The Metropolitan Los Angeles planning area is the most urbanized planning area, with urban use steadily decreasing from 1.9 maf in water year 2006 to 1.5 maf in water year 2010. More water is used in the Metropolitan Los Angeles planning area for managed wetlands (27 taf/yr.) than for agriculture (about 5-6 taf/yr.).

Water supplies are from varied sources, including the Colorado River, Owens River (local imports), and SWP. In addition, about 600 taf of groundwater are extracted and 50-90 taf of wastewater are recycled each year.

The Santa Ana planning area is also a highly urbanized area, with 1.2-1.5 maf of water applied to urban uses. About 130-180 taf/yr. are applied to agricultural uses and about 5 taf/yr. for managed wetlands. Supplies are primarily groundwater, with about 500-750 taf extracted each year. The remainder of the supply comes from the Colorado River, SWP, local sources, and reuse. Wastewater is recycled at the rate of 55 to 110 taf/yr.

The San Diego planning area also has substantial urban water use, at about 630-950 taf/yr. Agricultural applied water ranges from 240 taf to over 300 taf annually. Managed wetlands use is about 1 taf/yr.

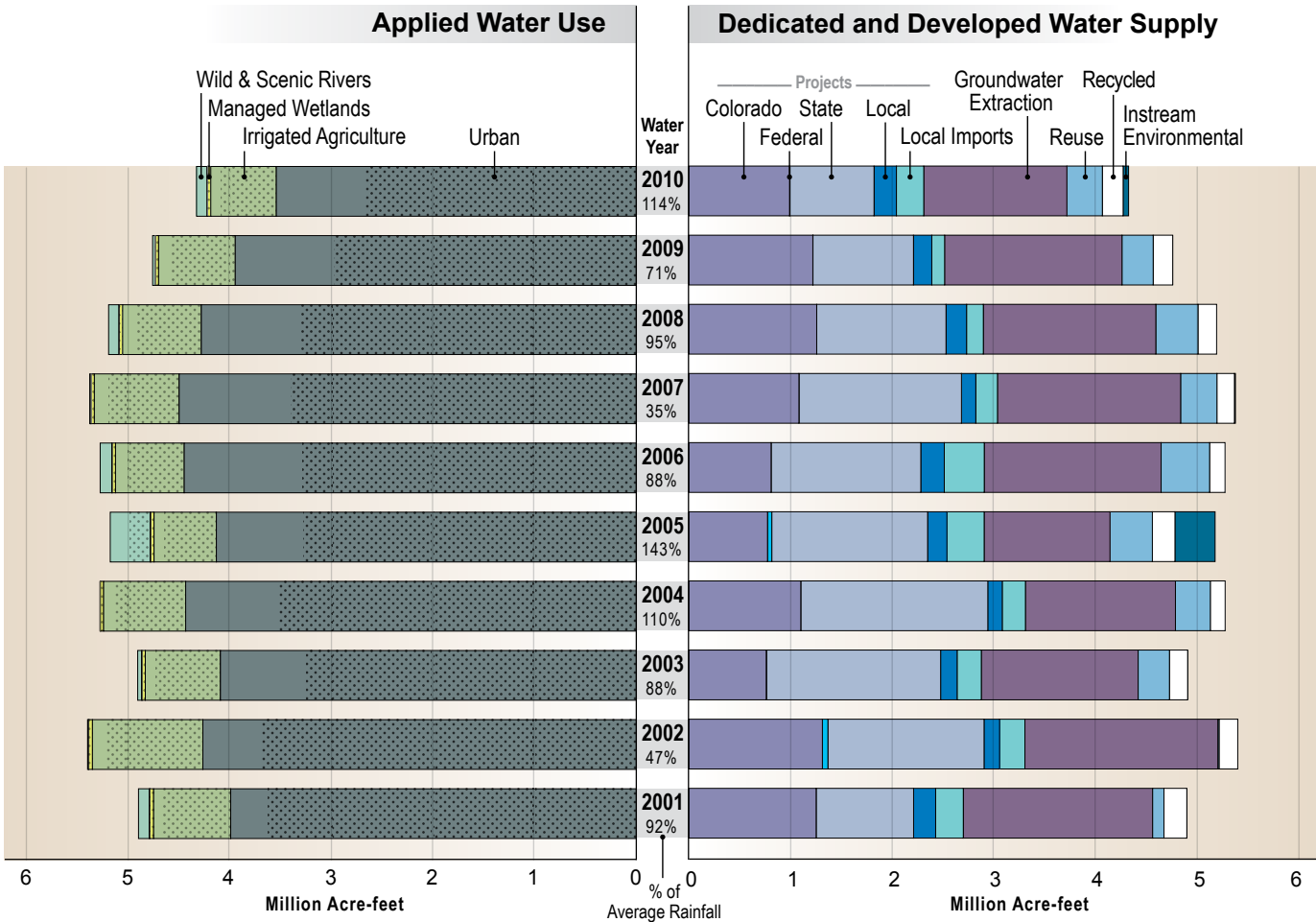
San Diego planning area depends on Colorado River and SWP deliveries to supply most of these uses. There are also about 50-100 taf in local supplies, 60 taf of groundwater, and 40-50 taf in reclaimed wastewater available.

Project Operations

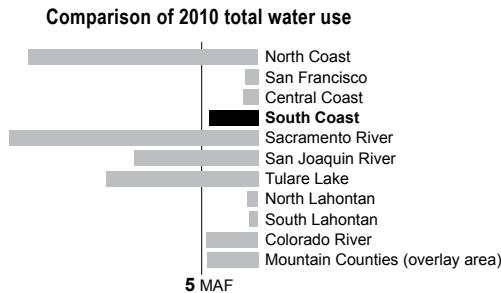
Water management in the region is among the most complex in the world. Systems convey imported water to the region; capture, store, and treat water supplies within the region; and deliver water throughout the region. The following paragraphs describe major water supply infrastructure that delivers imported water to the South Coast region.

Figure SC-14 South Coast Hydrologic Region Water Balance by Water Year (2001-2010)

California’s water resources vary significantly from year to year. Ten recent years show this variability for water use and water supply. Applied Water Use shows how water is applied to urban and agricultural sectors and dedicated to the environment and the Dedicated and Developed Water Supply shows where the water came from each year to meet those uses. Dedicated and Developed Water Supply does not include the approximately 125 million acre-feet (MAF) of statewide precipitation and inflow in an average year that either evaporates, are used by native vegetation, provides rainfall for agriculture and managed wetlands, or flow out of the state or to salt sinks like saline aquifers (see Table SC-16). Groundwater extraction includes annually about 2 MAF more groundwater used statewide than what naturally recharges – called groundwater overdraft. Overdraft is characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years.



Stippling in bars indicates **depleted (irrecoverable) water use** (water consumed through evapotranspiration, flowing to salt sinks like saline aquifers, or otherwise not available as a source of supply)



For further details, refer to Vol. 5, *Technical Guide*, and the Volume 4 article, "California’s Groundwater Update 2013."

Key Water Supply and Water Use Definitions

Applied water. The total amount of water that is diverted from any source to meet the demands of water users without adjusting for water that is depleted, returned to the developed supply or considered irrecoverable (see water balance figure).

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.

Instream environmental. Instream flows used only for environmental purposes.

Instream flow. The use of water within its natural watercourse as specified in an agreement, water rights permit, court order, FERC license, etc.

Groundwater Extraction. An annual estimate of water withdrawn from banked, adjudicated, and unadjudicated groundwater basins.

Recycled water. Municipal water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource.

Reused water. The application of previously used water to meet a beneficial use, whether treated or not prior to the subsequent use.

Urban water use. The use of water for urban purposes, including residential, commercial, industrial, recreation, energy production, military, and institutional classes. The term is applied in the sense that it is a kind of use rather than a place of use.

Water balance. An analysis of the total developed/dedicated supplies, uses, and operational characteristics for a region. It shows what water was applied to actual uses so that use equals supply.

South Coast Water Balance by Water Year Data Table (TAF)

	2001 (92%)	2002 (47%)	2003 (88%)	2004 (110%)	2005 (143%)	2006 (88%)	2007 (35%)	2008 (95%)	2009 (71%)	2010 (114%)
APPLIED WATER USE										
Urban	3,990	4,264	4,091	4,433	4,131	4,447	4,497	4,279	3,945	3,541
Irrigated Agriculture	758	1,086	739	807	613	676	834	774	754	645
Managed Wetlands	37	36	31	31	32	31	32	32	32	32
Req Delta Outflow	0	0	0	0	0	0	0	0	0	0
Instream Flow	4	4	4	4	4	6	4	4	4	4
Wild & Scenic R.	108	8	40	0	395	114	10	102	23	104
Total Uses	4,897	5,397	4,905	5,275	5,175	5,273	5,376	5,191	4,757	4,326
DEPLETED WATER USE (STIPPLING)										
Urban	3,621	3,679	3,248	3,520	3,268	3,283	3,397	3,299	2,971	2,663
Irrigated Agriculture	665	946	631	695	506	556	693	638	621	540
Managed Wetlands	37	36	31	31	32	31	32	32	32	32
Req Delta Outflow	0	0	0	0	0	0	0	0	0	0
Instream Flow	0	0	0	0	0	0	0	0	0	0
Wild & Scenic R.	0	0	0	0	202	0	0	0	0	0
Total Uses	4,323	4,660	3,911	4,246	4,008	3,870	4,122	3,969	3,625	3,236
DEDICATED AND DEVELOPED WATER SUPPLY										
Instream	0	0	0	0	395	0	10	0	0	54
Local Projects	217	153	162	142	190	231	141	202	180	220
Local Imported Deliveries	272	249	238	228	366	393	213	165	126	269
Colorado Project	1,251	1,313	760	1,100	773	808	1,082	1,257	1,219	990
Federal Projects	0	54	1	0	42	0	0	0	1	1
State Project	959	1,536	1,715	1,840	1,533	1,473	1,599	1,272	989	830
Groundwater Extraction	1,862	1,898	1,543	1,476	1,238	1,740	1,802	1,697	1,745	1,408
Inflow & Storage	0	0	0	0	0	0	0	0	0	0
Reuse & Seepage	112	12	308	343	417	477	357	415	307	349
Recycled Water	225	184	179	146	222	152	172	183	192	204
Total Supplies	4,897	5,397	4,905	5,275	5,175	5,273	5,376	5,191	4,757	4,326

The California Aqueduct, a component of the SWP, owned and operated by DWR, is 444 miles long and carries SWP supplies to water agencies throughout California. The aqueduct begins at the Delta; and the water 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 Tehachapi, the aqueduct divides into two branches — the West and the East. Water in the East Branch flows to Lake Palmdale, Lake Perris, and the San Geronio Pass area, and the West Branch water flows 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 kilowatt-hours generated annually); 21 reservoirs (5.8 maf capacity); storage tanks; and canals, tunnels, and pipelines (California Department of Water Resources 2008b).

The CRA is 242 miles long, owned and operated by the MWD, and conveys Colorado River water to the South Coast region. 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 was constructed between 1933 and 1941 to ensure a steady supply of drinking water to Los Angeles. The aqueduct includes four reservoirs, five pumping plants, 63 miles of canals, 92 miles of tunnels, and 83 miles of buried conduit and siphons.

The LAA comprises two aqueducts. The first, the Owens Valley aqueduct, was completed in 1913; and the second LAA was completed in 1970. The first LAA was designed to deliver water from the Owens River near Independence to the City of Los Angeles. The second LAA, constructed to meet the additional water needs of a growing population, 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 second LAA increased the city's capacity to deliver water from the Mono Basin and Owens Valley from 485 cfs to 775 cfs.

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 cfs. The first aqueduct (Pipelines 1 and 2) extends 70 miles, from the CRA near San Jacinto to San Vicente Reservoir. Constructed by the U.S. Department of the Navy and USBR between 1945 and 1954, the two pipelines share common tunnels and inverted siphons. The 94-mile second aqueduct (Pipelines 4 and 5) was constructed by SDCWA during 1957 to 1979 and is 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. Pipeline 5 ends at Lake Murray. MWD owns and operates the northern portions of the pipelines; the delivery point to SDCWA is located 6 miles south of the San Diego-Riverside county line (U.S. Bureau of Reclamation 2008).

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. Three RWQCBs have jurisdiction in the South Coast: Los Angeles RWQCB (Region 4), Santa Ana RWQCB (Region 8), and San Diego RWQCB (Region 9). Each RWQCB identifies impaired water bodies, establishes priorities for the protection of water quality, issues WDRs, and takes appropriate enforcement actions within its jurisdiction. Specific water quality issues within the South Coast include beach closures, contaminated sediments, agricultural discharges, salinity management, and port and harbor discharges.

Surface Water Quality

The Los Angeles region is the state's most densely populated and industrialized region. Despite that, many of the watersheds in the region range over large areas that are highly diverse. A designated wilderness area may be found in one part of a watershed, while extensive development dominates another part; and agriculture possibly exists in yet another area of the watershed. To add to the complexity, more than 1,000 point source discharges of wastewater are regulated by the Los Angeles RWQCB; and surface water and groundwater within the Los Angeles region are insufficient to support its population. Consequently, water imported from other areas meets about 50 percent of freshwater demands in the region. Restrictions on imported water, as well as drought conditions, have necessitated water conservation measures at times. In addition, the demand for water is being partially fulfilled by the increasing use of recycled water for groundwater replenishment, urban irrigation, and industrial processing.

Approximately 15 percent of the 823 Clean Water Act (CWA) Section 303(d) surface water quality impairments (2010) in the Los Angeles region are related to excessive nutrients. The majority of these impairments occur in lakes, reservoirs, and streams. In more urban watersheds, metals are generally the more prevalent pollutants of concern while in watersheds with more agricultural activities, salts, nutrients, and, at times, pesticides are more prevalent.

Surface water quality data for the Upper Santa Clara River in Los Angeles County are based on the DWR investigation of water quality and beneficial uses conducted for the Upper Santa Clara River Hydrologic Area. The investigation found that Castaic Lake and Castaic Lagoon water are influenced by thermal stratification and biochemical processes. Castaic Lake, which supplies drinking water to residents in the Santa Clarita Valley, contains levels of chloride that can at times vary significantly, depending on hydrologic conditions and on regulatory decisions involving the Delta. The Los Angeles RWQCB has set a total maximum daily load of chloride TMDL of 100 milligrams per liter (mg/L) for the Santa Clara River. Within the lake, levels of chloride can fluctuate above and below this value. The Santa Clarita Valley Sanitation District is currently tasked with reducing the chloride levels within the Upper Santa Clara River. The water use agencies within the region are working with the sanitation district to evaluate options for lowest cost alternatives to meet the compliance levels. The Santa Clarita Valley Sanitation District plans to install ultraviolet disinfection and reverse osmosis treatment to bring the chloride levels in the wastewater discharged from its two water reclamation plants into compliance with the chloride TMDL.

In the Santa Ana planning area, the water found in less developed and non-agricultural areas of the watershed is typically the highest quality water in the watershed. Agricultural, industrial, commercial, and residential developments over the past 150 years have degraded surface water quality. Pollutants include nutrients, salinity, sediment, pesticides, and microbial contaminants. In developed areas and agricultural areas, stormwater carries pollutants from roads, parking lots, and other sources, degrading the quality of water as it flows downstream.

The approaches available to manage surface water quality include managing urban runoff through municipal National Pollutant Discharge Elimination System (NPDES) permits, developing drainage area management plans (DAMPs), water quality management plans for new development and redevelopment, and encouraging low-impact development. Protection of surface waters also can be achieved through construction of wetlands, implementing BMPs, using brine lines, and building and operating appropriate wastewater treatment facilities.

Regulatory measures are also in place to assure surface water quality impairment is not affecting downstream beneficial uses. Water bodies that do not meet water quality standards are identified as impaired by the RWQCB and the SWRCB, and are placed on the 303(d) List of Water Quality Limited Segments. A water body remains on the list until a TMDL is adopted and the water quality standards are attained — or there are sufficient data to demonstrate that water quality standards have been met and delisting should occur. Multiple TMDLs for bacteria, nutrients, sediments, pesticides, selenium, and salt are in place across the watershed and are being addressed through multi-agency task forces, many of which are administered by SAWPA.

The potential impact of trace levels of constituents of emerging concern in surface water supplies is also an increasing concern for the water and wastewater agencies, regulators, and the public. These include a wide range of chemical constituents such as pharmaceuticals, personal care products, pesticides, and other synthetic organic compounds. Potential sources include thousands of chemicals in consumer and health-related products such as drugs, food supplements, fragrances, sunscreen agents, deodorants, and insect repellents. Typically, these constituents of emerging concern are found at low concentrations (i.e., parts per trillion) in water bodies. Some of these chemicals enter surface water through the discharge of treated effluent when the public disposes of unused pharmaceuticals through the sewer system or the pharmaceuticals that are consumed are not entirely broken down in the human body.

Constituents of emerging concern currently are not regulated by federal or State agencies, and very few have regulatory levels or California Notification Levels. In general, when detected, the chemicals occur at low concentrations in surface water. Although ecological impacts on fish and other wildlife have been shown for some of these trace contaminants in water bodies, much less is known about potential human health effects. However, some of these constituents are known or suspected to have endocrine-disrupting effects if present at a sufficiently high concentration.

As part of the issuance of a tentative WDR General Order in 2006, the Santa Ana RWQCB requested that a program be developed to study and evaluate the potential water quality impacts of emerging constituents in imported water and wastewater discharges. Under the administration of SAWPA, a multi-agency task force of local water, wastewater, and imported water agencies was formed to evaluate an appropriate list of emerging constituents to voluntarily monitor. The Emerging Constituents Sampling and Investigation Program is now conducted annually and is submitted to the Santa Ana RWQCB each year by the Emerging Constituents Program Task Force. This program is revised and updated annually as research and regulatory monitoring requirements arise. The Emerging Constituent Program Task Force also integrates findings and recommendations from the CDPH and the SWRCB's Water Recycling Policy expert panel on emerging constituents monitoring as they arise.

Groundwater Quality

Groundwater quality in the South Coast region has been degraded substantially from background levels, and much of the degradation reflects land use practices. For example, fertilizers and pesticides, typically used on agricultural lands, can degrade groundwater when irrigation-return waters containing such substances seep into the subsurface. In areas with failing or improperly sited septic systems, nitrogen, and pathogenic bacteria from can seep into groundwater and result in health risks to those who rely on groundwater for domestic supply. In areas with industrial or commercial activities, above ground and underground storage tanks contain hazardous substances. Thousands of these tanks in the region have leaked or are leaking, discharging

petroleum fuels, solvents, and other substances into the subsurface. These leaks as well as other discharges to the subsurface can seep into and pollute groundwater aquifers, which is often difficult, costly, and extremely slow to clean up.

Metropolitan Los Angeles

The following are some examples of groundwater quality challenges in the Metropolitan Los Angeles area.

Upper Santa Clara River Valley. In the Upper Santa Clara River Valley, the groundwater basin has two aquifers: the Alluvial Aquifer, whose quality is primarily influenced by rainfall and streamflow; and the Saugus Formation, which is a much deeper aquifer and recharged primarily by a combination of rainfall and deep percolation from the partially overlying alluvium. The larger part of the Upper Santa Clara River Valley's groundwater supply is from the alluvial aquifer, between 30,000 to 40,000 af/yr.; and a smaller portion of the Upper Santa Clara River Valley's water supply is drawn from the Saugus Formation, between 7,500 and 15,000 af/yr. in normal water years.

Perchlorate has been a water quality concern in the Upper Santa Clara River Valley since 1997 when it was originally detected in four wells in the eastern part of the Saugus Formation, near the former Whittaker-Bermite facility. In 2007 CDPH established a maximum contaminant level (MCL) for perchlorate of 6 micrograms per liter ($\mu\text{g/L}$). As a result of the perchlorate contamination, six wells — four that tap the Saugus Formation and two that tap the alluvial aquifer — were taken out of service upon the detection of perchlorate. These six wells have either (1) been abandoned and replaced, (2) been returned to service with the addition of a water treatment plant designed to remove perchlorate and permitted by the CDPH Drinking Water Program, or (3) will be replaced under an existing perchlorate litigation settlement agreement (see Section 5 of the CLWA 2010 UWMP for more details on this issue).

San Gabriel Valley and San Fernando Valley Groundwater Basins. In the San Gabriel Valley and San Fernando Valley groundwater basins, volatile organic compounds (VOCs) from industry and nitrates from subsurface sewage disposal and past agricultural activities are the primary pollutants in these groundwater basins. These deep alluvial basins do not have a continuous effective confining layer above the groundwater, and as a result pollutants have seeped through the upper sediments into the groundwater. Approximately 20 percent of groundwater production capacity for municipal use in the San Gabriel Valley has been shut down as a result of this pollution.

In light of the widespread pollution in both the San Gabriel Valley and San Fernando Valley groundwater basins, the California Department of Toxic Substances Control has designated large areas of these basins as high-priority Hazardous Substances Cleanup sites. Furthermore, the U.S. Environmental Protection Agency (EPA) has designated these areas as Superfund sites. The Los Angeles RWQCB and the EPA are overseeing investigations to further define the extent of pollution, identify the responsible parties, and begin remediation in these areas.

The LADWP has developed programs to accelerate treatment for San Fernando Valley groundwater, which includes a comprehensive groundwater system improvement study, monitoring well installations, interim wellhead treatment, and collaboration with regulatory agencies and government officials to identify those responsible for the contamination.

City of Glendale. The City of Glendale has been the lead agency for research to determine the effectiveness of processes to remove the contaminant chromium-6 from local groundwater supplies. In 2013, CDPH proposed an MCL of 10 parts per billion for chromium-6, and CDPH expects to issue a final MCL for chromium-6 in 2014. The final phase of the City of Glendale's research is to determine the feasibility of decreasing the level of the contaminant below 1 part per billion.

Central and West Coast Groundwater Subbasins (Coastal Plain of Los Angeles). Seawater intrusion that has occurred in these basins is now under control in most areas through an artificial recharge system of injection wells that form freshwater barriers along the coast. Groundwater in the lower aquifers of these basins is generally of good quality, but large plumes of saline water have been trapped behind the barrier of injection wells in the West Coast Subbasin, degrading significant volumes of groundwater with high concentrations of chloride. Furthermore, the quality of groundwater in parts of the upper aquifers of both basins is degraded by both organic and inorganic pollutants from a variety of sources, such as leaking tanks, leaking sewer lines, and illegal discharges. As the aquifers and confining layers in these alluvial basins are typically interfingering, the quality of groundwater in the deeper production aquifers is threatened by migration of pollutants from the upper aquifers.

Ventura County Groundwater Basins. Groundwater in several of the Ventura County groundwater basins has been, and continues to be, overdrafted (particularly in the Oxnard Plain and Pleasant Valley areas) despite efforts to artificially recharge groundwater and to control groundwater pumping. Some aquifers in these groundwater basins are also hydraulically connected with seawater; and therefore, seawater is intruding further inland, degrading large volumes of groundwater with high concentrations of chloride. In addition, nutrients and other dissolved constituents in irrigation return-flows are seeping into shallow aquifers and degrading groundwater in these basins. Furthermore, degradation and cross-contamination are occurring as degraded or contaminated groundwater travels between aquifers through abandoned and improperly sealed wells and corroded active wells.

There are also some communities in Ventura County that use septic systems that are impacting groundwater quality. The Los Angeles RWQCB has determined that nitrates and other contaminants discharged from septic systems used by the El Rio community (to the northwest of Oxnard) were threatening groundwater quality. In many wells in the El Rio area, nitrate is present at levels exceeding the drinking water MCL established by the State and federal governments. The Watersheds Coalition of Ventura County is working to construct a sewer system to the area to eliminate the use of septic systems and improve water quality.

Santa Ana Planning Area

Among the groundwater quality challenges facing the Santa Ana watershed basins, high salt and nitrate concentrations are the most pervasive. Sources of elevated levels include mineral content in the sediments, recharge and drainage patterns, source water quality, irrigation, wastewater discharges, and historical land use. Managing levels of TDS in groundwater basins is a significant challenge as the recycling of wastewater increases in the watershed. Each cycle of residential water use typically adds approximately 200 mg/L of salt to the water. Industrial and commercial operations may contribute higher levels. Construction and use of salinity management facilities, such as brine lines and desalters, are being used to prevent salt-buildup and to remediate high

TDS groundwater basins. Elevated levels of nitrates in groundwater originate primarily from use of fertilizers, confined animal feedlots, and wastewater treatment facilities.

There are five management zones in the Santa Ana River watershed area. They are the Upper Santa Ana River Basin, Chino Basin, Middle Santa Ana River Basin, San Jacinto River Basin, and the Lower Santa Ana River Basin. In addition to salts and nitrates, some basin areas are also challenged by VOC contamination, perchlorate, trichloroethylene (TCE), tetrachloroethylene (PCE), dibromochloropropane (DBCP), arsenic, and chromium-6. Here is summary of the issues and actions being implemented to address those issues by the local agencies.

Upper Santa Ana River Basin. The Upper Santa Ana River Basin is divided into seven smaller zones. In the Bunker Hill management zones, the largest area of groundwater contamination is the Newmark Superfund Site. Treatment plants are operating to remove VOC contamination. A total of 13 extraction wells produce, on average, approximately 26,000 af/yr., and that water is treated at four treatment plants.

In the Bunker Hill B management zone, a 6-mile-long plume of VOC and ammonium perchlorate contamination, known as the Crafton-Redlands Plume, was first detected in the early 1980s. Approximately 46 drinking water wells have been affected. A number of wellhead treatment units and treatment plants to remove these contaminants are being operated by the cities of Redlands, Loma Linda, and Riverside.

Cherry Valley is an unincorporated area located northeast of the City of Beaumont in the Beaumont management zone. The community is not served by a sanitary sewer system. The only source of drinking water for the community is groundwater. A study commissioned by the San Timoteo Watershed Management Authority indicated an ongoing degradation of the quality of the groundwater due to nitrate. The source of the nitrate was attributed to the use of on-site wastewater treatment systems (i.e., septic systems). The County of Riverside has adopted three ordinances to ban new septic systems unless the systems are designed to remove 50 percent of the nitrogen in the treated wastewater. Beaumont Cherry Valley Water District is in the process of providing a sewer system to a major portion of the area and is seeking funding from the Clean Water State Revolving Fund for the project.

Chino Basin, Cucamonga, and Rialto Management Zones. The Chino Basin is experiencing rapid commercial and residential development. The groundwater quality in the basin is generally good, with better groundwater quality found in the northern portion where recharge occurs. Salinity and nitrate concentrations generally increase in the southern portion of the basin. Between 2001 and 2006, about 80 percent of the private wells sampled south of Highway 60 had nitrate concentrations greater than the drinking water MCL. In addition, pollution from point sources and emerging contaminants is a concern for the overall groundwater quality in Chino Basin. Constituents that have the potential to affect groundwater quality include VOCs, arsenic, and perchlorate.

In the Rialto management zone, at least 20 public supply wells for the city of Rialto, city of Colton, West Valley Water District, and Fontana Water Company have been contaminated by perchlorate. Water treatment systems have been installed on 11 of these wells. Arsenic at concentrations greater than the drinking water standard is also a concern and appears to be limited to the deeper aquifer zone near the city of Chino Hills. Chromium-6 may also pose a

groundwater challenge for the Chino Basin when a final chromium-6 drinking water MCL is adopted.

Middle Santa Ana River Basin. Several active sites in the City of Riverside's groundwater production system have increased monitoring schedules to address the presence of contaminants, including nitrate, PCE, DBCP, and perchlorate. As a result, the City of Riverside has implemented blending plans, increased monitoring schedules, and installed wellhead treatment to address these elevated levels. Blending plans also are being used to reduce nitrate levels in wells exceeding drinking water standards.

Agricultural activities in the San Jacinto River Basin are suspected to be partially responsible for elevated salt and nitrate concentrations in the groundwater. Septic system discharges are creating significant water quality problems that have triggered local agency and the Santa Ana RWQCB's regulatory response in the unincorporated areas of Quail Valley (north of Canyon Lake) and Enchanted Heights (west Perris). The basin is dotted with several other areas believed to be at risk of water quality degradation from septic systems. A septic system management plan has been developed by Riverside County Flood Control.

A Groundwater Salinity Management Program, developed by EMWD, addresses several water quality issues in this area. The Perris South Subbasin contains a surplus of marginal- to unusable-quality groundwater that flows into the adjacent high-quality Lakeview Subbasin, rendering several wells unusable and threatening the remaining production of the basin. Because imported water is unavailable, blending to improve water quality is not an option. Therefore, three desalination facilities, two constructed and one being designed, will recover high TDS water in the Menifee and Perris South groundwater management zones for potable use. In addition to providing safe drinking water, the desalters will play a role in reducing the migration of brackish groundwater into areas of good-quality groundwater. Several active wells are operating with increased monitoring schedules since the presence of various contaminants has been confirmed, including nitrate, TCE, PCE, TDS, and other VOCs. In general, treatment is not required for these contaminants, and the latest monitoring results indicate that the contaminant levels are not increasing.

Lower Santa Ana River Basin. The Lower Santa Ana River Basin contains four groundwater management zones: Orange County, Irvine, La Habra, and Santiago. The Orange County and Irvine management zones are important water supplies for Orange County and are discussed in the following paragraphs. The La Habra and Santiago management zones have minimal pumping, and water quality objectives for TDS and nitrate have not been established since there is limited data.

The Orange County Groundwater Basin is the source of approximately 60-70 percent of the water supply for 2.3 million people. About 90 percent of the groundwater pumped from this basin meets drinking water standards without treatment. The remaining 10 percent requires treatment for VOCs, salts, or other contaminants.

A shallow VOC plume exists in the Anaheim/Fullerton area where VOC concentrations exceed drinking water standards over approximately a 6 square mile area. To address this plume, the North Basin Groundwater Protection Project is being designed to extract and treat VOC-contaminated groundwater and recharge treated water back into the groundwater basin. Other VOC plumes exist in Santa Ana: the Seal Beach Naval Weapons Station and the now-closed

Tustin Marine Corps Air Station. Various other sites have generally shallow VOC contamination or other contaminants. The Tustin desalters use reverse osmosis and ion exchange treatment systems to reduce high levels of TDS, nitrate, and perchlorate in a section of Tustin. Areas in Garden Grove have groundwater with high nitrate concentrations that are likely the result of historical agricultural practices.

The Irvine Management Zone is a subbasin of the Orange County Groundwater Basin. Water naturally flows between the boundaries, but the operation of the Irvine Desalter limits movement of water between the two management zones.

In the Irvine Management Zone some groundwater is contaminated with VOCs from the now-closed El Toro Marine Corps Air Station and also contains high TDS and nitrate concentrations. The Irvine Desalter uses reverse osmosis, air stripping, and carbon absorption treatment to remove contaminants from the groundwater. Water treated for VOC contamination is distributed by the IRWD in its non-potable water system (i.e., irrigation and other non-potable uses). Water treated for high TDS and nitrate is distributed through the potable water system.

SAWPA has also implemented a task force approach to monitor and address groundwater quality challenges. The task force involves multiple agencies who agree to collaboratively prepare water quality monitoring reports and analysis to assure that beneficial uses of groundwater are protected.

Drinking Water Quality

In general, drinking water systems in the region deliver water to their customers that meets federal and State drinking water standards. In January 2013, the SWRCB completed a statewide assessment of community water systems that rely on contaminated groundwater. Contamination of local groundwater resources results in higher costs for rate payers and consumers due to the need for additional water treatment. This report identified 162 community drinking water systems in the region that rely on at least one contaminated groundwater well as a source of supply (Table SC-17). A total of 584 community drinking water wells are affected by groundwater contamination, and the most prevalent contaminants are nitrate, perchlorate, PCE, and TCE (Table SC-18). The region also has a high number of community drinking water wells that are affected by multiple contaminants. Nearly half of the 584 affected wells have multiple contaminants; this may further increase treatment costs if two or more treatment technologies are needed to remove the contaminants in order to provide a safe drinking water supply.

Groundwater Conditions and Issues

Groundwater Occurrence and Movement

Aquifer conditions and groundwater levels change in response to varying supply, demand, and climate conditions. During dry years or periods of increased groundwater use, seasonal groundwater levels tend to fluctuate more widely. Subject to annual recharge conditions, this may result in a long-term decline in groundwater levels, both locally and regionally. Depending on the amount, timing, and duration of groundwater level decline, nearby well owners may need to make wells deeper or place pumps lower to regain access to groundwater.

Table SC-17 Summary of Contaminants affecting Community Drinking Water Systems in the South Coast Hydrologic Region

Principal Contaminant (PC)	Community Drinking Water Systems where PC exceeds the Primary Maximum Contaminant Level (MCL)	Number of Community Drinking Water Wells where PC exceeds the Primary Maximum Contaminant Level (MCL)
Nitrate	81	270
Perchlorate	47	166
Gross alpha particle activity	47	89
Tetrachloroethylene (PCE)	40	141
Trichloroethylene (TCE)	38	146
Arsenic	26	44
Uranium	18	35
Carbon tetrachloride	16	51
Fluoride	14	29
1,1-Dichloroethylene (1,1-DCE)	9	35
1,2-Dichloroethane (1,2-DCA)	9	23
1,2-Dibromo-3-chloropropane (DBCP)	7	29

Source: *Communities That Rely on a Contaminated Groundwater Source for Drinking Water*. State Water Resources Control Board 2013.

Note:
Only the 12 most prevalent contaminants are shown. Of the 584 affected wells, 276 have multiple contaminants; 158 wells are affected by nitrate and other contaminant(s); 134 wells are affected by perchlorate and other contaminant(s); 97 wells are affected by both nitrate and perchlorate contamination.

As groundwater levels fall, they can affect the interaction between surface water and groundwater by inducing additional infiltration and recharge from surface water systems, which reduce groundwater discharge to surface-water baseflow and wetland areas. Extensive lowering of groundwater levels also can result in land subsidence due to the dewatering, compaction, and loss of storage within finer grained aquifer systems. Land subsidence may result in permanent and irreversible loss of aquifer storage capacity due to inelastic compaction of the aquifer's sedimentary matrix.

During years of normal or above-normal precipitation, or during periods of low groundwater extraction, aquifer systems tend to recharge and respond with rising groundwater levels. As groundwater levels rise, they reconnect to surface water systems, contributing to surface water baseflow or wetlands, seeps, and springs.

Groundwater moves from areas of higher hydraulic potential to areas of lower hydraulic potential, typically from higher elevations to lower elevations. The direction of groundwater

Table SC-18 Summary of Community Drinking Water Systems in the South Coast Hydrologic Region Relying on One or More Contaminated Groundwater Well That Exceeds a Primary Drinking Water Standard

Community Drinking Water Systems and Groundwater Wells Grouped by Water System Population	Number of Affected Community Drinking Water Systems	Number of Affected Community Drinking Water Wells
Small \leq 3,300)	45	73
Medium 3,301 - 10,000	20	35
Large \geq 10,000	99	476
Total	164	584
Source: <i>Communities That Rely on Contaminated Groundwater Source for Drinking Water</i> . State Water Resources Control Board 2013.		

movement can also be influenced by groundwater extractions. Where groundwater extractions are significant, groundwater may flow toward the extraction point. Rocks with low permeability can restrict groundwater flow through a basin.

Depth to Groundwater and Groundwater Elevation Contours

Groundwater monitoring makes data available to prepare the depth to groundwater and groundwater elevation contours. The depth to groundwater has a direct bearing on the costs associated with well installation and groundwater extraction operations. Knowing the local depth to groundwater can also provide a better understanding of the interaction between the groundwater table and the surface water systems, and the contribution of groundwater aquifers to the local ecosystem.

Depth-to-groundwater data for some of the groundwater basins in the region are available online via DWR's Water Data Library (<http://www.water.ca.gov/waterdatalibrary/>), DWR's CASGEM system (<http://www.water.ca.gov/groundwater/casgem/>), and the USGS National Water Information System (<http://waterdata.usgs.gov/nwis>).

DWR monitors the depth to groundwater in some groundwater basins within the region and have produced groundwater elevation maps for the West Coast subbasin of the Coastal Plain of Los Angeles Groundwater Basin and the San Pasqual Valley Groundwater Basin. Several local agencies independently or cooperatively measure groundwater levels and produce groundwater elevation contour maps for basins within their jurisdictions. Examples of local agencies that produce groundwater elevation contour maps for some areas of the region include:

- Orange County Water District (OCWD).
- Water Replenishment District of Southern California (WRD).
- United Water Conservation District.
- Chino Basin Watermaster.
- Main San Gabriel Basin Watermaster.
- Upper Los Angeles River Area Watermaster.

Groundwater elevation contours can help estimate the direction, gradient, and rate of groundwater flow.

Groundwater Level Trends

Groundwater levels within groundwater basins in the region are highly variable because of the physical variability of aquifer systems, the variability of surrounding land use practices, and the variability of groundwater availability and recharge. Plots of depth-to-groundwater measurements in wells over time (groundwater level hydrographs) allow analysis of seasonal and long-term groundwater level variability and trends. The hydrographs presented in Figures SC-15A to SC-15C help explain how local aquifer systems respond to changing groundwater pumping quantities and to resource management practices. The hydrograph name refers to the well location (township, range, section, and tract).

Figure SC-15A shows hydrograph 04N18W29M002S, which is from a well located near the Santa Clara River in the Piru subbasin within the Santa Clara River Valley Groundwater Basin. The hydrograph depicts the aquifer responses to hydrologic variations, groundwater extraction, and groundwater recharge. The well is completed in a narrow portion of the valley, in alluvium and the underlying San Pedro Formation, dominated by agricultural developments. The hydrograph depicts aquifer responses to hydrologic cycles and seasonal variations. For example, during winter or spring season, when precipitation is generally the most abundant, precipitation and associated runoff replenishes the aquifer system. Similarly, during wet and above-normal years, the aquifer system is fully recharged and groundwater levels reach almost the same elevation, about 620 feet above mean sea level. In contrast, during drought periods, such as 1976-1977, the late 1980s to early 1990s, and 2007-2009, groundwater levels typically decline (United Water Conservation District 2008).

During the drought of 2007-2009, however, the United Water Conservation District released captured stormwater runoff and used SWP water from Lake Piru to facilitate recharge within the Piru subbasin and the down-gradient Fillmore subbasin. The water that did not percolate into the Piru and Fillmore subbasins flowed downstream to the Santa Paula subbasin and the Freeman Diversion, which facilitated additional groundwater recharge (United Water Conservation District 2008). In addition to artificial recharge, infiltration of irrigation water also replenishes the aquifer system (United Water Conservation District 2011). Thus the hydrograph also illustrates the aquifer response to successful implementation of groundwater recharge during the 2007-2009 drought.

Figure SC-15B shows hydrograph 03S09W32P003S, which is from a public supply well located near Anaheim Lake, in the Coastal Plain of Orange County Groundwater Basin. The hydrograph depicts the long-term groundwater levels for a relatively stable aquifer that is managed conjunctively and is artificially recharged using recycled water and imported water. The well is completed in alluvium approximately 1 mile north of the current location of the SAR. Anaheim Lake is a groundwater recharge basin that uses water from MWD, the SAR, and recycled water from the Groundwater Replenishment System (GWRS), a project cooperatively operated by the OCWD and the Orange County Sanitation District (Orange County Water District 2009). The groundwater levels tend to decline during drought periods such as 1976-1977, the late 1980s to early 1990s, and 2007-2009. During wetter hydrology, the groundwater levels tend to rise. Despite annual groundwater level fluctuations of 40 to 80 feet, the groundwater levels have remained relatively stable for the last five decades. By using a variety of conjunctive management

approaches, the OCWD has maintained relatively stable long-term groundwater levels at this location.

Figure SC-15C shows hydrograph 01S03W21H001S, which is from a well located in the city of Redlands, in the Bunker Hill subbasin of the Upper Santa Ana Valley Groundwater Basin. The hydrograph depicts the steep drawdown of groundwater levels from the 1940s to the 1960s, the rise in groundwater levels from the late 1960s to the 1980s, and general aquifer responses to hydrologic variations and groundwater extraction. The well is completed in a mixed-use area near residential, commercial, and agricultural developments. The hydrograph shows that groundwater level steadily declined between 1945 and 1966. After groundwater rights in the basin were adjudicated in 1969, groundwater levels rose and have remained relatively stable. The SBVMWD imports water from the SWP and conjunctively manages water supplies within its service area. Surface water is preferentially used during periods of high precipitation so that the groundwater supply can be utilized during drought periods.

Change in Groundwater Storage

Change in groundwater storage is the difference in stored groundwater volume between two time periods. Examining the annual change in groundwater storage over a series of years helps identify the aquifer response to changes in climate, land use, or groundwater management over time. If the change in storage is negligible over a period represented by average hydrologic and land use conditions, the basin is considered to be in equilibrium under the existing water-use scenario and current management practices. However, declining storage over a period characterized by average hydrologic and land use conditions does not necessarily mean that the basin is being managed unsustainably or is subject to conditions of overdraft. Utilization of groundwater in storage during years of diminishing surface water supply, followed by active recharge of the aquifer when surface water or other alternative supplies become available, is a recognized and acceptable approach to conjunctive water management.

Additional information regarding the risks and benefits of conjunctive management can be found online from Update 2013, Volume 3, Chapter 9, “Conjunctive Management and Groundwater.”

Some local groundwater agencies within the region periodically develop change in groundwater storage estimates for groundwater basins within their jurisdictions. Developing change in storage estimates allows local groundwater managers to evaluate changing storage trends relative to changing land use patterns, hydrologic variability, and sustainable use of groundwater resources. Examples of local agencies that have determined change in storage include:

- Orange County Water District (OCWD).
- Water Replenishment District of Southern California (WRD).
- United Water Conservation District.
- San Bernardino Valley Municipal Water District (SBVMWD).

Land Subsidence

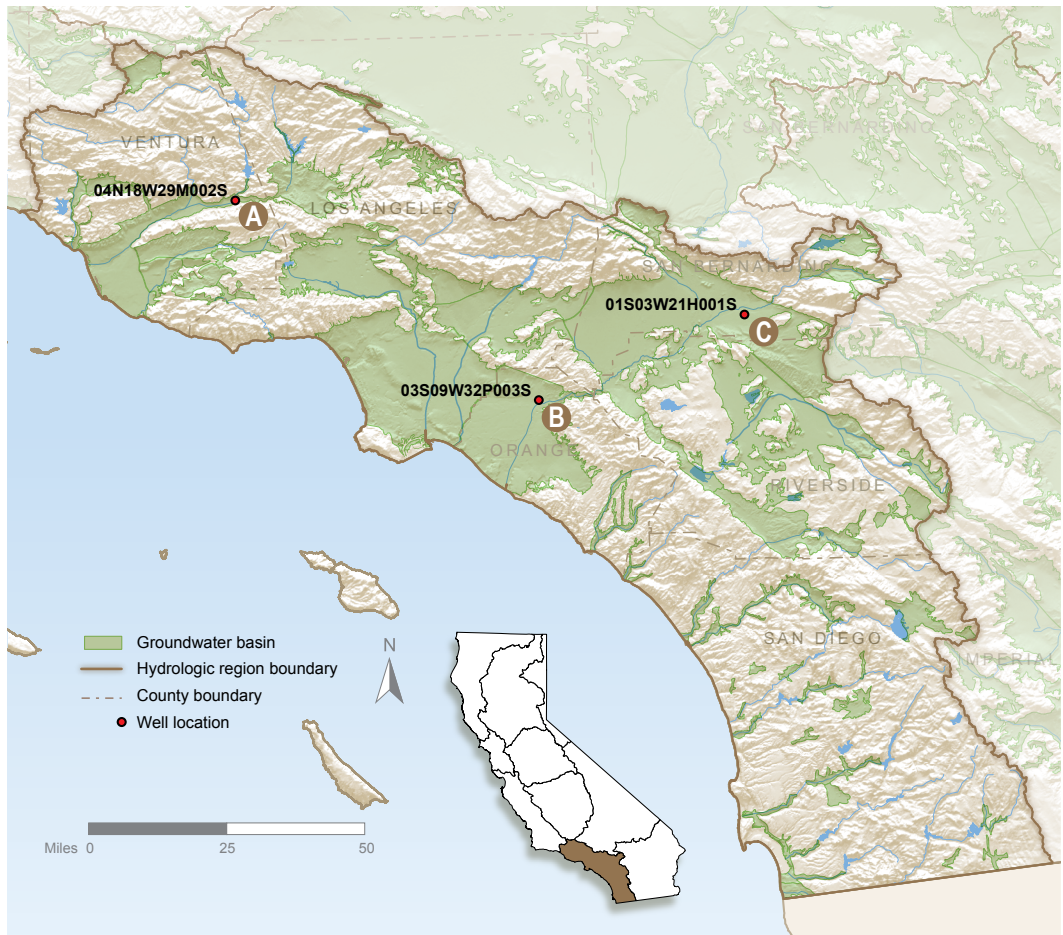
In the southwestern portion of Chino subbasin of the Upper Santa Ana Valley Groundwater Basin, ground fissures resulting from regional subsidence were identified as early as the 1970s (Chino Basin Watermaster 2007). The area of land subsidence coincides with an area that has

Figure SC-15 Groundwater Level Trends in Selected Wells in the South Coast Hydrologic Region

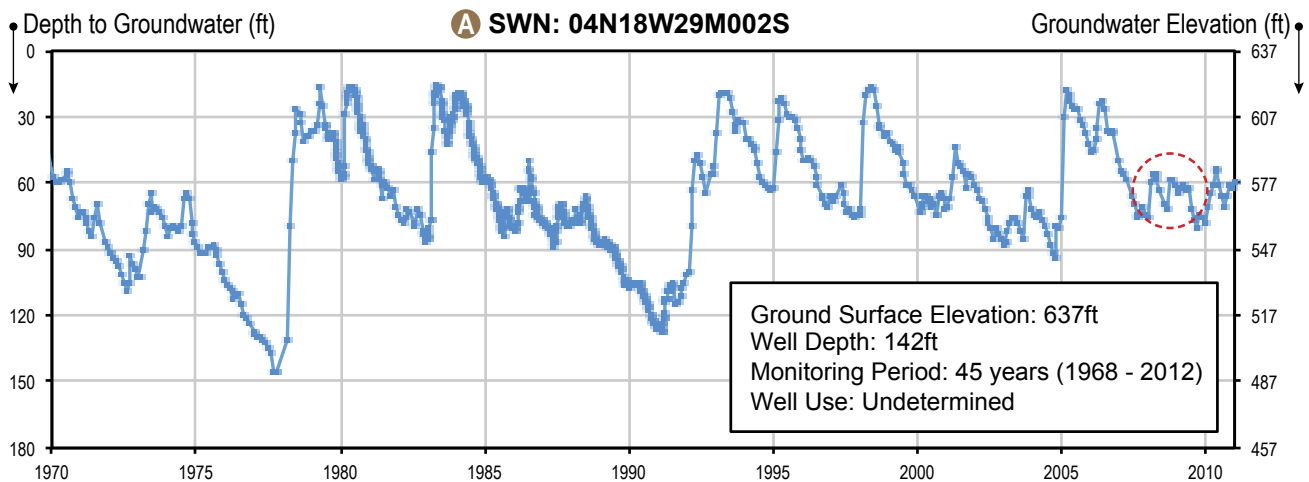
Aquifer response to changing demand and management practices

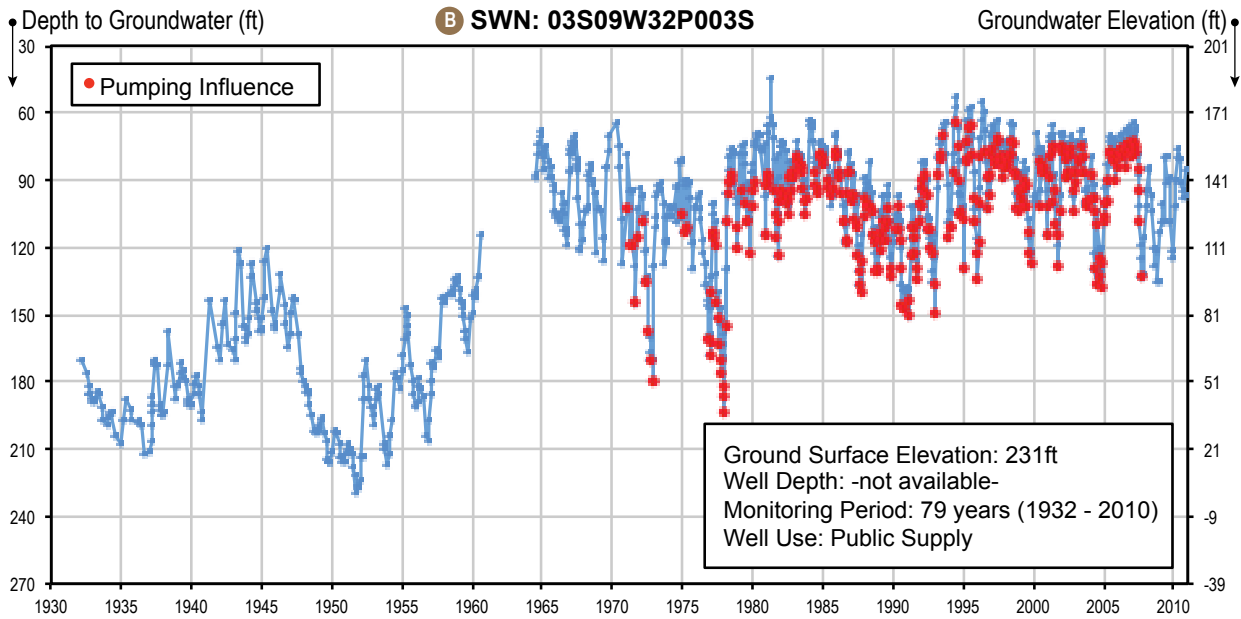
Hydrographs were selected to help tell a story of how local aquifer systems respond to changing groundwater demand and resource management practices. Additional detail is provided within the main text of the report.

Regional locator map



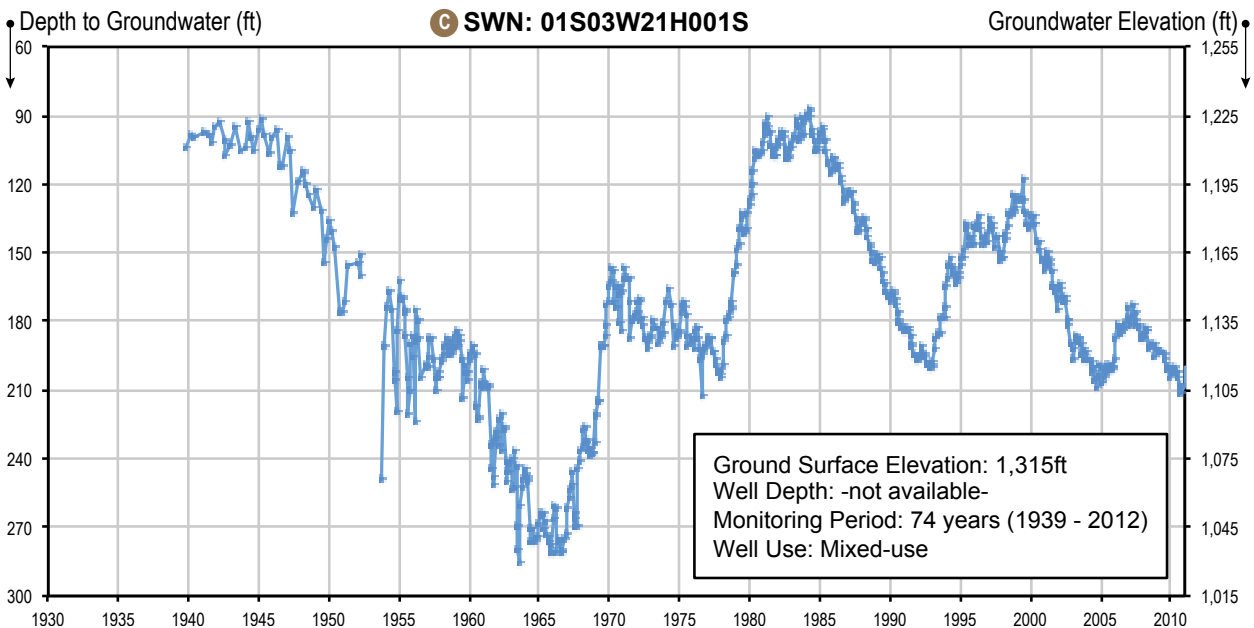
A Hydrograph 04N18W29M002S: illustrates the aquifer response to the long-term hydrologic cycles and seasonal variations associated with the local precipitation conditions. The surrounding aquifer was successfully recharged using captured stormwater runoff during the drought of 2007-09 (circled in red).





B Hydrograph 03S09W32P003S: Shows the successful recovery of groundwater levels associated with use of recycled and imported water in lieu of pumping groundwater, and conjunctive management of surface water and groundwater supplies.

C Hydrograph 01S03W21H001S: demonstrates the successful reversal of long-term decline in the groundwater levels as a result of basin adjudication in 1969 which triggered conjunctive management of surface water and groundwater supplies.



experienced significant declines in groundwater levels — as much as 200 feet (Wildermuth 1999). The Chino Basin Watermaster published a Subsidence Management Plan in 2007, and the watermaster actively monitors aquifer-system deformation, vertical ground-surface deformation, and horizontal ground-surface deformation. Two extensometers, which record aquifer-system compression or expansion data, are installed at the Ayala Park Extensometer facility (Chino Basin Watermaster 2007). Investigations by Kleinfelder (1993, 1996) concluded that a maximum of about 2 feet of subsidence occurred in the city of Chino between 1987 and 1995; about 1 foot of the subsidence occurred between 1993 and 1995. Wildermuth (2011) concluded that 2.5 feet of land subsidence occurred between 1985 and 2000, and that little inelastic subsidence has occurred in the area since 2000.

Land subsidence has also been evaluated in the Coastal Plain of Orange County Groundwater Basin. A study conducted by DWR (1980) cited survey data from the Orange County Surveyor that indicated a subsidence rate of up to 0.84 inch per year between 1956 and 1961 near the city of Santa Ana. Satellite radar images reviewed by Bawden et al. (2001) indicated a subsidence rate of about 0.5 inch per year near Santa Ana between 1993 and 1999, which coincided with a period of net groundwater withdrawal (Orange County Water District 2009). The OCWD estimates that the groundwater basin can be temporarily overdrafted by approximately 500 taf without causing irreversible seawater intrusion and land subsidence. The OCWD monitors groundwater levels and manages groundwater extraction in the basin and systematically replenishes the aquifer as part of conjunctive water management. For example, the OCWD has been actively recharging the groundwater basin since 1949 (Orange County Water District 2009). By conjunctively using surface water and groundwater resources, and by maintaining a long-term balance of groundwater production and recharge, the negative effects of seawater intrusion and land subsidence have been minimized.

In Ventura County, the Oxnard subbasin of the Santa Clara River Valley Groundwater Basin has experienced land subsidence and seawater intrusion as a result of groundwater pumping. As early as the 1940s, groundwater levels in the upper aquifer system declined beneath sea level, and widespread seawater intrusion commenced (Fox Canyon Groundwater Management Agency 2007). In the late 1950s, groundwater levels in the lower aquifer system declined beneath sea level. However, seawater intrusion was not detected in the lower aquifer system until the late 1980s. Groundwater levels in the lower aquifer system declined further as groundwater pumping from the lower aquifer system increased to offset reduced groundwater pumping from the upper aquifer system. The over-pumping of the aquifers led to seawater intrusion and resulted in up to 2.6 feet of land subsidence in the adjacent Pleasant Valley Groundwater Basin (United Water Conservation District 2012). The permanent loss of aquifer storage resulting from land subsidence is estimated to be about 200 taf (Fox Canyon Groundwater Management Agency 2007).

The San Jacinto Groundwater Basin is located in a seismically active area within the San Jacinto Fault Zone in Riverside County. Researchers estimate that this groundwater basin has experienced tectonic subsidence at an average rate of 0.2 inch per year for the past 40,000 years (Morton 1995). In addition to tectonic subsidence, the San Jacinto area has undergone aquifer-system compaction as a result of long-term groundwater withdrawals. The rate of land subsidence resulting from groundwater withdrawal is about one inch per year (Morton 1995). Although there is no active land subsidence monitoring occurring, the local water agencies have agreed to reduce groundwater production to be within the safe yield of the area to minimize potential for additional land subsidence (WRIME 2007).

Near Coastal Issues

Coastal waters are affected by a variety of activities that include:

- Municipal and industrial wastewater discharges.
- Cooling water discharges.
- Leaking septic systems.
- Oil spills from tankers and offshore platforms.
- Vessel wastes.
- Dredging.
- Increased development and loss of habitat.
- Illegal dumping.
- Natural oil seeps.

Approximately 15 percent of the 823 CWA Section 303(d) surface water quality impairments (2010) in the region are for pathogen-related pollutants, the majority at locations along the open coast such as beaches. Other coastal waters, such as harbors and marinas, are listed as impaired for a variety of legacy pesticides (DDT, in particular); metals; and other organics (polycyclic aromatic hydrocarbons [PAHs] and PCBs). Pollutants often accumulate in the sediments of harbors and marinas. This complicates the task of conducting maintenance dredging, owing to disposal issues, and can also affect marine life. Many harbors and marinas are located at sites of former large wetland complexes and at the mouths of rivers; the harbors and marinas are utilized by a diverse array of marine life despite the extensive anthropogenic changes to the areas. Prevention of additional pollution and cleanup of in-place pollutants can contribute greatly to improving local fisheries and the near-shore coastal ecosystem.

As seawater or ocean desalination technology advances in the South Coast region, the coastal environments near the facilities must be monitored for possible impacts. Testing is under way for the facility owned by the City of Long Beach regarding the feasibility of using intake structures on the seafloor as a way to avoid coastal environmental concerns.

Flood Management

Floods in the South Coast Hydrologic Region are generally dangerous because of the interaction of weather events and the built landscape. Flooding in 1969 took the lives of 103 people and caused more than \$160 million in damages to the South Coast region. Due to increased development, the 1969 flood was the worst on record for the counties of Ventura, Orange, San Bernardino, and Riverside. 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. 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. A heavy downpour led to a spill at the Las Lajas Dam near Simi Valley, resulting in considerable erosion on Las Lajas Creek and bridge damage in

Moorpark. (See figures SC-16 and SC-17 for statistics on the region's exposure to the 100-year and 500-year floodplains.)

Unusually heavy storms hit the region in 2005, 2006, and 2010, causing debris flows. In 2005, two powerful Pacific Ocean storms landed on shore, bringing heavy rainfall and snow. Many of the region's rivers had significant flow, including the Santa Clara River in Ventura County, the SAR, and the Mission River in San Diego. Mud and debris flows blocked roads and caused property damage. A landslide caused loss of life in the community of La Conchita in western Ventura County. (For information regarding record floods that have occurred on selected streams in the region, see Table SC-19).

The impacts of the storms of 2005, 2006, and 2010 were of an increased magnitude because they occurred shortly after major brush fires. Major fires included the Old and Cedar fires in the San Bernardino Mountains and the Station fire in the San Gabriel Mountains. Erosion of the slopes, which had been laid bare by the loss of vegetation, clogged debris basins in both mountain ranges. Emergency debris removal operations for the basins were required to create capacity in the basins.

Damage Reduction Structures

Los Angeles County Drainage Area

The Los Angeles County Drainage Area system is a flood management system that was initially developed in the 1800s and was completed by 1970. The system consists of concrete river channels, dams and reservoirs, flood retention and debris basins, and spreading grounds. It was developed in response to severe flooding that had plagued the County of Los Angeles for over a century. The Los Angeles River, in particular, was both unpredictable and uncontrollable and posed a threat to the adjacent established communities. The river was known to change course between flowing west into Santa Monica Bay and flowing south toward San Pedro Bay. In 1815, the Los Angeles River flood washed away the original Pueblo de Los Angeles (between downtown Los Angeles and Chinatown). In 1825, a flood caused swamps to be formed between the Pueblo location and the Pacific Ocean.

Santa Ana Planning Area

Prado Dam was built primarily for downstream flood protection, and 92 percent of the SAR watershed lies above it. More recently, the dam has become a vital component of the water supply management program in the region, and has allowed the creation of ecologically important habitat areas behind the dam. According to a Santa Ana main stem report, when Prado Dam was built, it was intended to provide protection against flooding caused by a 200-year event. Because the area has become so heavily populated, that number has decreased to 70 years, with downstream channel capacity reduced to approximately 50 years.

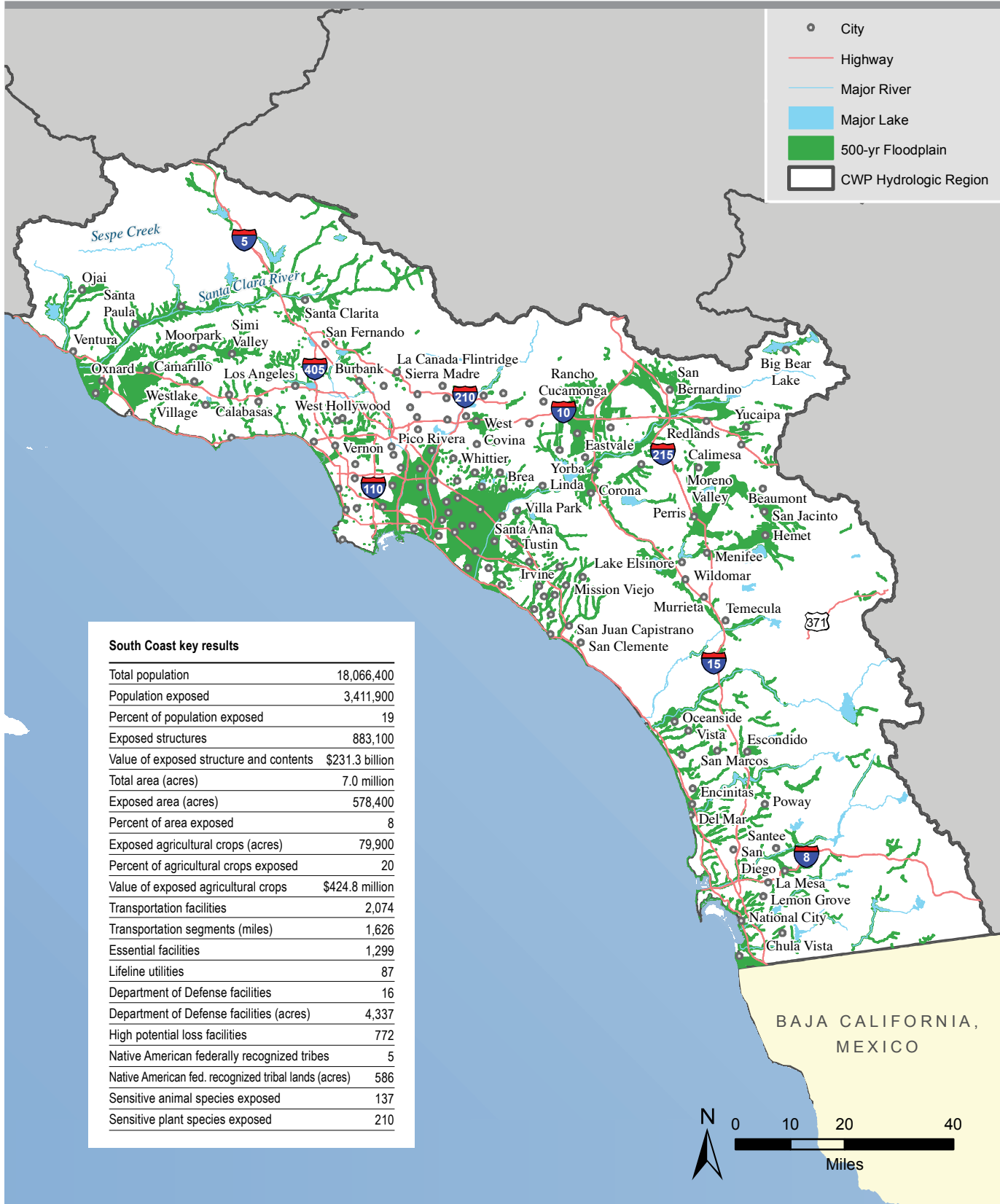
As a result, the USACE initiated the Santa Ana River Mainstem Project (SARP) in 1964, and by 2010 most of the project was completed with a few parts still ongoing. The USACE completed a survey report in 1975 and the Phase I General Design Memorandum for the SARP in 1980. Construction of the SARP was authorized by Section 401(a) of the Water Resources Development Act of 1986. Construction of the SARP was initiated in 1989, and completion was scheduled for 2010.

Figure SC-16 Flood Hazard Exposure to the 100-Year Floodplain in the South Coast Hydrologic Region



Source: California's Flood Future Report 2013

Figure SC-17 Flood Hazard Exposure to the 500-Year Floodplain in the South Coast Hydrologic Region



Source: California's Flood Future Report 2013

The SARP is located along a 75-mile reach of the SAR in Orange, Riverside, and San Bernardino counties. The plan for flood control improvements includes three principal features:

1. Lower river channel modification for flood control along 30.5 miles of the SAR, from Prado Dam to the Pacific Ocean.
2. Construction of Seven Oaks Dam (about 3.5 miles upstream of the existing Prado Dam), with a gross reservoir storage of 145,600 af.
3. Enlargement of Prado Dam to increase reservoir storage capacity from 217,000 af to 362,000 af.

Water Governance

The CRWDA and its related agreements have been the objects of legal challenges for almost a decade. Eleven lawsuits were originally filed against the CRWDA. Five of the lawsuits were dismissed and the remaining consolidated for trial. In 2010, the trial court ruled that an important agreement in the CRWDA, the Quantification Settlement Agreement Joint Powers Agreement, was invalid because of a violation related to the appropriation clause (article XVI, section 7) of the California Constitution. This ruling also invalidated 11 other agreements in the CRWDA. However, in December 2011, the Third District Court of Appeal reversed the trial court ruling, permitted the water agencies to continue with the CRWDA implementation, and ordered some of the litigation back to the trial court for further proceedings. In early 2012, the California Supreme Court declined to hear arguments for the lawsuits. Compliance with the Brown Act and California Environmental Quality Act (CEQA) was the focus of the remaining lawsuits. In June 2013, the trial court ruled that the CRWDA was in compliance with the Brown Act and CEQA, essentially validating the historic Colorado River agreement for water transfers and exchanges for the water agencies in Southern California.

There is a heavy reliance on groundwater supplies for most of the South Coast Hydrologic Region, and the groundwater rights in many major groundwater basins in the region have been adjudicated. For the Santa Clara River planning area, there is the Santa Paula Basin. For the Metropolitan Los Angeles PAs, the adjudicated basins are the Central and West Coast subbasins, Main San Gabriel Basin, Puente Basin, Raymond Basin, and the Upper Los Angeles River Basin. In the Santa Ana area, they are Bunker Hill, Chino, Cucamonga Basin, Rialto-Colton Basin, and the Six Basin. In San Diego, the lone basin is the Santa Margarita Basin.

In the Santa Clara River area, State legislation established the Fox Canyon Groundwater Management Agency. This agency is initiating actions to mitigate problems for some of the subbasins of the Upper Santa Clara River Valley basin.

In the Santa Ana area, litigation of surface water use and rights relating to groundwater use has a long history within the SAR system. During the mid-1960s, OCWD filed a lawsuit involving several thousand defendants in the upper watershed of Riverside and San Bernardino counties, as well as hundreds of cross-defendants in Orange County, for surface water rights to support management of the Orange County Groundwater Basin. On April 17, 1969, a stipulated judgment (the Prado Settlement) was entered in the case, which provided that water users in the Orange County area have rights to receive an annual average supply of 42,000 af of baseflow at Prado Dam, together with the right to all storm flow reaching Prado Dam. Lower basin users may make full conservation use of Prado Dam and Prado Reservoir subject to flood control use. Water

Table SC-19 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 Dulzurae	11	11.2	11,700
San Diego R.	at Fashion Valley, at San Diego	28 ^b	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 ^b	20.5	44,000
Santa Margarita R.	near Temecula	21 ^b	22.5	31,000
Temecula Cr.	near Aguanga	6	14.6	8,100
Murrieta Cr.	at Temecula	15 ^b	17.2	25,000
San Juan Cr.	at La Novia Street Bridge, at San Juan Capistrano	16	20.7 ^a	28,500
Santa Ana R.	at Santa Ana	57 ^b	9.0	31,700
Temescal Cr.	above Main Street, at Corona	24 ^b	6.7	4,720
San Jacinto R.	near Elsinore	12	11.8	16,000
Salt Cr.	at Murrieta Road, near Sun City	2	11.2 ^{c, a}	4,120
San Jacinto R.	near San Jacinto	14	5.3 ^a	45,000
Santa Ana R.	at MWD Crossing, near Arlington	1,152	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 ^f	38	15.4	48,100
Big Tujunga Cr.	below Hansen Dam	18 ^b	7.6	15,200
Los Angeles R.	at Long Beach ^f	194	18.3	128,700
Los Angeles R.	at Sepulveda Dam	39	12.1 ^a	14,700

Stream	Location	Mean Annual Runoff (taf)	Peak Stage of Record (ft)	Peak Discharge of Record (cfs)
Ballona Cr.	at Culver City ^f	36	16.0	32,500
Malibu Cr.	at Malibu Canyon ^f	21	21.4	33,800
Calleguas Cr.	near Camarillo	37	10.5 ^a	25,900
Santa Clara R.	at Montalvo ^c	12 ^b	17.4	165,000
Sespe Cr.	near Fillmore	93	25.0 ^{a,d}	85,300
Piru Cr.	above Frenchmans Flat	31	n/a	36,000
Santa Clara R.	near Piru	55	12.7 ^a	32,000
Ventura R.	near Ventura	51 ^b	29.3 ^a	63,600

Notes:

Cr = creek, R = river, taf = thousand acre-feet, ft = feet, cfs = cubic feet per second

^a Different date than peak discharge

^b Most recent but less than period of record

^c Gage discontinued 2004

^d Resulting from a debris wave

^e Gage discontinued 2007

^f Data source not U.S. Geological Survey

users in the upper basin, represented by upper basin SAWPA agencies, specifically the Inland Empire Utilities Agency (IEUA), the Western Municipal Water District (WMWD), EMWD, and SBVMWD, have the right to pump, extract, conserve, store, and use all surface water and groundwater supplies within the upper area, providing the lower area's entitlement is met.

Management plans for both surface water and groundwater have been updated by SAWPA member agencies, including the Santa Ana IRWM. SAWPA, a joint powers authority formed as a result of cooperation among the litigants from the 1969 Prado Settlement, was first structured as a regional planning agency in 1968. In 1972, SAWPA was reformed as a planning and project implementation agency to support planning recommendations to protect the Santa Ana River watershed.

Groundwater Governance

California does not have a statewide management program or statutory permitting system for groundwater. However, one of the primary vehicles for implementing local groundwater management in California is a groundwater management plan (GWMP). Some local agencies manage groundwater through adoption of groundwater ordinances, and others manage groundwater through authorities granted by special acts of the Legislature. Additional avenues of groundwater management include basin adjudications, IRWM plans, UWMPs, and agricultural water management plans.

A summary assessment of some of the GWMPs in the region is provided below, while a detailed assessment is available online from Update 2013, Volume 4, *Reference Guide*, the article, “California’s Groundwater Update 2013.” The assessment was based on a GWMP inventory developed through a joint DWR/Association of California Water Agencies (ACWA) online survey and follow-up communication by DWR in 2011 and 2012.

Groundwater Management Assessment

Table SC-20 lists the GWMPs in the region, while Figure SC-18 shows the location and distribution of the GWMPs. GWMPs prepared in accordance with the 1992 Assembly Bill (AB) 3030 legislation, as well as those prepared with the additional required components listed in the 2002 SB 1938 legislation, are shown. Some GWMPs were not reviewed as part of Update 2013 because they were received after the initial assessment period. These include Chino Basin GWMP by IEUA, Bunker Hill Basin GWMP by SBVMWD, and Arlington Basin GWMP by WMWD.

The GWMP inventory shows 15 GWMPs within the South Coast region, all of which are fully contained within the region. Many of the plans meet the requirements of a GWMP, but also include surface water management and are not exclusively GWMPs. Eleven of the 15 GWMPs have been developed or updated to include the SB 1938 requirements and are considered active for the purposes of the GWMP assessment.

CWC Section 10753.7 requires that six components be included in a GWMP for an agency to be eligible for State funding administered by DWR for groundwater projects. The requirement associated with the 2011 AB 359 (Huffman) legislation, applicable to groundwater recharge mapping and reporting, did not take effect until January 2013 and was not included in the current assessment. In addition, the requirement for local agencies outside of recognized groundwater basins is noted, as applicable to any of the GWMPs in the region.

In addition to the six required components, CWC Section 10753.8 provides a list of 12 voluntary components that may be included in a GWMP. DWR *Bulletin 118-2003*, Appendix C (California Department of Water Resources 2003) provides a list of seven recommended components related to management development, implementation, and evaluation of a GWMP, which should be considered to help ensure effective and sustainable groundwater management.

As a result, the GWMP assessment was conducted using the following criteria:

- How many of the post SB 1938 GWMPs meet the six required components included in SB 1938 and incorporated into CWC Section 10753.7?
- How many of the post SB 1938 GWMPs include the 12 voluntary components included in CWC Section 10753.8?
- How many of the implementing or signatory GWMP agencies are actively implementing the seven recommended components listed in DWR *Bulletin 118-2003*?

A summary of the GWMP assessment is provided in Table SC-21.

Figure SC-18 Location of Groundwater Management Plans in the South Coast Hydrologic Region



Table SC-20 Groundwater Management Plans in the South Coast Hydrologic Region

Map Label	Agency Name	Date	County	Basin Number	Basin Name
SC-1	Castaic Lake Water Agency	2003	Los Angeles	4-4.07	Santa Clara River Valley East Subbasin
	Newhall County Water District				
	Santa Clarita Water Division				
	Valencia Water Company				
SC-2	City of Beverly Hills				
	No signatories on file	1999	Los Angeles	4-11.02	Hollywood Subbasin
SC-3	City of Corona	2008	Riverside	8-2.09	Temescal Subbasin
	No signatories on file			8-4	Elsinore
SC-4	Eastern Municipal Water District West San Jacinto Groundwater Basin	1995	Riverside	8-5	San Jacinto
	No signatories on file			8-2.08	San Timoteo Subbasin
SC-5	Elsinore Valley Municipal Water District	2005	Riverside	8-4	Elsinore
	No signatories on file				
SC-6	Fox Canyon Groundwater Management Agency	2007	Ventura	4-4.02	Oxnard Subbasin
	United Water Conservation District			4-4.03	Mound Subbasin
	Calleguas Municipal Water District			4-4.04	Santa Paula Subbasin
				4-6	Pleasant Valley
				4-7	Arroyo Santa Rosa Valley
				4-8	Las Posas Valley
SC-7	Ojai Basin Groundwater Management Agency	2007	Ventura	4-2	Ojai Valley
	No signatories on file				
SC-8	Orange County Water District	2009	Orange	8-1	Coastal Plain of Orange Orange County
	No signatories on file				
SC-9	Rainbow Municipal Water District	2005	San Diego	9-7	San Luis Rey Valley
	No signatories on file				

Map Label	Agency Name	Date	County	Basin Number	Basin Name
SC-10	San Diego Water Department, City of San Pasqual Basin	2007	San Diego	9-10	San Pasqual Valley
	No signatories on file				
SC-11	San Juan Basin Authority and the Metropolitan Water District of Southern California	1994	Orange	9-1	San Juan Valley
	Trabuco Canyon Water District			9-2	San Mateo Valley
	Santa Margarita Water District				
	City of San Juan Capistrano				
	Moulton Niguel Water District				
SC-12	Stakeholders of the Hemet / San Jacinto Water Management Area	2007	Riverside	8-5	San Jacinto
	Eastern Municipal Water District				
	Lake Hemet Municipal Water District				
	City of Hemet				
	City of San Jacinto				
SC-13	United Water Conservation District	2011	Ventura	4-4.05	Fillmore Subbasin
				4-4.06	Piru Subbasin
SC-14	Ventura County Waterworks District No. 8 - City of Simi Valley	2007	Ventura		Non-B118 Basin
SC-15	Water Replenishment District	1998	Los Angeles	4-11.01	Central
	No signatories on file			4-11.03	West Coast

Notes:

Table represents information as of August 2012.

Some groundwater management plans (GWMPs) were not reviewed as part of Update 2013 because they were received after the initial assessment period. These include Chino Basin GWMP by Inland Empire Utilities Agency, Bunker Hill Basin GWMP by San Bernardino Valley Municipal Water District, and Arlington Basin GWMP by Western Municipal Water District.

Table SC-21 Assessment of Groundwater Management Plan Components

SB 1938 GWMP Required Components	Percent of Plans that Meet Requirement
Basin Management Objectives	64
BMO: Monitoring/Management Groundwater Levels	100
BMO: Monitoring Groundwater Quality	100
BMO: Inelastic Subsidence	91
BMO: SW/GW Interaction & Affects to Groundwater Levels and Quality	64
Agency Cooperation	100
Map	100
Map: Groundwater basin area	100
Map: Area of local agency	100
Map: Boundaries of other local agencies	100
Recharge Areas (1/1/2013)	Not Assessed
Monitoring Protocols	64
MP: Changes in groundwater levels	100
MP: Changes in groundwater quality	100
MP: Subsidence	82
MP: SW/GW Interaction & Affects to Groundwater Levels & Quality	82
SB 1938 GWMP Voluntary Components	Percent of Plans that Include Components
Saline Intrusion	73
Wellhead Protection and Recharge	91
Groundwater Contamination	82
Well Abandonment & Destruction	91
Overdraft	82
Groundwater Extraction & Replenishment	82
Monitoring Groundwater Levels and Storage	91
Conjunctive Use Operations	91
Well Construction Policies	91
Construction and Operation	55
Regulatory Agencies	91
Land Use	82

Bulletin 118-03 Recommended Components	Percent of Plans that Include Component
GWMP Guidance	91
Management Area	100
BMOs, Goals, and Actions	100
Monitoring Plan Description	45
IRWM Planning	91
GWMP Implementation	100
GWMP Evaluation	100
Notes: BMO=basin management objective, IRWM=integrated regional water management, GWMP=groundwater management plan, MP=monitoring rotocols, SW/GW= surface water/groundwater	

Factors Contributing to Success and Impediment to Groundwater Management

The survey participants were also asked to identify key factors that promoted or impeded successful groundwater management.

Eleven agencies from the region participated in the survey. Ten of the responding agencies identified data collection and sharing, outreach and education, and sharing of ideas as key factors for a successful GWMP implementation. Other important factors identified by the responding agencies include developing an understanding of common interest, broad stakeholder participation, adequate funding, adequate surface water supplies, developing and using a water budget, and adequate time.

More than half of the respondents pointed to the lack of adequate funding as the biggest impediment to GWMP implementation. Funding is a challenging factor for many agencies because the implementation and the operation of groundwater management projects are generally expensive and because funding typically is limited to locally raised money or to State and federal grants. About a third of the respondents stated that limited groundwater supply and surface storage and conveyance capacities were impediments to GWMP implementation.

Nine respondents felt long-term sustainability of their groundwater supply was possible, while the rest felt long-term sustainability could be an issue.

More detailed information on the DWR/ACWA survey and assessment of the GWMPs are available online from Update 2013, Volume 4, *Reference Guide*, the article “California’s Groundwater Update 2013.”

Groundwater Ordinances

Groundwater ordinances are laws adopted by local authorities, such as cities or counties, to manage groundwater. In 1995, the California Supreme Court declined to review a lower court

decision (*Baldwin v. Tehama County*) that says that State law does not occupy the field of groundwater management and does not prevent cities and counties from adopting ordinances to manage groundwater under their police powers. Since 1995, the *Baldwin v. Tehama County* decision has remained untested; thus, the precise nature and extent of the police power of cities and counties to regulate groundwater is still uncertain.

A number of counties in the region have adopted groundwater ordinances. The most common ordinances regulate well construction, abandonment, and destruction. However, none of the ordinances alone provide for comprehensive groundwater management.

Special Act Districts

Special acts of the Legislature have granted greater authority to manage groundwater to a few local agencies or districts. These agencies generally have authority to (1) limit groundwater export and extraction (upon evidence of overdraft or threat of overdraft) or (2) require reporting of extraction and to levy replenishment fees.

There are many Special Act Districts established by the California State Legislature consisting of different authorities that may or may not have groundwater management authority. It is not part of the scope for Update 2013 to identify Special Act Districts in the region or the established agencies. This report includes the GWMPs that were prepared by these agencies and submitted to DWR, as discussed in the preceding section.

Court Adjudication of Groundwater Rights

Another form of groundwater management in California is through the courts. There are currently 24 groundwater adjudications in California. The South Coast Hydrologic Region contains 15 of those adjudications (Table SC-22 and Figure SC-19).

One example is the adjudication of the Central and West Coast subbasins of the Coastal Plain of Los Angeles Groundwater Basin. More than 60 years ago, groundwater overdraft and declining water levels in these two subbasins threatened the area's groundwater supply and caused seawater intrusion into the aquifers. Timely but separate legal actions were initiated to halt the overdraft and prevent further deterioration, which resulted in the adjudication of the two subbasins by the Superior Court of Los Angeles County. Since that time, groundwater extraction from the two subbasins is limited to the amounts set by the Superior Court judgment and is monitored by a court-appointed watermaster. The Watermaster Service Area of the Central subbasin overlies about 227 square miles of the groundwater basin in southeastern Los Angeles County; 23 incorporated cities and several unincorporated communities are in the Watermaster Service Area. The West Coast subbasin underlies about 160 square miles in the southwestern part of the coastal plain of Los Angeles County; 20 incorporated cities and several unincorporated areas overlie the groundwater basin.

Other Groundwater Management Planning Efforts

Groundwater management also occurs through other avenues such as IRWM plans, UWMPs, and agricultural water management plans. Box SC-1 summarizes groundwater management aspects included in these planning efforts.

Table SC-22 Groundwater Adjudications in the South Coast Hydrologic Region

Court Judgment	Basin Number	County	Judgment Date
Beaumont Basin	7-21.04, 8-2.08	Riverside	2004
Chino Basin	8-2.01	Riverside, San Bernardino	1978
Cucamonga Basin	8-2.02	San Bernardino	1978
Central Basin	4-11.04	Los Angeles	1965
West Coast Basin	4-11.03	Los Angeles	1961
Main San Gabriel Basin	4-13	Los Angeles	1973
Raymond Basin	4-23	Los Angeles	1944
Western San Bernardino	8-2.06, 8-2.04, 8-2.03, 8-2.05	Riverside, San Bernardino	1969
Rialto-Colton	8-2.04	San Bernardino	1961
Santa Margarita River Watershed	9-6, 8-4, 8-5, 9-4, 9-5	Riverside and San Diego	1966
Santa Paula Basin	4-4.04	Ventura	1996
Six Basins	4-13	Los Angeles, San Bernardino	1998
Upper Los Angeles River Area	4-12	Los Angeles	1979
Puente Basin	4-13	Los Angeles	1985
San Jacinto	8-5	Riverside	1954

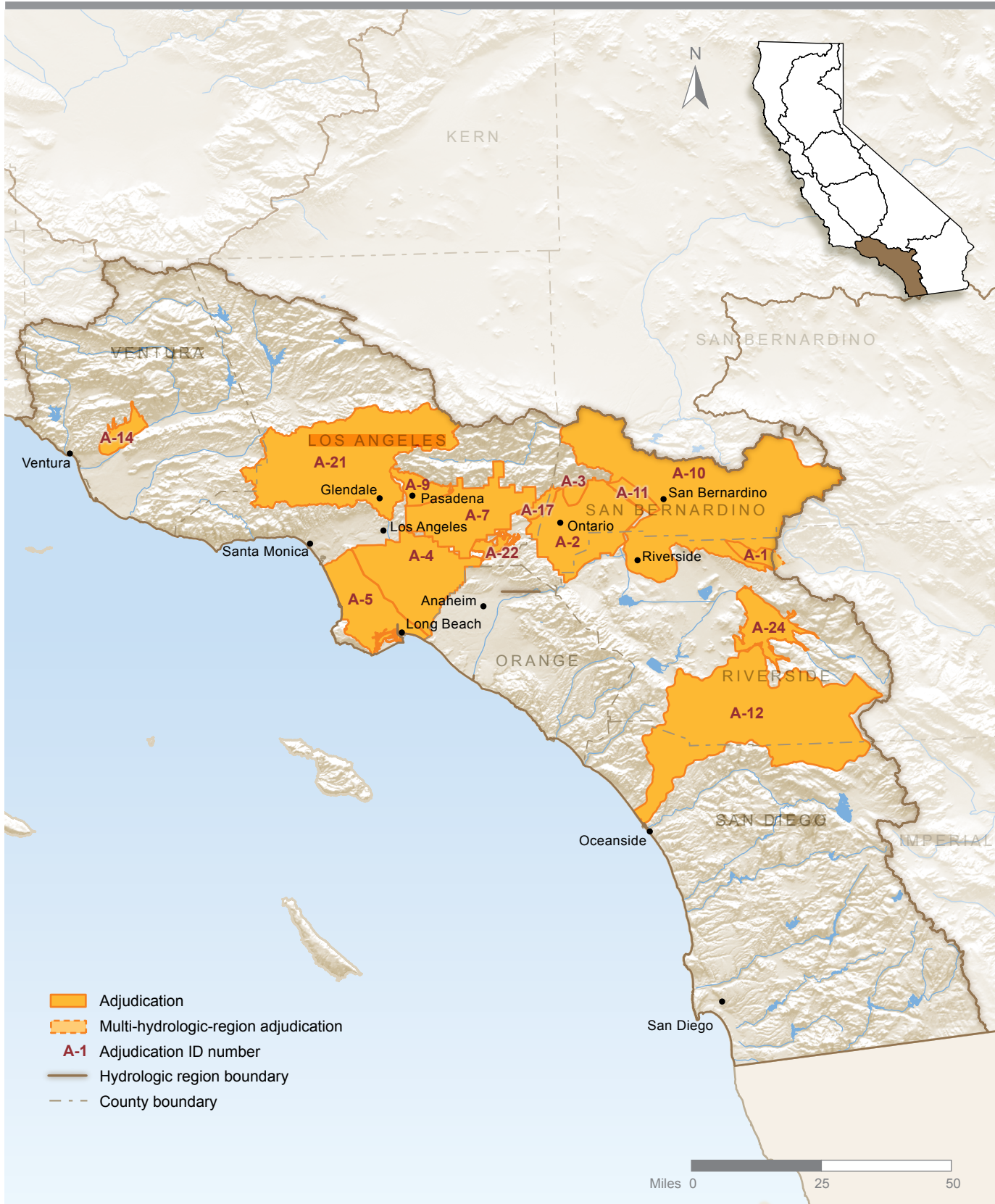
Note: Table represents information as of April 2013.

Current Relationships with Other Regions and States

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, and agricultural production) established in other regions affect water resources available to the South Coast. Responsible for a region that is dependent on others, the South

Figure SC-19 Groundwater Adjudications in the South Coast Hydrologic Region



Box SC-1 Other Groundwater Management Planning Efforts in the South Coast Hydrologic Region

The integrated regional water management plans (IRWMPs), urban water management plans (UWMPs), and agricultural water management plans (AWMPs) in the South Coast Hydrologic Region that include components related to groundwater management are briefly discussed below.

Integrated Regional Water Management Plans

Eight IRWM regions cover a portion of the South Coast Hydrologic Region and all have adopted IRWMPs. The Watershed Coalition of Ventura County IRWM Plan (Ventura IRWMP) is the only plan that crosses into adjacent Central Coast region. The groundwater management is conducted by local entities that use a variety of mechanisms to manage groundwater.

The Upper Santa Clara River IRWMP relies on a memorandum of understanding executed by local entities to manage local groundwater supplies cooperatively. The cooperating agencies have integrated their database management, developed and utilized a numerical groundwater flow model for analysis of groundwater basin yield and containment of groundwater contamination, and continued to monitor and report on the status of basin conditions.

Within the Greater Los Angeles County IRWM planning area, most of the groundwater basins are adjudicated and follow the groundwater management guidelines established by their respective adjudications. Groundwater management is identified as one of this IRWM region's strategies. However, actual groundwater management is deferred to local entities.

The Santa Ana Watershed Project Authority IRWMP contains some of the most sophisticated multi-agency groundwater management planning and saline management strategies in the nation. A regional groundwater management plan was developed, and although the IRWM group is not directly responsible for managing groundwater basins in their watershed, the IRWM group coordinates the numerous groundwater management local planning within the watershed. Groundwater management zones have been designated for the IRWM planning area to monitor water quality issues such as high total dissolved solids and nitrates. Another key objective is balancing groundwater pumping with increased recharge to fully utilize groundwater basin storage capability.

The Upper Santa Margarita Watershed IRWMP leaves groundwater management to local entities, which is accomplished through projects that enhance groundwater levels such as artificial recharge or by improving management of the basin through conjunctive use projects.

The San Diego IRWMP also defers groundwater management to local entities that have established groundwater management plans and implement groundwater management through projects in their areas. The IRWMP lists groundwater management strategies that are important to water supply diversity such as promoting use of groundwater basins for seasonal or carryover storage and emergency storage, implementing land use and developing methods that reduce the impacts of impermeable pavement on groundwater recharge and promote the use of permeable surfaces, protecting and conserving open space that affects recharge areas, enabling opportunities for conjunctive use and remediating contaminated groundwater supplies, and installing seawater intrusion barriers.

The South Orange County IRWMP also defers groundwater management to local entities. The objectives of this IRWMP are balancing groundwater pumping with increased recharge capabilities that effectively uses the storage capacity of the groundwater basin.

Urban Water Management Plans

Urban water suppliers prepare UWMPs to support their long-term resource planning and to ensure adequate water supplies are available to meet existing and future water uses. Urban use of groundwater is one of the few uses that meter and report annual groundwater extraction volumes. The groundwater extraction data is currently submitted with the UWMP and then manually translated by DWR staff into a database. Online methods for urban water managers to directly enter their water use along with their plan updates is being evaluated by DWR.

Agricultural Water Management Plans

Water and irrigation districts develop AWMPs to improve farm water management efficiency while the environment benefits. New and updated AWMPs that addressed several new requirements were submitted to DWR by December 31, 2012 for review and approval.

Coast agencies recognize the need to invest in water management strategies in these other regions to provide coordinated benefits.

Interregional and Interstate Activities

Interstate Actions

The MWD has a diversion and storage agreement with the Southern Nevada Water Agency (SNWA) for unused Colorado River supplies. In the agreement, MWD will be able to divert and store a certain quantity of SNWA's unused Colorado River water supplies. SNWA can request that the supplies be returned to them in later years; MWD would divert less Colorado River.

In an agreement with the USBR, MWD has been able to store conserved Colorado River water supplies in Lake Mead. Some of the stored water comes from MWD's Land Management, Crop Rotation, and Water Supply Program agreement with the Palo Verde Irrigation District.

Agreement with Mexico

International cooperation continues to be critical for successful management of the Colorado River. The United States and Mexico have collaborated in the past on Colorado River issues. In late 2012, the countries did so again with the development of Minute 319 to the United States-Mexico Treaty for the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande: "Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California." Minute 319 calls for the implementation of certain actions and policies that include (1) a continuation of agreement identified in Minute 318 related to the repair and upgrade of infrastructure in Mexico impacted by the 2010 earthquake in the Mexicali Valley, (2) establishment of water supply delivery procedures for the United States and Mexico during wet and dry hydrologic conditions, (3) establishment of a program (the Intentionally Created Mexican Allocation) that permits Mexico to store water in the United States for delivery at a later time, and (4) implementation of a pilot study focused on the re-establishment of waterflows to the Colorado River delta in Mexico.

A 5-year agreement has been reached between the United States and Mexico that exchanges 95 taf of Mexico's share of the Colorado River for financial assistance with the repairs of damage to water delivery infrastructure in the Mexicali Valley caused by the 2010 El Mayor-Cucapah Earthquake. Several hundred miles of irrigation canals were damaged by the seismic event, affecting about 80,000 acres of farmland in the valley. MWD, the SNWA, and Central Arizona Water Conservation District will collectively provide \$10 million to assist in the repairs. MWD will contribute \$5 million toward the costs and will receive 47.5 taf of water supplies.

Collaborative Efforts with Areas Adjacent to the Watershed

The Santa Ana IRWM region is surrounded by six other IRWM regions: South Orange County Watershed Management Area, Upper Santa Margarita, Greater Los Angeles County, Gateway Region, Coachella Valley, and Mojave.

Of these six regions, the largest opportunities for coordination and cooperation are with Greater Los Angeles, South Orange County, and Gateway. Coordination with Orange County is frequent, with part of Orange County being located in the watershed; and there are multiple forums for coordination. As part of this planning effort, meetings were held with Greater Los Angeles and Gateway. SAWPA proactively seeks meeting with neighboring regions quarterly to share and stay abreast of critical issues, ongoing efforts, and opportunities for collaboration in the region.

The watershed area encompasses the service areas of many local agencies and organizations. There are over 120 local agencies contained within the watershed that may be considered water entities.

Sacramento-San Joaquin Delta

SWP contractors in the South Coast region — including MWD, CLWA, SBVMWD, VCWPD, SGPWA, and San Gabriel Valley Municipal Water District — work with DWR to coordinate delivery of SWP supplies. Because of a series of short-term ecosystem collapses in 2007, including declines in native species and significant loss of habitat, MWD also participates with DWR and other State, federal, and local agencies and environmental organizations in the development of the Bay Delta Conservation Plan. MWD 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 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. Environmental concerns, droughts, and other important factors that affect supply reliability, including the vulnerability of Delta levees to failure caused by floods and earthquakes, as well as long-term management and maintenance of SWP conveyance infrastructure, will affect future deliveries. As the regional SWP wholesaler, MWD 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 Water Delivery Agreement: Federal Quantification Settlement Agreement

In 2003, the CRWDA resulted in the movement of supplies between the Colorado River and South Coast hydrologic regions. SDCWA was assigned rights to 77,700 af/yr. of water that are being conserved as a result of lining the All-American and Coachella canals in Imperial County. The canal-lining project has been completed, and 77,700 af are being delivered to San Diego annually. Another 16,000 af/yr. of water conserved by lining of the All-American Canal will go to the San Luis Rey Indian Water Rights Settlement Parties.

In compliance with the CRWDA, the IID continues to implement its voluntary land-fallowing to generate conserved water supplies to meet its obligations for the SDCWA/IID water supply transfer agreement and mitigation of Salton Sea impacts related to water supplies transfers out of Imperial Valley. Fallowing activities commenced in fiscal year 2003-2004 with 5,764 acres and

water supply savings of 38.6 taf. In fiscal year 2012-2013, the total land fallowed in the program was 31,860 acres with a savings of 185.6 taf; and in 2013-2014, the totals are 34,433 acres and 185.6 taf (provisional) of conserved supply. The program ends in 2017.

The land fallowing and water supply transfer program between MWD and Palo Verde Irrigation District is being implemented smoothly. The 35-year program, which began in 2005, fallows between 7 and 28 percent of irrigated lands in the Palo Verde Valley each year. Between 29.5 taf and 118.05 taf of water is available annually for MWD. The payment received for the fallowing of land helps stabilize the local economy in the valley and provide financial assistance for specific local community improvement programs. In 2011, about 122 taf of water supplies were transferred. For 2012, about 74 taf was transferred.

During the Colorado River Upper Basin drought years of 2009 and 2010, the agencies agreed to move additional Colorado River water supplies to MWD. In calendar year 2010, about 32 taf of water supplies from Palo Verde Irrigation District to MWD to help mitigate the impacts of the drought.

The projects completed for the 1988 Water Conservation Agreement between the IID and MWD permits the transfer of conserved water supplies to MWD's service area. In 2011, about 100 taf of water supply was transferred to the MWD; and in 2012, it was almost 94 taf.

Other Water Storage and Transfers

South Coast agencies continue to build relationships with agencies in 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 South Coast region's overall strategic planning to meet peak demand during the dry season.

MWD has water management program agreements to improve water supply reliability. The programs with Arvin-Edison WSD and Kern Delta Water District can provide 125,000 af in 12 months under most conditions. Semitropic WSD and Mojave Water Agency can provide an additional 31,500 af to 307,520 af, depending on the program's unused capacity and the SWP allocation. All of the Mojave return water and a portion of the Semitropic return water is made available from an exchange of SWP supplies so the return capability is reduced under lower SWP allocations. A program with the SBVMWD provides an additional 20,000 af/yr. The water from the program can be carried over in an account up to 50,000 af of storage.

Environmental Mitigation

Several environmental mitigation projects are under way in the region for compliance with requirements of the CRWDA including the Managed Marsh Project, Air Quality Mitigation Program, and Burrowing Owl Burrow Avoidance Program. These projects are managed and funded by a joint powers authority, which consists of members from IID, SDCWA, CVWD, and DFW. The Managed Marsh Project is the phased planning and construction of a managed wetland (marsh) for small animals and birds. Phase I established 365 acres of new wetlands and was completed in 2009. Phase II will add 330 acres to this habitat and is currently in the design stage. The final phase will be completed by 2019 and will increase the size of the wetland to

approximately 959 acres. The Air Quality Mitigation Program installed six air quality monitoring stations around the Salton Sea to gather baseline data on dust emissions. The Burrowing Owl Avoidance Program is being implemented to (1) provide on-site monitoring during operation and maintenance tasks to help maintenance crews identify and avoid sensitive burrowing habitats, (2) provide semi-annual training to IID staff on the owl habitat, and (3) modify existing and develop new strategies to mitigate the impacts of these maintenance activities.

Inyo County and LADWP continue to collaborate on the maintenance of existing and planning for new environmental enhancement and mitigation projects in Owens Valley. Two agreements serve as the catalyst for cooperation: the “1991 Agreement Between the County of Inyo and the City of Los Angeles and its Department of Water and Power on a Long Term Groundwater Management Plan for Owens Valley and Inyo County” and “1997 Memorandum of Understanding between the City of Los Angeles Department of Water and Power, County of Inyo, the California Department of Fish and Wildlife, the California State Lands between the principle parties.” The most significant is the Lower Owens River Project which re-established waterflows for more than 60 miles of the Owens River and created about 2,000 acres of wetland and riparian habitat adjacent to the river.

The City of Los Angeles and the Great Basin Unified Air Pollution Control District are working together to stabilize a portion of the exposed surface of the Owens Dry Lake in Inyo County. This is being accomplished with shallow flooding, planting of salt grass, and spreading of gravel. By late 2013, about 42 square miles of the lakebed surface had been stabilized.

USBR Colorado River Study

The sustainability of the Colorado River water supplies was examined in a new study released by USBR in 2012. The study is titled “Colorado River Basin Water Supply and Demand Study.” With contributions from the basin states and stakeholders throughout the Colorado River watershed, the study defines the water supply and use imbalances which may occur 50 years into the future and demonstrate the effectiveness of possible strategies or portfolios (actions and programs) that might be used to mitigate the imbalances. The hydrology of the watershed was examined under historical conditions and with emphasis on any conditions that may be impacted by global climate change. Water demands in the watershed were made under different economic scenarios. Regardless of the conditions, municipal and industrial uses are expected to increase in response to population growth. The Colorado River supplies will be stressed if no actions are taken. The study concludes that the implementation of strategic plans or portfolios (resource management strategies) can limit the impacts of the problems. Programs and actions in the plans include urban and agricultural water use efficiency programs, utilization of recycled water and other alternative sources of potable water supplies, and water supply transfer and exchange agreements.

Regional Water Planning and Management

There is a history of intra-regional integrated water management planning in the South Coast region. Water-related challenges have been present for many years, including groundwater overdraft, seawater intrusion, brackish groundwater, water-quality degradation problems, flooding, and dependence on decreasing supplies of imported State water. Over time, these challenges have led to collaboration among affected communities, agricultural users, and other

parties, and have necessitated development of a variety of projects and programs. With the advent of IRWM funding, the collaboration has increased and become more inclusive of interests previously not as involved in water management, including those working toward improved habitat/ecosystem management and improvement of recreational opportunities. The region has benefitted from this greater level of coordination and integration, which has also led to a more efficient use of local funding resources. (More information is available on the DWR IRWM Web site: <http://www.water.ca.gov/irwm/grants/index.cfm>.)

More information on the IRWM planning activities in the South Coast Hydrologic Region is presented in the IRWM plan summaries in the “Looking to the Future” section later in this report.

Santa Clara and Metropolitan Los Angeles Planning Areas

IRWM planning activities for the Santa Clara River and Metropolitan Los Angeles PAs have attracted stakeholders representing a wide range of agencies, organizations, and causes. The represented agencies and organizations have interests in water supplies, wastewater, flood management, recreation, and habitat protection. They include entities from the public, non-profit, and private sectors. Despite the diversity and some divergence of interests, the stakeholders realize that they must put past differences aside and collaborate on the planning and implementation of projects and policies, which are likely to benefit the regions. Planning activities examine regional as well as watershed issues, thereby addressing the needs and priorities across all major watersheds. Although collaboration among the planning regions is generally good, issues of overlap between IRWM region boundaries and coordination persist.

Representatives from the Upper Santa Clara River Watershed and the Watersheds Coalition of Ventura County have met to coordinate their respective IRWM plan activities, to share project ideas, and discuss watershed issues important to both watershed groups. The two groups meet on a regular basis.

Update 2009 reported on the projects, which were still in the planning stages, though much work has been accomplished since then.

Calleguas Regional Salinity Management Project

The Calleguas Regional Salinity Management Project 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 salt management project will improve water supply reliability by facilitating the development of up to 40,000 af of new, local water supplies each year, and by expanding the distribution and use of recycled water from areas with abundant supplies to areas of need.

Fillmore Integrated Water Recycling and Wetlands Project

The City of Fillmore in Ventura County constructed a water-softening plant, a state-of-the-art wastewater treatment plant, and a recycled water distribution system. It also started a ban on new or replacement home brine-discharging water softeners. Approximately 150 af/yr. of treated effluent is being recycled in local schools, parks, and greenbelt areas, offsetting the demand for potable water.

Conversion of Septic Tanks to Sewers

Several communities in the Oxnard area of Ventura County were taken off septic systems and connected to sewers. Nearly 450 residential and commercial /industrial septic systems that had been discharging wastewater into local groundwater aquifers were taken off-line, resulting in water quality improvements.

Arundo Removal

Additional removal projects of the evasive *Arundo* (giant reed) plant have been completed in several watersheds in Ventura County. All areas that have been cleared continue to be monitored and are subject to additional clearing operations if the reed begins to re-sprout. The objectives of removing the non-native invasive giant reed include restoring the native habitat, reducing flood hazards, reducing fire risks, improving water quality, and enhancing groundwater recharge.

Development of Watershed Management/Protection Plans

Stakeholders in each of the three major watersheds (Calleguas Creek, Ventura River, and Santa Clara River) have engaged in watershed-wide planning and management efforts. These efforts have included data collection and data gaps analysis through monitoring and modeling, identification of critical issues and problems, and identification of solutions in the form of action plans or project lists.

Regional Water Efficiency Program

The water wise Web site, an online tool that emphasizes ways to be more efficient in use of external water, was developed to help property owners and managers use water more efficiently on landscapes, including information on plant selection, efficient irrigation system design, and irrigation maintenance strategies. See <http://www.bewaterwise.com>.

Pellet Water Softening Treatment Plant

Newhall County Water District provides a blend of local groundwater and imported water to its customers. Local groundwater, especially from the Saugus Formation, is high in calcium and magnesium, which results in high hardness. The main objective of the Pellet Softening Project is to improve drinking water quality by removing calcium. This in turn will reduce the consumer need for point-of-use water softeners and help reduce the amount of chloride discharged to the local water reclamation plants.

Santa Clarita Valley Sanitation District Automatic Water Softener Rebate and Public Outreach Program

Automatic water softeners, also known as self-regenerating water softeners, have been the largest controllable source of chloride. The source control efforts have focused on the removal of these units. The project will consist of home inspections, issuing notices of violations to residents that still have their automatic water softeners; issuing rebates to residents that remove their automatic water softeners; chloride monitoring; and public outreach.

Santa Clarita Valley Water Use Efficiency Strategic Plan

Before SB X7-7, the Santa Clarita Valley Family of Water Suppliers proactively adopted a plan to achieve 10 percent water demand reduction by 2030. With the current state mandate of 20 percent water demand reduction by 2020, the Family of Water Suppliers needs to continue to fund programs within the Santa Clarita Valley Water Use Efficiency Plan and look for additional ways to manage savings. While some of this conservation may be passive (from updates to plumbing code in new construction), considerable new programs and expanded current programs will need to be implemented to reach these goals.

Santa Ana Planning Area

The IRWM planning region in the Santa Ana planning area, also known as SAWPA's One Water One Watershed (OWOW) plan, covers northern Orange, a small section of southern Los Angeles, western Riverside, and southwestern San Bernardino counties. The participants represent a wide range of agencies, organizations, and interests. The contact database includes over 4,000 stakeholders. There is a high degree of integration and collaboration between the participants\ stakeholders, which include water supply and wastewater agencies, State and federal agencies, and local cities and counties. The representation also includes regional Native American tribes and other local organizations. Planning within the region occurs on regional as well as watershed basis – thereby addressing the needs and priorities across all the subregion.

Major IRWM projects funded by the State with grants administered by SAWPA in the previous decade within the Santa Ana planning area are described below.

Orange County Groundwater Replenishment System

Orange County's GWRS produces 70 mgd of highly treated wastewater for groundwater recharge and a seawater intrusion barrier. Located in the lower SAR watershed, it is one of the largest water reclamation facilities west of the Mississippi River. Planning for the Phase II expansion to 100 mgd and an ultimate capacity of 130 mgd commenced in mid-2012.

Arlington Desalter Interconnection Project

The Arlington Desalter Interconnection Project will improve water supply reliability in the region. It constructs a two-way intertie that will connect an existing portion of the City of Corona Department of Water and Power's water system with WMWD's system.

Impaired Groundwater Recovery

The Impaired Groundwater Recover Project will recover and treat impaired groundwater to increase local drinking water supplies for the IRWD service area to meet growing demands. The project will supplement IRWD's current annual potable supplies, reduce demands of imported water, and increase IRWD's diversity of local supply.

Perchlorate Wellhead Treatment System Pipelines (West Valley Water District)

The Perchlorate Wellhead Treatment System Pipelines will remove perchlorate, nitrate, and TCE from two contaminated drinking-water production wells located in the Rialto-Colton

Groundwater Basin. The project will construct the necessary piping to connect the basin to the groundwater wellhead treatment plant.

Water Conservation Programs through Incentives

The Municipal Water District of Orange County (MWDOC) provides rebate incentives to its customers to reduce water consumption and encourage water conservation. MWDOC is targeting publicly owned and other commercial landscape properties to encourage the removal of non-functional turf, upgrade antiquated irrigation timers to weather-based self-adjusting irrigation timers, and covert high-volume overhead spray irrigation to low-volume irrigation.

For Proposition 84 IRWM Round 1, SAWPA is moving forward with the following projects:

1. **Groundwater Replenishment System — Flow Equalization Project.** This project will more effectively utilize the available flow of secondary effluent from Orange County Sanitation District and maximize recourse processing and overall production from the GWRS.
2. **Sludge Dewatering, Odor Control, and Primary Sludge Thickening.** This project will make necessary improvements to Orange County Sanitation District’s Plant No. 1, which supplies secondary effluent to the OCWD’s GRWS, benefitting the region by creating natural supplies of potable water.
3. **East Garden Grove Wintersburg Channel.** This urban runoff and treatment project will divert up to 3 mgd of dry weather urban runoff from the regional flood-control channel draining a watershed area of over 22 square miles into an approximate 15-acre area in Huntington Beach Central Park for enhanced natural treatment using specialized wetland treatment trains and a reconstructed human-made lake system designed for polished treatment.
4. **Romoland A Flood System.** This project consists of two detention basins and approximately 11,800 feet of lineal open channel and storm drains designed to collect stormwater and control runoff while removing debris, silt, and other contaminants providing a solution for non-point source pollution.
5. **Santa Ana Watershed Vireo Monitoring.** This project provides data at a granularity that is needed for the permitting and continued operations of facilities located within riparian corridors within the SAR watershed.
6. **Mill Creek Wetlands.** This project also known as the Cucamonga Creek Watershed Regional Water Quality Project focuses on improving water quality, preserving and enhancing the environment, improving regional integration and coordination, providing recreational opportunities, maintaining quality of life, and providing economically effective water solutions.
7. **Cactus Basin 3.** This project will reduce local flooding, reduce downstream flooding potential, and reduce the size and cost of downstream drainage facilities.
8. **Inland Empire Brine Line Rehabilitation and Enhancement.** This project will address the Lower Reach and extend the Brine Line’s service life, meet new loading conditions, and restore diminished capacity to the Lower Reach.

9. **Perris II Desalination Facility.** This project, operated by EMWD, will supply brackish feed water to the existing Menifee and Perris I desalters located within the Perris Valley, then ultimately supply brackish feed water to the Perris II Desalter (planned operational by 2014) to make beneficial use of local degraded brackish groundwater in a long-term step in generating new local potable water resources.
10. **Chino Creek Wellfield Development.** The project is a component of the larger Chino Creek Wellfield Development Project and is part of the Chino Desalter Phase 3 Expansion, which consists of the development of the three production wells — Wells 1, 2, and 3.

San Diego Subregion

The San Diego Funding Area covers western San Diego, southern Orange, and southwestern Riverside counties. It comprises three IRWM planning regions: San Diego, Upper Santa Margarita and South Orange County. There is a high degree of integration and collaboration between the stakeholders, as evidenced by the formation of the Tri-County Funding Area Coordination Committee. The Tri-FACC members have signed an MOU that commits them to work together to improve the reliability and quality of water supplies in the funding area; enhance planning within the funding area, especially across regional boundaries; and identify opportunities to support common goals and projects. The MOU states that Tri-FACC partners agree to divide the total Proposition 84 IRWM funding available to the San Diego Funding Area using a mutually acceptable formula based on a combination of land area and population as of 2007. The agencies represent water supply, wastewater, flood management, recreation, and habitat protection entities in the public, non-profit, and private sectors. Planning within the region occurs on regional as well as watershed basis, thereby addressing the needs and priorities across all major watersheds.

Since Update 2009, the IRWM groups are moving forward with a variety of different projects.

Santa Margarita Conjunctive Use Project

The Santa Margarita Conjunctive Use Project provides for enhanced recharge of the groundwater basin beneath the U.S. Marine Corps Base Camp Pendleton in northern San Diego County. It also includes a seawater intrusion barrier using recycled water, a distribution system, and advanced water treatment facilities. This project will provide a new water supply of about 6,800 af/yr. for Camp Pendleton and the Fallbrook Public Utility District and resolve a long-standing water-rights dispute between Fallbrook and the federal government

Biofiltration Wetland Creation and Education Program

Through the Biofiltration Wetland Creation and Education Program, the San Diego Zoological Society developed a biofiltration wetland within the San Diego Zoo Safari Park, which has improved water quality within the park through natural biological filtration. Additional benefits include wetlands habitat enhancement, reduced water consumption, and education for park visitors about water conservation and wetlands.

North San Diego County Cooperative Demineralization Project

Sponsored by the San Elijo Joint Powers Authority, the North San Diego County Cooperative Demineralization Project will construct advanced water treatment at the San Elijo Water Recreation Facility (SEWRF) for salinity management, production expansion, stormwater treatment, and pollution mitigation in the environmentally sensitive San Elijo Lagoon. The SEWRF demineralization facility also will provide integral logistics and technical data to support current planning and design efforts for a future brackish water desalination facility.

Recycled Water Distribution System Expansion, Parklands Retrofit, and Indirect Potable Reuse/Reservoir Augmentation Project

This City of San Diego Recycled Water Distribution System Expansion, Parklands Retrofit, and Indirect Potable Reuse/Reservoir Augmentation Project comprises both traditional recycling projects (purple pipes) and support for advanced water treatment (indirect potable reuse). Approximately 2,550 feet of new recycled water pipelines will be installed, and 1,100 af/yr. of recycled water is projected to be delivered for irrigation purposes. It also is extending the existing recycled water distribution system to selected parklands and implementing the second phase of a three-phase project designed to demonstrate the ability to treat water for indirect potable reuse in the San Diego region.

Chollas Creek Runoff Reduction and Groundwater Recharge Project

With the Chollas Creek Runoff Reduction and Groundwater Recharge Project, the County of San Diego set out to demonstrate the practical implementation of a range of low-impact development practices with the goal of reducing runoff and providing groundwater recharge. Three county facilities in the Chollas Creek subwatershed of the Pueblo San Diego hydrologic unit were selected for the demonstration.

Vail Lake Stabilization and Conjunctive Use Project

Rancho California Water District constructed a transmission main and pump station to convey untreated imported water from MWD's Pipeline No. 6 to Vail Lake. The facilities will convey imported untreated water acquired from SBVMWD for storage in Vail Lake and subsequent groundwater recharge in the Upper Valle De Los Caballos Recharge Ponds. The project construction also includes Quagga Mussel Control Facilities because the SBVMWD raw water supply contains quagga mussels and Vail Lake is currently free of the invasive species.

Implementing Nutrient Management in the Santa Margarita River Watershed

Nutrient management in the Santa Margarita River watershed is a joint effort between the Riverside County Flood Control and Water Conservation District and the County of San Diego. The goal of the project is to address nutrients in the watershed that will help identify use of water quality objectives. The project will collect data to support modeling in the Santa Margarita River estuary and watershed to develop TMDLs and continue ongoing research to develop the estuarine nutrient numeric endpoint framework, based on dissolved oxygen and macroalgae as endpoints.

Water Conservation Programs through Incentives

The Rancho California Water District provides rebate incentives to its customers to reduce water consumption and encourage water conservation. The program is focused on reducing water use by the district's agricultural clients through the implementation of on-farm water use efficiency strategies.

Camp Pendleton Seawater Desalination Project

The San Diego County Water Authority is reviewing the feasibility and cost to build a seawater desalination plant near the U.S. Marine Base Camp Pendleton. If construction proceeds, it is projected to meet 7 percent of the region's water supplies. This proposed project is part of SDCWA's plan to enhance water reliability in the region by diversifying its supply sources. More information can be found online at: <http://www.sdcwa.org/sites/default/files/desal-camp-pendleton-fs.pdf>.

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 projects have been planned and developed through processes such as IRWM collaboration to expand the development of strategic, multi-benefit projects that meet regional water demands, to improve water quality, and to enhance environmental functions. Coordination among numerous stakeholders in development of the IRWM plans has been one of the biggest successes in the region, resulting in South Coast agencies acquiring \$135 million in Proposition 50 grant funding for local water resources projects. Descriptions of those accomplishments follow.

Water Transfers and Groundwater Storage

In addition to agreements made by MWD and the CLWA, other wholesale and retail water agencies in the region have entered into groundwater storage agreements with agencies in the Central Valley to improve the reliability of their water supplies. SDCWA has an agreement with the Semitropic WSD for banked water supplies. The IRWD is in an agreement with the Rosedale-Rio Bravo WSD for banked supplies. It has a second agreement with the same agency for the storage of floodwaters of the Kern River. EMWD is partnering with the cities of Hemet and San Jacinto, the Lake Hemet Municipal Water District, and the Soboba Band of Luiseno Indians on the Integrated Recharge and Recovery Project. This is a groundwater conjunctive use project to help improve supply reliability in southwestern Riverside County. A demonstrative project was constructed for testing. Design and scheduling are complete for the permanent facility, which consists of recharge basins, extraction wells, pump station upgrades, and pipelines.

Increasing Local Surface Water Storage and Emergency Management

South Coast agencies are developing partnerships for reservoir construction, reoperation, and maintenance to meet water demands. SDCWA is nearing completion on a project to raise the dam at the City of San Diego's San Vicente Reservoir by 117 feet. Site restoration and the building of recreational facilities are among the tasks left to complete. This will increase the storage

in the reservoir from 90 to 242 taf and provide assistance in the delivery of water supplies to SDCWA's member agencies. The San Vicente Dam Raise Carryover Project is one of several projects designed improve the reliability of water supplies during emergencies. The San Diego County Water Authority and its member agencies, through their Integrated Contingency Plan and Emergency Storage Project are taking actions to prepare for and appropriately respond to a catastrophic interruption of water supplies. A drought model ordinance is being developed to identify actions to be taken to minimize the impacts, including a methodology for allocating municipal and industrial supplies to their member agencies. The Emergency Storage Project establishes connections between several reservoirs, pipelines, and pump stations with the SDCWA service area; the San Vicente Dam project was a key activity of the plan.

Desalination

Update 2009 provided an excellent summary of operational brackish groundwater desalination projects that are operational in the region. New facilities are still being planned for in the EMWD's service area in Riverside County and for the Chino Basin in San Bernardino County. The CDPH recently awarded State grant funds to the WMWD, which will be used to expand the pumping capacity of the Chino I and Chino II desalting facilities.

The City of Oxnard completed construction on its state-of-the-art brackish groundwater desalination plant in 2008. It currently treats 7.5 mgd of brackish groundwater supplies.

Ocean or seawater desalination activities have increased since Update 2009. Construction of the Carlsbad Desalination Plant in Carlsbad, California, has been under way since late 2012. Poseidon Resources, a private company, obtained all of the required environmental permits and clearances for the facility. In addition to building the facility, it will design and build a pipeline to deliver the new water supplies to the SDCWA's aqueduct. SDCWA has an agreement with Poseidon to purchase the supplies from the facility over a 30-year period. Plans call for the plant to be operational and delivering water supplies by November 2015. It will be able to create up to 50 mgd of new water supplies for the SDCWA service area.

Testing continues for the City of Long Beach Water Department's desalination facility to determine the type of a seafloor intake structure that needs to be built that draws in seawater and minimizes the impacts on the near-shore coastal environment. A similar structure could be used in the discharge of brine by-product. The facility is scheduled to be online by the year 2020 and producing about 20 taf of water supply annually.

A seawater desalination pilot project is under way for the MWDOC South Orange Coastal Ocean Desalination Project in the City of Dana Point. Slant wells are being constructed on the shore in Dana Point and studied to determine if they are effective seawater intake structures for the yet-to-be-constructed desalination facility. When built, the facility is expected to generate 16 taf of supply annually.

Recycled Water

Recycled water use meets more than 7.5 percent of the South Coast Hydrologic Region's water supply demands, which is the highest regional rate in the state. Continued expansion and planning for new recycled water projects is expected to continue to support the region's water

supply reliability. These projects include the San Diego Water Purification Demonstration Project, which will consider San Vicente augmentation, expansion of the GWRS in Orange County, IEUA's Carbon Canyon project, and multiple smaller projects currently in various phases of planning and development.

As part of the Water Reuse Program, the City of San Diego successfully completed the Water Purification Demonstration Project in 2012. The goal of the project was to determine the feasibility of augmenting San Vicente Reservoir with water supplies, such as treated wastewater, that have been subjected to advanced water purification process. Project results indicated that the concept of using water that has been treated with the process to augment the reservoir is feasible. It also yielded estimates on the costs to design, build, and maintain a full-scale facility and the kind of public outreach program that must be implemented to inform the public. Also documented was the environmental and regulatory permitting processes needed for the facility.

The recycled water programs for the EMWD and IRWD continue to expand. The supplies produced by the agencies are used for the irrigations of crops (permanent and row crops) and landscaping (turf grass, trees, and shrubs) and for industrial cooling towers. As mentioned in previous water plan updates, EMWD uses recycled water supplies almost exclusively for the Hemet-San Jacinto Constructed Wetlands; a managed wetlands facility. In 2012, EMWD delivered 37 taf and IRWD delivered 26 taf of recycled water supplies to customers.

With assistance from SWRCB, a number of water agencies in the South Coast region made significant progress in upgrading and expanding their infrastructure to increase the local use of recycled water supplies. The agencies included the cities of Burbank and San Clemente, IEUA, Lake Arrowhead Community Services District, OCWD, Upper San Gabriel Municipal Water District, and the Yucaipa Valley Water District.

Water agencies in the Santa Clara planning area are looking to expand their use of recycled water supplies. The Camrosa Water District and Camarillo Sanitation District built a pipeline that increases the flow and use of recycled water supplies in the Camrosa Water District service area. The City of Ventura completed a feasibility study to determine the preferred actions to take to increase recycled water uses by its water customers. This study also evaluated the use of this supply for Santa Clara River wetland areas.

The cities of Burbank, Glendale, and Los Angeles are actively involved with projects, both individually and collectively, to increase the use of recycled water in their respective service areas. Most of the supplies will be used for the irrigation of parks, school athletic fields, and other landscaped areas. In addition to landscape irrigation, the recycled water supplies at the Los Angeles Equestrian Center will be used for dust control around the stables and corrals at the facility.

In 2012, the City of Los Angeles released its comprehensive strategic plan for the expansion of recycled water use within the city over the next several decades. The document was titled "City of Los Angeles Recycled Water Master Planning." It describes the work and financial commitments needed to increase the annual use of the supply from 8 taf presently to 59 taf by 2035. Included in the plan are several projects currently under way which will increase the annual uses by over 11 taf. An important action of the expansion will be the recharge of the San Fernando Valley Groundwater Basin with recycled water supplies. Before recharging, these supplies will be subjected to further treatment through the Advanced Water Purification process.

In the Santa Ana planning area, the IEUA, in conjunction with several of the local water agencies, continues to make progress in expanding the use of recycled water supplies. Current infrastructure projects are being expanded to reach new customers for the supplies. The Chino Groundwater Basin is now being recharged with recycled water supplies provided by IEUA. In fiscal year 2011-12, recycled water deliveries for agriculture, landscape irrigation, and groundwater recharge totaled a little more than 29 taf.

Groundwater

The cities of Burbank and Glendale are assisting the City of Los Angeles in the development of local groundwater supplies. Burbank operates the Burbank Operable Unit, a groundwater remediation facility built under the EPA Superfund program. Contaminated groundwater is pumped and treated at the facility, transported to Burbank’s water treatment facility and then to its retail water customers. At times, local demands are not sufficient to operate the facility at full capacity. A new agreement between the cities of Burbank and Los Angeles would permit Los Angeles to tap into the unused water supplies. Infrastructure will be built to connect the cities’ conveyance systems and measure and sample the water supplies. Between 0.6 and 2.0 taf of treated groundwater supplies would be available for Los Angeles annually.

Glendale will assist Los Angeles with its groundwater production from the San Fernando Basin. The agreement between the cities requires Glendale to rehabilitate two of its older wells. Groundwater supplies from these wells would be conveyed to Los Angeles through newly constructed infrastructure.

Water Use Efficiency

As discussed earlier, to improve the reliabilities of water supplies and mitigate the impacts of water shortages, most wholesale and retail water agencies in the South Coast region are implementing water use efficiency programs either independently, or collectively.

To assist their retail water customers with the purchase of water use efficient appliances and equipment, MWD and its member agencies are implementing the “SoCal Water\$mart” program. The program is discussed in more detail in the “Integrated Water Management Plan Summaries” subsection of “Looking to the Future” later in this report. It provides a wide range of appliances and equipment that are rebate-eligible for retail customers within MWD’s service area. Included are high efficiency toilets, high efficiency clothes washers, plumbing flow control valves, weather-based controllers, soil moisture probes, and air-cooled ice machines. For more information about the program, go to www.socalwatersmart.com.

In addition to rebates, MWD and its member agencies operate the “Bewaterwise” Web site with information and links for appropriate landscape plant materials and irrigation hardware and operation. For more information, go to www.bewaterwise.com.

Many retail water agencies within the MWD service are offering their own respective rebates for customers for exterior water use efficiency projects. The cities of Long Beach, Los Angeles, San Diego, and Santa Monica and the IRWD offer financial incentives to home and business customers seeking to remove turf grass or lawns in exchange for water efficient gardens. A number of agencies offer one-day classes taught by landscape professionals on water-efficient

plants and irrigation systems. The City of Ventura holds landscaping classes for its retail customers as part of its Waterwise Gardening program. Ventura, San Diego, and a number of cities are partnering with the organization, Surfriders, to disseminate information and hold classes on the construction of systems to capture rainwater for landscape irrigation. The program is called “Ocean Friendly Gardens.”

The Rancho California Water District, California Department of Food and Agriculture, and the Temecula Winegrowers Association are partnering on a study to determine if Regulated Deficit Irrigation technique can be utilized for wine grapes grown in southwest Riverside County. The study is titled the “Temecula Valley Winegrowers Research and Demonstration Project.” In addition to water supply savings, the project will identify other ways to improve the efficiencies of irrigation operations for the grapes and monitor soil salinity conditions under varying irrigation conditions to determine impacts on the quality of the red wine grapes.

Implementation of Mobile Lab programs are continuing for the Riverside-Corona Resource Conservation District in Riverside County, the Mission Resource Conservation District in San Diego, and the Ventura County Resource Conservation District in Ventura. Trained technicians in each area provide on-site evaluations and recommendations to farmers and landscape managers on ways to improve the efficiencies of their irrigation operations and mitigate soil erosion problems. These programs have been in operation since the 1980s.

Land Use Planning

Concurrently with the 2011 adoption of the City of Santa Clarita General Plan, the County of Los Angeles adopted the One Valley One Vision (OVOV) Santa Clarita Valley Area Plan. The OVOV is a joint effort between Los Angeles County, the City of Santa Clarita, and Santa Clarita Valley residents and businesses to create a single vision and defining guidelines for the future growth of the entire Santa Clarita Valley planning area. The OVOV effort is intended to achieve enhanced cooperation between Los Angeles County and the City of Santa Clarita, coordinated land use planning, improved infrastructure and natural resource management, and enhanced quality of life for those who live and work in Santa Clarita Valley.

Stormwater Capture/Groundwater Recharge

Big Tujunga Dam — San Fernando Groundwater Enhancement Project

LADWP and the Los Angeles County Flood Control District (LACFCD) approved a cooperative agreement on September 18, 2007, for the Big Tujunga Dam — San Fernando Groundwater Enhancement Project. This project will increase stormwater capture and provide other benefits, including improvements in flood prevention and environmental enhancement through seismically retrofitting the dam and spillway. Annual stormwater capture will increase by 4,500 af/yr. for a total capture amount of 6,000 af/yr. The project is integrated with the following LADWP stormwater capture projects: Hansen Spreading Grounds Enhancement Project, Tujunga Spreading Grounds Enhancement Project, and the Sheldon-Arleta Methane Gas Collection Project. Both the Greater Los Angeles County IRWM Plan and the Tujunga/Pacoima Watershed Plan are being incorporated into the project. LADWP contributed \$9 million of the \$105 million project cost. The project was completed in July 2011.

Hansen Spreading Grounds Enhancement Project

The Hansen Spreading Grounds is a 120-acre parcel located adjacent to the Tujunga Wash Channel downstream from the Hansen Dam. Under a cooperative agreement, the LACFCD and LADWP propose to modernize the facility to increase intake and storage capacity thereby improving groundwater recharge, flood protection, and water quality while providing recreational benefits and native habitat improvements. The project was completed in January 2013.

Tujunga Spreading Grounds Enhancement Project

The Tujunga Spreading Grounds Enhancement Project is designed to increase average annual stormwater capture by 8,000 af/yr. through relocating and automating the current intake structure on the Tujunga Wash, installation of an automated intake structure on the Pacoima Wash, and reconfiguration of the Tujunga Spreading Basins. Other multiple benefits include habitat improvements, passive recreation, educational opportunities, flood protection, and water quality improvements. Owned by LADWP, the Tujunga Spreading Grounds are operated by LACFCD in conjunction with other facilities along the Tujunga and Pacoima wash channels. Construction is expected to begin in summer 2014 and finish by 2015.

Glen Oaks Stormwater Capture Project

Smaller stormwater capture projects are also generating interest in the South Coast region. The City of Los Angeles Department of Public Works; the Los Angeles Department of Water and Power; and a local organization, the Los Angeles Beautification Team, are working together to complete the Glen Oaks Storm Water Capture Project. Utilizing funds from Proposition O (City of Los Angeles 2004), six bioswales and four dry wells have been installed to capture surface runoff from storms from a small watershed for groundwater recharge. Additional dry wells will be installed in Phase II of the project. The groundwater basin in the area will be recharged with about 75 af of storm runoff each year.

Flood Management

Coastal Mapping

FEMA is performing a detailed coastal engineering analysis and mapping of the Pacific coast of California. Results from this study will be used to remap California's coastal flood risk and wave hazards. FEMA's coastal mapping efforts benefit from new technologies and coastal data contributed by a consortium of federal and State agencies, academic institutions, and private sector consultants. The study will be based on new high-resolution bathymetric and topographic data acquired from the California Ocean Protection Council and National Oceanic and Atmospheric Administration.

Levee Analysis

Across the South Coast region, the new Levee Analysis and Mapping Approach will be used by FEMA to analyze and map areas on the landward side of non-accredited levee systems that are shown on FEMA's Flood Insurance Rate Maps. Under FEMA's prior levee approach, a levee system that did not meet the National Flood Insurance Program requirements was analyzed and mapped as if it had no effect on the landward side of the levee system during the base

(1-percent-annual-chance) flood. This was known as the “without levee” approach. Given recent technological advances in data collection and hydrologic and hydraulic modeling, FEMA is able to implement a more refined approach to mapping flood hazards in areas landward of levee systems.

Watershed Management

The USACE, LACFCD, and Ventura County Watershed Protection District are collaborating on the Santa Clara River Watershed Feasibility Study. Goals of the study include the identification of solutions for flooding and regional flood control problems in the watershed, identification of sedimentation and erosion problems, and ways to improve water quality. Phases of the study that have been completed include the hydrologic modeling, geomorphic study, and floodplain mapping of the watershed. The sediment transportation component will be completed in 2015. Lower and Upper Calleguas Creek Watershed Protection Plan — conducted by the Ventura County Watershed Protection District, Calleguas Municipal Water District, and cities of Camarillo Moorpark, Thousand Oaks, and Simi Valley — documented problems in the watershed resulting from flood risks from existing FEMA flood hazard areas.

Challenges

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

Environmental Concerns in Delta

Uncertainty about the availability and reliability of imported water supplies from the Delta through the SWP is of primary concern to the South Coast region. Two important federal court rulings on the Delta are presently impacting the operations of the SWP and the Central Valley Project. To resolve these legal issues, the draft Bay Delta Conservation Plan has been proposed. It is a comprehensive strategic plan with actions and policies. If implemented, it would restore the environmental habitat of the Delta; increase the availability and reliability of water supplies for urban, agricultural, and environmental water users; and provide solutions to the impacts of climate change. A comprehensive draft environmental impact report/environmental impact statement was released in 2013 for public review.

Water Resource Development

Water districts throughout the South Coast region must remain engaged in IRWM planning to identify and develop the new water supplies needed to keep pace with the anticipated increase in population. The planning and implementation of local water supply projects (groundwater conjunctive use, seawater and groundwater desalination, and recycled water), water transfer and groundwater storage agreements, and water use efficiency programs have been important tools for the agencies to keep pace with demands, become less dependent on imported supplies, and to help them mitigate the impacts of critically dry years in the state. Decisions will be needed on the feasibility and sources of funding to expand the current projects and for the development of new projects.

The region's flood control systems are designed to quickly move storm flow 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.

Water Quality

Salinity in both local and imported supplies will continue to be a challenge for local water agencies. Salinity sources in local groundwater supplies include the deep percolation of unused agricultural and urban applied 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.

Surface water quality issues in the region exist and must be addressed for the stormwater and surface runoff. Both types of flows contribute contaminants to local creeks and rivers, lagoons, beaches, and bays. For example, the Chino Basin faces substantial nutrient loading impacts from dairy farming, which affect groundwater quality and downstream SAR water quality. Commercial shipping can also influence water quality, especially in San Diego Bay and the Long Beach and Los Angeles harbors.

Water Costs

Water agencies and their customers will be required to adapt to cost increases for their water supplies. Variables that may influence increases in costs include costs to SWP Contractors to pay for the Bay Delta Conservation Plan components, TMDL compliance and NPDES permits, upgrade of existing or construction of new water treatment facilities to address water quality standards, water transfer and groundwater storage agreements to increase the reliability of the supply, and increasing water rates.

Disadvantaged Communities

IRWM planning activities need to adopt and implement policies and actions to assist water users in disadvantaged communities in the region. This would include providing both technical and financial assistance with water treatment and conveyance and wastewater systems repairs and upgrades.

Climate Change and Sustainability

Climate change models project warmer and drier conditions for the South Coast region. Modifications are also possible in the timing and type of precipitation and the timing and volumes of surface runoff in the key watersheds of the region's imported water supplies. More extreme storm events may exceed reservoir storage capacity and therefore result in allocated water supplies being discharged to the ocean. Sea level rise may affect local aquifers and Delta water quality through seawater intrusion and impact local coastal water and wastewater infrastructure.

Present-day flood control facilities may need to be upgraded to adequately handle the runoff from these extreme events and prevent significant losses of properties and lives. Conversely, drought events could also increase in intensity in the future. The drier conditions could impact the natural recharge and safe yields of the region's groundwater basins. All of these uncertainties related to climate change could potentially decrease the delivery of imported supplies and impact the ability of local agencies to meet urban, agricultural, and environmental demands.

Adaptation strategies must be developed, tested, and implemented to mitigate the potential impacts of sea level rise. Residential communities, businesses, schools, power, water, and wastewater facilities, and wetlands and other important environmental habitat could sustain significant damage from combined sea level rise and flooding events.

As water supply development is considered, the energy and greenhouse gas (GHG) emission impacts must be addressed to assure that proposed water development projects are sustainable.

Watershed Protection

The water supply requirements for the restoration and maintenance of important environmental habitats must be identified by stakeholders in the IRWM planning processes. These demands need to be balanced against the demands of urban and agricultural users in the region.

Land Use Planning

Although irrigated lands continue to be urbanized, the South Coast region still has several important agricultural areas. These would include highly productive fresh market vegetable and citrus fruit lands in Ventura County on the Oxnard Plain and adjoining areas, the citrus fruit and nursery lands in coastal and interior San Diego County, and the dairy industry in the Chino and adjoining basins. Planted and harvested acres total about 250,000 acres annually. In addition to the contributions to the state's agricultural industry, the farming operations in these areas help local economies. The water supply requirements for agriculture need to be balanced against those for the urban and environmental users in the region.

Flood Control Infrastructure

Recurrent flooding is a problem in many places in the South Coast region. At many locations, lives, homes, businesses, farmlands, 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. 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.

Wildfires

Wildfires may denude steep erodible slopes in canyons and upland areas that lie directly above urban development. 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.

Looking to the Future

Future Conditions

Future Scenarios

Update 2013 evaluates different ways of managing water in California, depending on alternative future conditions and differing characteristics of regions throughout the state. The ultimate goal is to evaluate how different regional response packages, or combinations of resource management strategies from Volume 3, 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 of managing uncertainty and risk at the regional level. The future scenarios are composed of factors related to future population growth and climate change. Growth factors for the South Coast Hydrologic Region are described below. Climate change factors are described in general terms in Volume 1, Chapter 5, “Managing an Uncertain Future.”

Water Conservation

Update 2013 scenario narratives include two types of water use conservation. The first is conservation that occurs without policy intervention (called background conservation). This includes upgrades in plumbing codes and end user actions such as purchases of new appliances and shifts to more water efficient landscape absent a specific government incentive. The second type of conservation expressed in the scenarios is through efficiency measures under continued implementation of existing best management practices California Urban Water Conservation Council’s Memorandum of Understanding Regarding Urban Water Conservation in California (last amended in September 2011). These are specific measures that have been agreed upon by urban water users and are being implemented over time. Any other water conservation measures that require additional action on the part of water management agencies are not included in the scenarios, and would be represented as a water management response.

South Coast Growth Scenarios

Future water demand in the South Coast Hydrologic Region is affected by a number of growth and land use factors, including population growth, planting decisions by farmers, and size and

type of urban landscapes. See Table SC-23 for a conceptual description of the growth scenarios used in Update 2013. The water plan quantifies several factors that together provide a description of future growth and how growth could affect water demand for the urban and agricultural sectors in the South Coast Hydrologic Region. Growth factors vary among the scenarios to describe some of the uncertainty faced by water managers. For example, it is impossible to predict future population growth accurately so Update 2013 uses three different, but plausible population growth estimates when determining future urban water demands. In addition, Update 2013 considers up to three different alternative views of future development density. Population growth and development density will reflect how large the urban landscape will become by 2050 and are used in Update 2013 to quantify encroachment into agricultural lands by 2050 in the South Coast Hydrologic Region.

For Update 2013, DWR worked with researchers at the University of California, Davis, to quantify the amount of growth that might occur in the South Coast Hydrologic Region through 2050. The UPlan model was used to estimate a year 2050 urban footprint under the scenarios of alternative population growth and development density (for information on the UPlan model, see <http://ice.ucdavis.edu/project/uplan>). UPlan is a simple rule-based urban growth model intended for regional or county-level modeling. The needed space for each land use type is calculated from simple demographics and is assigned based on the net attractiveness of locations to that land use (based on user input), locations unsuitable for any development, and a general plan that determines where specific types of development are permitted. Table SC-24 describes the amount of land devoted to urban use for 2006 and 2050, and the change in the urban footprint under each scenario. As shown in the table, the urban footprint grew by about 180,000 acres under low population growth scenario (LOP) by 2050, relative to the 2006 base-year footprint of about 1.8 million acres. The urban footprint under the high population scenario (HIP), however, grew by about 600,000 acres. The effect of varying housing density on the urban footprint is also shown.

Table SC-25 describes how future urban growth could affect the land devoted to agriculture in 2050. Irrigated land area is the total agricultural footprint. Irrigated crop area is the cumulative area of agriculture, including multi-crop area, where more than one crop is planted and harvested each year. Each of the growth scenarios shows a decline in irrigated acreage over existing conditions, but to varying degrees. As shown in the table, irrigated crop acreage declines by about 20,000 acres by 2050 as a result of low population growth and urbanization in the South Coast Hydrologic Region, while the decline under high population growth was about 100,000 acres.

South Coast 2050 Water Demands

This section provides a description for how future water demands might change under scenarios organized around themes of growth and climate change described in this report. The change in water demand from 2006 to 2050 is estimated for the South Coast Hydrologic Region for the agriculture and urban sectors under nine growth scenarios and 13 scenarios of future climate change. The climate change scenarios include the 12 Climate Action Team scenarios described in Volume 1, Chapter 5, “Managing an Uncertain Future,” and a 13th scenario representing a repeat of the historical climate (1962-2006) to evaluate a “without climate change” condition.

Figure SC-20 shows the change in water demands for the urban and agricultural sectors under nine growth scenarios, with variation shown across 13 climate scenarios. The nine growth scenarios include three alternative population-growth projections and three alternative urban-land development densities, as shown in Table SC-23. The change in water demand is the difference

Table SC-23 Conceptual Growth Scenarios

Scenario	Population Growth	Development Density
LOP-HID	Lower than Current Trends	Higher than Current Trends
LOP-CTD	Lower than Current Trends	Current Trends
LOP-LOD	Lower than Current Trends	Lower than Current Trends
CTP-HID	Current Trends	Higher than Current Trends
CTP-CTD	Current Trends	Current Trends
CTP-LOD	Current Trends	Lower than Current Trends
HIP-HID	Higher than Current Trends	Higher than Current Trends
HIP-CTD	Higher than Current Trends	Current Trends
HIP-LOD	Higher than Current Trends	Lower than Current Trends

between the historical average for 1998 to 2005 and future average for 2043 to 2050. Urban demand is the sum of indoor and outdoor water demand, where indoor demand is assumed not to be affected by climate. Outdoor demand, however, depends on such climate factors as the amount of precipitation falling and the average air temperature. Change in water demand is shown under a repeat of historical climate conditions and for 12 scenarios of future climate change.

Urban demand increased under most growth scenarios tracking with population growth. On average, it increased by about 600 taf under the three current-trend population scenarios, and about 1,900 taf under the three high population scenarios when compared with the historical average of about 3,850 taf. However, on average water demand decreased by 20 taf under the low population scenarios due to background water conservation. The results show change in future urban water demands are less sensitive to housing density assumptions or climate change than to assumptions about future population growth.

Agricultural water demand decreases under all future scenarios as a result of reduction in irrigated lands caused by urbanization and background water conservation, when compared with the historical average water demand of about 790 taf. Under the three low population scenarios, the average reduction in water demand was about 225 taf, while it was about 390 taf for the three high population scenarios. For the three current trend population scenarios, this change was about 290 taf. The results show agricultural water demands are sensitive to assumptions about population growth and housing density by reducing the amount of lands for irrigated agriculture.

Integrated Regional Water Management Plan Summaries

Inclusion of the information contained in IRWM plans into Update 2013 regional reports has been a common suggestion by regional stakeholders at the regional outreach meetings since the inception of the IRWM program. To this end, the California Water Plan has taken on the task of summarizing readily available IRWM plans in a consistent format for each of the regional reports. (This collection of information will not be used to determine IRWM grant eligibility.)

Table SC-24 Growth Scenarios (Urban) — South Coast Hydrologic Region

Scenario ^a	2050 Population (thousand)	Population Change (thousand) 2006 ^b to 2050	Development Density	2050 Urban Footprint (thousand acres)	Urban Footprint Increase (thousand acres) 2006 ^c to 2050
LOP-HID	21,582.3 ^d	2,377.1	High	2,001.5	157.0
LOP-CTD	21,582.3	2,377.1	Current Trends	2,026.3	181.8
LOP-LOD	21,582.3	2,377.1	Low	2,050.7	206.2
CTP-HID	24,717.8 ^e	5,512.7	High	2,171.7	327.2
CTP-CTD	24,717.8	5,512.7	Current Trends	2,211.1	366.6
CTP-LOD	24,717.8	5,512.7	Low	2,246.3	401.8
HIP-HID	33,516.7 ^f	14,311.5	High	2,374.7	530.2
HIP-CTD	33,516.7	14,311.5	Current Trends	2,444.7	600.2
HIP-LOD	33,516.7	14,311.5	Low	2,506.7	662.2

Notes:

^a See Table SC-23 for scenario definitions.

^b 2006 population was 19,205.2 thousand.

^c 2006 urban footprint was 1,844.5 thousand acres.

^d Values modified by the California Department of Water Resources (DWR) from the Public Policy Institute of California.

^e Values provided by the California Department of Finance.

^f Values modified by DWR from the Public Policy Institute of California.

All IRWM plans are different in how they are organized. Therefore, finding and summarizing the content in a consistent way proved difficult. It became clear through these efforts that a process is needed to allow those with the most knowledge of the IRWM plans, those that were involved in the preparation, to have input on the summary. It is the intention that this process be initiated following release of Update 2013 and will continue to be part of the process for *California Water Plan Update 2018*. This process will also allow for continuous updating of the content of the “atlas” (explained below) as new IRWM plans are released or existing IRWM plans are updated.

In addition to these summaries, all summary sheets will be provided in one IRWM Plan Summary “Atlas” as an article included in Volume 4, *Reference Guide*. This atlas will, under one cover, provide an “at-a-glance” understanding of each IRWM region and highlight each region’s key water management accomplishments and challenges. The atlas will showcase how the dedicated efforts of individual regional water management groups (RWMGs) have individually and cumulatively transformed water management in California.

As can be seen in Figure SC-21, there are eight regional water management planning groups in the South Coast Hydrologic Region.

Table SC-25 Growth Scenarios (Agriculture) — South Coast Hydrologic Region

Scenario ^a	2050 Irrigated Land Area ^b (thousand acres)	2050 Irrigated Crop Area ^c (thousand acres)	2050 Multiple Crop Area ^d (thousand acres)	Change in Irrigated Crop Area (thousand acres) 2006 to 2050
LOP-HID	208.6	223.2	14.6	-17.0
LOP-CTD	205.4	219.8	14.4	-20.4
LOP-LOD	202.0	216.2	14.2	-24.0
CTP-HID	181.5	194.2	12.7	-46.0
CTP-CTD	175.9	188.2	12.3	-52.0
CTP-LOD	170.7	182.7	12.0	-57.5
HIP-HID	143.3	153.4	10.0	-86.8
HIP-CTD	132.7	142.0	9.3	-98.2
HIP-LOD	122.3	130.9	8.6	-109.3

Notes:

^a See Table SC-23 for scenario definitions.

^b 2006 Irrigated land area was estimated by the California Department of Water Resources (DWR) to be 223.9 thousand acres.

^c 2006 Irrigated crop area was estimated by DWR to be 240.2 thousand acres.

^d 2006 multiple crop area was estimated by DWR to be 16.3 thousand acres.

Region Description

As of late 2013, the RWMGs in the South Coast Hydrologic Region have received a total of about \$1.5 billion in funding from both State and non-State sources: \$242,501,309 from the State and \$1,261,260,449 from non-State sources. Table SC-26 provides a funding source breakdown for the region. Information for the Watersheds Coalition of Ventura County IRWM plan was not available for Update 2013.

The following are short descriptions of the IRWM areas and plans in the South Coast Hydrologic Region.

Greater Los Angeles County

The Greater Los Angeles County (GLAC) region, located in coastal Southern California, is made of four counties: Los Angeles, Orange, San Bernardino, and Ventura. It is primarily defined by the coastal watersheds within the area that drain into Santa Monica Bay and San Pedro Bay. These watersheds include the Lower San Gabriel, Los Angeles River, North Santa Monica Bay, South Bay, Upper Los Angeles River, Upper San Gabriel River, and Rio Hondo River. The GLAC region is bordered by four other IRWM planning regions: Ventura, Upper Santa Clara River, Antelope Valley, and Mojave. The Gateway and Santa Ana Watershed Project Authority regions overlap the southeastern portion of the GLAC region.

Figure SC-21 Regional Water Management Groups in the South Coast Hydrologic Region



San Diego

The San Diego IRWM region comprises 11 parallel and similar watersheds that discharge to coastal waters in the western half of San Diego County. These 11 were chosen primarily on the basis of regulatory, jurisdictional, and political boundaries, as well as similarities in hydrology, watershed characteristics, and water supply. The region extends east from the Pacific Ocean, through one of the most populous areas in the nation, to the ridgeline of a forested mountain range.

Santa Ana Water Project Authority

The boundary of the region largely follows the boundary of the Santa Ana River watershed and is generally bounded by the Pacific Ocean, the San Gabriel Mountains, the San Bernardino Mountains, the Santa Margarita Mountains, and the San Jacinto Mountains. The Santa Ana River flows roughly 100 miles through the region and drains the largest coastal stream system

Table SC-26 South Coast IRWM Plan Funding

IRWM Region	Prop. 50 Planning Grant	Prop. 50 Implementation Grant	Prop. 84 Planning Grant	Prop. 84 Implementation Grant ^a	Prop. 1E Stormwater Grant	Regional Totals ^b
Gateway Region			\$950,000 \$407,000			\$1,357,000
Greater Los Angeles County	\$1,000,000 \$425,000	\$25,000,000 \$87,624,893	\$1,000,000 \$352,560	\$25,600,000 \$97,278,509	\$57,842,059 \$80,845,047	\$376,968,068
San Diego		\$25,000,000 \$353,892,695	\$1,000,000 \$465,880	\$7,900,000 \$9,761,844	\$14,900,000 \$15,798,100	\$428,718,519
Santa Ana WPA		\$25,000,000 \$229,661,000	\$1,000,000 \$559,691	\$12,660,004 \$217,682,042		\$486,562,737
South Orange County WMA		\$25,000,000 \$128,194,599	\$457,416 \$447,244	\$2,316,780 \$2,833,560	\$5,000,000 \$9,009,085	\$173,258,684
Upper Santa Clara River			\$1,000,000 \$335,000	\$6,931,000 \$9,004,449		\$17,270,449
Upper Santa Margarita			\$777,050 \$260,198	\$2,167,000 \$16,422,053		\$19,626,301
Total	\$1,000,000 \$425,000	\$100,000,000 \$799,373,187	\$6,184,466 \$2,827,573	\$57,574,784 \$352,982,457	\$77,742,059 \$105,652,232	\$242,501,309 \$1,261,260,449
Grand Total \$1,503,761,758						

Notes:

IRWM = integrated regional water management, WPA = Watershed Project Authority, WMA = Watershed Management Area

This table is up-to-date as of late 2013. Information on the Watersheds Coalition of Ventura County IRWM plan was not available for Update 2013.

Grant figures in **bold** are State-funded. Grant figures in regular type are non-State funded.

^a Does not include Proposition 84 Implementation Grant Round 2 Awards.

^b Grant figures represent money awarded to specific regional water management groups and do not represent the total amount of money spent on each hydrologic region, as some regional water management groups straddle two or more hydrologic regions.

in Southern California. It includes parts of Orange, Riverside, and San Bernardino counties, as well as a small portion of Los Angeles County. The watershed’s population, already one of the most densely populated in the state, is home to over 6 million people. The regional population is projected to grow to almost 10 million within the next 50 years.

South Orange County Watershed Management Area

The South Orange County Watershed Management Area (SOCWMA) IRWM region encompasses the San Juan Hydrologic Unit (SJHU) as defined by the State Water Boards. The region covers portions of San Diego, Orange, and Riverside counties and is composed of coastal watersheds including Laguna Coastal Streams, Aliso Creek, and San Juan Creek. Over 90 percent of the region is undeveloped, with the majority of development concentrated in the northwestern portion of the region.

Upper Santa Clara River

The Upper Santa Clara River region is located within the upper portion of the Santa Clara River watershed and includes portions of both Ventura and Los Angeles counties. It is bounded by the San Gabriel Mountains to the south and southeast, the Santa Susana Mountains to the southwest, the Liebre Mountains and Transverse Ranges to the northeast and northwest, and the Ventura County line to the west. The region encompasses the City of Santa Clarita, the unincorporated communities of Castaic, Stevenson Ranch, West Ranch, Agua Dulce, and Acton, as well as portions of the Angeles National Forest.

Upper Santa Margarita

The Upper Santa Margarita IRWM region is located in Southern California and is the portion of the Santa Margarita watershed that falls within Riverside County. The communities of Temecula, Murrieta, Murrieta Hot Springs, and Wildomar fall within the region. The remainder of the region is unincorporated areas of Riverside County and tribal lands. The region contains a variety of nearly undisturbed natural habitats, including chaparral-covered hillsides, riparian woodlands, and costal marshes. The Santa Margarita River flows through the region, forming near the City of Temecula and flowing into the Pacific Ocean at the Santa Margarita lagoon in San Diego County.

Gateway Region

The Gateway region coincides with the Gateway Cities Council of Governments boundary. It includes 26 mainland Gateway Cities in southeastern Los Angeles County and several adjoining unincorporated communities. These cities include Long Beach, Cerritos, Whittier, Vernon, Montebello, and Lynwood. The boundary is based upon and coincident to both natural and political boundaries including a common groundwater basin, a common wholesale provider, similar water, economic, and social issues, and a similar natural topography and watershed.

Key Challenges and Goals

Greater Los Angeles County

GLAC faces the following challenges:

- Water quality.
- Water supply.
- Open space.
- Recreation and habitat.
- Flood management.

To address the challenges, GLAC has identified the following goals/objectives:

- Improve water supply.
- Improve water quality.
- Enhance habitat.
- Enhance open space and recreation.
- Sustain infrastructure for local communities.

San Diego

San Diego faces the following challenges:

- Flood control.
- Climate change.
- Salinity/brine management.
- Water quality and supply.
- Institutional issues.

To address the challenges, the San Diego has identified the following goals/objectives:

- Optimize water supply reliability.
- Protect and enhance water quality.
- Provide stewardship of our natural resources.
- Coordinate and integrate water resource management.

Santa Ana Water Project Authority

SAWPA faces the following challenges:

- Climate change.
- Colorado River drought conditions.
- Energy and fiscal crisis.
- Population growth and development.
- Delta vulnerability.

To address the challenges, SAWPA has identified the following goals/objectives:

- Maintain reliable and resilient water supplies and reduce dependency on imported water.
- Manage at the watershed scale for preservation and enhancement of the natural hydrology to benefit human and natural communities.
- Preserve and enhance the ecosystem services provided by open space and habitat within the watershed.
- Protect beneficial uses to ensure high quality water for human and natural communities.
- Accomplish effective, equitable, and collaborative integrated watershed management.

Southern Orange County Watershed Management Area

SOCWMA faces the following challenges:

- Water supply and quality.
- Water system reliability.
- Water conservation and recycled water.
- Groundwater management.
- Flood management.

To address the challenges, SOCWMA has identified the following goals/objectives:

- Integrate flood management.
- Improve water quality.
- Increase water supply and reliability.
- Promote water use efficiency.
- Protect natural resources.

Upper Santa Clara River

Upper Santa Clara River region faces the following challenges:

- Water supply and demand.
- Water quality.
- Natural resources stewardship.
- Flooding.
- Climate change.

To address the challenges, the Upper Santa Clara River region has identified the following goals/objectives:

- Implement technological, legislative, and behavioral changes that will reduce user demands for water.
- Maximize water system operational flexibility and efficiency, including energy efficiency.
- Understand future regional demands and obtain necessary water supply resources.
- Supply drinking water with appropriate quality, improve groundwater quality, and attain water quality standards.
- Preserve and improve ecosystem health, improve flood management, and preserve and enhance water-dependent recreation.

Upper Santa Margarita

Upper Santa Margarita region faces the following challenges:

- Water supply.
- Water quality.
- Flood management.
- Environmental stewardship and recreation.

To address the challenges, the Upper Santa Clara Margarita region has identified the following goals/objectives:

- Develop a more reliable and diverse portfolio of water supplies.
- Promote economic, social, and environmental sustainability.
- Improve water quality.
- Restore, enhance, and maintain habitats and open space.
- Promote sustainable floodplain management.

- Promote appropriate recreational opportunities.
- Promote appropriate land use planning.
- Increase stakeholder involvement and stewardship.
- Maximize implementation of water resources projects.

Gateway Region

The Gateway Region faces the following challenges:

- Water quality.
- Aging infrastructure.
- Urbanization.
- Floods.

To address the challenges, the Gateway region has identified the following goals/objectives:

- Identify and address the water dependent natural resources needs of the Gateway region watersheds.
- Protect and enhance water quality.
- Optimize and ensure water supply reliability.
- Coordinate and integrate water resource management.
- Provide stewardship of the region's water dependent natural resources through enhancement of amenities and infrastructure.
- Manage flood and stormwater to reduce flood risk and water quality impacts.

Water Supply and Demand

Greater Los Angeles County

The region has a diverse mix of supply including imported water, groundwater, local surface water, and recycled water. Imported water supply originates from the SWP, the CRA, and the LAA. Groundwater makes up a significant portion of the supply, approximately 35 percent in 2010. Supply is estimated to increase from 1,645,000 af/yr. in 2010 to 2,055,000 af/yr. in 2035. Demand is projected to increase from 1,515,000 af/yr. in 2010 to 1,830,000 af/yr. in 2035.

San Diego

The majority of water supply within the region is imported, with the remainder coming from local surface water, recycled water, and local groundwater. The water demand in the region in the fiscal year 2010-2011 was 526,945 af/yr. The San Diego IRWM plan projects that demand with pending annexations and additional anticipated growth will be 785,685 af/yr. in a normal year and 839,020 af/yr. in a single dry year by 2035.

Santa Ana Water Project Authority

The watershed gets about 50 percent of its water from local precipitation in the form of surface water and stored as groundwater. The watershed imports about 30 percent of its water from the

SWP and Colorado River. The remaining 20 percent of the watershed's water supply is recycled water.

Southern Orange County Watershed Management Area

Water supply in the region is a mixture of local supplies (groundwater, recycled water, and surface water) and imported water from MWD. Imported water accounts for 90 percent of the region's water supply. Demand for 2009-2010 was 113,445 af/yr., which is projected to increase to 137,215 af/yr. by 2035.

Upper Santa Clara River

Groundwater and imported water are the two main water supplies within the region. Water is imported from a variety of sources including the SWP and Buena Vista-Rosedale. Imported water supply was around 80,000 af/yr. in 2010 and is expected to decrease to about 77,000 af/yr. by 2030. Groundwater supply in the region was 65,110 af/yr. in 2010 and is estimated to grow to around 68,000 af/yr. by 2035. In 2010, demand was roughly 92,000 af/yr., which is projected to increase to almost 110,000 af/yr. by 2030.

Upper Santa Margarita

The region has a varied water supply portfolio, including surface water, groundwater, reclaimed water, and imported water. The majority of demands are met through imported water. There are four water distributors within the region, each of which anticipate having ample supply to meet demands through 2030. Demands are expected to increase from 150,000 af/yr. in 2010 to 192,000 af/yr. by 2030.

Gateway Region

The region's water supply is largely groundwater (67 percent), supplemented by surface water provided by wholesalers (29 percent) and recycled water purveyors (4 percent). The region projects that by 2030, recycled water use will double and that water supply will increase from 292,800 af/yr. in 2010 to 362,600 af/yr. in 2030. Demand is projected to increase from 288,400 af/yr. in 2010 to 348,400 af/yr. in 2030.

Water Quality

Greater Los Angeles County

Surface water quality is generally better in the headwaters and upper portions of the watersheds and is degraded by urban and stormwater runoff closer to the Pacific Ocean. Common contaminants include trash, sediments, nutrients, bacteria and viruses, oil and grease, and metals. A number of TMDLs for the impaired water bodies in the region have been developed by the SWRCB. Groundwater quality varies throughout the region and is based on naturally occurring conditions, historical land use patterns, and groundwater extraction patterns. Nitrates, VOCs, and MTBE (a gasoline additive) contribute to groundwater quality issues.

San Diego

The RWQCB has identified over 72 inland surface waters and a number of impaired coastal and marine waters as not complying with applicable water quality standards. Primary water quality constituents of concern for the region's surface waters include coliform bacteria, sediment, nutrients, salinity, metals, and toxic organic compounds. The RWQCB has completed TMDLs for several of these non-complying water bodies, and has initiated TMDLs for a number of additional impaired water bodies.

Santa Ana Water Project Authority

High priority water quality problems include maintaining the salt balance in the watershed, reducing anthropogenic pollutants in surface water runoff to optimize beneficial uses, preventing pollutants from contaminating groundwater, and cleanup and management of existing contaminated groundwater sites.

Southern Orange County Watershed Management Area

While the quality of imported water is high, the quality of local water requires ongoing protection. Urbanized spaces have placed considerable stress on the quality of local resources, particularly TDS, nitrates, and metals. There are 27 water bodies that have been listed as impaired by the RWQCB, with a number of TMDLs either established or being developed. Groundwater quality in the San Juan Valley Basin is poor due to high TDS, which prohibits domestic use. Currently, desalters are used to increase the use of groundwater.

Upper Santa Clara River

Surface water quality within the region is impacted by chloride, nitrogen, coliform, and pesticides. The Santa Clara River watershed has two adopted TMDLs due to non-attainment of identified water quality objectives, pertaining to nitrogen and chloride. A third TMDL exists for three lakes within the region that are impaired due to trash. Groundwater quality in the region is generally good, with low organic matter and microbes. However, mineral content is quite high which results in "hard" groundwater, causing scaling issues on water delivery infrastructure. Nitrate, sulfate, and perchlorate are other contaminants which affect groundwater quality in the region.

Upper Santa Margarita

Surface water quality within the region is generally good, with some areas affected by agricultural land use practices and urbanization. Groundwater is also of generally good quality, but can suffer from high levels of constituents due to natural erosion processes. There are several surface water bodies within the region that have been designated as impaired by the RWQCB, including Long Canyon, Temecula Creek, and Murrieta Creek. Surface water constituents of concern are TDS, manganese, and iron. Groundwater quality continues to suffer from fluoride and manganese. The MCL for fluoride in the region is 2 mg/L. Regional samples have found ranges between 0.2 mg/L and 7.6 mg/L.

Gateway Region

Groundwater quality suffers from a number of issues including natural contaminants, industrial and agricultural activities, and seawater intrusion. Surface waters are contaminated with oil, metals, pesticides, and other toxic chemicals and disease-causing pathogens due to stormwater and urban runoff. The region identified protecting and enhancing water quality as a goal for the IRWM plan, citing the importance of attaining TMDLs for constituents of concern and effectively reducing major sources of pollutants.

Flood Management

Greater Los Angeles County

Flood management in the region is primarily managed by county agencies and include flood control districts for Los Angeles, Ventura, Orange, and San Bernardino counties. Flood risk in the area has historically been minimized due to armoring creek and river banks with concrete. Many dams within the region have primarily been developed for flood management purposes. The region has prioritized expanding and restoring existing wetlands, which retain natural functions and developing constructed wetlands, which recreate natural functions and can improve flood protection.

San Diego

Flooding within the San Diego IRWM region typically occurs during periods of heavy rainfall, particularly after long dry spells. To address flood risks, a Multi-Hazard Mitigation Plan was developed for San Diego County which includes specific goals, objectives, and actions to help address or mitigate identified risks. San Diego County Flood Control District also provides flood warning services for San Diego County, including a flood warning system, a Web cam program, and a flood forecast program.

Santa Ana Water Project Authority

There are several flood control agencies within the region that oversee flood management activities. The San Bernardino County Flood Control District has jurisdiction over the largest and most up-gradient areas in the watershed. Riverside County Flood Control and Water Conservation District manages the intermediate and lower eastern section; and Orange County Flood Control District manages the lower, more coastal portion. The completion of the Santa Ana River Mainstem Project will reduce the risk of a catastrophic flood event in the Santa Ana River Watershed. However, there remains significant flood risk related to tributary watercourses within the watershed, compounded by potential impacts of wildfires and earthquakes.

Southern Orange County Watershed Management Area

Flooding is identified as a major concern within the region. A number of projects have been identified that will address flood management including channel improvements, feasibility studies, and ecosystem restoration projects. The region currently has a number of flood management strategies, which are overseen by the Orange County Flood Control District. The district's Regional Backbone Flood Control Infrastructure provides primary flood control and is composed of channels, dams, retarding basins, pump stations, and levees. The ALERT (Automatic Local Evaluation on Real Time) Flood Detections System consists of a network

of over 100 sensors located throughout the county that transmit data to allow for real-time monitoring of storm conditions.

Upper Santa Clara River

A portion of the region is located in 100- and 500-year floodplains along the Upper Santa Clara River. As the river flows to the Los Angeles-Ventura County line, the width of the floodplain ranges between 800 feet and 3,000 feet. The region is characterized by “flashy” conditions, where flood flows increase, peak, and subside rapidly in response to high-intensity rainfall. Various programs and policies guide flood management in the region, including ordinances adopted by local governments and federal requirements. The region is committed to reducing impervious area within the region and promoting low-impact development, green streets, and other stormwater recharge projects.

Upper Santa Margarita

Flood management has been identified as a major concern for the region. Riverside County Flood Control and Water Conservation District is the primary agency that conducts flood management within the region. The region is committed to improving coordination with land use planners, flood managers, and resource managers to promote sustainable floodplain projects. The Murrieta Creek Flood Control, Environmental Restoration, and Recreation Project is an ongoing project in conjunction with the USACE that will increase flood protection along Murrieta Creek.

Gateway Region

The IRWM plan identified flooding as one of the four major challenges facing the region. To address this, many sections within the IRWM plan aim to incorporate flood management. The region promotes the creation of an integrated flood management program, which seeks to manage flood and stormwater to reduce risk, protect and enhance water quality, and recycle and reuse stormwater and urban drainage. As part of the IRWM planning process, a survey was conducted to catalog existing problem areas for flooding within the region. These results will be used to develop and implement flood management projects and programs in high flood risk areas.

Groundwater Management

Greater Los Angeles County

The GLAC region overlies nearly 20 groundwater basins, including the Central, West Coast, San Fernando, Orange County, Hollywood, Main San Gabriel, and Santa Monica basins. Most of the basins within the region have been adjudicated. Groundwater producers within these basins follow management guidelines established by their respective adjudications. Groundwater quality is a significant issue in the region, with some aquifers having such high salt levels that they require treatment to make the supply available for consumption.

San Diego

The San Diego IRWM region contains 24 groundwater basins, of which three have storage capacity above 100,000 af. A small number of the region’s population relies solely on

groundwater, which is limited by rainfall, recharge infiltration rates, and limited groundwater storage capacity. In 2012, 3 percent of the region's supply portfolio came from local groundwater.

Santa Ana Water Project Authority

Groundwater is a major source of supply for the region. There are about 40 groundwater basins in the watershed (depending on how they are defined and boundaries are drawn); many are inter-related. The region's Basin Plan outlines water quality objectives within these basins for nitrogen and TDS. The Basin Plan also requires that concentrations of TDS and nitrate be estimated every three years for each of the management zones to determine management actions. Groundwater overdraft, while minimal, is another issue faced by the region.

Southern Orange County Watershed Management Area

There are two primary groundwater basins within the region, San Juan Valley and San Mateo. A Groundwater Management and Facility Plan for the San Juan Valley Basin was prepared in 1994. Due to high TDS levels, desalters are used to increase the quality of groundwater in the region. Conjunctive use is being investigated as a means to increase storage, but limitations such as basin storage capacity, pumping capacity, recharge capacity, water quality, and institutional constraints exist. Currently, groundwater supplies roughly 4,000 af/yr., which is projected to increase to 10,504 af/yr. by 2035.

Upper Santa Clara River

There are two delineated groundwater basins within the region, including the Acton Valley Basin and the Santa Clara River Valley East Subbasin. During a normal year, groundwater supplies are between 71,900 af/yr. and 89,400 af/yr., but drop to between 60,400 af/yr. and 74,900 af/yr. during a one-year dry event. In 2003, a GWMP was adopted for the Santa Clara River Valley East Subbasin. The GWMP, through its four management objectives, complements and formalizes a number of existing water supply and water resource planning and management activities in the region. Most notably, the GWMP includes a basin-wide monitoring program, which provides inputs into basin yield assessments.

Upper Santa Margarita

Eight subbasins within the Temecula and Pauba groundwater basins provide a portion of the region with groundwater. The remaining groundwater used within the region is extracted from basins that are outside the regional boundary. Groundwater extractions within the region are under court oversight; however, the groundwater basins are not adjudicated. The amount of groundwater produced annually varies depending on rainfall, recharge, and the amount and location of pumping. In the past, up to 16,000 af/yr. of imported water has been used to recharge the Pauba Groundwater Basin.

Gateway Region

The majority of the region overlies the Central Subbasin (Central Basin) of the Coastal Plain of Los Angeles Groundwater Basin. There are a number of groundwater contamination issues, but efforts to improve quality are ongoing, including recent efforts to clean up a waste solvent and hydrocarbon plume under the cities of Whittier, Santa Fe Springs, and Norwalk. The IRWM plan

also identifies groundwater quality protection and improvement as an important area for project and program implementation.

Environmental Stewardship

Greater Los Angeles County

More than 90 percent of the coastal wetlands in the region have been eliminated. Due to this, aquatic habitat protection and restoration is a special priority, particularly in the North Santa Monica Subregion, as many areas within that subregion are used heavily for recreation. The region is also home to a number of threatened and endangered species, including the southernmost steelhead trout population in the state. There are patches of significant ecological areas within the GLAC region, including along the Malibu coastline and the Verdugo Mountains. The region is committed to environmental stewardship, with programs such as steelhead fishery restoration and creek barrier removal.

San Diego

There are a number of organizations involved in environmental stewardship work within the San Diego region, including environmental management of lagoons, habitat conservation, and land preservation. The San Diego Conservation Resources Network assists in coordinating efforts among the region's conservancy groups. IRWM plan objectives further this work by promoting projects that protect, restore, and maintain habitat and open space, and reduce sources of pollutants to protect and enhance environmental health.

Santa Ana Water Project Authority

Human development and activities in the watershed have greatly reduced the floodplain and associated habitats and affected the river's natural function and processes. One of the most challenging agents of deleterious change has been a multitude of non-native, invasive species. There are several existing environmental plans within the region including the Upper Santa Ana River Wash Land Management and Habitat Conservation Plan and the Western Riverside County Multiple Species Habitat Conservation Plan. The region is committed to environmental stewardship through preserving open space and recreational opportunities, promoting sustainable water solutions, and improving regional integration and coordination.

Southern Orange County Watershed Management Area

There are a number of environmental organizations involved throughout the region. Their work ranges from raising environmental awareness to reducing pollution in the region's watersheds and coastal waters. The region is committed to pursuing further environmental stewardship efforts including improving watersheds, floodplains, and instream functions, improving landscapes, and protecting habitat.

Upper Santa Clara River

The Santa Clara River is one of the last free-flowing natural riparian systems remaining in Southern California and provides breeding sites, traveling routes, and other essential resources for wildlife. A large and growing preservation and restoration movement is under way in the

region, which has local jurisdictions working in conjunction with habitat preservation advocacy groups. This movement strives to restore balance and improve water quality of the Santa Clara River. In addition, the Conceptual Area Protection Plan was developed as part of an extensive partnership effort with the goal of preserving essential open space and viable connections for wildlife movement between two core habitat areas: the San Gabriel Mountains and the Castaic Ranges.

Upper Santa Margarita

The richly diverse biological resources of the region are experiencing rapidly increasing developmental pressures in many areas. These resources include riparian corridors, wetlands, mountains, and desert that support rare vegetation communities and critical habitat for sensitive species. The region encompasses approximately the southern third of the area covered by the Western Riverside Multi-Species Habitat Conservation Plan. This plan creates an integrated approach to enable habitat conservation planning along with plans for development and transportation in this high growth region.

Gateway Region

The region is primarily a built-out urban environment with limited areas that are natural habitat or which would be defined as a significant ecological resource. This limited area is being managed and protected through the land use planning process under cities and county general plans and related planning efforts. The IRWM plan has made environmental habitat protection and improvement projects a priority for the region, stating that plan development looked for projects to improve the limited ecosystem currently in the region.

Climate Change

Climate change is already affecting the South Coast Hydrologic Region and will have significant impacts on water and other resources in the future. Changes in timing, amount, and type of precipitation and surface runoff affect the availability of local and imported water supplies. Extremes in precipitation are projected to increase with climate change.

Greater Los Angeles County

Extremes in precipitation were evident for the Los Angeles Civic Center when it recorded 4.4 inches of rain (30 percent normal) in water year 2002; but in water year 2005, it recorded 37.5 inches (254 percent of normal). During the 1983 El Niño Southern Oscillation (ENSO) event, sea levels were the highest ever recorded in Los Angeles, 12.7 inches above projected high tides. Furthermore, the March snowpack in the San Gabriel Mountains is expected to decline from a 0.7-inch level in 2010 to zero by the end of the century. With declining snowpacks and increasing sea levels, temperatures, precipitation extremes, flooding, and wildfire risks, the region is taking action to mitigate and adapt to a changing climate. The Los Angeles Regional Collaborative for Climate Action and Sustainability (LARC) was formed to serve as a network to share information, foster partnerships, and develop system-wide strategies to address climate change through sustainable communities. Since its formation, LARC has engaged the cities in Los Angeles County through workshops, meetings, and conferences and has contracted with University of California, Los Angeles in evaluating temperature and precipitation projections for the region. The LADWP has been evaluating the effects of climate change on the watersheds

supplying water to the City of Los Angeles. Los Angeles County of Public Works has initiated a basin study with the USBR to look at conserving stormwater as a supply. This study will involve downscaled climate change and hydrologic modeling. The GLAC IRWM region itself has initiated a climate change workgroup to assess the region's vulnerabilities as part of updating its IRWM plan.

San Diego

The San Diego Foundation completed a Regional Focus 2050 Study of San Diego County, which summarized current climate trends and projections, as well as mitigation and adaptation strategies. This was the first comprehensive regional assessment of climate change impacts to San Diego County. Projections for the region include average annual temperatures rising by 1.5 to 4.5 °F, sea levels increasing by 12 to 18 inches, and water demand increasing by 37 percent with supply decreasing by 18 percent. The International Council for Local Environmental Initiatives - Local Governments for Sustainability also prepared a sea level rise adaptation strategy for San Diego Bay. The San Diego IRWM region itself is finalizing a climate change planning study, which analyzes vulnerabilities and strategies for the region.

Santa Ana Water Project Authority

Western Riverside and southwestern San Bernardino counties are expected to see a 3.5- to 6-inch decline in precipitation, while the mountain areas, like Big Bear, could see a drop of 8 to 10 inches. The March snowpack in the Big Bear area is expected to decline from 2.5 inches to 1.4 inches in 2030 and to almost zero by 2090. With declining snowpacks and increasing sea levels, temperatures, precipitation extremes, flooding, and wildfire risks, the region is taking action to mitigate and adapt to a changing climate. The Santa Ana Watershed IRWM region, with the USBR, has finalized a basin study for its watershed region that assesses local climate change impacts. The basin study includes groundwater modeling and hydrology projections for the Santa Ana Watershed and provides information in updating the region's IRWM plan (One Water One Watershed 2.0).

Southern Orange County Watershed Management Area

With declining snowpacks and increasing sea levels, temperatures, precipitation extremes, flooding, and wildfire risks, the region is taking action to mitigate and adapt to a changing climate. The climate change concerns will be considered as part of updating the IRWM plan currently under way for the region.

Upper Santa Clara River

With declining snowpacks and increasing temperatures, precipitation extremes, flooding, and wildfire risks, the region is taking action to mitigate and adapt to a changing climate. The Upper Santa Clara River IRWM region has initiated work on determining regional vulnerabilities and adaptation strategies and incorporating climate change objectives into its IRWM planning processes. The region also participated with neighboring regions in a workshop to share knowledge of climate change, regional vulnerabilities, and strategies.

Upper Santa Margarita

With declining snowpacks and increasing temperatures, precipitation extremes, flooding, and wildfire risks, the region is taking action to mitigate and adapt to a changing climate. The Upper Santa Margarita Watershed IRWM region is updating its IRWM plan to include climate change objectives and performance measures and will be convening a work group to address climate change concerns.

Gateway Region

With declining snowpacks and increasing sea levels, temperatures, precipitation extremes, flooding, and wildfire risks, the region is taking action to mitigate and adapt to a changing climate.

Tribal Communities

Greater Los Angeles County

The GLAC region contacted the Native American Heritage Commission (NAHC) to determine if the region was home to any tribes or tribal interests. The response from the NAHC indicated that the region is not home to any current tribes or tribal lands. A letter explaining the IRWM plan update process was sent to parties on a list provided by NAHC of individuals with tribal interests in the region.

San Diego

San Diego County features the largest number of tribes and Reservations of any county in the United States. There are 18 federally recognized Tribal Nation Reservations and 17 tribal governments because the Barona and Viejas bands share joint-trust and administrative responsibility for the Capitan Grande Reservation. These Reservation lands, which are governed by Tribal Nations, total approximately 127,000 acres or 198 square miles. Two additional tribal governments do not have federally recognized lands: (1) the San Luis Rey Band of Luiseño Indians (though the band remains active in the San Diego region) and (2) the Mount Laguna Band of Luiseño Indians. As part of the 2013 IRWM plan development process, the RWMG contacted the 17 federally recognized tribal governments in San Diego County through their respective EPA director, water director, or other environmental liaison. Increased participation of tribal groups is a goal moving forward in the San Diego IRWM program. The La Jolla Band of Luiseno Indians served on the regional advisory committee (RAC) until the composition of the RAC membership was reorganized under the RAC charter. The RAC charter ensures the RAC will always reserve a seat for a tribal representative, though that seat is currently vacant.

Santa Ana Water Project Authority

The region's tribes believe that the past is the foundation of their future. The Soboba Band of Luiseno Indians, the San Manuel Band of Serrano Mission Indians, the Morongo Band of Mission Indians, and the Santa Rosa Band of Cahuilla Indians reside within the Santa Ana River watershed. There are also several non-federally recognized tribes in the watershed's boundary. Tribes face critical and serious water and related resources challenges, such as failing septic systems, isolation, language barriers, flood risk, and lack of funding and or resources.

Southern Orange County Watershed Management Area

The state and federally recognized Juaneno Band of Mission Indians are participants in the IRWM planning process. The IRWM group conducts ongoing outreach to tribal representatives throughout the region. The IRWM group solicits to local tribes as part of the public outreach process. The public workshops aim to engage tribal representatives in identifying the major issues and priorities of their lands, and how the priority projects may impact them.

Upper Santa Clara River

No tribes are identified within the region, and no further tribal information is available in the region's IRWM plan.

Upper Santa Margarita

The Anza, Cahuilla, Pechanga, and Ramona tribes reside in the region. The upper watershed region is working with the Cahuilla Tribe to develop a project to benefit the reservation and its residents. No further tribal information is available in the region's IRWM plan.

Gateway Region

The Gateway Water Management Authority (GWMA) contacted the NAHC and received a list of representatives for the Gabrieleno-Tongva Tribe. These contacts were notified of all meetings and activities and invited to participate as a stakeholder during and after the IRWM plan development. While there are tribal interests and residents in the region, there are no tribal reservations or facilities within the Gateway region.

Disadvantaged Communities

Greater Los Angeles County

DACs are located throughout the GLAC region. A DAC subcommittee provides direction and oversight to DAC outreach activities including the DAC Outreach Evaluation Program. The DAC subcommittee also facilitated and supported several efforts to help identify DAC representatives that could speak to DAC issues relative to water management. Additionally, the region created a DAC coordinator position to function as a liaison between the region and DACs and to participate in reviewing DAC projects for consideration for implementation funding. The GLAC region applied for and received specialized funding from DWR to develop a draft DAC outreach process and implement the process as a pilot program that could then be used to revise the process based on lessons learned.

San Diego

Based on the 2010 Census data, 8 of San Diego County's 18 incorporated cities are considered DACs or contain DACs. These cities are El Cajon, Imperial Beach, Oceanside, Carlsbad, Escondido, San Marcos, National City, and San Diego. Additionally, based on the same data, 24 of the 58 City of San Diego community planning areas (CPAs) and 18 of the 23 county CPAs are considered DACs or contain areas that qualify as DACs. In order to guide and assist outreach efforts in the county, the RWMG drafted the San Diego IRWM Public Outreach and Disadvantaged & Environmental Justice Community Involvement Plan. The RWMG has worked

directly with many organizations that are involved with addressing water-related issues of DACs and environmental justice communities within the region, including San Diego Coastkeeper, Environmental Health Coalition, Rural Community Assistance Corporation, Jacobs Center for Neighborhood Innovation, Groundwork San Diego-Chollas Creek, WildCoast, and others. Targeted outreach has focused on identifying DAC issues, needs and concerns as well as ensuring DAC and environmental justice representation on the regional advisory committee.

Santa Ana Water Project Authority

Approximately 69 percent of the cities/communities within the region are considered disadvantaged or contain DACs. In terms of population, approximately 26 percent (1.4 million residents) of the total watershed population is considered disadvantaged. Issues concerning DACs include water quality, groundwater quality, water infrastructure, and communication. In order to get the widest possible assessment of the concerns of the residents of minority and/or low-income communities in the region, a series of one-on-one interviews and community group meetings were held over a period of two months in 2008. The interviews were conducted in English and Spanish in the cities of Colton and Rialto in San Bernardino County, Lake Elsinore and Pedley in Riverside County, and Santa Ana in Orange County. OWOW 2.0, an update of OWOW 1.0, expands DAC outreach and also classifies DACs into regions.

Southern Orange County Watershed Management Area

DAC involvement is an important part of the South Orange County IRWMP process. The DACs of South Orange County are in the City of Laguna Woods. In order to develop a DAC Outreach Program that could be used countywide, Orange County Watersheds staff partnered with Latino Health Access, a local nonprofit organization established in 1993 to help meet the multiple health needs of the Latino community.

Upper Santa Clara River

None of the communities within the geographic areas including the county, the City of Santa Clarita, the valley, and the outlying areas of the watershed are DACs. While no DACs that met the strict State definition were identified, both the City of Santa Clarita and the county have identified areas where particular outreach efforts are merited due either to substandard infrastructure, substandard housing, or similar concerns.

Upper Santa Margarita

DACs in the region are concentrated in the western and eastern portions of the watershed in Murrieta, unincorporated Murrieta Hot Springs, and unincorporated areas of eastern Riverside County. The region's stakeholder process was designed to capture input of DACs through a series of public workshops. However, the region has a planning target for the regional objectives to increase stakeholder involvement and stewardship, including adding DAC representatives.

Gateway Region

Approximately 47 percent of the households within the larger Gateway region are considered disadvantaged. The region outlines a specific task to make sure that the water-related needs

of DACs in the region were considered and that mitigations are in place if projects hinder or adversely impact DACs.

Governance

Greater Los Angeles County

The GLAC region is led by the regional leadership committee (LC) and is supported by five subregional steering committees. The LC consists of 25 signatories of an MOU. Chaired by the Los Angeles County Flood Control District, the LC is responsible for making decisions on the scope and content of the IRWM plan. To assist in specific areas of IRWM plan development, five subregional steering committees were created. In addition, the LC has created both standing and ad-hoc subcommittees, including the legislative committee and the DAC subcommittee.

San Diego

The RWMG was formed through an MOU between the San Diego County Water Authority, the City of San Diego, and San Diego County. The RWMG is responsible for overseeing the planning and implementation of the IRWM plan and coordinating with other planning partners and local stakeholders.

Santa Ana Water Project Authority

The SAWPA, a joint powers authority, serves as the RWMG. It is composed of five major member agencies including the EMWD, IEUA, the OCWD, SBVMWD, and WMWD. With a “bottom-up” governmental approach, the RWMG is supported by 10 working groups, SAWPA administration and staff, and additional open public participation. A steering committee composed of elected officials and representatives from the three counties, municipalities, water districts, the private sector, and the environmental and regulatory communities, are tasked with approving the goals and objectives of the plan, strategic decision-making, project prioritization, and issuing recommendations.

Southern Orange County Watershed Management Area

In 2004, the South Orange County IRWM Group was formed to coordinate efforts and develop an IRWM plan. Members of the group include Orange County, cities within Orange County, and special districts. A cooperative agreement between all members of the IRWM planning group was established to provide a framework for planning and implementing the region’s IRWM plan. Through this agreement, an executive committee was formed with the purpose of overseeing plan implementation. A management committee was also formed to support the executive committee.

Upper Santa Clara River

The RWMG was initially established by an MOU in 2007 between seven parties and one ex-officio member. In 2011, a new MOU included all parties into the RWMG. RWMG members include CLWA, City of Santa Clarita, Los Angeles Flood Control District, and River and Mountains Conservancy. Subcommittees, formed on an as-needed basis, support targeted plan development and implementation efforts.

Upper Santa Margarita

The RWMG was formed under an MOU between the Riverside County Flood Control and Water Conservation District, the County of Riverside, and the Rancho California Water District. The Rancho California Water District serves as the lead agency and as the lead funding and contracting agency for regional projects.

Gateway Region

In 2007, the Gateway cities formed the GWMA under a joint powers authority to lead planning efforts for IRWM plan development and implementation. The GWMA, which serves as the RWMG for the region, is composed of 24 members representing cities and agencies within the Gateway region. There are several groups that support the efforts of the GWMA, including a technical consultant team, stakeholders, and the public.

Implementation of Resource Management Strategies

Volume 3, *Resource Management Strategies*, contains detailed information on the various strategies that can be used by water managers to meet their goals and objectives. A review of the resource management strategies addressed in the available IRWM plans is summarized in Table SC-27.

As alluded to in this report, water agencies in the South Coast Hydrologic Region have been implementing resource management strategies to satisfy the urban, agricultural, and environmental water demands within their respective service areas. Programs implemented to date include the utilization of recycled water, water supply transfers and exchanges, the transfer of water supplies, and the desalination of brackish groundwater.

Water supply transfers and exchanges have been important strategies utilized by water agencies to supplement their existing sources of supplies. Examples of these transfers and exchanges have been identified in other sections of this report.

Conjunctive Management and Groundwater Storage

Conjunctive management, or conjunctive use, refers to the coordinated and planned use and management of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives. Managing both resources together, rather than in isolation, allows water managers to use the advantages of both resources for maximum benefit.

Conjunctive use of surface water, groundwater, and recycled water has been utilized in the South Coast Hydrologic Region for decades. To meet water demands, groundwater pumping is supplemented by surface water from the Colorado River and the SWP. Surface water and recycled water are also used to replenish declining aquifers. Many agencies have erected systems of barriers to allow more efficient percolation of ephemeral runoff from surrounding mountains.

A DWR/ACWA survey was undertaken in 2011 and 2012 to inventory and assess conjunctive management projects in California. Box SC-2 is a summary of the inventory effort.

Table SC-27 Resource Management Strategies Addressed in IRWM Plans in the South Coast Hydrologic Region

Resource Management Strategy	Gateway Region	Greater Los Angeles	San Diego	SAWPA	SOCWMA	Upper Santa Clara River	Upper Santa Margarita
Agricultural Water Use Efficiency		X	X	X		X	X
Urban Water Use Efficiency	X	X	X	X	X	X	X
Flood Management	X	X	X	X	X	X	X
Conveyance – Delta		X	X	X			X
Conveyance – Regional/Local	X	X	X		X	X	X
System Reoperation	X	X	X		X	X	X
Water Transfers	X	X	X	X	X	X	X
Conjunctive Management and Groundwater	X	X	X	X	X	X	X
Desalination - Brackish Water and Seawater	X	X	X	X	X	X	X
Precipitation Enhancement						X	
Recycled Municipal Water	X	X	X	X	X	X	X
Surface Storage – CALFED		X	X			X	
Surface Storage – Regional/Local	X	X	X		X	X	X
Drinking Water Treatment and Distribution	X	X	X	X	X	X	X
Groundwater and Aquifer Remediation		X	X	X	X	X	
Match Water Quality to Use		X	X	X	X	X	X
Pollution Prevention	X	X	X	X	X	X	X
Salt and Salinity Management		X	X	X	X	X	X
Urban Stormwater Runoff Management		X	X	X	X	X	X
Agricultural Lands Stewardship			X	X		X	X

Resource Management Strategy	Gateway Region	Greater Los Angeles	San Diego	SAWPA	SOCWMA	Upper Santa Clara River	Upper Santa Margarita
Ecosystem Restoration	X	X	X	X	X	X	X
Forest Management		X		X		X	X
Land Use Planning and Management	X	X	X	X	X	X	X
Recharge Area Protection	X	X	X	X	X	X	X
Watershed Management	X	X	X	X	X	X	X
Economic Incentives - Loans, Grants, and Water Pricing	X	X	X	X	X	X	X
Water-Dependent Recreation	X	X	X	X	X	X	X
Notes:							
SAWPA = Santa Ana Watershed Project Authority, SOCWMA = South Orange County Watershed Management Area							
Information for the Watersheds Coalition of Ventura County IRWM plan was not available for Update 2013.							

The DWR/ACWA survey identified 89 agencies or programs that operate a conjunctive management or groundwater recharge program in California, of which 32 are located in the South Coast Hydrologic Region. Eighteen of the 32 agencies responded to the survey. These agencies have implemented various conjunctive management programs to optimize the use of groundwater and surface water resources.

As shown in Figure SC-22, a rather obvious goal — being part of a conjunctive management program — was identified by more than 80 percent of the survey participants as being the primary goal and objective for their programs. Additional objectives such as overdraft correction, salinity intrusion prevention, and water quality protection were identified by about a quarter or more of the survey respondents. Most of the survey respondents included multiple goals and objectives for their programs.

Survey participants were asked to rank a list of seven potential constraints encountered when developing a conjunctive management or water banking program — with a “1” for minimal constraint, a “3” for moderate constraint, or a “5” for significant constraint. As shown in Figure SC-23, limited aquifer storage, cost, institutional constraints, political constraints, and water quality issues were indicated to be the greatest constraints, with average rankings from 3.0 to 3.9 (moderate constraint). Surprisingly, legal constraint, with a score of 2.0, was indicated as low to moderate constraint. This is likely owing to the relatively high number of adjudicated groundwater basins in the region.

Available details about some of the conjunctive management projects in the region are provided below. Additional information regarding conjunctive management projects, survey results, and

Box SC-2 Statewide Conjunctive Management Inventory Effort in California

The effort to inventory and assess conjunctive management projects in California was conducted through literature research, personal communication, and documented summary of the conjunctive management projects. The information obtained was validated through a joint survey by the California Department of Water Resources (DWR) and the Association of California Water Agencies (ACWA) survey. The survey requested the following conjunctive use program information:

1. Location of conjunctive use project;
2. Year project was developed;
3. Capital cost to develop the project;
4. Annual operating cost of the project;
5. Administrator/operator of the project; and
6. Capacity of the project in units of acre-feet.

To build on the DWR/ACWA survey, DWR staff contacted by telephone and e-mail the entities identified to gather the following additional information:

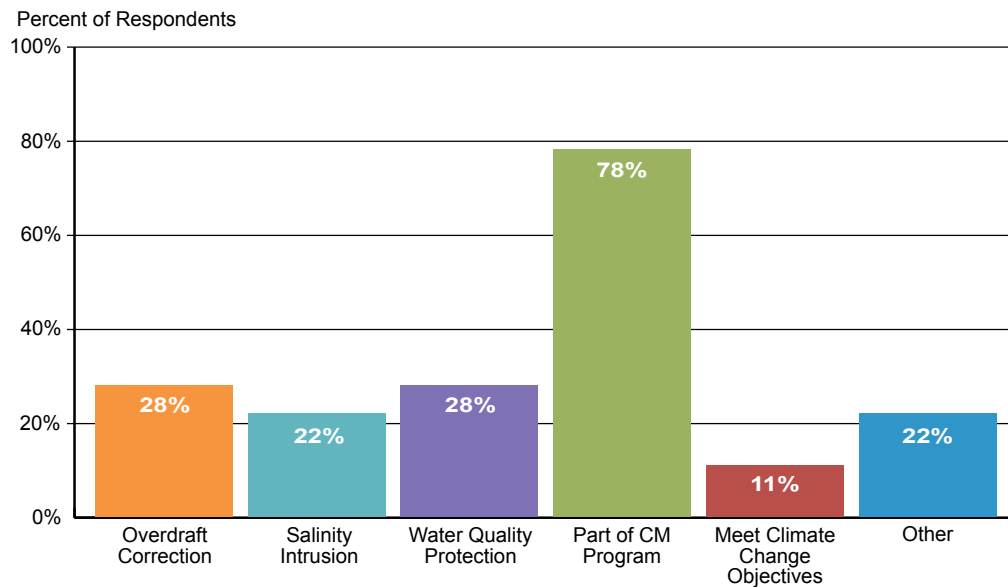
7. Source of water received;
8. Put and take capacity of the groundwater bank or conjunctive use project;
9. Type of groundwater bank or conjunctive use project;
10. Program goals and objectives; and
11. Constraints on development of conjunctive management or groundwater banking (recharge) program.

Statewide, a total of 89 conjunctive management and groundwater recharge programs were identified. Conjunctive management and groundwater recharge programs that are in the planning and feasibility stage are not included in the inventory.

a statewide map of conjunctive management projects, as of July 2012, is available online from Update 2013, Volume 4, *Reference Guide*, the article “California’s Groundwater Update 2013.”

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 conjunction with the LACFCD, implemented several stormwater capture projects with the goal of increasing long-term groundwater recharge by a minimum 20 taf/yr. 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).

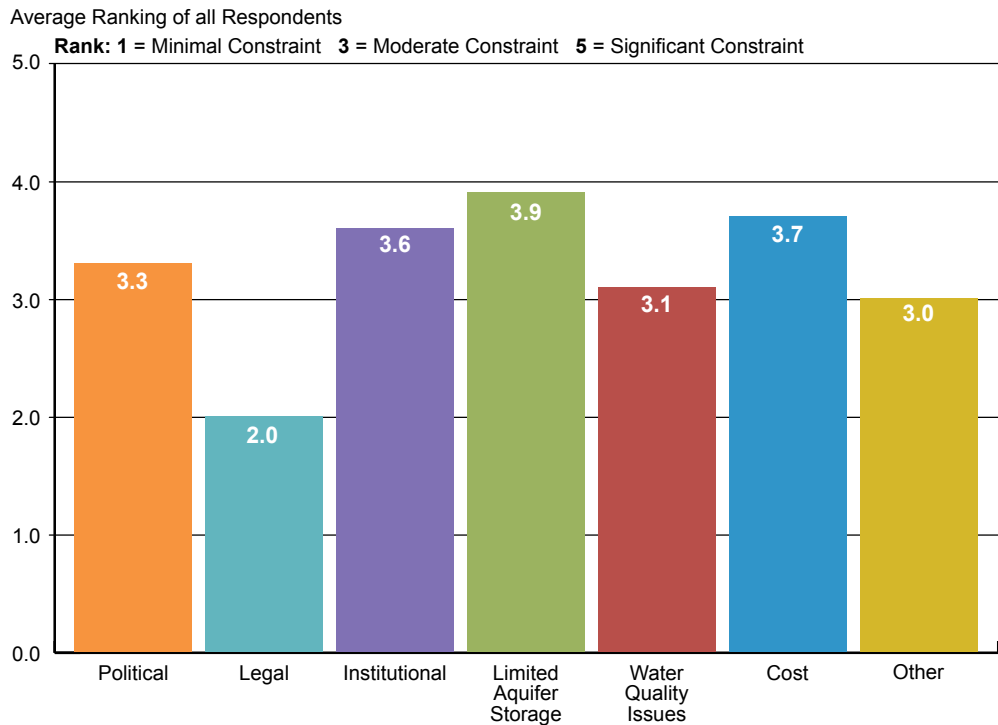
MWD has agreements with more than a dozen water agencies located in the South Coast and Tulare Lake hydrologic regions to operate conjunctive management programs. In the South Coast region, the conjunctive-use project operators include about 30 public and private entities that utilize a variety of methods to conjunctively manage surface water and groundwater supplies. MWD does not directly store or extract water, but has contractual rights to request groundwater recharge and extraction. The conjunctive use programs were developed between 2002 and 2006, and each program has a 25-year term. The goals and objectives of MWD and its member

Figure SC-22 Conjunctive Management Program Goals and Objectives

agencies include conjunctively using water resources to improve water supply reliability and sustainability, correcting overdraft where applicable, and meeting climate change challenges. The annual recharge and extraction by MWD member agencies vary and are dependent on such factors as surface water availability and overall water demand. In addition to MWD agreements, some member agencies independently operate conjunctive use projects and recharge additional water to the basins they manage. According to MWD, the estimated annual recharge in its service area is about 750 taf of active groundwater recharge. The sources of water used for recharge are stormwater, recycled water, the SWP, and the Colorado River. The operating cost of the MWD-member agency conjunctive-use programs range between \$55 and \$147 per af. The constraints of the conjunctive use programs identified by MWD include political and institutional constraints, impacted water quality, limited recharge capacities, and complex geology.

The Water Replenishment District of Southern California (WRD) operates conjunctive use programs in the West Coast and the Central groundwater subbasins. The WRD conjunctive use programs (<http://www.wrd.org/index.php>) recharge the aquifers underlying their service area using direct percolation, in-lieu recharge, and direct injection. The WRD works cooperatively with the LACFCD, which physically applies the water resources obtained by the WRD. The WRD conjunctive use program annually recharges about 255 taf of water and withdraws about 245 taf of water. The water sources used by the WRD include the SWP, the Colorado River, recycled water, and local surface water. The objectives of the WRD conjunctive use programs are overdraft correction, prevention of seawater and salinity intrusion, and protection of groundwater quality. The major constraints of the WRD conjunctive use programs include political, institutional, legal, and infrastructural constraints.

Figure SC-23 Constraints Toward Development of Conjunctive Management and Water Banking Programs



Note: Based on 14 of 32 Agencies/Projects Reporting Data

Groundwater extraction in the Santa Ana planning area is supported by incidental and artificial recharge of recycled water, imported water, and stormwater supplies. On average, about 80 taf/yr. of imported supplies from MWD are recharged each year to support groundwater production.

The Coastal Plain of Orange County Groundwater Basin, managed by the OCWD, provides most 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 area, with numerous spreading grounds developed to recharge groundwater basins. These conjunctive management programs use water from the SWP and recycled water to replenish about 16.5 taf of water annually into the aquifers underlying their service area by utilizing direct percolation and in-lieu recharge. In addition, the OCWD collaborates with the Orange County Sanitation District to operate the GWRS, the world’s largest advanced water purification system for potable reuse. The GWRS (<http://www.gwrssystem.com/home.html>) became operational in 2008 and purifies treated wastewater (70 taf/yr.), producing high-quality water that exceeds State and federal drinking water standards. The treated water is injected into a seawater intrusion barrier and is pumped to recharge basins near the SAR; the water then percolates into the groundwater basin and replenishes the aquifer system.

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. The Fallbrook Public Utility District’s Santa Margarita Conjunctive Use Project, construction of which is now under way, will conjunctively manage a Santa Margarita River groundwater basin to provide

approximately 6 taf of new local supply annually. The local groundwater basin in and around the city of Temecula benefits from recharge of stormwater runoff stored in Vail Lake, which is operated by the Rancho California Water District. Desalination of poor-quality groundwater continues with a desalting facility operated by the City of San Juan Capistrano.

Additional conjunctive use programs under way include IEUA Cyclic Storage Agreement (Chino Basin) and Three Valley Municipal Water District Cyclic Storage Agreement (main San Gabriel Valley Basin).

Additional information regarding conjunctive management in California, as well as discussion on associated benefits, costs, and issues, can be found online in Update 2013, Volume 3, Chapter 9, “Conjunctive Management and Groundwater.”

Groundwater Desalination

Desalination of brackish groundwater supplies continue in the South Coast Hydrologic Region. This process permits water agencies to utilize local water resources rather than rely on more costly imported supplies. In the Santa Clara River planning area, the City of Oxnard’s brackish groundwater desalter has been operational since 2008. In the Metropolitan Los Angeles planning area, the 3-mgd Goldsworthy Desalter, owned and operated by the WRD, provides brackish groundwater desalination for the dual purposes of remediation of a saline plume located within the West Coast Subbasin and provision of a reliable local water source to Torrance.

This resource management strategy is heavily used in the Santa Ana area. The Arlington desalting facility is located near the City of Riverside and is owned and operated by the WMWD. The Chino Desalter Authority owns and operates the Chino I and II facilities. The Santa Ana Watershed Planning Authority assumed a key role in the construction of these facilities. The Arlington facility currently treats a little less than 6 taf of brackish groundwater annually, with a capacity to produce 7.8 taf. The Chino facilities produce between 24 and 26 taf annually, operating at maximum capacity. A third facility for Chino will be operational in the near future and would produce an additional 13 taf of water supply annually. The EMWD operates the Menifee and Perris I desalters. A second facility in the Perris Valley will be operational by 2015. With the third facility, EMWD estimates that the desalters would provide 7.5 taf annually with a capacity of 10.7 taf/yr.

Other desalting facilities in the Santa Ana area include the Temescal facility, owned by the City of Corona, and the Irvine Desalter Project, a joint groundwater quality restoration project by IRWD and OCWD. The Temescal facility yields about 17 taf/yr.; the Irvine Desalter Project yields 0.4 af/yr. of non-potable water supplies and 5 taf/yr. of potable water supplies; and the Tustin Seventeenth Street Desalter, which is owned and operated by the City of Tustin, yields approximately 2.1 af/yr.

In the San Diego planning area, there are the City of Oceanside’s Mission Basin Desalter (6.37 mgd) and Sweetwater Authority’s Reynolds Groundwater Desalination Facility (4 mgd). In addition, the City of San Juan Capistrano owns and operates the Groundwater Recovery Plant (5 mgd), which will be utilized in the treatment of groundwater supplies contaminated by MTBE.

Recycled Water

The use of recycled water supplies continues to increase in the South Coast region. A number of factors are contributing to this increase. They include upgrades of existing, and construction of, new wastewater treatment facilities with the necessary equipment to treat and disinfect the supplies, better infrastructure (pipelines and reservoirs) to deliver the supplies to customers, and the implementation of programs to promote the use of these supplies.

Recycled water in the Santa Clara River planning area will be an important water supply source in the near future. Recycled water supplies are being delivered by the Camrosa Water District; Camarillo Sanitation District; Triunfo Sanitation District, in conjunction with the Las Virgenes Municipal Water District; Ventura County Waterworks District No. 1; Santa Clarita Sanitation District, in conjunction with the CLWA; and Simi Valley Water Quality Control Plant. The City of Oxnard expects to be delivering recycled water from an advanced water treatment facility currently under construction as part of its GREAT Program. The supply is being utilized for landscape irrigation, industrial uses, and for the irrigation of non-edible commercial crops.

In the Metropolitan Los Angeles area, the use of recycled water supplies continues to increase throughout the area. For the City of Los Angeles, recycled water projects include irrigation of landscaping at Griffith Park, the Japanese Garden, Wildlife Preserve, and the Lake Balboa facilities in the Sepulveda Basin Recreation Area in the San Fernando Valley; and the Westside Water Recycling Project. The latter project utilizes recycled water supplies from the Edward C. Little Water Recycling Facility, which is operated by the West Basin Municipal Water District (WBMWD). In fiscal year 2009-2010, almost 32 taf of recycled water supplies were delivered to users in Los Angeles. The Edward Little Water Recycling Facility produced a little more 30 taf in fiscal year 2009-2010 for customers inside and outside of its service area. For municipal and industrial customers within its service, which includes the Chevron Refinery, WBMWD delivered 15.5 taf; it also delivered about 8 taf for the West Coast Basin Seawater Barrier. In a multi-party agreement, WBMWD has agreed to recharge the barrier exclusively with recycled water supplies from its facility. The facility will be undergoing expansion in the near future for a fifth time (Phase V expansion).

Outside of the City of Los Angeles, the increase in recycled water use is the result of a partnership between the Sanitation Districts of Los Angeles County, water and governmental agencies, and local businesses. In fiscal year 2011-2012, recycled water deliveries for groundwater recharge, landscape irrigation, industrial uses (cooling towers, dust control), and agriculture were almost 74 taf.

In the Santa Ana area, the largest recycled water project is the GWRS in Orange County. The facility is undergoing expansion, but the Orange County Coastal Plain Groundwater Basin is being recharged annually with 72 taf of recycled water supplies. As discussed earlier, agencies with successful recycled water programs include the IEUA, EMWD, and IRWD.

Several wastewater reclamation facilities are in operation in the San Diego area. In 2010, recycled water uses totaled about 28 taf. By 2035, those uses are expected to increase to almost 50 taf.

In the Temecula Valley of Riverside County, the Santa Rosa Water Reclamation Facility and the Temecula Valley Regional Water Reclamation Facility treat the wastewater flows to Title 22

requirements. For the Rancho California Water District, recycled water use in its service area was about 4.4 taf in 2010. Potential uses could increase that to 10.8 taf by 2035.

Water Use Efficiency

Over 100 wholesale and retail urban water agencies in the South Coast region are signatories to the MOU Regarding Urban Water Conservation and members of the California Urban Water Conservation Council. More importantly, these agencies are engaged in the implementation of the programs and policies collectively known as the urban BMPs. As a management tool, the BMPs are part of the overall strategy to address short-term issues, such as droughts, and long-term problems, such as meeting future demands with less than reliable supplies. In its 2010 Regional Urban Water Management Plan, MWD restated its goal of achieving a 20 percent per capita water use reduction for its service area through regional water conservation and local resources programs.

A variety of water-use efficiency programs are being implemented in the region. These include rebates and direct installation programs for high-efficiency toilets for residential and commercial customers, residential and commercial audit/surveys, and irrigation system audits for large landscape areas. Some are handled quite adequately by individual retail water agencies, while the daily operations of others are handled by regional wholesale agencies.

In an effort to assist its member agencies with program implementation, MWD continues several regional programs, for example the “SoCal Water\$mart ” and “Save Water – Save a Buck.” These programs provide partial rebates for the purchase of water-efficient appliances, fixtures, and equipment for residential, commercial, and industrial customers within MWD’s service area. There is also some flexibility in how the programs can be utilized. WMWD and LADWP use SoCal Water\$mart, to assist their customers on the purchases of high-efficiency clothes washing machines. LADWP uses that same program to assist with rebates on the purchase of rotating nozzles, weather-based irrigation controllers, and for the implementation of a program that includes the removal of turf grass and installation of climate-appropriate plants and other kinds of landscaping materials. The SoCal Water\$mart program helps LADWP commercial and multi-family customers with the purchase of water-efficient equipment and interior fixtures.

Examples of water-use efficiency programs being implemented locally are LADWP’s California Friendly® Landscape Incentive Program and Technical Assistance program, which offers financial incentives for custom water-saving projects and for its commercial, industrial, and institutional customers.

Many agencies in the South Coast region have implemented water supply conserving rate structures, such as tiered or seasonal pricing. An example of this pricing strategy is from the IRWD. It began implementation of an allocation-based rate structure in 1991. Customized monthly water-use bases are developed for each customer; adjustments are based on landscape and weather factors. Customers who exceed their allocations pay higher rates for their metered water supplies. Since its initiation, IRWD has noted reductions in water uses for landscape and residential customers.

In addition to the treatment and deliver of water supplies, wholesale and retail water agencies are often the main source of information and news about water resources in the state and locally. This fact has prompted many wholesale and retail water agencies to develop water education programs

to serve municipal and industrial customers and schools within their respective service areas. The dissemination of information is handled in a variety of different ways, from printed literature (technical reports to general information brochures), electronic media (DVDs), and utilization of the Internet (Web sites with information and downloadable material). Some programs feature speaker bureaus (staff that makes presentations at public events and school activities) and tours of water facilities. During emergencies, those staff members provide information and updates to the appropriate local television, radio, newspaper, and Internet services. In addition to the array of programs targeting its municipal and industrial customers, the City of San Diego interacts with their customers by running annual water conservation film and poster contests.

Pollution Prevention

Beneficial uses form the cornerstone of water quality protection under the Southern California RWQCBs basin plans. Once beneficial uses are designated, appropriate water quality objectives can be established, and programs that maintain or enhance water quality can be implemented to ensure the protection of beneficial uses. The designated beneficial uses, together with water quality objectives (referred to as “criteria” in federal regulations), form water quality standards. Such standards are mandated for all water bodies within the state under the CWC. In addition, the federal CWA mandates standards for all surface waters.

In many cases, protecting the quality of groundwater or surface water (through protection of beneficial uses) results in protection of a local water supply that can help minimize the need for use of imported water. RWQCBs within the South Coast Hydrologic Region implement the resource management strategies described below, either regularly through a variety of ongoing programs or through specific activities that occurred from 2009 through 2013.

The RWQCBs implement a wide variety of pollution prevention activities, and statewide policies have been established to address both point and non-point sources of pollution. Many of these activities overlap with other resource management strategies described below. The RWQCBs issue either individual or general NPDES permits to prevent pollution from point source discharges. Development of TMDLs for impaired water bodies, the incorporation of waste load and load allocations into permits, and the general enforcement of regulations all aid in pollution prevention, as well. Additionally, regulation of hydromodification, or changes from the natural state of streamflows and channels, through the CWA Section 401 water-quality certification program, aids in pollution prevention and protection of wetlands.

The Los Angeles RWQCB is also addressing non-point source pollution, such as runoff from irrigated agriculture, impacts from on-site wastewater treatment systems, pollution associated with marinas, and runoff from livestock and horse enclosures. In such cases, the RWQCB has the authority to protect water quality through WDRs, waivers of WDRs, or prohibitions.

RWQCBs may issue both categorical and individual waivers. In the case of categorical waivers, the RWQCB must approve and issue categorical waiver criteria either by adopting a specific resolution or a basin plan amendment. Once a categorical waiver is approved by the RWQCB, RWQCB staff may be delegated the responsibility of reviewing and approving categorical waivers. Four categorical waivers have been approved in the region, as set forth in Resolution No. 53-5 (adopted in 1953). These are for septic tanks, swimming pool discharges, on-site-drilling mud discharges from single oil wells, and discharges from private impoundments or

lakes. Individual waivers are typically for construction or development projects that are short-term or one-time events.

The CWA Sections 303(d) and 305(b) contain backstop provisions designed to ensure that all State water quality standards are met, including in water bodies where existing permit effluent limitations and other water quality programs are not stringent enough to ensure achievement of water quality standards. The CWA Section 305(b) requires each state to assess the state's water resources every other year. These water quality assessments are reported to the EPA and are used to identify and list impaired waters, as required by Section 303(d). The resulting list is referred to as the 303(d) list. The State of California's 303(d) list is prepared per the Water Quality Control Policy for Developing California's CWA Section 303(d) List. The 305(b) report and the 303(d) list are combined into the California 303(d)/305(b) Integrated Report.

The CWA also requires states to develop and implement TMDLs for the impaired water bodies identified on the 303(d) list. A TMDL specifies the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and allocates pollutant loadings to point and non-point sources. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis. TMDLs may be developed to address water quality, sediment quality, fish tissue, or other impairments of beneficial uses.

States must develop plans to implement the TMDLs (Code of Federal Regulations, Title 40, Part 130.6). The RWQCBs hold regulatory authority for many of the instruments used to implement the TMDLs, such as the NPDES permits and WDRs. The Los Angeles RWQCB has adopted or reconsidered 10 TMDLs since 2009. A total of 43 TMDLs are in effect within the Los Angeles region (including those established by the EPA).

Ecosystem Restoration

The RWQCB continues its involvement in the Southern California Wetlands Recovery Project (WRP), which is a partnership of public agencies working cooperatively to acquire, restore, and enhance coastal wetlands and watersheds between Point Conception and the border with Mexico. Using a non-regulatory approach and an ecosystem perspective, the WRP works to identify wetland acquisition and restoration priorities, prepare plans for these priority sites, pool funds to undertake these projects, implement priority plans, and oversee post-project maintenance and monitoring. When compared with estimated historical acreages, Los Angeles County has lost 93 percent of its wetlands, whereas Ventura County has lost 58 percent of its wetlands. Currently, the WRP funds wetlands projects that involve planning, restoration, or acquisition. Some of this region's wetlands that are given a high priority for funding include Los Cerritos Wetlands, Malibu Lagoon, Ormond Beach Wetlands, and the Ventura River estuary.

Several major recent activities of the WRP have direct relevance to wetlands protection efforts. The WRP participated in development of a method, known as the California Rapid Assessment Method, to assess the condition of wetlands. This method is in the process of being incorporated into monitoring for various regulatory programs, such as 401 certifications. It will also serve as a major component of the Integrated Wetlands Regional Assessment Program (IWRAP), which is under development by the WRP in coordination with similar efforts elsewhere in the state. Other ongoing activities include the mapping of existing wetland and riparian acreages to serve as a baseline in the IWRAP and development of a Wetlands Tracker database to aid in tracking gains and losses of wetlands acres across both regulatory and non-regulatory programs.

Salt and Salinity Management

Recognizing that increased recycled water use could result in increased salt and nutrient loading to local groundwater basins, the SWRCB Recycled Water Policy requires every groundwater basin/subbasin in the state to have a salt and nutrient management plan. The intent of this requirement is to make certain that salts and nutrients from all sources are managed on a basin-wide or watershed-wide basis, in a manner that ensures the attainment of water quality objectives and protection of beneficial uses.

Implementation plans developed for those groundwater basins where water quality objectives for salts or nutrients are being exceeded, or are threatening to be exceeded, are expected to be adopted by the RWQCBs as basin plan amendments.

Urban Runoff Management

The Los Angeles region manages municipal stormwater and urban runoff through issuance of NPDES permits for discharges from municipal separate storm sewer systems (MS4s), also called storm drain systems. There are currently three MS4 permits in effect within the Los Angeles region: for discharges from MS4s within the County of Los Angeles, and the incorporated cities therein, except the City of Long Beach; for discharges from MS4s within the City of Long Beach; and for discharges from MS4s within the Ventura County Watershed Protection District, County of Ventura, and the incorporated cities therein.

An important part of the municipal permits (Los Angeles County and City of Long Beach) are the Standard Urban Stormwater Mitigation Plans (SUSMPs) and numerical design standards for BMPs. The SUSMPs are designed to ensure that stormwater pollution is addressed in one of the most effective ways possible (i.e., by incorporating BMPs in the design phase of new development and redevelopment). It provides for numerical design standards to ensure that stormwater runoff is managed for water quality and quantity concerns. The purpose of the SUSMP requirements is to minimize, to the maximum extent practicable, the discharge of pollutants of concern from new development and redevelopment. The numerical design standard is that post-construction treatment BMPs be designed to mitigate (infiltrate or treat) stormwater runoff from the first three-quarters of an inch of rainfall, prior to its discharge to a stormwater conveyance system.

Watershed Management

The watershed management resource management strategy is the process of creating and implementing plans, programs, projects, and activities to restore, sustain, and enhance watershed functions. The Los Angeles RWQCB has a watershed coordinator staff person who has participated since 1996 in development and implementation of numerous plans, programs, projects, and activities led by local stakeholder organizations and agencies. The watershed coordinator also reports on watershed health through State of the Watershed reports and develops a document (Watershed Management Initiative Chapter) that explains the RWQCB's implementation of its regulatory programs on a watershed-scale, where appropriate. Watershed-based monitoring of the receiving waters is now required in permits for publicly owned treatment works within the Los Angeles and San Gabriel river watersheds, and watershed-based monitoring programs are being developed in the Malibu Creek and Santa Clara River watersheds. These programs are intended to coordinate with monitoring conducted by other entities so as to answer important watershed health questions while making more efficient use of limited public funds.

Stormwater Capture

LADWP is preparing a stormwater capture master plan that will investigate and create potential strategies for implementation of stormwater and watershed management programs and projects in the City of Los Angeles. The master plan will be used to guide decision-makers in the city when making decisions affecting how the city meets its centralized and distributed stormwater capture goals. The master plan will include evaluation of existing stormwater capture facilities and projects, quantify the maximum stormwater capture potential, develop feasible stormwater capture alternatives (e.g., projects, programs, potential policies), and provide potential strategies to increase stormwater capture. The master plan will also evaluate the multi-beneficial aspects of increasing stormwater capture, including potential open-space alternatives; improved downstream water quality; and peak flow attenuation in downstream channels, creeks, and streams such as the Los Angeles River.

Reduce Water Demand

Under OWOW, the SAWPA IRWM plan, a water-use efficiency pillar or workgroup of stakeholders was established to define the existing conditions, challenges and obstacles, goals and objectives, and strategies to improve water use efficiency throughout the watershed. A goal of reducing water use by 20 percent by 2020 was established for the watershed. This will be achieved primarily through compliance with SB X7-7, passed as part of the State Comprehensive Water Package in November 2009.

Operational Efficiency and Transfers

Under the most recent update to the OWOW plan, referred to as OWOW 2.0, a new pillar workgroup was established and described as the Operational Efficiency and Water Transfer Pillar. Under this pillar, SWOT (Strength, Weaknesses, Opportunities, and Threats) evaluations will be conducted in cooperation with the major water supply agencies in the watershed. From this analysis, areas of water resource strengths will be matched with areas of opportunities across the watershed to explore internal water transfers in order to optimize water availability and reliability.

Increase Water Supply

Under the adopted OWOW plan and the current OWOW 2.0 Plan, all aspects of increasing water supply have been examined and considered. A defined goal of drought-proofed watershed by the year 2030 has been established. A pillar group composed of multiple water, wastewater, and groundwater management professionals has collaborated under the Water Resource Optimization Pillar to define specific implementation measures to assure ensuring sufficient water supplies to meet future demands. This pillar has conducted extensive investigation of the conjunctive management and groundwater storage availability, proposed increased desalination, defined plans for expanded municipal water recycling, and recommended more surface storage in the region and locally to meet peak demands. Goals for these strategies include storing sufficient water to account for half of the watershed water demand for three years, reusing all SAR flow at least once, capturing and recharging 80 percent of rainfall, and assuring adequate water supply and safe wastewater treatment and disposal.

Improve Water Quality

Under the adopted OWOW plan, a pillar workgroup, composed of stakeholders across in the watershed with expertise in water quality, prepared a detailed evaluation of the current conditions, the SWOT, and the strategies necessary to achieve long-term goals. For the Santa Ana watershed, the OWOW plan defined goals of meeting all water quality standards and removing salt from the watershed to improve salt balance. SAWPA has been a leader in working collaboratively on multiple projects to improve drinking water, cleaning up tainted or impaired groundwater basins, assuring beneficial uses are met, implement source control, working with the MS4 stormwater permittees in urban runoff management programs, and conducting one of the most progressive salinity management programs in the state with the construction of a 93-mile brine disposal pipeline to the ocean.

Practice Resources Stewardship

In the Santa Ana planning area, under OWOW, the Water and Land Use Planning Pillar was created to address the need for better coordination among the community planning field and the water planning field to assure mutual benefits. Under OWOW 2.0, a new pillar was formed, described as the Natural Resources Stewardship pillar, which has outlined some very progressive strategies to improve resource stewardship. One of these programs conducted by SAWPA is called Forest First. Under an MOU with the U.S. Forest Service, SAWPA and USFS will collaboratively work on projects in the watershed forest headwaters, including (1) Hazardous Fuels Reduction; (2) Meadow Restoration; (3) Chaparral Restoration on the Front Country above Recharge Areas; (4) Run-Off Reduction on Roads that Cross Forest Lands; and (5) Removal of Invasive Species and Restoration of Native Vegetation. Watershed management has been a longstanding practice and mission of SAWPA. For the Santa Ana planning area, the SAR watershed covers the same area. The OWOW plan reflects a regional, integrated water resource plan as well as the watershed plan.

Improve Flood Management

Under OWOW Plan 1.0, a pillar workgroup was established that specifically addresses flood risk management. The pillar workgroup, consisting primarily of flood control districts and other interested parties who worked together to define current conditions, define SWOT and establish strategies to meet the OWOW mission and goals. The goal defined for flood risk management by the Year 2030 was to meet California FloodSAFE goals and construct soft-bottom flood systems.

The California FloodSAFE program is a collaborative statewide effort designed to accomplish five broad goals:

- Reduce the chance of flooding.
- Reduce the consequences of flooding.
- Sustain economic growth.
- Protect and enhance ecosystems.
- Promote sustainability.

FloodSAFE includes four major categories:

- Improve emergency response.
- Improve flood management systems.

- Inform and assist public.
- Improve operations and maintenance.

All FloodSAFE program actions are designed to accomplish specific objectives that help satisfy the five goals.

Climate Change

For over two decades, the State and federal governments have been preparing for climate change effects on natural and built systems with a strong emphasis on water supply. Climate change is already affecting many resource sectors in California, including public health, water, agriculture, biodiversity, and transportation and energy infrastructure (U.S. Global Change Research Program 2009; California Natural Resources Agency 2009). Climate model simulations, based on the Intergovernmental Panel on Climate Change’s 21st century scenarios, project increasing temperatures in California, with greater increases in the summer (Intergovernmental Panel on Climate Change 2013). Projected changes in annual precipitation patterns in California will result in changes to surface runoff timing, volume, and type (Cayan et al. 2008). Recently developed computer downscaling techniques (model simulations that refine computer projections to a scale smaller than global models) indicate that California flood risks from warm-wet, atmospheric river-type storms may increase beyond those that we have known historically, mostly in the form of occasional more-extreme-than-historical storm seasons (Dettinger 2011).

Currently, enough data exist to warrant the development of contingency plans, mitigation (i.e., reduction) of GHG emissions, and incorporation of adaptation strategies (i.e., methodologies and infrastructure improvements that benefit the region at present and into the future). While the State of California is taking aggressive action to mitigate climate change through reducing emissions from GHGs and implementing other measures (California Air Resources Board 2008, 2013), global impacts from carbon dioxide and other GHGs that are already in the atmosphere will continue to affect climate through the rest of the century (Intergovernmental Panel on Climate Change 2013).

Resilience to an uncertain future can be achieved by implementing adaptation measures sooner rather than later. Because of the economic, geographical, and biological diversity of California, vulnerabilities and risks from current and future anticipated changes are best assessed on a regional basis. Many resources are available to assist water managers and others in evaluating their region-specific vulnerabilities and identifying appropriate adaptive actions (U.S. Environmental Protection Agency and California Department of Water Resources 2011; California Emergency Management Agency and California Natural Resources Agency 2012a). The most comprehensive report to date on climate change observations, impacts, and projections for the southwestern United States, including California, is the *Assessment of Climate Change in the Southwest United States* (Garfin et al. 2013).

Observations

The region’s observed temperature and precipitation vary greatly owing to complex topography, geography, and relation to the Pacific Ocean. Regionally specific air temperature trends for the past century are available from the Western Regional Climate Center (2013). The WRCC serves as a repository of historical climate data and information. Air temperature records for the past

century are summarized by the WRCC into distinct climate regions (Abatzoglou et al. 2009), which are geographically different from hydrologic regions. DWR's hydrologic regions do not correspond directly to WRCC's climate regions. A particular hydrologic region may overlap more than one climate region and thus have different climate trends in different areas. For the purposes of this regional report, however, climate trends within climate regions are considered to be relevant trends for respective portions of this hydrologic region (Figure SC-24).

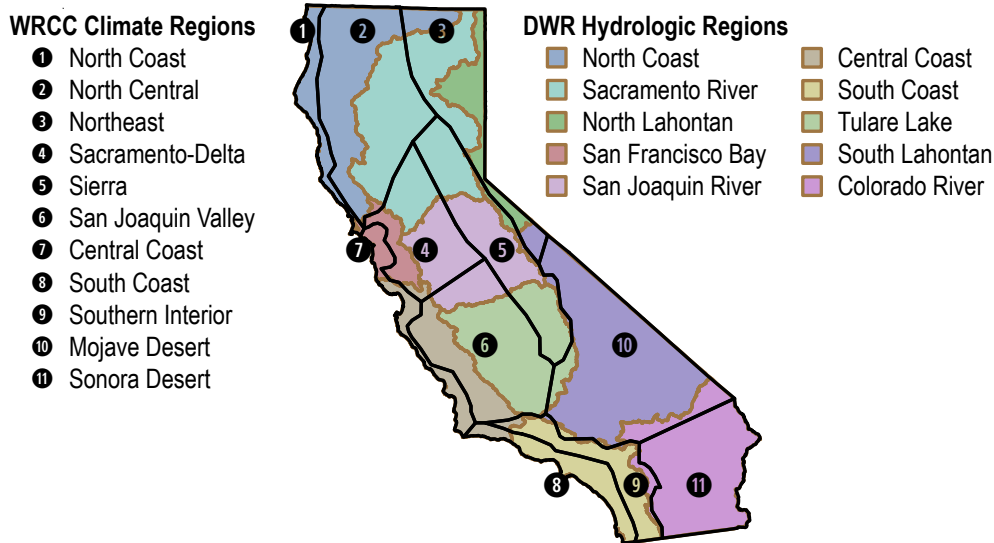
Statewide, California's temperature already has risen by 1 °F (0.6 °C), mostly at night and during the winter, with higher elevations experiencing the highest increase (California Department of Water Resources 2008a). Locally in the South Coast Hydrologic Region within the WRCC South Coast climate region, mean temperatures have increased by about 1.9-3.0 degrees Fahrenheit (°F) (1.1-1.6 Celsius (°C)) in the past century, with minimum and maximum temperatures increasing 2.7-3.7 °F (1.5-2.1 °C) and by 1.1-2.3 °F (0.6-1.3 °C), respectively (Western Regional Climate Center 2013). Within the WRCC Southern Interior climate region, mean temperatures have increased 1.0-2.2 °F (0.6-1.2 °C) in the past century, with minimum and maximum temperatures increasing 1.3-2.3 °F (0.7-1.3 °C) and 0.7-2.1 °F (0.4-1.2 °C), respectively (Western Regional Climate Center 2013).

The South Coast region also is experiencing impacts from climate change through changes in precipitation patterns, surface runoff volumes and timing, and streamflow timing, which in turn affect availability of local and imported water supplies. Many cities in the South Coast region experienced their lowest recorded annual precipitation at least twice within the past decade and a half (California Department of Water Resources 2008a). The National Weather Service reported that as of December 15, 2013, downtown Los Angeles could be on record as having its driest calendar year in 2013 with only 3.49 inches (8.86 centimeters [cm]) of rain recorded, or just 26 percent of normal rainfall to date (National Weather Service Forecast Office 2013). During the last century, the average early snowpack in the Sierra Nevada, which is an important source of water for the South Coast through the SWP and LAA, decreased by about 10 percent, which equates to a loss of 1.5 maf of snowpack storage (California Department of Water Resources 2008a).

Water supplies coming from the Colorado River Basin outside California are also decreasing (California Natural Resources Agency 2009). Similar climate effects, although much more variable, are occurring in the Rocky Mountains snowpack that supplies the Colorado River, another important source of water for the Colorado River region (Christensen et al. 2004; Mote et al. 2005; Williamson et al. 2008; Guido 2008). Even though variability exists in the snowpack levels of the Rocky Mountains and spatial patterns of trends are not consistent, streamflows in the Colorado River appear to be peaking earlier in the year (Stewart et al. 2005; Garfin 2005), and the average water yield of the Colorado River could be reduced by 10-20 percent as a result of climate change (U.S. Bureau of Reclamation 2011).

Sea level rise degrades the quality of imported water from the Delta and affects local coastal water and wastewater infrastructure, requiring substantial capital investments by local agencies. Sea level rise further exacerbates salinity intrusion and affects coastal groundwater resources. According to the California Climate Change Center, sea level rose 7 inches (18 cm) along California's coast during the past century (California Department of Water Resources 2008a; California Natural Resources Agency 2009).

Figure SC-24 DWR Hydrologic and Western Region Climate Center Climate Regions



The Western Region Climate Center (WRCC) divides California into 11 separate climate regions, and generates historic temperature time-series and trends for these regions (http://www.wrcc.dri.edu/monitor/cal-mon/frames_version.html). DWR maintains 10 hydrologic regions, with the Delta and Mountain Counties being overlays of other DWR hydrologic regions. Each DWR hydrologic region spans one or more of the WRCC climate regions.

The State's sea-level rise guidance documents reported that the coast of California experienced two very large ENSO events in 1983 and in 1997 to 1998, with costly storm damage to private property and public infrastructure. These damages occurred from a combination of elevated sea levels and large storm waves, which often coincided with high tides. During the 1983 ENSO event, sea levels were the highest ever recorded in San Diego and Los Angeles, 11.4 inches (29.0 cm) and 12.7 inches (32.3 cm), respectively, above predicted high tides. (California Climate Action Team 2010, 2013).

Projections and Impacts

While historical data are directly observed indicators of how the climate is changing, they cannot by themselves project what future conditions may be like under different GHG emissions scenarios. Current climate science uses computer modeling to simulate and develop future climate projections. A recent study by the Scripps Institution of Oceanography uses the most sophisticated methodology to date, and indicates that between 2060 and 2069, annual mean temperatures would be 3.4-4.9 °F (1.9-2.7 °C) higher across the state than they were between 1985 and 1994 (Pierce et al. 2012). Between 2060 and 2069, the annual mean temperature would increase by 3.8 °F (2.1 °C) for the WRCC South Coast climate region, with increases of 3.2 °F (1.8 °C) during the winter months and 4.3 °F (2.4 °C) during summer. The WRCC Southern Interior climate region has similar projections, with annual mean temperatures increasing by 4.3 °F (2.4 °C), winter temperatures increasing by 3.4 °F (1.9 °C), and summer temperatures increasing by 4.9 °F (2.7 °C) (Pierce et al. 2012). Climate projections from Cal-Adapt indicate that the mean temperatures between 1990 and 2100 are projected to increase about 5-6 °F (2.8-

3.3 °C) during winter and up to 5-10 °F (2.8-5.6 °C) during summer along the coast, with larger projected increases inland (California Emergency Management Agency and California Natural Resources Agency 2012b).

Several local studies have been completed or are under way to project local impacts of climate change. LARC through the University of California at Los Angeles analyzed temperatures for the Greater Los Angeles region and projected that temperatures in the Los Angeles area would rise by an average of 4-5 °F (2.2-2.8 °C) by the middle of this century, tripling the number of extreme heat days in the Los Angeles downtown area and quadrupling the number in the valleys and at high elevations (C-Change.LA 2013; Hall et al. 2012). Earlier, Hayhoe et al. (2004) also downscaled projections for California and found that the projected increases in heat wave days are proportionally greatest for the Metropolitan Los Angeles area with the number increasing four to eight times, depending on the emissions scenario analyzed, and that associated heat-related mortality in Los Angeles also would increase. It is important to note, though, that actual impacts would depend on preparedness and other factors (Hayhoe et al. 2004). Additional analyses are being conducted by RWMGs and local agencies within the South Coast region as discussed later in the adaptation section.

Changes in precipitation across California due to climate change could result in changes in type of precipitation (rain or snow) in a given area, in timing or total amount, and in surface runoff timing and volume. Precipitation projections from climate models for California are not all in agreement, but most anticipate drier conditions in the southern part of California, with heavier and warmer winter precipitation in the north (Pierce et al. 2012). Because there is a lower model resolution of localized precipitation changes, there exists a need to adapt to this uncertainty at the regional level (Qian et al. 2010).

Although annual precipitation will vary by area, reduced precipitation in the South Coast region would affect local reservoirs and the replenishment of the region's groundwater. Projections for the South Coast region indicate that low-lying coastal areas could lose 3-5 inches (8-13 cm) of precipitation by 2090, with western Riverside and southwestern San Bernardino counties projected to see a 3.5- to 6-inch (9- to 15-cm) decline, while the mountain areas, such as Big Bear, could see a drop of 8-10 inches (20-25 cm) (California Emergency Management Agency and California Natural Resources Agency 2012b).

On the other hand, extremes in California's precipitation are projected to increase with climate change. Recent computer downscaling techniques indicate that California flood risks from warm-wet, atmospheric river-type storms may increase beyond those that we have known historically, mostly in the form of occasional more-extreme-than-historical storm seasons (Dettinger 2011). Examples of such extremes were evident for the Los Angeles Civic Center and the San Diego Airport when they recorded 4.4 inches (11.2 cm) of rain (30 percent of normal) and 3.3 inches (8.4 cm) of rain (33 percent of normal) in water year 2002, respectively (California Department of Water Resources 2009). In water year 2005, they each recorded 37.5 inches (95.3 cm; 254 percent of normal) and 22.6 inches (57.4 cm; 222 percent of normal) (California Department of Water Resources 2009). Increased winter runoff could result in increased flood hazards, with flows potentially exceeding reservoir storage capacities and discharging to the ocean. Higher flow volumes could scour stream and flood control channels, degrading aquatic and riparian habitats already affected by shifts in climate and placing additional stress on special-status species.

For the California coast south of Cape Mendocino, the National Research Council (2012) projected that sea level will rise about 2-12 inches (4-30 cm) by 2030, 5-24 inches (12-61 cm) by 2050, and 17-66 inches (42-167 cm) by 2100. The National Research Council (2012) also noted that as the projection period lengthens, uncertainties — and thus ranges — increase. Over the short-term, it is anticipated that ENSO events would be more damaging to the coastline than the gradual sea level rise California is experiencing (California Climate Action Team 2010, 2013). Nevertheless, sea level rise is expected to degrade the quality of imported water from the Delta and impact local coastal water and wastewater infrastructure, requiring substantial capital investments by local agencies. Sea level rise will further exacerbate salinity intrusion and affect coastal groundwater resources. Low-lying farmlands, such as the Oxnard Plain, may also be inundated by sea water (Moser et al. 2008; California Natural Resources Agency 2009).

The volume of Sierra Nevada snowpack, which is an important source of water for the South Coast through the SWP and LAA, is projected to continue to decline as warmer temperatures raise the elevation of snow levels, reduce spring snowmelt, and increase winter runoff. Rising temperatures from downscaled models produce reduced snowpack in the Sierra, with impacts on winter recreation, streamflow, and water storage and supply (Hayhoe et al. 2004). Based on historical data and modeling, researchers at the Scripps Institution of Oceanography project that, by the end of this century, the Sierra snowpack would experience a 48-65 percent loss from its average at the end of the previous century (Pierce and Cayan 2013). Reduced snow and precipitation in the Sierra Nevada range and the Rocky Mountains that serve the Colorado River basin will affect the imported water supply for the South Coast region and could cause potential overdrafting of the region's groundwater basins. Earlier peak stream flows will reduce the flexibility in how the state manages its reservoirs to protect downstream communities from flooding while ensuring a reliable water supply.

Locally in the South Coast region, the March snowpack amount in the Big Bear area is projected to decline from 2.5 inches (6.4 cm, the 2010 level) to 1.4 inches (3.6 cm) in 2030 and to almost zero by 2090, with the San Gabriel Mountains decreasing from a 0.7-inch (1.8-cm) level in 2010 to zero by the end of the century (California Emergency Management Agency and California Natural Resources Agency 2012b). LARC analyzed snowfall for the mountains in the Los Angeles area and projected a decline of up to 42 percent of their annual snowfall by mid-century (Sun et al. 2013). Such declines in snowpack in the South Coast region would affect mountain communities dependent on snow-based tourism.

Water supplies within California are already stressed because of current demand and expected population growth. About 85 percent of California's residents live and work in coastal counties, which are home to unique ecosystems that offer opportunities for recreation and tourism, provide habitat for rare species, and buffer coastal communities from flood and erosion (California Natural Resources Agency 2009). Between 1980 and 2003, California's coastal population grew more than any other coastal community in the United States, with a total increase of 9.9 million people (Crossett et al. 2004; California Natural Resources Agency 2009). By 2050, the coastal population is expected to grow to over 32 million people (NPA Data Services 2000; California Natural Resources Agency 2009). The uncertainty regarding the extent of these environmental changes will no doubt reduce the ability of local agencies to meet the water demand and protect infrastructure for the South Coast region, if these agencies are not adequately prepared.

Changes in climate and runoff patterns may create competition among sectors that utilize water. The agricultural water demand and demand for landscape irrigation within the region could

increase as a result of higher evapotranspiration rates and potentially longer growing seasons caused by increased temperatures. Prolonged drought and decreased water quality could diminish water-based recreational opportunities at South Coast reservoirs and streams, while rising sea levels, more intense wave actions, and changes in beach replenishment patterns could squeeze coastal recreation bounded by development and transportation systems (for more information, see Volume 3, *Resource Management Strategies*, Chapter 31, “Water-Dependent Recreation”). Environmental water supplies would need to be retained in reservoirs for managing instream flows to maintain habitat for aquatic species throughout the dry season. Currently, Delta pumping restrictions are in place to protect endangered aquatic species. Climate change is likely to further constrain the management of these endangered species and the state’s ability to provide water for other uses. For the South Coast region, this could further reduce supplies available for import through the SWP during the non-winter months. SWP operators already must balance between preventing winter floods with maintaining water storage for summer dry periods, a balance that could be disrupted by earlier runoff (Cayan et al. 2008; Hayhoe et al. 2004).

Besides earlier runoff, reservoir managers and SWP operators are also challenged by other factors. With increasing temperatures, net evaporation from reservoirs is projected to increase by 15-37 percent (Medellin-Azuara et al. 2009; California Natural Resources Agency 2009). In addition, prolonged drought events are likely to continue and further affect the availability of local and imported surface water and contribute to the depletion of groundwater supplies.

Higher temperatures and decreased moisture during the summer and fall seasons will increase the South Coast’s vulnerability to wildfire hazards in the region and affect local watersheds. The extent to which climate change will alter the existing risk of wildfires is variable (Westerling and Bryant 2006), and little change is projected for most of the region, which is already at a high fire risk (California Emergency Management Agency and California Natural Resources Agency 2012b). However, early snowmelt and drier conditions have been correlated with an increase in the size and intensity of these fires (Westerling 2012), even though local Santa Ana winds are projected to decline in intensity (Hughes et al. 2009; California Natural Resources Agency 2009). Some models using vegetation distribution and productivity have projected that, by the end of the century, the total annual area burned could range from 9 percent to 15 percent greater than normal and that the greatest increases in annual area burned were simulated along the south coast and other areas (Lenihien et al. 2006). Areas, such as the San Jacinto Mountains (a mountain range between the South Coast and Colorado River hydrologic regions), would likely have 1.5 to 2.0 times more fires (California Emergency Management Agency and California Natural Resources Agency 2012b). Furthermore, wildfires have historically been linked to debris flow flooding in vulnerable communities within the South Coast region. The highly unpredictable nature of alluvial fans within the region has created flooding situations dependent on rain, vegetation, and wildfires (Stuart 2012).

A recent study that explores future climate change and flood risk in the Sierra — and which used downscaled simulations from three global climate models (GCMs) under an accelerating GHG emissions scenario that is more reflective of current trends — indicates a tendency toward increased three-day flood magnitude. By the end of the 21st century, all three projections yield larger floods for both the moderate-elevation northern Sierra Nevada watershed and for the high-elevation southern Sierra Nevada watershed on the western side, even for GCM simulations with 8-15 percent declines in overall precipitation. The increases in flood magnitude are statistically significant for all three GCMs for the period 2051-2099. By the end of the 21st century, the magnitudes of the largest floods increase to 110-150 percent of historical magnitudes.

These increases appear to derive jointly from increases in heavy precipitation amount, storm frequencies, and days with more precipitation falling as rain and less as snow (Das et al. 2011).

Even though this study focused on the western side of Sierra Nevada, these scenarios could potentially be indicative of other regional settings already experiencing flooding risks. Therefore, it is essential for local agencies to take action and be ready to adapt to climate change to protect the well-being of local communities.

Adaptation

Changes in climate have the potential to affect the water resources of the South Coast region, upon which the state depends for economic and environmental benefits. These changes would increase the vulnerability of natural and built systems in the region. Impacts on natural systems would challenge aquatic and terrestrial species by diminishing water quantity and quality, and shifting eco-regions. Built systems would be affected by changing hydrology, shifts in runoff timing, and loss of natural snowpack storage, making the region more dependent on surface storage in reservoirs and groundwater sources. Preparing for increased future water demand for both natural and built systems may be particularly challenging to meet with less natural storage and less overall supply.

The South Coast region contains a diverse landscape with different climate zones and complex topographic and hydrogeologic systems, making it difficult to find one-size-fits-all adaptation strategies. Water managers and local agencies must work together to determine the appropriate planning approach for their operations and communities. While climate change adds another layer of uncertainty to water planning, it does not fundamentally alter the way water managers already address uncertainty (U.S. Environmental Protection Agency and California Department of Water Resources 2011). However, stationarity (the concept that natural systems fluctuate within an unchanging envelope of variability) can no longer be assumed so new approaches will likely be required (Milly et al. 2008). Whatever planning approach is used, it is necessary for water managers and communities to start implementing adaptation measures sooner than later so as to be prepared for current and future changes.

IRWM planning is a framework that allows water managers to address climate change on a smaller, more regional scale. Climate change is now a required component of all IRWM plans (California Department of Water Resources 2010, 2012). IRWM regions must identify and prioritize their specific vulnerabilities to climate change and identify the adaptation strategies that are most appropriate. Planning and adaptation strategies to that address vulnerabilities should be proactive and flexible, starting with proven strategies that will benefit the region today and adding new strategies that will be resilient to the uncertainty of climate change.

Adaptation strategies to consider for managing water in a changing climate include restoring existing flood control and riparian corridors, implementing tiered pricing to reduce water consumption and demand, increasing regional natural water storage systems, encouraging low-impact development to reduce stormwater flows, promoting economic diversity, and supporting alternative irrigation techniques within the agriculture industry. To further safeguard water supplies, other promising strategies include adopting more water-efficient cropping systems, investing in water-saving technologies, and developing conjunctive use strategies. In addition, tracking forest health and reducing accumulated fuel load would provide a more resilient watershed ecosystem that can mitigate for floods, droughts, and fires. Developing

adaptive management plans to address the impacts of sea level rise, preserving undeveloped and vulnerable shorelines, and facilitating gradual retreat of vulnerable infrastructure help to prepare for increasing rise in sea level. (California Department of Water Resources 2008a; Hanak and Lund 2011; California Emergency Management Agency and California Natural Resources Agency 2012c; Jackson et al. 2012.)

Local, State, and federal agencies face the challenge of interpreting climate change data and determining which methods and approaches are appropriate for their planning needs. The *Climate Change Handbook for Regional Water Planning* provides an analytical framework for incorporating climate change impacts into regional and watershed planning processes and considers adaptation to climate change (U.S. Environmental Protection Agency and California Department of Water Resources 2011). This handbook provides guidance for assessing the vulnerabilities of California's watersheds and regions to climate change impacts, and prioritizing these vulnerabilities.

Strategies to manage local water supplies must be developed with the input of multiple stakeholders (Jackson et al. 2012). While both adaptation and mitigation are needed to manage risks and are often complementary and overlapping, there may be unintended consequences if efforts are not coordinated (California Natural Resources Agency 2009). Central to adaptation in water management is full implementation of IRWM plans that address regionally appropriate practices that incorporate climate change information. These IRWM plans, along with regional flood management plans, can integrate water management activities that connect corridors and restore native aquatic and terrestrial habitats to support the increase in biodiversity and resilience for adapting to changes in climate (California Natural Resources Agency 2009). However, with limited funds, RWMGs must prioritize their investments.

The San Diego RWMG recognizes the opportunities for collaboration and has been coordinating with land use planners in updating its IRWM plan. SAWPA has recognized the benefits forest watersheds provide to downstream communities and is working with the USFS on a variety of projects. In partnership with DWR, the California State University at San Bernardino — Water Resources Institute has developed a Web-based portal for land use planning in alluvial fans, which uses an integrated approach in assessing hazards and resources (California State University, San Bernardino 2012; Lien-Longville 2012).

In addition to RWMGs, local entities are fostering partnerships through which communication and research on climate change has been developing. LARC was formed as a network to share information, foster partnerships, and develop systemwide strategies to address climate change through sustainable communities within the Los Angeles area (University of California, Los Angeles Institute of the Environment and Sustainability 2013). At the southern end of the South Coast region, the San Diego Foundation developed a comprehensive regional assessment of climate change impacts on San Diego County and presented a public outreach brochure that not only discusses the impacts but also provides solutions to adapt to the impacts, including sea level rise, water shortages, and energy needs (Peters et al. 2011).

Adaptation also is essential in assessing the South Coast's imported water supplies. The LAA system is vulnerable to disruption from earlier snowmelt runoff because it has smaller surface water storage compared to other large conveyance systems in California (Harrington 2013, personal communication). In preparing for climate change, LADWP completed a study to evaluate the effects of climate change on the LAA's eastern Sierra watershed, a source of

imported water for the South Coast region. The LADWP study identified possible adaptation measures that could be implemented to mitigate the potential negative effects of climate change on the hydrology of the region over the next century, as well as the potential negative impact on water quality. These adaptation measures included creating new storage downgradient of Owens Valley to capture and store wet year flows for use during dry years and pursuing water transfers delivered from the SWP into the LAA (American Geophysical Union 2011; Pettijohn and Hsu 2013, personal communication).

Additional work is under way to better understand impacts of climate change and other stressors on another imported water supply for the South Coast region, the Colorado River. The USBR has completed a basin study to define current and future imbalances in water supply and demand in the Colorado River Basin and the adjacent areas of the basin states, including California, that receive Colorado River water (U.S. Bureau of Reclamation 2011, 2012). Through this study, USBR developed and analyzed adaptation and mitigation strategies to resolve those imbalances. Future actions must occur to implement these solutions; therefore, USBR is coordinating with the basin states, tribes, conservation organizations, and other stakeholders (U.S. Bureau of Reclamation 2012).

The LACFCD, which is responsible for conducting groundwater replenishment operations, has initiated a basin study with the USBR for the Los Angeles Basin. This study will define options for meeting future water demands through increased capture of stormwater in the Los Angeles Basin; determine where imbalances in supply and demand exist or are projected; and identify issues where changes to the operation of water supply systems, modifications to existing facilities, development of new facilities, or implementation of non-structural changes could help resolve water supply issues in a changing climate (Los Angeles County Flood Control District and U.S. Bureau of Reclamation 2012). In preparing an update to its OWOW IRWM plan, SAWPA also is working with USBR on a basin study for the SAR watershed, which is assessing climate change impacts within the SAR watershed and developing groundwater modeling and hydrology projections (Santa Ana Watershed Project Authority 2012).

Other RWMGs within the South Coast, such as the Watersheds Coalition of Ventura County and the Upper Santa Clara River Watershed IRWM, have determined regional vulnerabilities and adaptation strategies and are incorporating climate change into their IRWM planning processes. Central to adaptation in water management is full implementation of IRWM plans addressing regionally appropriate practices that incorporate climate change adaptation. These IRWM plans, along with regional flood management plans, can integrate water management activities that connect corridors and restore native aquatic and terrestrial habitats to support the increase in biodiversity and resilience for adapting to changes in climate (California Natural Resources Agency 2009).

Additional studies and tools continue to be developed within the South Coast region. A coastal resilience catalog and planning tools were developed to address local sea level rise for the Ventura County coastline (The Planning Center-DC&E 2013). LARC has completed studies on effects of climate change on temperature and snowfall for the Greater Los Angeles region and continues to conduct additional studies on other parameters, such as precipitation, hydrology, and fire (<http://c-change.la/>).

Furthermore, cities are also becoming more pro-active. According to the Luskin Center for Innovation report, the City of Santa Monica has adopted a general plan element that addresses

climate change. The City of Long Beach has a comprehensive climate planning within its Sustainable City Plan and is currently developing a general plan update that will incorporate climate change considerations, while the City of Irvine has an energy plan and a draft climate action plan, and is currently developing several climate and sustainability planning tools. Roughly one-third of Southern California cities have taken steps towards reducing GHG emissions, but more work needs to be done, not only in mitigating for but also in adapting to climate change (DeShazo and Matute 2012).

MWD has been using an adaptive management approach in its integrated resources plan. As part of its 2010 update of the integrated resources plan, MWD conducted a reliability analysis addressing potential climate change impacts and used the results to prioritize its management programs. Adaptive management is a suitable planning approach for MWD because its water supply system is subjected to multiple sources of uncertainty and relies heavily on imported water and because it wants to keep down its costs and keep up water reliability for its South Coast water users (U.S. Environmental Protection Agency and California Department of Water Resources 2011). Whatever approach is used, it is necessary for water managers and communities to start implementing adaptation measures sooner than later to prepare for an uncertain future.

The State of California has developed additional online tools and resources to assist water managers, land use planners, and local agencies in adapting to climate change. These tools and resources include the following:

- *Safeguarding California: Reducing Climate Risk* (http://resources.ca.gov/climate_adaptation/docs/Safeguarding_California_Public_Draft_Dec-10.pdf), which identifies a variety of strategies across multiple sectors (other resources can be found at <http://www.climatechange.ca.gov/adaptation/strategy/index.html>).
- *California Adaptation Planning Guide* (http://resources.ca.gov/climate_adaptation/local_government/adaptation_planning_guide.html) developed into four complementary documents by the California Emergency Management Agency and the California Natural Resources Agency to assist local agencies in climate change adaptation planning.
- Cal-Adapt (<http://cal-adapt.org/>), an online tool designed to provide access to data and information produced by California's scientific and research community.
- *Urban Forest Management Plan Toolkit* (<http://www.ufmptoolkit.com/>), sponsored by the California Department of Forestry and Fire Management to help local communities manage urban forests to deliver multiple benefits, such as cleaner water, energy conservation, and reduced heat-island effects.
- California Climate Change Portal (<http://www.climatechange.ca.gov/>).
- DWR Climate Change Web site (<http://www.water.ca.gov/climatechange/resources.cfm>).
- The Governor's Office of Planning and Research Web site (http://www.opr.ca.gov/m_climatechange.php).

Several resource management strategies found in Volume 3 of Update 2013 not only assist in meeting water management objectives in the South Coast Hydrologic Region, but also provide benefits for adapting to climate change, including the following:

- Chapter 2, "Agricultural and Urban Water Use Efficiency."
- Chapter 3, "Urban Water Use Efficiency."
- Chapter 4, "Flood Management."

- Chapter 8, “Water Transfers.”
- Chapter 9, “Conjunctive Management and Groundwater Storage.”
- Chapter 10, “Desalination – Brackish and Sea Water.”
- Chapter 11, “Precipitation Enhancement.”
- Chapter 12, “Municipal Recycled Water.”
- Chapter 14, “Surface Storage — Regional/Local.”
- Chapter 15, “Drinking Water Treatment and Distribution.”
- Chapter 16, “Groundwater/Aquifer Remediation.”
- Chapter 18, “Pollution Prevention.”
- Chapter 19, “Salt and Salinity Management.”
- Chapter 21, “Agricultural Land Stewardship.”
- Chapter 22, “Ecosystem Restoration.”
- Chapter 23, “Forest Management.”
- Chapter 24, “Land Use Planning and Management.”
- Chapter 25, “Recharge Area Protection.”
- Chapter 26, “Sediment Management.”
- Chapter 27, “Watershed Management.”
- Chapter 28, “Economic Incentives — Loans, Grants, and Water Pricing.”
- Chapter 31, “Water-Dependent Recreation.”








The myriad of resources and choices available to managers can seem overwhelming, and the need to take action given uncertain future conditions is daunting. There are many low-regret actions that water managers in the South Coast region can take to prepare for climate change, regardless of the magnitude of future warming. These low-regret actions involve adaptation options where moderate levels of investment increase the capacity to cope with future climate risks (The World Bank 2012).

Water managers and others will need to consider both the natural and built environments as they plan for the future. Stewardship of natural areas and protection of biodiversity are critical for maintaining ecosystem services important for human society, such as flood management, carbon sequestration, pollution remediation, and recreation. Land use decisions are central components in preparing for and minimizing the impacts from climate change (California Natural Resources Agency 2009). Increased cross-sector collaboration among water managers, land use planners, and ecosystem managers provides opportunities for identifying common goals and actions needed to achieve resilience to climate change and other stressors.

Mitigation

California’s water sector consumes about 12 percent of total statewide energy (19 percent of statewide electricity, and about 32 percent of statewide natural gas, and negligible amounts of crude oil). As shown in Figure 3-28, “Energy Use Related to Water,” water conveyance and extraction accounts for about 2 percent of energy consumption in the state, with 10 percent of total statewide energy use attributable to end-users of water (California Energy Commission

Figure SC-25 Energy Intensity per Acre-Foot of Water

Type of Water	Energy Intensity ( = 1-250 kWh/AF  = 251-500 kWh/AF)	Percent of Regional Water Supply*
Colorado (Project)		21%
Federal (Project)	 <250 kWh/AF	<1%
State (Project)		27%
Local (Project)	 <250 kWh/AF	4%
Local Imports	0*	5%
Groundwater		33%

* Los Angeles Aqueduct is a net energy provider

Energy intensity (EI) in this figure is the estimated energy required for the extraction and conveyance of one acre-foot of water. These figures reflect only the amount of energy needed to move from a supply source to a centralized delivery location (not all the way to the point of use). Small light bulbs are for EI greater than zero, and less than 250 kilowatt hours per acre foot (kWh/af). Large light bulbs represent 251-500 kWh/af of water (e.g., four light bulbs indicate that the water source has EI between 1,501-2,000 kWh/af).

*The percent of regional water supply may not add up to 100% because not all water types are shown in this figure. EI values of desalinated and recycled Water are covered in Volume 3, *Resource Management Strategies*. For detailed descriptions of the methodology used to calculate EI in this figure, see Volume 5, *Technical Guide*.

demand. Since energy usage is closely related to GHG emissions, this information can support measures to reduce GHGs, as mandated by the State. (Energy Intensity is discussed in Box SC-3.)

Figure SC-25, “Energy Intensity per Acre-Foot of Water,” shows the amount of energy associated with the extraction and conveyance of one af of water for each of the major water sources in this region. The quantity of each water source used in the region is also included, as a percentage. For reference, Only extraction and conveyance of raw water in Figure 3-29 “The Water-Energy Connection in Chapter 3, “California Water Today,” Volume 1 are illustrated in Figure SC-25. Energy required for water treatment, distribution, and end uses of the water are not included. Not all water types are available in this region. Some water types flow mostly by gravity to the delivery location and may require little or no energy to extract and convey. As a default assumption, a minimum EI less than 250 kilowatt hours per acre foot (kWh/af) was assumed for all water types).

Recycled water and water from desalination used within the region are not show in Figure SC-25 because their EI differs in important ways from those water sources. The EI of both recycled and desalinated water depend not on regional factors but rather on much more localized, site, and application specific factors. Additionally, the water produced from recycling and desalination is typically of much higher quality than the raw (untreated) water supplies evaluated in

2005, 2013; California Public Utilities Commission 2010). Energy is used in the water sector to extract, convey, treat, distribute, use, condition, and dispose of water and wastewater. Figure 3-29, “Water and Energy Connection” (Volume 1) shows all of the connections between water and energy in the water sector; both water use for energy generation and energy use for water supply activities. The regional reports in Update 2013 are the first to provide detailed information on the water-energy connection, including energy intensity (EI) information at the regional level. EI information is designed to help inform the public and water utility managers about the relative energy requirements of the major water supplies used to meet

Box SC-3 Energy Intensity

Energy Intensity (EI), as defined in *California Water Plan Update 2013*, is the amount of energy needed to extract and convey an acre-foot (af) of water from its source to a delivery location. Extraction refers to the process of moving water from its source to the ground surface. Many water sources are already at ground surface and require little or no energy for extraction, whereas others, such as groundwater or seawater for desalination, require energy to move the water to the surface. Conveyance refers to the process of moving water from a location at the ground surface to a different location. Conveyance can include pumping of water up and over hills and mountains or can occur via gravity. EI should not be confused with total energy — that is, the amount of energy (e.g., kilowatt hours [kWh]) required to deliver all of the water from a water source to customers within the region. EI focuses not on the total amount of energy used to deliver water to customers, but instead the portion of energy required to extract and convey a single unit of water (in kWh/af). In this way, EI gives a normalized metric that can be used to compare alternative water sources. (For detailed descriptions of the EI methodology and the delivery locations assumed for the water types presented, see Volume 5, *Technical Guide*).

In most cases, this information will not have sufficient detail for actual project-level analysis. However, these generalized, region-specific metrics provide a range in which energy requirements fall. The information can also be used in more detailed evaluations by using tools such as WeSim (<http://www.pacinst.org/publication/wesim/>), which allows modeling of water systems to simulate outcomes for energy, emissions, and other aspects of water supply selection.

Although not identical, EI is closely related to greenhouse gas (GHG) emissions (for more information, see “Climate Change and the Water-Energy Nexus” in Volume 1, Chapter 3, “California Water Today”). On average in California, generation of 1 megawatt-hour (MWh) of electricity results in the emission of about one-third of a metric ton of GHG (eGrid 2012). This estimate takes into account all types of energy generation throughout the state and electricity imported to the state.

Reducing GHG emissions is a State mandate. Water managers can support this effort by considering EI in their decision-making process. It's important to note that water supply planning must take into consideration myriad different factors in addition to energy impacts, such as public safety, water quality, firefighting, ecosystems, reliability, energy generation, recreation, and costs.

Accounting for Hydroelectric Energy

Generation of hydroelectricity is an integral part of many of the state's large water projects. The State Water Project (SWP), Central Valley Project (CVP), Los Angeles Aqueduct, Mokelumne Aqueduct, and Hetch Hetchy Aqueduct all generate large amounts of hydroelectricity at large multi-purpose reservoirs at the heads of each system. In addition to hydroelectricity generation at head reservoirs, several of these systems also generate hydroelectric energy by capturing the power of water falling through pipelines at in-conduit generating facilities. In-conduit generating facilities refer to hydroelectric turbines placed along pipelines to capture energy as water runs downhill in a pipeline (conduit). Hydroelectricity is also generated at hundreds of smaller reservoirs and run-of-the-river turbine facilities.

Because of the many ways hydroelectric generation is integrated into water systems, accounting for hydroelectric generation in EI calculations is complex. In some systems, such as the SWP and CVP, water generates electricity and then flows back into the natural river channel after passing through the turbines. In other systems, such as the Mokelumne Aqueduct, water can leave the reservoir by two distinct outflows, one that generates electricity and flows back into the natural river channel, and one that does not generate electricity and flows into a pipeline leading to water users. In both situations, experts have argued that hydroelectricity should be excluded from EI calculations because the energy generation system and the water delivery system are, in essence, separate (Wilkinson 2000).

DWR has adopted this convention for its EI calculations. All hydroelectric generation at head reservoirs has been excluded. Consistent with Wilkinson (2000) and others, DWR has included in-conduit and other hydroelectric generation that occurs as a consequence of water deliveries, such as the Los Angeles Aqueduct's hydroelectric generation at plants on the system downstream of the Owen's River diversion gates. The California Department of Water Resources has made one modification to this methodology to simplify the display of results: energy intensity has been calculated at each main delivery point in the systems. If the hydroelectric generation in the conveyance system exceeds the energy needed for extraction and conveyance, the EI is reported as zero. That means no water system is reported as a net producer of electricity, even though several systems (e.g., Los Angeles Aqueduct, Hetch Hetchy Aqueduct) produce more electricity in the conveyance system than is used.

This methodology does not account for several unique benefits that hydroelectric generating facilities at reservoirs provide, including grid stabilization, back up for intermittent renewable energy sources, and large amounts of GHG free energy

Figure SC-25. For these reasons, discussion of energy intensity of recycled and desalinated water are found separately in Volume 3, *Resource Management Strategies*.

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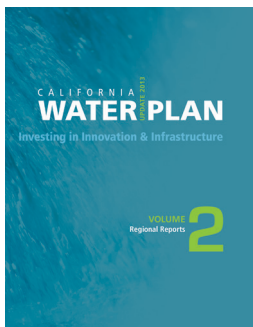
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Update 2013 includes a wide range of information, from a detailed description of California's current and potential future conditions to a "Roadmap For Action" intended to achieve desired benefits and outcomes. The plan is organized in five volumes — the three volumes outlined below; Volume 4, *Reference Guide*; and Volume 5, *Technical Guide*.



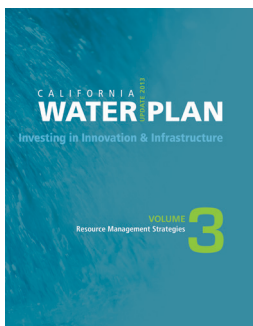
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Integrated water management is a comprehensive and collaborative approach for managing water to concurrently achieve social, environmental, and economic objectives. In the California Water Plan, these objectives are focused toward improving public safety, fostering environmental stewardship, and supporting economic stability. This integrated approach delivers higher value for investments by considering all interests, providing multiple benefits, and working across jurisdictional boundaries at the appropriate geographic scale. Examples of multiple benefits include improved water quality, better flood management, restored and enhanced ecosystems, and more reliable water supplies.

Edmund G. Brown Jr.

Governor
State of California

John Laird

Secretary for Natural Resources
Natural Resources Agency

Mark Cowin

Director
Department of Water Resources



October 2014