South Coast Hydrologic Region — Table of Contents

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Acronyms and Abbreviations Used in This Report

[under development]

µg/L	micrograms per liter
ACWA	Association of California Water Agencies
af	acre-feet
af/year	acre-feet per year
ASBS	Area of Special Biological Significance
BMO	Basin Management Objective
BMPs	best management practices
CASGEM	California Statewide Groundwater Elevation Monitoring
CCP	Conservation Credits Program
CDPH	California Department of Public Health
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CLAA	City of Los Angeles Aqueduct
CLWA	Castaic Lake Water Agency
CUWCC	California Urban Water Conservation Council
CWP	California Water Plan
DAMP	Drainage Area Management Plans
DFW	California Department of Fish and Wildlife
DWR	California Department of Water Resources
EI	energy intensity
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GAMA	Groundwater Ambient Monitoring and Assessment
GCM	global climate model
GDM	Phase I General Design Memorandum
GHG	greenhouse gas
gpm	gallons per minute
GWMP	groundwater management plan
GWRS	Groundwater Replenishment System
HIP	high population scenario
IEUA	Inland Empire Utilities Agency
IID	Imperial Irrigation District
IRWD	Irvine Ranch Water District
IRWM	integrated regional water management
IRWMP	integrated regional water management plan
IWM	integrated water management
kWh	kilowatt-hour
LACDA	Los Angeles County Drainage Area
LADPW	Los Angeles County Department of Public Works
LADWP	City of Los Angeles Department of Water and Power
LID	low-impact development

LOP	low population growth scenario
maf	million acre-feet
Metropolitan	Metropolitan Water District of Southern California
mg/L	milligrams per liter
mgd	million gallons per day
MOU	memorandum of understanding
MWD	Municipal Water District
MWDOC	Municipal Water District of Orange County
MWh	megawatt-hour
NPDES	National Pollutant Discharge Elimination System
OVOV	One Valley One Vision
PA 40	Metropolitan Los Angeles Planning Area
PA 40	San Diego Planning Area
PA 403	Santa Ana Planning Area
PA	Planning Area
QSA	Federal Quantification Settlement Agreement of 2003
RWMG	Regional Water Management Group
RWMG	regional water management group
RWQCB	Regional Water Quality Control Board
San Bernardino Valley MWD	San Bernardino Valley Municipal Water District
SAR	Santa Ana River
SARI	Santa Ana Regional Interceptor
SARP	Santa Ana River Mainstem Project
SAWPA	Santa Ana Watershed Project Authority
SAWPA	Santa Ana Watershed Project Authority
SB x7-	Water Conservation Act of 2009
SBCFCD	San Bernardino County Flood Control District
SGPWA	San Gorgonio Pass Water Agency
SNMP	salt and nutrient management plan
Stormwater Plan	Stormwater Capture Master Plan
SUSMP	Standard Urban Storm Water Mitigation Plan
SWOT	Strength, Weaknesses, Opportunities, and Threats
SWP	State Water Project
SWRCB	State Water Resources Control Board
taf	thousand acre-feet
TCE	trichloroethylene
TDS	total dissolved solids
Update 2013	*California Water Plan Update 2013*
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UWMP	urban water management plan
VCWPD	Ventura County Watershed Protection District
VOC	volatile organic compound
WQO	water quality objective
WRD	Water Replenishment District

WSD	Water Storage District
WSD	water storage district

South Coast Hydrologic Region

South Coast Hydrologic Region Summary

[This section is under development.]

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 land. 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 Sana Diego counties (see Figure SC-1).

PLACEHOLDER Figure SC-1 South Coast Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

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 basins include the Ojai, Santa Clarita, Santa Rosa, and Simi Valleys in the Santa Clara Planning Area (PA), San Fernando and San Gabriel Valleys in the Metropolitan Los Angeles area, the Chino Basin and the Pomona, Elsinore, and San Jacinto valleys in the Santa Ana area, and the Carmel and San Dieguito Valleys in the San Diego area.

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.

The San Gabriel and San Bernardino mountains are part of the geologic province known as the Transverse Range. From the Oxnard Plain eastward, the topography is dominated by west-to-east trending hills, small to moderate mountain ranges, and valleys. The Los Angeles Basin is part of the province. The uplifted marine terraces in the coastal zone of the San Diego area and the eastern mountain ranges, beginning with the Jacinto Mountains in the north, are part of the Peninsular Range province. Surface runoff to the Pacific Ocean has carved river valleys into the terraces. The freshwater flows in many of the rivers and streams in the area drain into lagoons and marshes along the coast.

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 region. They are the Los Padres, Angeles, San Bernardino, and Cleveland national forests and Cuyamaca-Rancho and Chino Hills State parks.

Watersheds

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

PLACEHOLDER Figure SC-2 Watersheds in the South Coast Hydrologic Region

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Santa Clara Planning Area Watersheds

The watersheds of the Santa Clara PA 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 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 is located in the watershed, Lake Casitas which provides water supplies downstream for local urban and agricultural users. The topography of the watershed is rugged and, as a result, the surface waters that drain the watershed have very steep gradients, ranging from 40 feet per mile at the mouth to 150 feet per mile at the headwaters. 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 kind of programs and environmental data 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 watershed which is about 654 square miles in size. The upper portion is bounded by the San Gabriel Mountains to the south and southeast, the Santa Susana Mountains to the southwest, the Liebre Mountains which are all part of the Transverse Ranges to the northeast and northwest, and extends westward to the Ventura County Line. Elevations range from about 800 feet on the valley floor to about 6,500 feet in the San Gabriel Mountains. The headwaters of the Santa Clara River are at an elevation of about 3,200 feet at the divide separating the Region from the Mojave Desert. 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. 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 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 (State Water Project supplies), and some recycled water supplies are used. The Santa Clara River Enhancement and Management Plan provides guidance to local stakeholders about the kinds of actions and programs that can help sustain and improve the watershed conditions.

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 the City of Simi Valley. Its main hydrologic feature is Calleguas Creek whose headwaters lie near the City of Simi Valley. Arroyo Simi, Arroyo Canejo, and Arroyo Santa Rosa are important tributaries. Much of the western portion of the watershed has intense agricultural land use activities. Further 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 which 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 (ASBS) 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. Impacts on the aquatic life in both the lagoon and the inland streams have resulted from the presence of pesticide residues (DDT), PCBs, and some metals. High levels of minerals and nitrates are also common the groundwater beneath the watershed.

Metropolitan Los Angeles Planning Area Watersheds

The watersheds of the Metropolitan Los Angeles PA are heavily urbanized and have issues with urban runoff and the loss of ecosystems. The PA has four major watersheds: Santa Monica Bay, Los Angeles River, Dominguez Channel, and San Gabriel River. These watersheds begin in the surrounding Santa Monica and San Gabriel Mountains and 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. It is a coalition of several smaller watersheds, including Malibu and Topanga creeks. The topography of the watershed is a combination of steep-slope mountains, coastal sand dunes, and several small basins. Much of the watershed remains undeveloped. There are urban developments, 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 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 steelhead trout continue to spawn in relatively large numbers in the upper portions of the creek despite a major barrier to upstream migration, Rindge Dam. 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. Urban uses and the channelization of several tributaries to Malibu Creek have caused an imbalance in the natural flow regime in the watershed and led to habitat impacts in Malibu Lagoon. Pollutants of concern, many of which are discharged from nonpoint 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 the south by the Baldwin Hills. Drainage is provided by Ballona Creek and two small tributaries. The watershed is heavily urbanized and includes the cities of Beverly Hills, Culver City, and West Hollywood and portions of the cities of Inglewood, Los Angeles, and Santa Monica. Several environmental sites are located in the western margin of the watershed. These are the Ballona Wetlands, Ballona Lagoon, and Oxford Lagoon. The California Department of Fish and Wildlife (DFW), 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 to be released on the plan. Ideas for consideration include the establishment of facilities for walking and bird watching and repositioning of the existing levees to help with restoring the native habitat and for flood protection of the urban area around the wetlands.

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 run-off and reduce the impacts from major flood events. The Los Angeles River Revitalization Master Plan was approved by the City of Los Angeles 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 underway or planned. One such study is underway by the U. S. Army Corp. of Engineers to determine the feasibility of re-establishing riparian vegetation on 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 and it 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 located in eastern Los Angeles County. The watershed extends to the coast and is a prominent member of the Transverse Range 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 there are flood control dams on the river. In this part of the watershed, the San Gabriel River has a West Fork and East Fork. This part of the river 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 underway by The National Park Service to examine the recreational and open space needs for the San Gabriel River watersheds. Also, the study will identify strategies to protect and enhance the natural resources and environmental habitat. The study is entitled San Gabriel watershed and Mountains Special Resource Study and is authorized under Public Law 108-042.

Santa Ana Planning Area Watersheds

Urban development in the Santa Ana area was occurring at a steady pace until the years just prior to the 2008 financial recession. Open space and agricultural lands were being used to accommodate the growth. Although many challenges in the Santa Ana PA are related to urban development, other challenges include water supplies, flood protection, and ecosystem preservation. The PA consists of one major watershed, the Santa Ana River watershed, and a few subwatershed areas including the San Diego Creek subwatershed and the San Jacinto River subwatershed. Watershed scale planning is provided by the Santa Ana Watershed Project Authority Santa Ana (One Water One Watershed) Integrated Water Resources Management Plan. This plan was supported by a number of subwatershed integrated plans including Central Orange County Integrated Regional and Coastal Watershed Management Plan, North Orange County Integrated Regional and Coastal Watershed Management Plan, Integrated Regional Management Plan for San Jacinto River Watershed, Upper Santa Ana River Watershed Integrated Regional Water

Management Plan, and Western Municipal Water District (MWD) Integrated Regional Water Management Plan.

Santa Ana River Watershed

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

The Santa Ana River flows more than 100 miles and drains the largest coastal stream system in

PLACEHOLDER Figure SC-3 Santa Ana River Watershed

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Southern California. It discharges into the Pacific Ocean at the City of Huntington Beach. The total length of the Santa Ana River (SAR) and its major tributaries is about 700 miles.

Today, only 20 percent of the river is a concrete channel, mostly being near the mouth of the river. 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 to more than 146,000 acre-feet per year (af/year), as measured at the Prado Dam. Base flow is expected to rise to 370,000 af/year by 2025, a projected increase of 153 percent since 1990.

River flow from Seven Oaks Dam to the City of San Bernardino consists mainly of storm flows, flow from the Lower San Timoteo Creek, and rising groundwater. From the City of San Bernardino to the City of Riverside, the river flows perennially and much of the reach is operated as a flood control facility. The principal tributary streams in the upper watershed originate in the San Bernardino and San Gabriel Mountains. These tributaries include San Timoteo, Reche, Mill, Plunge, City, East Twin, Waterman Canyon, Devil Canyon, Cajon Creeks, and University Wash from the San Bernardino Mountains; and Lone Pine, Lytle, Day, Cucamonga, Chino, and San Antonio Creeks from the San Gabriel Mountains.

River flow in Orange County consists of highly treated effluent, urban runoff, irrigation runoff water, imported water applied for groundwater recharge, and groundwater forced to the surface by underground barriers (SAWPA 2004). Near Corona, the SAR cuts through the Santa Ana Mountains and the Peralta-Chino Hills, which together form the northern end of the Peninsular Ranges in Southern California. The SAR then flows onto the Orange County coastal plain where the valley floor is reached, and where sediment deposits are more prevalent. Floodplains are strewn with boulders and characterized by sand and gravel washes. Within this valley floor, the transport and depositional processes are less confined by higher terrain as water, dissolved material and sediment move toward the sea. Over time, aquatic and terrestrial wildlife have adapted to this dynamic process and channel formation. However, rapid urbanization has artificially increased the rate of sedimentation and loss of habitat in this part of the watershed, negatively affecting water quality and wildlife habitat.

PLACEHOLDER Photo SC-1 Prado Wetlands Area

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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 Orange County coastal plain is composed of alluvium derived from the mountains. Upstream from the Santa Ana Canyon lay Prado Dam and Prado Wetlands; SAR flows are passed through the Prado Wetlands to improve water quality before being used for Orange County Groundwater Basin recharge. Santiago Creek, the only major tributary to the lower SAR, joins the SAR in the City of Santa Ana. Currently, the SAR is a concrete channel from 17th Street in the City of Santa Ana to Adams Avenue in Huntington Beach. The riverbed is ordinarily dry from 17th Street to the Victoria Street Bridge. The Greenville-Banning Channel, which carries stormwater discharge and urban runoff, is channelized to the Victoria Street Bridge where it joins the SAR. Discharge from the Greenville-Banning Channel combines with tidal flow from the Pacific Ocean causing the SAR to be wet from the Victoria Street Bridge to the mouth of the SAR.

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. To support the large population, the watershed is heavily urbanized although 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 impacted local water quality. The watershed continues to have riparian, wetland, and other wildlife habitat.

San Diego Creek Watershed

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 watershed have resulted in the sedimentation of the bay and channel basins. For years there have been concerns about declining water quality from sediments, nutrients, pathogens, and toxics. Habitats for many wildlife species are being isolated by new construction that cuts off long-used wildlife corridors.

San Jacinto River Watershed

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.

Other Watersheds

Two other important subwatersheds in the Santa Ana region include the Anaheim-Bay Huntington Harbor (AB-HH) and Lower San Gabriel River/Coyote Creek. The AB-HH watershed encompasses an area of 81 square miles. The main surface water systems that provide drainage in this watershed are the Bolsa Chica Channel that provides drainage to the Anaheim Bay-Huntington Harbor Complex; and the East Garden Grove-Wintersburg Channel that carries flow to Bolsa Bay and ultimately to Huntington Harbor.

The Lower San Gabriel/Coyote Creek sub-watershed covers an area of 85 square miles and is located in the northernmost portion of the County of Orange. This watershed straddles the county line for Los Angeles and Orange counties in its upper reaches and then continues southward through Orange County until it discharges into the San Gabriel River in Long Beach.

San Diego Planning Area Watersheds

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

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 US Marine Corps Base Camp Pendleton, north of the City of Oceanside. The lower portion of the watershed and estuary has largely escaped the development typical of the South Coast and are, therefore, able to support a relative abundance of functional habitats and wildlife. The upper portion is one of the fastest growing areas in California. Issues that have arisen include excessive nutrient inputs, erosion and sedimentation, groundwater degradation and contamination with nitrates and other salts, habitat loss, channelization, and flooding.

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

Carlsbad Watershed

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

San Dieguito River Watershed

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

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 due to urban runoff and sewage spills. Excessive groundwater extraction, increasing TDS, and 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. Storm water 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 mile of the watershed is part of the San Diego Multiple Species Conservation Plan (MSCP) effort that provides habitat for endangered plant and animal species. Other important conservation areas include the San Diego National Wildlife Refuge, Rancho Jamul Ecological Reserve, and vernal pools. Water quality concerns include elevated coliform bacteria in the Pacific Ocean receiving waters near Coronado.

Tijuana River Watershed

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

Groundwater Aquifers

Groundwater resources in the South Coast Hydrologic Region are supplied by both 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 for the region is provided below.

Aquifer Description

Alluvial Aquifers

The South Coast Hydrologic Region contains 73 California Department of Water Resources (DWR) Bulletin 118-2003 recognized alluvial groundwater basins and subbasins, which underlie approximately 3,500 square miles, or 32 percent, of the region. Most 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. 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.

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

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

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

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The Coastal Plain of Orange County Groundwater Basin is located adjacent to the southeast of the Coastal Plain of Los Angeles Groundwater Basin (Los Angeles basin), and will be described together with the Los Angeles basin because the two groundwater basins have similar depositional settings and aquifer characteristics. Collectively, the groundwater basins cover approximately 836 square miles. The water-bearing units include multiple unconfined and confined aquifers. The Coastal Plain groundwater basins are divided into forebay and pressure areas. Forebay areas refer to areas of higher permeability and recharge to underlying aquifers. Pressure areas refer to areas where groundwater percolation is impeded due to deposits of low permeability and where groundwater is confined. Most of the central and coastal portions of the Coastal Plain of Orange County Groundwater Basin are in a pressure area while the majority of the northeast portion of the basin is within the forebay area. The Coastal Plain of Los Angeles Groundwater Basin is composed of four subbasins — Santa Monica, Hollywood, West Coast, and Central. Three primary forebay areas are identified in the northeast portion of the Central subbasin - Los Angeles Forebay Area, Montebello Forebay Area, and the Whittier Forebay Area. The rest of the Central subbasin and the entire West Coast subbasin are identified as a pressure area. The oldest water-bearing deposits are composed of sand, siltstone, and conglomerates which form the Pliocene Upper Fernando Group. The Upper Fernando Group is approximately 350 to 500 feet thick, and the upper portion of this deposit is referred to as the lower aquifer system in the Coastal Plain of Orange County Groundwater Basin (DWR 2003). The lower aquifer system consists of numerous aquifers of variable thickness. However, groundwater is not heavily extracted from the lower aquifer system due to colored water and higher costs associated with deeper well construction (OCWD 2009). The Upper Fernando Group correlates with the Pico Formation, which underlies portions of the Coastal Plain of Los Angeles Groundwater Basin. Overlying the Pico Formation, San Pedro Formation primarily composed of marine and continental sands, gravel, silts, and clays (DWR 1967). The San Pedro Formation contains the following aquifers in downward succession — Hollydale, Jefferson, Lynwood, Silverado, and Sunnyside. The Lynwood and Silverado aquifers are the most important groundwater producers within this formation. The Silverado aquifer ranges in thickness from 50 to 500 feet and merges with overlying aquifers in various areas of the Coastal Plain of Los Angeles Groundwater Basin and is one of the main productive units within the basin (DWR 1961).

The Upper Santa Ana Valley Groundwater Basin is composed of nine subbasins underlying an area of approximately 761 square miles. The sediments in the basin consist of Pleistocene to Holocene alluvial deposits derived from the San Gabriel, San Bernardino, Santa Ana, and San Jacinto Mountains, and to a lesser degree, from the Puente Hills and Chino Hills. The groundwater conditions are unconfined to confined, and the water-bearing deposits are typically hundreds of feet thick and exceed 1,000 feet in some subbasins. The water-bearing units in the western portion of the groundwater basin consist of

Holocene alluvium up to 150 feet thick and Pleistocene alluvium up to 700 feet thick. Most of the wells extract water from the coarse deposits of the Pleistocene alluvium. The highest producing wells in the central portion of the subbasin yield 500 to 1,000 gallons per minute. Besides Quaternary alluvium, the San Timoteo Formation is a widely deposited water-bearing unit in the eastern portion of the basin. The San Timoteo Formation is an alluvial deposit estimated to be 1,500 to 2,000 feet thick and is primarily composed of gravel, silt, and clay. The water-bearing portion of the formation is estimated to be 700 to 1,000 feet deep (DWR 2003). The aquifers in the groundwater basin are generally recharged by precipitation infiltrating the alluvial fans along the base of the surrounding mountains and along the SAR and its tributaries. The aquifers are also artificially recharged by local groundwater managers using a variety of conjunctive management methods.

The Santa Clara River Valley Groundwater Basin is composed of six subbasins underlying 299 square miles. The primary water-bearing deposits — Quaternary alluvium, Pleistocene terrace deposits, the Pleistocene San Pedro Formation, and the Pliocene to Pleistocene Saugus Formation — are derived from the surrounding the Santa Ynez, Topatopa, Piru, San Gabriel, and Santa Monica Mountains. The alluvial aquifer system consists of stream channel and floodplain deposits generally composed of unconsolidated sand and gravel with silt and clay. The thickness of the alluvium is 200 to 240 feet throughout most of the groundwater basin and is thickest in the Mound subbasin where it reaches 500 feet (DWR 2003). Groundwater in the alluvium is generally unconfined. The aquifers within the groundwater basin are generally recharged by infiltration of water along the Santa Clara River, its tributaries, and through the valley ground surface. The aquifers are also artificially recharged by infiltration of irrigation water and percolation of diverted runoff and imported water in percolation basins.

Fractured-Rock Aquifers

Fractured-rock aquifers are typically found in the mountain and foothill areas adjacent to alluvial groundwater basins. Due 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-rock aquifers yield 10 gallons per minute (gpm) or less. Although fractured-rock aquifers are less productive compared to alluvial aquifers, they commonly serve as the sole source of water and a critically important water supply for many communities. Most of the water used in the South Coast Hydrologic Region is derived from alluvial aquifers; therefore, information related to fractured-rock aquifers in the region was not developed as part of *California Water Plan Update 2013* (Update 2013).

More detailed information regarding the aquifers in the South Coast Hydrologic Region is available online from Update 2013, Volume 4, Reference Guide, the article "California's Groundwater Update 2013" and DWR Bulletin 118-2003.

Well Infrastructure and Distribution

Well logs submitted to DWR for water supply wells completed during 1977 through 2010 were used to evaluate the distribution of water wells and the uses of groundwater in the South Coast Hydrologic Region. 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).

Four counties were included in the analysis of well infrastructure for the South Coast Hydrologic Region. Orange County is fully contained within the region, while Ventura, Los Angeles, San Diego, Riverside, San Bernardino Counties are partially within the region. 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. Thus well log data for Orange, Ventura, Los Angeles, and San Diego Counties are discussed in this report, while well log data for Riverside and San Bernardino Counties are discussed in the Regional Reports for the Colorado River and South Lahontan Hydrologic Regions, respectively. 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 less than 3,000 in Ventura County. In most counties, monitoring wells make up the majority of well logs — 7,600 is in Los Angeles County, followed by about 3,800 in Orange County and 1,100 in Ventura County. San Diego County also has a relative 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. Communities with a high percentage of monitoring wells compared to other well types may indicate the presence of groundwater quality monitoring to help characterize groundwater quality issues.

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

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

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

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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.

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

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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, with an average of about 1,200 wells per year. The fluctuations in the numbers of domestic wells drilling are likely associated with population growth and residential housing construction. The increase in domestic well drilling in the region during the late 1980s and early 1990s is likely due to increases in housing construction during that period. Similarly, the 2007 to 2010 decline in domestic well drilling is likely due to declining economic conditions and related drop in housing construction. A portion of the lower number of well logs recorded for the 2007 through 2010 period could be due to late processing of well logs.

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

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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 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 installations are more closely related to weather conditions, cropping trends, and availability of surface water supply. Figure SC-7 shows a relatively steady number (100-200) of annual irrigation well completion, with the exception of 1991. In 1991, more than 500 irrigation wells were installed in the region, likely associated with 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."

California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization

The Legislature in 2009, as part of a larger package of water-related bills, passed Senate Bill 7x 6 (SBx7 6; Part 2.11 to Division 6 of the California Water Code Section 10920 et seq.), requiring 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 was later named the "California Statewide Groundwater Elevation Monitoring" or "CASGEM" Program. The new legislation requires DWR to identify the current extent of groundwater elevation monitoring within each of the alluvial groundwater basins defined under Bulletin 118-2003. The legislation also requires DWR to prioritize groundwater basins to help identify, evaluate, and determine the need for additional groundwater level monitoring by considering available data. Box SC-1 provides a summary of these data considerations and resulting possible prioritization category of basins. *More detailed information on groundwater basin prioritization is available online from Update 2013, Volume 4, Reference Guide, the article "California's Groundwater Update 2013."*

PLACEHOLDER Box SC-1 California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization Data Consideration

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Figure SC-8 shows the groundwater basin prioritization for the region. Of the 73 basins within the region, 14 basins were identified as high priority, 22 as medium priority, five as low priority, and the remaining 32 as very low priority. Table SC-3 lists the high and medium CASGEM priority groundwater basins for the region. The 36 basins designated as high or medium priority account for 94 percent of the population and 95 percent of groundwater supply for the region. The basin prioritization could be a valuable tool to help evaluate, focus, and align limited resources for effective groundwater management, and reliability and sustainability of groundwater resources.

PLACEHOLDER Figure SC-8 CASGEM Groundwater Basin Prioritization for the South Coast Hydrologic Region

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PLACEHOLDER Table SC-3 CASGEM Groundwater Basin Prioritization for the South Coast Hydrologic Region

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South Coast Hydrologic Region Groundwater Monitoring Efforts

Groundwater resource monitoring and evaluation is a key aspect to understanding groundwater conditions, identifying effective resource management strategies, and implementing sustainable resource management practices. California Water Code (Section10753.7) 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. Groundwater level monitoring well information includes only active monitoring wells — those wells that 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

A list of the number of monitoring wells in the region by monitoring agencies, cooperators, and CASGEM monitoring entities is provided in Table SC-4. The locations of these monitoring wells by monitoring entity and monitoring well type are shown in Figure SC-9. Table SC-4 shows that a total of 1,798 wells in the region have been actively monitored for groundwater levels 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 U.S. Geological Survey (USGS) monitors 339 wells in 15 basins and 15 designated CASGEM monitoring entities monitor the remaining 1,442 wells in 34 basins. A comparison of Figure SC-8 discussed previously and Figure SC-9 indicate that many of the basins identified as having a high or medium priority under the CASGEM groundwater basin prioritization have been monitored for groundwater levels.

PLACEHOLDER Table SC-4 Groundwater Level Monitoring Wells by County Entity in the South Coast Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure SC-9 Monitoring Well Location by Agency, Monitoring Cooperator, and CASGEM Monitoring Entity in the South Coast Hydrologic Region

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The groundwater level monitoring wells are categorized by the type of well use and include domestic, irrigation, observation, public supply, and other. Groundwater level monitoring wells identified as "other" include a combination of the less common well types, such as stock wells, test wells, industrial wells, or unidentified wells (no information listed on the well log). Wells listed as "observation" also include those wells described by drillers in the well logs as "monitoring" wells. Domestic wells are typically relatively shallow and are in the upper portion of the aquifer system, while irrigation wells tend to be deeper and are in the middle-to-deeper portion of the aquifer system. Some observation wells are constructed as a nested or clustered set of dedicated monitoring wells, designed to characterize groundwater conditions at specific and discrete production intervals throughout the aquifer system. Figure SC-10 shows that wells identified as observation, irrigation, and public supply collectively account for 67 percent of the monitoring wells in the region, while wells listed as other comprise 29 percent of the total; domestic wells comprise less than five percent of the total.

PLACEHOLDER Figure SC-10 Percentage of Monitoring Wells by Use in the South Coast Hydrologic Region

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Groundwater Quality Monitoring

Groundwater quality monitoring is an important aspect to effective groundwater basin management and is one of the components that are required to be included in groundwater management planning in order for local agencies to be eligible for State funds. Numerous State, federal, and local agencies participate in groundwater quality monitoring efforts throughout California. A number of the existing groundwater quality monitoring efforts were initiated as part of the Groundwater Quality Monitoring Act of 2001, which implemented goals to improve and increase the statewide availability of groundwater quality data. A summary of the larger groundwater quality monitoring efforts and references for additional information are provided below.

Regional and statewide groundwater quality monitoring information and data are available on the State Water Resources Control Board (SWRCB) 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 also has 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. Additional information regarding assessment and reporting of groundwater quality information is furnished later in this report.

PLACEHOLDER Table SC-5 Sources of Groundwater Quality Information

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Land Subsidence Monitoring

Land subsidence has been shown to occur in areas experiencing significant declines in groundwater levels. In the South Coast Hydrologic Region, land subsidence associated with groundwater withdrawal has been documented in the Chino, Coastal Plain of Orange County, Oxnard Basin, and San Jacinto Groundwater Basins. The results from the subsidence monitoring are provided 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.

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, Ventura, and San Gabriel 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, 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, tidepools, and significant ecological diversity, the nearshore areas between the Ventura County line and Latigo Point was designated by the SWRCB as an ASBS, which is afforded special protection for marine life to the extent that waste discharge are 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 PA include the aquatic and riparian habitats along Ventura and Santa Clara Rivers and their tributaries and estuaries. The primary goal of the Watersheds Coalition of Ventura County is to bring together stakeholders to develop integrated watershed management strategies and coordinate ecosystem restoration efforts to achieve long term sustainability of local water resources. Ongoing projects and programs include land acquisition for protection and restoration of habitat and ecosystem restoration projects which remove barriers to steelhead passage, restore sediment transport and natural hydrologic regimes on the river, restore riparian and wetland habitats, and remove the invasive giant reed (*Arundo donax*) from local rivers and tributaries.

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 fish species such as unarmored threespine stickleback (*Gasterosteus aculeatuswilliamsoni*).

The natural ecosystem, comprised of a wide variety of biological resources (plant and animal species), as well as physical attributes (land, water, air and other important natural factors), is a vital resource contributing to the economic and physical well-being of the communities of the Upper Santa Clara River watershed.

Key ecosystems in the Metropolitan Los Angeles PA 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 PA include the upper Newport Bay and the constructed wetlands behind Prado Dam, Seven Oaks Dam, and Hemet/San Jacinto. The Santa Ana Watershed Project Authority

(SAWPA) is responsible for many projects underway 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 (SARI) pipeline designed to convey non-reclaimable, high-saline brine out of the watershed, non-native plant removal program, constructed wetlands, wetland expansion, habitat restoration, and wildlife conservation and enhancement. Environmental groups such as the Orange County Coastkeeper are working to restore ecosystem function and improve water quality within coastal marshes. In Orange County's developed watersheds, restoration activities include the removal of debris and trash, reversion to natural channel configuration, revegetation with native species, and a regional invasive species removal program. Many projects contain a public education component intended to integrate public outreach and education of outlying neighborhoods, as well as of visitors to the restoration site.

Key ecosystems in the San Diego PA 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 local, State, and federal 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 underway 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 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 therefore 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). 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 Federal Emergency Management Agency (FEMA) for large-scale debris basin cleanout operations.

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

- Some existing culverts and channels do not have sufficient capacity to carry flood waters resulting from the event having 1 percent probability of occurrence in any year.

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

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, higher totals do occur in the mountains. The eastern and southern sections can be impacted 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.

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

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Demographics

Population

In 2010, the population in the South Coast Hydrologic Region was 19,580,000. The population in the region represented about 53 percent of the population of the state for that year. In 2010, about 47 percent (9,165,000) of the regional population lived in the Metropolitan Los Angeles Planning and about 28 percent (5,421,000) lived in the Santa Ana area. Since 2000, the net growth in the region has been 1.4 million people.

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 did impact population growth. Although many cities in the region experienced growth between 2008 and 2010, some cities remained relatively stable while several others lost population.

Tribal Communities

There are approximately 25 Native American tribes within the South Coast Hydrologic Region (shown in Box SC-1, *California Water Plan Update 2009*) which are all 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), agriculture 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.

Senate Bill 18 (Chapter 905, Statues of 2004), requires cities and counties to consult with Native American Indian tribes during the adoption or amendments of local general plans or specific plans. A contact list of appropriate tribes and representatives within this region is maintained by the Native American Heritage Commission. A Tribal Consultation Guideline prepared by Governor's Office of Planning and Research is available online at: http://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf.

Soboba Band of Luiseno Indian Reservation is within the Santa Ana watershed boundaries. The Soboba Indian Reservation was established by an Executive Order that set aside 3,172.03 acres of land for their permanent occupation and use. Located at the foothills of the San Jacinto Mountains in Riverside County, the reservation has deep canyons and rolling hills. It is 1,600 feet above sea level beginning at the San Jacinto River, which borders the reservation's western boundary to about 2,600 feet in the northeastern and southern portions.

Although the Soboba Reservation is entirely in the Santa Ana watershed, several other Indian tribes border the watershed. Though not limited to, in the past, the Morongo, San Manuel, Pechanga, Cahuilla and Ramona tribes have lived on other lands and traveled to the watershed for cultural reasons.

The Pala Band of Mission Indians lives in northern San Diego County within the San Luis Rey watershed. The 12,273-acre reservation is home to the Cupeno and Luiseno people. The Pala Band of Mission Indians have expressed that the priorities for the tribe are climate change adaptation related to water, preparing for water scarcity, drought, and water conservation.

Currently, tribal landholdings located in this region include the Barona, Campo, Capitan Grande, Highland (Serrano), Inaja-Cosmit, Jamul, La Jolla, La Posta, Mesa Grande, Pechanga, Pala, Pauma-Yuima, Poway (San Luis Rey), Ramona, Rincon, Riverside (Sherman Indian Museum), San Fernando (Fernando Tataviam), San Manuel, San Pasqual, Santa Ana (Juaneno/Acjachemem), Santa Ysabel, Soboba, Sycuan, and Viejas reservations, Rancherias, and communities. On the boundary with the Colorado River region are the Cahuilla, Ewiiaapaayp (Cuyapaipe), Los Coyotes, Manzanita, and Santa Rosa reservations.

Disadvantaged Communities

The State of California defines a Disadvantaged Census Tract as a census tract with a household income less than 80 percent of the California median household income. They also define a Severely Disadvantaged Census Tract as a census tract with a household income less than 60 percent of the California median household income. In 2007, the California median household income was $58,361 as reported by the U.S. Census Bureau (USCB 2007).

Approximately 69 percent of the cities or communities within the Santa Ana PA are therefore considered disadvantaged or contain disadvantaged communities. The Santa Ana PA contains some of the state’s poorest residents. In 2000, the per capita income of portions of the Inland Empire was about 25 percent below the state average (Schreiber 2003). Based on 2000 U.S. Census data, the San Gabriel and Lower Los Angeles Rivers Watershed Region has 17 of 68 cities that qualify as a disadvantage community and approximately 1.6 million out of 4.7 million (or 40 percent) of its population lives within a disadvantaged community.

Land Use Patterns

Urban development continues to encroach on what remains of a once-great agricultural industry. 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 areas are under constant pressure by encroachment of surrounding urban lands.

As remaining acres of buildable land decreases 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 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.

Planted and harvest acres of irrigated crops are decreasing slowly in the South Coast region. Between 2006 and 2010, the planted acres went from 242,000 acres to 232,000 acres; about 4 percent decline. Major crops include citrus and subtropical, almost 120,000 acres of orchards in production in 2010 and miscellaneous vegetables and truck, over 78,000 acres for the same year. Although agricultural land use activities have withered to just a fraction of what it 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, in the Santa Clara PA, 111,000 acres of crops were planted and harvested in 2010. This includes more than 48,000 acres of tomatoes, lettuce, cole, and other miscellaneous vegetable and truck crops and more than 58,000 acres of citrus and subtropical fruit including lemons and avocados. Table SC-7 shows the major crops grown in the South Coast region.

PLACEHOLDER Table SC-7 South Coast Hydrologic Region Top Crops 2010 (in acres)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

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 the PA. 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, it has slightly more than 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 PA, the production of citrus and subtropical orchards, over 13,000 acres in production in 2010, and the planting and harvesting of vegetables and nursery crops, almost 11,000 acres for the same year, are scattered throughout the region. Large orchards of orange 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 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. Many streambeds have been lined with concrete to facilitate flood management, thereby decreasing groundwater recharge. This is a particular problem for those groundwater basins which have historically been over-pumped, such as in the Los Angeles River watershed. Bridges and other structures over channelized streams can slow flow velocity and cause adjacent flood damage, as seen in the Calleguas Creek watershed. Because of intense urbanization and loss of natural habitat, there is a focus on conserving the natural areas that remain within the region.

Concern over effective land use planning for reducing wildfire risk and ensuring rapid response strategies has become more urgent as development continues to move into urban interface 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. Planners and legislators are increasingly looking to understand and manage the South Coast landscape to reduce such losses. 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 (Cal Fire 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 — e.g., Balboa Lake in the Sepulveda Basin area of Los Angeles County, Hemet/San Jacinto Multi-Purpose Constructed Wetlands in Riverside County, San Jacinto Wildlife Area in Riverside County, San Joaquin Marsh along San Diego Creek in Orange County, and Santee Lakes in San Diego — are maintained through discharge of reclaimed water supplies. Discharges from upstream wastewater treatment plants (WWTPs) contribute inflows to many of the region's coastal lagoons and estuaries. Constructed wetlands along the 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.

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

Water Supplies

To meet current and growing demands for water, the South Coast region is leveraging all available water resources: imported water, water transfers, conservation, local surface water, groundwater, recycled water, and desalination. Given the level of uncertainty about water supply from the Delta and Colorado River, local agencies have emphasized diversification. Local water agencies now utilize a 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 acre-feet per year of local supplies through water recycling, desalination, groundwater, and surface storage programs. By 2021, the area will receive an additional 277,700 acre-feet per year because of the San Diego County Water Authority-Imperial Irrigation District (SDCWA-IID) water conservation, transfer, and canal-lining programs. This diverse mix of sources provides flexibility in managing resources in wet and dry years. For an overview of the region's flow of water see Figure SC-11.

PLACEHOLDER Figure SC-11 South Coast Hydrologic Region Inflows and Outflows

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Surface Water

Reservoirs in the South Coast Hydrologic Region provide storage for surface runoff from local watersheds or water supplies imported through the State Water Project (SWP), Colorado River Aqueduct, or the City of Los Angeles Aqueduct (CLAA). Flood control structures capture local runoff and some direct it to groundwater recharge facilities.

In the Santa Clara PA, surface water supplies come from Lake Casitas (254,000 acre-feet), Lake Piru (100,000 acre-feet), and from diversion projects along the Santa Clara River, Ventura River, Santa Paula Creek, Piru Creek, Sespe Creek, and Conejo Creek. Natural surface flows from these diversions are also directed to spreading basins to replenish local aquifers. The most southern reservoir on the West Branch of the SWP California Aqueduct is Castaic Lake. Bouquet Reservoir, built in 1934, is a part of the CLAA system built by the City of Los Angeles in 1913.

In the Metropolitan Los Angeles area, flood control dams, operated by the Los Angeles County Department of Public Works (LADPW) on the Los Angeles River and San Gabriel River, 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 CLAA. Las Virgenes MWD uses Las Virgenes Reservoir to store treated water it has purchased from MWD.

Several water storage reservoirs are in the Santa Ana PA. This includes the terminus reservoir for the SWP, Lake Perris, and the Metropolitan Water District of Southern California-owned Lake Mathews and Diamond Valley reservoirs. Big Bear Lake, Canyon Lake, and Lake Irvine are smaller facilities, but 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 PA has a total of 25 reservoirs with seventeen 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

The amount and timing of groundwater extraction, along with the location and type of its use, are fundamental components for building a groundwater basin budget and identifying effective options for groundwater management. Although some types of groundwater extractions are reported for some California basins, the majority of groundwater pumpers are not required to monitor, meter, or publicly record their annual groundwater extraction amounts. Groundwater supply estimates furnished herein are based on water supply and balance information derived from DWR land use surveys, and from groundwater supply information voluntarily provided to DWR by water purveyors or other State agencies.

Groundwater supply varies throughout the region. Several groundwater basins in the region have legal limitations on the quantities of water which can be pumped annually, usually the safe yield. In addition, some areas have very limited groundwater supplies and must rely on other sources to meet the water uses in the areas.

Groundwater supply is reported by water year (October 1 through September 30) and categorized according to agriculture, urban and managed wetland uses. The associated information is presented by PA, county, and by the type of use. Reference to total water supply represents the sum of surface water and groundwater supplies in the region, and local reuse.

2005-2010 Average Annual Groundwater Supply and Trend

Table SC-8 provides the 2005-2010 average annual groundwater supply by PA and by type of use, while Figure SC-12 depicts the PA 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). Out of the 4.7 maf total supply, groundwater supply is 1.6 maf and represents about 34 percent of the region's total water supply; 31percent (1.2 maf) of the overall urban water use and 54 percent (385 thousand acre-feet [taf]) of the overall agricultural water use being met by groundwater. No groundwater resources are used for meeting managed wetland uses in the region. Although statewide, groundwater extraction in the region accounts for about 10 percent of California's 2005-2010 average annual groundwater supply, it accounts for nearly half of the total water supply for the Santa Clara and Santa Ana PAs, with three-quarters or more of agricultural water uses in the two PAs being met by groundwater.

PLACEHOLDER Table SC-8 South Coast Hydrologic Region Average Annual Groundwater Supply by Planning Area and by Type of Use (2005-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure SC-12 Contribution of Groundwater to the South Coast Hydrologic Region Water Supply by Planning Area (2005-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Regional totals for groundwater based on county area will vary from the PA estimates shown in Table SC-8 because county boundaries do not necessarily align with PA or hydrologic region boundaries. Orange County is fully contained within the South Coast Hydrologic Region, while Ventura, Los

Angeles, San Diego, Riverside, San Bernardino Counties are partially within the region. Groundwater supply for Riverside and San Bernardino Counties are discussed in the Regional Reports for the Colorado River and South Lahontan Hydrologic Regions, respectively. For the South Coast Hydrologic Region, county groundwater supply is reported for Orange, Los Angeles, San Diego, and Ventura counties (Table SC-9). Overall, groundwater contributes to approximately 28 percent of the total water supply for the four-county area; the range varies from less than 5 to more than 50 percent for individual counties. Groundwater supplies in the four-county area are used to meet about one half of the agricultural water use and one quarters of the urban water use.

In the case of Ventura County, although there are 32 groundwater basins in the county, most of the supplies are pumped from groundwater basins beneath the Oxnard Plain-Pleasant Valley area — Oxnard, Mugu, Hueneme, Fox Canyon, and Grimes Canyon aquifers. In the Los Angeles County portion of the region, groundwater supplies are pumped from aquifers beneath the Santa Clara River Valley and the Acton Valley Groundwater Basins.

PLACEHOLDER Table SC-9 South Coast Hydrologic Region Average Annual Groundwater Supply by County and by Type of Use (2005-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

As shown in Table SC-8 and Figure SC-12, Metropolitan LA and Santa Ana PAs are the largest users of groundwater in the region with an average annual groundwater supply of about 623 and 637 taf, respectively, with each accounting for about 40 percent of the total groundwater supply for the region. Although Santa Ana PA relies on groundwater supplies for 40 percent for meeting its overall water uses, more than 80 percent of the urban water use within the PA is met by groundwater.

In 2010, about 578 taf of groundwater was pumped in the Metropolitan LA PA, about 40 percent of the overall supplies needed. Major groundwater basins in the PA include the San Gabriel Valley, San Fernando Valley, and Sylmar Groundwater Basins which serve the intensely urbanized and industrialized inland areas of Los Angeles County; the Central and West Coast subbasins of the Coastal Plain of Los Angeles Groundwater Basin which serve the heavily urbanized coastal portions of Los Angeles County. A substantial portion of the water supply needed by the residents, businesses, and industries in the area overlying the Central and West Coast subbasins is from groundwater pumping. Pumping operations in groundwater basins in the PA are limited by the courts via adjudication of water rights.

In the Santa Ana PA, in 2009 about 475 taf of groundwater was pumped. Important basins in the PA include the Coastal Plain of Orange County, Upper Santa Ana Valley, Elsinore, San Jacinto, Hemet Lake Valley, and Seven Oaks Valley Groundwater Basins. In the Santa Ana PA, spreading basins are used to artificially replenish many of these groundwater basins.

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."*

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, and water use efficiency practices.

Figures SC-13 and 14 summarize the 2002 through 2010 groundwater supply trends for the region. The right side of Figure SC-13 illustrates the annual amount of groundwater versus other water supply, while the left side identifies the percent of the overall water supply provided by groundwater relative to other water supply. 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. Figure SC-14 shows the annual amount and percentage of groundwater supply trends for meeting urban, agricultural, and managed wetland uses.

PLACEHOLDER Figure SC-13 South Coast Hydrologic Region Annual Groundwater Supply Trend (2002-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure SC-14 South Coast Hydrologic Region Annual Groundwater Supply Trend by Type of Use (2002-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Figure SC-13 indicates that the annual water supply for the region has remained relatively stable between 2002 and 2010, which is likely due to relatively stable climatic conditions and surface water supply for the region. Between 2002 and 2010, annual water supply fluctuated between 4.1 maf and 5.2 maf. Figure SC-13 and SC-14 indicate that during the same period, groundwater supply has fluctuated between 1.2 maf and 1.9 maf, and provided between 27 and 38 percent of the total water supply for the region. Figure SC-14 indicates that groundwater supply meeting urban use ranged from about 70 to 90 percent of the annual groundwater extraction, with the remaining groundwater extraction meeting agricultural use. Groundwater was not used for meeting any managed wetland use.

Imported Water

Water is brought into the South Coast region from three major sources: the Sacramento-San Joaquin Delta, Colorado River, and Owens Valley/Mono Basin. All three are facing water supply cutbacks because of climate change and environmental issues. Although imported water supplies historically served to help the South Coast region grow, today it is 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 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. LADWP owns and operates the LAAs for conveyance of imported water from the Owens Valley to the City of Los Angeles.

The Colorado River is managed and operated by USBR under numerous compacts, federal laws, court decisions and decrees, contracts, and regulatory guidelines collectively known as the “Law of the River” (Table SC-10). This collection of documents apportions the water and regulates the use and management of the Colorado River among the seven basin states and Mexico. Metropolitan, the largest SWP contractor and primary South Coast region wholesaler, delivers an average of 1.4 or more million acre-feet of SWP and CRA supplies (depending on the availability of surplus water) to its 26 cities, 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 (Table SC-11 and Table SC-12)

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

PLACEHOLDER Table SC-10 Key Elements of the Law of the Colorado River

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table SC-11 Quantification and Annual Approved net Consumptive use of Colorado River Water by California Agricultural Agencies

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table SC-12 Annual Interstate Apportionment of Water from the Colorado River Mainstream within California under the Seven Party Agreement

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Water Transfers

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 Metropolitan Water District of Southern California (Metropolitan), Castaic Lake Water Agency (CLWA), San Bernardino Valley Municipal Water District (San Bernardino Valley MWD), Ventura County Watershed Protection District (VCWPD) (formerly Ventura County Flood Control District), San Gorgonio Pass Water Agency (SGPWA), and San Gabriel Valley Municipal Water District. Metropolitan's contract with DWR is for 1.91 million acre-feet 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 Sacramento-San Joaquin Bay 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 due to a lack of storage, with full deliveries in only the wettest years. Other obstacles that must be overcome in importing water through the SWP include limitations on the movement of water across the Delta system, constraints related to water quality, and the cost of the water. The Governor's Delta Vision Strategic Plan (2008) recently recommended two co-equal goals and associated actions: (1) restore the Delta ecosystem, and (2) create a reliable water supply for California. The plan recommends improving the existing channel through the Delta, developing a second conveyance channel, increasing storage capacity, and expanding local supplies to reduce dependence on imports. The Bay-Delta Conservation Plan, under development by a collaboration of State, federal, and local water agencies, will further address the recovery of endangered and sensitive fisheries in the Delta.

Colorado River System

Another imported water supply source for the region is the Colorado River. California water agencies have a legal entitlement of 4.4 million acre-feet annually of Colorado River water. Of this amount, 3.85 million acre-feet are assigned in aggregate to agricultural users; Metropolitan's annual entitlement is 550,000. Metropolitan is the fourth priority for Colorado River supplies. In supply shortage conditions, the first three priorities would receive their full entitlements; Metropolitan's supplies could be reduced. Until a few years ago, Metropolitan routinely had access to 1.2 million acre-feet annually because Arizona and Nevada had not been using their full entitlement and the Colorado River flow was often adequate to yield surplus water. Metropolitan delivers the available water via the 242-mile CRA and the regional conveyance system.

The Metropolitan diverts Colorado River supplies based on the agreements in the 1931 California Seven-Party Agreement and the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003 (QSA), which further quantifies priorities established in the 1931 document (see Imported Water Supplies, page SC-26 of this report). Metropolitan's 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 increased their diversions in accord with their authorized entitlements. Since 2003, Metropolitan's annual deliveries have varied from a low of 633,000 acre-feet in 2006 to a high of 897,000 acre-feet in 2005. The QSA also identifies measures to conserve and transfer water through the lining of existing earthen canals. The San Diego County Water Authority has further developed conservation and transfer agreements with Imperial Irrigation District to augment its Colorado River Aqueduct supply. With full implementation of the programs identified in the QSA, Metropolitan plans to divert 852,000 acre-feet per year of Colorado River water annually plus any unused agricultural water that may be available. Additional conjunctive use agreements that Metropolitan have in operation to manage its Colorado River Aqueduct supply include the Hayfield, Chuckwalla, and Lower Coachella Valley groundwater storage programs.

Owens Valley/Mono Basin

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

Diversion of water from streams flowing into Mono Lake has been reduced following 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 [MOU]) and the Great Basin Air Pollution Control District/City of Los Angeles MOU (to reduce particulate matter air pollution from the Owens Lake bed).

Other Water Transfers

Prior to 1991, water transfers within the South Coast region had been limited to transfers of annual groundwater basin rights (which continue to occur). Recently, municipal population growth and the need for water supply reliability have resulted in the growth of water transfer agreements. Metropolitan participates in multiple water exchange and storage programs, including agreements with Semitropic Water Storage District (WSD), Arvin-Edison WSD, San Bernardino Valley MWD, Kern-Delta Water District, Mojave Water District, and the Governor's Water Bank. The Castaic Lake Water Agency, to augment its imported water supplies, entered into agreements with several water agencies in the San Joaquin Valley. The agreements with the Buena Vista Water Storage District and Rosedale-Rio Bravo Water Storage District are long-termed, adding 11 taf annually. It also has a limited term agreement with the Semitropic WSD for 15 taf through the year 2020.

In 1998, SDCWA entered into a transfer agreement with Imperial Irrigation District (IID) to purchase conserved agricultural water. The agreement is an important element of the QSA. In 2011, SDCWA received 75,000 taf. The quantity will increase in 10 taf increments annually up to 2000 taf per year in 2021 and then remain fixed for the duration of the 75-year agreement. Metropolitan conveys the transfer water to SDCWA via an exchange agreement.

The Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003 resulted in the concrete lining of the Coachella Canal and All-American Canal. The water supply savings from both projects are being transported to the San Diego County Water Authority, 77 taf annually, and to several bands of Mission Indians in northern San Diego County.

Recycled Water

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 as described in General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water.

Additionally, the Regional Board 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 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.

Desalination

Seawater desalination projects are moving forward in the South Coast region. Two facilities will be constructed by a private company, Poseidon Resources. Recently, the San Diego County Water Authority board of directors approved an agreement with the company to purchase water supplies from the, yet to be built, facility in the City of Carlsbad. This facility will be able to produce up to 50 million gallons per day (mgd) of supplies. The same company is also working with the City of Huntington Beach to build a similar-sized facility there. The City of Long Beach, in coordination with the U.S. Bureau of Reclamation, City of Los Angeles Department of Water and Power, and DWR, currently operates a seawater desalination research and development facility. Other facilities are being proposed for Dana Point 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 demands 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 demands 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-13 shows the downward trend in urban water uses in the South Coast region, by PA.

PLACEHOLDER Table SC-13 Annual per Capita Water Use by Planning Area South Coast Hydrologic Region

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

Agriculture water uses followed the same general trend as urban water uses in the region. After peaking in 2007, annual water uses have been gradually declining. Total applied water uses ranged from a high of 822 taf in 2007 and 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. Stomping or actual removal occurred in Riverside and San Diego counties.

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 area averaged about 3.6 taf annually for the same period. In 2010, Sespe Creek in the Santa Clara 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.

With concerns about costs and supply reliability, farmers and irrigation managers in the South Coast region are utilizing the most appropriate hardware and integrating the necessary practices in order to irrigate their crops as efficiency 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 being irrigated with a combination of hand-move sprinklers and buried pressurized drip irrigation systems. Most all nursery operations use either drip systems, mini-jet sprinklers, or a combination of both in their irrigation operations. Lastly, citrus and avocado orchards from Ventura County to San Diego County are irrigated with well-maintained mini-jet and other sprinklers.

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 of the community drinking water systems in the region are medium or large water systems (serving more than 3,300 people). These water systems deliver drinking water to more than 95 percent of the region's population (see Table SC-14). In addition, there are 19 water systems that primarily provide wholesale drinking water to retail water purveyors.

There is an estimated 182 small water systems in the region with most small water systems serving fewer than 500 people (see Table SC-14). 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 and 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).

PLACEHOLDER Table SC-14 Breakdown of Water System Size

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Water Conservation Act of 2009 (SB x7-7) Implementation and Issues

Urban Water Use Efficiency

Water conservation is a fundamental component of the South Coast region's water management planning. Water agencies in the South Coast have been aggressively implementing water conservation since the 1990s. Many local water agencies are signatories to the California Urban Water Conservation Council (CUWCC) MOU for urban water conservation and also have adopted Urban Water Management Plans to ensure water supply reliability during normal, dry, and multiple dry years. These agencies implement the best management practices (BMPs) and demand management measures contained in those documents. The backbone of Metropolitan's conservation program is the Conservation Credits Program (CCP), initiated in 1988, that contributes $195 per acre-foot of water conserved to assist member agencies in pursuing urban BMPs and other demand management opportunities. All of the region's water suppliers have water conservation programs for their customers which feature residential and commercial water saving tips, rebates for water efficient purchases (e.g., low-flow toilets, high-efficiency clothes washers, weather-based irrigation controllers), and tools for implementing landscape/garden improvements. Local agencies are also developing water conservation master plans and conservation rate structures as well as working closely through integrated regional water management (IRWM) planning efforts to develop coordinated water efficiency programs.

The Water Conservation Act of 2009 (SBx7-7) requires each urban retail agency to establish in its urban water management plan (UWMP) a reduction goal for 2020 to help California achieve a 20 percent statewide reduction in daily per capita water use. SBx7-7 required 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 urban water management plans to DWR. The urban water management plans indicate the South Coast Hydrologic Region had a population-weighted baseline average water use of 188 gallons per capita per day with an average population-weighted 2020 target of

159 gallons per capita per day. The Baseline and Target Data for individual South Coast urban water suppliers is available on the DWR Urban Water Use Efficiency Web site.

Agricultural Water Use Efficiency

With concerns about costs and supply reliability, farmers in the South Coast region are utilizing the most appropriate hardware and integrating the necessary practices in order to irrigate their crops as efficiency 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 hand-move sprinklers and buried pressurized drip irrigation systems. The sprinklers are often used in the early stages of growth for the crop, with drip emitters or drip tape handling the remainder 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 celeries. Most all citrus and subtropical fruit orchards grown in the region are irrigated with micro-jet sprinklers; a strategy that originated back in the 1980s. Irrigation efficiencies of 80 percent or better can be achieved.

The Water Conservation Act of 2009 (SB x7-7) requires each agricultural water supplier 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

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 (CLAA deliveries) and local reservoirs were also quite high in 2006. The CLAA imported slightly less than 393 taf and contributions from local reservoirs totaled 231 taf.

However, within a matter of a few years, these supplies were noticeably impacted 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 impacted. 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 CLAA were 126 taf in 2009 but 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 QSA 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; 1,219 taf and 990 taf, respectively.

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

The use of recycled water supplies showed a gradual increase. In 2006, about 152 taf was delivered to customers and that increased to more than 294 taf in 2010.

PLACEHOLDER Figure SC-15 South Coast Water Balance by Water Year, 2001-2010

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table SC-15 South Coast Hydrologic Water Balance Summary, 2001-2010

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

The South Coast Hydrologic Region consists for four PAs. The instream environmental use (instream and wild and scenic requirements) for the region is limited to the Santa Clara PA (PA 401). There is an instream requirement in San Diego PA (PA 404), but it rarely has measurable flow. Managed wetland environmental use occurs in three PAs. See Table SC-15 and Figure SC-15.

PA 401 urban applied water averaged about 250 taf per year 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 per year. Instream use was fairly constant at about 4 taf per year, while the wild and scenic flows varied from about 10 to about 400 taf. Most of this flow was reused downstream.

Primary supply for PA 401 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 per year of recycled wastewater being applied.

The Metropolitan Los Angeles PA (PA 402) is the most urbanized PA, with urban use steadily decreasing from 1.9 MAF in water year 2006 to 1.5 MAF in WY 2010. More water is used in PA 402 for managed wetlands (27 taf/year) than for agriculture (about 5-6 taf/year).

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 PA (PA 403) is also a highly urbanized area, with 1.2-1.5 maf of water applied to urban uses. About 130-180 taf/ year are applied to agricultural uses and about 5 taf for managed wetlands. Supplies are primarily groundwater with about 500-750 taf being 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 55-110 taf/year.

The San Diego PA (PA 404) also has substantial urban water use, at about 630-950 taf/year. Agricultural applied water ranges from 240 to over 300 taf annually. Managed wetlands use is about 1 taf/year.

PA 404 depends upon 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 deliver imported water to the South Coast region.

The California Aqueduct, a component of the SWP, is 444 miles long, owned and operated by DWR, and carries SWP supplies to water agencies throughout California. The aqueduct begins at the Sacramento-San Joaquin 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 Tehachapis, 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 Gorgonio 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 KWh generated annually); 21 reservoirs (5.8 MAF capacity); storage tanks; and canals, tunnels, and pipelines (DWR 2008b).

The CRA is 242 miles long, owned and operated by San Bernardino Valley 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 2 reservoirs, 5 pumping plants, 63 miles of canals, 92 miles of tunnels, and 84 miles of buried conduit and siphons.

The CLAAs comprise two aqueducts. The first LAA (or the Owens Valley aqueduct) was completed in 1913 and the second LAA was completed in1970. The first LAA was designed to deliver water from the Owens River near Independence to the City of Los Angeles. The second LAA, which added transport capacity in order to exhaust the city's water rights from the Mono Basin, starts at the Haiwee Reservoir just south of Owens Lake. Running roughly parallel to the first aqueduct, it carries water 137 miles to the City of Los Angeles.

The San Diego Aqueducts, with two branch lines, make up the backbone of the SDCWA system. The five pipelines in the two aqueducts have a combined capacity of 826 cubic feet per second (cfs). The first aqueduct (Pipelines 1 and 2) extends 70 miles from the CRA near San Jacinto to San Vicente Reservoir. Constructed by the Navy Department and US Bureau of Reclamation (USBR) during1945 to 1954, the two pipelines share common tunnels and inverted siphons. The 94-mile second aqueduct (Pipelines 4 and 5) were constructed by SDCWA during 1957 to 1979 and are operated separately. Pipeline 3 extends from the CRA to Lower Otay Reservoir, and Pipeline 4 terminates at San Diego's Alvarado Treatment Plant near Lake Murray. Pipeline 5 ends at Lake Murray. Metropolitan owns and operates the northern portions of the pipelines; the delivery point to SDCWA is located six miles south of the San Diego-Riverside county line (USBR 2008a).

Water Quality

Surface Water Quality

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 (DWR 1993). The investigation found that Castaic Lake and Castaic Lagoon water are influenced by thermal stratification and biochemical processes. Castaic Lake contains levels of chloride that can at times vary significantly depending on hydrologic conditions and on regulatory decisions involving the Sacramento San Joaquin Delta. The Los Angeles RWQCB has set a chloride TMDL of 100 milligrams per liter (mg/L). 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 River. The water use agencies within the region are working with the Sanitation District to evaluate options to come up with the lowest cost alternative to meet the compliance levels.

The Los Angeles Region is the state's most densely populated and industrialized region. Despite that, many of the watersheds in this 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 possibly agriculture exists in yet a different 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 and ground waters within the Los Angeles Region are insufficient to support its population. Consequently, water imported from other areas meets about 50 percent of fresh water 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 non-potable purposes such as greenbelt irrigation and industrial processing and servicing.

Approximately 15 percent of the 823 Clean Water Act 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.

In the Santa Ana PA, water 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 last approximately 150 years have degraded surface water quality. Pollutants include nutrients, sediment, pesticides and microbial contaminants such as bacteria. Concentrations of soluble mineral substances commonly referred to as *salinity,* or TDS, also impact surface water quality. 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 (DAMP) and 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 impacting 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 take place. 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 the Santa Ana Watershed Project Authority.

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 constituents, also referred to as ‘emerging constituents’, include a wide range of chemical constituents such as pharmaceuticals, personal care products, pesticides, and other synthetic organic compounds. Potential constituents may include thousands of chemicals in consumer and health-related products such as drugs, food supplements, fragrances, sunscreen agents, deodorants, and insect repellants. 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 to 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 Waste Discharge Requirement 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 on an annual based and is submitted to the Regional Board each year by the Emerging Constituents Program Task Force. This program is revised and updated annually as research and regulatory monitoring requirements arise. The EC Task Force also integrates findings and recommendations from the CDPH and the State Board's Water Recycling Policy expert panel on emerging constituents EC monitoring as they arise.

Groundwater Quality

One challenge to groundwater supplies is contamination, by total dissolved solids (TDS or salinity) and nitrates. These salts accumulate mostly through use and evaporation, but also are introduced to the water supply by way of agricultural fertilizers and septic tanks. Furthermore, other forms of contamination found are TCE, PCE (commonly used solvents) and Perchlorate (fertilizer, fireworks and explosives). All these forms of contamination must be removed from the water using various treatment methods before it can be introduced into the water supply system.

Santa Clara and Metropolitan Los Angeles

The groundwater basin has two sources of groundwater, the Alluvial Aquifer whose quality is primarily influenced by rainfall and stream flow, 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 Valley's groundwater supply is from the Alluvial Aquifer, between 30,000 to 40,000 af/year; and a smaller portion of the Valley's water supply is drawn from the Saugus Formation, between 7,500 and 15,000 af/year in normal water years.

Local groundwater does not have microbial water quality problems. Parasites, bacteria and viruses are filtered out as the water percolates through the soil, sand and rock on its way to the aquifer. Even so, disinfectants are added to local groundwater when it is pumped by wells to protect public health. Local groundwater has very little TOC and generally has very low concentrations of bromide, minimizing potential for DPB formation. Taste and odor problems from algae are not an issue with groundwater.

The mineral content of local groundwater is very different from SWP water. The groundwater is very "hard," and it has high concentrations of calcium and magnesium (approximately 250 to 600 mg/L total hardness as $CaCO3$). Groundwater may also contain higher concentrations of nitrates and chlorides when compared to SWP water. However, all groundwater meets drinking water standards.

Perchlorate is a regulated chemical in drinking water. In October 2007, CDPH established an MCL for perchlorate of 6 micrograms per liter (µg/L). Perchlorate has been a water quality concern in the Valley since1997 when it was originally detected in four wells operated by the Purveyors in the eastern part of the Saugus Formation, near the former Whittaker-Bermite facility. As a result of the contamination, six wells were ultimately taken out of service upon the detection of perchlorate including four Saugus wells and two alluvial wells. All have either been (1) abandoned and replaced, (2) returned to service with the addition of treatment facilities that allow the wells to be used for municipal water supply as part of the overall water supply systems permitted by CDPH or (3) will be replaced under an existing perchlorate litigation settlement agreement (See Section 5 of the Castaic Lake Water Agency's 2010 UWMP for more details on this issue).

The general quality of ground water in the Region has degraded substantially from background levels. Much of the degradation reflects land uses. For example, fertilizers and pesticides, typically used on agricultural lands, can degrade ground water when irrigation-return waters containing such substances seep into the subsurface. In areas that are unsewered, nitrogen and pathogenic bacteria from overloaded or improperly sited septic tanks can seep into ground water and result in health risks to those who rely on ground water for domestic supply.

In areas with industrial or commercial activities, aboveground 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 that result from inadequate handling, storage, and disposal practices, can seep into the subsurface and pollute ground water. Compared to surface water pollution, investigations and remediation of polluted ground waters are often difficult, costly, and extremely slow.

Examples of specific groundwater quality problems include:

- 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 much of the ground water throughout these basins. These deep alluvial basins do not have continuous effective confining layers above ground water and as a result pollutants have seeped through the upper sediments into the ground water. Approximately 20 percent of groundwater production capacity for municipal use in the San Gabriel Valley has been shut down due to 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 Regional Board and EPA are overseeing investigations to further define the extent of pollution, identify the responsible parties, and begin remediation in these areas.

The Los Angeles Department of Water and Power has developed programs to accelerate treatment for the San Fernando Valley groundwater which includes a comprehensive Groundwater System Improvement Study, installing monitoring wells, interim wellhead treatment, and working with regulatory agencies and government officials to identify those responsible for the contamination.

The City of Glendale has been the lead agency for research to determine the effectiveness of processes to remove the contaminant, Chromium IV, from local groundwater supplies. The current State level for the contaminant in drinking water is 5 parts per billion. The final phase of the research is to determine the feasibility of decreasing the level of the contaminant below 1 part per billion.

- Central and West Coast Groundwater Basins (Los Angeles Coastal Plain): Seawater intrusion that has occurred in these basins is now under control in most areas through an artificial recharge system consisting of spreading basins and injection wells that form fresh water barriers along the coast. Ground water 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 Basin, degrading significant volumes of ground water with high concentrations of chloride. Furthermore, the quality of ground water 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 interfingered, the quality of ground water in the deeper production aquifers is threatened by migration of pollutants from the upper aquifers.
- Ventura Central Groundwater Basins: Despite efforts to artificially recharge ground water and to control levels of pumping, ground water in several of the Ventura Central basins has been, and continues to be, overdrafted (particularly in the Oxnard Plain and Pleasant Valley areas). Some of the aquifers in these basins are in hydraulic continuity with seawater; thus seawater is intruding further inland, degrading large volumes of ground water with high concentrations of chloride. In addition, nutrients and other dissolved constituents in irrigation return-flows are seeping into shallow aquifers and degrading ground water in these basins. Furthermore, degradation and cross-contamination are occurring as degraded or contaminated ground water travels between aquifers through abandoned and improperly sealed wells and corroded active wells.

Unsewered areas of Ventura County, such as the El Rio area (to the northwest of Oxnard), represent another source of pollution to ground water in the Ventura Central Basins. In many wells in the El Rio area, nitrate is present in levels exceeding maximum contaminant levels (MCLs) established by the state and federal government.

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 historic land use. Managing levels of TDS in groundwater basins is a significant challenge as the recycling of waste water 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-build up and to remediate high TDS groundwater basins. Elevated levels of nitrates in groundwater originate primarily from use of fertilizers, confined animal feedlots, and waste water treatment facilities.

There are five management zones in the SAR 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 basins areas are also challenged by VOC contamination, perchlorate, TCE, PCE, DBCP, arsenic, hexavalent chromium. Here is summary of the issues and actions being implemented to address those issues by the local agencies.

<u>Upper Santa Ana River Basin</u>

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 thirteen extraction wells produce on average approximately 26,000 af/year, which are treated at the four treatment plants.

In the Bunker Hill B management zone, a six-mile long plume of VOC and ammonium perchlorate contamination, known as the Crafton-Redlands Plume, was first detected in the early 1980’s. Approximately 46 drinking water wells have been affected. A number of well head 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 the 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 onsite waste 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 discharged wastewater. Beaumont Cherry Valley Water District is in the process of providing sewer service to a major portion of the area and has applied for State Revolving Fund loans 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 (TDS) and nitrate concentrations increase in the southern portion of the Basin. Between 2001 and 2006, about 80 percent of the private wells south of Highway 60 had nitrate concentrations greater than the MCL. Pollution from point sources and emerging contaminants are concerns for the overall groundwater quality in Chino Basin. Constituents that have the potential to impact groundwater quality include VOCs, arsenic, and perchlorate.

In the Rialto management zone, at least 20 wells providing 40,135 gallons per minute (gpm) of domestic water supply capacity to the Cities of Rialto and Colton, West Valley Water District and Fontana Water Company have been contaminated by perchlorate. Well head treatment is operating on 11 of these wells. Arsenic at levels above the MCL appears to be limited to the deeper aquifer zone near the City of Chino Hills. Total chromium and hexavalent chromium, while currently not a groundwater issue for Chino Basin, may become so, depending on the promulgation of future standards.

Middle Santa Ana River Basin

Several active sites in the City of Riverside's groundwater production system have increased monitoring schedules due to the presence of contaminants including: nitrate, PCE, dibromochloropropane (DBCP), and perchlorate. As a result, the City of Riverside has implemented blending plans, increased monitoring schedules, and installed well-head treatment to address these elevated levels. Blending plans also are being used to reduce nitrate levels in wells exceeding allowable limits.

San Jacinto River Basin Agricultural activities in the San Jacinto River Basin are suspected to be partially responsible for elevated salt and nitrate concentrations in the groundwater. Septic tank discharges are creating significant water quality problems that have triggered local agency and the Regional Board'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. Due to the unavailability of imported water, 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 clean 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 due to the confirmed presence of various contaminants including nitrate, TCE, PCE, TDS, and other VOCs. Treatment is not required, and monitoring indicates no increase in contaminant levels over time.

Lower Santa Ana River Basin

The Lower Santa Ana River Basin contains four groundwater management zones: Orange County, Irvine, La Habra, and Santiago. The La Habra and Santiago Management Zones have minimal pumping and TDS and nitrate WQOs have not been established due to the scarcity of data. This section focuses on the Orange County and Irvine Management Zones, which are important sources of water in Orange County.

The Orange County Groundwater Basin is the source of approximately 60 to 70 percent of the water supply for 2.3 million people. Of this total production, about 90 percent meets drinking water standards without treatment. The remaining 10 percent requires treatment for VOCs, salts, or other constituents.

A shallow VOC plume exists in the Anaheim/Fullerton area where VOC concentrations exceed MCLs over approximately six square miles. 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 Orange, 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, using reverse osmosis and ion exchange, treat high TDS, nitrate, and perchlorate levels in a section of Tustin. Areas in Garden Grove have groundwater with high nitrate concentrations that are likely the result of historic agricultural practices.

The Irvine Management Zone is a sub-basin 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.

Groundwater contaminated with VOCs exceeding MCLs from the now closed El Toro Marine Corps Air Station also contains high TDS and nitrate concentrations. The Irvine Desalter, using reverse osmosis, air stripping, and carbon absorption, was built to treat the contaminated water. Water treated for VOC contamination is distributed after treatment through the Irvine Ranch Water District non-portable system (irrigation and other non-potable uses); water treated for high TDS and nitrate is distributed through the potable system.

To address and monitor groundwater quality challenges, SAWPA has implemented a task force approach involving multiple agencies who collaboratively agree to prepare water quality monitoring reports and analysis to assure beneficial uses in groundwater are protected.

Drinking Water Quality

See Table SC-16 and Table SC-17 for information regarding contaminants affecting drinking water quality in the South Coast region.

PLACEHOLDER Table SC-16 Summary of Contaminants Affecting Community Drinking Water Systems in the South Coast Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table SC-17 Summary of Community Drinking Water Systems in the South Coast Hydrologic Region Relying One or More Contaminated Groundwater Well that Exceeds a Primary Drinking Water Standard

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Land Subsidence

In the southwestern portion of Chino subbasin of the Upper Santa Ana Valley Groundwater Basin, ground fissures resulting from regional subsidence have been identified as early as the 1970s (CBWM 2007). The area of land subsidence coincides with an area which has 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 (CBWM 2007). Investigations by Kleinfelder (1993, 1996) concluded that a maximum of about two feet of subsidence have occurred in the City of Chino from 1987 to 1995; about one foot of this has occurred from 1993 to 1995. Wildermuth (2011) concluded that two and a half feet of land subsidence occurred from 1985 to 2000, and that little inelastic subsidence has occurred in the area since 2000.

Land subsidence has also been documented in the Coastal Plain of Orange County Groundwater Basin. DWR (1980) reported a subsidence rate of up to 0.84 inch per year from 1956 to 1961 near the City of Santa Ana. Bawden et al. (2001) reported a subsidence rate of 0.5 inch per year near Santa Ana from 1993 to 1999, which coincided with a period of net groundwater withdrawal (OCWD 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 and conjunctively manages groundwater in the basin. The OCWD extracts groundwater, but also systematically replenishes the aquifer. The OCWD has been actively recharging groundwater since 1949 (OCWD 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.

The Oxnard subbasin of the Santa Clara River Valley Groundwater Basin, in Ventura County has experienced land subsidence and seawater intrusion due to groundwater pumping. As early as the 1940s, groundwater levels in the upper aquifer system declined beneath sea level, and widespread seawater intrusion commenced (FCGMA 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 (UWCD 2012). The permanent loss of aquifer storage due to land subsidence is estimated to be about 200 taf (FCGMA 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 due to long-term groundwater withdrawals. The rate of land subsidence due to 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 land subsidence (WRIME 2007).

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 and, depending on annual recharge conditions, 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 deepen wells or lower pumps to regain access to groundwater.

Lowering of groundwater levels can also impact the surface water–groundwater interaction by inducing additional infiltration and recharge from surface water systems, thereby reducing the groundwater discharge to surface water base flow and wetlands areas. Extensive lowering of groundwater levels can also result in land subsidence due to the dewatering, compaction, and loss of storage within finer grained aquifer systems.

During years of normal or above normal precipitation, or during periods of low groundwater use, 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 base flow or wetlands, seeps, and springs.

The movement of groundwater is from areas of higher hydraulic potential to areas of lower hydraulic potential, typically from higher elevations to lower elevations. The direction of groundwater movement can also be influenced by groundwater extractions. Where groundwater extractions are significant, groundwater may flow towards the extraction point. Rocks with low permeability can restrict groundwater flow through a basin. For example, a fault may contain low permeability materials and restrict groundwater flow.

Depth to Groundwater

The depth to groundwater has a direct bearing on the costs associated with well installation and groundwater extraction operations. Understanding the local depth to groundwater can also provide a better understanding of the local interaction between the groundwater table and the surface water systems, and the contribution of groundwater aquifers to the local ecosystem.

Groundwater levels in the region vary from basin to basin. In some parts of the region, groundwater may be found near the ground surface, whereas in other parts, groundwater is found hundreds of feet below the ground surface. Depth-to-groundwater contours for the region were not developed as part of the groundwater content enhancement for the CWP Update 2013. However, depth-to-groundwater data for some of the groundwater basins in the region are available online via DWR's Water Data Library, DWR's CASGEM system, and the USGS National Water Information System. Some references and links to local agencies that independently or cooperatively monitor the groundwater levels in the basins and develop groundwater elevation maps are provided in the next section.

Groundwater Elevations

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

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. However, groundwater elevation contours for the region were not developed as part of the groundwater content enhancement for the CWP Update 2013. 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 include the following.

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

Groundwater Level Trends

Plots of depth-to-water measurements in wells over time (groundwater level hydrographs) allow analysis of seasonal and long-term groundwater level variability and trend over time. Because of the highly variable nature of the physical aquifer systems within each groundwater basin, and because of the variable nature of annual groundwater availability, recharge, and surrounding land use practices, the hydrographs presented herein do not attempt to illustrate or depict average aquifer conditions over a broader region. Rather, the selected hydrographs are intended to help tell a story about how the local aquifer systems respond to changing groundwater pumping quantity and to the implementation of resource management practices. The hydrographs are designated according to the State Well Number System (SWN), which identifies each well by its location using the public lands survey system of township, range, section, and tract.

<u>Hydrograph 04N18W29M002S</u>

Hydrograph 04N18W29M002S (Figure SC-GW-16A) 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. During drought periods such as 1976-1977, the late 1980s to early 1990s, and 2007-2009, groundwater levels typically decline. In contrast, 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 (UCWD 2008).

During the drought of 2007-2009, the United Water Conservation District released captured storm 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 (UWCD 2008). In addition to artificial recharge, infiltration of irrigation water also replenishes the aquifer system (UCWD 2011). The hydrograph thus also illustrates the aquifer response to successful implementation of groundwater recharge during the 2007-2009 drought.

Hydrograph 03S09W32P003S

Hydrograph 03S09W32P003S (Figure SC-GW-16B) 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 which is managed conjunctively and is artificially recharged using recycled water and imported water. The well is completed in alluvium approximately one mile north of the current location of the SAR. Anaheim Lake is a groundwater recharge basin which uses water from the Metropolitan Water District, the SAR, and recycled water from the Groundwater Replenishment System, a project cooperatively operated by the Orange County Water District (OCWD) and the Orange County Sanitation District (OCWD 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 the relatively stable long-term groundwater levels at this location.

Hydrograph 01S03W21H001S

Hydrograph 01S03W21H001S (Figure SC-GW-16C) 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 have risen and remained relatively stable. Groundwater levels do fluctuate in response to variations in hydrologic conditions. In wet years such as 1978, 1993, 1998, and 2005, groundwater levels rise, while in drier years, groundwater levels decline. The San Bernardino Valley MWD 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.

PLACEHOLDER Figure SC-16 Groundwater Level Trends in Selected Wells in the South Coast Hydrologic Region

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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 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 Storage."*

Changes in groundwater storage estimates for basins within the region were not developed as part of the groundwater content enhancement for the CWP Update 2013. Some local groundwater agencies 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 determine change in storage include the following:

- Orange County Water District
- Water Replenishment District of Southern California
- United Water Conservation District

Near Coastal Issues

Coastal waters are impacted by a variety of activities which 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 Clean Water Act 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 polychlorinated biphenyls [PCBs]). Pollutants often accumulate in the sediments of harbors and marinas. This complicates the task of conducting maintenance dredging due to disposal issues and can also impact 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 underway for the facility owned by the City of Long Beach on feasibility of using intake structures on the seafloor as a way to avoid coastal environmental concerns.

Flood Management

Risk Characterization

Floods in the South Coast 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 Hydrologic 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 spill at the Las Llajas Dam near Simi Valley, resulting in considerable erosion on Las Llajas Creek and bridge damage in Moorpark. See Figures SC-17 and SC-18 for statistics on the region's exposure to the 100-year and 500-year floodplains.

PLACEHOLDER Figure SC-17 Flood Hazard Exposure to the 100-Year Floodplain in the South Coast Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure SC-18 Flood Hazard Exposure to the 500-Year Floodplain in the South Coast Hydrologic Region

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Unusually heavy storms hit the region in 2005, 2006, and 2010, causing debris flows. In 2005, two powerful Pacific Ocean storms came on shore to bring heavy rainfall and snow. Many of the region's rivers had significant flow including the Santa Clara River in Ventura County, the SAR, and 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.

The impacts of the storms of 2005, 2006, and 2010 increased in 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, 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.

PLACEHOLDER Table SC-18 Record Floods for Selected Streams, South Coast Hydrologic Region

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Damage Reduction Measures

Santa Ana Planning Area

Most flood damage reduction strategies historically have consisted of hardening and straightening the stream channels to maximize drainage efficiency and buffering peak flows by providing large flood storage facilities. In general, communities in the SAR watershed have been effective at reducing flood damage risk, allowing the traditional California urban and suburban development to be maximized. However, some highly populated areas remain vulnerable to flooding even in fairly modest storms. In addition, the current principle strategies are expensive in terms of money, natural resources impacts, and lost water supply. Changing community values are forcing a re-evaluation of the traditional approach to managing flood risk, in effect changing the terms in the "cost-benefit" equation used for the past century.

There are two additional key issues that flood management must address in order to succeed. First, the basic goals of flood control efforts throughout the watershed need to be clarified and reaffirmed. Although there are few formalized rules, the most common planning and design guideline in the region is to design for the 100-year flood. How and why that level of protection became a community standard, and whether or not it is appropriate, is not free from doubt. There have been recent bills in the legislature proposing different standards, e.g. 200-year protection. This should be a watershed-scale community decision based on a balance of risks and economic and environmental costs. To facilitate such an agreement, we need a common vocabulary for the risks and costs associated with flooding and other competing issues, such as water supply and water quality.

Second, the reality has been that very early land use decisions have preceded flood management strategies and have severely limited the alternatives that flood managers can consider. Once development has been allowed to encroach into a floodplain, regional storage and hardened, straightened, and levied channels may be the only feasible approaches. Ideally, it would be better to devise a flood management strategy during the original planning of the development of a region, so that flood risk management and other land and water needs could be optimized. Because that has never been the practice in most regions, and because many regions are now highly urbanized, flood control agencies and other local agencies will need to collaborate to determine what, if any, new approaches would be productive going forward.

Existing Damage Reduction Structures

Los Angeles County Drainage Area

The Los Angeles County Drainage Area (LACDA) system is a flood management system that started to be 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 specific, 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 the Santa Monica Bay and flowing south towards the 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.

Catastrophic flood events continued through the turn of the 20th century. In 1914, one of the most devastating floods caused approximately $10 million in damages throughout the developing Los Angeles basin, which brought a public outcry for action to address the recurrent flooding problems. As a result, by the following year the Los Angeles County Flood Control District was formed to undertake initial flood control efforts, including the construction of major dams and some channelization. Due to the flooding disasters, the Los Angeles River's purpose was shifted from water supply to flood control. After two more destructive floods in the 1930s, Federal assistance was requested and the U.S. Army Corps of Engineers (USACE) took a lead role in channelizing the river. The channelization effort began in 1938 and required three million barrels of concrete and 100,000 workers. By 1960, the project was completed to form a fifty-one mile concrete-lined watercourse through thirteen cities.

PLACEHOLDER Photo SC-2 Major Flooding in the 1800s & Early 1900s

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Before channelization of the river, flood control projects and utilization of the river as a source of water changed the system of streams, wetlands, and swamps of the natural lands. Channelization provided flood control for the increasingly developed region and a consistent path for the river course. Today, the banks of the river are almost fully lined along its entire length.

In February 1980, flooding caused the lower Los Angeles River to reach channel capacity; therefore, the County of Los Angeles requested the USACE to review the level of flood protection provided by the LACDA system. The 1987 USACE's LACDA review study concluded that the lower Los Angeles River and Rio Hondo provided a 25 to 40-year level of flood protection. As a result, the Water Resources Development Act of 1990 authorized construction of the LACDA project. The USACE completed the LACDA Review Final Feasibility Report in June 1992, which defined the scope of the Project to restore a minimum 100-year level of protection; the LACDA project was approved for construction in 1995.

By 1995, the areas surrounding the river consisted of urbanized development. In the event of a 100-year storm, the communities would have suffered tremendously as floodwaters would have overflowed the levees and eroded the landward side of the levees. Approximately 82 square miles of dense urban areas would have been inundated and impacted 500,000 residents and 177,000 structures in 14 communities. The impacts would have resulted in $2.3 billion in flooding damage. In 1998, due to the threat of flooding, the Federal Emergency Management Agency required 72,000 property owners to purchase flood insurance at a cost of $32 million annually, until the LACDA project was completed.

The LACDA project area included improvements to the lower Los Angeles River, Rio Hondo, and the lower portion of Compton Creek. To increase the flood capacity to a 100-year level of protection, the Project involved raising the earthen levee embankment or building parapet walls on top of 21 miles of existing levees by approximately four feet. The LACDA project also involved the modification of 24 vehicular, railroad, and utility bridges. The construction was originally estimated to take twelve years and cost $375 million. However, due to increases in federal funding the project was completed ahead of schedule in December 2001 and cost $220 million. As a result, the LACDA project was designed to provide multi-purpose features, which converted the Los Angeles River from a single-use flood control facility to a multi-use facility that includes recreational trails, landscaping and aesthetics, and habitat restoration opportunities.

PLACEHOLDER Photo SC-3 Los Angeles River-Deforest Park and Bike Trail

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Santa Ana Planning Area

Prado Dam was built primarily for downstream flood protection, and 92 percent of the Santa Ana River watershed lies above it. More recently, the dam also has become a vital component of the water supply management program in the region, and has al-lowed the creation of ecologically important habitat areas behind the dam. According to a Santa Ana mainstem report, when Prado Dam was built, it was to provide protection against flooding in 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 was completed in 2010. The USACE completed a survey report in 1975 and the Phase I General Design Memorandum (GDM) 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 scheduled for 2010.

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 the 30.5 miles of the SAR from Prado Dam to the Pacific Ocean.
2. Construction of Seven of Seven Oaks Dam (about 3.5 miles upstream of the existing Prado Dam) with a gross reservoir storage of 145,600 acre-feet (af).
3. Enlargement of Prado Dam to increase reservoir storage capacity from 217,000 af to 362,000 af.

The Seven Oaks Dam Watershed comprises 177 square miles, excluding 32 square miles that is isolated by Baldwin Lake. The principal tributary within the Seven Oaks canyon area is Bear Creek, which drains 55 square miles, and has an average gradient of 460 feet/mile. The only existing structure that would affect flood flows in this sub-watershed is Big Bear Lake, which is a water conservation reservoir. It collects water from a 38-square-mile drainage area, and has a surcharge storage capacity of about 8,600 af between the top of the conservation pool and the top of the dam. Aside from Seven Oaks Dam, the only other major flood control dam above Prado Dam is San Antonio Dam.

Other smaller flood control improvements exist along Cucamonga, Deer, Lytle, and Cajon Creeks above Prado Dam, Carbon Canyon Dam and Villa Park Dam in Orange County. These include channelization, debris basins, storm drains, levees, stone and wire-mesh fencing, stone walls or rip-rap along the banks of stream channels, concrete side slope protection, and drop structures. There are more than 100 water conservation and recreational reservoirs in the basin, with storage volumes ranging from 5 af to 182,000 af in Lake Mathews. These improvements affect the regimen of lesser flood flows, but do not appreciably affect major flood flows. Lake Elsinore can have considerable influence on flood flows depending on its water surface elevation at the beginning of a storm.

By 1988, the USACE noted that the SAR was uncontrolled for much of its length in Riverside and San Bernardino Counties above Prado Dam. Flooding in 1969 had caused serious damage to sewage treatment plants, sewage lines, and bridges, and had flooded large areas of agricultural land and caused heavy bank erosion along most of the river. Below Prado Dam, the USACE calculated that downstream communities enjoyed about 70-year flood protection, while parts of the channel near Fountain Valley and Huntington Beach could not contain a 50-year flood. A 100-year flood would inundate over 160 square miles of urbanized land in Orange County.

The intent of the SARP was to provide the developed and developing areas in the watershed with approximately 100-year flood protection through the end of the project life. While this system of infrastructure has been in development, the three counties that comprise the watershed and the various cities within them, have overseen the growth of the region's population and its conversion, broadly speaking, from agriculture to an urban setting. The population of the three counties comprising the watershed was less than 400,000 in 1940, and is now more than 7 million, most densely concentrated in the SAR watershed.

In addition to the mainstem of the SAR, the regional flood control agencies each have extensive plans governing flood management for tributaries. For example, the Upper SAR watershed is contained within San Bernardino County Flood Control District's (SBCFCD's) jurisdiction. There are approximately seven major and three minor mainline flood control systems draining directly into the SAR from San Bernardino County. In addition, two systems flow directly into Prado Flood Control Basin which connects to the SAR. Of these 12 mainline systems, eight are built to their ultimate capacity. The remaining ones are in an interim condition and need upgrading. Many of the regional subsystems that feed these main lines are in interim condition; a few others are merely proposed facilities.

Though most concrete structures typically are designed to have a 50-year lifespan, SBCFCD has a number of facilities that are older than 50 years and still function well. Many of the SBCFCD's facilities were built by the USACE in the 1930s, 1940s, 1950s, 1960s and 1970s. Most of those facilities still are considered to be stable and secure structures with little or no repair requirements.

From SBCFCD's perspective, the majority of the mainline system is built out to ultimate, but the interim facilities operating within our jurisdiction are in need of improvements. The regional interim subsystems consist of rail and wire revetment or simple rock slope protection. These facilities experience erosion and undercutting on a regular basis. Also, these interim systems do not provide the ultimate capacities and as communities develop, increasing runoff volumes further compromise those capacities. In conclusion, although the mainline systems are complete, the regional subsystems are acceptable at best, and the flood control system as a whole is in need of improvements.

Water Governance

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

In the Santa Clara area, State legislation established the Fox Canyon Groundwater Management Agency. This agency is initiating actions to mitigate problems for some of the sub-basins 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, Orange County Water District filed a lawsuit involving several thousand defendants in the upper watershed Riverside and San Bernardino Counties and 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 (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 acre-feet of base flow 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 reservoir subject to flood control use. Water users in the upper basin, represented by the upper basin SAWPA agencies of IEUA, WMWD, EMWD and SBVMWD, have the right to pump, extract, conserve, store and use all surface and groundwater supplies within the upper area, providing lower area entitlement is met.

Management plans for both surface water and groundwater have been prepared and implemented primarily by the SAWPA member agencies including the Santa Ana IRWM. As a result of the cooperation among the litigants from the 1969 Prado Settlement, a joint powers authority known as the Santa Ana Watershed Project Authority (SAWPA) was formed first as a regional planning agency in 1968 and then in 1972 reformed as to assist regional planning and then as a planning and project implementation agency to support planning recommendation. In fact, the regional planning conducted in SAWPA's early days, went on to become the basis for the State Regional Board plans now conducted for water quality planning across the state.

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 agencies utilize their local police powers to manage groundwater through adoption of groundwater ordinances. Groundwater management also occurs through other avenues such as basin adjudication, IRWM plans (IRWMPs), urban water management plans, and agriculture water management plans.

Groundwater Management Assessment

Figure SC-19 shows the location and distribution of the GWMPs within the region 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 2011-2012. Table SC-19 furnishes a list of the same. GWMPs prepared in accordance with the 1992 AB 3030 legislation, as well as those prepared with the additional required components listed in the 2002 SB 1938 legislation are shown. Information associated with the GWMP assessment is based on data that was readily available or received through August 2012. Requirements associated with the 2011 AB 359 (Huffman) legislation, related to groundwater recharge mapping and reporting, did not take effect until January 2013 and are not included in the current GWMP assessment.

PLACEHOLDER Figure SC-19 Location of Groundwater Management Plans in the South Coast Hydrologic Region

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PLACEHOLDER Table SC-19 Groundwater Management Plans in the South Coast Hydrologic Region

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The GWMP inventory indicates that 15 GWMPs exist within the region. All 15 GWMPs are fully contained within the South Coast Hydrologic Region. All but one of the GWMPs cover areas overlying Bulletin 118-2003 alluvial basins. Many of the plans meet the requirements of a GWMP, but also include surface water management and are not exclusively GWMPs. Collectively the 15 GWMPs cover 1,900 square miles. This includes about 1,400 square miles (40 percent) of the Bulletin 118-03 alluvial groundwater basin area in the region. Eleven GWMPs have been developed or updated to include the SB 1938 requirements and are considered active for the purposes of the CWP Update 2013 GWMP assessment. The eleven active GWMPs cover 15 of the 36 basins identified as high or medium priority basins under the CASGEM basin prioritization project (see Table SC-3). The 36 high and medium priority basins account for about 94 percent of the population and about 96 percent of groundwater supply for the region. However, the 15 basins covered by the active GWMPs account for only about 22 percent of the population and about 35 percent of groundwater supply.

Based on the information compiled through inventory of the GWMPs, an assessment was made to understand and help identify groundwater management challenges and successes in the region, and provide recommendations for improvement. Information associated with the GWMP assessment is based on data that were readily available or received through August 2012 by DWR. The assessment process is briefly summarized below.

The California Water Code Section10753.7 requires that six components be included in a groundwater management plan for an agency to be eligible for state funding administered by DWR for groundwater projects, including projects that are part of an IRWM program or plan (see Table SC-20). Three of the components also contain required subcomponents. 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 GWMP assessment. In addition, the requirement for local agencies outside of recognized groundwater basins was not applicable for any of the GWMPs in the region.

In addition to the six required components, Water Code Section 10753.8 provides a list of twelve components that may be included in a groundwater management plan (see Table SC-20). Bulletin 118-2003, Appendix C provides a list of seven recommended components related to management development, implementation, and evaluation of a GWMP, that should be considered to help ensure effective and sustainable groundwater management plan (see Table SC-20).

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 California Water Code Section10753.7?
- How many of the post SB 1938 GWMPs include the twelve voluntary components included in California Water Code 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?

PLACEHOLDER Table SC-20 Assessment for SB1938 GWMP Required Components, SB 1938 GWMP Voluntary Components, and Bulletin 118-03 Recommended Components

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

In summary, assessment of the groundwater management plans in the South Coast Hydrologic Region indicates the following:

- Seven of the eleven active GWMPs adequately address all of the required components listed under California Water Code Section10753.7; plans that fail to meet all of the required components do not address the Basin Management Objective (BMO) subcomponents for monitoring inelastic land subsidence or the interaction of surface water and groundwater. Analysis of the GWMPs for other regions also reveals that when a plan lacks BMO details for surface water and groundwater interaction or land subsidence, it generally lacks details for corresponding Monitoring Protocols as well.
- Six of the eleven active GWMPs incorporate the 12 voluntary components listed in Water Code Section10753.8; one plan incorporates 11 of the voluntary components; two plans incorporate ten of the voluntary components, and the two remaining plans incorporate eight or fewer of the voluntary components.
- Four of the eleven active GWMPs include all seven components and six plans include six of the seven components recommended in Bulletin 118-2003.

The DWR/ACWA survey asked respondents to identify key factors that contributed to the successful implementation of the agency’s GWMP. 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.

Survey participants were also asked to identify factors that impeded implementation of GWMP. The respondents pointed to the lack of money 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 typically are expensive and because the sources of funding for projects typically are limited to either locally raised monies or to grants from State and federal agencies. Half of the respondents said that limited groundwater supply and surface storage and conveyance capacities are impediments to their GWMP implementation.

Finally, the survey asked if the respondents were confident in the long-term sustainability of their current groundwater supply. Nine respondents felt long-term sustainability of their groundwater supply was possible, while the remaining respondents felt long-term sustainability could be an issue.

The responses to the survey are furnished in Tables SC-21 and SC-22. *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."*

PLACEHOLDER Table SC-21 Factors Contributing to Successful Groundwater Management Plan Implementation in the South Coast Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table SC-22 Factors Limiting Successful Groundwater Management Plan Implementation in the South Coast Hydrologic Region

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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.

There are a number of groundwater ordinances that have been adopted by counties in the region (Table SC-23). The most common ordinances are associated with groundwater wells. These ordinances regulate well construction, abandonment, and destruction; however, none of the ordinances provide for comprehensive groundwater management.

PLACEHOLDER Table SC-23 Groundwater Ordinances that Apply to Counties in the South Coast Hydrologic Region

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Special Act Districts

Greater authority to manage groundwater has been granted to a few local agencies or districts created through a special act of the Legislature. The specific authority of each agency varies, but the agencies can be grouped into two general categories: (1) agencies having authority to limit export and extraction (upon evidence of overdraft or threat of overdraft) or (2) agencies lacking authority to limit extraction, but having authority to require reporting of extraction and to levy replenishment fees.

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-24 and Figure SC-20).

PLACEHOLDER Table SC-24 Groundwater Adjudications in the South Coast Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure SC-20 Groundwater Adjudications in the South Coast Hydrologic Region

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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; twenty-three 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; twenty incorporated cities and several unincorporated areas overlie the groundwater basin.

Other Groundwater Management Planning Efforts

Groundwater management also occurs through other avenues such as IRWMPs, urban water management plans, and agriculture water management plans. Box SC-2 summarizes these other planning efforts.

PLACEHOLDER Box SC-2 Other Groundwater Management Planning Efforts in the South Coast Hydrologic Region

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State Funding Received

Santa Clara Planning Area

In 2011, CLWA, as the grantee agency for the Upper Santa Clara River IRWM Region and on behalf of the Regional Water Management Group (RWMG), applied for and was awarded a $6,931,000 Implementation Grant from the DWR through its Proposition 84 IRWM grant program. The $6.9 million Implementation Grant award from Round 1 of DWR's Proposition 84 Implementation Grant Program will help fund four projects that were developed in response to the objectives of the IRWMP. The projects are (1) CLWA's Santa Clarita Valley Water Use Efficiency Plan programs, (2) Newhall County Water District's removal of sewer trunk line from the Santa Clara riverbed, (3) CLWA's Santa Clarita Valley South End Recycled Water Project (Phase 2C) and (4) the City of Santa Clarita/U.S. Forest Service Santa

Clara River and San Francisquito Creek Arundo and Tamarisk removal project. In 2012, CLWA applied for and received notice of draft recommendation of an award of $734,000 from DWR's IRWM Planning Grant Program to update its 2002 Recycled Water Master Plan and prepare the associated environmental documentation, and to update its Water Use Efficiency Strategic Plan. There is an effort underway to identify projects appropriate for the Round 2 Implementation Grant funds currently available through DWR's IRWMP program, applications are due in March 2013.

Santa Ana Planning Area

In 2011, SAWPA received $12.7 million dollars in grant funding to support water related infrastructure and the OWOW Plan goals and objectives from California Proposition 84, Chapter 2, IRWM Implementation Round 1. In 2011, SAWPA applied for and received $1 million in grant funding from the California DWR Prop. 84, Chapter 2, IRWM Planning Grant program, which will allow the OWOW Plan to be updated by late 2013.

Local Investment

Since 2008, SAWPA has invested $1.1 million in local IRWM planning in support of the OWOW plan development. This included extensive coordination, planning and out region throughout the region. In addition, agencies in the watershed are providing $234,167,320 in local funding to match the $12.7 million received from DWR Prop 84 IRWM Implementation grant program.

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

Interregional and Interstate Activities

Interstate Actions

The Metropolitan has a diversion and storage agreement with the Southern Nevada Water Agency for unused Colorado River supplies. In the agreement, Metropolitan 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; Metropolitan would divert less Colorado River.

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

Agreement with Mexico

A five-year agreement has been reached between the United States and Mexico which 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; impacting about 80,000 acres of farmland in the valley. The Metropolitan, the Southern Nevada Water Authority, and Central Arizona Water Conservation District will collectively provide $10 million to assist in the repairs. Metropolitan will contribute $5 million towards 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, as shown in the map below, including: 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 Los Angeles, South Orange County, and Gateway. Coordination with Orange County is frequent, as part of Orange County is 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 Metropolitan, CLWA, San Bernardino Valley MWD, VCWPD, SGPWA, and San Gabriel Valley MWD — 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, Metropolitan also participates with DWR and other State, federal, and local agencies and environmental organizations in the development of the Bay Delta Conservation Plan (BDCP). Metropolitan further maintains individual relationships with each of its 26 member agencies for sale and conveyance of SWP supplies, as well as adjacent agencies with which it has storage and transfer agreements (see discussion below).

Significant restrictions were placed on SWP pumping in accordance with the December 2007 federal court imposed interim rules to protect the Delta smelt (*Hypomesus transpacificus*). Additionally, the inherent annual variability in location, timing, and amount of precipitation in California introduces uncertainty to the availability of future SWP deliveries. Environmental concerns, droughts, and other important factors that impact supply reliability include the vulnerability of Delta levees to failure due to floods and earthquakes, as well as long-term management and maintenance of SWP conveyance infrastructure will impact future deliveries. As the regional SWP wholesaler, Metropolitan is continuing to develop closer relationships with DWR and other State agencies to deal with fundamental Delta issues including environmental protection and levee rehabilitation.

Colorado River

Metropolitan and USBR have been working together for many decades to manage Colorado River deliveries, including drought allocation planning and salinity management. Allocations and diversions of Colorado River water function within the legal and administrative rules known as the “Law of the River” (see Table SC-3). With full implementation of the programs identified in the QSA, Metropolitan expects to be able to annually divert 852,000 acre-feet of Colorado River water plus any unused agricultural water that may be available. With continuation of the current drought, however, the South Coast’s reliance on diversions of excess Colorado River water (such as wet-year flows and allocated but unused supplies) will place substantial pressure on regional water availability.

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

Owens Valley and Mono Basin

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

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

Other Water Storage and Transfers

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

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

Metropolitan's programs with the Kern-Delta Water District and Mojave Water District operate in a similar manner. Dry-year yields for Metropolitan are 50,000 acre-feet and 35,000 acre-feet, respectively.

Some excess floodwater can be routed into the California Aqueduct through the Kern River Intertie. This water is transported from the Tulare Lake Hydrologic Region to the South Coast Hydrologic Region for water supply. Quantities are limited by the flow capability of the aqueduct and by available space in the SWP reservoirs in Southern California.

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

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

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

In 2003, the QSA resulted in the movement of supplies between the Colorado River and South Coast regions. SDCWA was assigned rights to 77,700 acre-feet per year of water that will be conserved through lining of the All-American and Coachella canals in Imperial County. The canal-lining project has been completed and 77,700 acre-feet are being delivered to San Diego annually. Another 16,000 acre-feet per year of water conserved with the lining of the All-American Canal will go the San Luis Rey Indian Water Rights Settlement Parties.

Regional Water Planning and Management

There is a history of intra-regional integrated water management (IWM) 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 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 towards 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. Find more information on the DWR IRWM Web site: http://www.water.ca.gov/irwm/grants/index.cfm.

Santa Clara Planning Area

The Upper Santa Clara River IRWMP identified objectives for implementation within the watershed. The objectives generally apply to the Region as a whole and are meant to focus attention on the primary needs of the Region. The objectives are:

- Reduce Potable Water Demand: Implement technological, legislative and behavioral changes that will reduce user demands for water.
- Increase Water Supply: Understand future regional demands and obtain necessary water supply sources.
- Improve Water Quality: Supply drinking water with appropriate quality; improve groundwater quality; and attain water quality standards. Promote Resource Stewardship: Preserve and improve ecosystem health, and preserve and enhance water-dependent recreation.
- Flooding/Hydromodification: Reduce flood damage and/or the negative effects on waterways and watershed health caused by hydromodification and flooding out-side the natural erosion and deposition process endemic to the Santa Clara River.
- Take Action within the watershed to Adapt to Climate Change
- Promote Projects and Actions that Reduce Greenhouse Gas Emissions

Santa Clara and Metropolitan Los Angeles Planning Areas

IRWM planning activities for the Santa Clara and Metropolitan Los Angeles PAs have attracted stakeholders representing a wide range of agencies and organizations and causes. The agencies and organizations represented 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 in interests, the stakeholders realize that past differences must be set aside and collaborate on the planning and implementation of projects and policies which can have a positive 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 regions is generally good, issues of overlap between IRWM region boundaries and coordination persist.

The group representing the Upper Santa Clara River Watershed IRWM group and the lower watershed Watersheds Coalition of Ventura County (WCVC) IRWMP group have met to coordinate their respective IRWMP activities, to share project ideas, and discuss watershed issues that are 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. However, much work has been accomplished since then.

Joint Projects

Calleguas Regional Salinity Management Project

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

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 acre-feet per year 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 which 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 enhance 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; Waterwise Garden Web Site

An online tool was developed to help property owners and managers to use water more efficiently on landscapes, including information on plant selection, efficient irrigation system design and irrigation maintenance strategies.

Santa Ana Planning Area

The Integrated Regional Water Management Region in the Santa Ana PA, also known as the SAWPA One Water One Watershed 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 includes water supply and wastewater agencies, other State and federal agencies, and local cities and counties. The representation also includes regional Indian 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 sub-region.

Projects

Major IRWM projects that have been administered by SAWPA and funded by the State in the previous decade in the Santa Ana PA are as follows:

Orange County Groundwater Replenishment System

Orange County Groundwater Replenishment System produces 70 mgd of highly treated wastewater for groundwater recharge and a seawater intrusion barrier. Located in the lower Santa Ana River watershed, it is one of the largest water reclamation facilities west of the Mississippi River. 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 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 (Corona) water system with the Western Municipal Water District's (WMWD's) system.

Impaired Groundwater Recovery

The Project will recover and treat impaired groundwater to increase local drinking water supplies for the Irvine Ranch Water District (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 (WVWD)

The Project will remove perchlorate, nitrate, and trichloroethylene (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 (WTP).

Water Conservation Programs through Incentives

The Municipal Water District of Orange County (MWDOC) provides rebate incentives to their customers to reduce water consumption and encourage water conservation. MWDOC is targeting publicly owned and other commercial landscape properties to en-courage 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, the Santa Ana Watershed Protection Agency is moving forward with the following projects.

1. **Ground Water Replenishment System** – Flow Equalization Project. This project will more effectively utilize the available flow of secondary effluent from Orange County Sanitation District (OCSD) 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 (OCSD) Plant No. 1 that supplies secondary effluent to the Orange Country Water Districts 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 million gallons per day 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 manmade 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 storm water and control runoff while removing debris, silt and other contaminates providing a solution for nonpoint 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 Santa Ana River 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 & 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 to reduce the size and cost of downstream drainage facilities.
8. **Inland Empire Brine Line Rehabilitation and Enhancement.** This project Lower Reach IVB will address Lower Reach IVB 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 Eastern Municipal Water District (EMWD) Project 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 2013) 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 (CCWF) 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.

Other noteworthy multi-beneficial projects in the PAs include the following:

1. **Go Gridless by 2020** — In February 2012, the Inland Empire Utilities Agency (IEUA) adopted a new initiative by which it aims to generate all the power it uses during peak electricity-usage hours by the Year 2020. IEUA is well on their way with the establishment of several improvements in wind, solar, fuel cell and food-waste to energy projects that are being implemented through public/private partnerships. Together, these projects generate over 10 megawatts of renewable energy for the agency.
2. **7 Oaks Dam Conservation and Garden Friendly Program** – Through a regional partnership of WMWD & SBVMWD , upper watershed agencies, new agreements between these two agencies to start the process to capture water behind 7 Oaks Dam for water conservation and allow water to be more readily recharged by downstream agencies. Agreements have been forged among not just SBVMWD and WMWD, but also EMWD and IEUA and several other entities, to create the Inland Empire Garden Friendly program to encourage more water efficient landscape irrigation practices, which has been adopted by multiple landscapers and the business community including Home Depot.

San Diego Sub-region

The IRWM Region covers western San Diego, southern Orange, and southwestern Riverside counties. The stakeholders represent wide range of agencies, organizations, and interests in the region. There is a high degree of integration and collaboration between the stakeholders as evident by the formation of the Tri-County Funding Area Coordination Committee (Tri-FACC). 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 water-sheds.

San Diego IRWM Projects

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

Santa Margarita Conjunctive Use Project

This project provides for enhanced recharge of the groundwater basin beneath the Marine Corps Base 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 per year for Camp Pendleton and Fallbrook Public Utilities District and resolve a long-standing water rights dispute between Fallbrook and the federal government

Biofiltration Wetland Creation and Education Program

Through this project, the San Diego Zoological Society developed a bio-filtration wetland within the San Diego Zoo Safari Park that 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, this project will construct advanced water treatment at the San Elijo Water Recreation Facility (SEWRF) for salinity management, production expansion, storm-water 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 project comprises both traditional recycling projects (purple pipes) and support for advanced water treatment. More than 18,000 feet of new recycled water pipelines will be installed and 1,500 af/year of recycled water is projected to be delivered for irrigation purposes. It will also extend the existing recycled water distribution system to selected parklands and implement an advanced water treatment plant 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 this project the County of San Diego set out to demonstrate the practical implementation of a range of low-impact development (LID) practices with the goal of reducing runoff and providing groundwater recharge. Three County facilities in the Chollas Creek sub-watershed 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 Metropolitan's Pipeline No. 6 to Vail Lake. The facilities will convey imported untreated water acquired from San Bernardino MWD 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 MWD 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

This project 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 Santa Margarita River watershed that will help identify use of water quality objectives (WQOs). The project will collect data to support modeling in the SMR estuary and watershed in order to develop TMDLs and continue ongoing research to develop the estuarine nutrient numeric endpoint (NNE) framework, based on dissolved oxygen and macroalgae as endpoints.

Water Conservation Programs through Incentives

The Rancho California Water District (RCWD) provides rebate incentives to their 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.

Accomplishments

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

Integrating Water Management Efforts

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

Increasing Local Surface Storage

South Coast agencies are developing partnerships for reservoir construction, reoperation, and maintenance in order to meet water demands. The Carryover Storage and San Vicente Dam Raise project is a joint project by SDCWA and the City of San Diego to raise the existing dam at San Vicente Reservoir to provide 152 taf in additional capacity.

Tri-County Funding Area Coordinating Committee

The Upper Santa Margarita Regional Water Management Group (RWMG), San Diego RWMG, and South Orange County RWMG collaborate in the San Diego Funding Area through a joint MOU that established the inter-regional body known as the Tri-County Funding Area Coordinating Committee (FACC). Through this unprecedented effort, the FACC is working together to improve planning across regional boundaries and identify opportunities to support common goals and projects. In the most recent

DWR implementation grant program for IRWM programs, the Upper Santa Margarita and San Diego RWMGs collaborated successfully to receive funding for a joint project to establish nutrient water quality objectives for the Sana Margarita River watershed.

Recycled Water

The Groundwater Replenishment System in Orange County is undergoing an expansion which is scheduled for completion in 2014. When completed, the facility will have the capability of providing 103 taf of recycled water supplies; an increase of 31 taf from its current capacity. The project is a key component of long-term strategic water planning for the county which anticipates significant increases in population and water demands over the next two decades.

The City of Los Angeles recently completed its Recycled Water Master Plan which pro-vides a comprehensive strategy on how it can increase the use of recycled water sup-plies to 59 taf by 2035. It identifies potential non-potable uses of the supplies such as landscape irrigation, cooling, and dust suppression at construction sites, groundwater replenishment actions (similar to those being implemented with the Groundwater Replenishment System in neighboring Orange County), and possible financing strategies for the activities.

Recycled water supplies are utilized at a number of projects within Los Angeles. These projects include landscape irrigation at Griffith Park, the Japanese Garden, Wildlife Preserve, and Lake Balboa sites within the Sepulveda Basin Recreation Area in the San Fernando Valley, and the Westside Water Recycling Project. The last project utilizes supplies from the Edward C. Little Water Recycling Facility which is operated by the West Basin Municipal Water District. In 2009, recycled water supply deliveries were 38 taf.

Desalination

California Water Plan Update 2009 provided an excellent summary of operational brackish groundwater desalination projects which are operational in the region. New facilities are still being planned for in the Eastern Municipal Water District’s service area and on the Chino Basin. The California Department of Public Health recently awarded State grant funds the Western Municipal Water District which will be used to expand the pumping capacity of the Chino I and Chino II desalting facilities.

Ocean or seawater desalination activities have increased since Update 2009. As mentioned earlier, San Diego County Water Authority board of directors approved the purchase of up to 56 taf of water supplies from the, yet to be constructed, seawater desalination facility in the City of Carlsbad in November 2012. The agreement is with the private company, Poseidon Resources, which will build the facility; the agreement is for 30 years. The desalination facility, which will have a capacity to produce up to 50 mgd, will be constructed adjacent to the Encina Power Plant and will include a 10 mile pipeline to deliver the water supplies to the SDCWA Aqueduct. Separate agreements for water supply purchases will be initiated by the Vallecitos Municipal Water District and Carlsbad Municipal Water District, both are member agencies of the SDCWA. After financing is secured and construction gets underway, the facility is planning to commence start-up testing in 2015. Poseidon Resources is also working with the City of Huntington Beach, in Orange County, on a similar sized facility.

Testing is underway at the City of Long Beach Water Department’s desalination facility to determine the feasibility of seafloor intake structure to pull in seawater and minimize the impacts on near shore coastal environment. A similar structure could be used in the discharge of brine by-product. The facility is scheduled to be on-line by the year 2020 and producing about 20 taf of water supply annually.

A seawater desalination pilot project is underway for the Municipal Water District of Orange County's South Orange Coastal Ocean Desalination Project in the City of Dana Point. Slant wells are being installed 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.

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.

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. OVOV is a joint effort between the County, the City of Santa Clarita, and Santa Clarita Valley (Valley) residents and businesses to create a single vision and defining guidelines for the future growth of the entire Valley PA. The OVOV effort is intended to achieve enhanced cooperation between the County and the City, coordinated land use planning, improved infrastructure and natural resource management, and enhanced quality of life for those who live and work in the Valley.

Controlling NPS Pollution

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

Hazard Mitigation Plans

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

Stormwater Capture\Groundwater Recharge

Sheldon-Arleta Methane Gas Collection Project

In 1998, a task force comprised of representatives from LADWP, other City of LA departments (Bureau of Sanitation (BOS), Bureau of Engineering, and Environmental Affairs) and the Upper Los Angeles River Area Watermaster was formed to review the issues surrounding the recharge of groundwater through spreading at the Tujunga Spreading Grounds. The objective of this Task Force was to maximize water spreading at the Tujunga Spreading Grounds without causing off-site landfill gas migration. An outcome of the Task Force was the Sheldon-Arleta Methane Gas Collection Project. The project is designed to restore the original Tujunga Spreading Grounds capacity of 250 cfs with the potential for future enhancement by bringing the Tujunga Spreading Basins closest to the Sheldon-Arleta landfill back online. The Tujunga Spreading Grounds are located adjacent to the closed Sheldon-Arleta Landfill.

During spreading operations, water displaces air from the ground potentially increasing migration of methane gas generated by the landfill. In the past, elevated levels of methane gas have been detected in the surrounding communities. Therefore, restrictions were enacted curtailing spreading operations to 20 percent of their original capacity. This project is a joint effort between LADWP and BOS to replace the methane gas collection system within the landfill and thereby contain methane gas onsite. The project is being implemented by LADWP through LABOS's Proposition "O" Clean Water Bond program. Proposition "O" funded approximately $3 million of the $9 million cost. Construction began in 2007 and was completed in November 2009.

Big Tujunga Dam – San Fernando Groundwater Enhancement Project.
LADWP and LACFCD approved a cooperative agreement on September 18, 2007 for the Big Tujunga Dam –San Fernando Groundwater Enhancement Project. This Project will in-crease 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/year for a total capture amount of 6,000 af/year. 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 Integrated Regional Watershed Management Plan and the Tujunga/Pacoima Watershed Plan are being incorporated into the Project. LADWP is contributing $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. To accomplish the goals of the project, a phased approach is being proposed. Phase 1A will deepen and reconfigure the existing basins; Phase 1B will improve the intake capacity by replacing a radial gate with a new rubber dam and telemetry system; and Phase 2 will develop other compatible uses such as recreational trails and native habitat for the community. Estimated recharge is 17,284 af/year, and estimated cost of this project is $10 million of which LADWP will fund $5 million. The Phase 1A reconstruction of the spreading grounds was completed in December 2009 and the Phase 1B intake structure will commence in May 2012 and should be completed by Oct 2012.

Tujunga Spreading Grounds Enhancement Project
The Tujunga Spreading Grounds Enhancement Project is designed to increase average annual stormwater capture by 8,000 af/year 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 early 2013 and finish by mid-2015.

In the Santa Ana PA, extensive progress has been made in stormwater capture and groundwater recharge in both the upper watershed and lower watershed. In the upper watershed, agencies such as San

Bernardino Valley Water Conservation District and the San Bernardino County Flood Control District have developed programs to expand and enhance groundwater recharge. These projects address State and regional priority goals for self-reliance and are consistent with recent legislation encouraging such practices. In the Chino Basin, as a result of funding from CA Prop 13 Water Bond to SAWPA, a total of 16 new and reconfigured flood control basins were constructed that allow for joint use as percolation basins of imported water and stormwater resulting in 100,000 af/year of new recharge. In the lower watershed, Orange County Water District has been able to expand their stormwater capture facilities along the SAR to now capture an average of 57,500 af/year based on the past 10 years.

Pala Wastewater Treatment Plant

Completed in April 2009, the wastewater treatment plant was a response to treat all wastewater generated within the reservation and all flows from the Pala Casino Spa and Resort. Though not mandated, the treatment plant meets CDPH, Title 22 criteria for unrestricted irrigation. In accordance with the Pala Band of Mission Indians continued environmental stewardship, the construction of the treatment plant included many sustainable elements.

Pala Band of Mission Indians Water Conservation Workshops

The Pala Band of Mission Indians Environmental Protection department holds regular water conservation workshops to educate reservation residents about indoor and outdoor water conservation and landscaping.

Challenges

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

Key Challenges

Resource Development

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

Drought

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

Climate Change

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

Sustainability

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

Environmental Concerns in Delta

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

Groundwater Overdraft

Groundwater overdraft and lower groundwater levels are further water supply challenges to the region. Historically, agricultural, industrial, and urban development has led to increased groundwater pumping from many of the region’s basins. Natural recharge is typically insufficient to maintain basin water levels and current pumping levels due to the extent of impervious surfaces and the presence of clay soils. In some basins, over-extraction of groundwater has caused lowering of groundwater tables and seawater intrusion, contributed to land subsidence, and resulted in legal solutions, adjudication, to resolve disputes over pumping rights within specific basins.

Watershed Protection

Strategic planning is needed to balance the water demands of the urban, agriculture, and environment sectors with the available water supplies in important watersheds in the region.

Runoff Management

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

Salinity

Salinity in both local and imported supplies will continue to be a challenge for local water agencies. Salinity sources in local groundwater supplies include concentration from agricultural tailwater, imported water, seawater intrusion, discharge of treated wastewater, and recycled water. Higher levels of treatment are also needed following long-range import of water supplies, as TDS levels are increased during conveyance. High salinity levels and perchlorate contamination contribute to degraded Colorado River supplies. Seawater intrusion and agricultural drainage threatens to increase the salinity of SWP supplies.

The long-term salt balance of the region's groundwater basins is an increasingly critical management issue. Abandoned groundwater basins, due to high salinity levels, have only recently been restored through brackish water desalting projects.

Water Recycling

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

Flood Control Infrastructure

Major challenges include maintenance of 100-year flood protection where it has been provided throughout the South Coast in light of continued urbanization and climate change. Major flood control projects in the Los Angeles, San Gabriel, and Santa Ana areas are threatened as urbanization in the upper watersheds adds to storm volumes. Local funding for flood maintenance and construction projects has become less effective in recent years because of several factors: Laws enacted in response to heightened public awareness of the need to protect the environment have increased the cost of upkeep and improvement; concern for endangered species has made scheduling more complex; both environmental and endangered species conditions have made permits more difficult to obtain; measures to reduce taxation, especially on property, have rendered revenue increases difficult to achieve, and inflation has increased costs. Meeting the requirements of these new restraints has become a high-profile local challenge. Concerns related to funding include invasive species, sediment in channels and reservoirs, decreasing levels of protection as runoff rates increase with urbanization and climate change, aging infrastructure, structural deficiencies of dams, and debris basins that are too small. Finally, adequate evaluation is needed of the long-term secondary impacts of environmental enhancements proposed for integration into flood control projects.

Water Costs

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

Local Flooding Impacts

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

Effects of Urbanization

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

Preparedness for and Response to Flood Events

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

Debris Flows

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

Stormwater Capture

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

Invasive Species

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

Drought and Flood Planning

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

Drought Planning

Following consecutive years of above-average precipitation in the state, dry conditions settled in, peaking in the winter of 2008 and 2009. Coupled with the legal ruling on the Delta, wholesale and retail water responded with region-wide decisions and actions to mitigate the impacts. The Metropolitan utilized the guidelines from Water Surplus and Drought Management Plan, which was adopted in 1999, in its response to the dry conditions. The guidelines provide the framework for the coordination of delivery operations to member agencies of surplus or stored water supplies and the pursuit of transfer and banking programs and agreements to mitigate the impacts of any shortages. The conditions also prompted MWDSC to activate its Water Supply Allocation Plan for fiscal year 2009-2010. The WSAP is a component for the WSDMP and can be activated in the plan's critical shortage stages.

Retailed water agencies throughout the region, even those with diversified resources, responded aggressively to the challenges posed by these conditions. Many of the agencies have active water shortage contingency plans and ordinances and implemented the appropriate responses and measures based on their supply situation and decisions made by MWD on the imported supply allocations.

Drought Preparedness

Local agencies have been improving their ability to respond to droughts, based on the experiences of recent dry periods, steady improvement in the implementation and effectiveness of water use efficiency programs and policies, and utilization of other or alternative water supplies to meet demands. Many of these water agencies have prepared emergency response plans to respond to short- and long-term supply problems. Many of these are well-documented in management plans prepared in response to the Urban Water Management Planning Act.

Flood Planning

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

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

Some areas within the region have recently developed flood mitigation plans and a multi-hazard mitigation plans while others are partnering with FEMA to update flood hazard maps and also working on levee certification.

Looking to the Future

Future Conditions

Future Scenarios

For Update 2013, the California Water Plan (CWP) evaluates different ways of managing water in California depending on alternative future conditions and different regions of the state. The ultimate goal is to evaluate how different regional response packages, or combinations of resource management strategies from Volume 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 to manage uncertainty and risk at a regional level. The future scenarios are comprised of factors related to future population growth and factors related to future climate change. Growth factors for the South Coast are described below. Climate change factors are described in general terms in Volume 1, Chapter 5.

South Coast Growth Scenarios

Future water demand in the South Coast hydrologic region is affected by a number of growth and land use factors, such as population growth, planting decisions by farmers, and size and type of urban landscapes. See Table SC-2 for a conceptual description of the growth scenarios used in the CWP. The CWP quantifies several factors that together provide a description of future growth and how growth could affect water demand for the urban, agricultural, and environmental sectors in the South Coast region. Growth factors are varied between the scenarios to describe some of the uncertainty faced by water managers. For example, it is impossible to predict future population growth accurately, so the CWP uses three different but plausible population growth estimates when determining future urban water demands. In addition, the CWP 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 in 2050 and are used by the CWP to quantify encroachment into agricultural lands by 2050 in the South Coast region.

PLACEHOLDER Table SC-25 Conceptual Growth Scenarios

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

For Update 2013, DWR worked with researchers at the University of California, Davis, to quantify how much growth might occur in the South Coast 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 (see http://ice.ucdavis.edu/project/uplan for information on the UPlan model). 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-26 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 thousand acre under low population growth scenario (LOP) by 2050 relative to 2006 base-year footprint of about 1800 thousand acres. Urban footprint under high population scenario (HIP), however, grew by about 600 thousand acres. The effect of varying housing density on the urban footprint is also shown.

PLACEHOLDER Table SC-26 Growth Scenarios (Urban) – South Coast

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Table SC-27 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 thousand acres by year 2050 as a result of low population growth and urbanization in the South Coast region, while the decline under high population growth was higher by about 100 thousand acres.

PLACEHOLDER Table SC-27 Growth Scenarios (Agriculture) – South Coast

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

South Coast 2050 Water Demands

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

Figure SC-21 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-25. The change in water demand is the difference 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. The solid blue dot in Figure SC-21 represents the change in water demand under a repeat of historical climate, while the open circles represent change in water demand under 12 scenarios of future climate change.

PLACEHOLDER Figure SC-21 Change in South Coast Agricultural and Urban Water Demands for 117 Scenarios from 2006-2050 (thousand acre-feet per year)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Urban demand increased under all 9 growth scenarios tracking with population growth. On average, it increased by about 1210 thousand acre-feet under the three low population scenarios, 2100 thousand acre-feet under the three current trend population scenarios and about 3790 thousand acre-feet under the three high population scenarios when compared to historical average of about 3850 thousands-acre-feet. 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 due to reduction in irrigated lands as a result of urbanization and background water conservation when compared with historical average water demand of about 790 thousand acre-feet. Under the three low population scenarios, the average reduction in water demand was about 160 thousand acre-feet while it was about 330 thousand acre-feet for the three high population scenarios. For the three current trend population scenarios, this change was about 210 thousand acre-feet. The results show that low density housing would result in more reduction in agricultural demand since more lands are lost under low-density housing than high density housing.

Integrated Water Management Plan Summaries

Inclusion of the information contained in IRWMPs into the CWP 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 CWP update has taken on the task of summarizing readily available IWM plans in a consistent format for each of the regional reports. This collection of information will not be used to determine IRWM grant eligibility. This effort is ongoing and will be included in the final Water Plan updates and will include up to four pages for each IRWMP in the regional reports.

In addition to these summaries being used in the regional reports we intend to provide all of the summary sheets in one IRWMP Summary "Atlas" as an article included in Volume 4. 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.

All IRWMPs 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 IRWMPs — those who were involved in the preparation — to have input on the summary. It is the intention that this process be initiated following release of Water Plan Update 2013 and will continue to be part of the process of the update process for CWP Update 2018. This process will also allow for continuous updating of the content of the atlas as new IRWMPs are released or existing IRWMPs are updated.

As can be seen in Figure SC-22, there are eight IRWM planning efforts ongoing in the South Coast Hydrologic Region.

PLACEHOLDER Figure SC-22 Integrated Water Management Planning in the South Coast Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Placeholder Text: At the time of the Public Review Draft the collection of information out of the IRWMPs in the region has not been completed. Below are the basic types of information this effort will summarize and present in the final regional report for each IRWMP available. An opportunity will be provided to those with responsibility over the IRWMP to review these summaries before the reports are final.

Region Description: This section will provide a basic description of the IRWM region. This would include location, major watersheds within the region, status of planning activity, and the governance of the IRWM. In addition, a IRWM grant funding summary will be provided.

Key Challenges: The top five challenges identified by the IRWM would be listed in this section.

Principal Goals/Objective: The top five goals and objectives identified in the IRWMP will be listed in this section.

Major IRWM Milestones and Achievements: Major milestones (Top 5) and achievements identified in the IRWMP would be listed in this section.

Water Supply and Demand: A description (one paragraph) of the mix of water supply relied upon in the region along with the current and future water demands contained in the IRWMP will be provided in this section.

Flood Management: A short (one paragraph) description of the challenges faced by the region and any actions identified by the IRWMP will be provided in this section.

Water Quality: A general characterization of the water quality challenges (one paragraph) will be provided in this section. Any identified actions in the IRWMP will also be listed.

Groundwater Management: The extent and management of groundwater (one paragraph) as described in the IRWMP will be contained in this section.

Environmental Stewardship: Environmental stewardship efforts identified in the IRWMP will be summarized (one paragraph) in this section.

Climate Change: Vulnerabilities to climate change identified in the IRWMP will be summarized (one paragraph) in this section.

Tribal Communities: Involvement with tribal communities in the IRWM will be described (one paragraph) in this section of each IRWMP summary.

Disadvantaged Communities: A summary (one paragraph) of the discussions on disadvantaged communities contained in the IRWMP will be included in this section of each IRWMP summary.

Governance: This section will include a description (less than one paragraph) of the type of governance the IRWM is organized under.

Resource Management Strategies

Volume 3 contains detailed information on the various strategies which can be used by water managers to meet their goals and objectives. A review of the resource management strategies addressed in the available IRWMPs is summarized in Table SC-28.

PLACEHOLDER Table SC-28 Resource Management Strategies addressed in IRWMP's in the South Coast Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the 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 and groundwater 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 is 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 survey undertaken in 2011-2012 jointly by DWR and ACWA to inventory and assess conjunctive management projects in California is summarized in Box SC-3. *More detailed information about the survey results and a statewide map of the conjunctive management projects and operational information, as of July 2012, is available online from Update 2013, Volume 4, Reference Guide, the article "California's Groundwater Update 2013."*

PLACEHOLDER Box SC-3 Statewide Conjunctive Management Effort in California

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Conjunctive Management Inventory Results

Of the 89 agencies or programs identified as operating a conjunctive management or groundwater recharge program in California, 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.

Based on the information reported in the survey, the administrator/operator of a conjunctive management project is generally the lead agency of the project. Most of the survey respondents included multiple goals and objectives. As shown in Figure SC-23, 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.

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 TL-24, limited aquifer storage, cost, institutional constraints, political constraints, and water quality issues were indicated to be the greatest constraints, with an average ranking of 3.0 to 3.9 (moderate constraint). Surprisingly, legal constraint was indicated as in-between low to moderate constraint, with a score of 2.0. This likely is due to the relatively high number of adjudicated groundwater basins in the region.

PLACEHOLDER Figure SC-23 Conjunctive Management Program Goals and Objectives

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure SC-24 Constrains Towards Development of Conjunctive Management and Water Banking Programs

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Available details about some of the conjunctive management projects in the region are furnished below.

Many agencies in the Metropolitan LA PA 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. Los Angeles Department of Water and Power, in conjunction with the Los Angeles County Flood Control District, implemented several storm water capture projects with the goal of increasing long-term groundwater recharge by a minimum 20 taf per year. In addition, recycled water is infiltrated in spreading grounds and injected (along with imported water) along the coast to form barriers to seawater intrusion at three locations (the Alamitos, Dominguez Gap, and West Coast barriers).

The Metropolitan has agreements with more than one dozen of their 26 member agencies to operate conjunctive management programs. According to the MWD, some conjunctive management programs include groundwater basins located in the South Coast and Tulare Lake Hydrologic Regions. In the South Coast Hydrologic 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. The 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 their member 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 factors such as surface water availability and overall water demand. According to the MWD, the estimated annual recharge in the South Coast Hydrologic Region is about 51 taf and the estimated annual extraction is about 70 taf. In addition to the MWD agreements, some member agencies independently operate conjunctive use projects and recharge additional water to the basins they manage. The source of water used for recharge is the SWP and the Colorado River. The operating cost of the MWD-member agency conjunctive use programs range between $55 and $147 per acre-foot. The constraints of the conjunctive use programs identified by the

MWD include political and institutional constraints, impacted water quality, limited aquifer storage, and complex geology.

The Water Replenishment District (WRD) operates conjunctive use programs in the West Coast and the Central Groundwater Basins. 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. WRD 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, and legal constraints.

Groundwater extraction in the Santa Ana PA is supported by incidental and artificial recharge of recycled water, imported water, and storm water supplies. On average, about 80 taf per year of imported supplies from Metropolitan are recharged each year to support groundwater production.

The Coastal Plain of Orange County Groundwater basin, managed by the Orange County Water District (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 Groundwater Replenishment System (GWRS), the world's largest advanced water purification system for potable reuse. The GWRS (http://www.gwrsystem.com/home.html) became operational in 2008 and purifies treated wastewater (70 taf/year), 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 which percolates into the groundwater basin and replenishes the aquifer system.

Groundwater production in the San Diego PA is limited by lack of storage capacity in local aquifers, availability of groundwater recharge, and degraded water quality. The local groundwater basin in and around the City of Temecula benefits from recharge of storm water 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 underway in San Bernardino County 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 from Update 2013, Volume 3, Chapter 9, "Conjunctive Management and Groundwater Storage."

Regional Resource Management Strategies

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 which have been implemented 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.

Groundwater Desalination

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

This resource management strategy is heavily used in the Santa Ana area. The Arlington desalting facility provides is located near the City of Riverside and is owned and operated by Western Municipal Water District. 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 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. The Eastern Municipal Water District 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.

Other desalting facilities in the Santa Ana area include the Temescal facility, by the City of Corona, the Irvine Desalter Project, a joint groundwater quality restoration project by IRWD and OCWD. The Temescal facility yields about 17 taf and the Irvine Desalter Project yields 0.4 af/year of non-potable water supplies and 5 taf/year of potable water sup-plies which yields 7.7 taf/year of potable drinking water and 4 taf/year of non-potable water, and the Tustin Seventeenth Street Desalter, which is owned and operated by the City of Tustin, and yields approximately 2.1 af/year.

In the San Diego PA, 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 PA 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 Castaic Lake Water Agency, and Simi Valley Water Quality Control Plant. The City of Oxnard expects to be delivering recycled water from an advance water treatment facility currently under construction as part of its Oxnard 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, recycled water supplies are being utilized through-out. Within the City of Los Angeles, recycled water projects include landscape irrigation at Griffith Park, the Japanese Garden, Wildlife Preserve, and Lake Balboa sites within the Sepulveda Basin Recreation Area in the San Fernando Valley, and the Westside Water Recycling Project. The last project utilizes supplies from the Edward C. Little Water Recycling Facility which is operated by the West Basin Municipal Water District. In 2009, about 38 taf of recycled water supplies were delivered to different users throughout the city. 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 M & I 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).

In the Santa Ana area, the largest recycled water project is the Groundwater Replenishment System in Orange County. The facility is currently undergoing expansion, but Orange County Coastal Plain groundwater basin is being recharged annually with 72 taf of recycled water supplies. Water agencies with active recycled water programs include the Inland Empire Utilities Agencies (IEUA), Eastern Municipal Water District (EMWD), and Irvine Ranch Water District. All three agencies are moving ahead with plans to install the necessary facilities in order to deliver the supplies to potential customers within their respective service areas. IEUA reported a little less than 25 taf of recycled water deliveries in 2009-2010, EMWD reported a little over 28 taf in deliveries, and IRWD reported about 22 taf.

Several wastewater reclamation facilities are in operation in the San Diego area. In San Diego County, recycled water use has proven to be and will continue to be reliable water supply source. In 2010, recycled water uses totaled about 28 taf. By 2035, those uses are expected to increase to almost 50 taf. The City of San Diego recently completed a pilot study to determine the feasibility of using recycled water supplies to augment non-recycled water supplies in local reservoirs. Data from the study are being analyzed for presentation to the City Council.

In the Temecula Valley of Riverside County, two facilities treat urban wastewater and are the source of recycled water supplies. The facilities are the Santa Rosa Water Reclamation Facility and the Temecula Valley Regional Water Reclamation Facility; both 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 CUWCC. 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 is-sues, 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, the Metropolitan restated its goal of achieving 1.033 MAF of water supply savings from programs by the year 2025.

A variety of water use efficiency programs are being implemented in the region. These include rebates and direct installation programs for ultra-low flush and 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, Metropolitan continues to offer a blend existing (Water Conservation Credits program) and successful programs in addition new consumer assistance programs to help achieve water savings goals. The latest are the “SoCal WaterSmart” and “Save Water-Save A Buck.” Both provide partial rebates for the purchase of water efficient appliances, fixtures, and equipment for residential, commercial, and industrial customers within Metropolitan’s service area. There is also some flexibility in how the programs can be utilized. For SoCal WaterSmart, the Western Municipal Water District, and the City of Los Angeles Department of Water and Power (LADWP) use the program 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 climate-appropriate plants and other kinds of landscaping materials. The Save Water-Save A Buck 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 is the LADWP ultra-low flow and high efficiency toilet rebates for its single-family residential customers and Technical Assistance program which offers financial incentives for water saving projects and financial assistance for its CII customers.

Water supply conserving rate structures are slowly being developed and implemented in the region. An example of this pricing strategy is from the Irvine Ranch Water District. It began implementation of 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; 31 percent for the landscape.

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 have water education programs to serve in the municipal and industrial customers and schools within their respective service areas. The dissemination of information is handled in variety of different ways; from printed literature (technical reports to general information brochures), the media (DVDs), and utilization of the internet (Web sitess with information and downloadable material). Some programs feature speaker bureaus (staff to make presentations at public events and school activities) and tours of water facilities. In during emergencies, provide information and updates to the appropriate local television, radio, newspaper, and internet services.

In addition to the array of programs targeting its M & I customers, the City of San Diego interacts with their customers by running annual water conservation film and poster contests. The city is one of several agencies to operate a water-efficient demonstration garden to provide suggestions on climate-appropriate plants and irrigation systems for residential and commercial landscaping. The garden is located on the campus of Cuyamaca Community College in southern San Diego County.

Pollution Prevention

Beneficial uses form the cornerstone of water quality protection under the Basin Plan. 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 California Water Code. In addition, the federal Clean Water Act mandates standards for all surface waters.

In many cases, protecting the quality of ground or surface waters (through protection of beneficial uses) results in protection of a local water supply that can help minimize the need for use of imported water. Regional Boards within the South Coast Hydrologic Region implement the following Resource Management Strategies either regularly through a variety of ongoing programs or through specific activities which occurred during 2009 – 2013.

The Water Boards implement a wide variety of pollution prevention activities and statewide policies have been established to address both point and nonpoint sources of pollution; many of these activities overlap with other resource management strategies described below. The Water Boards issue either individual or general National Pollutant Discharge Elimination System (NPDES) permits to prevent pollution from point source discharges. Development of Total Maximum Daily Loads (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 stream flows and channels, through the CWA Section 401 water quality certification program, aids in pollution prevention and protection of wetlands.

The Los Angeles Regional Board is also addressing nonpoint source pollution such as runoff from irrigated agriculture, impacts from onsite wastewater treatment systems (OWTS), pollution associated with marinas, and runoff from livestock and horse enclosures. In such cases, the Regional Board has the authority to protect water quality through WDRs, waivers of WDRs, or prohibitions.

Regional Boards may issue both categorical and individual waivers. In the case of categorical waivers, the Regional Board must approve and issue categorical waiver criteria either through adopting a specific resolution or Basin Plan amendment. Once a categorical waiver is approved by the Regional Board, Regional Board staff may be delegated the responsibility to review and approve 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 Clean Water Act Section 303(d) List. The 305(b) report and the 303(d) list are combined into the California 303(d)/305(b) Integrated Re-port.

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 (40 CFR 130.6). The Regional Boards hold regulatory authority for many of the instruments used to implement the TMDLs, such as the NPDES permits and WDRs. The Los Angeles Regional Board has adopted or reconsidered ten TMDLs since 2009. A total of 43 TMDLs are in effect within the Los Angeles Region (including those established by EPA).

Ecosystem Restoration

The Regional Board continues involvement in the Southern California Wetlands Recovery Project (WRP) which is a partnership of public agencies working cooperatively to acquire, re-store, and enhance coastal wetlands and watersheds between Point Conception and the Inter-national 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 to estimated historical acreages, Los Angeles County has lost 93 percent of its wetlands while Ventura County has lost 58 percent of its wetlands. Currently, the Project funds wetlands projects which involve planning, restoration, or acquisition. Some of the this region's wetlands given a high priority for funding include Los Cerritos Wet-lands, Malibu Lagoon, Ormond Beach Wetlands, and the Ventura River estuary.

Several major recent activities of the WRP have direct relevance to our wetlands protection efforts. The WRP participated in development of a method to assess the condition of wetlands, the California Rapid Assessment Method (CRAM). 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/sub-basin in the state to have a salt and nutrient management plan (SNMP). 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.

Per the Recycled Water Policy, SNMPs shall be tailored to address water quality concerns in each basin and may include constituents other than salt and nutrients that adversely impact basin/sub-basin water quality. The policy also dictates that each salt and nutrient management plan includes:

- A basin/sub-basin wide monitoring plan that includes an appropriate network of monitoring locations to determine whether concentrations of salt, nutrients, and other constituents of concern are consistent with applicable water quality objectives.
- A provision for annual monitoring of Constituents of Emerging Concern
- Water recycling and stormwater recharge/use goals and objectives
- Salt and nutrient source identification, basin/sub-basin assimilative capacity and loading estimates, together with fate and transport of salts and nutrients.
- Implementation measures to manage salt and nutrient loading in the basin on a sustainable basis.
- An antidegradation analysis demonstrating that the projects included within the plan will collectively satisfy the requirements of the Antidegradation Policy (Resolution No. 68-16).

Implementation plans developed for those groundwater basins where water quality objectives for salts or nutrients are being, or are threatening to be, exceeded are expected to be adopted by the Regional Water Boards 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 Storm Water Mitigation Plans (SUSMPs) and numerical design standards for BMPs. The SUSMPs are designed to ensure that storm water 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 storm water 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) storm water runoff from the first ¾ inch of rainfall, prior to its discharge to a storm water conveyance system.

Watershed Management

The watershed management RMS is the process of creating and implementing plans, programs, projects, and activities to restore, sustain, and enhance watershed functions. The Los Angeles Regional Board 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) which explains the Board'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 (POTWs) within the Los Angeles and San Gabriel Rivers 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 in order to answer important watershed health questions while making more efficient use of limited public funds.

Stormwater Capture

The Los Angeles Department of Water and Power is preparing a Stormwater Capture Master Plan (Stormwater Plan) that will investigate potential strategies for advancement of stormwater and watershed management in the City of Los Angeles. The Stormwater Plan will be used to guide decision makers in the City when deciding how the City will develop both centralized and distributed stormwater capture goals. The Stormwater Plan will include evaluation of existing stormwater capture facilities and projects, quantify the maximum stormwater capture potential, develop feasible stormwater capture alternatives (i.e., projects, programs, potential policies, etc.), and provide potential strategies to increase stormwater capture. The Stormwater 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.

The Stormwater Plan will recommend stormwater capture projects, programs, policies, and incentives for the City of Los Angeles.

Benefits of the Stormwater Plan include:

- Investigation of stormwater capture models such as the Groundwater Augmentation Model and the Watershed Management Modeling System to identify maxi-mum potential groundwater recharge.
- Increased water conservation.
- Improved water quality.
- Reduced peak flow in the Los Angeles River.

Project partners and supporters include:

- City of Los Angeles Department of Water and Power
- City of Los Angeles Department of Public Works
- County of Los Angeles Department of Public Works
- TreePeople, Inc.

A Request for Proposal for the Stormwater Plan was released in late 2011. The contract is anticipated to be awarded by March 2012, and completion of the Stormwater Plan will take approximately 24 months.

In the Santa Ana PA, the following State water plan objectives are being addressed through the defined CA Water Plan water resource management strategies.

Reduce Water Demand

Urban Water Use Efficiency & Agricultural Water Use Efficiency – Under the SAWPA IRWMP defined as "One Water One Watershed", a water use efficiency pillar or workgroup was established of stakeholders 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 was established for the watershed. This will be primarily achieved through compliance with Senate Bill 7 – Statewide Water Conservation passed as part of the State Comprehensive Water Package in Nov. 2009. This legislation establishes one of the most progressive mandates to establish statewide water use efficiency standards in the State's history and will result in significant water use efficiency for both urban and agricultural water suppliers. For the first time in California's history, this bill requires the development of agricultural water management plans and requires urban water agencies to reduce statewide per capita water consumption 20 percent by 2020.

Operational Efficiency and Transfers

Water Transfers – Under the most recent update to the OWOW Plan described as OWOW 2.0, a new pillar 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 up areas of opportunities across the watershed to explore internal water transfers in order to optimize water availability and reliability.

Increase Water Supply

Conjunctive Management and Groundwater Storage, Desalination, Recycled Municipal Water, Surface Storage-Regional/Local – 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 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 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 year, reuse of all SAR flow at least once, capture and recharge of 80 percent of rainfall, and assuring adequate water supply and safe wastewater treatment and disposal.

Improve Water Quality

Drinking Water Treatment and Distribution, Groundwater Remediation/Aquifer Remediation, Matching Water Quality to Use, Pollution Prevention, Urban Runoff Management, Salt and Salinity Management – 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, SWOT, and 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, 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 the State's 93-mile brine disposal pipeline to the ocean.

Practice Resources Stewardship

Land Use Planning and Management, Forest Management, Watershed Management – In the Santa Ana PA, under OWOW planning a pillar workgroup was created for Water and Land Use Planning 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 long standing practice and mission of the Santa Ana Watershed Project Authority, administrator of the OWOW plan. For the Santa Ana PA, 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

Flood Risk 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:

1. Reduce the Chance of Flooding
2. Reduce the Consequences of Flooding
3. Sustain Economic Growth
4. Protect and Enhance Ecosystems
5. Promote Sustainability

FloodSAFE includes four major categories

A. Improve Emergency Response
B. Improve Flood Management Systems
C. Inform and Assist Public
D. Improve Operations and Maintenance

All Flood-SAFE 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 impacting many resource sectors in California, including water, transportation and energy infrastructure, public health, biodiversity, and agriculture (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. Projected changes in annual precipitation patterns in California will result in changes to surface runoff timing, volume, and type (Cayan 2008). Recently developed 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).

Currently, enough data exist to warrant the importance of contingency plans, mitigation (i.e., reduction) of greenhouse gas (GHG) emissions, and incorporating 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), global impacts from carbon dioxide and other GHGs that are already in the atmosphere will continue to impact climate through the rest of the century (Intergovernmental Panel on Climate Change 2007.

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).

Observations

The region's observed temperature and precipitation vary greatly due to complex topography. Regionally-specific temperature data can be retrieved through the Western Regional Climate Center (WRCC). The region's observed temperature and precipitation vary greatly due to complex topography. Regionally-specific temperature data can be retrieved through the Western Regional Climate Center (WRCC). The WRCC has temperature and precipitation data for the past century. Through an analysis of National Weather Service Cooperative Station and PRISM Climate Group gridded data, scientists from the WRCC have identified 11 distinct regions across the state for which stations located within a region vary with one another in a similar fashion. These 11 climate regions are used when describing climate trends within the state (Abatzoglou et al. 2009). DWR's hydrologic regions, however, do not correspond directly to WRCC's climate regions. A particular hydrologic region may overlap more than one climate region and, hence, have different climate trends in different areas. For the purpose of this regional report, climate trends of the major overlapping climate regions are considered to be relevant trends for respective portions of the overlapping hydrologic region.

Locally in the South Coast hydrologic region within the WRCC South Coast climate region, mean temperatures have increased by about 1.9 to 3.0 °F (1.1 to 1.7 °C) in the past century, with minimum and maximum temperatures increasing by about 2.6 to 3.7 °F (1.4 to 2.1 °C) and by 1.1 to 2.3 °F (0.6 to 1.3 °C), respectively (Western Regional Climate Center 2012). Within the WRCC Southern Interior climate region, mean temperatures have increased by about 1.0 to 2.2 °F (0.6 to 1.2 °C) in the past century, with minimum and maximum temperatures increasing by about 1.3 to 2.4 °F (0.7 to 1.3 °C) and by 0.7 to 2.1 °F (0.4 to 1.2 °C), respectively (Western Regional Climate Center 2012). 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 2008).

The South Coast region also is currently experiencing impacts from climate change through changes in statewide precipitation and surface runoff volumes, 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 (DWR 2008). 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 2008).

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 to 20 percent due to climate change (U.S. Bureau of Reclamation 2011).

Sea level rise degrades the quality of imported water from the Sacramento-San Joaquin Delta and impacts local coastal water and wastewater infrastructure, requiring substantial capital investments by local agencies. Sea level rise further exacerbates salinity intrusion and impacts 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 2008; California Natural Resources Agency 2009).

The State's sea-level rise guidance documents reported that the coast of California experienced two very large El Niño Southern Oscillation (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.

Projections and Impacts

While historical data are measured indicators of how the climate is changing, they cannot project what future conditions may be like under different GHG emissions scenarios. Current climate science uses modeling methods to simulate and develop future climate projections. A recent study by Scripps Institution of Oceanography uses the most sophisticated methodology to date, and indicates by 2060 to 2069, temperatures will be 3.4 to 4.9 °F (1.9 to 2.7 °C) higher across the state than they were from 1985 to 1994 (Pierce et al. 2012). By 2060 to 2069, the annual mean temperature will 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 Inland 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 indicated that the mean temperatures between 1990 and 2100, mean temperatures are projected to increase about 5 to 6 (2.8 to 3.3 °C) during winter and up to 5 to 10 °F (2.8 to 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 underway to project downscaled local impacts of climate change. The Los Angeles Regional Collaborative for Climate Action and Sustainability (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 will rise by an average of 4 to 5 °F (2.2 to 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 (http://c-change.la/la-climate-studies/; Hall et al. 2012).

Changes in annual precipitation across California, either in timing or total amount, will result in changes to the type of precipitation (rain or snow) in a given area and to the timing and volume of surface runoff. 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 less scientific detail on 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 will affect local reservoirs and the replenishment of the region’s groundwater. Projections for the South Coast region indicate that low-lying coastal areas will lose 3 to 5 inches (8 to 13 cm) of precipitation by 2090, with western Riverside and southwestern San Bernardino Counties expected to see a 3.5 to 6-inch (9 to 15-cm) decline, while the mountain areas, like Big Bear, could see a drop of 8 to 10 inches (20 to 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, while 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). Winter runoff could result in flashier flood hazards, with flows potentially exceeding reservoir storage capacities and discharging to the ocean. Higher flow volumes will scour stream and flood control channels, degrading aquatic and riparian habitats already impacted 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 to 12 inches (4 to 30 cm) by 2030, 5 to 24 inches (12 to 61 cm) by 2050, and 17 to 66 inches (42 to 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 will be more damaging to the coastline than the gradual sea level rise California is experiencing (Climate Action Team 2010). Nevertheless, sea level rise is expected to degrade the quality of imported water from the Sacramento-San Joaquin 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 impact 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 Sierra Nevada snowpack, which is an important source of water for the South Coast through the SWP and LAA, is expected to continue to decline as warmer temperatures raise the elevation of snow levels, reduce spring snowmelt, and increase winter runoff. Based on historical data and modeling, researchers at Scripps Institution of Oceanography project that, by the end of this century, the Sierra snowpack will experience a 48 to 65 percent loss from its average at the end of the previous century (van Vuuren et al. 2011). Although annual precipitation will vary by area, reduced snow and precipitation in the Sierra Nevada range and the Colorado River basin will affect the imported water supply for the South Coast region and cause potential overdrafting of the region’s groundwater basins.

Locally in the South Coast region, the March snowpack in the Big Bear area is projected to decline from 2.5 inches (6.4 cm; 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 will impact the mountain communities dependent on tourism for their economies. In addition, earlier seasonal flows will reduce the flexibility in how the state manages its reservoirs to protect downstream communities from flooding while ensuring a reliable water supply.

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 U.S. 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 2000; California Natural Resources Agency 2009). The uncertainty on 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 demand within the region could increase due to higher evapotranspiration rates 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 (refer to Regional Management Strategy for Water-Dependent

Recreation). Environmental water supplies would need to be retained in reservoirs for managing instream flows in order to maintain habitat for aquatic species throughout the dry season. Currently, Sacramento-San Joaquin 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 would further reduce supplies available for import through the SWP during the non-winter months (Cayan 2008; Hayhoe 2004).

With increasing temperatures, net evaporation from reservoirs is projected to increase by 15 to 37 percent (Medellin-Azuara et al. 2009; California Natural Resources Agency 2009). Prolonged drought events are likely to continue and further impact 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 impact local watersheds. The extent to which climate change will alter the existing risk to 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). Nevertheless, some areas, such as the San Jacinto Mountains (a mountain range between the South Coast and Colorado River regions), will likely have 1.5 to 2 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, using downscaled simulations (refining computer projections to a scale smaller than global models) 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, even for GCM simulations with 8 to 15 percent declines in overall precipitation. The increases in flood magnitude are statistically significant for all three GCMs for the period 2051 to 2099. By the end of the 21st Century, the magnitudes of the largest floods increase to 110 to 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 Sierra, 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 impact the region, upon which the state depends for its economic and environmental benefits. These changes will increase the vulnerability of natural and built systems in the region. Impacts to natural systems will challenge aquatic and terrestrial species by diminishing water quantity and quality and shifting eco-regions. Built systems will be impacted by changing hydrology and 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 with less natural storage and less overall supply.

The South Coast region contains a diverse landscape with different climate zones, 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 in order 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 IRWMPs (California Department of Water Resources 2009). 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 the 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 LID to reduce storm water 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 will 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 all help to be prepared for increasing rise in sea level. (California Department of Water Resources 2008; Hanak and Lund 2011; California Emergency Management Agency and California Natural Resources Agency 2012c; California Natural Resources Agency 2012; 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 a regional and watershed planning process 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.

Central to adaptation in water management is full implementation of IRWMPs that address regionally appropriate practices that incorporate climate change adaptation. These IRWMPs, 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 the regional water management groups (RWMGs) must prioritize their investments.

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).

The San Diego Regional Water Management Group (RWMG) recognizes the opportunities for collaboration and has been coordinating with land use planners in updating its IRWMP. The Santa Ana Watershed Project Authority (SAWPA) has recognized the benefits forest watersheds provide to downstream communities and is working with the U.S. Forest Service 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 (http://aftf.csusb.edu/; 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 system-wide strategies to address climate change through sustainable communities within the Los Angeles area (http://www.environment.ucla.edu/larc/). At the southern end of the South Coast region, the San Diego Foundation developed a comprehensive regional assessment of climate change impacts to San Diego County and presented a public outreach brochure that not only discusses the impacts but also provides solutions to adapt to these 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. In preparing for climate change, LADWP contracted a study to evaluate the effects of climate change on the LAA watershed, a source of imported water for the South Coast region. This study identified possible adaptation measures that could be implemented to mitigate the potential negative effects of climate change on the hydrology of the region, as well as the potential negative impact to water quality. These adaptation measures included creating new storage downgradient of Owens Valley during dry years and diverting water from the SWP at Neenach (AGU 2011).

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. U.S. Bureau of Reclamation (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; U.S. Bureau of Reclamation 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 Los Angeles County Flood Control District of the Department of Public Works (LACDPW), 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 storm water 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 non-structural changes could help resolve water supply issues in a changing climate (Los Angeles County Department of Public Works and U.S. Bureau of Reclamation 2012). SAWPA also is working with USBR on a basin study for its watershed region that assesses climate change impacts within the region in preparing an update to its One Water One Watershed IRWMP and that includes groundwater modeling and hydrology projections for the Santa Ana River watershed (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, 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 IRWMPs that address regionally appropriate practices that incorporate climate change adaptation. These IRWMPs, 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 still needs to be done, not only in mitigating for but also in adapting to climate change. (DeShazo and Matute 2012)

MWD, a major South Coast wholesale supplier of water from the SWP and CRA, has been using an adaptive management approach in its Integrated Resources Plan (IRP). As part of its 2010 update of the IRP, 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 to 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 in order to be prepared 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:

- *2009 California Climate Adaptation Strategy* (http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.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* (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)

There are several Resource Management Strategies found in Volume 3 of the *California Water Plan Update 2013* that not only assist in meeting water management objectives but also provide benefits for adapting to climate change, including the following:
Agricultural and Urban Water Use Efficiency

- Water Transfers
- Conjunctive Management and Groundwater Storage
- Desalination
- Precipitation Enhancement
- Recycled Municipal Water
- Surface Storage – Regional/Local
- Drinking Water Treatment and Distribution
- Groundwater/Aquifer Remediation
- Pollution Prevention
- Salt and Salinity Management
- Agricultural Land Stewardship
- Economic Incentives
- Ecosystem Restoration
- Forest Management

- Land Use Planning and Management
- Recharge Area Protection
- Water-dependent Recreation
- Watershed Management
- Integrated Flood Management
- Sediment Management

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 has a large energy footprint, consuming 7.7 percent of statewide electricity (California Public Utilities Commission 2010). Energy is used in the water sector to extract, convey, treat, distribute, use, condition, and dispose of water. Figure 3-26, "Water-Energy Connection" in Volume 1, CA Water Today 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. This 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 demand. Because energy usage is related to GHG emissions, this information can support measures to reduce GHGs, as mandated by the State.

Figure SC-10 shows the amount of energy associated with the extraction and conveyance of one acre-foot of water for each of the major sources in this region. The quantity used is also included, as a percent. For reference, Figure 3-26, Water-Energy Connection (in Volume 1, Chapter 3, "California Water Today") highlights which water-energy connections are illustrated in Figure SC-10, which focuses only on extraction and conveyance of raw water. 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 by gravity to the delivery location and, therefore, do not require any energy to extract or convey (represented by a white light bulb).

Recycled water and water from desalination used within the region are not show in Figure SC-10 because their EIs differ in important ways from those water sources. The EIs 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 Figure SC-10. For these reasons, discussion of the EIs of desalinated water and recycled water are included in *Volume 3, Resource Management Strategies*.

EI, sometimes known as embedded energy, is the amount of energy needed to extract and convey an acre-foot of water from its source (e.g. groundwater or a river) to a delivery location, such as a water treatment plant or SWP delivery turnout. Note that 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 no energy for extraction, but others like groundwater or sea water 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, typically but not always a water treatment facility. Conveyance can include pumping of water up hills and mountains or can occur by gravity.

EI should not be confused with total energy — that is, the amount of energy (e.g. kilowatt-hour or kWh) required to deliver all of the water from a water source to customers within a region. EI focuses not on the total amount of energy used to deliver water, but rather the energy required to deliver a single unit of water (in kWh/acre-foot). In this way, EI gives a normalized metric that can be used to compare alternative water sources.

In most cases, this information will not be of 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 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. It is important to note that water supply planning must take into consideration a myriad of different factors, in addition to energy impacts, costs, water quality, opportunity costs, environmental impacts, reliability, and many other factors.

EI is closely related to GHG emissions, but not identical, depending on the type of energy used (see *Water Plan Volume 1, California Water Today, Water-Energy section*). In California, generation of one megawatt-hour (MWh) of electricity results in the emission of about a third of a metric ton of GHG, typically referred to as carbon dioxide equivalent or CO_2e (eGrid 2012). (Go to http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_GHGOutputrates.pdf.) This estimate takes into account the use of GHG-free hydroelectricity, wind, solar, and fossil fuel sources like natural gas and coal. The GHG emissions from a specific electricity source may be higher or lower than this estimate.

Reducing GHG emissions is a State mandate. Water managers can support this effort by considering EI factors, such as those presented here, in their decision-making process. Water use efficiency and related BMPs also can reduce emissions of GHGs (*See Volume 2, Resource Management Strategies*).

Accounting for Hydroelectric Energy

Generation of hydroelectricity is an integral part of many of the state's large water projects. In 2007, hydroelectric generation accounted for nearly 15 percent of all electricity generation in California (http://www.energy.ca.gov/hydroelectric/). The SWP, Central Valley Project, LAA, Mokelumne

Aqueduct, and Hetch Hetchy Aqueducts 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 that are placed along pipelines to capture energy as water runs downhill in a pipeline [conduit].). Hydroelectricity also is generated at hundreds of smaller reservoirs and run-of-the-river turbine facilities.

Hydroelectric generating facilities at reservoirs provide unique benefits. Reservoirs like the SWP's Oroville Reservoir are operated to build up water storage at night when demand for electricity is low, and release the water during the daytime hours when demand for electricity is high. This operation, common to many of the state's hydropower reservoirs, helps improve energy grid stabilization and reliability and reduces GHG emissions by displacing the least efficient electricity generating facilities. Hydroelectric facilities are also extremely effective for providing back-up power supplies for intermittent renewable resources like solar and wind power. Because the sun can unexpectedly go behind a cloud or the wind can die down, intermittent renewables need back up power sources that can quickly ramp up or ramp down depending on grid demands and generation at renewable power installations.

Despite these unique benefits and the fact that hydroelectric generation was a key component in the formulation and approval of many of California's water systems, accounting for hydroelectric generation in EI calculations is complex. In some systems like the SWP and Central Valley Project, water generates electricity and then flows back into the natural river channel after passing through the turbines. In systems like 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 flowing into the East Bay Municipal Utility District service area. In both these 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 the EI for hydropower in the regional reports. All hydroelectric generation at head reservoirs has been excluded from Figure SC-10. 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 CLAA's hydroelectric generation at San Francisquito, San Fernando, Foothill, and other power plants on the system (downstream of the Owens River Diversion Gates). DWR has made one modification to this methodology to simplify the display of results; EI 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 (0); i.e., no water system is reported as a net producer of electricity, even though several systems do produce more electricity in the conveyance system than is used (e.g., LAA, Hetch Hetchy Aqueduct). (For detailed descriptions of the methodology used for the water types presented, see Volume 5, *Technical Guide*.)

PLACEHOLDER Figure SC-10 Energy Intensity of Raw Water Extraction and Conveyance in the South Coast Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

References

References Cited

Abatzoglou JT, Redmond KT, Edwards LM. 2009. Classification of Regional Climate Variability in the State of California. Journal of Applied Meteorology and Climatology, 48, 1527-1541.

AGU. 2011. Projected 21st Century Impacts of Climate Change on the CLAA and Adaptation Measures to Mitigate Impacts. Los Angeles Department of Water and Power contract, GC43B-0890. http://rd.tetratech.com/climatechange/projects/los_angeles_aqueduct.asp.

California Air Resources Board. 2008. Climate Change Scoping Plan: A Framework for Change. http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm.

California Department of Water Resources. 2008. Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water.

California Department of Water Resources. 2009. California Water Plan Update 2009: Colorado River Integrated Water Management. Bulletin 160-09, Volume 3, Regional Reports.

California Department of Water Resources. 2010. Proposition 84 & Proposition 1E Integrated Regional Water Management Guidelines.

California Emergency Management Agency and California Natural Resources Agency. 2012a. California Adaptation Planning Guide (four documents). http://resources.ca.gov/climate_adaptation/local_government/adaptation_planning_guide.html.

California Emergency Management Agency and California Natural Resources Agency. 2012b. California Adaptation Planning Guide: Understanding Regional Characteristics. http://resources.ca.gov/climate_adaptation/docs/APG_Understanding_Regional_Characteristics.pdf.

California Emergency Management Agency and California Natural Resources Agency. 2012c. California Adaptation Planning Guide: Identifying Adaptation Strategies. http://resources.ca.gov/climate_adaptation/docs/APG_Identifying_Adaptation_Strategies.pdf.

California Natural Resources Agency. 2009. 2009 California Climate Adaptation Strategy. http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf.

California Natural Resources Agency. 2012. Draft California Climate Adaptation Strategy Update 2012: Draft Outline Water Sector Adaptation to Climate Change Impacts. (DWR draft outline: http://www.water.ca.gov/climatechange/docs/WaterSectorStrategiesSASC-draft.pdf).

California Public Utilities Commission. 2010.

Cayan D. 2008. Climate Change Scenarios for the California Region. Climatic Change, 87(s1), 21-S42.

Christensen NS, Wood AW, Voisin N, et al. 2004. Effects of Climate Change on the Hydrology and Water Resources of the Colorado River Basin. Climatic Change, vol 62, pp. 337 - 363.

Climate Action Team. 2010. State of California Sea-Level Rise Interim Guidance Document. Developed by the Sea-Level Rise Task Force of the Coastal and Ocean Working Group. http://www.water.ca.gov/climatechange/docs/SLR_GuidanceDocument_SAT_Responses.pdf.

Crossett KM, Culliton TJ, Willey PC, and Goodspeed TR. 2004. Population Trends along the Coastal United States: 1980-2008. Coastal Trends Report Series. Silver Spring, MD: NOAA National Ocean Service. http://oceanservice.noaa.gov/programs/mb/pdfs/coastal_pop_trends_complete.pdf.

Das T, Dettinger MD, Cayan DR, Hidalgo HG. 2011. Potential increase in floods in California's Sierra Nevada under future climate projections. Climatic Change 2011.

DeShazo JR and Matute J. 2012. Progress Report: Climate Action Planning in Southern California. Luskin Center for Innovation, Luskin School of Public Affairs, University of California – Los Angeles. http://luskin.ucla.edu/sites/default/files/Luskin%20Climate%20Report.pdf.

Dettinger M. 2011. Climate Change, Atmospheric Rivers, and Floods in California – A Multimodel Analysis of Storm Frequency and Magnitude Changes. Journal of the American Water Resources Association.

EGrid. 2012. Version 1.0 Year 2009 GHG Annual Output Emission Rates. http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_GHGOutputrates.pdf.

Garfin G. 2005. Climate Change in the Colorado River Basin. Colorado River Basin Climate: Paleo, Present, Future. Special Publication for Association of California Water Agencies and Colorado River Water Users Association Conferences.

Guido Z. 2008. Mountain Snowpack in the West and Southwest. Southwest Climate Change Network. http://www.southwestclimatechange.org/impacts/water/snowpack.

Hall A, Sun F, Walton D, Capps S, Qu X, Huang H-Y, Berg N, Jousse A, Schwartz M, Nakamura M, Cerezo-Mota R. 2012. Mid-Century Warming in the Los Angeles Region: Part I of the "Climate Change in the Los Angeles Region" Project. Los Angeles Regional Collaborative for Climate Action and Sustainability and University of California at Los Angeles.

Hanak E, Lund, JR. 2011. Adapting California's Water Management to Climate Change. Springer Science+Business Media B.V., DOI 10.1007/s10584-011-0241-3. http://www.waterlawsymposium.com/sites/default/files/Hanak&Lund_climatic_change.pdf.

Hayhoe K et al. 2004. Emissions Pathways, Climate Change, and Impacts on California. Proceedings of the National Academy of Science. Volume 101: 34.

Hughes M, Hall A, and Kim J. 2009. Anthropogenic Reduction of Santa Ana Winds. PIER Research Report, CEC-500-2009-015-D. Sacramento, CA: California Energy Commission.

Intergovernmental Panel on Climate Change. 2007. IPCC Fourth Assessment Report: Climate Change 2007: Synthesis Report. http://www.ipcc.ch/publications_and_data/ar4/syr/en/main.html.

Jackson L, Haden VR, Wheeler SM, Hollander AD, Perlman J, O'Geen T, Mehta VK, Clark V, Williams J, Thrupp A (University of California, Davis). 2012. Vulnerability and Adaptation to Climate Change in California Agriculture. California Energy Commission. Publication number: CEC-500-2012-031. http://www.energy.ca.gov/2012publications/CEC-500-2012-031/CEC-500-2012-031.pdf.

Lien Longville S. January 31, 2012. DWR Workshop: Climate Change, Extreme Weather, and Southern California Floods (http://www.water.ca.gov/climatechange/docs/013112agenda.pdf). Reducing Impacts of Climate Change, Extreme Weather, and Southern California Floods: Case Study in Implementation of the Integrated Approach for Sustainable Development on Alluvial Fans presentation. http://www.water.ca.gov/climatechange/docs/Longville_AFTF2012Jan31_ClimateChangeExtremeWeatherSouthernCalifornia-SusanLien131.pdf.

Los Angeles County of Public Works and U.S. Bureau of Reclamation. 2012. Los Angeles Basin Storm Water Conservation Study: Plan of Study. ftp://dpwftp.co.la.ca.us/pub/wmd/LABASINSTUDY.

Medellin-Azuara J, Connell CR, Madani K, Lund JR, Howitt RE. 2009. Water Management Adaptation with Climate Change. PIER Research Report, CED-500-2009-049-D, Sacramento, CA: California Energy Commission.

Milly PCD, Betancourt J, Falkenmark M, Hirsch RM, Kundzewicz ZW, Lettenmaier DP, Stouffer RJ. 2008. Stationarity Is Dead: Whither Water Management? Science 319: 573-574. http://wwwpaztcn.wr.usgs.gov/julio_pdf/milly_et_al.pdf.

Moser S, Franco G, Pittiglio S, Chou W, Cayan D. 2008. The Future Is Now: An Update on Climate Change Science Impacts and Response Options for California. 2008 Climate Change Impacts Assessment Project – Second Biennial Science Report to the California Climate Action Team, CEC-500-2008-071, Sacramento, CA.

Mote PW, Hamlet AF, Clark M, Lettenmaier DP. 2005. Declining Mountain Snowpack in Western North America. Bulletin of the American Meteorological Society 86(1):39-49.

NPA, as cited in Boesch DF, Fields JC, Scavia D (eds.). 2000. The Potential Consequences of Climate Variability and Change on Coastal and Marine Resources. Report of the Coastal Areas and Marine Resources Sector Team, U.S. National Assessment. Silver Spring, MD: NOAA.

National Research Council of the National Academies. 2012. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. Prepublication of The National Academies Press, Washington, D.C.

http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=13389&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+nationalacademies%2Fna+%28News+from+the+National+Academies%29.

Peters S, Engel D, Kelly B, Young E. 2011. San Diego's Changing Climate: A Regional Wake-up Call, A Summary of the Focus 2050 Study. The San Diego Foundation.

Pierce DW, Das T, Cayan DR, Maurer EP, Miller NL, Bao Y, Kanamitsu M, Yoshimura K, Snyder MA, Sloan LC, Franco G, Tyree M. 2012. Probabilistic Emissions of Future Changes in California Temperature and Precipitation Using Statistical and Dynamical Downscaling. Climate Dynamics. Springer-Verlag, DOI 10.1007/s00382-012-1337-9. http://meteora.ucsd.edu/cap/pdffiles/Pierce_etal_2012_CD.pdf.

Qian Y, Ghan SJ, Leung LR. 2010. Downscaling Hydroclimatic Changes Over the Western US Based on CAM Subgrid Scheme and WRF Regional Climate Simulations. International Journal of Climatology, April.

Santa Ana Watershed Project Authority. 2012. Santa Ana River Watershed Climate Change Workshop. http://www.sawpa.org/.

Stewart IT, Cayan DR, Dettinger MD. 2005. Changes toward Earlier Streamflow Timing across Western North America. Journal of Climate 18:1136–1155.

Stuart, M. 2012. DWR Workshop: Climate Change, Extreme Weather, and Southern California Floods (http://www.water.ca.gov/climatechange/docs/013112agenda.pdf). Alluvial Fan Task Force: Mission, History, and Outcomes presentation. http://www.water.ca.gov/climatechange/docs/Mark%20Stuart_AFTF2012Jan31_ClimateChangeExtremeWeatherSoCalFlooding%20Final-MarkStuart131.pdf.

Sun F, Hall A, Walton D, Capps S, Davis Reich K. 2013. Mid- and End-of-Century Snowfall in the Los Angeles Region: Part II of the "Climate Change in the Los Angeles Region" Project. Los Angeles Regional Collaborative for Climate Action and Sustainability and University of California at Los Angeles, funded by U.S. Department of Energy and the National Science Foundation. http://c-change.la/wp-content/uploads/2013/06/Snowfall-Final-Report.pdf.

The Planning Center/DC&E. 2013. Coastal Resilience Ventura Catalogue and Analysis of Local Sea-Level Rise Planning Tools: Final Report. Submitted to The Nature Conservancy.

The World Bank. 2012. Climate Change: Adaptation Guidance Notes - Key Words and Definitions. http://climatechange.worldbank.org/content/adaptation-guidance-notes-key-words-and-definitions.

U.S. Bureau of Reclamation. 2011. Colorado River Basin Water Supply and Demand Study: Basin Study Program Fact Sheet. http://www.usbr.gov/lc/region/programs/crbstudy/FactSheet_May2011.pdf.

U.S. Bureau of Reclamation. 2012. Colorado River Basin Water Supply and Demand Study: Executive

Summary. http://www.usbr.gov/WaterSMART/bsp/index.html.

U.S. Environmental Protection Agency, Region 9 and California Department of Water Resources. 2011. Climate Change Handbook for Regional Water Planning. http://www.water.ca.gov/climatechange/CCHandbook.cfm.

U.S. Global Change Research Program. 2009. *Global Climate Change Impacts in the United States*. T.R. Karl, J.M. Melillo, and T.C. Peterson (eds.). Cambridge University Press. Cambridge, United Kingdom.

van Vuuren DP, Edmonds J, Kainuma M, Riahi K, Thomson A, Hibbard K, Hurtt GC, Kram T, Krey V, Lamarque JF, Masui T, Meinshausen M, Nakicenovic N, Smith SJ, Rose SK. 2011. The Representative Concentration Pathways: An Overview. Climatic Change, v.109.

Westerling A. 2012. DWR Workshop: Climate Change, Extreme Weather, and Southern California Floods (http://www.water.ca.gov/climatechange/docs/013112agenda.pdf). Climate Change and Wildfire Extremes presentation. http://www.water.ca.gov/climatechange/docs/DWR_extremes-Tony%20Westerlling131.pdf.

Westerling A, Bryant B. 2006. Climate Change and Wildfire in and around California: Fire Modeling and Loss Modeling. A Repot from California Climate Change Center, CEC 500-2006-190-SF. http://ulmo.ucmerced.edu/pdffiles/06CEC_WesterlingBryant.pdf.

Western Region Climate Center. 2012. Climate Variability in the State of California. Journal of Applied Meteorology and Climatology, 48, 1527-1541. (On-line data citation, accessed 10/3/2012: http://www.wrcc.dri.edu/monitor/cal-mon/frames_version.html).

Wilkinson, RC. 2000. Methodology for Analysis of the Energy Intensity of California’s Water Systems, and an Assessment of Multiple Potential Benefits through Integrated Water-Energy Efficiency Measures. Exploratory Research Project supported by Ernest Orlando Lawrence Berkeley Laboratory, California Institute for Energy Efficiency.

Williamson S, Ruth M, Ross K, Irani D. 2008. Economic Impacts of Climate Change on Colorado: A Review and Assessment Conducted by the Center for Integrative Environmental Research, University of Maryland. http://www.cier.umd.edu/climateadaptation/Colorado%20Economic%20Impacts%20of%20Climate%20Change.pdf.

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
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		

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

	Total Number of Well Logs by Well Use						
County	**Domestic**	**Irrigation**	**Public Supply**	**Industrial**	**Monitoring**	**Other**	**Total Well Records**
Ventura	707	571	95	21	1148	356	2898
Los Angeles	2820	283	425	128	7611	2705	13972
Orange	59	114	125	23	3863	1054	5238
San Diego	6828	3099	384	88	3313	1329	15041
Total Well Records	**10414**	**4067**	**1029**	**260**	**15935**	**5444**	**37149**

Table SC-3 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	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
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	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 VALLEY		61,131
Low	5	*See Update 2013, Volume 4, Reference Guide, the article "California's Groundwater Update 2013"*			
Very Low	32	*See Update 2013, Volume 4, Reference Guide, the article "California's Groundwater Update 2013"*			
Totals:	**73**			**Population of GW Basin Area:**	**14,849,557**

Table SC-4 Groundwater Level Monitoring Wells by Monitoring Entity in the South Coast Hydrologic Region

State and Federal Agencies		Number of Wells
DWR		17 (see note)
USGS		339
	Total State and Federal Wells	**356**
CASGEM Monitoring Entities		**Number of Wells**
Chino Basin Watermaster		46
County of Ventura, Watershed Protection District		456
Eastern Municipal Water District		312
Main San Gabriel Basin Watermaster		44
Orange County Water District		372
Puente Basin Watermaster		13
Rancho California Water District		26
Raymond Basin Management Board		24
San Bernardino Valley Municipal Water District		56
San Gorgonio 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 Entities	**1,442**
	Grand Total	**1,798**

Notes:

Table includes groundwater level monitoring wells having publically 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.

Table represents monitoring information as of July, 2012

Table SC-5 Sources of Groundwater Quality Information

Agency	Links to Information
State Water Resources Control Board	Groundwater • Communities that Rely on a Contaminated Groundwater Source for Drinking Water • Nitrate in Groundwater: Pilot Projects in Tulare Lake Basin/Salinas Valley • Hydrogeologically Vulnerable Areas • Aquifer Storage and Recovery • Central Valley Salinity Alternatives for Long-Term Sustainability (CV-Salts) GAMA • GeoTracker GAMA (Monitoring Data) • Domestic Well Project • Priority Basin Project • Special Studies Project • California Aquifer Susceptibility Project Contaminant Sites • Land Disposal Program • Department of Defense Program • Underground Storage Tank Program • Brownfields
California Department of Public Health	Division of Drinking Water and Environmental Management • Drinking Water Source Assessment and Protection (DWSAP) Program • Chemicals and Contaminants in Drinking Water • Chromium-6 • Groundwater Replenishment with Recycled Water
Department of Water Resources	Groundwater Information Center • Bulletin 118 Groundwater Basins • California Statewide Groundwater Elevation Monitoring (CASGEM) • Groundwater Level Monitoring • Groundwater Quality Monitoring • Well Construction Standards • Well Completion Reports
Department of Toxic Substances Control	• EnviroStor
Department of Pesticide Regulation	Groundwater Protection Program • Well Sampling Database • Groundwater Protection Area Maps
U.S. Environmental Protection Agency	US EPA STORET Environmental Data System
United States Geological Survey	USGS Water Data for the Nation

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

Year	Average Temps, Maximum (Fo)	Average Temps, Minimum (Fo)	Average Daily Temperatures (Fo)	Average Precipitation (inches)	Average ETo (inches)
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

Notes:

Fo = logarithmic average of temperature difference

ETo = reference evapotranspiration

Table SC-7 South Coast Hydrologic Region Top Crops 2010 (in acres)

Crop	Acres
Citrus and Subtropical*	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: DWR and County Agricultural Commissioner Annual Reports

Note: *Includes avocados

Table SC-8 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**	**%**	**TAF**	**%**	**TAF**	**%**	**TAF**	**%**
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%
404	San Diego	33.9	13%	35.3	5%	0	0%	69.2	7%
2005-10 Annual Average HR Total		**385.4**	**54%**	**1,219.6**	**31%**	**0**	**0%**	**1,605.0**	**34%**

Notes:

TAF = thousand acre-feet

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

2005-10 precipitation equals 91 percent of the 30-year average for the South Coast region.

Table SC-9 South Coast Hydrologic Region Average Annual Groundwater Supply by County 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	
County	**TAF**	**%**	**TAF**	**%**	**TAF**	**%**	**TAF**	**%**
Los Angeles	54.5	78%	703.4	37%	0.0	0%	757.8	38%
Orange	1.8	13%	10.2	2%	0.0	0%	12.1	2%
San Diego	18.0	8%	27.7	5%	0.0	0%	45.6	5%
Ventura	224.3	73%	26.6	16%	0.0	0%	250.8	53%
2005-10 Annual Ave. Total	**298.5**	**48%**	**767.8**	**24%**	**0.0**	**0%**	**1,066.3**	**28%**

Notes:

TAF = thousand acre-feet

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

2005-10 precipitation equals 91 percent of the 30-year average for the South Coast region.

Table SC-10 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	California Seven-Party Agreement	An agreement among seven California water agencies/districts to recommend to the Secretary of Interior how to divide use of California's apportionment among the California water users.
US-Mexican Water Treaty	1944	Apportions Mexico a supply of 1.5 MAF annually of Colorado River water, except under surplus or extraordinary drought conditions.
US Supreme Court Decree in Arizona v. California, et al.	1964, supplemented 1979	Rejected California's argument that Arizona's use of water from the Gila River, a Colorado River tributary, constituted use of its Colorado River apportionment. Ruled that Lower Basin states have a right to appropriate and use tributary flows before the tributary co-mingles with the Colorado River. Mandated the preparation of annual reports documenting the uses of water in the three Lower Basin states. Quantifies tribal water rights for specified tribes, including 131,400 afy for diversion in California. Quantified Colorado River mainstream present perfected rights in the Lower Basin states.
Colorado River Basin Project Act	1968	Authorized construction of the Central Arizona Project. Requires Secretary of the Interior to prepare long-range operating criteria for major Colorado River reservoirs.
Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs	1970, amended 2005	Provided for the coordinated operation of reservoirs in the Upper and Lower Basins and set conditions for water releases from Lake Powell and Lake Mead.
Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003	2003	Complex package of agreements that, in addition to many other important issues, further quantifies priorities established in the 1931 California Seven-Party Agreement and enables specified water transfers (such as the water conserved through lining of the All-American and Coachella canals to SDCWA) in California.

Source: Adapted from U.S. Bureau of Reclamation 2008c

Table SC-11 Quantification and Annual Approved Net Consumptive Use of Colorado River Water by California Agricultural Agencies

	Quantified amount	Quantified net consumptive use, 2010	Actual net consumptive use, 2010	Quantified annual net consumptive use, 2026–2047
Priority 1, 2, and 3b. 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 taf	420 taf	312.2 taf [d]	420 taf
Priority 3a CVWD	330 taf	333 taf	306.1 taf	424 taf
Priority 3a Imperial Irrigation District	3,100 taf	2733.8 taf	2545.6 taf [b]	2,607.8 taf
Total California Agricultural Use	3,850 taf	3,486.8 taf	3,163.9 taf	3,451.8 taf
IID CRWDA Exhibit C Payback		19 taf	0 taf [b]	0 taf
CVWD CRWDA Exhibit C Payback		9.2 taf	0 taf [b]	0 taf
Total Priority 1-3 Use	3,850 taf	3515 taf	3163.9 taf	3,446.3 taf
Remainder of 3.85 maf for use by MWD (and SDCWA and 14.5 taf Misc. PPRs) through priority rights and transfer agreements.	0 taf	335 taf [c]	686.1 taf [c]	403.7 taf [c]

Notes:

taf = thousand acre-feet; maf = million acre-feet

[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.

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, US Department of the Interior, Bureau of Reclamation Lower Colorado Region, pp 37, http://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2010/2010.pdf.

Table SC-12 Annual Intrastate Apportionment of Water from the Colorado River Mainstream within California under the Seven Party Agreement [a]

Priority Number	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.
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.	
Priority 4	MWDSC for coastal plain of Southern California-550,000 af/yr.
Priority 5	An additional 550,000 af/yr to MWDSC, and 112,000 af/yr for the City and County of San Diego. [b]
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.
Total of Priorities 1 through 6 is 5.362 maf/yr.	
Priority 7	All remaining water available for use in California, for agricultural use in California's Colorado River Basin.

Notes:

af/yr = acre-feet per year; maf = million acre-feet; taf/yr = thousand acre-feet per year

[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 Indian present perfected rights is approximately 15 taf/yr.

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

[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 Priority 6 and 7.

Amounts represent consumptive use.

Table SC-13 Annual Per Capita Water Use By Planning Area South Coast Hydrologic Region

Region	Per Capita Water Use 2006	Per Capita Water Use 2007	Per Capita Water Use 2008	Per Capita Water Use 2009	Per Capita Water Use 2010
Santa Clara	189	183	195	204	181
Metropolitan L.A.	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)

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

Table SC-14 Breakdown of Water System Size

Water System Size	Number of Community Systems	Percent Number of community in Region	Population Served	Percent of Population served
Large (> 10,000 Pop)	181	41 %	19,456,617	98%
Medium (3301 - 10,000 Pop)	57	13 %	358,422	1.8%
Small (500 - 3300 Pop)	66	15 %	94,231	0.5%
Very Small (< 500 Pop)	116	26 %	19,437	0.1%
CWS that Primarily Provide	19	4 %	---	---
TOTAL	439		19,928,707	

Notes:

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

Table SC-15 South Coast Hydrologic Region Water Balance Summary, 2001-2010

Table SC-X Central 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	1,250	1,313	760	1,100	773	808	1,082	1,257	1,219	990
Imports from Other Regions	1,255	1,786	1,009	2,037	1,673	1,786	1,940	1,199	1,136	1,533
Total	**11,832**	**8,133**	**11,237**	**14,944**	**17,790**	**11,424**	**6,570**	**12,003**	**9,474**	**13,995**
Water Leaving the Region										
Consumptive Use of Applied Water * (Ag, M&I, Wetlands)	1,628	1,887	1,651	1,739	1,515	1,580	1,732	1,653	1,531	1,354
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	2,325	2,617	2,101	2,347	2,128	2,137	2,237	2,162	1,941	1,722
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	8,947	4,853	9,602	11,894	14,145	8,742	3,921	9,448	7,344	11,675
Total	**12,900**	**9,357**	**13,354**	**15,980**	**17,990**	**12,459**	**7,890**	**13,264**	**10,816**	**14,751**
Change in Supply										
[+] Water added to storage [-] Water removed from storage										
Surface Reservoirs	332	53	-81	-102	509	-70	-243	-188	-231	116
Groundwater **	-1400	-1276	-1035	-934	-709	-965	-1077	-1073	-1111	-871
Total	**-1068**	**-1223**	**-1116**	**-1036**	**-200**	**-1035**	**-1320**	**-1261**	**-1342**	**-755**
Applied Water * (Ag, Urban, Wetlands) (compare with Consumptive Use)	4,633	5,173	4,676	5,068	4,564	4,781	5,052	4,844	4,458	3,962

* 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.

** 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 – *California's Groundwater Update 2013* and Volume 5 Technical Guide.

n/a = not applicable

Table SC-16 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 MCL	No. of Community Drinking Water Wells where PC exceeds the Primary 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: Water Boards 2012 Draft Report on "Communities that Rely on Contaminated Groundwater"

Notes: Only the 12 most prevalent contaminants are shown. 276 of the 584 affected wells 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.

Table SC-17 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

	Small Systems ≤ 3,300	Medium Systems 3,301-10,000	Large Systems ≥ 10,000	Total
No. of Affected Community Drinking Water Systems	43	20	99	162
No. of Affected Community Drinking Water Wells	73	35	476	584

Source: Water Boards 2012 Draft Report on "Communities that Rely on Contaminated Groundwater"

Table SC-18 Record Floods for Selected Streams, South Coast Hydrologic Region

Stream	Location	Mean annual runoff (taf)	Peak stage of record (ft)	Peak discharge of record (cfs)
Cottonwood Cr.	above Tecate Creek, near Dulzura[5]	11	11.2	11,700
San Diego R.	at Fashion Valley, at San Diego	282	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	452	20.5	44,000
Santa Margarita R.	near Temecula	212	22.5	31,000
Temecula Cr.	near Aguanga	6	14.6	8,100
Murrieta Cr.	at Temecula	152	17.2	25,000
San Juan Cr.	at La Novia Street Bridge, at San Juan Capistrano	16	20.71	28,500
Santa Ana R.	at Santa Ana	572	9.0	31,700
Temescal Cr.	above Main Street, at Corona	242	6.7	4,720
San Jacinto R.	near Elsinore	12	11.8	16,000
Salt Cr.	at Murrieta Road, near Sun City	2	11.23 1	4,120
San Jacinto R.	near San Jacinto	14	5.31	45,000
Santa Ana R.	at MWD Crossing, near Arlington	1152	16.6	47,800
Lytle Cr.	at Colton	6	14.8	17,500
San Timoteo Cr.	near Loma Linda	3	8.2	15,000
San Gabriel R.	below Santa Fe Dam, near Baldwin Park	47	22.2	30,900
Rio Hondo	below Whittier Narrows Dam	125	13.8	38,800
Rio Hondo	at South Gate[6]	38	15.4	48,100
Big Tujunga Cr.	below Hansen Dam	182	7.6	15,200
Los Angeles R.	at Long Beach[6]	194	18.3	128,700
Los Angeles R.	at Sepulveda Dam	39	12.11	14,700
Ballona Cr.	at Culver City[6]	36	16.0	32,500
Malibu Cr.	at Malibu Canyon[6]	21	21.4	33,800
Calleguas Cr.	near Camarillo	37	10.51	25,900
Santa Clara R.	at Montalvo[3]	122	17.4	165,000
Sespe Cr.	near Fillmore	93	25.01,4	85,300

Stream	Location	Mean annual runoff (taf)	Peak stage of record (ft)	Peak discharge of record (cfs)
Piru Cr.	above Frenchmans Flat	31	n/a	36,000
Santa Clara R.	near Piru	55	12.71	32,000
Ventura R.	near Ventura	512	29.31	63,600

Note:

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

[1] Different date than peak discharge

[2] Most recent but less than period of record

[3] Gage discontinued 2004

[4] Resulting from a debris wave

[5] Gage discontinued 2007

[6] Data source not USGS

Table SC-19 Groundwater Management Plans in the South Coast Hydrologic Region

Map Label	Agency Name	Date	County	Basin Number	Basin Name
SC-1	**Castaic Lake Water**	2003	Los Angeles	4-4.07	Santa Clara River Valley
	Newhall County Water District				
	Santa Clarita Water				
	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			4-4.03	Mound Subbasin
	Calleguas Municipal			4-4.04	Santa Paula Subbasin
				4-6	Pleasant Valley
				4-7	Arroyo Santa Rosa
				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				

Map Label	Agency Name	Date	County	Basin Number	Basin Name
SC-9	**Rainbow Municipal Water District**	2005	San Diego	9-7	San Luis Rey Valley
	No signatories on file				
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			9-2	San Mateo Valley
	Santa Margarita Water				
	City of San Juan				
	Moulton Niguel Water District				
SC-12	**Stakeholders of the Hemet / San Jacinto Water Management Area**	2007	Riverside	8-5	San Jacinto
	Eastern Municipal				
	Lake Hemet Municipal				
	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

Table SC-20 Assessment for SB 1938 GWMP Required Components, SB 1938 GWMP Voluntary Components, and Bulletin 118-03 Recommended 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 & 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 component**
Saline Intrusion	73%
Wellhead Protection & Recharge	91%
Groundwater Contamination	82%
Well Abandonment & Destruction	91%
Overdraft	82%
Groundwater Extraction & Replenishment	82%
Monitoring	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, & Actions	100%
Monitoring Plan Description	45%
IRWM Planning	91%
GWMP Implementation	100%
GWMP Evaluation	100%

Table SC-21 Factors Contributing to Successful Groundwater Management Plan Implementation in the South Coast Hydrologic Region

Key components	Respondents
Data collection and sharing	10
Outreach and education	10
Developing an understanding of common interest	9
Sharing of ideas and information with other water resource managers	10
Broad stakeholder participation	9
Adequate surface water supplies	8
Adequate regional and local surface storage and conveyance systems	7
Water budget	8
Funding	9
Time	8

Table SC-22 Factors Limiting Successful Groundwater Management Plan Implementation in the South Coast Hydrologic Region

Limiting Factors	Respondents
Funding for groundwater management projects	6
Funding for groundwater management planning	4
Unregulated Pumping	2
Groundwater Supply	4
Participation across a broad distribution of interests	1
Lack of Governance	-
Surface storage and conveyance capacity	4
Understanding of the local issues	2
Access to planning tools	-
Outreach and education	1
Data collection and sharing	1
Funding to assist in stakeholder participation	3

Table SC-23 Groundwater Ordinances that Apply to Counties in the South Coast Hydrologic Region

County	Groundwater Management	Recharge	Well Abandonment & Destruction	Well Construction Policies
Los Angeles	-	Y	-	-
Orange	-	-	-	Y
Riverside	-	-	Y	Y
San Bernardino	Y*	-	Y	Y
San Diego	Y**	-	-	-
Ventura	-	-	Y	Y

Notes:

* One or more ordinances exist which provide protection against exceeding the safe yield of a groundwater basin and impacts associated with exceeding the safe yield.

** General policies exist to reduce or prevent overdraft.

Table SC-24 Groundwater Adjudications in the South Coast Hydrologic Region

Court Judgment	Basin Number	County	Judgment
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.

Table SC-25 Conceptual Growth Scenarios

Scenario	Population Growth	Development Density
LOP-HID	Lower than Current Trends	Higher than Current Trends
LOP-CTD	Lower than Current Trend	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

Source: California Department of Water Resources 2012.

Table SC-26 Growth Scenarios (Urban) — South Coast

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

Source: California Department of Water Resources 2012.

Notes:

[a] See Table SC-25 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.

Table SC-27 Growth Scenarios (Agriculture) —South Coast

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

Source: California Department of Water Resources 2012.

Notes:

[a] See Table SC-25 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.

Table SC-28 Resource Management Strategies Addressed in IRWMPs in the South Coast Hydrologic Region

Resource Management Strategy	IRWMP 1	IRWMP 2
Agricultural Water Use Efficiency		
Urban Water Use Efficiency		
Conveyance – Delta		
Conveyance – Regional/Local		
System Reoperation		
Water Transfers		
Conjunctive Management & Groundwater		
Desalination		
Precipitation Enhancement		
Recycled Municipal Water		
Surface Storage – CALFED		
Surface Storage – Regional/Local		
Drinking Water Treatment and Distribution		
Groundwater and Aquifer Remediation		
Match Water Quality to Use		
Pollution Prevention		
Salt and Salinity Management		
Agricultural Lands Stewardship		
Economic Incentives		
Ecosystem Restoration		
Forest Management		
Land Use Planning and Management		
Recharge Areas Protection		
Water-Dependent Recreation		
Watershed Management		
Flood Risk Management		
Flood Management		
Desalination (Brackish and Sea Water)		
Salt and Salinity Management		

Figure SC-1 South Coast Hydrologic Region

Figure SC-2 South Coast Hydrologic Region Watersheds

Figure SC-3 Santa Ana River Watershed

[figure to come]

Photo SC-1 Prado Wetlands Area

[photo to come]

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

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

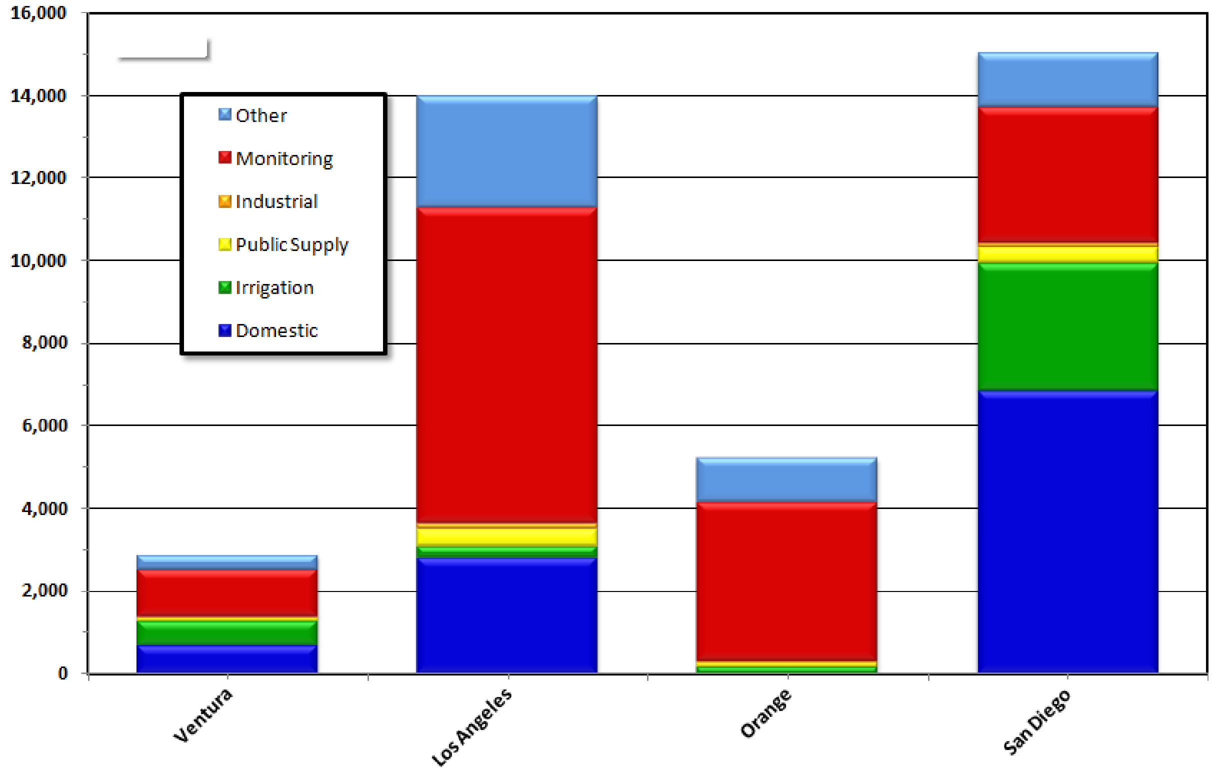


Figure SC-6 Percentage of Well Logs by Use for the South Coast Hydrologic Region (1977-2010)

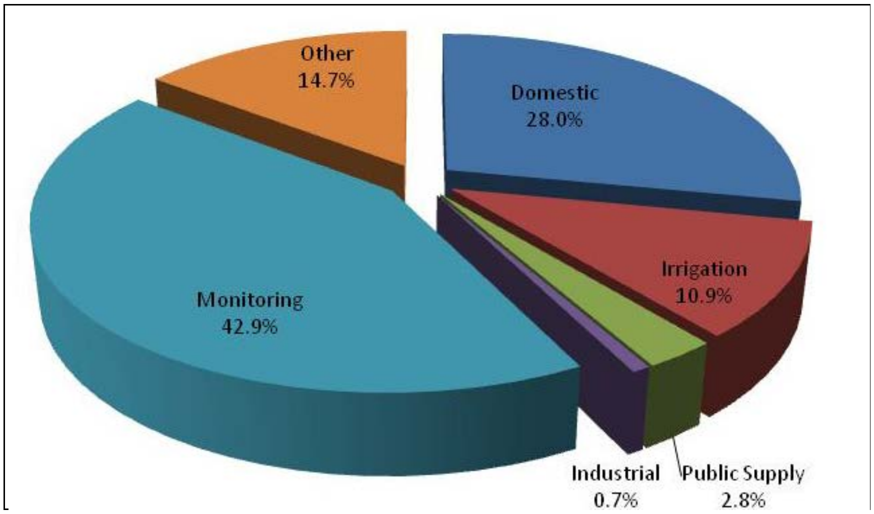


Figure SC-7 Number of Well Logs Filed per Year by Use for the South Coast Hydrologic Region (1977–2010)

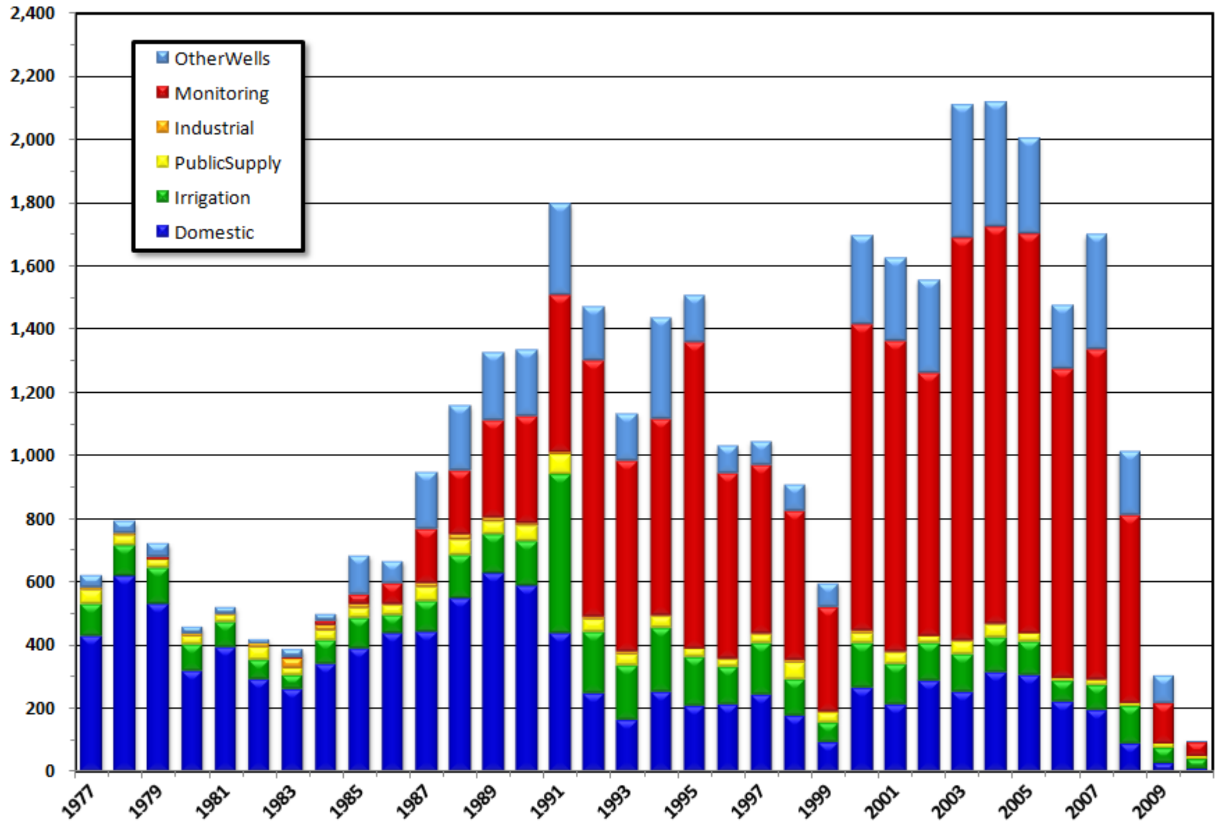


Figure SC-8 CASGEM Groundwater Basin Prioritization for the South Coast Hydrologic Region

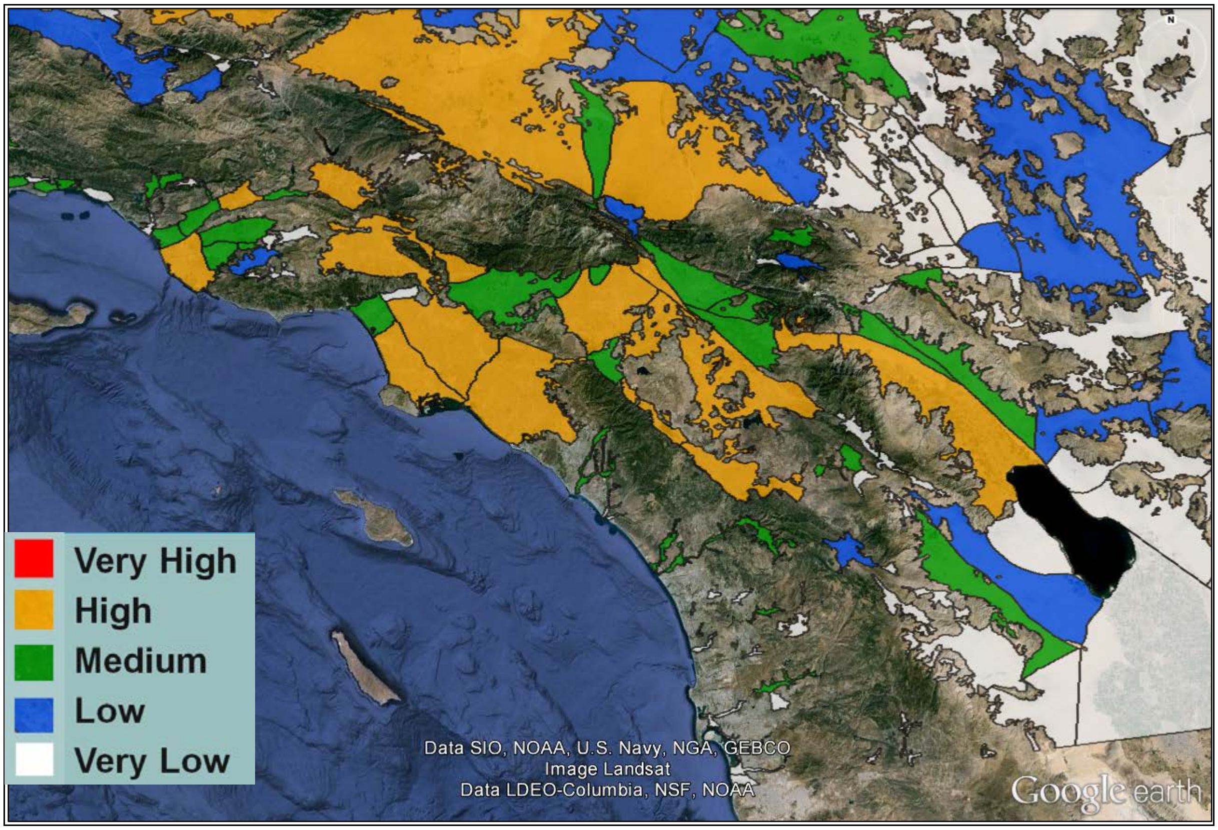
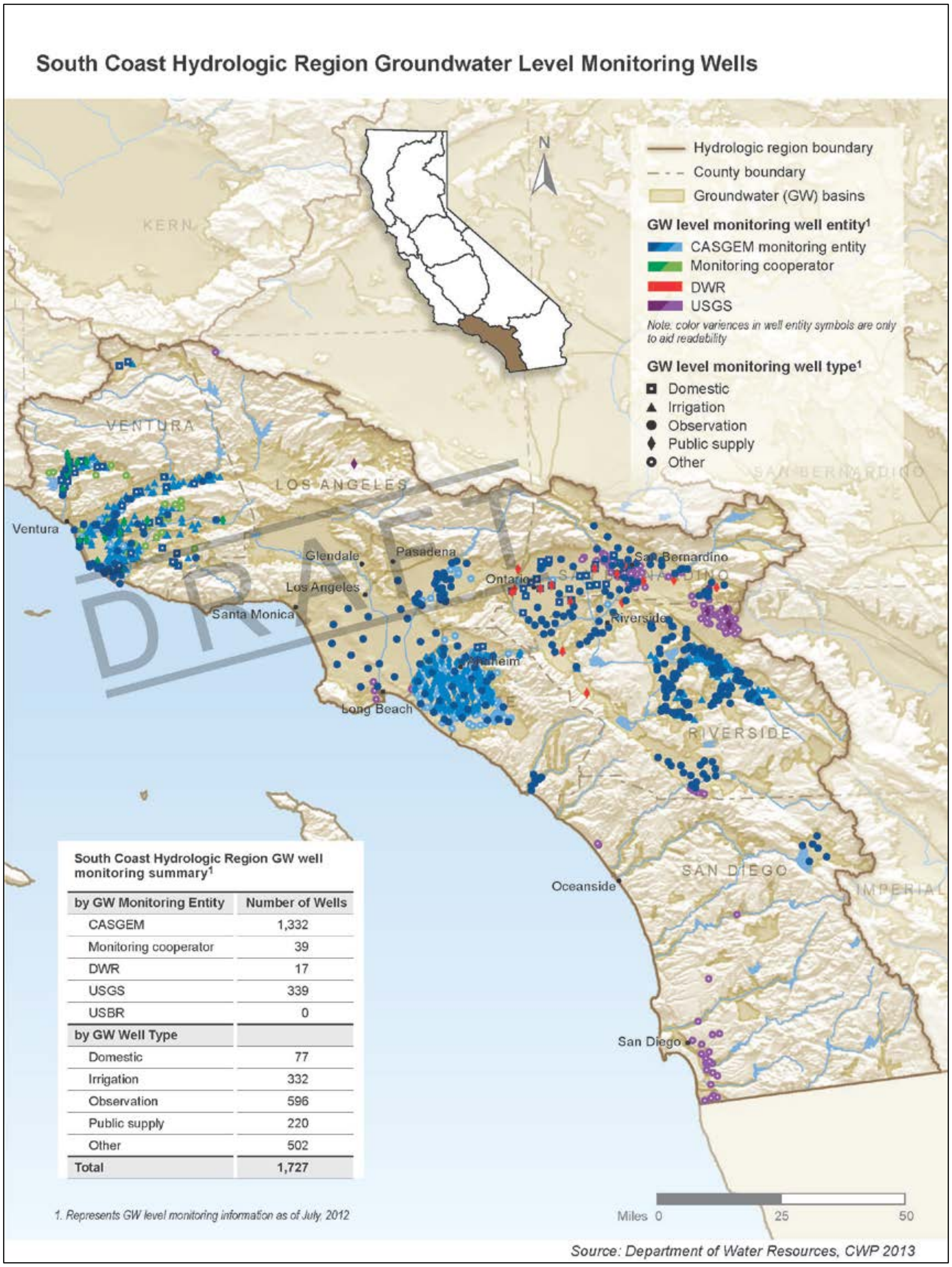


Figure SC-9 Monitoring Well Location by Agency, Monitoring Cooperator, and CASGEM Monitoring Entity in the South Coast Hydrologic Region



South Coast Hydrologic Region GW well monitoring summary[1]

by GW Monitoring Entity	Number of Wells
CASGEM	1,332
Monitoring cooperator	39
DWR	17
USGS	339
USBR	0
by GW Well Type	
Domestic	77
Irrigation	332
Observation	596
Public supply	220
Other	502
Total	**1,727**

Figure SC-10 Percentage of Monitoring Wells by Use in the South Coast Hydrologic Region

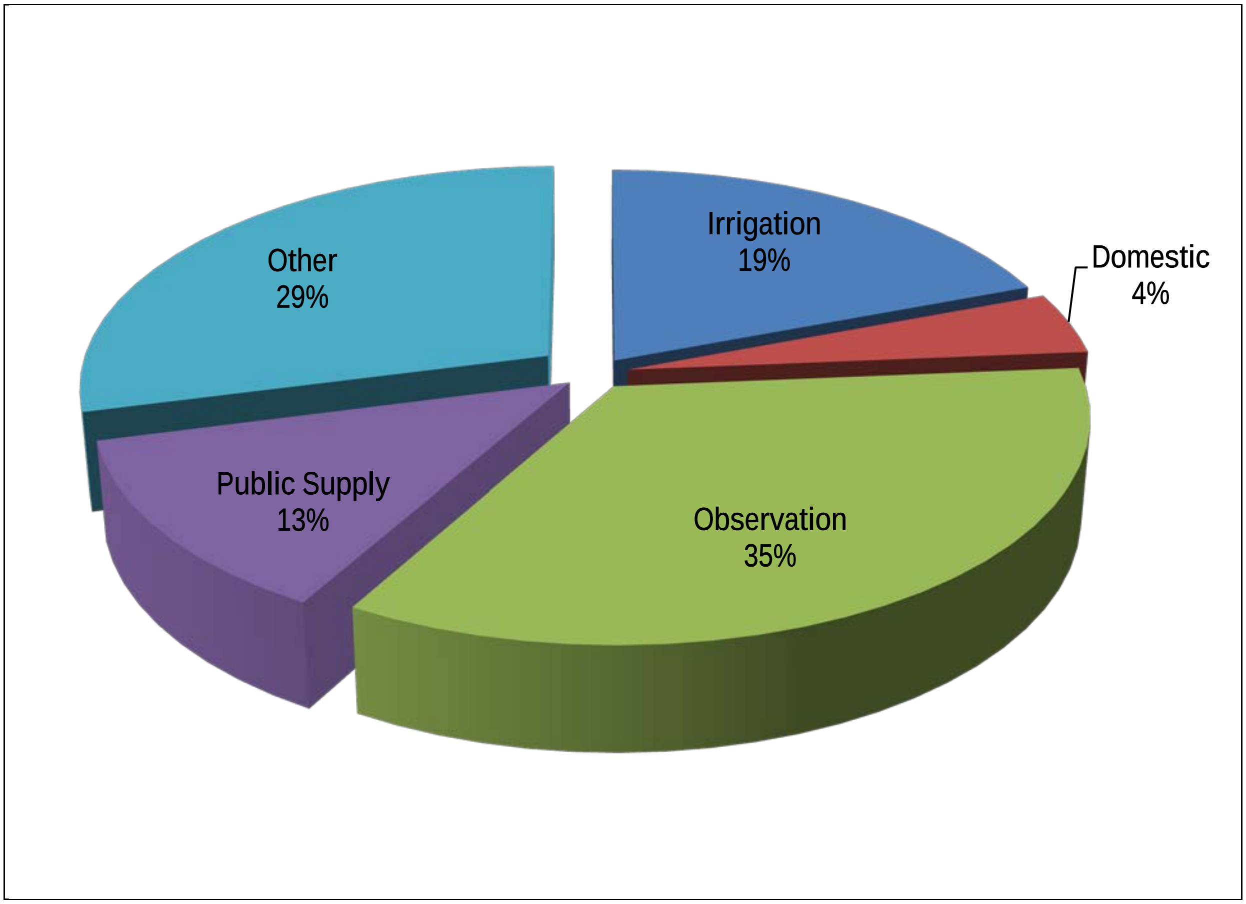


Figure SC-11 South Coast Hydrologic Region Inflows and Outflows in 2010

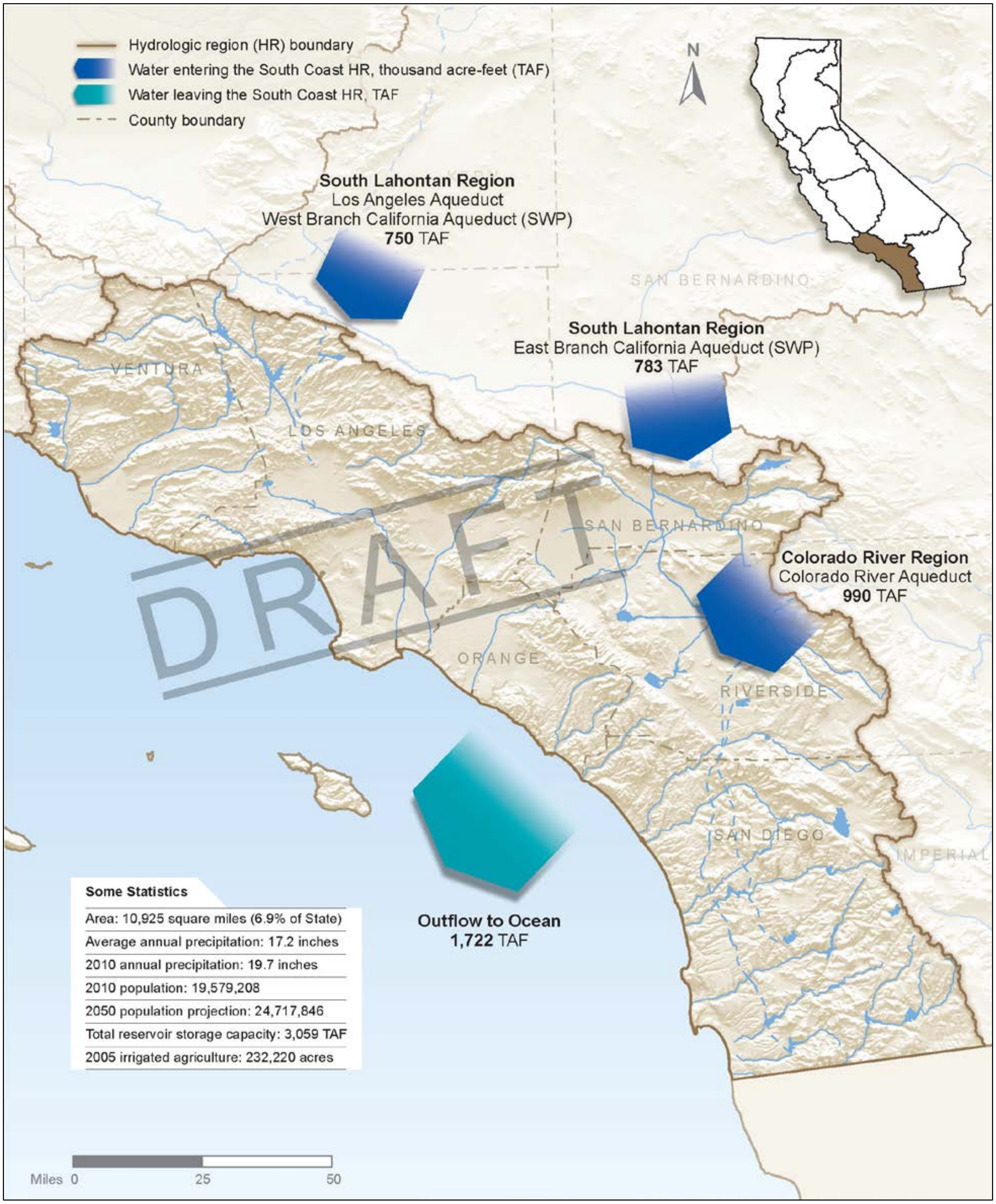


Figure SC-12 Contribution of Groundwater to the South Coast Hydrologic Region Water Supply by Planning Area (2005-2010)

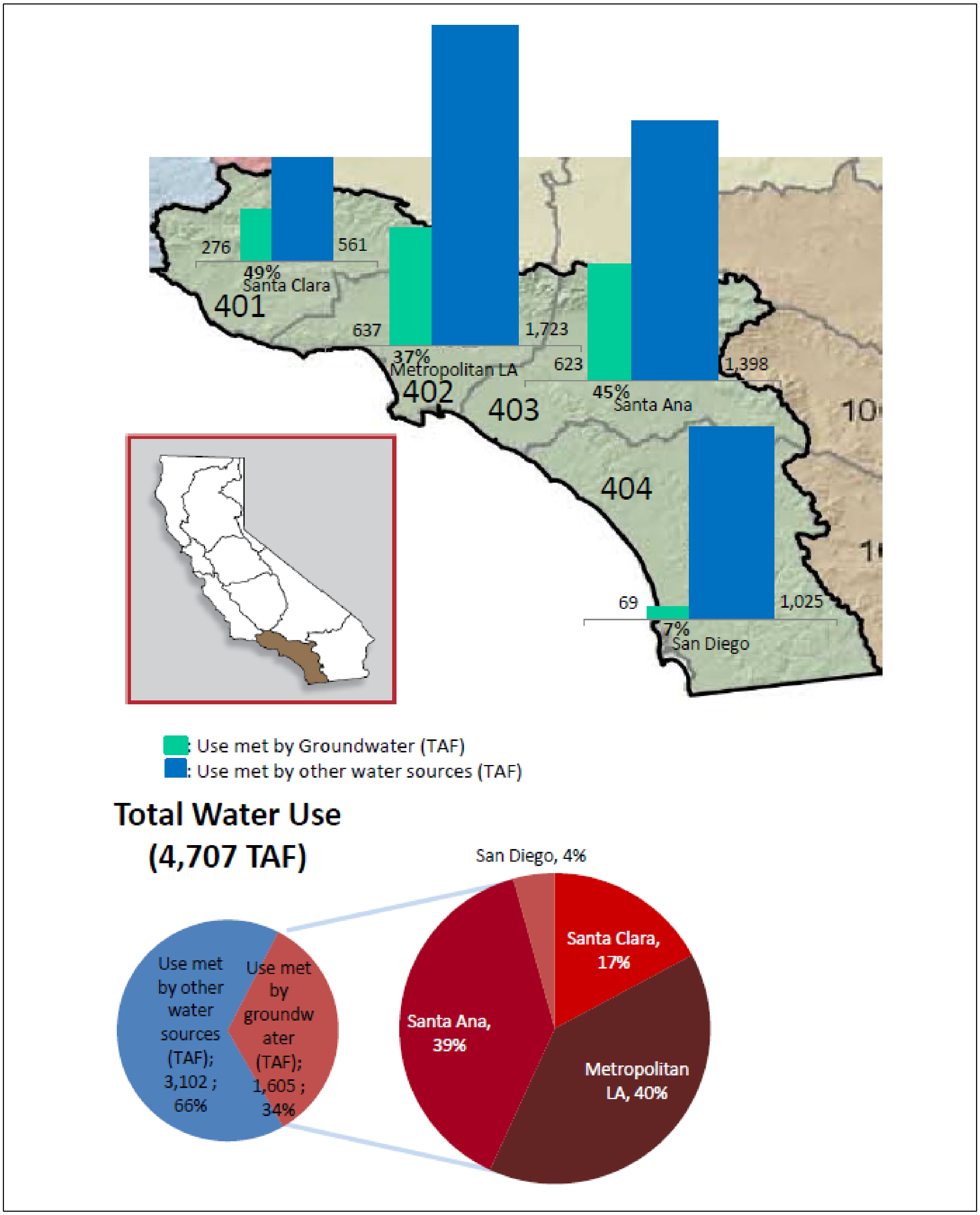


Figure SC-13 South Coast Hydrologic Region Annual Groundwater Water Supply Trend (2002-2010)

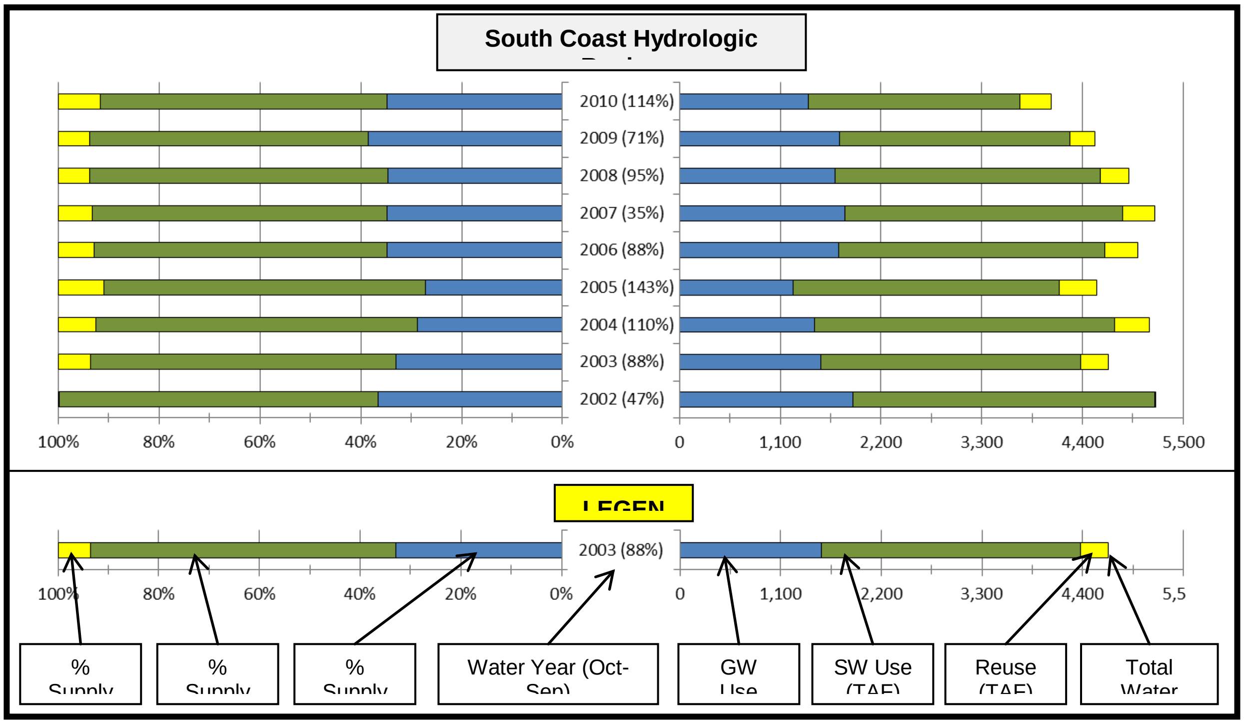


Figure SC-14 South Coast Hydrologic Region Annual Groundwater Supply Trend by Type of Use (2002-2010)

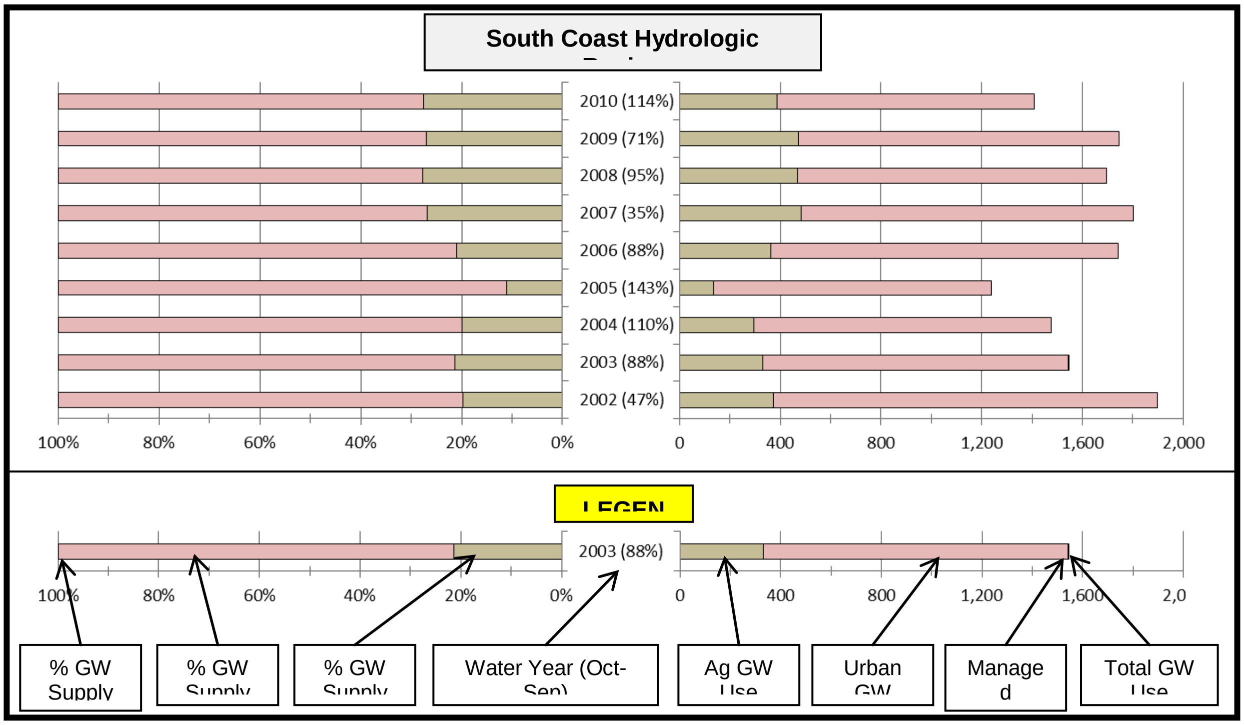
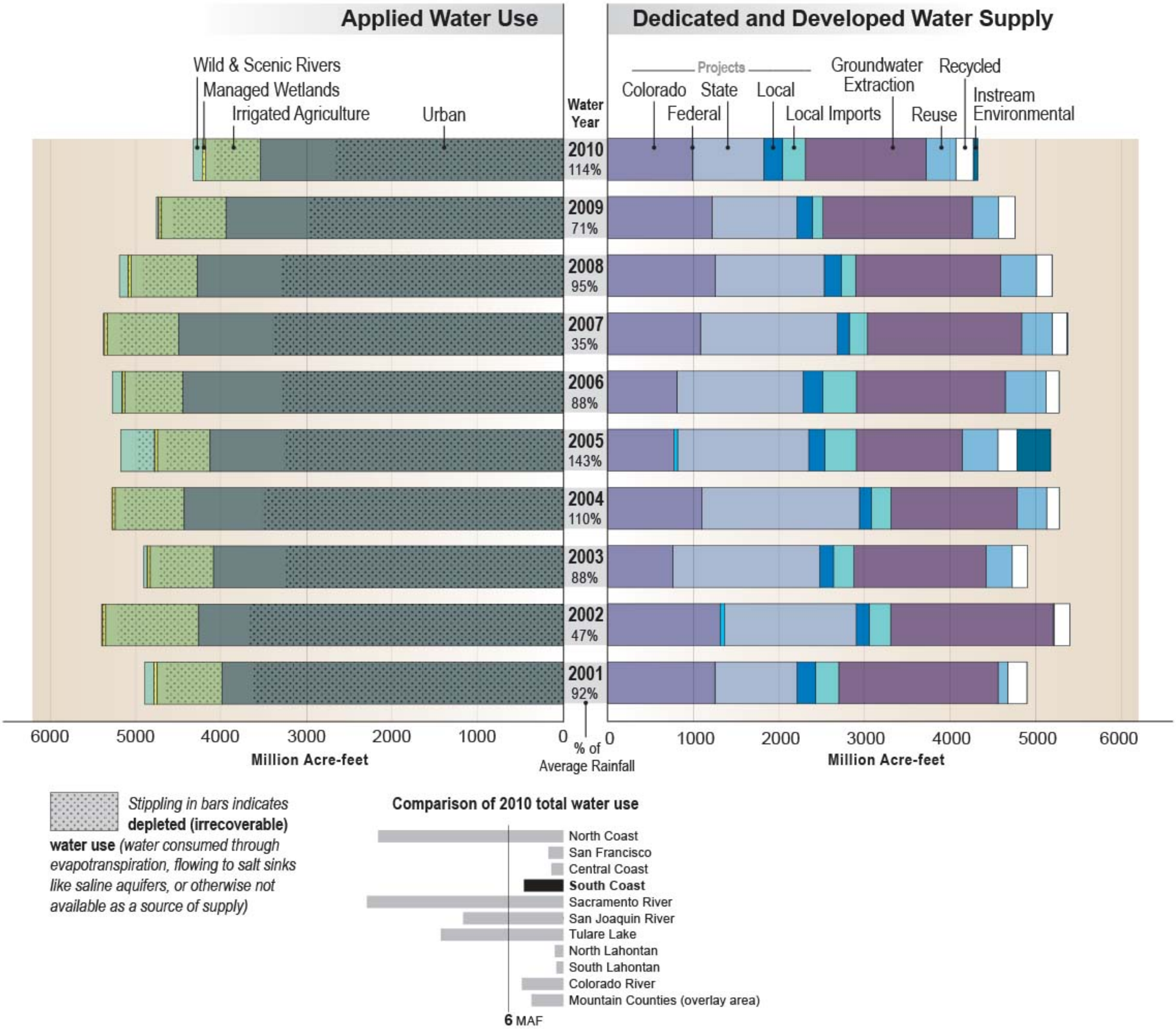


Figure SC-15 South Coast Hydrologic Region Water Balance by Water Year, 2001-2010

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. 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.



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 (MAF)

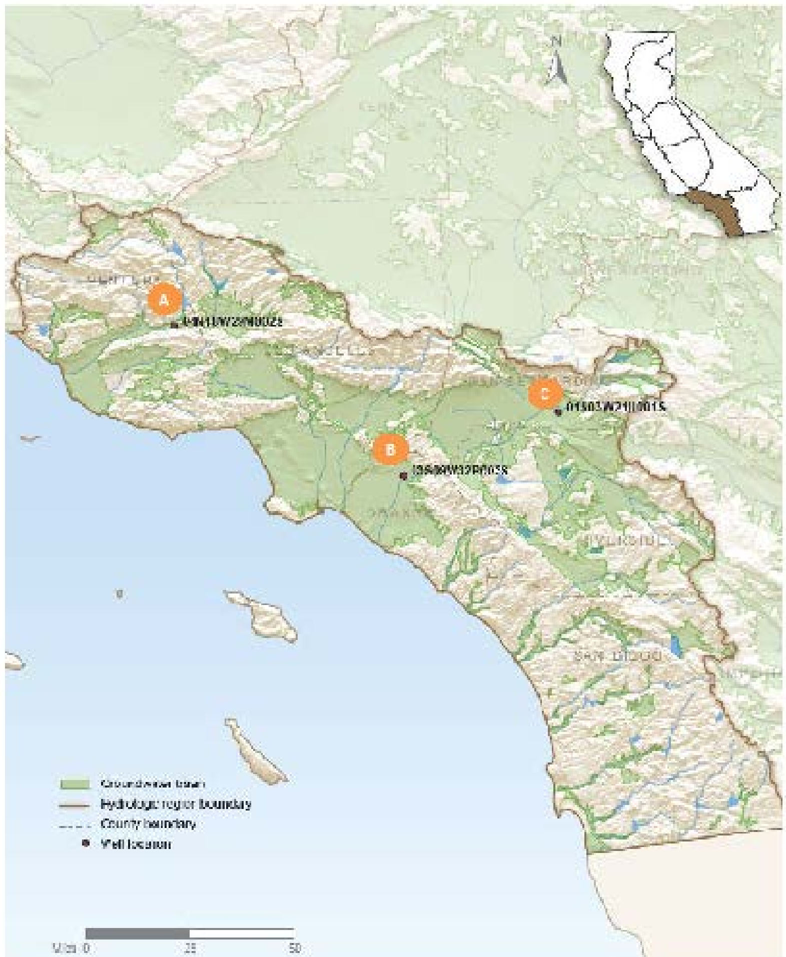
	2001 (92%)	2002 (47%)	2003 (88%)	2004 (110%)	2005 (143%)	2006 (88%)	2007 (35%)	2008 (95%)	2009 (71%)	2010 (114%)
Applied Water Use										
Urban	3990	4264	4091	4433	4131	4447	4497	4279	3945	3541
Irrigated Agriculture	758	1086	739	807	613	676	834	774	754	645
Managed Wetlands	37	36	31	31	32	31	32	32	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	**4897**	**5397**	**4905**	**5275**	**5175**	**5273**	**5376**	**5191**	**4757**	**4326**
Depleted Water Use (stippling)										
Urban	3621	3679	3248	3520	3268	3283	3397	3299	2971	2663
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	**4323**	**4660**	**3911**	**4246**	**4008**	**3870**	**4122**	**3969**	**3625**	**3236**
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**

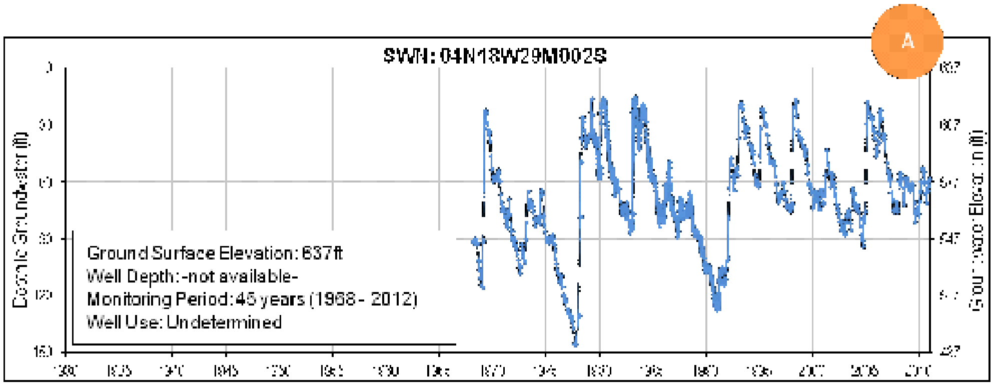
Figure SC-16 Groundwater Level Trends in Selected Wells in the South Coast Hydrologic Region

Figure X-x **South Coast hydrographs**

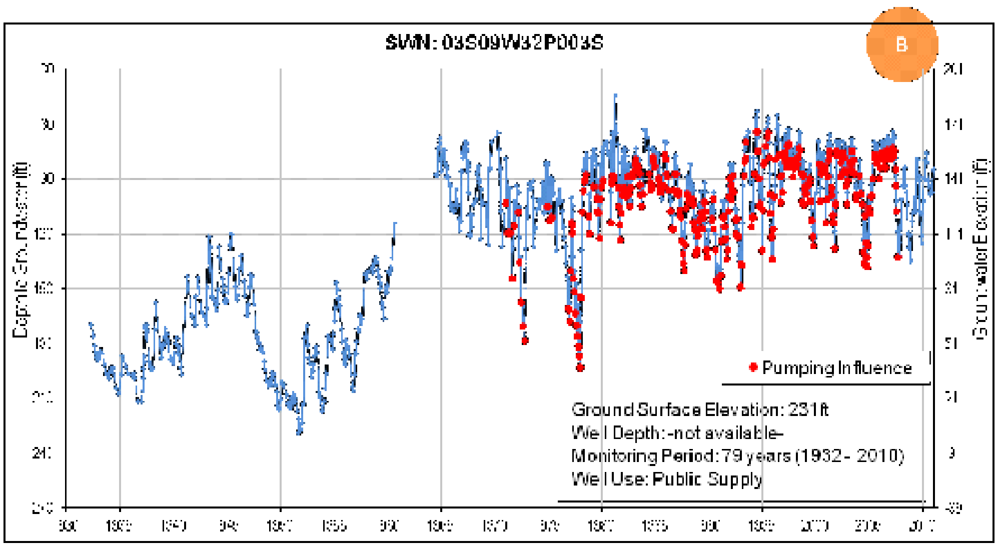
Aquifer response to changing demand and management practices

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

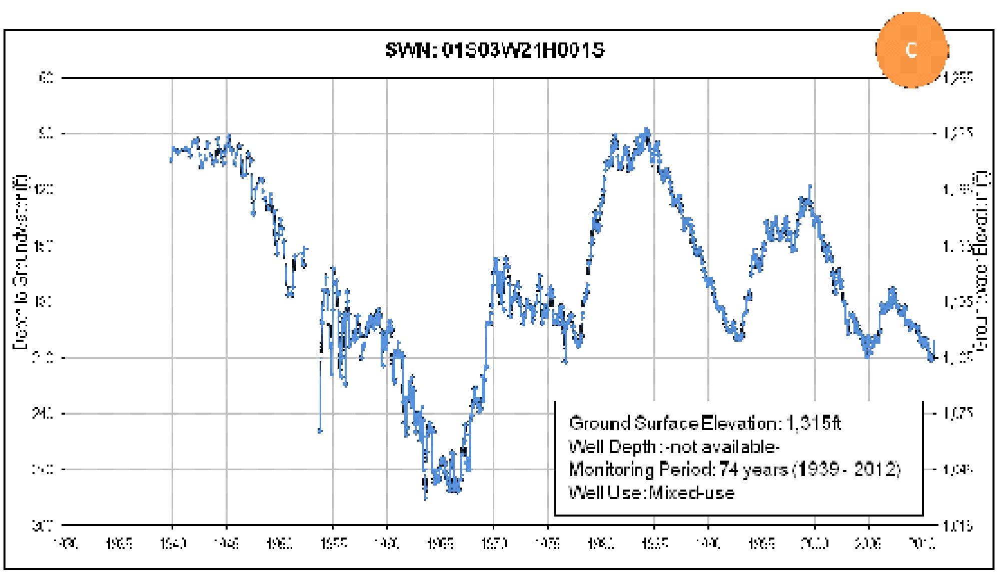




Hydrograph 04N18W29M002Si llustrates the aquifer response to weather cycles of dry and wet hydrology and successful implementation of groundwater recharge during the drought of 2007-09.



Hydrograph 03S09W32P003S illustrates the improvement and stabilization of groundwater levels through recharge and conjunctive water management using water from multiple sources.



Hydrograph 01S03W21H001S: highlights the aquifer response following adjudication of the basin's groundwater rights in1969 and to successful conjunctive management strategies.

Figure SC-17 Flood Hazard Exposure to the 100-Year Floodplain in the South Coast Hydrologic Region

South Coast Key Results

Total Population:	18,066,400	Transportation Facilities:	803
Population Exposed:	393,100	Transportation Segments (miles):	423
Percent of Population Exposed:	2	Essential Facilities:	165
Exposed Structures:	116,100	Lifeline Utilities:	21
Value of Exposed Structure and Contents:	$35.7 Billion	Dept. of Defense Facilities:	16
Total Area (acres)	7.0 Million	Dept. of Defense Facilities (acres):	1,252
Exposed Area (acres)	262,200	High Potential Loss Facilities:	101
Percent of Area Exposed:	4	Native American Tribes:	5
Exposed Ag.Crops (acres):	46,200	Native American Tribal Lands (acres):	583
Percent of Ag. Crops Exposed:	12	Sensitive Animal Species Exposed:	136
Value of Exposed Ag. Crops:	$216.0 Million	Sensitive Plant Species Exposed:	210

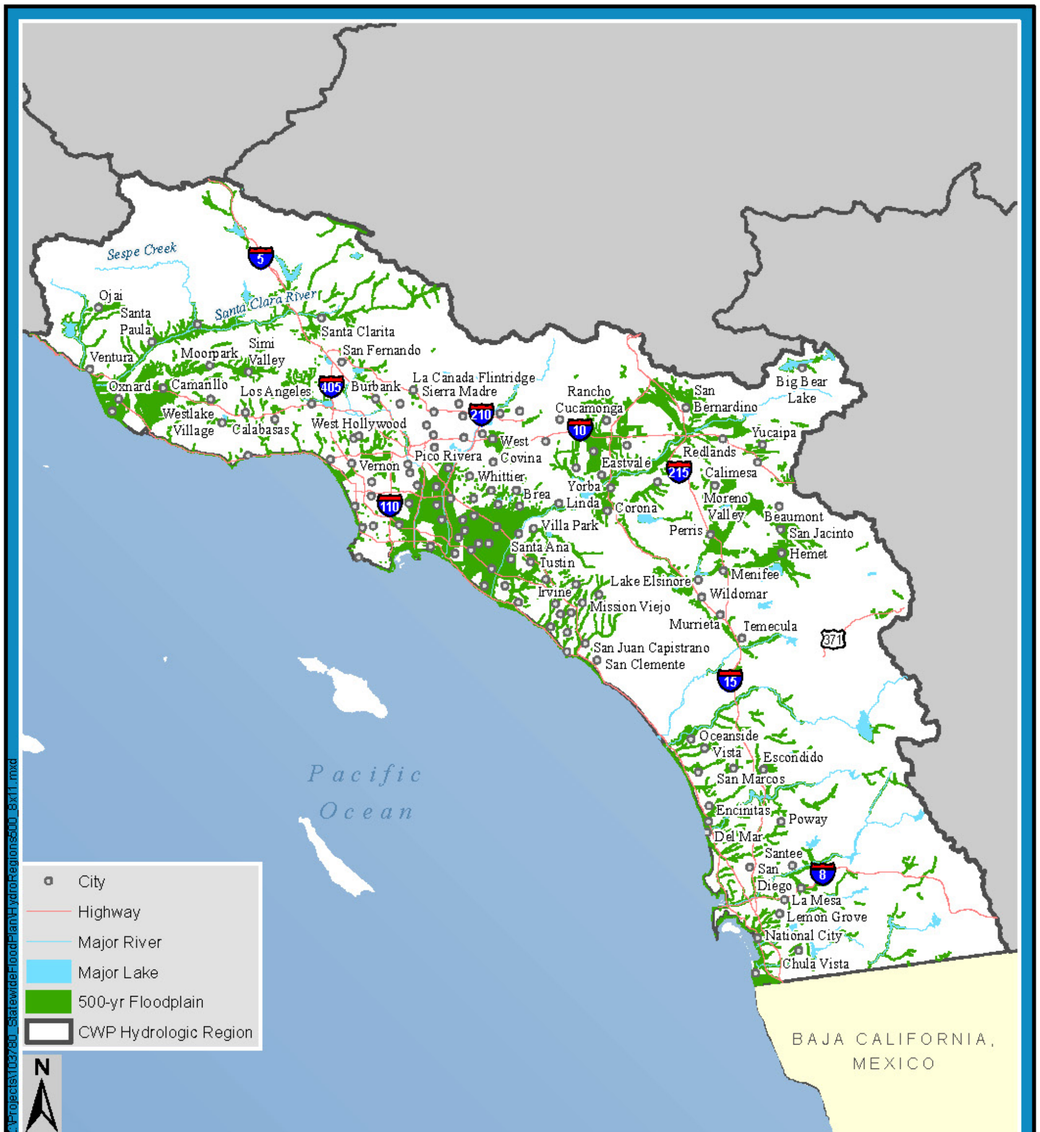
Statewide Flood Hazard Exposure Summary for the South Coast Hydrologic Region 100-year Floodplain

STATEWIDE FLOOD MANAGEMENT PLANNING PROGRAM

FloodSAFE CALIFORNIA

Jan 28, 2013

Figure SC-18 Flood Hazard Exposure to the 500-Year Floodplain in the South Coast Hydrologic Region



South Coast Key Results

Total Population:	18,066,400	Transportation Facilities:	2,074
Population Exposed:	3,411,900	Transportation Segments (miles):	1,626
Percent of Population Exposed:	19	Essential Facilities:	1,299
Exposed Structures:	883,100	Lifeline Utilities:	87
Value of Exposed Structure and Contents:	$231.3 Billion	Dept. of Defense Facilities:	16
Total Area (acres)	7.0 Million	Dept. of Defense Facilities (acres):	4,337
Exposed Area (acres)	578,400	High Potential Loss Facilities:	772
Percent of Area Exposed:	8	Native American Tribes:	5
Exposed Ag.Crops (acres):	79,900	Native American Tribal Lands (acres):	586
Percent of Ag. Crops Exposed:	20	Sensitive Animal Species Exposed:	137
Value of Exposed Ag. Crops:	$424.8 Million	Sensitive Plant Species Exposed:	210

Statewide Flood Hazard Exposure Summary for the South Coast Hydrologic Region 500-year Floodplain

STATEWIDE FLOOD MANAGEMENT PLANNING PROGRAM

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Jan 28, 2013

Photo SC-2 Major Flooding in the 1800s & Early 1900s

[photo to come]

Photo SC-3 Los Angeles River-Deforest Park and Bike Trail

[photo to come]

Figure SC-19 Location of Groundwater Management Plans in the South Coast Hydrologic Region

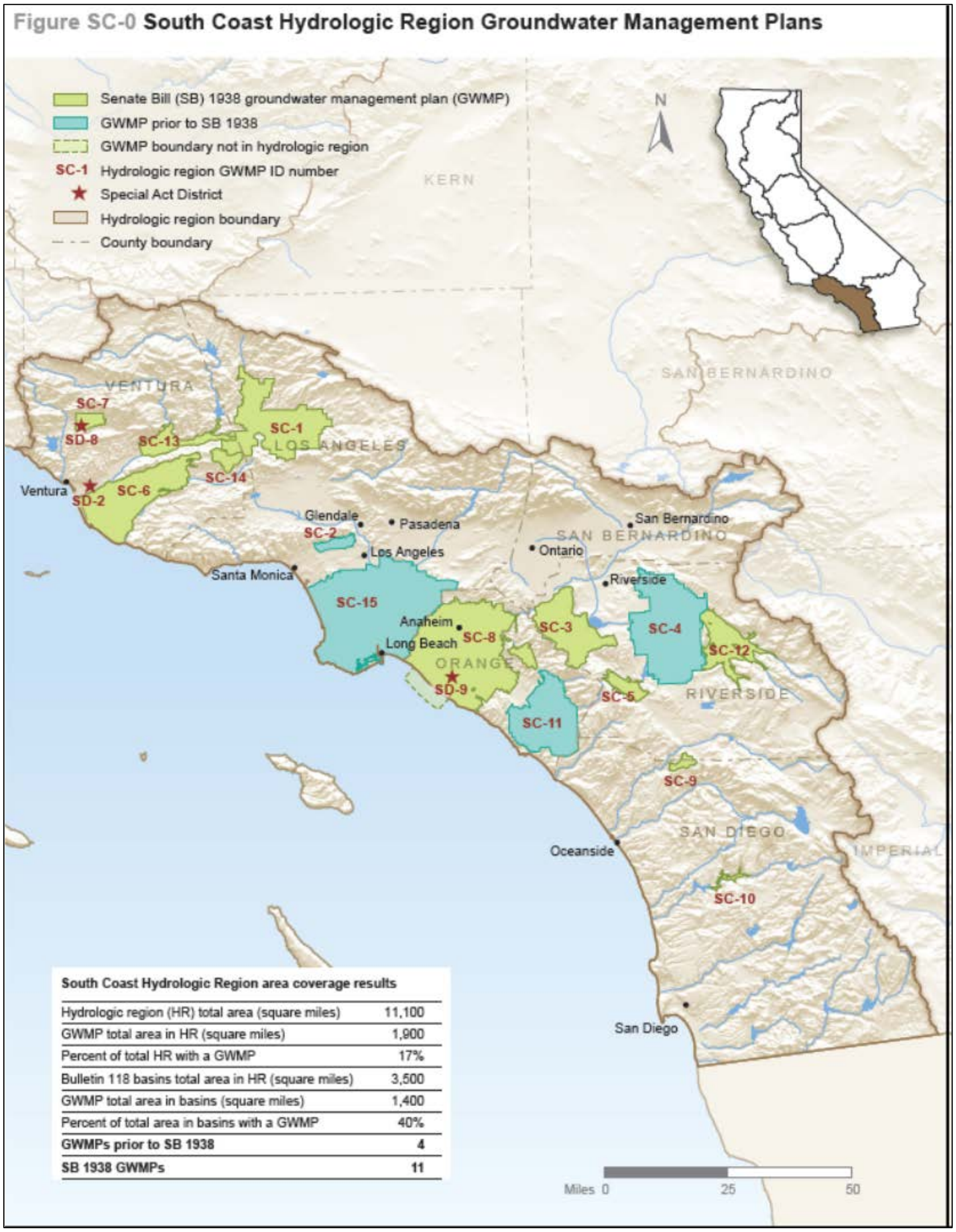


Figure SC-20 Groundwater Adjudications in the South Coast Hydrologic Region

Figure SC-21 Change in the South Coast Agricultural and Urban Water Demands for 117 Scenarios from 2006-2050 (thousand acre-feet per year)

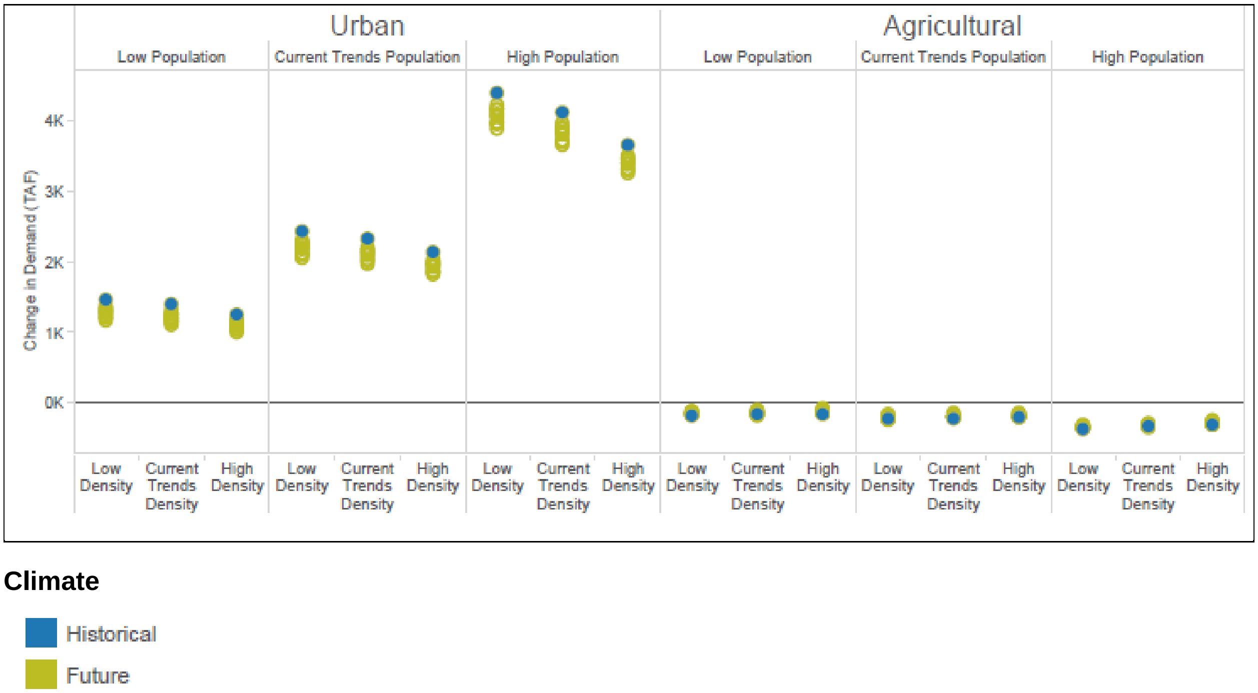


Figure SC-22 Integrated Water Management Planning in the South Coast Region

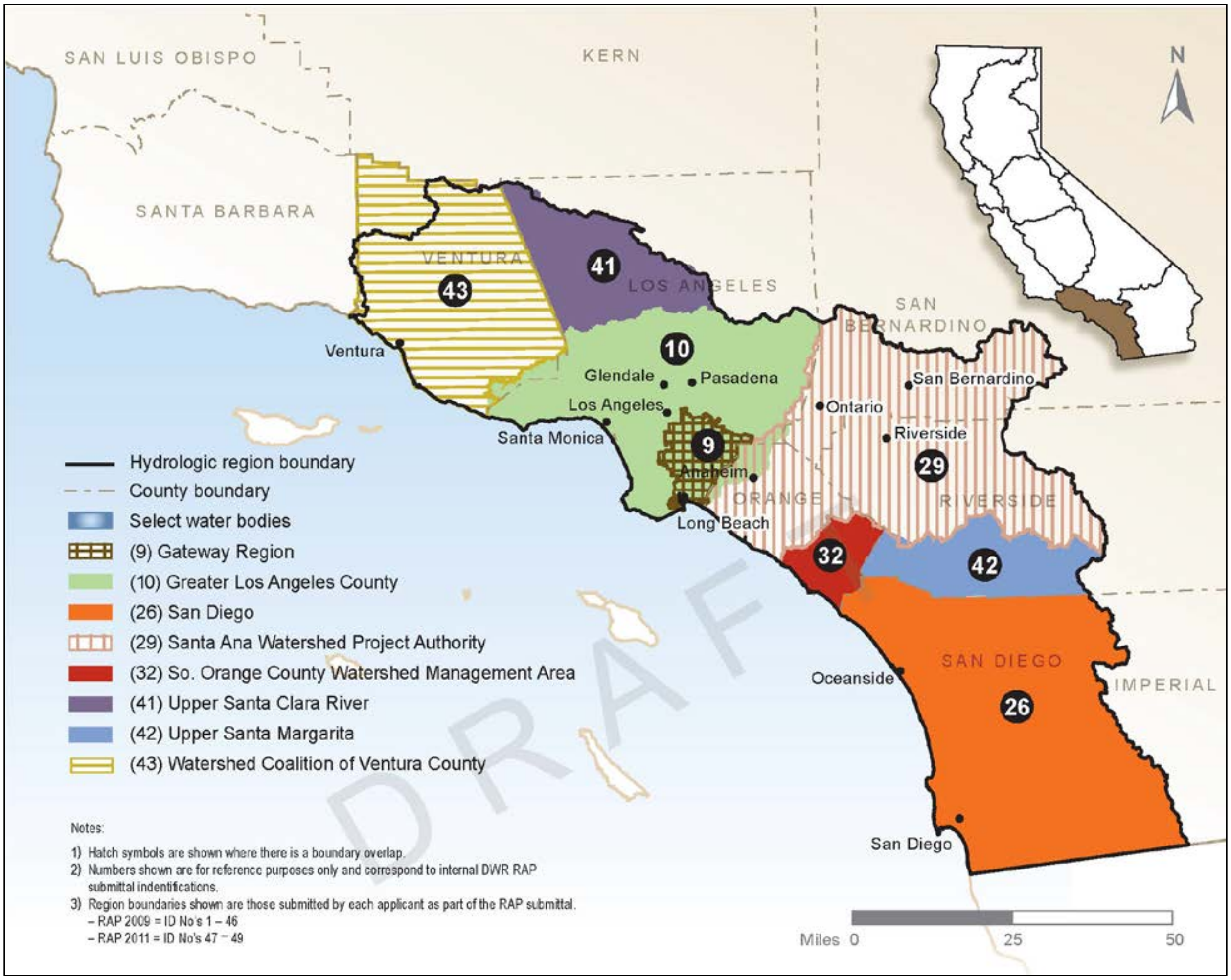


Figure SC-23 Conjunctive Management Program Goals and Objectives

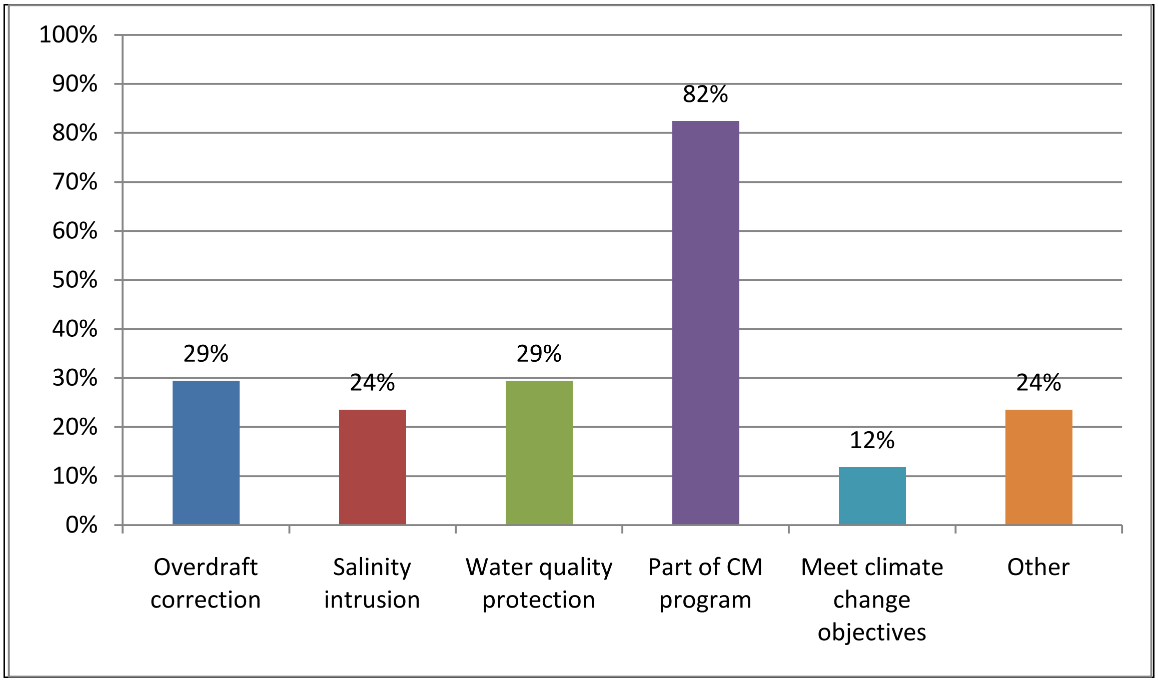


Figure SC-24 Constraints towards Development of Conjunctive Management and Water Banking Programs

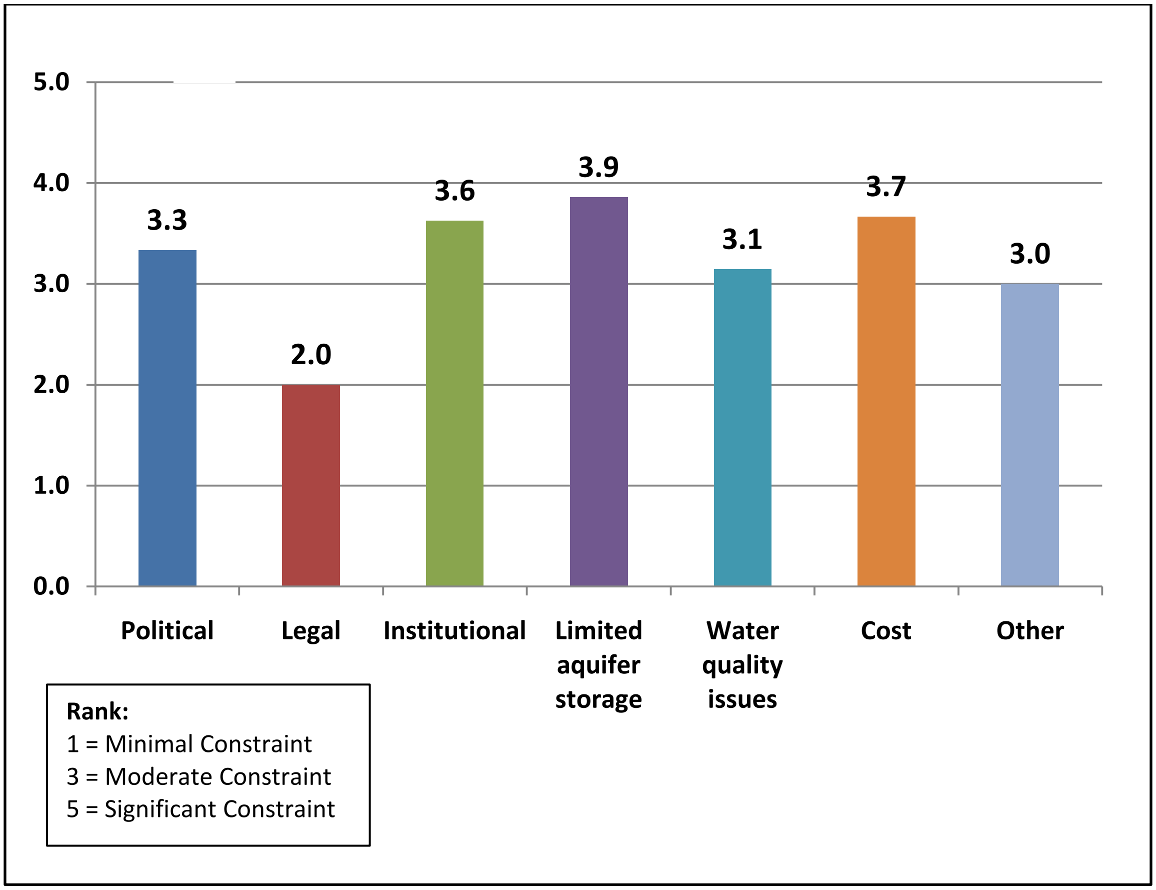
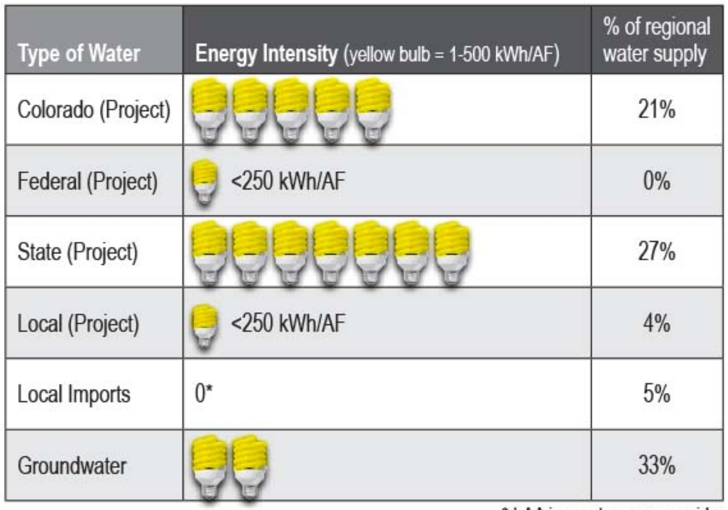


Figure SC-25 Energy Intensity of Raw Water Extraction and Conveyance in the South Coast Region

Figure x: South Coast energy intensity per acre foot of water



Type of Water	Energy Intensity (yellow bulb = 1-500 kWh/AF)	% of regional water supply
Colorado (Project)		21%
Federal (Project)	<250 kWh/AF	0%
State (Project)		27%
Local (Project)	<250 kWh/AF	4%
Local Imports	0*	5%
Groundwater		33%

* LAA is a net energy provider

Energy intensity per acre foot of water

Energy intensity (EI) in this figure is the total amount of energy required for the extraction and conveyance of one acre-foot of water and does not include treatment, distribution to point of use, or end use energy (e.g., water heating). These figures should be seen as ranges within which the EI of different sources of each water type would likely fall i.e., a water type with four bulbs should be interpreted to mean that most sources of that water type in the region would have an EI of between 1,501-2,000 kWh/ acre-ft of water. Smaller light bulbs represent an EI of greater than zero, and less than250 kWh/acre-ft. EI of desalinated and recycled water is not shown, but is covered in Resource Management Strategies #XX and #YY respectively, Volume 3. (For detailed description of the methodology used to calculate EI in this figure, see Technical Guide, Volume 5 or References Guide, Volume 4 (TBD)).

Box SC-1 California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization Data Considerations

Senate Bill 7x 6 (SBx7 6; Part 2.11 to Division 6 of the California Water Code § 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 listed below:.

1. The population overlying the basin,
2. The rate of current and projected growth of the population overlying the basin,
3. The number of public supply wells that draw from the basin,
4. The total number of wells that draw from the basin,
5. The irrigated acreage overlying the basin,
6. The degree to which persons overlying the basin rely on groundwater as their primary source of water,
7. Any documented impacts on the groundwater within the basin, including overdraft, subsidence, saline intrusion, and other water quality degradation, and
8. 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
- Very Low

Box SC-2 Other Groundwater Management Planning Efforts in the South Coast Hydrologic Region

The Integrated Regional Water Management plans, Urban Water Management plans, and Agriculture Water Management plans in the South Coast Hydrologic Region that also include components related to groundwater management are briefly discussed below.

Integrated Regional Water Management Plans

There are eight IRWM regions covering a portion of the South Coast Hydrologic Region. Seven regions have adopted IRWM plans, while one IRWM region has finalized its plan. The Watershed Coalition of Ventura County IRWM Plan (Ventura IRWM plan) is the only plan which crosses into adjacent Central Coast and South Coast Hydrologic Regions. The groundwater management is conducted by local entities that use a variety of mechanisms to manage groundwater.

The Upper Santa Clara River IRWM Plan relies on an MOU executed by local entities to cooperatively manage local groundwater supplies. The cooperating agencies have integrated their database management efforts; 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 IRWM Plan contains some of the most sophisticated multi-agency groundwater management planning and saline management strategies in the U.S. A regional GWMP 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 efforts 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 to balance groundwater pumping with increased recharge to fully utilize the storage capability of the groundwater basins.

The Upper Santa Margarita Watershed IRWM Plan leaves groundwater management to local entities. Groundwater management 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 IRWM Plan also defers groundwater management to local entities who have established groundwater management plans and who implement groundwater management through projects in their areas. The IRWM plan 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, protect and conserve 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 IRWM Plan also defers groundwater management to local entities. The objectives of the IRWM plan are to balance groundwater pumping with increased recharge capabilities that effectively use the storage capacity of the groundwater basin.

Urban Water Management Plans

Urban Water Management plans are prepared by California's urban water suppliers 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 Urban Water Management plan 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 currently under evaluation and review by DWR. Because of the time-line, the plans could not be reviewed for assessment for Water Plan Update 2013.

Agricultural Water Management Plans

Agricultural Water Management plans are developed by water and irrigation districts to advance the efficiency of farm water management while benefitting the environment. New and updated Agricultural Water Management plans addressing several new requirements were submitted to DWR by December 31, 2012 for review and approval. These new or updated plans provide another avenue for local groundwater management, but because of the time-line, the plans could not be reviewed for assessment for Water Plan Update 2013.

Box SC-3 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 DWR-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 email 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.