Table of Contents for the South Lahontan Hydrologic Region Report

Tables

Figures

South Lahontan Hydrologic Region

South Lahontan Hydrologic Region Summary

This section is under development

Current State of the Region

Setting

The South Lahontan Hydrologic Region represents about 17 percent of the land area in California: over 17 million acres of land. The region includes Inyo County and portions of Mono, San Bernardino, Kern, and Los Angeles counties. It is bounded to the north by the drainage divide between Mono Lake and East Walker River; to the west and south by the Sierra Nevada, San Gabriel, San Bernardino, and Tehachapi mountains; to the southeast by the New York Mountains and to the east by the state of Nevada (Figure SL-1).

PLACEHOLDER Figure SL-1 South Lahontan Hydrologic Region 2010 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.]

The topography of the South Lahontan region is characterized by fault-bounded mountain blocks separated by basins filled principally with alluvial and lake sediments and lesser volcanic material. The region is part of the basin and range province, which spans Nevada, western Utah, southern Idaho, southern Oregon, southeastern California, and southwestern Arizona. The highest and lowest points in the conterminous United States are in the central part of the region: Mt. Whitney, with an elevation of 14,495 feet above sea level, and Badwater in Death Valley, at 282 feet below sea level. The most prominent mountain ranges are the Sierra Nevada, the White-Inyo Mountains, the Panamint Range, the Amargosa Range, the Tehachapi Mountains, the San Gabriel Mountains, and the San Bernardino Mountains.

The region's past tectonic activities and current climate are responsible for the region's present day hydrologic and drainage characteristics. The bordering mountain ranges have left the region without an outlet to the Pacific Ocean. As a result, all rivers and streams drain to internal basins. For most of the year, flows in these waterways are, at best, intermittent; a reflection of the region's present day arid conditions. If flow does occur, it is usually the result of runoff from heavy rainfall. Playas or dry lakes found in these internal basins are a reflection of wetter conditions in the past.

The perennial flows in the Owens River reflect the wetter conditions found in the northern part of the region. Other perennial rivers benefitting from the higher precipitation and runoff from the snowmelt include Rush, Lee Vining, and Mill Creeks which, along with their tributaries, drain into Mono Lake. In the south, water flows in the rivers and streams are more intermittent or ephemeral. When there are flows, it is usually the result of runoff from heavy rainfall events. Important rivers in the southern portion are the Mojave and Amargosa Rivers.

The conditions in the north have also resulted in the formation of both natural and man-made lakes; some important for water supplies and others for recreation. Important lakes include Mono Lake, Grant Lake, June Lake, Convict Lake, Crowley Lake, Lake Mary, and Tinemaha and Haiwee Reservoirs. In the south, important lakes include Lake Arrowhead and the SWP's Silverwood Lake.

Native vegetation in the arid valleys and ranges is adapted for drought-tolerance and salt-tolerance, with communities including Mojave Creosote scrub, sagebrush scrub, Joshua Tree woodland, and alkali sink. In the cooler, wetter mountain areas, vegetation communities are zoned by elevation, and include pinyon-juniper woodland at intermediate elevations and alpine forest and fell-field communities at the highest elevations. Riparian and other native vegetation communities in the ephemeral streams of the watershed also provide critical habitat for some of the indigenous bird and animal species. These communities are sustained from the flows in streams following rainfall events and from the seeds, nutrients, and organic matter transported in these flows.

Major water facilities include the Los Angeles Aqueduct (LAA) and the west and east branches of the State Water Project (SWP).

Several large national parks and forests exist in the South Lahontan Region. These include Death Valley National Park, the Inyo National Forest, and the Mojave Natural Preserve. There are also several large military reservations in the Region.

Watersheds

Antelope Valley Watershed

The Antelope Valley watershed extends over portions of Kern, Los Angeles, and San Bernardino Counties and covers 2,400 square miles (see Figure SL-2). It is bounded by the San Gabriel Mountains on the south, the Tehachapi Mountains to the north, and a series of hills and buttes that generally follow the Los Angeles-San Bernardino County line to the east. Major communities include the cities of Lancaster, Palmdale, and California City; the towns of Boron, Mojave, and Rosamond; and Edwards Air Force Base. Most of the service area of the Antelope Valley-East Kern Water Agency (AVEK) lies within the watershed. Antelope Valley is a closed basin without a natural outlet to the Pacific Ocean.

PLACEHOLDER Figure SL-2 Watersheds and Ecosystems in the South Lahontan 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 watershed is actually a collection of several smaller watersheds. Many of the steams for these watersheds have their headwaters in the San Gabriel Mountains. These include Big Rock Creek, Little Rock Creek, and Amargosa Creek. Oak Creek has its headwaters in the Tehachapi Mountains. Amargosa Creek runs from south to north between the State Route 14 and Sierra Highway.

The construction of new homes and commercial buildings continues in the Antelope Valley but the pace has slowed in recent years because of the recession. Agricultural operations continue to the west, north, and east of the cities of Lancaster and Palmdale. Although considerably less than three decades ago, the total irrigated crop acres have averaged slightly less than 20,000 acres in recent years.

Littlerock Dam impounds the flowing water in Littlerock Creek in the south. The water stored behind the dam provides water supplies for urban and agricultural users downstream. The dam is operated by the Littlerock Creek Irrigation District and Palmdale Water District.

Two aqueducts convey water supplies in the watershed. The East and West Branches of the SWP conveys water supplies to SWP contractors outside of the region and provides water supplies to urban and agricultural users inside the region. SWP Contractor, Antelope Valley -East Kern Water Agency is responsible for the local deliveries. The City of Los Angeles Aqueduct also passes through the region.

Precipitation in the watershed ranges on average from less than 10 inches per year on the valley floor to more than 12 inches in the surrounding mountains. There are areas of the valley floor subject to flooding due to uncontrolled runoff from these nearby foothills, and this situation is aggravated by the lack of drainage facilities and defined flood channels. Heavy runoff and flooding are prevalent along Big Rock, Little Rock, Amargosa, and Anaverde creeks. Heavy winter rainfall and summer thunderstorms increase the potential for flash floods.

Storm water runoff that does not percolate into the ground eventually floods to the impermeable dry lakebeds at Edwards Air Force Base; Rosamond and Rogers Dry Lakes. Totaling about 60 square miles, these playas are generally dry, but are likely to be flooded following prolonged precipitation. Fine sediments carried by the storm water inhibit percolation as do the impermeable playa soils. Surface water can remain on the playa for up to five months until the water evaporates.

Mojave Watershed

The Mojave watershed is in San Bernardino County and covers an area of 4,500 square miles (see Figure SL-2). It includes the Mojave River and its associated floodplain. It is bounded to the south by the San Bernardino and San Gabriel mountains. The northern and eastern boundaries are provided by a series of smaller mountain ranges that include the Granite, Bristol, and Providence mountains. From the San Bernardino Mountains, the watershed extends northward to the city of Barstow before turning to the northeast. It includes Silver Lake, a dry lakebed near the community of Baker, and the dry lakebeds of Harper Lake, Coyote Lake, Troy Lake, Soda Lake, West Cronese, and East Cronese.

The main hydrologic feature of the watershed is the Mojave River whose headwaters are in the San Bernardino Mountains. Snowmelt provides most of water for the river and provides an estimated 54,000 acre-feet of annual recharge to the Mojave Groundwater Basin. After descending from Mojave River Dam in the Mojave River Forks Reservoir, the river meanders approximately 120 miles and terminates at Silver Dry Lake. For most of the year, the Mojave River channel is dry downstream of the dam except at the Narrows near Victor Valley and Afton Canyon where the subsurface flow beneath the riverbed is forced to the surface by geologic structures. Deep Creek, tributary to Mojave River, begins near Crestline in the San Bernardino Mountains. It flows most of the time, but may be dry in the summer. The Deep Creek watershed includes Lake Arrowhead, and the creek joins the Mojave River at Mojave Forks Reservoir.

The watershed has a combination of urban, agricultural, and environmental land and water uses. The urban area in Victor Valley, which includes the city of Victorville, has been expanding steadily for the past two decades. This expansion of the urban area has significantly modified the amount of waste discharges that could potentially affect water quality, including storm water and wastewater treatment.

Groundwater is the primary water supply source for all of the uses in the watershed. Overdraft conditions for several groundwater basins in the area, including the Mojave River Valley Basin, began in the 1950s. Formal adjudication of the basin occurred in 1996 through a stipulated judgment, which was appealed shortly after. On August 22, 2000, the California Supreme Court issued a decision that affirmed water rights priority in cases of competing water appointment.

Mojave Water Agency (MWA) completed its first pipeline and recharge project (Morongo Basin Pipeline) in 1994. SWP deliveries to the Mojave River at the Rock Springs recharge site began in 1994, and in 1995 recharge began in Yucca Valley. The Mojave River Pipeline, built in 1999, delivers SWP water to the Hodge and Lenwood recharge sites; it was extended later to Daggett/Yermo and Newberry Springs recharge sites.

MWA recently completed the Oro Grande Wash Recharge project which delivers SWP water to a groundwater recharge site in Victorville. MWA completed the Regional Recharge and Recovery (R3) Project in 2012. R3 is part of a conjunctive use project that will pump SWP water previously-stored in the Mojave River Basin and deliver it to retail water agencies in the Victor Valley area.

Mono Basin

The Mono Basin watershed is on the eastern slope of the Sierra Nevada in southern Mono County (see Figure SL-2). The watershed encompasses more than 800 square miles and is bounded by the Sierra Nevada, Bodie Hills, Cowtrack Mountain, and the Glass Mountains. Mono Lake is the main feature of the watershed, and in 2012 its surface area was 71.35 square miles: Mono Basin is a closed basin, with all streams draining into Mono Lake. These include Mill Creek, Lee Vining Creek, and Rush Creek, with its tributaries Parker Creek and Walker Creek. The watershed ranges in elevation from slightly above 6,300 feet on the surface of Mono Lake to more than 13,000 feet near the crest of the Sierra Nevada. Summers range from mild to cool, and winters are cold and snowy.

Native vegetation communities range from scrub to grasslands around Mono Lake to the coniferous forests, including the Jeffrey Pine forests and pinyon juniper woodland habitats in the eastern Sierra Nevada. The watershed is an important nesting and rest stop for over 300 species of nesting and migratory birds. Most of the species are migratory but some, such as the California gull, do nest.

Urbanized areas in the watershed are small and are concentrated mostly in Lee Vining, Grant Lake, and June Lake. Other than livestock grazing on native pasture lands, there is no agriculture. Projects are under way to restore the fishery and riparian vegetation for Rush and Lee Vining Creeks. All activities are being monitored to track improvements.

The level of Mono Lake has fluctuated in response to climatic changes, and more recently due to diversions of Mono Lake tributary streams. In 1941, the Los Angeles Department of Water and Power completed a tunnel connecting the Mono Basin with the headwaters of the Owens River, and began diverting water from Mono Basin to supplement the water supplied to the Los Angeles Aqueduct system from the Owens River. From 1941 to 1989, LADWP’s average diversions from the Mono Basin were approximately 67,000 acre-feet per year. As a result of litigation seeking to curtail exports and protect Mono Lake, no water was exported from 1990 through 1994. In 1994, the State Water Resources Control Board ordered that exports from Mono Basin to Los Angeles should be indexed to lake level in order to raise the water level of Mono Lake and to restore stream and waterfowl ecosystems. Exports increase incrementally as lake level rises until a target lake level elevation of 6,391 feet is reached, which is estimated to occur in approximately 20 to 30 years. Mono Lake reached a historic low of 6,372 feet, and has since risen to 6,384 feet in 2012.

LADWP's exports 16,000 acre-feet per year from the Mono Basin, per SWRCB Decision 1631. In 2011, the SWRCB granted the LADWP a temporary adjustment to the Decision 1631 decision of annual exports of 16,000 AF. The temporary ruling stated that from April 1, 2010 through March 31, 2012, LADWP would not export more than 32,000 AF from Mono Basin.

Owens River

The Owens River watershed (see Figure SL-2) extends from just north of the city of Mammoth Lakes in southern Mono County to Owens Lake in Inyo County. It is bordered by the crests of the Sierra Nevada to the west and White and Inyo mountains to the east. The watershed encompasses 2,604 square miles and its main hydrologic feature is the Owns River. Important tributaries to the river include Fish Slough and Convict, Horton, Rock, Bishop, Big Pine, Independence, and Lone Pine creeks.

The LAA was completed in 1913 to export water from the Owens Valley to Los Angeles, and is the principal water conveyance infrastructure in the Owens River watershed. Water exports from the Owens-Mono Planning Area to Los Angeles through the LAA have ranged from approximately 100,000 acre-feet per year to approximately 534,000 acre-feet per year, averaging approximately 328,000 acre-feet per year. Crowley Lake, Pleasant Valley Reservoir, Tinemaha Reservoir, and Haiwee Reservoir are associated with the LAA system. Other reservoirs in the Owens watershed are South Lake and Lake Sabrina, operated principally for hydropower generation by Southern California Edison. The Department of Fish and Game operates Hot Creek Hatchery, Fish Springs Hatchery, and Blackrock Hatchery to produce fish to support a recreational fishery.

Implementation continues for The Lower Owens River Project and other environmental enhancement and mitigation projects in the Owens Valley by the City of Los Angeles in conjunction with the County of Inyo and other parties. Two agreements serve as the catalyst for cooperation; the "1991 Agreement Between the County of Inyo and the City of Los Angeles and its Department of Water and Power on a long Term Groundwater Management Plan for Owens Valley and Inyo County" and "1997 Memorandum of Understanding between the City of Los Angeles Department of Water and Power, County of Inyo, the California Department of Fish and Wildlife (CDFW), the California State Lands between the principle parties." The 1991 agreement was in response to a settlement of a lawsuit filed by Inyo County to compel the City of Los Angeles to complete CEQA documentation regarding the operations of its second aqueduct which was completed in 1970.

The Lower Owens River Project (LORP) continues to be one of the largest and most ambitious river restoration projects undertaken in the history of the western United States. In 1913, LADWP began diverting water from Owens River in Inyo County for the LAA which dried up most of the 62 miles of the river below the intake. Permanent in-stream flow now exists in the river and riparian habitat has been created, providing a warm water fishery. LORP has resulted in a permanent water supply for the creation and enhancement of nearly 2,000 acres of wetland and riparian habitat beyond the river banks. The project provides many recreational opportunities.

The Owens Gorge Rewatering Project continues as well. The project is re-establishing the ecosystem in the Owens River between Crowley Lake and Pleasant Valley. In addition to the fishery, the project has created riparian habitat for birds and other wildlife.

Owens Lake serves as the terminal point for the Owens River. For about 75 years, the lake has remained relatively dry because of diversions from the tributaries of the Owens River for the irrigation of crops by local farmers in the 1800s and early 1900s and then by the LAA diversions from the Owens River beginning in 1913. The exposed lake bed, approximately 175 square miles, served as the source for alkali particulate matter during windstorms in the valley and was possibly related to health problems by residents in the area. However, in 1998, the Great Basin Unified Air Pollution Control District and the City of Los Angeles reached an agreement on dust control operations on Owens Lake. Utilizing water supplies from the LAA, the dust control activities include the shallow spreading of water over portions of the exposed lakebed, re-vegetation with salt grass, and dust control with gravel. A little more than 39 square miles is being mitigated in the project. In fiscal year 2008-9, 61.3 TAF was utilized for the different activities; in 2009-10, it was 66.9 TAF.

Urban land uses within the watershed are minimal and include the major cities of Mammoth Lakes and Bishop. Agriculture is located in the Long, Chalfant, Hamil, and Benton Valleys in Mono County, and adjacent to the city of Bishop and communities of Big Pine, Independence, and Lone Pine in Inyo County. Livestock grazing occurs on both public and private lands.

In 2010, LADWP released the Owens Valley Land Management Plan (OVLMP) to address concerns related to livestock grazing and other uses of the Los Angeles-owned land. Priority is being given to riparian areas, irrigated meadows, and sensitive plant and animal habitats. The plan will provide for the continuation of sustainable uses (including recreation, livestock grazing, agriculture, and other activities); will promote biodiversity and a healthy ecosystem; and will consider the enhancement of threatened and endangered species habitats. It will contain an implementation compliance with the California Environmental Quality Act and is specifically for land not included in the Lower Owens River Project

The OVLMP is the most recent addition to environmental management projects being implemented along the Owens River since 1991. Other important, on-going programs include the livestock grazing programs for riparian vegetation communities on Convict, McGee, and Mammoth creeks.

Amargosa River

The Amargosa River Watershed lies in both Nevada and California. Total area of the watershed, for both states, is a little less than 1.3 million acres. The watershed includes the Amargosa Valley and Death Valley and its main hydrologic feature is the Amargosa River. It is also one of the driest areas in the southwestern United States.

The headwaters for the Amargosa River are located in the Black and Timber Mountains near Yucca, Nevada. Most of the river flows beneath the surface, but near the communities of Shoshone and Tecopa and the Amargosa Canyon, it flows above ground and has created riparian and wetland habitats suitable for wildlife.

In 2007, the Bureau of Land Management released a draft of the Amargosa River Area of Critical Environmental Concern Implementation Plan. The plan outlined steps, that when implemented, would protect and restore sensitive riparian and wetland habitats and protect and conserve water resources essential to the maintenance of these critical habitats. The plan is for 21,552 acres of critical habitat in the watershed in California.

Mojave River

The ephemeral Mojave River drains an approximately 3,800 square- mile watershed, is the largest surface water drainage system of the MDB, and extends over 100 miles across the MDB from its headwaters in the San Bernardino Mountains (Cox et al., 2003; Enzel et al., 2003; SWS, 2005). Under present day conditions, perennial flow along the Mojave River is limited to just downstream of the Forks, in the vicinity of the Mojave Narrows, immediately downstream of the Victor Valley Wastewater Reclamation Authority (VVWRA) facility, and at Afton Canyon (SWS, 2005).

The Mojave River Valley is characterized by deep alluvial basins bordered by non-water bearing igneous and metamorphic mountain ranges and uplands (SWS, 2005). Groundwater from the floodplain and regional aquifers is the primary source of water in the region. The floodplain aquifer is approximately 200 feet thick and comprised of young, permeable alluvial deposits within and adjacent to the Mojave River channel (Stamos et al., 2001; Stamos et al., 2003). The floodplain aquifer is underlain and surrounded by the regional aquifer which consists of less permeable unconsolidated alluvial deposits that can be greater than 2,000 feet thick in places (Stamos et al., 2001; Stamos et al., 2003).

Northwest-striking right-lateral faults of the Eastern California Shear Zone (ECSZ) dissect the region (Dokka, 1983). These ECSZ faults are oriented parallel to the San Andreas Fault and many of them impede groundwater flow (Dokka, 1983; SWS, 2005).

Groundwater Aquifers

This section is under development.

Ecosystems

Antelope Valley

Significant Ecological Areas (SEAs) identified in the Antelope Valley have unique plant communities and serve as habitat for threatened or endangered species. The areas include Edwards Air Force Base, Big Rock Wash, Little Rock Wash, Rosamond Lake, Saddleback Butte State Park, Alpine Butte, Lovejoy Butte, Piute Butte, Desert-Montane Transect, and Fairmont and Antelope buttes. In addition, there are the Ritter Ridge and Portal Ridge Liebre Mountain SEAs that are outside the Antelope Valley Integrated Regional Water Management (IRWM) study area.

BLM, US Fish and Wildlife Service (USFWS), CDFW, and the cities of Lancaster and Palmdale jointly developed the West Mojave Habitat Conservation Plan, which includes the Antelope Valley. The plan will establish conservation areas to protect the desert tortoise, Mohave ground squirrel, and other sensitive plants, animals, and habitats.

Mojave River

The Mojave River region has several unique and important wetland and riparian areas. They are located along the banks of the Mojave River, at Harper Dry Lake, and along portions of Sheep Creek.

On the Mojave River, a Cottonwood Willow habitat area is located in an area known as the Upper and

Lower Narrows. Along the lower reaches of the Mojave River, an area identified as Camp Cady had thriving mesquite trees and three ponds. However, groundwater levels have fallen, and the mesquite groves are drying out. CDFW has purchased land on the western boundary and has initiated efforts to maintain channel flows and possibly re-establish surface ponding to maintain habitat for animals.

Afton Canyon, adjacent to the Mojave River, has been designated as an Area of Critical Environmental Concern. BLM is working to restore the riparian and wetland features in this area.

A federally designated wetland area exists at Harper Dry Lake. Runoff from agricultural activities produced a small marsh in the southwestern portion of Harper Dry Lake. A reduction in agricultural activities eliminated the source of runoff needed to maintain the marsh. In 2003, the Bureau of Land Management (BLM) initiated groundwater pumping to maintain California Watchable Wildlife Site #87 at Harper Dry Lake, which encompasses approximately 480 acres of marsh and has become a critical resource for migrating birds (BLM, 2007; CWWC, 2012). Mitigation funding was obtained from a nearby solar facility to install a well and pipeline for the marsh. The BLM applies up to 75 acre-feet per year to maintain the marsh. Water application is reduced in the summer to simulate natural conditions (CWWC, 2012).

Mojave National Preserve

The Mojave National Preserve is located in both the South Lahontan and Colorado River hydrologic regions; a majority of the preserve is in the South Lahontan. The total land area of the preserve is 1.6 million acres. It was established by Congress in 1994 and is presently managed by the National Park Service. The vegetation and the natural springs and seeps in this ecosystem provide habitat for about 300 wildlife species, which include 206 species of birds. There are three federally endangered, one federally threatened, six State-threatened, and one State-endangered plants and wildlife in the preserve. The desert tortoise is an example of a threatened animal species, and much of the preserve has been designated as critical habitat for it. The Joshua Tree Woodlands is an example of a sensitive and unique flora community. The preserve has historical artifacts and is available for recreational activities. The National Park Service has developed a General Management Plan for the preserve to protect the plant and animal and other resources, including the limited water supplies, and permit access from the public for research and recreational purposes.

San Bernardino National Forest Land Management Plan

The Land Management Plan for the San Bernardino National Forest was revised in 2006. The revised plan focuses attention on issues such as public access, future development, community protections, and the conservation of plant and animal species. It establishes protocols for working with and protecting lands owned by Native American Tribes

Owens Valley, Fish Slough, and Death Valley National Park

In the Owens Valley, Fish Slough is a refuge for endemic Owens Valley Pupfish, and has been designated as a BLM ACEC. Mono Lake is recognized as important habitat for waterfowl and shorebirds. Death Valley has a number of important habitats and endemic species. The perennially flowing reach of the Amargosa River between Tecopa and Dumont Dunes was designated as a Wild and Scenic River in 2009.

Flood

The risk of damage from floods is probably not as great in the South Lahontan region as in other areas of the State because of the lack of significant annual rain and snowfall. However, despite the historic trends of rain and snowfall, home and business owners, public and private property, and other assets, even endangered species, in the region are exposed to potentially damaging 500-year flood events in the South Lahontan Region. Flashfloods, debris flows, and alluvial fan flooding are all possible through the rapid melt of the snowpack in the Sierra Nevada Mountains and other ranges or by runoff from intense, prolong, summer thunderstorms. It is also worth noting that the infrequency of flooding events in the region can result in public apathy towards preparing for such events.

Major floods occur less regularly in the South Lahontan Hydrologic Region compared with the rest of the state. Flooding in the region is primarily flash flooding due to the geology and climate of the region; however, floods can take a variety of other forms, including alluvial fan, debris flow, stormwater, slow-rise, and engineered structure failure flooding.

Major floods occur less regularly in the South Lahontan Hydrologic Region than in many other parts of the state. In the South Lahontan Region, winter storms generally create the greatest flood damage. The larger streams exhibit slow-rise floods, but storms tend to be intense, also causing flash flooding. Most streams in the region are intermittent in their lower reaches, which have steep channelbed slopes and little vegetation. Severe local damage from floodwaters or debris flows could be sustained, often in summer, when thunderstorms generate floods upstream of an urban development. Extended storm periods combined with flat terrain may also give rise to shallow flooding of large areas with stormwater.

In March of 1938, the United States Geological Survey (USGS) reported record flows at four locations where widespread damage occurred, approximately 80 percent in urban areas and the remainder in agricultural areas. Damage was estimated at $2.5 million. Six persons died, and about 60,000 acres were inundated.

In January and February of 1969, rainfall intensities and amounts were greater and, except for the Mojave River and its tributaries, runoff peaks were generally greater during these floods than during the 1938 event. Although flood management facilities functioned during the January flood period, there was insufficient time to perform necessary repairs and maintenance before a late February storm struck, which caused nearly twice as much damage. Losses in San Bernardino County alone from the January storm amounted to more than $23 million, and losses from the February storm totaled more than $31 million. There was widespread flooding and many home evacuations in the Mojave River lowlands. All bridges and crossings between Victorville and Barstow were impassable. Major historic flood events in the South Lahontan region are listed in the California Flood Future Report Attachment C: Flood History of California Technical Memorandum.

Climate

The climate for most of the South Lahontan Hydrologic Region is arid. The valleys and lower foothills of the mountain ranges bordering the region are generally hot and dry during summers and cool and mostly dry in the winters. In the higher elevations of the Sierra Nevada or other mountain ranges in the region, conditions are different. Summers are often mild and dry and the winters are generally cold with significant amounts of rain and snow.

The arid conditions of the region are caused by the region’s mountains. The Sierra Nevada Mountains can effectively weaken storms sweeping in from Pacific Ocean and from the Gulf of Alaska causing rainshadows for many of the valleys, smaller mountain ranges, and hills to the east. Annual rainfall totals for much of the region averages 10 inches or less. In Death Valley, the average annual rainfall is around 2 inches. In contrast, precipitation along the crests and higher elevations of the Sierra Nevada and other mountain ranges can be impressive. In addition to rainfall, the annual snowfall amounts can range between 4 to 6 feet in average to above-average precipitation years. Lesser amounts of snow fall in the San Bernardino and San Gabriel ranges in the south.

Table SL-1 is an annual summary of maximum and minimum temperatures and rainfall data collected by CIMIS stations in the South Lahontan region. For the 2005 through 2010 period, hydrologic conditions began very wet, became very dry, and then ended up wet. However, annual maximum and minimum temperatures remain fairly steady, although slight increases did occur in the dry years. Reference evapotranspiration totals were also very steady during the period.

PLACEHOLDER Table SL-1 South Lahontan Hydrologic Region Summaries of Annual Regional Temperatures and Precipitation

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

Demographics

Population

Total population for the South Lahontan region for 2010 was 930,800. This is a 29 percent increase since 2000 and 13 percent since 2005. Over 90 percent of the population is concentrated in the Antelope Valley and Mojave River Planning Areas (PAs).

Major cities include Palmdale (152,750) and Lancaster (156,633) in the Antelope Valley PA and Victorville (115,103), Hesperia (90,173), Apple Valley (69,135), Adelanto (31,765), and Barstow (22,639) in the Mojave River PA (2010 U.S. Census). All have exhibited steady growth in population over the past decade and are of ever-increasing significance in the urban landscape of southern California. Although these cities can be 50 or more miles from jobs throughout the South Coast Hydrologic Region, the affordable housing in these areas continues to be a large attraction for homeowners. In addition, continued improvement in the region’s transportation system helps in making the long commutes tolerable. However, the nation’s recent recession served to slow the growth in sharp contrast to what was occurring in the early 2000s. Cities and towns on the eastern slopes of the Sierra Nevada and on the floor of the Owens Valley are smaller and provide the services and accommodations for vacationers and outdoor recreation enthusiasts. Cities include Mammoth Lakes (8,200) and Bishop (3,800). The Naval Air Weapons Station China Lake provides employment for many of the residents in the city of Ridgecrest (27,600). The other city in the Indian Wells Valley is California City (14,120).

In Water Plan Update 2013, we project population growth based on the assumptions of future scenarios. Discussion of the three scenarios used in this Water Plan and how the region’s population may change through 2050 can be found later in this report under Looking to the Future.

Senate Bill 18 requires cities and counties to consult with Native American Indian Tribes during the adoption or amendment of local general plans or specific plans (Chapter 905, Statutes of 2004). A contact list of appropriate tribes and representatives within a region is maintained by the Native American

Heritage Commission. A Tribal Consultation Guideline, prepared by the Governor's Office of Planning and Research, is available online at http://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf

Tribal Communities

The Owens Valley region receives very little precipitation and yet the area was teeming with plant life. The Big Pine Paiute Tribe learned to use the water available from snowmelt off the Sierra Nevada Mountains which fed streams and springs to irrigate lands leading to the cultivation of plant species. Tributaries of the Owens River on the west side of Owens Valley were dammed and diverted water to suitable fields through a series of irrigation ditches. When water was diverted from the tributary to the ditch, fish were recovered from the dry creek bed. Just before the seeds were ready for harvest, the main diversion dam was destroyed allowing the water to resume its natural course. There are 51 plant species in the Owens Valley which have been identified by the Paiute/Shoshone of the Owens Valley as culturally important as told by Julian Steward in Basin-Plateau Aboriginal Sociopolitical Groups (Bureau of American Ethnology Bulletin 120, Washington, DC, 1938). Of those 51 plant species, 23 are restricted to wet habitats. Wet habitats have been described in comments submitted by the Tribe on an EIR Concerning Water from the Owens Valley to Supply the Second Los Angeles Aqueduct as "moist places or meadows", "wet or damp places", "damp cultivated ground", "springy places", "moist banks", "wet lowlands", or "dampish places." The drying up of wetland areas causes a significant loss to culturally significant plants. Fifteen of the species restricted to wet habitats are used for medicinal purposes. If the wetlands were restored to pre-pumping conditions, then the Tribe could use plants for medicinal and other cultural purposes as our ancestors had done for centuries.

The Tribe has EPA approved water quality standards for Big Pine Creek. The Tribe monitors the water quality of Big Pine creek through chemical and biological analysis. The water table is monitored on the Big Pine Indian Reservation through three monitoring wells each with dedicated data loggers.

PLACEHOLDER Table SL-2 Granted Lands (with acreage)

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

Disadvantaged Communities

The region is characterized by many disadvantaged communities, scattered over wide geographic areas with concerted efforts being made to keep them involved and to sustain their participation in the planning process. Extensive public outreach efforts are currently underway in three IRWM regions to encourage participation in the IRWM planning process. The Inyo-Mono region holds one of five statewide grants with DWR to develop a pilot program to determine how to most efficiently and effectively identify and engage DACs in such a way that empowers them to more aptly address local and regional water priorities.

Land Use Patterns

Against the scenic backdrop of mountain ranges and large valleys, a majority of the urban and agricultural land uses of the South Lahontan Hydrologic Region have remained seemingly unchanged from many decades ago, with a scattering of small towns and tiny hamlets mixed in with pockets of ranching and irrigated agriculture. Increasingly significant, however, are the developing urban uses in the southern portion of the region which have economic and cultural ties with the busy metropolitan areas of the South Coast Hydrologic Region. Recreation continues to be important, especially the winter-season resorts in the town of Mammoth Lakes in the Sierra Nevada and the community of Lake Arrowhead in the San Bernardino Mountains. Also notable are the large areas of undeveloped and protected lands which have been set aside for recreation, preservation, managed use, and the military.

Most of the region's urban land uses continue to be concentrated in the southern-most planning areas. These are the Antelope Valley and Mojave River PAs. In Antelope Valley, the uses are anchored around the cities of Palmdale and Lancaster and for the Mojave River, it would be the cities of Victorville, Hesperia, Barstow, and Apple Valley. The urban uses within and on the perimeter of the cities have been expanded outward, with some in-filling, to accommodate the steady increases in population over the past decade. However, the nation's recent recession served to slow the growth, in sharp contrast to what was occurring in the early 2000s. In sharp contrast, the urban uses associated with the cities and towns in the eastern slopes of the Sierra Nevada and on the floor of the Owens, Mammoth Lakes and Bishop, are considerably smaller than those in the south. In the Indian Wells Valley, most of the uses are concentrated in the City of Ridgecrest, the Naval Air Weapons Station China Lake.

Most of the agricultural land uses in the South Lahontan Region continue to occur in the Owens-Mono, Antelope Valley, and Mojave River areas. Total irrigated crop acres planted and harvested between 2006 and 2010 have remained relatively stable; ranging from 65,520 and 64,570 acres. The primary crops were alfalfa, pasture grass, grains, and truck crops. Alfalfa and pasture grass represent more than 75 percent of the planted and harvested acres each year.

Almost half (29,600 acres in 2010) of the region's irrigated crop acreage was located in the Owens-Mono as irrigated pastureland. There has been little change in irrigated acres from year to year in this PA. Between 2005 and 2010, the annual total acres of crops in production ranged between 29,500 and 29,700. Most of the acres are for alfalfa and range and improved pasture grass. Production of the alfalfa and pasture grasses occurred mostly between the City of Bishop and the community of Lone Pine in Inyo County, and in the Chalfant, Hammil, Round, and Long Valleys in Mono County. In addition, almost 4,800 acres of alfalfa was grown annually in Fish Lake Valley, a rather remote valley whose groundwater is shared with the State of Nevada.

As mentioned earlier, some of the alfalfa and native and improved pasture grass acres were planted in response to the approved enhancement mitigation projects agreed to by the parties in the 1991 and 1997 agreements between the County of Inyo, City of Los Angeles, and other parties. It is important to note that many of the native and improved pasture grass fields in both counties receive irrigation water from the LAA. Hence, the farming operations are coordinated with the LADWP.

The next most agriculturally-active PA is the Antelope Valley, with 18,500 acres of irrigated crop production in 2010. The agricultural land uses are located mostly away from, but in some cases adjoining, the urban lands of the PA. The crops grown range from truck, which include onions, carrots, potatoes, to deciduous fruits (especially peaches), alfalfa and grain. There is even some acres of grapes; a little more than 300 acres.

The Mojave River areas is the third major area for agriculture in the region; with 13,300 acres of irrigated crops production in 2010. Most of the acreage is located in the Mojave River Valley, from near Victorville, northeast of the City of Barstow, and east beyond the community of Newberry Springs. This is alfalfa country, with much of the acreage irrigated with center pivot systems. There are also several small pockets of agricultural land uses scattered throughout the area. This includes several hundred acres of alfalfa and turf in Mesquite Valley near the Nevada border.

Although the overall total of planted and harvested acres is small, farmers in the Indian Wells Valley produced a variety of crops. In addition to alfalfa, vegetables and deciduous fruit were grown, mostly in the Tehachapi Valley. The Tehachapi Valley produced slightly less than 2,100 acres of crops in 2010. The Death Valley area, specifically the Mesquite Valley along the California-Nevada border, had a little less than 1,500 acres under production, mostly alfalfa and pasture.

The South Lahontan Region continues to have sizable agricultural land uses; producing 65,380 acres of irrigated crops in 2009. The primary crops were pasture, alfalfa, and vegetables. The region's acreage remains just about stable, having declined a scant 320 acres between 2005 (65,700 acres) and 2009.

Nearly half (29,780) of the region's irrigated crop acreage was located in the Owens-Mono area. There has been little change in irrigated acres from year to year in this area; in 2005, the Owens-Mono area produced 29,620 acres of irrigated crops, 160 acres less than in 2009. Most of the crop acres are for alfalfa and range and improved pasture grass. Production of the alfalfa and pasture grasses occurred mostly between the City of Bishop in the north and the community of Lone Pine in the south, and in the Chalfant, Hammil, Round, and Long Valleys in the north. Included in the totals are 4,760 acres of alfalfa that are grown annually in Fish Lake Valley, a rather remote valley whose groundwater is shared with the State of Nevada.

The Owens-Mono PA is a picturesque area, with expanses of green alfalfa and cattle-dotted pastures set immediately below steep-sided mountains up to 7,000 feet higher in elevation. The setting can make visitors forget that the annual precipitation is less than 10 inches in these valleys. Hence, most of the crops must be irrigated by groundwater supplies. The native and improved pasture grass areas are irrigated with releases from the Los Angeles Aqueduct. All irrigation operations are coordinated with the LADWP.

The second most agriculturally productive Planning Area is the Antelope Valley, with 18,640 acres of irrigated production. Located primarily away from, but in some cases adjoining, the urban lands of the PA, the irrigated crops here are fairly diverse and include onions, carrots, potatoes, deciduous fruits (especially peaches), alfalfa and grain, and even 320 acres of grapes. The PA's 2009 irrigated crop acreage declined by 30 acres from 2005. The irrigations of these crops are handled primarily with groundwater, with some direct deliveries from the SWP.

The Mojave River PA continues to be agriculturally productive, too, with 13,590 acres of irrigated crops, which is just a little less than the 13,940 acres seen in 2005. Most of the acreage is found along the Mojave River Valley, from near Victorville, northeast to the City of Barstow, and east beyond the community of Newberry Springs. This is alfalfa country, with much of the acreage watered with center pivot irrigation systems. There are a few pockets of small crop acreage here and there in the PA, including a few hundred acres of alfalfa and turf in Mesquite Valley near the Nevada border. Groundwater is used for all crops.

Rounding out the region's agriculture is the Indian Wells Valley PA, which produced 2,100 acres of crops, including vegetables and fruit in the Tehachapi Valley, and the Death Valley PA, specifically the

Mesquite Valley along the California-Nevada border, which cultivated 1,410 acres, mostly alfalfa and pasture. As in the region's other PA's, these areas saw little change in acreage between 2005 and 2009.

Much of the land within the South Lahontan region is publicly managed, including numerous parks, preserves, and recreation areas. Major units in the north include Death Valley National Park and Inyo National Forest, while the south features the Mojave National Preserve and the Angeles and San Bernardino National forests. Other notable parks include the Mono Lake Tufa State Reserve and Red Rock Canyon State Park. Large military facilities within the region include China Lake Naval Weapons Center, Fort Irwin National Training Center (Army), and Edwards Air Force Base.

There are many areas within the region that are susceptible to damage from wildfires, including much of the Eastern Sierra and Owens Valley, the relatively more heavily vegetated high desert, and the mountains to the south, including the San Gabriel and San Bernardino mountains. The region has been hit by several notable wildfires, including a fire in October 2003 that burned 1,000 acres of Silverwood Lake State Recreation Area; the park was nearly engulfed. Impacts to the SWP, including to the reservoir's future water quality, are still being evaluated.

Regional Resource Management Conditions

Water in the Environment

Environmental water uses are concentrated mostly in the Mono-Owens Planning Area of the South Lahontan Hydrologic Region. These uses include in-stream releases for Mono Lake and the Lower Owens River Project and applied water for the irrigation of enhancement mitigation projects being implemented for projects agreed to by the parties in the 1991 and 1997 agreements between the County of Inyo, City of Los Angeles, and other parties. The other important environmental use is tied to the Owens Lake Dust Control Project.

Instream flows for the rivers which drain into Mono Lake averaged 73 TAF for 2006 through 2009. That amount decreased slightly in 2010, about 59 TAF was reported. For the Owens River, instream flows between 2006 and 2009 averaged a little less than 16 TAF annually. In 2010, that increased slightly to 19 TAF. Wild and Scenic flow requirements were established in the PA in 2009 for portions of the Amargosa River, Cottonwood Creek, and Upper Owens River. In 2010, the reported amount was about 42 TAF.

Some environmental water demands are met with recycled water supplies. The Piute Ponds near the Lancaster Water Reclamation Plant received 8,711 AF and 6,089 AF in fiscal years 2010-2011 and 2011-2012, respectively. Victor Valley Wastewater Reclamation Authority discharges in excess of 14,000 acre-feet of recycled water supplies into the Mojave River channel which supports riparian vegetation and habitat for an area managed by CDFW.

Water Supplies

Groundwater and surface, imported, and recycled water supplies are used to meet the urban, agricultural, and environmental water demands in the South Lahontan region. In the northern portions of the region, some water agencies located in the foothills of the Sierra Nevada use surface (lake) water for all or a portion of their supplies. Groundwater is the main water source for much of the Owens Valley, Indian

Wells, and Mojave. In the Mojave River and Antelope valleys, water agencies are using groundwater, SWP water supplies, or a blend. The use of SWP water supplies in some communities helps to decrease the amount of water pumped from the groundwater basins.

Surface Supplies

Both the West and East branches of the SWP are in the region. Water supplies for the region are diverted from the East Branch. In addition to supplementing local supplies, the supply has helped mitigate the current groundwater issues, and it is a key factor in plans for groundwater banking and storage projects.

MWA has been taking increasing amounts of its SWP contract entitlements in response to recent rapid growth and to implement the Mojave Basin Area Judgment to replenish the Mojave River Valley Groundwater Basin.

In the San Bernardino Mountains, Lake Arrowhead (controlled by the Arrowhead Lake Association) is a 48,000 acre-feet reservoir providing recreational opportunities and water for residents in the area. The lake is also a major source of the water supply for the Lake Arrowhead Community Services District, which provides retail water and sewer services to the Lake Arrowhead area. In addition, Crestline-Lake Arrowhead Water Agency, a SWP contractor, pumps water from Silverwood Lake.

The Littlerock Reservoir has a 3,500 acre-feet capacity, provides water to Littlerock Creek Irrigation District and to Palmdale Water District (PWD), and serves urban users. Water supplies from the facility are released into a canal and conveyed to PWD’s Palmdale Lake for storage.

Other surface water sources that provide water supplies for mainly urban water users are in the eastern Sierra Nevada and include June and Mary lakes (near the city of Mammoth Lakes), both of which are in Mono County.

The LAA is the region’s other major water infrastructure. In 1913, the initial 233-mile-long aqueduct was completed by LADWP and began transporting water from Owens Valley to the city of Los Angeles. The aqueduct was extended 115 miles north into the Mono Basin in 1940 to divert additional water. A second, 137-mile-long, pipeline was completed in 1970. More recently, exports have been significantly modified and reduced as a result of LADWP’s environmental restoration and mitigation projects in Mono Basin and Inyo County.

There are nine reservoirs in the LAA system with a combined storage capacity of about 300,000 acre-feet. These reservoirs were built to store and regulate flows in the aqueduct. The northernmost reservoir is Grant Lake in Mono County. Seven of the nine reservoirs are in the South Lahontan region; the Bouquet and Drinkwater reservoirs are in the South Coast Hydrologic Region. Water from the aqueduct system passes through 12 hydropower plants on its way to Los Angeles. The annual energy generated is more than 1 billion kilowatt-hours, enough to supply the needs of 220,000 homes.

Most of the LAA infrastructure is in the South Lahontan region, however, most of the water supplies conveyed by the project are used in the South Coast Hydrologic Region. In the South Lahontan region, water supplies from the LAA are used for the irrigation of some of the native pasture grass fields and environmental enhancement projects identified in the 1991 EIR and for the vegetation to mitigate the dust problem on Owens Lake.

During the 2006 and 2010 period, most of the water demands in the region were met with ground water supplies. Total water supplies utilized during the period ranged from 600 TAF to 700 TAF. The peak was achieved in 2007 when additional water supplies were available from the SWP from the above average precipitation years of 2005 and 2006. Most of these supplies are used for groundwater recharge operations, primarily in the Mojave River area.

Most of the urban and agricultural water demands are met with groundwater supplies. Although annual totals can fluctuate, groundwater supplies generally meet about 70 percent of the demands in the region.

Groundwater

Groundwater supplies satisfy about 65 percent of the urban, agricultural, and environmental water demands annually in the South Lahontan Hydrologic Region. Seventy-six groundwater basins underlie about 55 percent of this hydrologic region.

The Owens Valley Groundwater Basin underlies Benton, Hammil, and Chalfant valleys in Mono County and Round and Owens valleys in Inyo County. The principal source of replenishment for this basin is percolation of streamflow from the surrounding mountains. Lesser sources of recharge include infiltration of excess irrigation waters and precipitation to the valley floor, as well as underflow from Long Valley. Total storage capacity of the basin is estimated to be 30 million acre-feet and 35 million acre-feet.

The Indian Wells Valley Basin is the sole source of water for the city of Ridgecrest, the communities of Inyokern and Trona, and the China Lake Naval Weapons Center. It is also the only supply for many private domestic, small water systems, and a small number of agricultural well owners.

The Mojave River Valley Basin is recharged through direct precipitation, ephemeral streamflow, infrequent surface flow of the Mojave River, and underflow of the Mojave River. In addition, the SWP water supplies, treated wastewater effluent, septic tank effluent, effluent from two fish hatchery operations, and irrigation waters are allowed to percolate into the ground and recharge the groundwater system.

The Mojave River Valley basins, El Mirage Basin and Lucerne Valley Basin, are included in the Mojave Basin Area Judgment. The Superior Court bound parties that agreed to stipulate to an Interim Judgment in 1993. Non-stipulated parties were not bound until after entry of the Judgment in 1996. Additional information is available on the MWA website at http://www.mojavewater.org.

The total storage capacity of the Antelope Valley Basin has been reported at 68 million acre-feet and 70 million acre-feet. Groundwater quality is excellent within most of the principal aquifer but degrades toward the northern portion of the dry lakes areas. High levels of arsenic, fluoride, boron, and nitrates are a problem in some areas of the basin.

Ongoing court proceedings will result in a final adjudication judgment for Antelope Valley Groundwater Basin. Currently there are no existing restrictions on groundwater pumping, however pumping may be altered or reduced as part of the final adjudication ruling.

AVEK is the largest SWP water contractor in this region and one of the largest in the state. AVEK provides water to five major municipal agencies, 16 smaller water service agencies, Edwards Air Force

Base, Palmdale Air Force Plant 42, the US Borax and Chemical Facilities, and some agricultural customers. AVEK was formed to bring imported surface water from the SWP into this region.

Water Uses

From 2006 through 2010, annual applied water demands for urban and agricultural water users in the South Lahontan region ranged from 659 TAF to 742 TAF; peak demands were achieved in 2007. Agricultural applied water demands ranged from 385 TAF to 425 TAF; also peaking in 2007. The higher uses probably reflect the drier hydrology and slightly warmer temperatures which occurred that year. For the region's urban users, annual applied water demands ranged from 273 TAF to 317 TAF. Urban demands declined during the 2008 – 2010 period. Statewide and local precipitation totals were below average and the decreased demands were probably responses to the implementation of voluntary and involuntary water use efficiency programs and policies by the water agencies and their customers. Negative impacts from the recent recession cannot be discounted as factors in the decline.

Most of the urban applied water demands in the region were met with groundwater supplies during the period. As mentioned previously, surface water supplies were utilized to meet some of urban water user demands in the northern Owens-Mono PA. Supplies from Mary and June Lakes, located in the eastern slopes of the Sierra Nevada Mountains, were conveyed to customers of the Mammoth Community Water District and June Lake Public Utilities District. In the Antelope Valley PA, SWP and surface water from Littlerock Reservoir are used to augment groundwater supplies. Groundwater is the only source of supply in the Mojave River PA and is supplied primarily by natural ephemeral flow from the Mojave River which originates in the San Bernardino Mountains. SWP for the Mojave River PA is primarily used for groundwater recharge of the now adjudicated basins and some limited direct use.

Despite having less than 5 percent of the population in the hydrologic region, per capita water demands continue to be high In the Owens-Mono PA. For 2006 through 2009, the values ranged from 306 to 368gpcd. This is because of the influx of travelers and recreational enthusiasts seeking to take advantage of winter (skiing) and summer (fishing, hiking, and camping) outdoor activities present in the area. The Mammoth Community Water District provides water service to a permanent population of about 7,000. However, this is somewhat misleading as the daily population could increase to as much as 13,000 people per day during the week and swell to as much as 30,000 on weekends and holidays because of the activities. This also occurs in the city of Bishop and communities of Big Pine, Independence, and Lone Pine in the Owens Valley. In the southern areas, Antelope Valley and Mojave River, the urban uses are influenced by the higher outside demands.

The conditions are just too arid in the region to grow crops without irrigation water. Most of the agricultural demands were met with groundwater supplies. However, there are exceptions. As noted earlier, in the Owens-Mono PA, diversions from the LAA are used to irrigate many of the native and improved native pasture grass fields. In the Antelope Valley PA, some deciduous fruit orchards in the western half of the Valley are irrigated with water from the SWP.

Most of the crop irrigations in the South Lahontan are handled primarily by sprinkler systems. Center pivot sprinkler systems are used to irrigate many alfalfa and field crop fields. Self-propelled side roll systems are common as well. Hand move sprinklers are usually employed for vegetables, especially when the land is prepared for planting and during the earlier growth stages of the crop. Many growers transition from sprinklers to furrow-flow irrigation as the crops mature. Tree crops are irrigated primarily with mini jet systems and permanent sprinklers.

Recycled water supplies, used mostly in the Antelope Valley PA, are utilized for local recreation and landscape irrigation needs. Some acres of forage crops cultivated in the PA are irrigated with recycled water supplies.

Many of the moderate and large urban water agencies are implementing some or all of the Urban Best Management Practices in their respective water service areas. The agencies are also implementing other new programs which target exterior water demands. Rebate programs now exist which encourage the use of weather-based irrigation controllers and upgrades of older irrigation systems. Turf removal programs are also being implemented. Residential customers receive financial assistance for removal of turf grass from around their homes and the installation of plants which are more suitable for the hot, dry conditions. Conservation efforts in the Mojave PA have resulted in a decrease in urban per-capita use from 284 gallons per capita per day (gpcd) in 2000 to 163 gpcd in 2012. A majority of this decrease in per-capita use is from a reduction in exterior water use for landscape irrigation. The MWA's turf removal program began in 2008 and as of early 2013 the program had over 3,500 participants and over five million square feet of turf had been removed.

Farmers are continuing to improve the efficiencies of their irrigation operations. Actions that have been implemented since the first energy crisis, in the early1980s, include operating irrigation pumps during off-peak hours to lower energy costs. On the water side, data being collected by CIMIS weather stations in the major agricultural areas are being accessed with greater frequencies, presumably by farmers, and landscape managers, seeking to monitor evapotranspiration rates and schedule future irrigations for their crops. This is being done for the Owens Lake project. CIMIS stations on the north and south shores of the lake are monitored daily to determine when to irrigate the salt-tolerant native grasses and plants which have been planted on the lakebed.

Drinking Water

The region has an estimated 187 community drinking water systems. The majority (over 80 percent) of these community drinking water systems are considered small (serving less than 3,300 people) with most small water systems serving less than 500 people (see Table SL-3). 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 (USEPA 2012).

In contrast, medium and large water systems account for less than 20% of region's drinking water systems, however these systems deliver drinking water to over 90% of the region's population (see Table SL-3). These water systems generally have financial resources to hire staff to oversee daily operations and maintenance needs, and hire staff to plan for future infrastructure replacement and capital improvements. This helps to ensure that existing and future drinking water standards can be met.

PLACEHOLDER Table SL-3 Drinking Water Systems in South Lahontan Region

[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 Status and Issues

Seventeen South Lahontan urban water suppliers have submitted 2010 urban water management plans to DWR. The Water Conservation Law of 2009 (SBx7-7) required urban water suppliers to calculate baseline water use and set 2015 and 2020 water use targets. Based on data reported in the 2010 urban water management plans, the South Lahontan Hydrologic Region had a population-weighted baseline average water use of 258 gallons per capita per day with an average population-weighted 2020 target of 207 gallons per capita per day. The Baseline and Target Data for individual South Lahontan urban water suppliers is available on the Department of Water Resources (DWR) Urban Water Use Efficiency website.

The Water Conservation Law of 2009 (SBx7-7) required agricultural water suppliers who supply more than 25,000 irrigated acres to prepare and adopt agricultural water management plans by December 31, 2012, and update those plans by December 31, 2015, and every 5 years thereafter. No plans were submitted from the South Lahontan Region. The region has no agricultural suppliers over the 25,000 acreage threshold.

Water Balance Summary

South Lahontan Hydrologic Region consists of five planning areas. The environmental water use in these planning areas is limited to instream requirements in the Mono-Owens Planning Area (PA 901) and wild and scenic rivers in PA 901 (Owens River and Cottonwood Creek) and Death Valley Planning Area (PA 903) (Amargosa River). There are no managed wetlands in South Lahontan HR. For more information on water balances, see Table SL-4 and Figure SL-3.

In PA 901, urban use is primarily residential and averages about 12 TAF per year. Agriculture applied water is about 175 to 200 TAF annually. The aforementioned instream use varies from about 65-100 TAF. The 2010 wild and scenic applied water added 42 TAF to the environmental use.

Local surface water provides one half to a third of the supplies, with the rest being groundwater extraction. Some of the instream requirement is reused downstream.

The Indian Wells Planning Area (PA 902) has a higher urban use than agricultural, averaging about 20 TAF per year urban and 10-11 TAF agricultural applied water. Supplies are primarily from groundwater, with 200-400 acre-feet of State Water Project deliveries.

Urban use in PA 903 averages 4 TAF, with agricultural use about 11 TAF annually. The wild and scenic applied water was about 1,400 acre-feet in 2010. The water supply comes from groundwater.

The Antelope Valley (PA 904) and Mojave River (PA 905) Planning Areas are the most urbanized areas in South Lahontan HR. Urban use in both planning areas is primarily residential and ranges from about 120 to 140 TAF annually in each PA. In PA 904, agricultural applied water ranges from 88 to 98 TAF per year. Agricultural use in PA 905 is a little higher, averaging about 100 TAF.

One-half to a third of the supply in PA 904 comes from State Water Project deliveries and a little local supply in wetter years, with the rest being groundwater. There are also about 200 acre-feet of reclaimed wastewater being used each year.

In PA 905, water supply consists of less State Water Project water and more groundwater, with a substantial amount of reuse and a little more reclaimed water than PA 904.

PLACEHOLDER Table SL-4 South Lahontan Hydrologic Region 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.]

PLACEHOLDER Figure SL-3 South Lahontan 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.]

Project Operations

The major water supply projects in the region move State Project Water to areas with need for supplemental water supplies. The Mojave River and Morongo Basin Pipelines deliver SWP water primarily to groundwater recharge sites throughout the region, with a few direct delivery connections. The Regional Recharge & Recovery Project was completed in 2012 as a conjunctive use project that banks SWP water in the ground in the Mojave River Floodplain and later recovers the water via production wells and delivers to retail water systems in Adelanto, Apple Valley, Hesperia and Victorville. Most of the SWP delivery infrastructure is designed to recharge SWP water to groundwater along the Mojave River floodplain. This can be a challenge when the Mojave River is flowing and there is not available ground surface for recharge operations. Also, not all demands for groundwater occur along the floodplain and there is still a need to alleviate pumping stresses that occur away from the floodplain. The region is able to withstand local and statewide droughts, including periods of low SWP water availability, thanks to most demands being met with groundwater; the groundwater basin functions as a buffer against extended periods of drought.

Cadiz Valley Water Conservation, Recovery, and Storage Project

Cadiz Inc. is a private corporation that owns approximately 34,000 mostly contiguous acres in the Cadiz and Fenner Valleys, which are located in the Mojave Desert; eastern San Bernardino County, California. On December, 2011, the Cadiz Inc., in collaboration with the Santa Margarita Water District and other water providers participating in the Project, collaboratively developed a Draft EIR for the Cadiz Valley Water Conservation, Recovery, and Storage Project. According to the applicant, underlying the Cadiz and Fenner Valleys and the adjacent Bristol Valley is a vast groundwater basin that holds an estimated 17 to 34 million acre-feet of fresh groundwater. . According to the Draft EIR, Southern California water providers could use water from this groundwater basin to replace or augment current supplies and enhance dry-year supply reliability. The project has met with controversy over the possibility that it will mine groundwater and dry up desert springs. The Draft EIR can be found at: http://www.smwd.com/operations/cadiz-project-draft-eir.html

Water Quality

The quality of the limited surface water is excellent in the South Lahontan region. It is greatly influenced by snowmelt and runoff from the eastern Sierra Nevada and the San Gabriel and San Bernardino mountains. Groundwater quality is also excellent in aquifers recharged by streams receiving mountain runoff. However, at lower elevations, groundwater and surface water is degraded in localized areas. This degradation occurs both naturally (from geothermal activity and from closed groundwater water basins that accumulate and increase salt concentration from evapotranspiration losses) and through human activities (for example, agricultural operations, treated municipal sewage disposal, and improper industrial waste disposal). The highest priority water quality issues in the region are listed below:

- Elevated concentrations of nitrates and total dissolved solids in groundwater from sewage treatment plants, septic systems, and dairy operations
- Groundwater overdraft, which causes pumping of older waters that have elevated levels of minerals (for example, total dissolved solids [TDS], arsenic, or fluoride)
- Effects of hydromodification, including sedimentation, erosion, and loss of riparian areas
- Prevention of future groundwater degradation by managing increasing recycled water applications
- Long-term management of groundwater polluted with industrial wastes at Department of Defense sites and with mining wastes at mine sites (groundwater contamination zones at Edwards Air Force Base and the former George Air Force Base will require groundwater monitoring for many decades or centuries.)
- Minimizing the loss of assimilative capacity in aquifers affected by multiple land uses.
- Dissolved metals in groundwater (e.g. hexavalent chromium in the Hinkley area)
- Dissolved industrial salts (e.g. perchlorate in the Barstow area)
- Increased soil loss and deposition associated with land disturbance from development activities.

Groundwater Quality

Antelope Valley

The quality of the groundwater supplies from the Antelope Valley groundwater basin is good. The concentration of TDS averages 300 milligrams per liter and ranges from 200 to 800 mg/L. There are some concerns about arsenic and nitrates in the groundwater.

Arsenic concentrations above 10 mg/L have forced the Los Angeles County Waterworks District (Lancaster) to put six wells on inactive status. Nitrate levels above 10 mg/L have been detected in the valley. Nitrates are also present in the groundwater near the community of Littlerock. This is directly because of the agricultural operations in the area.

Mojave River Valley

Water quality conditions are generally good throughout groundwater basins in the Mojave River Valley; however, as is common in arid basins of the southwest, there are localized issues associated with naturally occurring constituents such as arsenic, chromium, TDS, fluoride, boron, iron, and manganese. Additional information is available on the MWA website at http://www.mojavewater.org.

Elevated nitrate concentrations and TDS have been measured in the groundwater beneath some dairy waste disposal operations and sewage effluent disposal sites in the region. Fertilizers have been measured in wells and reservoirs near these operations.

Southeastern Inyo County

In southeastern Inyo County, the groundwater basin has TDS, fluoride, and arsenic levels which exceed the federal standards. That basin is in the only source of potable water supplies for residents of the communities of Tecopa and Tecopa Hot Springs and water treatment facilities are inadequate to clean-up the supplies. Local residents are faced with the problem of either driving to other urban centers to purchase water or use those supplies and face the prospects of health problems later on.

Aquifer Conditions and Issues

This section is under development.

Drinking Water Quality

In general, drinking water systems in the region deliver water to their customers that meet federal and state drinking water standards. Recently the Water Boards completed a draft statewide assessment of community water systems that rely on contaminated groundwater. Contamination of local groundwater resources results in higher costs for rate payers and consumers due to the need for additional water treatment. This draft report identified 73 community drinking water systems in the region that rely on at least one contaminated groundwater well as a source of supply (See Table SL-5). A total of 180 community drinking water wells are affected by groundwater contamination, and the most prevalent contaminants are arsenic, gross alpha particle activity, uranium, and fluoride all naturally occurring contaminants (See Table SL-5). The majority of the affected systems are small water systems which often need financial assistance to construct a water treatment plant or alternate solution to meet drinking water standards.

PLACEHOLDER Table SL-5 Summary of Community Drinking Water Systems in the South Lahontan Hydrologic Region that Rely on One or More Contaminated Groundwater Wells that Exceeds a Primary Drinking Water Standard

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Flood Management

The Inyo/Mono Watersheds Invasive Weed Control Program is an example of Integrated Flood Management in the South Lahontan Region. This is a three-phase project that will include flood management, creek restoration, and agricultural irrigation. Phase One is the study and engineering of up to three flood diversions, two reservoirs, 3 miles of creek restoration, and up to 500 acres of irrigation system.

Another example of an IWM project with a flood management component and ecosystem restoration is the West Walker River Restoration Plan. The goal of this project is develop a restoration plan via the completion of an assessment of the riverine and riparian conditions associated with approximately 3 miles of the West Walker River located within the area of Antelope Valley that is designated as an economically disadvantaged community. This area has experienced significant damage from stormwater events that have, in turn, resulted in significant impacts, including loss of productive farmlands, from flooding of the Walker River.

Risk Characterization

Winter storms can create the greatest potential for flood damage in the region. Historically, in the South Lahontan Hydrologic Region, flooding originates principally from melting of the Sierra snowpack (in the northern portion of region) and from rainfall. Flooding from snowmelt typically occurs in the spring and has a lengthy runoff period. Floods adjacent to the large rivers in the region can be cause by either the overtopping of embankments by slow-rising flood waters or flash flooding from high-intensity rainfall. As mentioned earlier, many streams in the region have intermittent flows, especially in their lower reaches. This can leave steep channel bed slopes and negatively impacts vegetation cover. Surface runoff from severe summer thunderstorms can cause damage downstream if channelized in these dry stream beds and pass through urban areas. Some of the urban and agricultural areas of the region are located on gently-sloping terrain which makes them vulnerable to flooding from large-scale rain events.

In the region, more than 150,000 people and nearly $12 billion in assets are exposed to the 500-year flood event. Table SL-6 provides a snapshot of people, structures, crops, and infrastructure, exposed to flooding in the region. Over 210 Threatened, endangered, listed, or rare plant and animal species exposed to flood hazards are distributed throughout the South Lahontan Hydrologic Region. Table SL-5 lists the number of sensitive species exposed to flood hazards in 100-year and 500-year events.

PLACEHOLDER Table SL-6 South Lahontan Hydrologic Region Exposures within the 100-Year and 500-Year Floodplains

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

Flood management agencies are responsible for operating and maintaining 244 miles of levees, 49 dams and reservoirs, 270 debris basins, and other facilities within the South Lahontan Hydrologic Region. For a list of major infrastructure, refer California's Flood Future Report.

In the South Lahontan Hydrologic Region, thirty-three local flood management projects or planned improvements were identified. Twenty-nine of these projects have costs totaling approximately $173 million. Twenty-one local planned projects use an IWM approach to flood management, including the Oak Creek Watershed Fire/Flood Restoration Phase I Project and the Amethyst Detention Basin Project. These identified projects and improvements are summarized in the California Department of Water Resources (DWR) State Flood Management Planning Program (SFMP) California's Flood Future: Recommendations for Managing the State's Flood Risk Report (California's Flood Future Report).

Water Governance

Integrated water management planning activities in two heavily urbanized areas of the South Lahontan HR have and will be impacted by groundwater adjudication judgments. In the Mojave River area, parties to the stipulated judgment for the Mojave River Groundwater Basin must comply with decisions handed down in the September 1993 Stipulated Judgment by the Superior Court and the California Supreme Court reaffirmation of the Appellate Court's decision in August 2000 regarding the Stipulated Judgment and the exclusion of the appealing parties from the Judgment. In addition to impacting the demands in the valley, the judgment impacted urban and agricultural uses and resulted in the completion of several groundwater recharge facilities. Additional information is available on the MWA website at http://www.mojavewater.org.

Litigation continues in the case which will result in the adjudication of the Antelope Valley Groundwater Basin in northern Los Angeles County. As reported in Update 2009, the legal boundary for the groundwater basin to be adjudicated has been established. Among the current activities, parties are stepping forward for consideration in the final judgment. Yet to be litigated are the historical groundwater extraction quantities for all of the parties.

In addition to the Mono Lake requirements, the LADWP provides the water supplies for environmental projects which are jointly agreed to by the agency and the County of Inyo. Impacts to the environment from the pumping of groundwater supplies for these projects are also closely monitored. .

California's water resource development has resulted in a complex, fragmented, and intertwined physical and governmental infrastructure. Although primary responsibility for flood management might be assigned to a specific local entity, aggregate responsibilities are spread among more than 75 agencies in the South Lahontan Hydrologic Region with many different governance structures. A list of agencies can be found in the California's Flood Future Report Attachment E: Information Gathering Technical Memorandum. Agency roles and responsibilities can be limited by how the agency was formed, which might include enabling legislation, a charter, a memorandum of understanding with other agencies, or facility ownership.

Current Relationships with Other Regions and States

Although most the MWA service area is in the South Lahontan Hydrologic Region, a portion of its service area does extend into the Colorado River Hydrologic Region (Lucerne and Johnson valleys and the Morongo Basin). This includes the communities of Yucca Valley (Hi-Desert Water District), which has an allocation of up to 4,282 acre-feet of MWA's surface water from the SWP; Joshua Tree (Joshua Basin Water District), an allocation up to 1,959 acre-feet; a County Service Area, an allocation of 73 acre-feet; and the Bighorn-Desert View Water Agency, an allocation up to 653 acre-feet.

Surface water is exported from the Owens and Mono portions of the South Lahontan Hydrologic Region to the South Coast Hydrologic Region by LADWP using the LAA. Recent exports through these facilities to the South Coast region were 148 thousand acre-feet in 2008, 137 thousand acre-feet in year 2009, 251 thousand acre-feet in 2010, and 358 thousand acre-feet in 2011.

The Mojave Water Agency, in its effort to prepare for increased demands in the future and mitigate the overdraft conditions of the Mojave River Groundwater Basin, has entered into agreements with water agencies outside of the region for additional supplies. One significant step was taken in 1997 when it purchased 25 TAF from the Berenda Mesa Water District Table A allocation of SWP water supplies. The actual transfer took place in 1998. In 2009, MWA executed a new agreement with the Dudley Ridge Water District for the permanent transfer of 14 TAF from that agency's Table A allocation of SWP water supplies. The water supplies would be transferred in stages; 7 TAF in 2010, 3 TAF in 2015, and 4 TAF in 2020. MWA's SWP Table A water supplies now total 89,800 acre-feet.

Regional Water Planning and Management

Integrated Regional Water Management Coordination and Planning

The IRWM Planning Act, signed by former Governor Schwarzenegger as part of SB1 in 2008 (CWC Sec. 10530 et seq), provides a general definition of an IRWM plan as well as guidance to DWR as to what IRWM program guidelines must contain. The Act states that the guidelines shall include standards for identifying a region for the purposes of developing or modifying an IRWM plan. The first regional acceptance process (RAP) spanned 2008-2009 and the second RAP was in 2011. Final decisions were released in fall 2009 and fall 2011. The region acceptance process is used to evaluate and accept an IRWM region into the IRWM grant program.

Most of the population for the South Lahontan region has been represented by four IRWM planning regions: Antelope Valley, Fremont Basin, Inyo-Mono, and Mojave. Because these plans are living documents, new regions may be formed or existing regions may be modified.

Some regional projects in the South Lahontan region are highlighted here.

- Upper Amargosa Creek Recharge and Nature Park Project - The Upper Amargosa Creek Recharge Project will provide the Antelope Valley with increased groundwater supplies and give local citizens a creek-side nature park. The recharge facility is envisioned to capture water supplies available from the SWP (aqueduct) and storm flows originating from the Amargosa Creek watershed and to percolate these waters into the Antelope Valley aquifer so the water may be extracted for beneficial use.
- Antelope Valley Water Supply Stabilization Project Number 2 - The Water Supply Stabilization Project No. 2 (WSSP2) is a groundwater banking project that will increase the reliability of the Antelope Valley Region's water supplies by storing excess water available from the State Water Project (SWP) during wet periods and recovering it to serve it to customers during dry and high demand periods or during a disruption in deliveries from the SWP. By "banking" excess water for future use, the WSSP2 will significantly reduce the Region's dependence on constant water deliveries from the Delta. The WSSP2 will also help to stabilize the groundwater basin and preserve agricultural land and open space.
- Regional Recharge and Recovery Project - The Regional Recharge and Recovery Project, known as "R^3," is a conjunctive use project currently under construction that will be a sustainable source of water supply for the Mojave region. R^3 will store State Water Project (SWP) water underground in the local aquifer and later recover and distribute the water to local retail water purveyors. It is an integral part of the Regional Water Management portfolio identified in MWA's 2004 Regional Water Management Plan.
- Inyo-Mono IRWM Planning Effort - Since its inception, the Inyo-Mono Regional Water Management Group has made great strides in developing an IRWM Plan for the eastern portions of California that conforms to the IRWM program. Open to the public and with a governance structure formally adopted by the Inyo-Mono group, an extensive array of stakeholders numbering over 40 entities are actively involved with developing highest priorities and strategies to address such priorities in the Inyo-Mono IRWM Plan.

Accomplishments

Environmental Restoration

Owens Valley and Mono Basin

The LADWP continues to implement restoration projects for the Owens River and Mono Basin. The agency continues to release runoff from the eastern Sierra Nevada into the major streams draining into Mono Lake to restore Mono Lake to a water surface elevation of 6,391 feet above sea level. The current elevation of the water surface is 6,384 feet (2012). Projects continue to be implemented for the floodplains around Rush and Lee Vining Creeks to restore the fisheries in each creek and riparian vegetation on the embankments.

In the Owens, implementation of the environmental restoration projects continues to be a collaborative effort between the LADWP, Inyo County, and other parties. The largest of the projects continues to be The Lower Owens River Project (LORP). Permanent flow is maintained in the historic 62-mile southern portion of the Owens River resulting in the establishment of the lush riparian habitat and providing a suitable environment for warm water fishery. The flow is maintained at 40 cfs and the supplies are provided from the Los Angeles Aqueduct. In fiscal year 2011-12, almost 20 TAF was required for the LORP and several nearby projects. About 2,000 acres of wetland and riparian habitat has been established on the floodplain of the river.

Other re-vegetation projects are continuing in the Owens Valley in response to the 1991settlement between LADWP and Inyo County on the EIR regarding the operations of the LADWP's second aqueduct. Several of the Enhancement\Mitigation projects were already being implemented prior to the settlement. Others were implemented in response to the impacts identified in the EIR. Slightly less than 12 TAF were utilized for the irrigation of these projects.

Further to the north, the Owens Gorge Rewatering Project is re-establishing the ecosystem in the Owens River between Crowley Lake and Pleasant Valley. In addition to the fishery, the project has created riparian habitat for birds and other wildlife. As part of the project, LADWP designated a reach of the Owens River immediately below Long Valley Dam as a sanctuary for threatened and endangered Owens Tui Chub fish.

Since 2001, LADWP has diverted water from the LAA for the Owens Lake Dust Mitigation Program. As of April 2010, LADWP has completed approximately 37 square miles of shallow flooding and 3.7 square miles of managed vegetation. Currently, LADWP is in the process of installing a 4-in gravel blanket in 2.03 square miles of lake playa. This project known as Phase 8 is scheduled to be completed in November 2012. Also, LADWP plans to start construction of Phase 7a later in 2012. Phase 7a consists of the installation of dust control measures including water, vegetation and gravel in an additional 3.1 square miles of lake bed. LADWP continues its efforts to comply with its dust mitigation commitments to minimize the impacts on air quality in the Lower Owens Valley.

Dust Control Measures

On January 2013, LADWP proposed a project (Phase 7a) to implement dust control measures on Owens Lake to meet regulatory requirements without increasing water commitments while maintaining existing habitat, improving aesthetics, providing safe limited access, preserving cultural resources, and utilizing existing infrastructure and vegetation. The proposed project consists of 3.1 square-miles of dust control and 3.4 square-miles of transitioned dust control for a total project area of 6.5 square-miles. LADWP's proposed project will implement current best available control measures including gravel cover, shallow flooding, and managed vegetation.

The Phase 7a project also includes construction of three new turnout facilities and modification to four existing turnout facilities; irrigation and drainage systems and other infrastructure to support shallow flooding, managed vegetation and tillage; construction of public amenities such as trails, boardwalks, and visitor outlooks; installation or reconfiguration of dust control area berms; improvement and re-routing of roads; and construction of a new water supply pipeline.

Water Supply

Mojave River

Strategic planning and construction continue to increase the reliability of water supplies from the Mojave River groundwater basin, which has been in overdraft since the early 1950s. The basin became adjudicated in 1996 with the appointment of the MWA as the basin watermaster. Implementation of the judgment has resulted in the purchase of replacement water imported from the SWP and the construction of groundwater recharge facilities to offset overdraft, primarily in the Victor Valley area. Thanks to these activities, most of the Mojave River groundwater basin is no longer in overdraft.

MWA has built the Morongo Basin and Mojave River pipelines which bring SWP water supplies to groundwater recharge facilities in the Morongo and Yucca Valleys and near the communities of Newberry Springs, Hodge, Lenwood, and Daggett. The agency continues work on the Oro Grande Wash Recharge project which delivers SWP water to a groundwater recharge site in Victorville. Up to 8 TAF of SWP will be recharged at this facility once it is completed.

Construction was also completed in 2012 for another groundwater recharge project, the Regional Resource and Recovery Project or R Cubed. SWP supplies will be spread at recharge basins in the floodplain of the Mojave River groundwater basin and in southern Apple Valley. MWA-owned production wells, located downstream of the basins, will pump out and deliver these supplies to several local retail water agencies. The beneficiaries include the cities of Adelanto and Hesperia, the Apple Valley Ranchos Water Company, Victorville Water District, and systems operated by the Golden State Water Company and San Bernardino County. Construction operations are divided into two phases with the yield of the first phase, completed in 2012, being 15 TAF.

Yucca Valley

MWA is also collaborating with water agencies in the Twentynine Palms-Lanfair Planning Area for the construction of additional groundwater recharge projects. The Big Horn Desert View Water Agency is the co-lead agency on the Ames Valley Recharge Project which is in San Bernardino County and north of the City of Yucca Valley. The project will recharge the groundwater basin of the same name with SWP supplies. It will include a pipeline intertie with the Morongo Pipeline, recharge facilities at Pipes Wash, and monitoring wells. Construction has commenced for a similar project to recharge the Joshua Tree groundwater basin. The lead agency for this project is the Joshua Basin Water District. A third project involves the City of Hesperia which has identified a site for the construction of a storm water detention basin. The site is near the Morongo Pipeline and could also be utilized for the recharge of SWP supplies.

Antelope Valley

The County of Los Angeles continues to make progress on its groundwater conjunctive use project in the Antelope Valley. The project was granted a waiver from the Lahontan RWQCB in 2010. Using 17 of wells, the County plans to inject a maximum of 6,843 AF of SWP water annually into the groundwater basin. Injection operations will occur only during wet hydrologic conditions when additional SWP supplies would be available. During dry conditions, the stored supplies could then be pumped by the local retail water agencies when less SWP supplies would be available.

Recycled Water

Recycled water use is increasing in the South Lahontan region. Uses are reported in the service area of the Mammoth Community Water District, in the Victor Valley, and Antelope Valley.

For the Mammoth CWD, recycled water is being used to meet some of the applied water requirements of the turf grass on golf courses. Over the next decade, recycled water will be used for equipment cooling and for landscape irrigation at commercial buildings.

In the Mojave River PA, the City of Adelanto, City of Barstow, Helendale Community Services District, Marine Corps Logistics Base in Barstow and Yermo, and VVWRA operate wastewater treatment plants. The Victorville Water District (VWD) completed construction on a 2.5 mgd wastewater treatment plant in 2010. Tertiary-treated wastewater from the VWD plant and from VVWRA is being delivered to the High Desert Power Plant for cooling. A little less than 400 AF of recycled water supplies are being delivered to a golf course for irrigation. The remainder of the recycled water is discharged into the Mojave River for groundwater recharge.

Long-range planning indicates the cities of Adelanto, Barstow, and Hesperia and the Victor Valley Wastewater Reclamation Authority will have local customers for tertiary-treated recycled water which they will be producing over the next decade. Recycled water use might be near 40 TAF by 2020.

In the Antelope Valley, construction is underway to install the infrastructure to deliver recycled water supplies to potential users in the cities of Lancaster and Palmdale. Los Angeles County and the US Army Corps of Engineers are assisting the City of Lancaster with the installation of a transmission line for the eventual conveyance of this supply from the Lancaster Wastewater Reclamation Plant to potential urban customers. The county is also working with the City of Palmdale on the design of the transmission, storage, and pump facilities to convey recycled water supplies from the Palmdale Wastewater Reclamation Plant. Planning efforts are moving forward on a pilot project to recharge the groundwater basin with recycled water and a program to encourage agricultural water customers to use recycled water.

The Hi-Desert Water District is designing Phase I of a wastewater treatment and water reclamation facility and collection system in order to address nitrate contamination in the area. Ultimately, this project will treat wastewater to meet Title 22 standards and be discharged to percolation basins where the treated effluent will be recharged into the Warren Valley groundwater basin.

Water Conservation

Even before the passage of the Water Conservation Act of 2009, many urban water agencies in the South Lahontan region were engaged in the planning and implementation of water conservation programs and activities within their respective service areas. In the Mojave River PA, twenty eight water and governmental agencies have formed the Alliance for Water Awareness and Conservation in 2003. Goals of the alliance are: (1) educate the local communities on the importance of water conservation, (2) provide the necessary tools to the local communities to enable them to achieve specific water conservation targets, and in response to SB x7-7 (3) attempt to achieve water savings of 10 percent by 2010 and 20 percent by 2020. As of 2010, the 20 percent goal had already been achieved.

Of the list of Urban Best Management Practices, residential home audits and high efficiency clothes washing machine rebates are being implemented with greater frequency. This includes the Mammoth Community Water District (MCWD), Palmdale Water District, Los Angeles County Waterworks District, and the Victorville Water District. Water agencies in the region continue to offer rebates on the purchase of ultra-low flush toilets (1.6 gallons per flush), but have begun to offered the rebates for the high efficiency toilets (1.2 gallons per flush). Sometimes, rebates may be offer for both toilets. Public information programs being implemented by the agencies are beginning to target exterior water uses. This includes conducting free workshops and providing published literature on landscaping and irrigation tips. This is being done in conjunction with the modifications to local building codes brought on by the Model Water Efficient Landscape Ordinance legislation.

New conservation programs are being implemented as well. The MCWD now offers rebates to its customers for irrigation system upgrades and for the purchase of weather-based irrigation controllers. The MWA is among several agencies now offering financial incentives for landscape conversions which include the removal of turf grass. This is an activity covered by the regional Water Conservation Incentive Program (WCIP). Since the program's inception in February 2008, over 5 million square feet of turf have been removed and 1,200 acre-feet/year of water saved. The WCIP was designed for water agencies that did not have financial incentive programs for their customers. Through partnership with MWA, it became possible for them to implement a program. It was also designed to augment the programs for water agencies that offered conservation incentives.

The Palmdale Water District has been implementing its "HydroPoint Weather Trak Irrigation Audit and Smart Controller Installation" program which provides technical assistance to farmers and landscape managers in the form of audits on their irrigation systems and operations and the installation of new weather-based controllers.

Challenges

Flood Challenges

Flood management challenges exist in the Antelope and Mojave River valleys. Key issues include the following.

- Levee portions of the Mojave River in Victorville require continuous maintenance • to remove sand buildups.
- The loss of the Mojave River floodplain results in stream channelization, and • groundwater pumping results in the loss of riparian habitat.
- Increasing urbanization of the watershed in the Victor Valley is increasing peak • storm flow velocities resulting in increased sediment loads and losses of riparian habitat.
- Improvements in coordination are needed in the Antelope Valley.•
- Flood control measures are often in conflict with groundwater recharge • requirements.
- Edwards Air Force Base requires delivery of sediments into the dry lakes to • maintain its operations area.

Mojave River Area

The SWP is the region's only source of imported supplemental water supply. MWA has made forward-looking investments in SWP "Table A" water supplies that are in excess of the region's current demands, but the vulnerability of those supplies due to environmental, regulatory and policy activities related to the Delta and management of the SWP may put the region at risk, depending upon the outcome of those activities (i.e. reduced SWP supply is a risk to MWA). The Mojave Region is a high-growth area (population grew about 40 percent between 2000 and 2010), with increasing water demands and a finite water supply. Balancing growth, water conservation, and acquisition of new water supplies will continue to be challenges as the area expands.

Antelope Valley

The continued urbanization in Antelope Valley and the increases in demand that accompany it require local water managers to seek and obtain additional and higher quality water supplies. This has been a challenge to the managers and stakeholders in the region. Much of the water used within the Antelope Valley Region is extracted from groundwater aquifers. Over the years, excessive pumping has put many of the groundwater basins in the region in states of overdraft. Water providers and managers within the region recognize the need to balance the water being pumped from the aquifers with the water being put back in; thus, adjudication is currently underway.

Water Quality Challenges

Some areas in the region continue to have issues meeting Federal and State drinking water standards in their groundwater basins. In the Inyo-Mono region, water from wells in Tecopa and Tecopa Hot Springs does not meet the State's safe drinking water standards for dissolved solids, fluoride and arsenic. A feasibility study is to be conducted to determine whether safe drinking water and fire flow storage facilities can be provided in these two communities.

Closed basins in the region struggle with increases in salinity in groundwater as use of recycled water increases. As a result, IRWM groups in the region are developing Salt Nutrient Management Plans which will provide guidance on meeting objectives to manage salts, nutrients, and other possible constituents of concern from all sources within the basin to maintain water quality objectives and support beneficial uses.

Owens Valley

The LADWP and local agencies are working collaboratively on the issues in Owens Valley and Mono Basins. However, underlying conflicts over water allocations and water rights in the region still exist and could result in litigation and jeopardize the current relationships between the parties. Hope exists that activities implemented through the development of the Integrated Regional Water Management Plan will encourage the parties to resolve their conflicts through collaborative processes and negotiations rather than through litigation.

Hazard Mitigation Planning

Water districts in the region have water supply shortage contingency plans that can be implemented to mitigate the effects of short- and long-term water shortages. In the event of an emergency, the water agencies will immediately coordinate with personnel in the appropriate local governmental agencies to implement actions mitigate the impacts and resolve the emergency as rapidly as possible. The Mammoth Community Water District has a specific plan that includes coordination procedures with local law enforcement, fire, medical, and other services; communications procedures; and stages of action.

The Disaster Mitigation Act of 2000 (DMA) required local governments to develop Hazard Mitigation Plans in order to qualify for additional disaster mitigation funding through Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The DMA also provided monies for developing the plans, which have emphasized community partnerships in planning for and responding to disasters; assessed and posited strategies for reducing risks; and identified capabilities and resources of local agencies for addressing various hazards. Kern, Los Angeles, San Bernardino, and Mono counties have written Hazard Mitigation Plans. These plans discuss and offer methods for reducing flood risks in their respective boundaries.

Drought Contingency Plans

With a heavy reliance on groundwater supplies, most all water agencies have been able to get through dry hydrologic conditions with little or no impacts. However, in response to the Urban Water Management Planning Act, these agencies have been able to develop water shortage contingency plans which can be activated in response to natural or man-made supply shortages. These plans identify the actions which should be taken by agencies to mitigate the impacts, if any, for the different levels of shortages. The actions include (1) water conservation measures which can be utilized to decrease demands at different supply shortage stages, (2) restrictions on certain kinds of water uses (landscape irrigations only on certain days), (3) emergency responses to sudden shortages caused by earthquakes, flooding, regional power outages, contamination, and terrorist acts, and (4) strategies to replace imported water supplies if reductions are imposed because of dry hydrologic conditions.

The implementation of groundwater recharge projects by the Mojave Water Agency, which includes water supply transfer agreements with agencies outside of the South Lahontan region, is providing additional water supplies which will help mitigate the impacts of droughts or other man-made supply shortages. As of the publication of MWA's 2010 Urban Water Management Plan, MWA had banked enough groundwater storage to fully meet local demands during a six-year drought on a 3-year complete outage on the SWP.

Looking to the Future

To address the needs of expanding urban area in the southern portion of the region, many water districts have taken a proactive approach to the water reliability problems by initiating studies and projects that could provide partial or complete solutions. These include water conservation programs, water recycling projects, groundwater exchanges and recovery, water marketing, and other water supply augmentation strategies. Agricultural practices and water uses in rural areas are anticipated to remain at current levels for the near future.

MWA and AVEK have several projects under way or completed that achieve some of water management objectives identified in their respective IRWM plans. MWA has completed Oro Grande Wash Recharge Project. Also, the Mojave River Well Field and Water Supply Pipeline Project (locally referred to as the Regional Recharge & Recovery or R3 project) will deliver SWP water to the Mojave River as well as direct pipeline connections to the water systems of major purveyors in the Victor Valley. The project was completed in 2012 and will be operational in 2013.Through a partnership with over 25 regional entities, the Alliance for Water Awareness and Conservation (AWAC) provides MWA a network with a common vision to be a collaborative alliance providing leadership, education, resources, support, ideas and solutions to agencies region-wide to conserve and protect our water supplies. By consistently developing and disseminating materials to increase the public awareness about water use efficiency, the regional per capita water use continues to drop, achieving regional water supply savings in the last ten years of over 20%, despite population increase of about 40% in the same time period.

The MWA has SWP entitlement exchange agreements with both Solano County Water Agency (SCWA) and Metropolitan Water District of Southern California (MWDSC). The program with MWDSC is similar to the program with SCWA, but it is a one-for-one exchange program, meaning that for every acre-foot MWDSC stores with MWA, one acre-foot will be returned. Between 2003 and 2010 about 45,000 acre-feet were stored in MWA and returned to MWDSC via the program. In 2011, MWA and MWDSC extended the term of the program to accommodate up to 390,000 acre-feet to be stored and returned between 2011 and 2035.

Between 2004 and 2006, the cities of Adelanto, Apple Valley, Hesperia and Victorville passed landscape ordinances requiring new development to include water conserving desert-friendly landscaping.

This list provides a list of some of the priority areas and needs specific to the South Lahontan Hydrologic Region from a CDFW perspective for California, in relation to California water supply.

- Acquisition of conservation easements on lands;
- Improvements in the coordination, management and implementation of groundwater management;
- Prevent or reduce negative impacts from invasive non-native species including those associated with water supply and conveyance projects such as quagga and zebra mussels, egeria densa, water hyacinth, and others;
- Protect or restore fish habitat through the improvement of fish passage conditions, gravel augmentation, hydrology, fish screens, and min/max flow;
- Restoration of riparian habitat, including conservation of riparian corridors;
- Water quality improvements (sediment, oxygen saturation, pollution, and temperature) to support healthy ecosystems;
- And, restoration projects that will improve upon existing wetlands, or creates new wetlands in appropriate areas.

Future Conditions

Future Water Demand

In this section a description is provided for how future South Lahontan hydrologic region water demands might change under scenarios organized around themes of growth and climate change described earlier. The change in water demand in South Lahontan region from 2006 to 2050 is estimated for agriculture and urban sectors under 9 growth scenarios and 13 scenarios of future climate change. The climate change scenarios included the 12 Climate Action Team scenarios described earlier and a 13th scenario representing a repeat of the historical climate (1962-2006) to evaluate a “without climate change” condition.

Urban Demand

Figure SL-4 shows a box plot of change in urban water demand under 9 growth scenarios for South Lahontan region with variation shown across 13 scenarios of future climate including one scenario representing a repeat of the historical climate. A box plot is a graphical representation showing the minimum, 25th percentile, median, 75th percentile, and maximum values. The red dot shows the mean or average value. 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, is dependent on climate factors like amount of precipitation falling and the average air temperature. Urban demand increased under all 9 growth scenarios tracking with population growth. On average, it increased by about 270 thousand acre-feet under the three low population scenarios, 350 thousand acre-feet under the three current trend population scenarios and about 580 thousand acre-feet under the three high population scenarios when compared to historical average of about 230 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.

PLACEHOLDER Figure SL-4 Change in Urban Water Demand

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

Agricultural Demand

Figure SL-5 shows a box plot of change in agricultural water demand in the South Lahontan region under 9 growth scenarios with variation shown across 13 scenarios of future climate including one scenario representing a repeat of the historical climate. A box plot is a graphical representation showing the minimum, 25th percentile, median, 75th percentile, and maximum values. The red dot shows the mean or average value. The change in water demand is the difference between the historical average for 1998 to 2005 and future average for 2043 to 2050. 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 350 thousand acre-feet. Under the three low population scenarios, the average reduction in water demand was about 8 thousand acre-feet while it was about 30 thousand acre-feet for the three high population scenarios. For the three current trend population scenarios, this change was about 10 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.

PLACEHOLDER Figure SL-5 Change in Agricultural Water Demand

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

Integrated Water Management Plan Summaries

Inclusion of the information contained in IRWMP's 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 California Water Plan has taken on the task of summarizing readily available Integrated Water Management Plan 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 CWP updates and will include up to 4 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 IRWMP's are different in how are organized and 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 IRWMP's, those that were involved in the preparation, to have input on the summary. It is the intention that this process be initiated following release of the CWP Update 2013 and will continue to be part of the process of the update process for Update 2018. This process will also allow for continuous updating of the content of the atlas as new IRWMP's are released or existing IRWMP's are updated.

As can be seen in Figure SL-6, there are 5 IRWM planning efforts ongoing in the South Lahontan Hydrologic Region.

PLACEHOLDER Figure SL-6 Integrated Water Management Planning in the South Lahontan 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 Text: At the time of the Public Review Draft the collection of information out of the IRWMP's 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 SL-7.

PLACEHOLDER Table SL-7 Resource Management Strategies addressed in IRWMP's in the South Lahontan 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.]

Regional Resource Management Strategies

In the northern part of the South Lahontan region, the Sierra Nevada Conservancy is very active on issues about the eastern flank of the Sierra Nevadas. The conservancy has granted funds to support the purchase of forest lands which are placed under conservation easements which allow for selective timber harvesting to preserve the health of the forest. Placing forest lands under conservation easements is an example of forest and watershed management and recharge area protection strategies. In addition the conservancy has funded habitat preservation projects that produce benefits under these same strategies. Finally the conservancy has also undertake fuel reduction projects which in the long term support the pollution protection strategy by preventing extreme wildfire events that have devastating impacts to water quality.

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 public health, water, agriculture, biodiversity, and transportation and energy infrastructure (CNRA, 2009; USGRCP, 2009). Climate model simulations, using the Intergovernmental Panel on Climate Change's (IPCC) 21st century climate scenarios, project increasing temperatures in California, with greater increases in the summer. Projected changes in annual precipitation patterns across 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, 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 (IPCC, 2007; UNEP, 2009).

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 (USEPA and DWR, 2011; Cal-EMA and CNRA, 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)*. Locally in the South Lahontan region within the WRCC Mohave Desert climate region, mean temperatures have increased by about 1.2 to 2.4 °F (0.7 to 1.3 °C) in the past century, with minimum and maximum temperatures increasing by about 1.5 to 2.6 °F (0.8 to 1.4 °C) and 0.9 to 2.3 °F (0.5 to 1.3 °C), respectively (WRCC, 2012). Within the WRCC Northeast climate region, mean temperatures have increased by about 0.8 to 2.0 °F (0.4 to 1.1 °C) in the past century, with minimum and maximum temperatures increasing by about 0.9 to 2.2 °F (0.5 to 1.2 °C) and 0.4 to 2.1 °F (0.2 to 1.2 °C), respectively (WRCC, 2012). Statewide, California's air temperature already has risen by 1 °F (0.6 °C), mostly at night and during the winter, with higher elevations experiencing the highest increase (DWR, 2008).

The South Lahontan region 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. During the last century, the average early snowpack in the Sierra Nevada, which is an important source of water for the South Lahontan region through the SWP and LAA, decreased by about ten percent, which equates to a loss of 1.5 million acre-feet of snowpack storage (DWR, 2008).

Sea level rise, although not a direct impact to the South Lahontan region, degrades the quality of the region's imported water from the Delta, as well as increases salinity intrusion and impacts the Delta levee infrastructure, requiring substantial capital investments by the public. According to the California Climate Change Center, sea level rose 7 inches (18 cm) along California's coast during the past century (DWR, 2008; CNRA 2009).

Projections and Impacts

While historic data is a measured indicator of how the climate is changing, it can't 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 2060-2069, temperatures will be 3.4 -4.9oF (1.9 -2.7oC) higher across the state than they were from 1985 to1994 (Pierce et al, 2012). By 2060-69, the annual mean temperature is projected to increase by 4.9 °F (2.7 °C) for the WRCC Mohave Desert climate region, with increases of 3.6 °F (2.0 °C) during the winter months and 5.9 °F (3.3 °C) during summer. The WRCC Northeast climate region has similar projections with annual mean temperatures increasing by 4.7 °F (2.6 °C), winter temperatures increasing by 3.4 °F (1.9 °C), and summer temperatures increasing by 6.5 °F (3.6 °C)..By the end of this century in 2100, mean temperatures are projected to increase Climate projections from Cal-Adapt indicate that the temperatures between 1990 and 2100 will increase about 5 to 10 °F (2.8 to 5.6 °C) during winter and 8 to 10 °F (4.4 to 5.6 °C) during summer (Cal-EMA and CNRA, 2012b).

With increasing temperatures, net evaporation from reservoirs is projected to increase by 15 to 37 percent (Medellin-Azuara, et al., 2009; CNRA, 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. Currently, groundwater supplies the water for over 65 percent of urban, agricultural, and environmental water demands in the South Lahontan region because much of the surface water is not locally available due to historic water appropriation rights (Cal-EMA and CNRA, 2012b).

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 the state 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).

The Sierra Nevada snowpack is expected to continue to decline as warmer temperatures raise the elevation of snow levels, reduce spring snowmelt, and increase winter runoff. Based upon historical data and modeling, researchers at Scripps Institution of Oceanography project that, by the end of this century, the Sierra Nevada snowpack will experience a 48 to 65 percent loss from its average at the end of the previous century (van Vuuren et al., 2011).. 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.

Locally in the South Lahontan region, the snowpack levels are projected to decline by over 50 percent (Cal-EMA and CNRA, 2012b). Such a decline in snowpack will impact the mountain communities dependent on tourism for their economies, such as the ski resorts of Mammoth Lakes where the winter population substantially increases with ski season (Cal-EMA and CNRA, 2012b). The hydrology and geomorphology of streams draining the northern slopes of the San Bernardino and San Gabriel mountains are similar to those for watercourses emanating from the eastern Sierra Nevada. The snowpack in these mountains are smaller because of their southern locations and lower peak elevations; however, the population and urbanized area are greater. Though hydrograph changes due to the reduced snowpack are projected to be smaller, relative to those in the Sierra Nevada range, impacts on these urban areas could be equally or more severe in the San Bernardino and San Gabriel ranges.

Although annual precipitation will vary by area, reduced precipitation in the South Lahontan region will affect local reservoirs and the replenishment of the region's groundwater. Projections for the South

Lahontan region indicate that precipitation will decline to as much as 15 inches (38 cm) depending on the location, such as reductions to under 4 inches (10 cm) annually in areas that receive less than 6 inches (15 cm) of rain while in other areas where rainfall exceeds 45 inches per year (114 cm/yr.) precipitation will decrease by 15 inches (38 cm) (Cal-EMA and CNRA, 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). Winter runoff could result in flashier flood hazards, with flows potentially exceeding reservoir storage capacities. 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.

Changes in climate and runoff patterns may create competition among sectors that utilize water. The agricultural demand within the region could increase because of higher evapotranspiration rates caused by increased temperatures. Prolonged drought and decreased water quality could diminish water-based recreational opportunities at South Lahontan reservoirs and streams. Environmental water supplies would need to be retained in reservoirs for managing instream flows to maintain habitat for aquatic and migratory species throughout the dry season not only within the region (such as for Mono Lake, a prominent stop for migrating birds), but also for the region's imported source water. Currently, Delta pumping restrictions are in place to protect endangered aquatic species. Climate change is likely to further constrain the management of these endangered species and the state's ability to provide water for other uses. For some areas of the South Lahontan region, this would further reduce supplies available for import through the SWP during the non-winter months (Cayan 2008; Hayhoe 2004). Reductions in the quantity of available SWP water would force local water agencies in the Antelope Valley (AVEK and PWD) to rely more heavily on local groundwater and local surface flows, or on other sources of imported water.

Higher temperatures and decreased moisture during the summer and fall seasons will increase the South Lahontan region's vulnerability to wildfire hazards and impact local watersheds. The extent to which climate change will alter the existing risk to wildfires is variable (Westerling and Bryant, 2006). However, by 2085, the risk is expected to increase up to 19.1 times in the northern part of Mono County, while the rest of Mono County and Inyo County can anticipate a wildfire risk between 1.1 to 4.8 times greater than current levels (Cal-EMA and CNRA, 2012b). Early snowmelt and drier conditions have been correlated with an increase in the size and intensity of these fires (Westerling, 2012). Frequent fires would mean less native vegetation to capture and reduce the velocities of surface runoff and maintain soil integrity. Erosion rates would increase, which could increase the destructive force of debris flows and sedimentation rates for flood control channels and reservoirs.

Wildfires have historically been linked to debris flow flooding in vulnerable communities within the South Lahontan 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 Sierras, 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. The frequency of floods by the end of this century increased for two of the models, but remained constant or declined for the third model. (Das, et al., 2011 .)

Even though this study focused on the Sierras, these scenarios could potentially be indicative of other regional settings already experiencing flooding risks. Sparse development in the region, however, precludes catastrophic flood damage over a widespread area. Nevertheless, it is essential for local agencies to take action and be ready to adapt to climate change to protect the well-being of their communities.

Adaptation

Climate change has the potential to impact the region, which the State depends upon 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 with diminished water quantity and quality, and shifting eco-regions. Built systems will be impacted by changing hydrology and runoff timing, loss of natural snowpack storage, making the region more dependent on surface storage in reservoirs and groundwater sources. Increased future water demand for both natural and built systems may be particularly challenging with less natural storage and less overall supply.

Water managers and local agencies must work together to determine the appropriate planning ap-proach 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 (USEPA and DWR, 2011). However, stationarity (the idea 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)

Integrated Regional Water Management (IRWM) planning is a framework that allows water managers to address climate change on a smaller, more regional scale. Climate change now is a required component of all IRWM plans (DWR, 2010). 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 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.

The South Lahontan region contains a diverse landscape with different climate zones, making it difficult to find one-size-fits-all adaptation strategies. Water supplies within California are already stressed because of current demand and expected population growth. Even though the South Lahontan region represents about two percent of the State's population, it grew by 14 percent between 2000 and 2005 (DWR, 2009). The uncertainty on the extent of these environmental changes will no doubt reduce the ability of local agencies to meet the water demand for the South Lahontan region, if these agencies are not adequately prepared.

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). Other adaptation strategies to consider for managing water in a changing climate include developing coordinated plans for mitigating future flood, landslide, and related impacts, implementing activities to minimize and avoid development in flood hazard areas, restoring existing flood control and riparian and stream corridors, implementing tiered pricing to reduce water consumption and demand, increasing regional natural water storage systems, encouraging low impact development to reduce storm water flows, and 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 in the mountain areas and reducing accumulated fuel load will provide a more resilient watershed ecosystem that can mitigate for floods, droughts, and fires (DWR, 2008; Hanak and Lund, 2011; Cal-EMA and CNRA, 2012c; CNRA, 2012; Jackson, et al., 2012.).

Local, state, and federal agencies face the challenge of interpreting new information 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 (USEPA and DWR, 2011). This handbook provides guidance for assessing the vulnerabilities of California's watersheds and regions to climate change impacts, and for prioritizing these vulnerabilities.

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

Already, RWMGs in the South Lahontan region are taking action. The Inyo-Mono RWMG has initiated work on determining regional vulnerabilities and adaptation strategies and incorporating climate change into its IRWM planning processes. One of the objectives for the Inyo-Mono IRWM plan is to address climate variability and reduce GHG emissions. The Mojave RWMG is implementing projects that assist in adapting to climate change. The Mojave RWMG has facilitated water conservation projects, is completing several recharge projects in the Oro Grande Wash, and is eradicating non-native species from the Mojave River within its jurisdictional boundary. The Mojave RWMG will be evaluating climate change impacts to its water supplies and infrastructure as part of updating its IRWM Plan, as well as planning for salt and nutrient management and flood management. The Antelope Valley RWMG also is incorporating salt management and regional flood management plans into its IRWM plan and was awarded funds to develop an operational groundwater bank through a groundwater recharge and recovery project and to implement through the City of Palmdale a flood control, recharge, and habitat restoration project in the Upper Amargosa Creek. Through its various conservation efforts, the Antelope Valley RWMG has been able to get retail water demands down by over 20 percent throughout its IRWM region.

In preparing for climate change, LADWP contracted a study to evaluate the effects of climate change on the LAA watershed. 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). In addition, the Sierra Nevada Alliance developed a climate change toolkit for the Sierra mountain communities (SNA, 2010). In the Victor Valley area, the Town of Apple Valley has adopted a climate action plan, in addition to developing targets and GHG inventories, while Victorville has a GHG inventory and included climate change in its adopted General Plan (DeShazo and Matute, 2012). According to the Luskin Center for Innovation report, 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).

The State of California has developed additional on-line 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 on-line 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* website (http://www.water.ca.gov/climatechange/resources.cfm)
- *The Governor's Office of Planning and Research* website (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

- Precipitation Enhancement
- Recycled Municipal Water
- Surface Storage – Regional/Local
- Drinking Water Treatment and Distribution
- Groundwater/Aquifer Remediation
- Pollution Prevention
- Salt and Salinity Management
- Agricultural Stewardship
- Economic Incentives
- Ecosystem Restoration
- Forest Management
- Land Use Planning and Management
- Recharge Area Protection
- Water-dependent Recreation
- Watershed Management
- Integrated Flood 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 Lahontan 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 (CNRA, 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% of statewide electricity (CPUC, 2010). Energy is used in the water sector to extract, convey, treat, distribute, use, condition, and dis-pose 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 the 2013 California Water Plan Update 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 deman. Since energy usage is related to Greenhouse Gas (GHG) emissions, this information can support measures to reduce GHG's, as mandated by the State.

Figure SL-7 shows the amount of energy associated with the extraction and conveyance of 1 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 CA Water Today, Volume 1 highlights which water-energy connections are illustrated in Figure SL-7; only 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 SL-7 because their energy intensity differs in important ways from those water sources. The energy intensity 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 SL-7. For these reasons, discussion of energy intensity of desalinated water and recycled water are included in Volume 3, Resource Management Strategies.

Energy intensity, sometimes also known as embedded energy, is the amount of energy needed to extract and convey (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, while 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.) 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 a State Water Project (SWP) delivery turnout(Energy from low-head pump lifts (less than 50 feet) used to divert water out of river channels or canals has been excluded from the calculations). Energy intensity should not be confused with total energy—that is, the amount of energy (e.g. kWh) required to deliver all of the water from a water source to customers within the region. Energy intensity 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, energy intensity gives a normalized metric which 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's 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 other many other factors.

Energy intensity is closely related to Greenhouse Gas (GHG) emissions, but not identical, depending on the type of energy used (see CA Water Today, Water-Energy, Volume 1). In California, generation of 1 megawatt-hour (MWh) of electricity results in the emission of about 1/3 of a metric ton of GHG, typically referred to as carbon dioxide equivalent or CO2e (eGrid, 2012). This estimate takes into account the use of GHG-free hydroelectricity, wind, and 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 energy intensity factors, such as those presented here, in their decision making process. Water use efficiency and related best management practices can also reduce 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% of all electricity generation in Californi a. The State Water Project, Central Valley Project, Los Angeles Aqueduct, 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(In-conduit generating facilities refer to hydroelectric turbines that are placed along pipelines to capture energy as water runs down hill in a pipeline (conduit)). generating facilities. Hydroelectricity is also generated at hundreds of smaller reservoirs and run-of-the-river turbine facilities.

Hydroelectric generating facilities at reservoirs provide unique benefits. Reservoirs like the State Water Project's Oroville Reservoir are operated to build up water storage at night when demand for electricity is low, and release the water during the day time 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 energy intensity calculations is complex. In some systems like the SWP and CVP, water generates electricity and then flows back into the natural river channel after passing through the turbines. In other systems like the Mokelumne aqueduct water can leave the reservoir by two distinct out flows, 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 energy intensity calculations because the energy generation system and the water delivery system are in essence separate (Wilkinson, 2000).

DWR has adopted this convention for the energy intensity for hydropower in the regional reports. All hydroelectric generation at head reservoirs has been excluded from Figure SL-7. Consistent with Wilkinson (2000) and others, DWR has included in-conduit and other hydroelectric generation that occurs as a consequence of water deliveries, such as the Los Angeles Aqueduct's hydroelectric generation at San Francisquito, San Fernando, Foothill and other power plants on the system (downstream of the Owen's River Diversion Gates). DWR has made one modification to this methodology to simplify the display of results: energy intensity has been calculated at each main delivery point in the systems; if the hydroelectric generation in the conveyance system exceeds the energy needed for extraction and conveyance, the energy intensity 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., Los Angeles Aqueduct, Hetch Hetchy Aqueduct). (For detailed descriptions of the methodology used for the water types presented, see Technical Guide, Volume 5).

PLACEHOLDER Figure SL-7 Energy Intensity of Raw Water Extraction and Conveyance in the South Lahontan 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.]

*Footnote: 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 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.

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Additional References

Personal Communications

Personal communication, including phone conversations, and emails with MWA, LADWP, MONO County and others