South Lahontan Hydrologic Region — Table of Contents

South Lahontan Hydrologic Region SL-1

South Lahontan Hydrologic Region Summary and Recommendations SL-1
Summary SL-1
Resource Management Strategies and Policies SL-1
Finance SL-1
Water Planning and Governance SL-1
Current State of the Region SL-1
Setting SL-1
Major Perennial Streams and Watersheds SL-3
Antelope Valley Watershed SL-3
Mojave Watershed SL-3
Mono Basin SL-5
Owens River SL-6
Amargosa River SL-7
Groundwater Aquifers SL-8
Ecosystems SL-8
Antelope Valley SL-8
Mojave River SL-8
Mojave National Preserve SL-9
San Bernardino National Forest Land Management Plan SL-9
Owens Valley, Fish Slough, and Death Valley National Park SL-9
Climate SL-9
Demographics SL-10
Population SL-10
Land Use Patterns SL-11
Tribal Lands SL-12
Tribal Communities SL-13
Regional Resource Management Conditions SL-13
Water in the Environment SL-14
Water Governance SL-14
Flood Management Governance and Laws SL-15
Water Supplies SL-15
Groundwater SL-16
Imported and Surface Supplies SL-17
Water Uses SL-18
Drinking Water SL-19
Project Operations SL-20
Water Quality SL-20
Drinking Water Quality SL-20
Groundwater Quality SL-21
Antelope Valley SL-21
Mojave River Valley SL-21
Southeastern Inyo County SL-21
Groundwater Level Trends and Issues SL-22
Flood Risk SL-22
Flood Management SL-23

Risk Characterization ... SL-24
Historic Floods ... SL-24
Flood Descriptions ... SL-24
Damage Reduction Measures ... SL-25
Levee Performance and Risk Studies ... SL-25
Accomplishments ... SL-26
Challenges ... SL-27
Current Relationships with Other Regions and States ... SL-27
Implementation Activities (2009-2013) ... SL-28
Drought Contingency Plans ... SL-28
Resource Management Strategies ... SL-28
Drinking Water Treatment & Distribution ... SL-29
Water Governance ... SL-29
State Funding Received ... SL-29
Local Investment ... SL-29
Water Conservation Act of 2009 (SB x7-7) Implementation Status and Issues ... SL-30
Interregional and Interstate Activities ... SL-30
Looking to the Future ... SL-30
Future Conditions ... SL-32
Future Scenarios ... SL-32
Climate Change ... SL-33
Precipitation and Extremes ... SL-33
Water Supply and Snowpack ... SL-34
Water Demand ... SL-34
Temperatures, Droughts, Wildfires, and Floods ... SL-35
Adaptation ... SL-36
Mitigation ... SL-39
Interregional and Interstate Planning Activities ... SL-40
Future Vision ... SL-40
Regional Future Vision ... SL-40
Tribal Objectives/Vision ... SL-40
Relevant Statewide Interests and Objectives ... SL-41
Regional Water Planning and Management ... SL-41
Integrated Regional Water Management Coordination and Planning ... SL-41
Recent Accomplishments ... SL-43
Hazard Mitigation Planning ... SL-43
Environment ... SL-43
Owens Valley and Mono Basin ... SL-43
Water Supply ... SL-44
Mojave River ... SL-44
Yucca Valley ... SL-44
Antelope Valley ... SL-45
Recycled Water ... SL-45
Water Conservation ... SL-45
Challenges ... SL-46
Flood Issues ... SL-47
Mojave River PA ... SL-47
Antelope Valley ... SL-47
Water Quality ... SL-47
Owens Valley ... SL-47
Disadvantaged Communities ... SL-48

Drought and Flood Planning SL-48
Resource Management Strategies..... SL-48
Strategy Availability..... SL-48
Regional Strategies..... SL-49
References..... SL-49
Additional References..... SL-52
Personal Communications..... SL-52

Tables

PLACEHOLDER Table SL-1 South Lahontan Hydrologic Region Summaries of Annual Regional Temperatures and Precipitation..... SL-10
PLACEHOLDER Table SL-2 Granted Tribal lands with acreage, South Lahontan Hydrologic Region SL-13
PLACEHOLDER Table SL-3 Drinking Water Systems in South Lahontan Hydrologic Region.... SL-20
PLACEHOLDER Table SL-4 Summary of Community Drinking Water Systems in the South Lahontan Hydrologic Region that Rely on One or More Contaminated Groundwater Well that Exceeds a Primary Drinking Water Standard..... SL-21
PLACEHOLDER Table SL-5 South Lahontan Hydrologic Region Exposures within the 100-Year and 500-Year Floodplains..... SL-25

Figures

PLACEHOLDER Figure SL-1 South Lahontan Hydrologic Region 2010 Inflows and Outflows SL-2
PLACEHOLDER Figure SL-2 Watersheds and ecosystems in the South Lahontan Hydrologic Region..... SL-8
PLACEHOLDER Figure SL-3 Energy Intensity of Water (extraction and conveyance)..... SL-40

South Lahontan Hydrologic Region

South Lahontan Hydrologic Region Summary and Recommendations

Summary

[**Placeholder Text**: Content needs to be developed.]

Resource Management Strategies and Policies

[**Placeholder Text**: Content needs to be developed.]

[**GW Placeholder Text**:
Contains
- Summary of groundwater-related resource management strategies and policies in the Hydrologic Region.
- Summary of groundwater data gaps for the Hydrologic Region, how these gaps affect groundwater management and policy, and recommendations to reduce data gaps in the future.
- Selected maps and tables from the main text of the report, as appropriate.
- Discussion on groundwater sustainability and sustainability indicators to monitor progress towards the resource sustainability.]

Finance

[**Placeholder Text:** Content needs to be developed.]

Water Planning and Governance

[**GW Placeholder Text**:
Contains
- Summary of groundwater governance associated with the various groundwater management plans (GWMPs), Integrated Regional Water Management (IRWM) Plans, conjunctive management projects and groundwater recharge projects, groundwater monitoring, groundwater ordinances, and adjudicated groundwater basins within the Hydrologic Region.
- Summary table of groundwater-related planning and governance within the Hydrologic Region.
- Summary discussion on Case Studies – successes and challenges.]

Current State of the Region

Placeholder Text:
[**Note:** Align with region description in IRWM standards.]

Setting

The South Lahontan Hydrologic Region represents about 17 percent of the land area in California. 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; and to the east by the state of Nevada (Figure SL-1).

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 northern part of the region: Mt. Whitney, with an elevation of 14,495 feet, 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. 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, Convict Lake, and Tinemaha and Haiwee Reservoirs. In the south, important lakes include Lake Arrowhead and the SWP's Silverwood.

Native vegetation in the arid valleys 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.

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

Several large parks 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.

PLACEHOLDER Figure SL-1 South Lahontan Hydrologic Region 2010 Inflows and Outflows

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Major Perennial Streams and 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.

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 Branch 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. 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 terminates at Silver Lake, a dry lakebed near the community of Baker. In addition to Silver Lake, other dry lakebeds include 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 52,000 acre-feet of annual recharge to the Mojave Groundwater Basin. The river is impounded behind the Mojave River Dam in the Mojave River Forks Reservoir, which is operated for water supply, flood management, water conservation, and recreation. After descending from the dam, it meanders approximately 120 miles and ends at Silver Dry Lake. For most of the year, the Mojave River channel is dry downstream of the dam except in the Narrows near Victor Valley and Afton Canyon where the subsurface 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 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 is currently constructing the Regional Recharge and Recovery (R3) Project, anticipated to be completed in 2012. R3 is part of a conjunctive use project that will pump previously-stored SWP water in the Mojave River Basin and deliver it to retail water agencies in the Victor Valley area.

The South Lahontan Hydrologic Region has more than 825,000 acres, approximately 150,000 residents, more than $10 billion in assets (crops, buildings, and public infrastructure), and over 210 sensitive species exposed to a 500-year flood event. Sierra snowmelt in the northern portion of the region and infrequent, high-intensity rainfall produces flash, debris flow, and alluvial fan flooding. Due to the infrequent nature of flooding and the low-density population, awareness of flood risk is inadequate.

Major floods occur less regularly in the South Lahontan Hydrologic Region than in many other parts of the state. In the South Lahontan Hydrologic 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 channel bed 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.

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 Los Angeles's exports from Mono Basin 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. This temporary change expired March 31 of this year.

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 Game, 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 Los Angeles Aqueduct 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 much recreation.

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 Los Angeles Aqueduct 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 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 Los Angeles Aqueduct, 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 small. The major cities are 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 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 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 Watershed lies in both Nevada and California. Total area of the watershed, for both states, is a little under 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 is 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.

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 advisory committee draft are included at the end of the chapter.]

Groundwater Aquifers

[**Placeholder Text**:
Describe major or significant groundwater basins found in this region. Description could include major agricultural and municipal areas served and trends in the use of groundwater, such as more reliance.]

GW Placeholder Text:

Contains

- Brief physical description of the significant alluvial and fractured rock (if applicable) aquifer systems within the Hydrologic Region.
- Brief description of the priority groundwater basins within the Hydrologic Region.
- Table showing the groundwater basins and subbasins within the Hydrologic Region, by their priority designations.
- Map showing the groundwater basins and subbasins within the Hydrologic Region, by their priority designations.
- Brief discussion of the well infrastructure, with an explanation of the data gaps associated with this important dataset.
- Brief and general discussion of groundwater occurrence and movement, and identification of key recharge and discharge areas, subject to availability of information.
- Map showing groundwater elevation contours with arrows depicting general direction of groundwater movement, subject to availability of information.

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), DFG, 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 and is maintained by DFG. Near the terminus of the Mojave River, an area identified as

Camp Cady had thriving mesquite trees and three ponds. However, groundwater tables have fallen, and the mesquite groves are drying out. DFG 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. Tailwater from a nearby farming operation had sustained the area but that has been replaced by surface runoff from a solar power plant operated by FPL Energy Operating Services for some of the marshes only. BLM is considering purchasing additional land to expand the wetland area.

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.

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 amount 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 rain-shadows 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 advisory committee draft are included at the end of the chapter.]

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 PAs.

Major cities include Palmdale (152,750; 2010 U.S. Census) 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. 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 2018, we project population growth based on the assumptions of future scenarios. Discussion of the three scenarios used in this Water Plan and how the region's population may change through 2050 can be found later in this report under Looking to the Future.

Senate Bill 18 (Chapter 905, Statutes of 2004) requires cities and counties to consult with Native American Indian Tribes during the adoption or amendment of local general plans or specific plans. A

contact list of appropriate tribes and representatives within a region is maintained by the Native American Heritage Commission. 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.

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 City of Mammoth Lakes in the Sierra Nevada and the City 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, and California City.

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 PA. There has been little change in irrigated acres from year to year in this PA; in 2005, the Owens-Mono PA 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 PA 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.

Many communities in the San Bernardino Mountains, including Lake Arrowhead, were hit by fire in October, 2007. More than 12,000 acres were burned and more than 400 homes and structures were destroyed.

Tribal Lands

A Native American Tribe may be federally recognized, and the federal government may set aside lands for Tribes as reservations. In California these reservations are often named "Rancherias." One interpretation of the Spanish term Rancheria is small Indian settlement. Granted Tribal lands in the South Lahontan region are listed in Table SL-2.

Tribal Communities

Placeholder Text:
[Describe tribal communities that exist in the region.]

PLACEHOLDER Table SL-2 Granted Tribal lands with acreage, South Lahontan Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Regional Resource Management Conditions

[**Placeholder Text**:
This subsection contains a discussion of the following topics. (Primary authors are regional entities who wish to partner with Regional Office staff, the water supply and balances work team, the integrated flood management work team, and the ecosystem planning work team.)

- A characterization of environmental water use and demands.
- Water portfolios (1998-2009).
- Change in groundwater storage.
- An updated write-up from the Update 2009 regional report flood appendix.]
-

[**Placeholder Text**:
(Sources of this information may be IRWM plans, statewide flood management planning report, groundwater enhancements, local agency, and portfolio data; Bulletin 118, State Water Resources Control Board, and Department of Public Health data; U.S. Army Corps of Engineers, Division of Flood Management, Federal Emergency Management Agency, Federal Energy Regulatory Commission [FERC], National Marine Fisheries Service, and operations criteria and plan [OCAP] reports; and FERC licenses.)]

[**Placeholder Text**:
Considerations for this subsection:

- Quantify water supplies, uses, quality, imports, and exports.
- Estimate uses by source, uses by sector, and other subcategories based on documented assumptions.
- If possible, indicate the level of uncertainty for reported data.
- Identify wild and scenic rivers, instream flow and Delta outflow requirements, etc.
- Describe water supply sources (groundwater, surface, recycling, desalination, regional imports, etc.) and water rights.
- Summarize agricultural, urban, and managed wetland water use.
- Compare water use and supply parameters to show effects on water availability for beneficial uses (change over time, relative fractions of total, use rates for each region, and correlated factors).
- Summarize water quality conditions.
- Describe flood management systems, risks, procedures, and responsibilities.
- Summarize key operational criteria for large regional water projects.
- Governance summary: Identify responsibility of local governments, tribal government, agencies, and institutions for managing water resources, flood protection, and wastewater.

- Provide links to detailed information in the reference guide.
- Describe tribal participation in regional resource management.]

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.

Some environmental water demands are met with recycled water supplies. The Piute Ponds near the Lancaster Water Reclamation Plant received 9,294 AF and 6,915 AF in fiscal years 2006-07 and 2007-08, respectively. Victor Valley Regional Wastewater Reclamation Plant discharges about 9,000 acre-feet of recycled water supplies into the Mojave River channel to support riparian vegetation and habitat for an area managed by DFG.

[**GW Placeholder Text**:

Contains

- Description of the groundwater related environmental issues for the Hydrologic Region based on connection, disconnection, or seasonal connection between the aquifer groundwater table and the local surface water systems (including wetlands), subject to availability of data.
- Description of the importance of protecting groundwater recharge areas, and potential environmental consequences associated with contaminated aquifers.]

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 PA, 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.

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 in the Owens-Mono Planning Area agreed on jointly by the agency and the County of Inyo. These coordinated activates include the Lower Owens River Project and enhancement mitigation projects associated with the 1991 EIR on the operations of the second Los Angeles Aqueduct.

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.

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.

Flood Management Governance and Laws

Water Code Division 5, Sections 8,000 - 9,651 has special significance to flood management activities and is summarized in California's Flood Future Report Attachment E: Information Gathering Technical Memorandum.

Recently, a number of laws regarding flood risk and land use planning were enacted in 2007. These laws establish a comprehensive approach to improving flood management by addressing system deficiencies, improving flood risk information, and encouraging links between land use planning and flood management. My. Two of the Assembly Bills (AB) that the California legislature passed are summarized below.

- **AB 70 (2007) Flood Liability** — provides that a city or county might be responsible for its reasonable share of property damage caused by a flood, if the State liability for property damage has increased due to approval of new development after January 1, 2008.
- **AB 162 (2007) General Plans** — requires annual review of the land use element of general plans for areas subject to flooding, as identified by FEMA or DWR floodplain mapping. The bill also requires that the safety element of general plans provide information on flood hazards. Additionally, AB 162 requires the conservation element of general plans to identify rivers, creeks, streams, flood corridors, riparian habitat, and land that might accommodate floodwater for purposes of groundwater recharge and stormwater management.

[**GW Placeholder Text**:

- Contains Discussions of the various governance approaches to groundwater management within the Hydrologic Region and identification of specific GWMPs, IRWM Plans, groundwater ordinances, and adjudicated groundwater basins within the Hydrologic Region.
- Table listing the GWMPs, IRWMPs, groundwater ordinances, and adjudicated groundwater basins.
- Maps showing area coverage for GWMPs and IRWMPs, and "dot" locations of groundwater ordinances and adjudicated basins.]

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 Antelope Valley, 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 Antelope Valley groundwater basin.

Groundwater

[GW Placeholder Text:

Contains

- Description of the major agricultural and municipal areas served and trends in the water use met by groundwater supply, such as more or less reliance on groundwater supply over time.
- Map illustrating the location of major water use met by groundwater supply.
- Table illustrating the trends in water use met by groundwater supply.
- Description of seasonal and long-term groundwater level trends, an overview of groundwater supply sustainability based on existing management considerations, and groundwater change in storage, subject to availability of information.
- Charts of selected well hydrographs illustrating the variability, challenges, and successes in groundwater management in the Hydrologic Region.]

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.

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.

Imported and 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 2009 period, most of the water demands in the region were met with ground water supplies. Total water supplies utilized during the period ranged from 751 TAF to 836 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 PA.

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

Water Uses

[**GW Placeholder Text**:

Contains

- Description of the annual groundwater use/demand by beneficial use (agricultural, municipal, and managed wetlands), and by aquifer type (alluvial versus fractured rock, if applicable),
- Discussion of groundwater use as it relates to basin priority.
- Map showing groundwater use as a percentage of the overall supply for alluvial and fractured rock aquifer (if applicable) areas, with overlay of basin prioritization.]

From 2006 through 2009, annual applied water demands for urban and agricultural water users in the South Lahontan region ranged from 671 TAF to 755 TAF. Agricultural applied water demands ranged from 385 TAF to 425 TAF; 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 270 TAF to 330 TAF; with the peak also occurring in 2007. After that year, urban demands actually decreased. 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 southern Antelope Valley PA, SWP and surface water from Littlerock Reservoir are used to augment groundwater supplies. Supplies from Lake Arrowhead are used in the Mojave River PA.

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 338 to 367; with the other values hovering near the higher one. 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 PA. 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 PAs, Antelope Valley and Mojave River, the urban uses are influenced by the higher exterior demands.

Most all of the agricultural demands in the South Lahontan region were met with groundwater supplies. In the Owens-Mono PA, diversions from the LAA are made to irrigate the 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. However, center pivot systems are used on a considerable amount of alfalfa and other field crop acres. 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 their fields 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.

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 lack 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 Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Project Operations

[**Placeholder Text**:
Major water supply project operations could be described here, along with challenges faced in the operations. Include a description of how reservoirs and facilities are operated to meet the varied and changing demands.]

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 closed groundwater basin environments) 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 (A very large groundwater containment zone at Edwards 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.

Drinking Water Quality

In general, drinking water systems in the region deliver water to their customer that meets 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-4). 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-4). 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-4 Summary of Community Drinking Water Systems in the South Lahontan Hydrologic Region that Rely on One or More Contaminated Groundwater Well that Exceeds a Primary Drinking Water Standard

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Groundwater Quality

[GW Placeholder Text: Content on groundwater quality will be provided by Jose Alarcon.]

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.

Elevated nitrate concentrations and TDS have been measured in the groundwater beneath dairy waste disposal operations in the region. Water supply reservoirs were also constructed adjacent to the older operations. Fertilizers have been measured in the 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.

Groundwater Level Trends and Issues

[**Placeholder Text**:
Describe the aquifer conditions, such as overdraft, loss of recharge areas, and issues that may be occurring with relationship to the available supply of water in the aquifer, including threats such as contaminant plumes. This section could potentially be combined with groundwater quality, above, at the author's discretion.]

[**GW Placeholder Text**:
Contains

- Key long-term groundwater level hydrographs for the Hydrologic Region with description of seasonal and long-term groundwater level trends and aquifer response to demand during wet, normal, and dry hydrologic conditions.
- Description of estimated annual change in groundwater in storage for 2005-2010, and for each pair of consecutive years (e.g., 2005-2006, 2006-07, etc.). For Hydrologic Regions where data are not available in DWR's Water Data Library or limited, identify this as a data gap.
- Map showing location of groundwater basins and associated change contours of groundwater levels and storage, subject to availability of information.
- Chart showing trends in annual and cumulative change in groundwater in storage, subject to availability of information.
- Table containing values for annual and cumulative change in groundwater levels and storage, subject to availability of information.
- Discussion and presentation of results from other related efforts for the Hydrologic Regions to estimate change in groundwater in storage, based on availability of data and information. These efforts may include local and regional agency groundwater modeling results and results from GRACE satellite analysis.
- Discussion of the historic land subsidence for the Hydrologic Region and the potential susceptibility for the future, if pertinent to the Hydrologic Region and subject to availability of data.
- General overview of aquifer sustainability based on above data and existing groundwater management practices. More detailed trends and assessment of sustainability indicators for Hydrologic Regions for which data or modeling results are available.]

Flood Risk

Flooding can deliver either environmental destruction or environmental benefits. Ecosystems can be devastated by extreme floods that wash away habitat, leaving deposits of debris and contaminants. Development in floodplains has reduced the beneficial connections between different types of habitat and adjacent floodway corridors; however, well functioning floodplains deliver a variety of benefits. Floodplains provide habitat for a significant variety of plant and wildlife species. Small, frequent flooding can recharge groundwater basins and improve water quality by filtering impurities and nutrients, processing organic wastes, and controlling erosion.

Typically, flood management agencies in large urban areas tend to be highly organized. Agencies in more rural counties or with low exposure to flooding are often handled by emergency responders or a single contact at the county. This can present a unique set of challenges when developing a project. Flood management in the South Lahontan Hydrologic Region of California has a unique set of challenges that were identified during meetings with local agencies in the hydrologic region. These challenges include:

- Inadequate coordination with and within Federal, State, and local agencies involved in flood management
- Inadequate flood information, including maps and recent data (There is a need for more recent flood data, including aerial photography.)
- Inconsistent and unreliable e funding streams for rural counties
- Outdated, ageing, and undersized flood infrastructure
- Permitting approvals and complex permitting requirements restrict ability of agencies to provide public safety for flood management

The identified issues were based upon interviews with 16 agencies with varying levels of flood management responsibilities in the South Lahontan Hydrologic Region. For a list of agencies with flood management responsibility in the hydrologic region that participated in these meetings, refer California's Flood Future Report Attachment E: Information Gathering Technical Memorandum. The agencies were asked about the status of flood management in their respective areas of responsibility.

Flood Management

Traditionally, the approach to flood management was to develop narrowly focused flood infrastructure projects. This infrastructure often altered or confined natural watercourses, which reduced the chance of flooding thereby minimizing damage to lives and property. This traditional approach looked at floodwaters primarily as a potential risk to be mitigated, instead of as a natural resource that could provide multiple societal benefits.

Today, water resources and flood planning involves additional demands and challenges, such as multiple regulatory processes and permits, coordination with multiple agencies and stakeholders, and increased environmental awareness. These additional complexities call for an Integrated Water Management approach, that incorporates natural hydrologic, geomorphic, and ecological processes to reduce flood risk by influencing the cause of the harm, including the probability, extent, or depth of flooding (flood hazard). Some agencies are transitioning to an IWM approach. IWM changes the implementation approach based on the understanding that water resources are an integral component for sustainable ecosystems, economic growth, water supply reliability, public health and safety, and other interrelated elements. Additionally, IWM acknowledges that a broad range of stakeholders might have interests and perspectives that could positively influence planning outcomes. An example of this is the Inyo/Mono Watersheds Invasive Weed Control Program. 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.

An example of 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

The South Lahontan Hydrologic 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; to the west and south by the Sierra Nevada, San Gabriel, San Bernardino, and Tehachapi mountains; and to the east by the state of Nevada. Drainage for most of the watershed in the region remains in the region and often drains into dry lakebeds and playas. Dry lakebeds and playas are a result of waters from sudden storms that dry up due to the arid climate in the region. Most of the perennial rivers in this region are in the northern portion of the region and have runoff from the Sierra Nevada Mountain Range. Examples of perennial rivers include the Owens River and Rush Creek. In the south, the Mojave and Amargosa rivers are typically dry for most of the year; however, water flows in the channels of both rivers after heavy rainfall. In addition, there are two locations on the Mojave River where groundwater is forced to the surface of the channel by geologic conditions.

Floods can be caused by heavy rainfall; by dams, levees, or other engineered structures failing; or by extreme wet-weather patterns. 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. Flooding from rainfall occurs in the winter and early spring, particularly when storms arriving from the Gulf of Alaska draw moisture-laden air from the tropics. This pattern is known as an Atmospheric River.

Historic Floods

Flood Descriptions

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.

Damage Reduction Measures

Floods in the South Lahontan Hydrologic region are primarily flash floods. This flooding occurs in washes and rivers that generally are dry for a majority of the year. Flood exposure identifies who and what is impacted by flooding. Two flood event levels are commonly used to characterize flooding:

- **100-Year Flood** is a shorthand expression for a flood that has a 1-in-100 probability of occurring in any given year. This can also be expressed as the 1 percent annual chance of, or "1 percent annual chance flood" for short.
- **500-Year Flood** has a 1-in-500 (or 0.2 percent) probability of occurring in any given year.

In the South Lahontan Hydrologic Region, more than 153,000 people and nearly $12 billion in assets are exposed to the 500-year flood event. Table SL-5 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-5 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 advisory committee draft are included at the end of the chapter.]

Levee Performance and Risk Studies

Flood Hazard mitigation planning is an important part of emergency management planning for floods and other disasters. Hazard Mitigation is defined as any sustained action taken to reduce or eliminate long-term risk to human life and property from hazards. Hazard Mitigation Planning is the process through which natural hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies that would lessen the impacts are determined, prioritized, and implemented. Hazard Mitigation Planning is required for state and local governments to maintain their eligibility for certain Federal disaster assistance and hazard mitigation funding programs.

Multi-Hazard Mitigation Plans (MHMPs) are required by FEMA as a condition of pre- and post-disaster assistance. The Stafford Act, as amended by the Disaster Mitigation Act of 2000, provides for states, tribes, and local governments to undertake a risk-based approach to reducing risks to natural hazards through mitigation planning. The National Flood Insurance Act reinforced the need and requirement for

mitigation plans linking flood mitigation assistance programs to state, tribal and local mitigation plans. FEMA-approved MHMPs were identified or collected for Los Angeles, San Bernardino, Kern, and Mono counties. Other risk assessment studies were prepared by various entities including USACE, FEMA, and the State Reclamation Board of California. For a list of risk studies, refer California's Flood Future Report Attachment G: Risk Information Inventory Technical Memorandum.

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 Integrated Water Management (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).

Accomplishments

In the South Lahontan region, a number of flood risk management recommendations were accomplished including:

- DWR has created a climate change handbook to help local agencies incorporate climate change into planning activities. In addition, the State of California has developed a statewide climate change adaptation strategy, requested that the National Academy of Science establish an expert panel to report on impacts of sea level rise, and issued interim guidance to agencies on planning for sea level rise in designated coastal and floodplain areas.
- DWR has collaborated with the USACE to produce California's Flood Future: Recommendations for Managing the State's Flood Risk, which will help guide local, State, and Federal decisions about policies and financial investments related to improved public safety and flood management throughout California. Information for the California's Flood Future Report was provided by 142 public agencies located in all 58 counties, as well as by State and Federal agencies.
- IRWM planning guidelines were revised to incorporate flood management into the process giving credit for including these flood benefits in Integrated Water Management projects.
- Comments and recommendations from the Flood Risk Management Strategy in the 2009 California Water Plan were used to inform:
    - SFMP California's Flood Future
    - IRWM planning
- Water Code Section 8307 links flood liability with local planning decisions. Cities and counties now share flood litigation liability with the State over unreasonably approved new development on previously undeveloped areas.

Challenges

Typically, flood management agencies in large urban areas tend to be highly organized. Agencies in more rural counties or with low exposure to flooding are often handled by emergency responders or a single contact at the county. This can present a unique set of challenges when developing a project. Flood management in the South Lahontan Hydrologic Region of California has a unique set of challenges that were identified during meetings with local agencies in the hydrologic region. These challenges include:

- Inadequate coordination with and within Federal, State, and local agencies involved in flood management
- Inadequate flood information, including maps and recent data (There is a need for more recent flood data, including aerial photography.)
- Inconsistent and unreliable e funding streams for rural counties
- Outdated, ageing, and undersized flood infrastructure
- Permitting approvals and complex permitting requirements restrict ability of agencies to provide public safety for flood management

Climate change will have a significant impact on the timing and magnitude of precipitation and runoff. Increased air temperatures could reduce the extent of snow pack in mountainous areas, thereby adding to the portion of watersheds that are available to contribute to direct winter runoff. Decreased snow pack would also reduce spring runoff volumes. Although future precipitation is somewhat uncertain, greater flood magnitudes are anticipated due to more frequent atmospheric river storm events (Dettinger, 2011). These changes could alter the magnitude and frequency of flood events, although specific effects might be difficult to reliably predict. However, the potential for increased frequency and magnitude of floods suggest that the enhancement of both structural and nonstructural measures for flood management is needed.

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 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.

Implementation Activities (2009-2013)

Placeholder Text:
[This subsection contains a discussion of the actions that have been taken since the last California Water Plan update to meet the water challenges in the region.

Considerations for this subsection:

The efforts we will be doing for the progress report format should provide some content for this section. We should not, however, be limited to the progress report if significant activities have occurred in the region since the last update.]

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.

[GW Placeholder Text:

Contains

- Description of components of the local drought contingency plans that call for increased groundwater use via groundwater substitution water transfers or other conjunctive management practices, if pertinent to the Hydrologic Region.]

Resource Management Strategies

Placeholder Text:
[Provide a description of any initiative or action that has taken place to implement any of the more than 27 resource management strategies during the period of this California Water Plan update (2009-2013).]

[**GW Placeholder Text**:

Contains

- Brief summary of DWR/ACWA joint survey and DWR's follow-up email and phone communications to conduct a survey to gather information on conjunctive management projects in the state.
- Description of the groundwater related conjunctive management projects for the Hydrologic Region.
- Table listing the conjunctive management projects.
- Dot Map showing location of the conjunctive management projects.
- Table showing responses on survey questions on conjunctive management projects.
- Charts showing projects by year project started, source of water, method of recharge, program goals, and potential constraints to conjunctive management, and other survey responses.
- Discussion on potential for conjunctive management in the Hydrologic Region subject to available aquifer space, source water, and infrastructure (conveyance, infiltration/injection, and extraction).
- Discussion on potential constraints to conjunctive management in the Hydrologic Region, including aquifer space, supply source, infrastructure, environmental, legal, regulatory, water quality, etc.]

Drinking Water Treatment & Distribution

[Placeholder Text:

[Note: Drinking water content under development for this section.]

Water Governance

[Placeholder Text:

[Describe any changes made to the water governance in the region since the last California Water Plan update. This would include any joint powers agreements and IRWM groups formed.]

[**GW Placeholder Text**:

Contains

- Brief description of the groundwater governance associated with the various GWMPs, IRWMPs, conjunctive management projects, groundwater recharge projects, groundwater monitoring, groundwater ordinances, and adjudicated groundwater basins within the Hydrologic Region.
- Table listing the above groundwater-related governance within the Hydrologic Region.
- Maps showing area coverage for GWMPs and IRWMPs, and "dot" locations of groundwater ordinances, adjudicated basins, and conjunctive management projects.
- Groundwater basin prioritization maps showing high, medium and low priority basins.]

State Funding Received

Placeholder Text:

[Describe the State funding received to implement water-related infrastructure, coordination, or planning in the region.]

Local Investment

Placeholder Text:

[Describe the local investment made to implement water-related infrastructure, coordination, or planning in the region.]

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

Placeholder Text:
[Provide a discussion of the status and major issues with implementation of the Water Conservation Act of 2009 for both urban and agricultural water conservation.]

Interregional and Interstate Activities

Placeholder Text:
[Describe those interregional and interstate activities that have occurred since the last California Water Plan update.]

[**GW Placeholder Text**:
Contains

- Description of interregional and interstate water resource planning activities that have identified increase use of groundwater in their planning (interstate examples include Klamath Basin for the North Coast Hydrologic Region, and the Honey Lake Basin for the North Lahontan Hydrologic Region).]

Looking to the Future

Placeholder Text:
[Notes: (1) Although the regional forums may seek consensus on objectives for the entire hydrologic region, this section will likely be a compilation of the IRWM and other local plan objectives. (2) Reference statewide priorities or IRWM guidelines to ensure consistency. (3) Because no single resource management strategy can meet the broad set of resource management objectives, this section is meant to shift planning approach/discussions from focusing on specific types of resource management strategies (e.g., desalination vs. conservation vs. storage, etc.) to an objectives-based planning approach.]

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 Ponds North of Aqueduct, a groundwater recharge projects. 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 should be completed by the end of 2012.

The Oro Grande Wash project is complete. The R3 project should be complete by the end of 2012.

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 substantial population growth.

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.

In general, priority ecosystem improvements for the State of California, in relation to its water supply, are identified by DFG as projects that achieve one or more of the following:

- Recovery for endangered and other at-risk species and native biotic communities, including rare natural communities;
- Restore natural processes, including fluvial geomorphology and natural vegetation recruitment;
- Restore natural hydrologic processes, including magnitude, duration and timing of flows;
- Maintain or enhance populations of selected species for sustainable commercial or recreational harvest;
- Protect or restore functional habitat types including, but not limited to, floodplain, riparian, and wetland;
- Prevent or reduce negative impacts from both aquatic and terrestrial non-native species including those associated with water supply and conveyance projects such as quagga and zebra mussels; and
- Improve instream flow as well as water and sediment quality conditions, including temperature, to support healthy ecosystems.

Each of these priorities is interrelated; often accomplishments towards one goal will also provide benefits to others. DFG has identified these priority ecosystem improvements for application throughout the state.

These priorities are not ranked, and are in no particular order. DFG cannot generally elevate the importance of one improvement type over another without information on the specific merits of the projects. However, projects that incorporate one or more of the above criteria would be viewed as valuable ecosystem improvements.

It is also important to note that many watersheds in California have completed watershed assessments, watershed management plans, and/or strategies. There are also various state conservation strategies or plans that have been completed in recent years. All of these documents identify resources within their respective project boundaries and needs for restoration, often including the potential for improving water resources via restoration or other actions. These plans should be cumulatively assessed and synthesized in relation to the California Water Plan in order to produce a document that (1) outlines common elements that address water resource issues; (2) identifies opportunities for restoration actions that will improve water resources; and (3) addresses the needs of species and/or habitats that are found and/or transcend watershed boundaries.

This list provides a list of some of the priority areas and needs specific to the South Lahontan Hydrologic Region from a DFG 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 Scenarios

Placeholder Text:
[This subsection contains a discussion of the following topic. (Primary authors would be from the analytical data and tools work team.)

- Water demand by sector for future scenarios.]

[Considerations for this subsection:

- How do the three future scenarios relate to regionally derived future plans/visions? This might be the best place to examine compatibilities and contrasts of local and state objectives.

Regional estimates regarding future agricultural, urban, and environmental water demands; economic development; flood management; land use; etc.]

Climate Change

Climate change is already impacting many resource sectors in California, including public health, water, agriculture, biodiversity, and transportation and energy infrastructure (CNRA, 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 (Cayan, 2008). Changes in annual precipitation patterns across California will result in changes to surface runoff timing, volume, and type.

While the State of California is taking aggressive action to mitigate climate change through reducing emissions from greenhouse gases (GHGs) and implementing other measures (CARB, 2008), global impacts from carbon dioxide and other GHGs that are already in the atmosphere will continue to impact climate through the rest of the century (IPCC, 2007). Resilience to an uncertain future can be achieved by implementing adaptation measures sooner rather than later. Because of the economic, geographical, and biological diversity of California, vulnerabilities and risks from current and future anticipated changes are best assessed on a regional basis. Many resources are available to assist water managers and others in evaluating their region-specific vulnerabilities and identifying appropriate adaptive actions (USEPA and DWR, 2011; Cal-EMA and CNRA, 2012a).

Precipitation and Extremes

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. Most climate simulations used by the 2009 Climate Action Team report project drier conditions in California (CNRA, 2009). 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).

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 in. (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 (Dettinger, 2012). 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.

Water Supply and Snowpack

During the last century, the average early snowpack in the Sierra Nevada decreased by about ten percent, which equates to a loss of 1.5 million acre-feet of snowpack storage (DWR, 2008). The Sierra Nevada snowpack, which is an important source of water for the South Lahontan region through the SWP and LAA, is expected to continue to decline as warmer temperatures raise the elevation of snow levels, reduce spring snowmelt, and increase winter runoff. DWR projects that the Sierra Nevada will experience a 25 to 40 percent reduction of snowpack from its historic average by 2050 (DWR, 2008). 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 snowpacks 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 snowpacks 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.

Sea level rise, although not a direct impact to the South Lahontan region, is expected to degrade the quality of the region's imported water from the Delta, as well as increase salinity intrusion and impact 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).

Water Demand

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.

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 species and migratory bird 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.

Temperatures, Droughts, Wildfires, and Floods

Temperature projections are in wide agreement on a warming trend statewide. California's temperature already has risen by 1 °F (0.6 °C), mostly at night and during the winter, with higher elevations experiencing the highest increase (DWR, 2008). 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).

Climate change is projected to result in even hotter months throughout the year. By 2040, mean temperatures are projected to increase by 1.5 to 2.5 °F (0.8 to 1.4 °C) during winter and by 3 to 5 °F (1.7 to 2.8 °C) during summer (Cal-EMA and CNRA, 2012b). By the end of this century in 2100, mean temperatures are projected to 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). Pierce, et al. (2012) offer a more sophisticated modeling study, which projects that by 2070 the annual mean temperature will 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) (Pierce, et al., 2012).

With increasing temperatures, net evaporation from reservoirs is projected to increase by 15-37 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).

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

As the science of climate change quickly develops and evolves, 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.

Tools, Resources, and Collaboration

In addition to the handbook mentioned above, 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)

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. 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).

Strategies

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.)

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

Local Actions

Already, some communities in the South Lahontan region are taking action. The Inyo-Mono Regional Water Management Group (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 Antelope Valley RWMG 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.

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).

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 (DeShazo and Matute, 2012), but more work still needs to be done, not only in mitigating for but also in adapting to climate change.

Planning Approaches

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

IRWM planning is a framework that allows water managers to address climate change on a smaller, more regional scale. Climate change is now a required component of all IRWM plans. IRWM regions must identify and prioritize their specific vulnerabilities, and identify adaptation strategies that are most appropriate for sub-regions. Planning strategies to address vulnerabilities and adaptation to climate change should be both proactive and adaptive, starting with low-regret strategies that benefit the region in the present-day, while adding future flexibility and resilience under uncertainty.

Mitigation

There is a need to mitigate for climate change by reducing the GHG emissions related to water usage, and comparing energy intensity of various water supplies when making portfolio choices. 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).

This is the first California Water Plan to include specific energy intensity information related to water. When making water management choices, water managers can include the energy intensity of individual supplies as part of the decision making process. Figure SL-3 indicates relative energy intensity of raw water extraction and conveyance for the primary water supply sources for this region (caption and footnotes under development). It provides a tool to assist decision making in water management regarding water and energy efficiency and to help evaluate what type of water supply portfolio is used to meet demand within the hydrologic region.

In addition, many water use efficiency and other best management practices can also mitigate climate change (see Volume 3, Resource Management Strategies).

PLACEHOLDER Figure SL-3 Energy Intensity of Water (extraction and conveyance)

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

*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.

Interregional and Interstate Planning Activities

Placeholder Text:
[This subsection contains a discussion of the following topics.

- A summary of relevant planning or implementation activities that will affect this region.
- Regional stake in process.
- Strategies for regional self-sufficiency: Define goals and purpose of self-sufficiency.]

[Considerations for this subsection:

- Consider listing Update 2009 objectives to reflect statewide objectives/vision:
  - Reduce Water Demand.
  - Improve Operational Efficiency and Transfers.
  - Increase Water Supply.
  - Improve Water Quality.
  - Practice Resource Stewardship.
  - Improve Flood Management.]

[GW Placeholder Text:
Contains

- Provide summary of the GWMPs for the Hydrologic Region with brief description of overlap, management gaps, and degree of coordination.]

Future Vision

Regional Future Vision

[Placeholder Text:
This subsection would describe the desired future condition that the local stakeholders have for this region. Concepts such as regional water self-sufficiency, flood protection from a 100-year flood, conservation goals, and land use goals could be described here.]

Tribal Objectives/Vision

[Placeholder Text:
Objectives and vision of the tribal interests in the region would be described here.]

Relevant Statewide Interests and Objectives

[Placeholder Text:
Describe statewide interests and objectives and how they might influence or affect the region. State government initiatives would be discussed in relation to the region.]

Regional Water Planning and Management

[Placeholder Text:
This subsection contains a discussion of the following topics.

- Discussion of (1) status of IRWM or other regional plans, highlighting key challenges and accomplishments; and (2) regional response strategies for meeting future water demands and quality standards, adapting to climate change, and achieving sustainability.]

[Placeholder Text::
(Information sources may be IRWM plans, urban water management plans, agricultural water management plans, groundwater management plans, water elements of general plans, floodplain management plans, stormwater plans, RWQCB basin plans and water quality reports, watershed management plans, habitat conservation plans, multi-species conservation plans, etc.)]

[Placeholder Text:
Considerations for this subsection:

- Review IRWM and other regional plan coverage, quality, level of integration, and next steps toward implementation.
- Identify needed improvements in IRWM plan coverage, participation, and integration across resource areas, institutions, watersheds, and methods.
- Showcase successful regional projects from IRWM plans.
- Summarize FloodSAFE's regional flood management plans and describe challenges and recommendations.
- Summarize RWQCB regional water quality plans and describe challenges and recommendations.
- Describe intraregional planning and management, challenges, and benefits.
- Review drought preparedness based on region and local plans.]

Integrated Regional Water Management Coordination and Planning

[Placeholder Text:
Note: Drinking water content under development for this section.]

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.

Flood management in the future will require unprecedented integration among traditionally varying agencies that have overlapping and sometimes conflicting goals and objectives. More reliable funding and improved agency alignment are required at all levels. Updated technical and risk management approaches will be needed to protect the public from flooding by assessing risk, as well as by improving flood readiness, making prudent land use decisions, and promoting flood awareness. Project implementation methods could benefit from IWM-based approaches to leverage the limited funding and other flood management resources. In short, future solutions should be aligned with broader watershed-wide goals and objectives and must be crafted in the context of IWM

Integrated Regional Water Management (IRWM) promotes the coordinated development and management of water, land, and related resources to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Flood management is a key component of an integrated water management strategy.

Recent Accomplishments

[GW Placeholder Text:

Contains

- Discussion of the GWMPs within the Hydrologic Region that are SB 1938 compliant. Highlight key aspects of effective groundwater management and conjunctive management efforts in these areas.
- Map showing high priority basins in the Hydrologic Region that are covered with SB 1938 compliant GWMPs.
- Case Studies: a) in groundwater management accomplishments/challenges associated with various groundwater aquifer conditions (declining aquifer, coastal aquifer, poor water quality aquifer, fractured rock aquifer, etc.);b) that illustrate potential and challenges associated with resources management strategies such as conjunctive management and groundwater storage; and c) that illustrate successes and challenges associated with implementation of groundwater legislation.]

Hazard Mitigation Planning

In addition to the counties identified in Update 2009, the counties of Riverside (adopted in 2000), San Diego (adopted in 2010), and Ventura (adopted in 2005) have Multi-Hazard Mitigation Plans. Draft versions of the plans have been prepared by the counties of Imperial (in 2007) and Orange (in 2009).

Environment

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.

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.

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 is also underway 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, scheduled for completion 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.

The Victorville Water District completed construction on a 2.5 mgd wastewater treatment plant in 2010. About 4 TAF of tertiary-treated wastewater is being delivered annually 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 Agency 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.

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, 4.6 million square feet of turf have been removed and 1,100 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.

[Placeholder Text:
Note: Drinking water content under development for this section.]

Challenges

[GW Placeholder Text:
Contains

- Summary of the number of GWMPs that <u>are not</u> SB1938 compliant, or <u>only partially</u> SB 1938 compliant. The challenges associated implementing the SB 1938 groundwater management criteria, and recommendations for improving or incorporating sustainable practices into local groundwater management.
- Map showing high priority basins for the Hydrologic Region those <u>do no</u>t have SB 1938 compliant GWMPs. The map shows overall area without compliant groundwater management planning, not area of individual groundwater basins.]

Flood Issues

Flood management challenges exist in the Antelope Valley. 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 PA

The SWP is the region's only source of imported supplemental water supply. The vulnerability of those supplies due to 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

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.

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.

Drought and Flood 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. Los Angeles County now has a Coordinate Agency Recovery Effort which is a multi-agency response program for both natural and man-made emergencies, including brush fires, floods, earthquakes, and even heat. 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.

Resource Management Strategies

Placeholder Text:
[Note: (1) Align with resource management strategy impacts and benefits of IRWM standards. (2) Information for this section will be regionally derived. The "statewide" strategies (i.e., the updated text from Volume 2 of Update 2009) will be published in a separate volume, not in these regional reports.]

Strategy Availability

[Placeholder Text:
This subsection contains a discussion of the following topics.

- Subset of more than 27 strategies that are potentially applicable within each region.
- Estimate of benefits that could be achieved considering all constraints (e.g., institutional regulatory, finance, local opposition, technology, conveyance, local land use, etc.).

[Placeholder Text: Considerations for this subsection:

- Estimation of resource management strategy potential of the 27 strategies detailed in Volume 2 of Update 2009.
- Water Evaluation and Planning (WEAP) results for the Sacramento, San Joaquin, and Tulare Lake Hydrologic Regions.]

Regional Strategies

Sierra Nevada Conservancy: 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.

[GW Placeholder Text:

Contains

- Discussion of the various existing groundwater related management strategies as it relates to groundwater management plans and IRWM plans, as well as conjunctive management projects and groundwater recharge projects, etc.
- Table listing the existing groundwater related management strategies.]

References

Abatzoglou, J.T., K.T. Redmond, and L.M. Edwards. 2009. Classification of Regional Climate Variability in the State of California. Journal of Applied Meteorology and Climatology, 48, 1527-1541.

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

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

Das, Tapash, Michael D. Dettinger, Daniel R. Cayan, and Hugo G. Hidalgo. 2011. Potential Increase in Floods in California's Sierra Nevada Under Future Climate Projections. Climatic Change, 2011.

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

(DWR) California Department of Water Resources. 2009. California Water Plan Update 2009: South Lahontan Integrated Water Management. Bulletin 160-09, Volume 3, Regional Reports.

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

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

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

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

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

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

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

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

Dettinger, Michael. 2012. DWR Workshop: Climate Change, Extreme Weather, and Southern California Floods (http://www.water.ca.gov/climatechange/docs/013112agenda.pdf). Climate Change, Extreme Precipitation, and Atmospheric Rivers presentation. http://www.water.ca.gov/climatechange/docs/dwr_extremes_wkshop_jan2012-MikeDettinger131.pdf.

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

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

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

Jackson, Louise, Van R. Haden, Stephen M. Wheeler, Allan D. Hollander, Josh Perlman, Toby O'Geen, Vishal K. Mehta, Victoria Clark, John Williams, and Ann Thrupp (University of California, Davis). 2012. Vulnerability and Adaptation to Climate Change in California Agriculture. California Energy Commission. Publication number: CEC-500-2012-031. http://www.energy.ca.gov/2012publications/CEC-500-2012-031/CEC-500-2012-031.pdf.

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

Medellin-Azuara, Josué, Christina R. Connell, Kaveh Madani, Jay R. Lund, and Richard E. Howitt. 2009. Water Management Adaptation with Climate Change. PIER Research Report, CED-500-2009-049-D, Sacramento, CA: California Energy Commission.

Milly, P.C.D., Julio Betancourt, Malin Falkenmark, Robert M. Hirsch, Zbigniew W. Kundzewicz, Dennis P. Lettenmaier, and Ronald J. Stouffer. 2008. Stationarity is Dead: Whither Water Management? Science 319: 573-574. http://wwwpaztcn.wr.usgs.gov/julio_pdf/milly_et_al.pdf.

Pierce, D.W., T. Das, D.R. Cayan, E.P. Maurer, N.L. Miller, Y. Bao, M. Kanamitsu, K. Yoshimura, M.A. Snyder, L.C. Sloan, G. Franco, and M. Tyree. 2012. Springer-Verlag, DOI 10.1007/s00382-012-1337-9. http://meteora.ucsd.edu/cap/pdffiles/Pierce_etal_2012_CD.pdf.

Qian, Yun, Steven J. Ghan, and L. Ruby Leung. 2010. Downscaling Hydroclimatic Changes Over the Western US Based on CAM Subgrid Scheme and WRF Regional Climate Simulations. International Journal of Climatology, April.

(SNA) Sierra Nevada Alliance. 2010. Sierra Climate Change Toolkit, 3rd Edition. http://www.sierranevadaalliance.org/publications/db/pics/1303760072_12034.f_pdf.pdf.

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

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

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

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

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

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

[GW Placeholder Text:
Contains
- References for all cited materials in the text.]

Additional References

[Placeholder Text:
List references here.]

GW Placeholder Text:
- Contains
- Additional information regarding methods and assumptions related to the groundwater-related data and analyses provided.

Personal Communications

Placeholder Text:
List references here.]

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

Year	Average temperatures maximum (F^o)	Average temperatures minimum (F^o)	Average daily temperatures (F^o)	Average precipitation (in)	Average ETo (in)
2005	73.01	42.64	57.78	9.17	60.23
2006	73.83	41.73	58.01	6.14	62.36
2007	74.87	42.17	57.75	3.12	64.44
2008	74.11	42.34	58.56	5.91	64.52
2009	73.87	41.92	57.75	5.29	63.33
2010	72.45	41.96	57.32	11.00	63.03

Source: California Irrigation Management Information System

ETo – Reference evapotranspiration

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

Water system size	Number of community systems	% of community systems in region	Population served	% of population served
Large (> 10,000 population)	18	10%	762,492	84%
Medium (3,301 - 10,000 population)	13	7%	80,670	9%
Small (500 – 3,300 population)	49	26%	54,629	6%
Very small (< 500 population)	105	56%	14,069	2%
CWS that primarily provide wholesale water	2	1%	---	---
TOTAL	187		911,860	

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

[Table CC-xx] Summary of Community Drinking Water Systems in the South Lahontan Hydrologic Region that Rely on One or More Contaminated Groundwater Well that Exceeds a Primary Drinking Water Standard

	Community drinking water systems and groundwater wells grouped by water system population			
	Small system	**Medium system**	**Large system**	**Total**
	≤ 3,300	**3,301 - 10,000**	**≥ 10,000**	
Number of affected community drinking water systems	54	10	9	73
Number of affected community drinking water wells	86	30	64	180

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

Note: Running Springs Water District (3610062) has wells in both South Coast & South Lahontan Regions

Table SL-5 South Lahontan Hydrologic Region Exposures within the 100-Year and 500-Year Floodplains

Segment exposed	1% (100-year) floodplain	0.2% (500-year) floodplain
Population	19,900, 3%	153,200, 21%
Structure and content value	$1.7 billion	$11.9 billion
Crop value	$25.6 million	$59.5 million
Crops (acres)	41,000	72, 000
Tribal lands (acres)	3	10
Essential facilities (count)	16	77
High potential-loss facilities (count)	9	10
Lifeline utilities (count)	4	8
Transportation facilities (count)	60	94
Department of Defense facilities (count)	4	4
State and federal threatened, endangered, listed, and rare plants [a]	100	104
State and federal threatened, endangered, listed, and rare animals [a]	113	113

Source: SFMP California's Flood Future Report.

[a] Many Sensitive Species have multiple occurrences throughout the state and some have very large geographic footprints that may overlap more than one analysis region. As a result, a single Sensitive Species could be counted in more than one analysis region. Because of this, the reported statewide totals will be less than the sum of the individual analyses regions.

Figure SL-3 Energy Intensity of Water (extraction and conveyance) for South Lahontan Hydrologic Region

Figure x: South Lahontan

type of water	energy intensity (white bulb = 0; yellow bulb = 1-500 Kwh./AF)
Colorado (Project)	*None in this region*
Federal (Project)	*None in this region*
State (Project)	
Local (Project)	*Data forthcoming*
Local Imports	*None in this region*
Groundwater	