California **Water Plan**
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North Lahontan

INTEGRATED WATER MANAGEMENT

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Regional Reports

Northern Region Office

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

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

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

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Cover Photos:

1. 2. 3. Lake Tahoe from High Camp by John Headlee, DWR
4. Pelicans on pond, Antelope Valley, Mono County by permission Hal Curti
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North Lahontan Hydrologic Region

Setting

The North Lahontan Hydrologic Region (North Lahontan region) includes part of the western edge of the Great Basin, a large landlocked area that covers most of Nevada and northern Utah. The eastern drainages of the Cascade Range and the eastern Sierra Nevada, north of the Mono Lake drainage, make up the region. All surface water drains eastward toward Nevada. This hydrologic region extends about 270 miles from the Oregon border to the southern boundary of the Walker River drainage in Mono County (Figure NL-1). The region covers 6,122 square miles, about 4 percent of California's total area, but is inhabited by only about 0.3 percent of the state's population. The region includes portions of Modoc, Lassen, Sierra, Nevada, Placer, El Dorado, Alpine, and Mono counties.

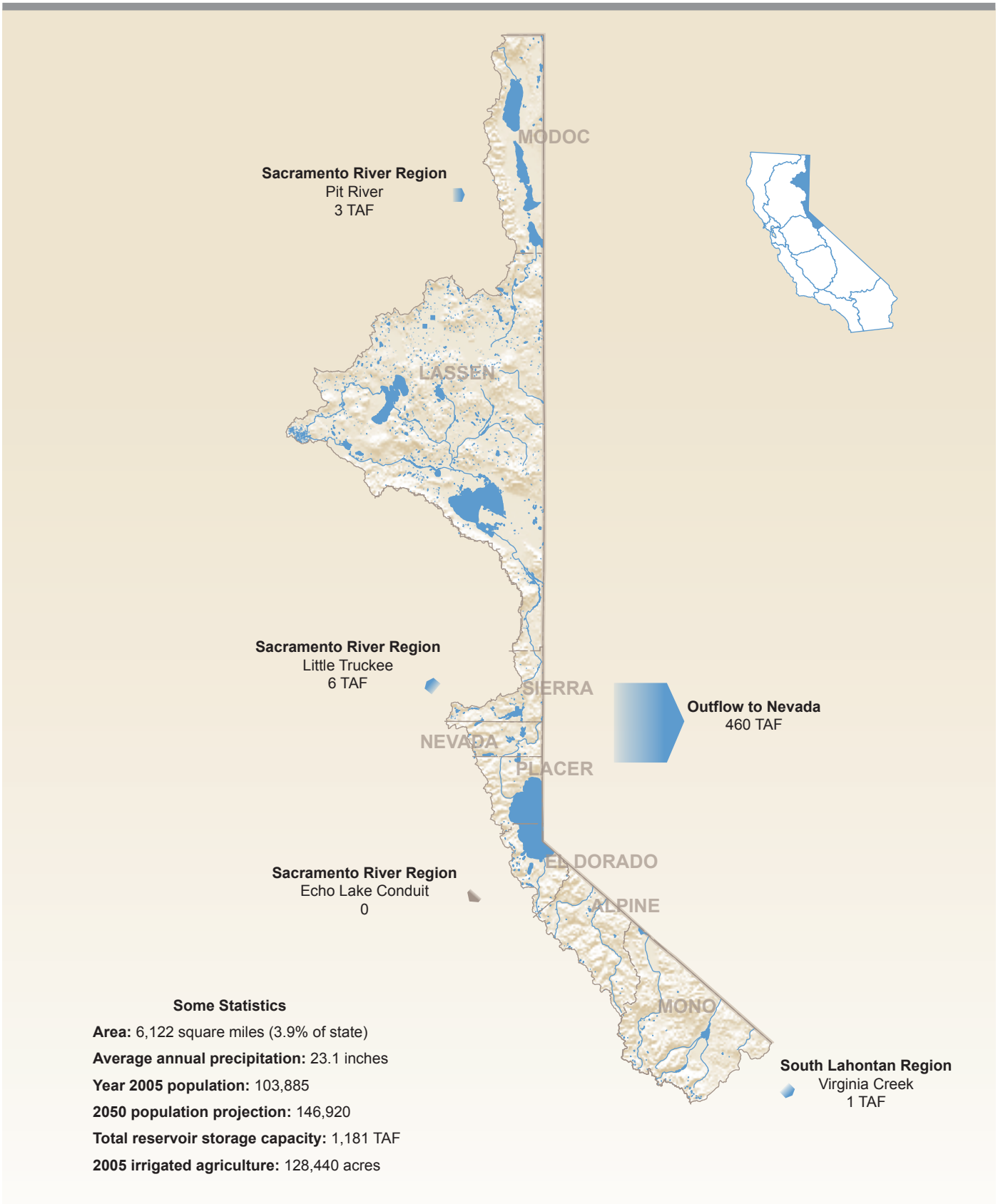
The region abounds with large, natural landscapes. The northern part is primarily arid high desert with relatively flat valleys at elevations of 4,000 to 5,000 feet. The eastern slopes of the Sierra Nevada comprise the central and southern portions of this region, which includes the California portion of the Lake Tahoe Basin. The major rivers of the region—Truckee, Carson, and Walker—carry the mountain snowmelt through California into Nevada. Mountain peaks up to 12,279 feet form the western boundary of the region.

Watersheds

The North Lahontan region contains all of the Susan River; the upper parts of the Truckee, Carson, and Walker River basins; and Surprise Valley watersheds. These streams have no outlets to the sea and terminate in lakes or playas. Most rivers have elevated base flows due to snowmelt from the Sierra Nevada and Cascade mountains, and from reservoir releases that maintain instream flows.

In the north, the Susan River flows southeasterly and empties into Honey Lake. Other minor streams in the north begin in the Warner Mountains and drain into Lower, Middle, or Upper Alkali lakes in Surprise Valley. The major portion of the Truckee River system originates in California and flows into Lake Tahoe and out toward Reno, Nevada, and then into Pyramid Lake. Trout Creek and the Upper Truckee River flow from the western slopes of the Carson Range and the eastern slopes of the Sierra into Lake Tahoe at the city of South Lake Tahoe. The Little Truckee River contributes near the head of Truckee Canyon just west of the river's exit into Nevada. The east and west forks of the Carson River are separate in California. They drain Alpine County and flow into Nevada. These forks of the Carson River meet near Minden, Nevada, and terminate near Fallon, Nevada, in either Carson Lake and Pasture or the Carson Sink. The East and West Walker rivers, entirely separate in California, originate in Mono County, flow into Nevada, join near Yerington, and then flow to Walker Lake.

Figure NL-1 North Lahontan Hydrologic Region 2005 inflows and outflows



Box NL-1 Acronyms and Abbreviations Used in This Report

Cal EMA	California Emergency Management Agency	NIMS	National Incident Management System
CDEC	California Data Exchange Center	NWS	National Weather Service
cfs	cubic feet per second	RAP	region acceptance process
CSD	community services district	SAR	Salt Absorption Ratio
CRS	Community Rating System	SEMS	Standardized Emergency Management System
DFG	California Department of Fish and Game	SAT	Soil Aquifer Treatment
DWR	California Department of Water Resources	State Water Board	State Water Resources Control Board
FEMA	Federal Emergency Management Agency	STPUD	South Tahoe Public Utility District
FIRMs	Flood Insurance Rate Maps	T-TSA	Tahoe-Truckee Sanitation Agency
HLWA	Honey Lake Wildlife Area	TDS	total dissolved solids
HMP	Hazard Mitigation Plan	TMDL	Total Daily Maximum Load
IRWM	Integrated Regional Water Management	TRCD	Tahoe Region Conservation District
Lahontan Water Board	Lahontan Regional Water Quality Control Board	TROA	Truckee River Operating Agreement
MOU	Memorandum of Understanding	TRPA	Tahoe Regional Planning Agency
NFIP	National Flood Insurance Program	TRWC	Truckee River Watershed Council
		USACE	United States Army Corps of Engineers
		USBR	US Bureau of Reclamation
		USGS	US Geological Survey

The North Lahontan region watersheds are listed in Table NL-1. Numerous watershed groups have been organized in the Carson River, Lake Tahoe, Truckee River, Susan River, and Honey Lake basins. See listings and discussion later in this report under Watershed Management.

Forest fires can increase flooding, surface erosion, mass wasting (landslides), and consequent degradation of water clarity through increased sediment loads. Forest fire effects that worsen runoff are the reduced surface vegetation and the "cooking" out of soil organics, which can form a nearly impervious (hydrophobic) layer of tars below the soil surface. As a result of the 2007 Angora fire (see photo Figure NL-2), 15 percent of highly erosive area tributary to the Upper Truckee River developed a high degree of hydrophobicity. Fortunately, this and precipitation conditions did not result in mass erosion.

Following the Angora fire, California Governor Arnold Schwarzenegger and Nevada Governor Jim Gibbons signed a memo of understanding establishing the California-Nevada Tahoe Basin Fire Commission. The commission performed a comprehensive review of the laws, policies, and practices that affect the vulnerability of the Tahoe Basin to wildfires. Its findings and recommendations were submitted May 27, 2008. To view the full report, go to http://resources.ca.gov/TahoeFireCommission/. One of the basic conclusions was that there should be more reduction of forest floor fuel. A $250 million effort over the next 10 years will reduce forest floor fuel. In 2008-2009, the effort will

Table NL-1 North Lahontan Hydrologic Region watersheds, from north to south

Watershed	Area (sq miles)	Location	Planning activity	Comments
Cow Head	—	Modoc County mostly in OR, NV		
Surprise Valley	756	Modoc County, partly in NV		
Madeline Plains	793	Lassen and Modoc Counties, mostly in CA		Receives water from Sacramento Hydrologic Region, Pit River
Smoke Creek Desert	—	Lassen County, almost entirely in NV		
Honey-Eagle Lakes	1,939	Lassen and Sierra counties, partly in NV	Subject to Lassen County Groundwater Ordinance	Groundwater extracted for wetlands and, in NV, from Fish Springs Ranch
Truckee River	932	Sierra, Nevada, and Placer counties	TROA, Tahoe-Sierra IRWM	Subject to numerous court orders and decrees, subject of major planning efforts
Lake Tahoe	506	Placer and El Dorado counties, partly in NV	TROA, Tahoe-Sierra IRWM, Tahoe Reg. Planning Agency	Subject to numerous court orders and decrees, subject of major planning efforts
Upper Carson	341	El Dorado, Alpine, and Mono counties in CA	TROA, Carson Water Subconservancy District, Alpine Watershed Group	Subject to the *Alpine* decree within TROA
West Walker	250	Alpine and Mono counties		Currently in litigation
East Walker	380	Mono County		Currently in litigation, Virginia Creek diversion in Walker Basin to Mono Lake basin which lies in South Lahontan Hydrologic Region

TROA = Truckee River Operating Agreement

IRWM = Integrated Regional Water Management

treat more forest land than was treated during the last seven years, and it will continue to double the historical pace. What remains unclear from the fuels reduction proposals are what effect the removal of brush will have on the erodibility and water-holding capacity of the soils and what consequent effect the effort will have on water quality and runoff hydrograph. As a result of this lack of specificity in the plans, the issue has been, as of the date of this writing, referred to the courts.

Ecosystems

Table NL-2 lists threatened and endangered species found in counties in the of North Lahontan Hydrologic region.

Modoc County is described as sage steppe into which western and Utah juniper are encroaching. Within that county, Surprise Valley has been described as high altitude (4,000 feet) desert valley with forested mountains on the west and a series of alkaline lakes in the valley and as part of the Great Basin because water drains to these lakes and evaporates.

Figure NL-2 Angora fire, Lake Tahoe, June 2007 (photograph)

Photo taken by Brian Garrett of US Forestry Service

Lassen County contains a Sage-Grouse and sagebrush ecosystem, portions of which are being preserved in the Buffalo-Skedaddle Population Management Unit. It also has Eagle and Honey lakes in its low lying portion. The Honey Lake Wildlife Area and Willow Creek Wildlife Area preserve existing wetlands in the area. Approximately 50,000 cattle graze in Lassen County on the grasses in the sagebrush areas and on irrigated pasture. The establishment of exotic species of grasses such as cheatgrass, an annual that lacks deeper root systems, has changed the ecosystem to one that is more erosive than that which existed when native grasses predominated.

In the more alpine Sierra, El Dorado, Nevada, Placer, and Alpine counties exist riparian and lacustrine (natural lakes, ponds and human-made reservoirs) ecosystems. The riparian ecosystems are labeled according to their inhabitants, thus area streams are referred to by conifer forest snowmelt streams, trout headwater streams, trout/sculpin streams, sucker/dace/redside streams, and whitefish cutthroat/sucker streams. Of the latter, the Lahontan cutthroat trout riverine variant (the other variant being lacustrine) persists currently in only 8.8 miles (2.4 percent) of the historical 360 miles of stream habitat. The goal of current watershed management initiatives is to increase that percentage. The small lakes (less than one-tenth acre in size) in this region are in glaciated, mountainous areas and were formed either as glacially scoured basins or deposited ridges of glacial debris that dammed streams. Snowmelt pools are clear, low in basic nutrients for plants (oligotrophic), and may contain only seasonal organisms. Farther downslope, smaller natural lakes have been augmented by the placement of low, human-made dams to provide water for agriculture or (originally) hydropower and now increasingly urban uses.

Table NL-2 North Lahontan Hydrologic Region inclusive list of threatened and endangered species

Scientific name	Common name	Federal status	California status	CA Dept. Fish and Game	CA Native Plant Society List
Oncorhynchus clarki henshawi	Lahontan Cutthroat Trout	Threatened	None		
Empedonax traillii	Willow Flycatcher	None	Threatened		
Rana pretiosa	Oregon spotted frog	Candidate	None	SC	
Haliaeetus leucocephalus	bald eagle	Delisted	Endangered		
Grus canadennsis	greater sandhill crane	None	Threatened		
Charadrius alexsandrinus niv	western snowy plover	Threatened	None	SC	
Strix nebulosa	great gray owl	None	Endangered		
Riparia riparia	bank swallow	None	Threatened		
Catostomus microps	Modoc sucker	Endangered	Endangered		
Chasmistes brevirostris	shortnose sucker	Endangered	Endangered		
Deltistes luxatus	Lost River sucker	Endangered	Endangered		
Vulpes vulpes necator	Sierra Nevada red fox	None	Endangered		
Gulo gulo	California wolverine	None	Endangered		
Taxidea taxus	American badger	None	None	SC	
Ovis Canadensis sierra	Sierra Nevada bighorn sheep	Endangered	Endangered		
Gratiola heterosepala	Boggs lake hedge-hyssop	None	Endangered		1B.2
Orcuttia tenius	slender orcutt grass	Threatened	Endangered		1B.1
Buteo swainsoni	Swainson's hawk	None	Threatened		

SC = Special Concern

The most notable feature of the region is Lake Tahoe, one of the low dammed, oligotrophic lakes. Now low in basic nutrients for plants, the lake's state could change if current efforts to keep it pristine are not effective. Concerns arise from the presence of invasive flora, Eurasian milfoil (*Myriophyllum spicatum*) and curly pond weed (*Potamogeton crispus*), and fauna such as the Asian clam. The latter was first observed in 2002, but now is abundant along the lake's southeast shore at depths of 3 to 30 feet. This is particularly unfortunate because it may indicate that Tahoe's waters contain enough calcium to support zebra and/or quagga mussels (if introduced) and because their very presence presents a substrate for such an invasion. Worse still is the perceived association of filamentous algae blooms that are thought to spring from the nutrient excretions of the Asian clam. Another invasive species that is terrestrial and therefore not related to Lake Tahoe is whitetop (*lepidium draba*), which is very aggressive and eliminates desirable vegetation. The plant tends to grow in floodplains and near water courses over the entire region and can be spread over longer distances by water conveyance of seeds or root fragments. Most of the water courses in the region have a whitetop infestation that may aggregate tens of thousands of acres, presenting

a major problem. The only control method other than mechanical removal is multiple applications of herbicides.

Although the western and Utah juniper are native to the region, and, therefore, not an invasive species, they are expanding beyond their original territory possibly due to anthropeogenic change in the form of past cattle grazing practices and fire suppression. The US Forest Service and Bureau of Land Management have instituted juniper removal projects with the Sierra Nevada Conservancy, contributing funding to the latter in the Buffalo-Skeddadel area.

In the lower reaches, human-made, multipurpose reservoirs were constructed originally for agriculture, flood control, and urban and recreational uses. But increasingly, often through legal intervention and water rights purchases, they have been turned to environmental restoration and urban uses. The ecosystems of human-made reservoirs differ from those of natural lakes in that the reservoir levels rise and fall, are generally steeper sided and thus vegetative littoral (shore side) zones are not established, and, generally, habitat structural diversity is lessened altering fish populations.

Finally, at the southern end of the North Lahontan region in the northern portion of Mono County, the ecosystem reverts to the sage desert of the northern portions again with irrigated pasture and alfalfa fields with some produce in the eastern valleys bordered by forested mountains to the west. Notably the West Walker River that meanders through this section of the region has been designated a California Wild and Scenic River and therefore is protected from further human-made modifications.

Climate

Dry summers with occasional scattered thundershowers characterize the region's climate. Most precipitation falls in late fall and winter. Precipitation is less than 5 inches in the valleys of Eastern Modoc and Lassen counties. Precipitation is about 30 inches in the Walker Mountains and more than 60 inches in the Sierra Nevada in the upper reaches of the Truckee, Carson, and Walker River basins. Most of the winter precipitation is snow, which generally accumulates in mountain areas above 5,000 feet. In the valleys, winter precipitation is a mixture of rain and some snow, which usually melts between storms. Snowpack from the eastern slopes of the Sierra Nevada melts in the late spring and summer to become the primary source of surface water supplies for Northern Nevada and for much of California in the region east of the Sierra.

Growing seasons vary considerably each year. In the mountain valleys, where most crops are grown, an average 120 days are frost free from late May to mid-September.

Some cloud seeding projects do take place about 60 miles to the west of the North Lahontan region. Questions have been raised regarding their effect on temporal and spatial precipitation patterns, but cause-and-effect is difficult to prove given the transitory nature of weather patterns.

Box NL-2 California Native American Tribal Information, North Lahontan Hydrologic Region

- Demographics: Tribes with historic or cultural ties to the North Lahontan region are primarily the Pit River (Achomawi), Maidu, Northern Paiute, Paiute, and Washoe.
  - Currently, Tribal landholdings located in this region include: Antelope Valley (Coleville), Bridgeport, Cedarville, Fort Bidwell, Meeks Bay, Susanville (Susanville, Honey Lake, Maidu Nation, and Wadatkuta), Woodfords, and XL Ranch reservations, rancherias, and communities. The Pyramid Lake and Walker River Paiute Tribes have their land bases in Nevada. Approximately fourteen individual allotments are also located within this region.
- Collaborative Efforts:
  - The Walker River Tribe actively participates in the Walker River Recovery Implementation Team, and the Management Oversight Group, as well as monitoring water conditions on the Walker River.
  - The Washoe Tribe has a series of MOUs with the US Forest Service for land use management in the Lake Tahoe Basin. In 2008, a pilot program was initiated to use traditional stewardship practices to regenerate meadow vegetation.
  - The Pyramid Lake Tribe is working with the US Fish and Wildlife Service on Lahontan Cutthroat Trout restoration and recovery; the Tribe is part of the management oversight team.
- Concerns and Priorities:
  - Restoration of native fisheries, especially the cui-ui and Lahontan Cutthroat Trout.
- Accomplishments:
  - In 1998, the Washoe Tribe was awarded a Special Use Permit by the US Forest Service to operate the Meeks Bay Resort and Marina. The Tribe also holds a permit for plant material gathering.
  - Fort Bidwell is evaluating options for geothermal wells.

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

Population

In 2005, North Lahontan region had the smallest population of the state's 10 hydrologic regions with 103,885 people. About 0.3 percent of the state's total population lives in this region, and 56 percent of the region's population lives in incorporated cities. Between 2000 and 2005, the region grew by 4,875 people, a growth of 5 percent over the 5-year period. For historical population data, 1960–2005, see Volume 5, Technical Guide.

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

California government code §65352.3 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. (See Box NL-2 for information about regional Tribal concerns.) A Tribal Consultation Guideline, prepared by the Governor's Office of Planning and Research, is available online at http://www.opr.ca.gov/programs/docs/09_14_05%20Updated%20Guidelines%20(922).pdf.

Land Use Patterns

Much of the region is either national forest or lands under the jurisdiction of the US Bureau of Land Management. Cattle ranching is the principal agricultural activity, and pasture and alfalfa are the dominant irrigated crops. Commercial crop production is very limited because of the short growing season, although garlic has been grown in Antelope Valley near Coleville on the West Walker River in the region's southern portion.

Tourism and recreation are the principal economic activities in the Truckee-Tahoe area and surrounding mountains. The lower meandering streams of the Walker, Carson, and Truckee rivers are famous for trout fly-fishing, but also offer water sports, hiking, and camping with the eastern Sierra as a backdrop. On a typical summer day in the high country, visitors in the Tahoe basin will outnumber full-time residents. During the winter, the population swells again as ski resorts attract visitors from all over the world as well as California's urban areas. The region has a number of world-class resorts.

A rapid increase in the number of new vacation homes in the 1990s and the early 21st century brought about controls on their effects such as storm water and Total Daily Maximum Loads (TMDLs) and also the ascendancy of watershed protection groups. Urban growth in the Lake Tahoe Basin is controlled by the Tahoe Regional Planning Agency (TRPA), which is responsible for protecting the basin's sensitive environment and water quality. To the north, the town of Truckee and the adjacent Martis Valley region are undergoing urban development.

The State wildlife areas around Honey Lake divert water to provide important habitat for waterfowl and several threatened or endangered species, including the bald eagle, sand hill crane, bank swallow, and peregrine falcon.

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 North Lahontan region are listed in Table NL-3.

Regional Water Conditions

Of the 140 separate entities that manage water in this hydrologic region, a few are listed below; it includes those Nevada interests that control most of the water in the region.

- South Tahoe PUD (STPUD) — water/wastewater
- Tahoe-Truckee Sanitation Agency. (T-TSA) — wastewater
- Truckee-Donner Public Utility District — water
- City of Susanville — water
- Tahoe Keys Water Co. — water
- Pyramid Lake Paiute Tribe — water for endangered species

Table NL-3 Granted Tribal lands in the North Lahontan Hydrologic Region

Rancheria	Acres	Tribal owner(s)
Susanville Rancheria (two separate locations with 80 acres donated and not in federal trust but added here). The Susanville Indian Rancheria, although it is made up of various other tribes, is recognized as a distinct political entity from the other tribes who make up the Susanville membership.	302	Northern Paiute, Northeastern Maidu, Washoe, Achomawi and Atsugewi
Cederville Reservation	20	Northern Paiute Indians
Fort Bidwell Reservation	3,335	Paiute Indians

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

- Washoe Paiute Tribe — water
- Truckee Carson Irrigation District — ag water
- Truckee Meadows Water Authority — urban water for Reno/Sparks
- Walker River Irrigation District — ag water
- Washoe County Water Conservation District. — ag water
- Carson Water Subconservancy District — bi-state watershed organization

Environmental Water

The region's rivers, in order of flow, are the Truckee, Walker, Carson, and Susan. Of major concern is the clarity of Lake Tahoe, which has been the subject of a $1.2 billion program and a Memorandum of Understanding between the United States and the states of California and Nevada. The East and West Carson rivers and Leavitt Creek, a tributary to the West Carson, are Wild and Scenic rivers. The east fork of the Carson River, Heenan Lake on a tributary to the east fork, the East Walker River, the Little Truckee River and Martis Creek Lake are trophy trout waters, that is, only trout over 18 inches may be caught there. Lahontan cutthroat trout, Paiute cutthroat trout found in Silver King Creek, and Eagle Lake Rainbow trout are heritage trout, that is, trout that existed in California before the intervention of European societies.

In addition to the Lake Tahoe clarity improvement program, another initiative in the region in the area of water governance is Truckee River Operating Agreement (http://www.usbr.gov/mp/troa/final_oa/index.html). TROA, if and when it is implemented, would resolve basinwide issues for a multitude of water rights decrees, court orders, and purchased water rights that affect the Truckee and Carson rivers. TROA contains operating procedures designed to make more efficient use of existing Truckee River reservoirs and to provide multiple benefits, such as enhanced conditions for endangered cui-ui and threatened Lahontan cutthroat trout; reduced streamflow variability; improved streamflows and water quality in all seasons; and maintenance of reservoir storage to better serve recreational uses (see Box NL-3).

At the time of this writing in 2009, TROA is yet to be implemented and may not be implemented for years. While TROA is pending, a number of decrees and agreements govern the operation of the Truckee River system and take into consideration the urban

Box NL-3 Truckee River Operating Agreement

On January 23, 2008, a final environmental impact report/environmental impact statement for the Truckee River Operating Agreement was released in connection with implementation of §205(a) of the Settlement Act, which directs the US Secretary of the Interior (Secretary) to negotiate an agreement with California and Nevada to increase the operational flexibility and efficiency of certain reservoirs in the Lake Tahoe and Truckee River basins. The proposed action would provide additional opportunities to store water in existing reservoirs for future urban water demands during periods of drought conditions in Truckee Meadows and to enhance spawning flows in the lower Truckee River for the benefit of Pyramid Lake fishes (i.e., federally endangered cui-ui and threatened Lahontan cutthroat trout). In addition, it would satisfy all applicable dam safety and flood control requirements and ensure that water is stored in and released from Truckee River reservoirs to satisfy the exercise of the Orr Ditch and the Truckee River General Electric decree water rights and minimize the Secretary's costs associated with operating and maintaining Stampede Reservoir. It would also increase recreational opportunities in the federal reservoirs (Lake Tahoe, Stampede, Prosser Creek, Martis Creek, and Boca), improve streamflows and fish habitat throughout the Truckee River basin, and improve water quality in the Truckee River.

uses, agricultural uses, and environmental needs including the level of Pyramid Lake and the well being of its cui-ui population. The primary agreements and decrees are General Electric Decree (1913, US District Court, Eastern District of CA); Truckee River Agreement (1935); Decree C-125 (1940, US District Court, Reno NV) pertaining to the Walker River; Orr Ditch Decree (1944, US District Court, Reno NV); and the Alpine Decree (1980, US District Court, Reno NV), which apportions the waters of the Carson River. Other decrees, agreements, and administrative regulations also affect the operation of the Truckee River. The California-Nevada Interstate Compact (1971) was ratified by both states, but not by Congress, which must ratify all such compacts before they take effect. However, California and Nevada both have policies to abide by the compact, and its terms informed the provisions of TROA. The above pre-TROA documents impose an operating regime on the Truckee River system that is inflexible in terms of storage and water releases but that TROA will improve upon. Public Law 101-618 (1990), the Truckee-Carson-Pyramid Lake Water Rights Settlement Act, (Settlement Act) will go into effect once TROA is implemented. The Settlement Act will settle numerous lawsuits over Truckee River water rights, formally allocate the waters between the states of California and Nevada, adopt the Alpine Decree, and usher in river operations pursuant to the more flexible terms of TROA.

Water Supplies

Unimpaired runoff of the streams and rivers of the North Lahontan region averages 1.5 million acre-feet per year, of which only about one-fifth occurs in the drier, northern portion. The largest rivers in the region and their average regulated runoff at the Nevada State line are the Truckee River with 540,000 acre-feet; the Carson River, 469,000 acre-feet; and the Walker River, 428,000 acre-feet. The Susan River is the only major river in the northern half of the region, and its annual discharge at Susanville averages 60,000 acre-feet.

Runoff in Modoc County flows into terminus lakes, specifically the upper, middle and lower lakes in Surprise Valley. A smaller portion of the runoff from the north and east

portions of the region flow into basins that feed groundwater in Oregon and Nevada. The Susan River flows in a southerly direction into Honey Lake in Lassen County, and Long Valley Creek flows in a northerly direction to the same lake. There is an interbasin transfer into the North Lahontan region from the South Pit River system, which is in the Sacramento River Hydrologic Region through Cedar Creek to Moon Lake (formerly Tule Lake Reservoir) and eventually to Madeline Plain.

Most of the runoff in the Truckee River Basin originates in the Sierra Nevada in California. A portion of that runoff is stored in federal reservoirs—Lake Tahoe in California and Nevada and Prosser Creek, Stampede, Boca, and Martis Creek reservoirs—and non-federal reservoirs—Donner and Independence lakes in California. Operation of these reservoirs regulates much of the flow in the Truckee River Basin in most years. Together these reservoirs can store about a million acre-feet of water. A number of court decrees, agreements, and regulations govern day-to-day operations, administered by the Federal Water Master for the Orr Ditch court. The reservoirs are operated to capture runoff as available when flow in the river is greater than that needed to serve downstream water rights in Nevada and to maintain prescribed streamflows in the Truckee River, known as Floriston Rates and measured at the Farad gage near the California-Nevada state line. Floriston Rates provide water for hydropower, urban use in Truckee Meadows, instream flow, and agricultural water rights. In general, each reservoir has authorization to serve specific uses. Releases are made from the reservoirs as necessary to meet dam safety or flood control requirements and to serve water rights when unregulated flow cannot be diverted to serve those rights. Minimum reservoir release rates are maintained as specified in applicable agreements and the reservoir licenses.

Water is exported from this region through an interbasin diversion of from 6,000 to 10,000 acre-feet per year from the Little Truckee River in the vicinity of Henness Pass to Sierra Valley in the Sacramento River Hydrologic Region for agricultural use. This diversion began in the late 19th century. Of similar vintage is a diversion of a lesser amount, 1,000 to 2,000 acre-feet per year, from Echo Lake south of Lake Tahoe into the Sacramento River Hydrologic Region for hydroelectric power generation.

In the southern half of the region, the east fork of the Carson River originates south of Ebbetts Pass in the Carlson-Iceberg wilderness at an elevation of 11,460 feet. The west fork of the Carson River originates near Lost Lakes at an elevation of 9,000 feet. The two forks cross the California-Nevada border and rejoin a mile southeast of Genoa, Nevada, to form the main stem. The only regulation on the Carson River in California are the relatively small (3,100 acre-feet) Heenan Lake Dam and Indian Creek Reservoir (3,100 acre-feet) on tributaries to the east fork of the Carson River.

Farther south on the Walker River, both Bridgeport Reservoir and Topaz Lake are large reservoirs operated by the Walker River Irrigation District to capture the spring snowmelt from the Sierra Nevada and provide summer irrigation water to Nevada farmers in that watershed. Because of the continuing lowering of the level of Walker

Lake (the terminus lake for the Walker River) and resultant increase in total dissolved solids (TDS), water rights on the Walker River are currently being litigated.

Most urban water uses in the North Lahontan region are supplied by groundwater wells. Twenty-four groundwater basins and two subbasins are recognized in the region. Thirteen of these basins are shared with Nevada, and one is shared with Oregon. These basins cover about 1.033 million acres (1,610 square miles) or about 26 percent of the entire region. Information about groundwater storage capacities is available for only 6 of the 26 basins; the combined storage for these underground basins is estimated at approximately 24 million acre-feet. Although the groundwater basins were delineated based on mapped alluvial fill, much of the groundwater produced actually comes from underlying fractured rock aquifers. This is particularly true in the volcanic areas of Modoc and Lassen counties where volcanic flows are interstratified with lake sediments and alluvium. Wells constructed in these volcanic formations commonly produce large amounts of groundwater, whereas wells constructed in fine-grained lake deposits produce less. Because the thickness and lateral extent of the fractured hard rocks outside of the defined basins are generally not known, actual groundwater in storage in these areas is also unknown.

About 5,000 acre-feet of reclaimed municipal wastewater are exported annually out of the Lake Tahoe Basin by the South Tahoe Public Utility District for recharge and agricultural use in the Carson River watershed. A slightly smaller amount of sewage effluent, in aggregate, is also exported from the basin by two sanitary districts on the Nevada side of Lake Tahoe. In the 1970s, the State partnered with the Tahoe-Truckee Sanitation Agency to build a state-of-the-art, tertiary wastewater treatment plant north of the Lake Tahoe Basin to reclaim the wastewater and return about 5,600 acre-feet to the Martis Valley groundwater basin each year. Farther to the north, the Susanville Sanitary District reclaims more than 3,000 acre-feet of wastewater each year for use on nearby irrigated pasturelands.

Table NL-4 lists the major lakes and reservoirs in the North Lahontan region other than the US Army Corps of Engineer's Martis Creek Lake, which is listed in Appendix A, Table NLA-3 Flood control reservoirs, because it pertains only to flooding. The total storage capacity of these lakes is 1.181 million acre-feet excluding Eagle and Honey lakes, which vary depending on the wetness of the water year.

Water Uses

The major use of water in the North Lahontan region is irrigated pasture or alfalfa, although garlic had been grown near Coleville in the south. Urban water use is less than that for agriculture, but is of growing importance. The major increases in population are in the region's neighboring state, Nevada. Most California urban uses are supplied by groundwater; urban use is growing in the population centers of Truckee and the Lake Tahoe area and the city of Susanville. A major portion of the water resources in the Truckee River Basin are used for environmental enhancement, mostly in Nevada, except for instream flow requirements in California.

Table NL-4 Major lakes and reservoirs in the North Lahontan Hydrologic Region

	Active storage (acre-feet)	Date	Description	Major tributary
Northern				
Eagle Lake	550,000 [1]	Geologic	Terminal Lake	Pine Creek
Honey Lake	Variable	Geologic	Terminal Lake	Susan River
Middle				
Boca Res.	41,100	1937	US Bureau of Reclamation	Little Truckee River
Donner Lake	9,500	1930s	Truckee Meadows Water Auth, Truckee-Carson ID	Snowmelt
Independence Lake	17,500	1939	Truckee Meadows Water Auth.	Snowmelt
Lake Tahoe	744,600 [2]	1913	US Bureau of Reclamation	Upper Truckee River
Prosser Creek Res.	29,800	1962	US Bureau of Reclamation	Prosser Creek
Stampede Res.	226,500	1970	US Bureau of Reclamation	Little Truckee River
Southern				
Bridgeport Lake	44,000	1924	Walker R. Irrigation Dist.	E. Walker River
Heenan Lake	3,100	1923	DFG fish rearing lake	E. Heenan Lake Creek
Topaz Lake	65,000	1937	Walker R. Irrigation Dist.	W. Walker River

1- No controlled outflow

2- This represents the acre-feet that is in top 6.1 feet above the rim and therefore controllable.

One use of water peculiar to the Lake Tahoe and Truckee basins is for snow-making at ski areas. TROA contains special provisions for snow-making water. Snow-making water is mostly recovered through melting. Therefore, a major fraction of snow-making water under TROA would not be counted in calculating the allocation of water between California and Nevada. Also, California is allowed 825 acre-feet per year, and Nevada is allowed 350 acre-feet per year. These must be reported, but they are not counted against either's allocation under TROA.

TROA identifies instream flow requirements for the Truckee River system at various points (Table NL-5). TROA establishes "bypass flows" or flows that are not to be diverted into hydropower stations on the Truckee Canyon reach of the main stem of the Truckee River. Instream flows have not been established for the Carson River in California because there are no regulation facilities on that river except Heenan reservoir. As a result of drought effects on fish, the California State Water Resources Control Board (State Water Board) issued a decision that a minimum instream flow of 20 cubic feet per second should be maintained below Bridgeport Dam on the East Walker River.

The principal environmental uses of water in the North Lahontan region are those of State wildlife areas around Honey Lake. The Honey Lake Wildlife Area (HLWA) in southern Lassen County consists of the 4,271-acre Dakin Unit and the 3,569-acre Fleming Unit. The two units provide important habitat for several threatened or endangered species, including the bald eagle, sandhill crane, bank swallow, and

Table NL-5 Minimum instream flows in the Truckee Basin

Location	Existing min. instream flow (cfs)	Enhanced min. TROA flow (cfs)
Below Lake Tahoe Dam	50-70	75
Below Donner Lake	2-3	5-8
Below Prosser Creek Dam	0-5	12-25
Below Independence Lake	2	2-8
Below Stampede Res.	22.5	45
Bypass flows, Truckee River	0-50	50-150

cfs = cubic feet per second

peregrine falcon. This wildlife area has winter-storage rights from the Susan River from November 1 until the last day of February. The HLWA also operates eight wells, each producing between 1,260 and 2,100 gallons per minute. In an average year, the HLWA floods 3,000 acres by March 1 for waterfowl brood habitat.

In 1989, the California Department of Fish and Game (DFG) purchased the 2,714-acre Willow Creek Wildlife Area in Lassen County to preserve existing wetlands and to increase the potential for waterfowl production and migration habitat. About 2,000 acres are wetlands and riparian habitats. The endangered bald eagle and sandhill crane also inhabit this area. The DFG operates the Doyle Wildlife Area, also in the Honey Lake Basin. This wildlife area is protected as dry land winter range for deer and requires less water than the Honey Lake or Willow Creek areas.

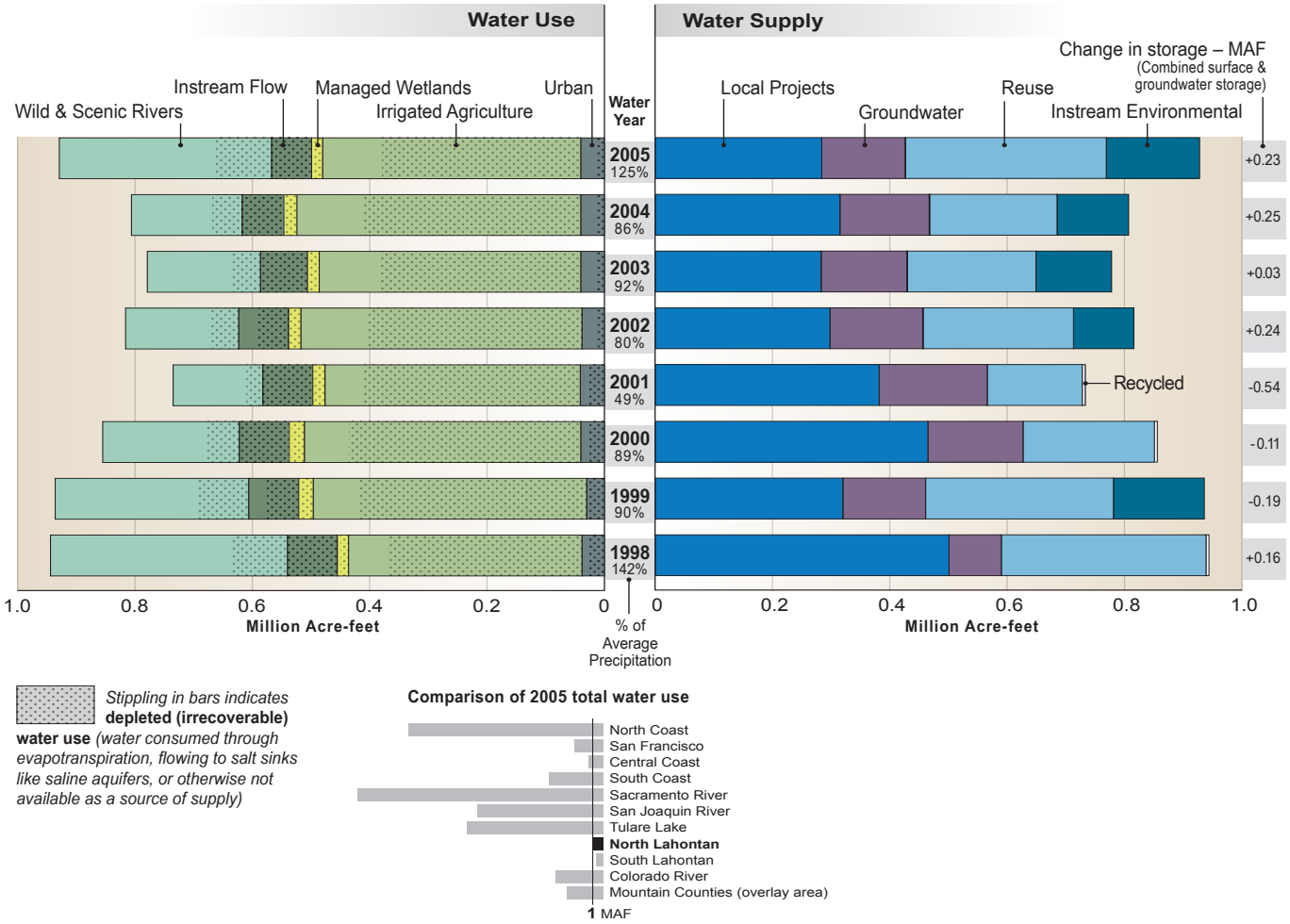
In Modoc and Lassen counties, groundwater is limited. Groundwater pumping capacity is known to diminish very rapidly during the first year of droughts. This could make management of these wildlife areas difficult in the future.

Rivers designated as wild and scenic constitute a large part of the environmental water use in the North Lahontan region although this use is flow-through in nature, i.e., the water is used simply by flowing through the river. The California portions of the interstate east fork of the Carson River and West Walker River and its Leavitt Creek tributary are State-designated wild and scenic.

Water Balance Summary

Figure NL-3 summarizes the total developed water supplies and distribution of the dedicated water uses within this hydrologic region for the eight years from 1998 through 2005. As indicated by the variation in the horizontal bars for wet (1998) and dry (2001) years, the distribution of the dedicated supply to various uses can change significantly based on the wetness or dryness of the water year. The more detailed numerical information about the developed water supplies and uses is presented in Volume 5 Technical Guide, which provides a breakdown of the components of developed supplies used for agricultural, urban, and environmental purposes and Water Portfolio data.

Figure NL-3 North Lahontan Hydrologic Region water balance, 1998–2005



For the North Lahontan region, agricultural water use is the largest component of the developed water supply, while dedicated environmental water for instream fishery flows is also a significant component of developed water use. Urban water uses in this region are a much smaller portion of the total. The water supply portion of Figure NL-3 also indicates that the largest supply source is from surface water flows, with some groundwater also in use. Water reuse from agricultural runoff is also a significant component of the supply to downstream water users within the region.

Table NL-6 presents information about the total water supply available to this region for the eight years from 1998 through 2005, and the estimated distribution of these water supplies to all uses. The annual change in the region's surface and groundwater storage is also estimated, as part of the balance between supplies and uses. In wetter water years, water will usually be added to storage; but during drier water years, storage volumes may be reduced. Of the total water supply to the region, more than half is either used by native vegetation; evaporates to the atmosphere; provides some of the water for agricultural crops and managed wetlands (effective precipitation); or flows to

other states, the Pacific Ocean, and terminus lakes. The remaining portion, identified as consumptive use of applied water, is distributed among urban and agricultural uses and for diversions to managed wetlands. For some of the data values presented in Table NL-6, the numerical values were developed by estimation techniques, because actual measured data are not available for all categories of water supply and use.

Water Quality

The Sierra water produced in California is typically high quality water. The primary concern in the Lake Tahoe portion of the region is the level of sediments and nutrients that are tributary to Lake Tahoe and the effect it has on the lake's clarity. Downstream of Lake Tahoe, the Truckee River has had both TDS and nutrient limits imposed on it. As a result of the TDS limit, the Tahoe-Truckee Sanitation Agency (T-TSA) was allowed to expand its water reclamation plant only if it included process improvements that reduced salt in its effluent. Other streams are impaired by various other pollutants from metals in mining districts to pathogens in areas where grazing takes place. In Surprise Valley and Susan River watersheds there are potential effects from livestock grazing and limited agriculture.

Septic Tank Discharges. Groundwater contamination from septic tank discharges in the community of Spaulding in the vicinity of Eagle Lake was a concern that resulted in action by the Lahontan Regional Water Quality Control Board (Lahontan Water Board). As a result, the Spaulding Community Services District (CSD) was formed and developed a septic tank effluent collection system and aeration ponds to treat the effluent without discharge into bodies of water. At another community on Eagle Lake to the north of Spaulding, the Stones-Bengard CSD was formed and operates a pumped septic tank effluent system much like that of the Spaulding CSD.

MTBE contamination. MTBE, used a gasoline additive until banned in California in 2004, leaked from underground storage tanks particularly in the South Lake Tahoe area. Further, until carbureted, two-stroke engines were banned from Lake Tahoe on June 1, 1999, the lake water was a source of onshore MTBE contamination. Since that time, MTBE in the waters of Lake Tahoe has decreased by 90 percent. MTBE is mainly confined to shallow aquifers, but has been found to depths of 80 feet causing the South Tahoe Public Utility District (STPUD) to shut down 13 of its drinking water wells and resulting in a $69 million settlement for the district to deal with MTBE contamination in the future. Now that the presumptive sources of MTBE have been stopped, MTBE levels will continue to abate.

Small Private Drinking Water Systems. Drinking water quality has also become a greater issue for many surface water systems around Lake Tahoe, forcing many of the smaller private systems to consolidate or change ownership because they are unable to afford the new monitoring and treatment regulatory requirements. STPUD, the largest water purveyor in the Tahoe basin, is also experiencing some difficulty in meeting these water quality requirements.

Table NL-6 North Lahontan Hydrologic Region water balance for 1998-2005 (thousand acre-feet)

North Lahontan Region	Water Year (Percent of Normal Precipitation)							
	1998 (142%)	1999 (90%)	2000 (89%)	2001 (49%)	2002 (80%)	2003 (92%)	2004 (86%)	2005 (125%)
Water Entering the Region								
Precipitation*	10,655	6,445	6,708	3,756	5,752	6,560	6,132	8,992
Inflow from Oregon/Mexico	0	0	0	0	0	0	0	0
Inflow from Colorado River	0	0	0	0	0	0	0	0
Imports from Other Regions	3	3	3	3	3	3	3	3
Total	**10,658**	**6,448**	**6,711**	**3,759**	**5,755**	**6,563**	**6,135**	**8,995**
Water Leaving the Region								
Consumptive Use of Applied Water ** (Ag, M&I, Wetlands)	263	323	327	307	321	300	323	294
Outflow to Oregon/Nevada/Mexico	1,391	1,315	754	552	730	921	738	1,350
Exports to Other Regions	12	12	12	9	10	8	11	7
Statutory Required Outflow to Salt Sink	180	140	141	113	103	129	122	160
Additional Outflow to Salt Sink	83	81	92	92	7	7	10	8
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	8,572	4,763	5,493	3,223	4,828	5,223	5,182	6,949
Total	**10,501**	**6,635**	**6,819**	**4,296**	**5,998**	**6,589**	**6,386**	**8,767**
Storage Changes in the Region [+] Water added to storage [–] Water removed from storage								
Change in Surface Reservoir Storage	147	-97	-66	-430	-151	59	-170	307
Change in Groundwater Storage ***	10	-90	-42	-107	-92	-85	-81	-79
Total	**157**	**-187**	**-108**	**-537**	**-243**	**-26**	**-251**	**228**
Applied Water ** (compare with Consumptive Use)	432	501	524	490	513	483	517	475

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

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

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

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

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

Priority Subregional Water Quality Issues/Status

Lake Tahoe. The top water quality issues emerging from the Lahontan Water Board's 2003 Triennial Review included proposals to revise the waste discharge prohibition for piers in Lake Tahoe. Lake Tahoe is the subject of its own chapter in the region's basin plan, and receives many specific and extraordinary water quality protections. The Porter-Cologne Water Quality Control Act bans the discharge of treated domestic wastewater effluent from California in the Lake Tahoe Basin; the same ban is in effect in Nevada by executive order, resulting in the export of all effluent from the basin. Programs to manage and restore the water quality and clarity of Lake Tahoe will need to continue in order to maintain the Lake's ecological integrity. Similarly, wildlife management in the basin should include the needs of fish and wildlife resources not only in the lake but also in its tributaries.

In the late 1960s, the clarity of the lake—as measured by the depth to which a "Secchi disk" (a small black and white disk of specific size) is visible—was about 100 feet; but in recent years, the average Secchi disk visibility has been closer to 70 feet. Early on, the main effort to maintain or enhance lake clarity was focused on the entry of nutrients, such as nitrogen and phosphorous used in landscaping fertilizers, to reduce algae. Recent research, however, indicates that the main contributor to reduced clarity is fine inorganic particles from erosion and traction sand on roads.

Roads and road maintenance activities, including snow and traction sand removal, and de-icing using salt, are the focus of new restrictions that are intended to reduce erosion and other water quality effects on the streams that enter Lake Tahoe. The traditional use of salt for road de-icing had resulted in adverse effects to the trees and plants which help prevent erosion and sediment from flowing into the lake. The amount of salt applied has been on a downward trend since the winter of 1993-1994, however, the decrease is not marked. Sand applied for traction has itself become a concern particularly at the head of Donner Lake where storm water drainage has caused deep sand banks to form. Currently, Caltrans files a yearly "De-icer Report," which details both the amount of sand applied and removed from catch basins. Lately, the amount of sand removed has been either a large percentage of that applied or, in some years, more than the amount applied. (Some erosive sand and pavement degradation sand are also trapped and removed.)

The Angora forest fire of June 2007 in the Tahoe Basin has brought about greater public discussion of forest management practices. In general, the future trend is to allow greater removal of undergrowth to reduce fire fuel loads. This may have the effect of reducing the water-holding capacity of the soil and increase erosion rates. However, increased fire severity due to the presence of fuel load leads to even larger increases in erosion.

Leviathan Mine. The abandoned Leviathan Mine, a Superfund site in the upper reaches of the Carson River watershed, affects creeks locally with acid mine drainage water, however, the linear extent of this impairment appears to have been reduced to only 4 miles downstream.

Carson and Walker River. In addition to grazing effects another of the top water quality issues identified by the Lahontan Water Board is sodium standards for the Carson and Walker rivers and their tributaries. On September 17, 2007, the Lahontan Water Board approved an amendment to the basin plan for the Carson and Walker rivers that changed the salt criterion from a percentage of salt to a criterion based on the Salt Absorption Ratio (SAR), which is a more reliable method of determining the hazard of salt to irrigated land and conforms to the standard observed in Nevada. This change has not affected the overall salt level because the TDS criterion has remained the same. The decline in the water level and associated water quality of Walker Lake is of great concern. The lake has become increasingly more saline such that the lake's historical Lahontan cutthroat trout population is severely threatened. Significant increases in the amount of fresh water entering Walker Lake would be required in order to maintain the level of the lake and restore the fishery. The office of Nevada's US Senator Harry Reid is working on a settlement to water disputes on the Walker River that would increase the amount of water that flows to the lake.

Water Governance

More complete information on water governance will be developed for California Water Plan Update 2013. This will include identification of local, State, Tribal, and federal government agencies and institutions that are responsible for managing the region's water resources, flood protection, and wastewater. A list of regional flood management participants is included in Appendix A Flood Management, and integrated regional water management plans provide information about water planning organizations in this region.

Flood Management

Flood Hazards

The North Lahontan region does not have a well-developed flood protection system. As a result, flooding often occurs along many streams, damaging agricultural and urban properties and causing channel and bank erosion. Improvement is needed to several aspects of flood protection in the region. Flood hazards include the following representative situations. (For specific instances, see Challenges)

- Protection from flooding is not provided for a flood equal to the event with 1 percent probability (1 percent event) for some residences and commercial facilities.
- Highways and roads are vulnerable to the 1 percent event in many locations.
- Some agricultural lands are subject to frequent flooding.
- Some streams are susceptible to bank and channel erosion damage during high flows.
- Some existing culverts and channels do not have sufficient capacity to carry flow resulting from the 1 percent event.
- Population growth and the ensuing development increase the area of impervious surface without sufficient mitigation, increasing peak runoff.

Box NL-4 Flood Management Agencies

Federal

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

Tribal

- Tribal governments of the region

State

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

Local

- Placer County Flood Control and Water Conservation District
- Tahoe Regional Planning Agency
- County and city emergency services units
- County and city planning departments
- County and city building departments
- Local conservation corps
- Local emergency response agencies
- Local initial responders to emergencies

- Mapping of the 1 percent event floodplain is incomplete in some areas.
- Some dams do not meet current State seismic, spillway, or other structural requirements.

Historic Floods

Major floods occurred in the North Lahontan region in 1950-51, 1962-63, 1964-65, 1986, and 1997. For more information on these floods see Appendix A, Flood Management. Flood records for selected flood-producing streams are listed in Appendix A in Table NLA-1.

Flood Governance

Flood management is a cooperative effort in which federal, tribal, State, and local governments all play significant parts. The principal participants are listed in Box NL-4, Flood Management Agencies. For more information on the agencies' roles, see Table NLA-2, Flood management participants, in Appendix A.

Flood Risk Management

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

Structural Approaches

Constructed Facilities. The North Lahontan region contains four small floodwater storage facilities and channel improvements. Reservoirs with flood control reservations have been built by US Army Corps of Engineers (USACE) on Martis Creek and by US Bureau of Reclamation (USBR) on Prosser Creek and at Stampede and Boca reservoirs on the Little Truckee River. The integrity of Martis Creek Reservoir is under investigation, and it is not now being used for flood control. All four reservoirs are designed to protect Reno, Nevada, and incidentally reduce flood damage in their respective stream channels and on the Truckee River. USACE enlarged the Truckee River's channel downstream of Lake Tahoe Dam at Tahoe City in 1988. Local sponsors and descriptions for reservoirs and non-storage flood control facilities in the region are listed in Appendix A in Table NLA-3 Flood control facilities.

Coordination and Reservoir Operations. There are no forecast-based operations agreements for operation of flood protection facilities in the region. However, during high water periods, reservoir operators coordinate with the California Department of Water Resources (DWR) and USACE during daily operations conferences at the State-Federal Flood Operations Center in Sacramento. These conferences often lead to voluntary modifications of individual schedules to improve overall system operation.

System operations are accomplished mainly by managing storage in the region's seven lakes and reservoirs—Lake Tahoe, Donner Lake, Prosser Creek Reservoir, Martis Creek Lake, Independence Lake, Stampede Reservoir, and Boca Reservoir. Out of a total of 1,089,570 acre-feet useable storage, 50,000 acre-feet is available for flood control. Flood control operations of Prosser Creek and Stampede and Boca reservoirs and any residual retarding effect from Martis Valley Lake are coordinated to limit Truckee River flows at Reno to 6,000 cubic feet per second when possible. The useable storage in these reservoirs is the key element to operations within the basin. Estimates of the downstream demands, water content of the snowpack, and capacity of these facilities to store and control releases downstream govern operations in any particular year.

During normal operations, Martis Creek Lake is maintained at a minimum pool and all inflow is released. At the present time, the integrity of Martis Creek Dam is being investigated, and the lake is not being used for flood control. Prosser Creek Reservoir has to be drawn down to provide 20,000 acre-feet of storage space for flood control by November 1 of each year. For flood control, Stampede Reservoir must be drawn down to have 22,000 acre-feet of storage space by November 1 of each year. Boca Reservoir must have 8,000 acre-feet of flood reservation space by November 1 of each year. For more information on flood control reservoirs, see Table NLA-3 in Appendix A.

Maintenance. Maintenance of flood control works is a critical activity which preserves the integrity of the facilities, ensuring continued protection for the public. This effort is made more difficult by two factors: (1) Lack of adequate financing for many installations is the result of tax-management efforts of the late 20th century which have placed controls on former sources of revenue, and (2) heightened public awareness of the

environment has resulted in new regulations making the permitting process lengthy and expensive. Compounding the problem, deferred maintenance can cause establishment of new habitat which then must be protected.

Maintenance of flood control facilities is usually the responsibility of the local maintaining agency, which is usually the local sponsor, or if there is none, the constructing agency. In this region, USACE projects are maintained directly by USACE. USBR projects are Prosser Creek Reservoir, Stampede Reservoir, and Boca reservoirs, which are maintained by USBR.

Land Use Management

Regulation. Nonstructural flood management measures are sparsely implemented in the North Lahontan region. Counties are the main agencies responsible for designating and regulating floodways. Placer County adopted an ordinance banning building in the Truckee River channel between Tahoe City and Squaw Creek, which USACE describes as subject to inundation. TRPA has a land use ordinance including subdivision and grading restrictions that prohibit construction requiring filling or grading of wetlands, stream environmental zones, or floodplains. All local land use jurisdictions must adopt a floodplain management ordinance identifying 1 percent floodplains and floodways, in order to qualify for Federal Emergency Management Administration (FEMA) flood insurance.

Flood Insurance. The National Flood Insurance Program (NFIP) is administered by FEMA. It enables property owners in participating communities to purchase insurance as protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. About 97 percent of California communities participate in the NFIP. Of those, approximately 12 percent participate in the Community Rating System (CRS) Program, which encourages communities to go beyond minimum NFIP requirements in return for reduced insurance rates. Quality floodplain mapping is critical to administering an effective flood insurance program, developing hydrologic and hydraulic information for determining floodplain boundaries, and allocating flood protection project funds.

FEMA has provided Flood Insurance Rate Maps (FIRMs) for all areas within the region. As of June 2009, FIRMs in one of the region's eight counties was updated in 2008, and five more are scheduled to be updated by 2010. Two counties are not scheduled for update.

CRS rates communities from 1 to 10 on the effectiveness of flood protection activities. The lower ratings bring larger discounts on flood insurance. Of the eight counties and three cities in the region, one county participates in CRS. As of May 2009, Placer County is in CRS Class 5. See http://www.fema.gov/business/nfip/crs.shtm for more information on the CRS system.

Disaster Preparedness, Response, and Recovery

Information and Education. The California Data Exchange Center (CDEC) provides real-time and historical hydrometeorological data for hundreds of stations statewide, as well as real-time data on releases, spill rates, and elevations of many reservoirs. For this region, CDEC provides gage data from the Natural Resources Conservation Service (38 gages), US Geological Survey (USGS) (23 gages), and several other federal, State, and local agencies, for a total of 132 gages, and real-time flow and stage data for the Susan, Truckee, Carson, and Walker rivers. For access to CDEC data, see http://cdec.water.ca.gov.

The USGS maintains and publishes statistics for stream gages nationwide. For access to USGS gage data, see http://waterdata.usgs.gov/nwis.

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

Accurate hydrologic and hydraulic models inform emergency actions before, during, and after floods. The National Weather Service's (NWS) Advanced Hydrologic Prediction Service uses historical hydrologic data, current river and watershed conditions, and near-term meteorological outlooks to forecast river flows. The service is publicly available for certain streams of the North Lahontan region. Locations are given in Appendix A, Table NLA-5 Advanced Hydrologic Prediction Service stream forecast points.

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

Recovery after a flood event may involve the funding and construction services of USACE if the facilities are parts of federal projects. Availability of resources to repair

local and private facilities; remove floodwater; and restore housing, businesses, and infrastructure often depends on the severity of the event and the allocation of event-specific federal or State funds. Flood preparedness and mitigation efforts are promoted and funded by many organizations, including city and county governments, Cal EMA, DWR, NWS, and USACE.

Relationship with Other Regions

Because the river channels of the Truckee, Carson, and Walker rivers naturally flow into Nevada, a large amount of the surface water from these watersheds has historically been reserved for use by Nevada interests under various interstate water rights settlements and agreements.

There are three small historical exports of surface water out of the North Lahontan region. At Echo Lakes in the upper Lake Tahoe Basin, an average of about 830 acre-feet per year is exported through a tunnel into the south fork of the American River in the Sacramento River region in conjunction with a hydroelectric power development (Project 184) that began in 1876. Another water export of from 6,000 to 10,000 acre-feet per year is taken from the upper reaches of the Little Truckee River for irrigation use in Sierra Valley (a part of the Feather River Basin within the Sacramento River Hydrologic Region). At the southern end of the North Lahontan region, a third small water diversion from Virginia Creek provides approximately 1,000 acre-feet per year of surface water to the Mono Lake Basin in the South Lahontan Hydrologic Region for summer irrigation purposes.

The only water import into the North Lahontan region occurs in northern Lassen County, where an average of about 3,000 acre-feet is imported from a tributary of the South Fork of the Pit River (Sacramento River Hydrologic Region) for irrigation in the Madeline Plains area.

Regional Water and Flood Planning and Management

Integrated Regional Water Management

The Integrated Regional Water Management (IRWM) Planning Act, signed by the Governor as part of SBx2-1 in 2008 (CWC Sec 10530 et seq.), provides a general definition of an IRWM plan as well as guidance to DWR as to what IRWM program guidelines must contain. The Act states that the guidelines shall include standards for identifying a region for the purposes of developing or modifying an IRWM plan. The first region acceptance process (RAP) spanned 2008-2009. Final decisions were released in fall 2009. The RAP is used to evaluate and accept an IRWM region into the IRWM grant program (See Figure NL-4).

Figure NL-4 Region acceptance process IRWM regions, North Lahontan Hydrologic Region

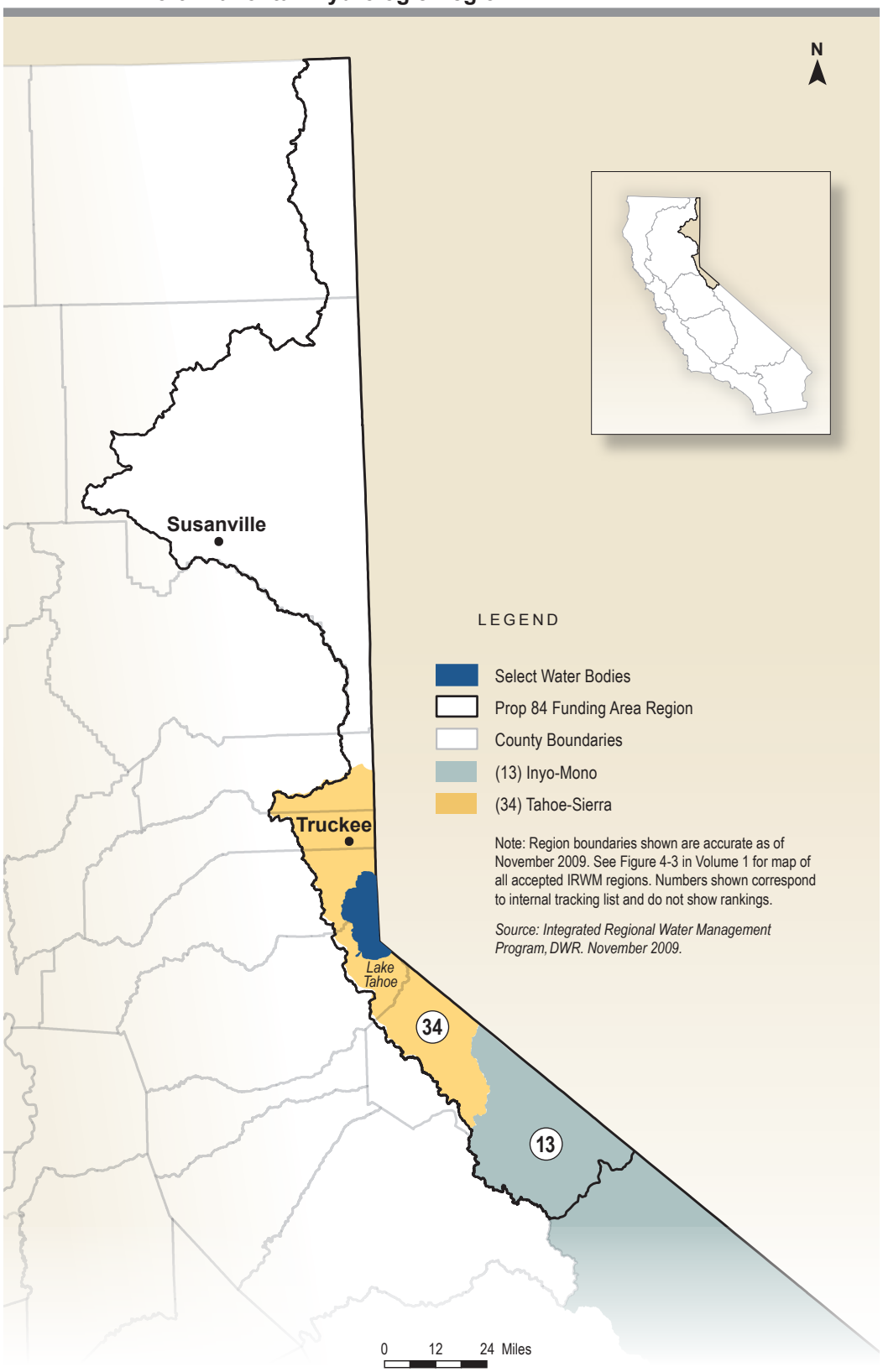


Table NL-7 Strategies of Tahoe-Sierra Integrated Regional Water Management Plan, North Lahontan Hydrologic Region

Strategy	Tahoe Sierra IRWM (Dec 2006)
Conjunctive use	✓
Desalination	✓
Ecosystem restoration	✓
Environment and habitat protection and improvement	✓
Flood management	✓
Groundwater management	✓
Imported water	✓
Land use planning	✓
Nonpoint source pollution control	✓
Recreation and public access	✓
Storm water capture and management	✓
Surface storage	✓
Water and wastewater treatment	✓
Water conservation	✓
Water quality protection and improvement	✓
Water recycling	✓
Water supply reliability	✓
Water transfer	✓
Watershed planning	✓
Wetland enhancement and creation	✓

Note: The summary information contained in these tables was obtained from various IRWM plans. For additional details or information related to a specific plan, please consult the current version of the plan or its authors.

The Tahoe Sierra IRWM region is located in the North Lahontan region. Its boundaries follow watersheds from north to south to include the Little Truckee River, Truckee River, Lake Tahoe, West Fork Carson River, and East Fork Carson River. This region's western and eastern boundaries are composed of the crest of the Sierra and the California-Nevada State line, respectively.

Projects in the Tahoe Sierra IRWM Plan comprise a wide range of projects including infrastructure improvements such as domestic water supply pipelines and the installation of water meters, an important effort that will gauge California's interstate water allocation in the future. Table NL-7 lists strategies outlined in the 2006 Tahoe-Sierra IRWM plan.

Watershed Management

Numerous watershed groups have been organized in the Carson River, Lake Tahoe, Truckee River, Susan River, and Honey Lake basins. Most are concerned with nonpoint source pollutants such as sediment and the restoration of watershed functioning.

- Alpine Watershed Group (organized under Alpine County) in 2002 under 205J grants from the US Environmental Protection Agency through the State

Water Board monitored nonpoint sources of pollutants (nutrients, salt, sediment, pathogens) and produced an Upper Carson River Watershed Water Quality Monitoring Program report in June 2007. In June 2004, the group produced an Upper Carson River Watershed Stream Corridor Condition Assessment report leading to the recommendation of and prioritization of streambank bio-stabilization projects and a GIS mapping of the watershed.

- Carson River Coalition, Carson City, Nevada, is the steering committee for the integrated watershed planning process for the Carson River watershed.
- Lassen Land & Trails Trust is active in the Susan River watershed in the vicinity of Susanville having created two streamside trails, restored streambanks, and purchased land for conservation purposes.
- League to Save Lake Tahoe, producer of the "Keep Tahoe Blue" bumper sticker, promotes water quality by monitoring the granting of urbanization building permits.
- The Sierra Nevada Conservancy operates in the Sierra and Cascade range outside the Tahoe Basin and was created by 2004 legislation authorizing $54 million in grants by Proposition 84 (2006) funds. In December 2007, $90,000 was granted to Truckee River Watershed Council for design and permitting of Coldstream Canyon watershed restoration and $49,900 for lower Squaw Creek restoration; the conservancy is engaged with the Eastern Sierra Land Trust for an assessment of the East Walker River. Proposition 84 (2007-2008) funds in amounts of $99,900 and $98,500 were granted by the conservancy to the Lassen County Firesafe Council and the US Bureau of Land Management for juniper removal on private and public lands, respectively.
- The California Tahoe Conservancy complements the jurisdiction of the Sierra Nevada Conservancy by operating only in the California portion of the Lake Tahoe watershed providing enhancements of Tahoe watersheds by such projects as the bi-state Van Sickle State Park in the vicinity of the Heavenly Valley ski area and the Upper Truckee marsh restoration project.
- Tahoe Region Conservation District (TRCD) has undertaken a number of projects including restoration of the Upper Truckee River and is heavily involved in nonpoint source pollution abatement by erosion control and water quality projects ($999,647 Proposition 13, 2004); TRCD and partner agencies received $3,003,779 (Proposition 40, 2006) for backyard conservation and best management practices; and $852, 958 for restoration of the old fish hatchery at Polaris Creek which has become the Tahoe City Field Station of the UC Davis Tahoe Environmental Research Center. TRCD and 10 partner organizations received $12.5 million under the IRWM process for watershed projects.
- T-TSA, the special district that owns and operates the Martis Valley Wastewater Treatment Plant, reclaims wastewater from much of the North Tahoe-Truckee region. With financial assistance of $11.6 million from DWR, T-TSA constructed a new biological system for nitrogen removal to replace an existing physical/chemical nitrogen removal system that had been adding salt to the water. On average, approximately 5 million gallons per day (5,600 acre-feet per year) of water is reclaimed and recharged into the agency's subsurface Soil Aquifer Treatment (SAT) system. The new biological nitrogen removal system provided relief to

downstream utilities in Nevada in meeting their TDS water quality criteria who, in turn, withdrew their objection to T-TSA increasing its capacity required to meet the needs of the growing surrounding communities. T-TSA monitors the Truckee River for nitrogen, phosphorus, coliform bacteria, and iron among other constituents at three sites placed above, at, and below the nearest point of the SAT system to the Truckee River. No effects have been noted.

- Town of Truckee and Placer County have storm water management plans that require water quality monitoring that will cost $200,000 to $250,000 per year. In response to a Technical Directive issued by the Lahontan Water Board, Placer County is heading an effort to monitor water quality in all portions of the Truckee River basin that are not tributary to Lake Tahoe. The county has assembled a list of stakeholders and will consolidate regional monitoring data available to date.
- Trout Unlimited established a Truckee office on August 24, 2007, and is promoting "Trout in the Classroom" projects in local schools and outreach to California University systems along with protecting the Meiss Meadows headwaters of the Upper Truckee River and supporting the re-establishment of the Lahontan cutthroat trout.
- Truckee Donner Land Trust and The Nature Conservancy purchased 3,344 acres from Sierra Pacific Power along Truckee Canyon between Floriston and the state line using $1.5 million from the California Natural Resources Department and money from an undisclosed private donor.
- Truckee Land Trust acquired land in Billy Mack Canyon at the west end of Donner Lake to abate effects of Highway 80 drainage at the west end of Donner Lake.
- The Truckee River Watershed Council (TRWC) coordinates funding and implements restoration projects directly related to the health, beauty, and economy of the watershed. Its role is to bring together stakeholders around the common goals of water quality and health of the river, streams, meadows and wetlands. The 40-odd participants of the TRWC are citizens, businesses, federal and State agencies, local government, and nonprofit organizations. Sponsored activities include Truckee River Day, an annual river day of 10 to 15 small-scale restoration projects that draws some 500 volunteers, and Adopt-A-Stream, a year-round water quality monitoring program. Other projects are facilitation and development of Truckee River Watershed Coordinated Watershed Management Strategy; acquisition of Perazzo Meadows; monitoring of Cold Creek and Coldstream Canyon assessment; Merrill Davies Meadow and Stream restoration and monitoring; Gray Creek assessment, restoration and monitoring; and erosion control retrofit for residential properties in the town of Truckee.

Challenges

Much of the northern portion of North Lahontan region is chronically short of water. In the Modoc and Lassen County areas, drought is a way of life for agriculture, and seasonal irrigation takes place only as long as water is available. During dry years, areas with little or no surface storage may only have irrigation water available for a short period early in the season, resulting in irrigation of limited acreage unless growers are

able to supplement their surface water supply by pumping groundwater. However, in the Modoc and Lassen regions, groundwater is also limited and some well-pumping capacities are known to diminish very rapidly during the first year of droughts.

While the TROA has the potential to settle 100 years of disputes over Truckee and Carson River waters, the execution and implementation of this agreement will require considerable effort in the coming years. For example, TROA still requires court approval of changes in water uses. TROA contains 14 chapters with more than 200 pages of administration, operating criteria, and conditions pertaining to water priorities, deliveries and water credits resulting from operation of the water facilities in the system.

In the Walker River basin, California and Nevada have been discussing interstate water allocation issues that could potentially affect future uses of the river in both states. A primary concern is the long-term decline in the water level and associated water quality of Walker Lake, which is the river's terminus in central Nevada. The water level at Walker Lake is estimated to have declined by more than 140 feet from a historical high elevation of about 4,080 feet in 1882 to 3,934 feet in December 2007. Starting in the early 1900s, much of the water in the Walker River was developed to provide water to agricultural lands in Nevada. Bridgeport Reservoir and Topaz Lake were built upstream to meet those needs. As the uses increased, the flows to Walker Lake diminished, and the lake has become increasingly more saline, such that the lake's Lahontan cutthroat trout population has become severely threatened. As the lake has declined, the level of salinity as measured by TDS has increased to 17,000 parts per million. Significant increases in the amount of fresh water entering Walker Lake will be needed in order to maintain or restore the fishery, which could affect the water uses and supplies of all upstream parties in both states. Other issues that could also affect existing water users in this basin are the potential water rights claims of the Walker River Indian Reservation, which is just upstream of Walker Lake.

Water quality in the North Lahontan region is generally very good, but many communities face specific water quality problems of which septic tank discharges, MTBE, salinity, and metals contamination in the vicinity of abandoned mines have already been mentioned above. Lake Tahoe's clarity has declined as development has increased around the shoreline, increasing the sediment load and nutrients reaching the lake and its tributaries.

Forest fires, grazing, and logging also present a threat to Lake Tahoe's water clarity due to related and subsequent erosion into the stream systems. The use of fertilizer in Lake Tahoe shore zones is prohibited, and since 1999, TRPA has banned the use of carbureted, two-stroke engines in all boats on the lake to prevent MTBE contamination. Restrictions on land development and soil disturbances are used in the continuing efforts to maintain or improve the lake's water quality, and programs that purchase and preserve sensitive lands are being implemented. Lake Tahoe is now extensively monitored by many federal and state agencies, and researchers such as the University of California,

Davis' Tahoe Environmental Research Center and the University of Nevada's Desert Research Institute.

Californians in the northern part of the North Lahontan region had been apprehensive about plans for the development of additional water supplies for the Reno, Nevada area. To date only the Fish Springs Ranch Project has been implemented, which consists of groundwater wells at the ranch in the Honey Lake Groundwater Basin and a 28-mile long, 30-inch diameter pipeline extending in a southerly direction to the vicinity of Stead, Nevada, and the Lemmon Valley suburb or Reno. As of the end of 2008, this project had not drawn its full permitted quantity of water (8,000 acre-feet per year) due to economic conditions prevailing at that time, but those conditions will change. It is, therefore, too early to tell if the quantity of groundwater extracted will be no more than that previously used on alfalfa fields at Fish Springs Ranch.

In the field of flood hazards, challenges include the following.

- Design and construction of flood control channels in developed areas will have to be performed carefully in order to not exacerbate erosion in upstream tributaries.
- Diverse stakeholder groups, multiple water uses, and the nature of the region's interstate watersheds erect significant hurdles to effective, cooperative planning and implementation of flood management.
- State funding for flood management activities is constrained by state lines, which presents difficulties in managing floods from a watershed-scale approach.

Drought and Flood Planning

In 2000, Congress enacted the Disaster Mitigation Act, which made available pre- and post-disaster mitigation funds for states and local entities that drafted Hazard Mitigation Plans (HMPs). Through multi-jurisdictional cooperation, these HMPs were to identify natural hazards within the entities' boundaries, assess the possible effects of the hazards on infrastructure and communities, and develop and implement mitigation strategies for reducing the loss of lives and property to natural disasters. Mono, Alpine, El Dorado, Placer, and Nevada counties have adopted HMPs that identify flood-prone areas and present measures for lessening the effects of floods.

FloodSAFE California is a strategic initiative of DWR and is guiding the development of regional flood management plans, which will encourage regional cooperation in identifying and addressing flood hazards. Regional flood plans will include flood hazard identification, risk analyses, review of existing measures, and identification of potential projects and funding strategies. The plans will emphasize multiple objectives, system resiliency, and compatibility with State goals and IRWM plans.

A drought plan is in place for major portions of the region held by the US Bureau of Land Management. TROA contains drought provisions also, but those pertain mostly to Nevada entities because the Sierra in California is their major source of surface water.

Looking to the Future

The northern part of this hydrologic region contains portions of Modoc, Lassen, and Sierra counties in which no major changes in water use are anticipated in the near future. A small amount of agricultural expansion may be possible in areas that can support additional groundwater development. Likewise, the modest need for additional urban and irrigation supplies can be met by some expansion of present surface systems or by increased use of groundwater.

Concern for protecting the limited groundwater resources of the region has led to establishment of formal groundwater management programs in the Honey Lake and Long Valley basins. In Modoc County, similar groundwater proposals are being considered for the Surprise Valley region. At present, neither the Honey Lake nor Long Valley groundwater management districts are active, but can be activated when needed. In the Lake Tahoe and Truckee River basins, TROA interstate allocation also establishes limits on groundwater wells and withdrawal limits from these areas.

The interstate surface waters of the Truckee, Carson and Walker rivers are controlled by federal watermasters according to existing federal court decrees. Some of these decrees may be revised to some degree in the next decade as a result of TROA implementation on the Truckee River and through litigation regarding the Walker River water uses. Because further water development in these basins may be limited, especially in Nevada, water transfers are expected to play an increasing role to meet changing and higher-priority needs. In Nevada, water transfers occur by acquisition of agricultural water rights which are then transferred to meet municipal needs in Reno/Sparks region.

In the Placer and Nevada county portions of the North Lahontan region, several large residential and commercial developments are being proposed for the Truckee and Martis Valley regions. If these developments are completed, it is likely that significant new demands will be placed on the groundwater supplies and sewage disposal capabilities of this region.

Climate Change

Climate change models suggest that the North Lahontan region will generally receive less annual precipitation, with more of that precipitation falling as rain. Climate change scenarios indicate a higher reliance on groundwater to maintain current levels of agricultural development. Similar climate change scenarios for the Lake Tahoe area indicate increased use of groundwater to accommodate population growth.

Future Scenarios

For Update 2009, we evaluated different ways of managing water in California depending on alternative future conditions and different regions of the state. The ultimate goal is to evaluate how different regional response packages, or combinations of resource management strategies from Volume 2, perform under alternative possible

Box NL-5 Scenario Descriptions

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

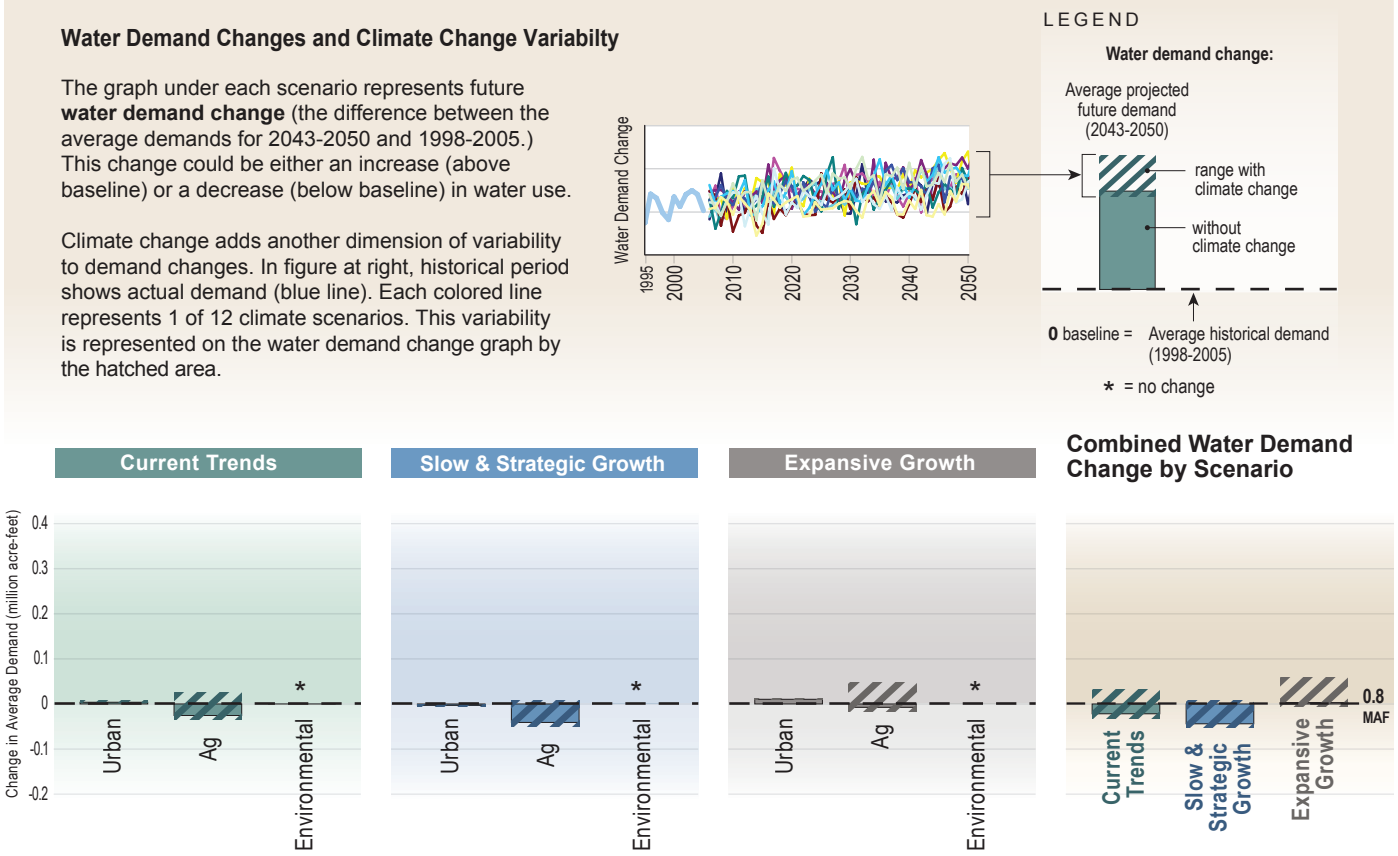
- **Scenario 1 – Current Trends.** For this scenario, recent trends are assumed to continue into the future. In 2050, nearly 60 million people live in California. Affordable housing has drawn families to the interior valleys. Commuters take longer trips in distance and time. In some areas where urban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

future conditions. The alternative future conditions are described as future scenarios. Together the response packages and future scenarios show what management options could provide for sustainability of resources and ways to manage uncertainty and risk at a regional level. See Box NL-5 for scenario descriptions.

Total Demand

Change in total water demand in the North Lahontan region for the three scenarios, Current Trends, Slow & Strategic Growth, and Expansive Growth is shown in Figure NL-5. The change in water demand is based on the difference between the historical average (1998-2005) and future average (2043-2050) water demands. Future average is shown with and without climate change. The change in water demand without climate change is shown with solid bars and the change with climate change is shown with hatched bars. As shown in the figure, the overall future water demand relative to historical period without climate change (solid bar) shows a reduction of about 20 thousand acre-feet under Current Trends scenario. The reduction is double under Slow & Strategic Growth (45 thousand acre-feet). Expansive Growth scenario, however, shows a slight increase in demand (3 thousand acre-feet). Considering the 12 alternative climate change sequences (hatched bar), both the Current Trends and Expansive Growth scenario show a wide variation in future water demand. The Current Trends scenario shows a change in future water demand ranging from a 30 thousand acre-feet reduction to an increase of about 30 thousand acre-feet. Similar but slightly larger range of

Figure NL-5 **2050 Water demand changes, North Lahontan Hydrologic Region**



demands is shown under the Expansive Growth scenario with a reduction in demand of about 5 thousand acre-feet to an increase of about 60 thousand acre-feet. Increase in water demand under climate change is probably due to a warmer and drier climate. Slow & Strategic Growth shows a slight increase in future water demand of 7 thousand acre-feet to a reduction in future demand of 55 thousand acre-feet.

Urban Demand Change

Figure NL-5 shows change in urban water demand in the North Lahontan region with and without climate under the Current Trends, Slow & Strategic Growth and Expansive Growth scenarios. Without climate change (solid bar), both the Current Trends and Expansive Growth scenarios show an increase in future urban water demand. It was about 4 thousand acre-feet increase under Current Trends scenario and 10 thousand acre-feet under Expansive Growth scenario. Slow & Strategic Growth, on the other hand, shows a reduction in future demand of about 3 thousand acre-feet. When climate change is factored in, the Current Trends and Expansive Growth scenarios show an increase in future urban water demand, while the Slow & Strategic Growth scenario consistently shows a reduction in future demand.

Agricultural Demand

Change in agricultural water demand in the North Lahontan region is shown in Figure NL-5. Agricultural water demand is generally reduced due to reduction in irrigated acreage and increases in water conservation. Without climate change (solid bar), Slow & Strategic Growth shows a slightly larger reduction (40 thousand acre-feet), followed by Current Trends scenario (25 thousand acre-feet). Expansive Growth scenario shows slightly less reduction (about 7 thousand acre-feet). Considering the 12 alternative climate change sequences studied (hatched bar), both the Current Trends and Expansive Growth scenario show a wide variation in future agricultural water demand. The Current Trends scenario shows change in future demand ranging from 35 thousand acre-feet reduction to an increase of about 10 thousand acre-feet. The Expansive Growth scenario shows a reduction in water demand of about 30 thousand acre-feet to a rise in demand of about 50 thousand acre-feet. The increases in water demand are due to climate sequences with a warmer and drier climate. The Slow & Strategic Growth scenario shows a reduction in future water demand of 50 thousand acre-feet to an increase of 6 thousand acre-feet.

Environment

Figure NL-5 shows a base environmental water demand of about 370 thousand acre-feet in North Lahontan region. No additional environmental water demands are assumed for the North Lahontan region beyond current commitments. For Update 2009 we were not able to estimate additional environmental objectives for every region. Please refer to Volume 1, Chapter 5 for more information.

Appendix A. Flood Management

Historic Floods

Flood Parameters

Table NLA-1, Record floods for selected streams, is based on US Geological Survey records. The stations were selected from all US Geological Survey gaging stations in the hydrologic region, according to the criteria in Box NLA-1.

Box NLA-1 Selection Criteria

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

Flood Descriptions

Early Floods. During 1950-51, intense winter rainstorms produced flooding on the Truckee, Carson, and Walker Rivers. The floods of 1962-63 caused extensive damage in the Carson River Basin. Severe floods occurred from December 1964 to January 1965, causing heavy damage in the Truckee River Basin.

February 1968. Continuous rain for nearly a week in February 1986 caused extensive flooding in the Honey Lake watershed. The Susan River and storm drains overflowed, inundating roads and stranding travelers in Susanville. Flooding in Honey Lake Valley isolated many ranchers from emergency services.

February 1986. Continuous rain for nearly a week caused extensive flooding in the Honey Lake watershed. The Susan River and storm drains overflowed inundating roads

Table NLA-1 Record floods for selected streams, North Lahontan Hydrologic Region

Stream	Location	Mean annual runoff (taf)	Peak stage of record (ft)	Peak discharge of record (cfs)
East Walker R.	near Bridgeport	106	6.7	1,910
West Walker R.	near Coleville	204	10.2	12,500
East Fork Carson R.	below Markleeville Creek, near Markleeville	260	11.8	18,900
West Fork Carson R. [1]	at Woodfords	80	15.4	8,100
Truckee R.	at Tahoe City	165	9.6	2,690
Truckee R.	near Truckee	234	10.0	11,900
Little Truckee R.	below Boca Dam, near Truckee	129[3]	6.1	2,720
Trout Cr. [1]	near Tahoe Valley	26	11.1[2]	615

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

1 Regionally significant site with less than 100 sq mi tributary watershed area

2 Different date than peak discharge

3 Most recent but less than period of record

and stranding travelers in Susanville. Flooding in Honey Lake Valley isolated many ranchers from emergency services.

January 1997. In early January 1997, an intense rainstorm falling on a large snowpack caused catastrophic flooding throughout the region. It was estimated that 200-year flood stages were reached on the West Fork Walker River, which damaged approximately six miles of Highway 395 and 100 homes in Walker Valley. A swollen Truckee River destroyed sewer and power lines leading to ski resorts, inundated residences and stores in Truckee and damaged 20 bridges and several stream gages. In Alpine County, floodwaters washed out road shoulders, destroyed bridges, and damaged highways 4, 88, and 89; damages for the county were estimated at $8.4 million.

Flood Governance

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

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

Flood Risk Management

Structural Approaches

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

Table NLA-2 Flood management participants, North Lahontan Hydrologic Region

	Structural approaches						Land use management								Preparedness, response, and recovery										
	Flood projects						Floodplains			Flood insurance			Regulation		Data management			Flood education	Event management						
	Financing	Development	Construction	Operation	Encroachment control	Maintenance	Conservation	Restoration	Delineation	Administration	Participation	FIRM mapping	Building permits	Designated floodways	Data collection	Hydrologic analysis	Data station maintenance		Preparedness	Response management	Response personnel	System administration	Recovery funding	Recovery operations	Mitigation
Federal agencies																									
Federal Emergency Management Agency										●		●											●		●
National Weather Service															●	●	●	●	●	●	●				
US Geological Survey															●	●	●								
US Army Corps of Engineers	●	●	●	●	●	●									●	●	●	●	●	●	●		●	●	●
US Bureau of Reclamation		●	●	●	●	●												●	●	●	●				
State and regional agencies																									
California Conservation Corps																				●	●				
Department of Corrections																					●				
Department of Forestry and Fire Protection																				●					
Department of Water Resources	●	●	●	●	●	●			●	●		●			●	●	●	●	●	●	●		●	●	
Emergency Management Agency																			●	●	●	●	●		●
Tahoe Regional Planning Agency (CA-NV)							●	●																	
Water Resources Control Board		●																							
Local agencies																									
County emergency services units																			●	●	●				
County planning departments														●											
County building departments													●												
Local flood maintenance organizations				●	●	●																			
Local conservation corps																				●	●				
Local initial responders to emergencies																			●	●	●				
Placer County Flood Control and Water Conservation District		●		●	●											●									

Table NLA-3 Flood control facilities, North Lahontan Hydrologic Region

Facility	Stream	Owner (sponsor)	Description	Protects
Reservoirs and lakes				
Martis Creek L.	Martis Cr.	USACE	See Note 1	Martis Creek, Truckee River, and Reno
Prosser Creek Res.	Prosser Cr.	USBR	20 taf flood control	Prosser Creek, Truckee River, and Reno
Stampede Res.	Little Truckee River	USBR	22 taf flood control	Little Truckee River, Truckee River, and Reno
Boca Res.	Little Truckee River	USBR	8 taf flood control	Little Truckee River, Truckee River and Reno
Non-storage flood control facilities				
Truckee River Improvement	Truckee R.	USACE	Improved channel	Tahoe City

taf = thousand acre-feet

1 Because this dam is subject to piping failure, it does not reliably provide its nominal 1,000 acre-feet of flood storage.

Table NLA-4 Flood emergency responders, North Lahontan Hydrologic Region

Responder	Level	Comment
Person(s) or organization(s) on the site	0	Any emergency
Emergency services units of the three cities in the region	1	Any emergency
Emergency services units of the eight counties in the region	1 or 2	Any emergency, and by request from Level 1 responders
Department of Water Resources	2	Flood Operations Center, flood fight and Corps liaison
California Emergency Management Agency, Inland Region	3	Any emergency, Alpine, El Dorado, Lassen, Modoc, Nevada, Placer, and Sierra Counties, by request of county (operational area)
California Emergency Management Agency, Southern Region	3	Any emergency, Mono County, by request of county (operational area)
US Army Corps of Engineers	3	Specified water-related emergencies, by request of DWR
California Conservation Corps	3	Personnel and equipment for flood fight
Department of Forestry and Fire Protection	3	Personnel and equipment for flood fight
California Emergency Management Agency Headquarters	4	All emergencies, entire hydrologic region, by request of Cal EMA Region

Table NLA-5 Advanced Hydrologic Prediction Service stream forecast points, North Lahontan Hydrologic Region

River Basin	Stream	Location
Susan River	Susan River	Susanville
Truckee River	Tahoe Basin	Lake Tahoe Inflow
Truckee River	Prosser Creek	Prosser Creek Reservoir
Truckee River	Little Truckee River	Stampede Reservoir
Truckee River	Little Truckee River	Boca Reservoir
Truckee River	Truckee River	Farad
Carson River	West Fork Carson River	Woodfords
Carson River	East Fork Carson River	Markleeville
Walker River	West Walker River	Coleville
Walker River	East Walker River	Bridgeport Reservoir

Disaster Preparation, Response, and Recovery

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

Table NLA-5 is a list of forecast points that can be used in the Advanced Hydrologic Prediction Service of the National Weather Service.

Regional Water and Flood Planning and Management

Integrated Regional Water Management

The Tahoe Sierra Integrated Regional Water Management Plan, the region's only IRWM plan, acknowledges the critical role of flood control, and identifies one flood control project, the Trout Creek Flood Control and Restoration project. Phase 1 of the project was completed in 2005 and Phase 2 will be implemented in the near future.

Appendix B. Selected References

General

Other general references for the North Lahontan Regional Report can be found in "Assumptions and Estimates" in Volume 5 Technical Guide of the Water Plan.

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Due to resource constraints, the North Lahontan Regional Report comes from either California Water Plan Update 2005, from contributing authors such as those from DWR's flood division and Northern Region Office in Red Bluff, or from readily available sources. Prime among the readily available sources was the Internet. Find a table in Volume 5 Technical Guide that presents detailed Internet resources. It is in chronological order according to when the Web site was visited.

Citations to the World Wide Web (URL) were accurate at the time of writing

The California Water Plan provides a framework for resource managers, legislators, Tribes, other decision-makers, and the public to consider options and make decisions regarding California's water future. Our goal is that this document meet Water Code requirements, receive broad support among those participating in California's water planning, and be a useful document. With its partners, DWR completed the final Update 2009 volumes and Highlights in December 2009.

The first four volumes of the update and the Highlights booklet are contained on the CD attached below. All five volumes of the update and related materials are also available online at *www.waterplan.water.ca.gov.*

Volume 1: The Strategic Plan
Volume 2: Resource Management Strategies
Volume 3: Regional Reports
Volume 4: Reference Guide
Volume 5: Technical Guide

For printed copies of the Highlights, Volume 1, 2, or 3, call 1-916-653-1097.
If you need this publication in alternate form, contact the Public Affairs Office at 1-800-272-8869.

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