VENTURA COUNTY STAR

Part 1

Running dry

Population growth, imperiled wildlife, global warming among factors soaking up limited water

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John Krist / Star staff
After the Green River leaves the Wind River Range in the northern Rockies, it winds across dry, high-elevation plains before turning south and heading for the canyonlands of the Southwest. It's the longest tributary of the Colorado River, which supplies much of the West's water.

BRIDGER WILDERNESS, Wyo. -- Here on the roof of the continent, a treeless landscape where only the piping of small birds breaks the silence, spires of naked rock cradle a small tarn named Peak Lake. Remote and isolated, it is often visited more by elk than by humans. Despite its distance from civilization, it is the perfect place to contemplate a crisis that might soon confront the fast-growing cities and suburbs of the American West.

There are many ways to describe that crisis. The U.S. Department of Interior, using the dry, cumbersome language of bureaucracy, put it this way in a recent report: "In some areas of the West, existing water supplies are, or will be, inadequate to meet the water demands of people, cities, farms and the environment even under normal water supply conditions."

Translation: too many people and too little water.

Peak Lake is milky gray-green, the characteristic hue of water in which extremely fine glacial silt -- rock that has been ground into flour by moving ice -- is suspended. Small glaciers still lie among the windswept peaks of the Wind River Range; their icy breath flavors the breeze, and their meltwater colors the lake.

The Wind River Range is a craggy link in the Continental Divide, a chain of mountains, hills and bumps in the prairie that winds across North America from top to bottom and separates rivers that flow east from those that flow west. The divide is topographically decisive and hydrologically implacable: A pair of raindrops that fall at the same time from the same cloud but land on opposite sides of a ridge, perhaps only a few feet from each other, are destined for different oceans thousands of miles apart.

Peak Lake is on the Pacific Ocean side of the divide. It is 10,515 feet above sea level, and snow may fall there in any month of the year. A handful of water dipped from its outlet stream is as clear and cold as a well-made martini, although James Bond would be disappointed by the lack of flavor and absence of spirituous kick.

Important river system

Peak Lake is the most upstream gathering of waters in the drainage of the Green River, the longest and therefore primary tributary of the Colorado River, which makes it the ultimate source of the most important river system in the West. All told, about 30 million people in two countries rely on the Colorado and its tributaries for all or part of their water and electricity. The Colorado provides half the water supply of the Metropolitan Water District, which serves nearly 18 million people in six Southern California counties, including two-thirds of the population of Ventura County.

John Krist / Star staff
Rising 502 feet above the Green River in Utah, Flaming Gorge Dam is one of four major water-storage projects in the Upper Colorado River drainage system.

If you think of the complex interaction of all the thousands of dams and pumps and pipes moving water from the Colorado and other rivers around the West as the hydraulic equivalent of an orchestra playing Beethoven's Fifth Symphony, touching the limpid water of Peak Lake is a bit like placing a finger on a single vibrating string of a single cello in the orchestra's fifth row. It connects you, however tenuously, to all the rest.

Or so you can imagine, as wan autumn sunlight glints off the surface of Peak Lake and wind whispers through frost-gilded grass along its shore. If your visit to that lake has come near the end of a journey that led you thousands of miles across seven states in an effort to understand how the region's plumbing systems work -- and how they must change to meet the needs of a growing population -- you might imagine something else.

You might imagine that when your hand touches that icy water, it feels the thrum of electrical generators, the spritzing chatter of irrigation sprinklers, the stroke of a canoe paddle in the quiet water of a delta wetland nearly 2,000 miles away. You might imagine you feel the handshake of farmers and city dwellers, commercial fishermen and duck hunters, cattle ranchers and restaurant dishwashers. You might feel the pulse of the West's past and its future.

Yoked to a common fate

Peak Lake is 18 miles by trail from the nearest road, which is rutted dirt. The trailhead is 56 miles from the nearest town, which is small and has the battered, utilitarian appearance of a 20-year-old pickup truck. The lake is 1,840 river miles from the Colorado's mouth, which is in Mexico at the Gulf of California.

In exceptionally wet years, the river meets that arm of the Pacific, also known as the Sea of Cortez and identified on some very old maps as the Vermillion Sea. In most years, however, barely a trickle of water finds its way there, and much of that is drainage from Mexican sewers and American farms, bearing only weak molecular kinship with the snowmelt gathered in Peak Lake.

The rest of the river system's natural flow is diverted for human use through a gargantuan network of dams and canals. The diverted water ends up in places as diverse as the lawns of Denver suburbs, the melon fields of southern Arizona, the golf courses of Las Vegas, the cotton fields of Mexicali and the kitchen faucets of Los Angeles.

When talking about water in the West, and particularly when talking about the region's most thoroughly manipulated drainage, the Colorado River watershed, numbers tend to fly as thick as snowflakes in a northern Rockies blizzard. The height of dams. Miles of river channel and lake shoreline. The storage capacity of reservoirs. Acre-feet, millions of gallons per day and cubic feet per second. Kilowatts of hydroelectric generating capability. This preoccupation with numbers reflects the historical pre-eminence of engineers in the management of the region's most precious resource.

Yet none of these figures, singly or even in aggregate, conveys the essence of the region's vast plumbing systems -- neither the system provided by nature nor the artificial version assembled over the past century to compensate for the perceived shortcomings of rivers and rainfall.

Nor do numbers alone effectively convey the nature of the profound challenges now threatening the integrity of the West's vast plumbing systems. Those challenges might also threaten the economic and social vitality of a region that depends upon those systems the way an emphysema sufferer relies on the plastic tube from a portable oxygen tank.

To really understand the West's life support system -- and the looming forces that might forever change the way it operates, as well as the way people live and work in the fastest-growing yet driest region of America -- requires a close-up look at the rivers and aqueducts that sustain it. It requires an appreciation of how those waterways link the fortunes of otherwise disparate communities, separated by vast geographic and cultural distances yet yoked to a common fate by their dependence on the same interconnected water system.

It requires following a drop of water from a river's headwaters to the sea, and it requires meeting some of the people who cherish, manipulate, fight over and manage that water.

Water has always been precious in the semiarid West, and the vast system of dams, aqueducts and pumps constructed over the past century at enormous public expense is mute evidence of a single, stark fact: It doesn't rain enough in most of the region to grow food or sustain industry. Yet the people of the West have behaved almost as if the native aridity of their adopted home does not matter, founding agricultural empires and urban population centers in places poorly equipped by natural hydrology to support them.

Craig Mailloux/ Star staff
The California Aqueduct zig-zags its way into northwest Los Angeles County as it carries water from Northern California. All the West's water sources are under increasing pressure.

Farmers in California's Imperial Valley, for example, grow a billion dollars worth of hay, melons, lettuce and other crops every year in a desert basin that receives less than 3 inches of rain annually. Las Vegas, the fastest-growing city in America, is likewise situated in a desert; the life-giving springs that first attracted settlers to it ("las vegas" means "the meadows" in Spanish) can support but a tiny fraction of the more than 1.5 million people who now call it home.

For 100 years, the region has been engaged in a sort of hydrological Ponzi scheme, borrowing water from one watershed after another to pay off the debt incurred by semi-desert cities and farms established in locations lacking adequate supplies of their own. The U.S. Bureau of Reclamation, established in 1902 and charged with studying potential water projects in Western states containing federal lands, became the pre-eminent enabler of that practice: It has built more than 600 dams and reservoirs in 17 states at a cost the General Accounting Office has calculated to be $21.8 billion.

By its own accounting, the bureau operates 58 power plants that generate 40 billion kilowatt-hours of electricity a year and light 6 million homes, delivers 10 trillion gallons of drinking water annually to more than 31 million people, and provides irrigation water to 140,000 farmers whose 10 million acres of cropland produce 60 percent of the nation's vegetables and 25 percent of its fruits and nuts.

In California, the bureau's domain includes the mammoth Central Valley Project, a network of 20 dams and reservoirs, 11 power plants and 500 miles of major canals and aqueducts. The CVP irrigates more than 3 million acres and supplies municipal and industrial water to 2 million urban residents. Locally, the agency's legacy includes lakes Casitas and Cachuma.

There's alarming evidence, however, that a day of reckoning is finally approaching.

Lake Mead and Lake Powell are the two biggest reservoirs in the United States, together capable of holding more than 54 million acre-feet of water (an acre-foot is 325,851 gallons, enough to cover a football field a foot deep, enough to supply two average Southern California households for a year). Today, however, they hold only half that, thanks to a brutal drought without precedent in recorded history. Lake Powell is at 42 percent of capacity; it has not been that empty since it was being filled for the first time nearly 40 years ago. The last time Lake Mead was half full, astronauts were about to set foot on the moon for the first time.

In California, thousands of acres of farmland in the Sacramento, San Joaquin and Imperial valleys are being fallowed so the water once used to grow crops on them can be sold to cities.

In drought-plagued Colorado, legislators are trying to revive "The Big Straw," a multibillion-dollar project that would siphon water from the west side of the Rockies and send it through a giant tunnel under the mountain range to slake the thirst of growing suburban communities on the east side.

And throughout the West, urban agencies, farmers and environmentalists are squaring off in court and in the hallways of state capitols, struggling over a water supply that no longer seems adequate to meet all the demands placed upon it. In the past two years, those conflicts have erupted into headline-grabbing showdowns in the Klamath Basin on the California-Oregon border, along the Rio Grande in New Mexico and in the Imperial Valley in the southwest corner of California.

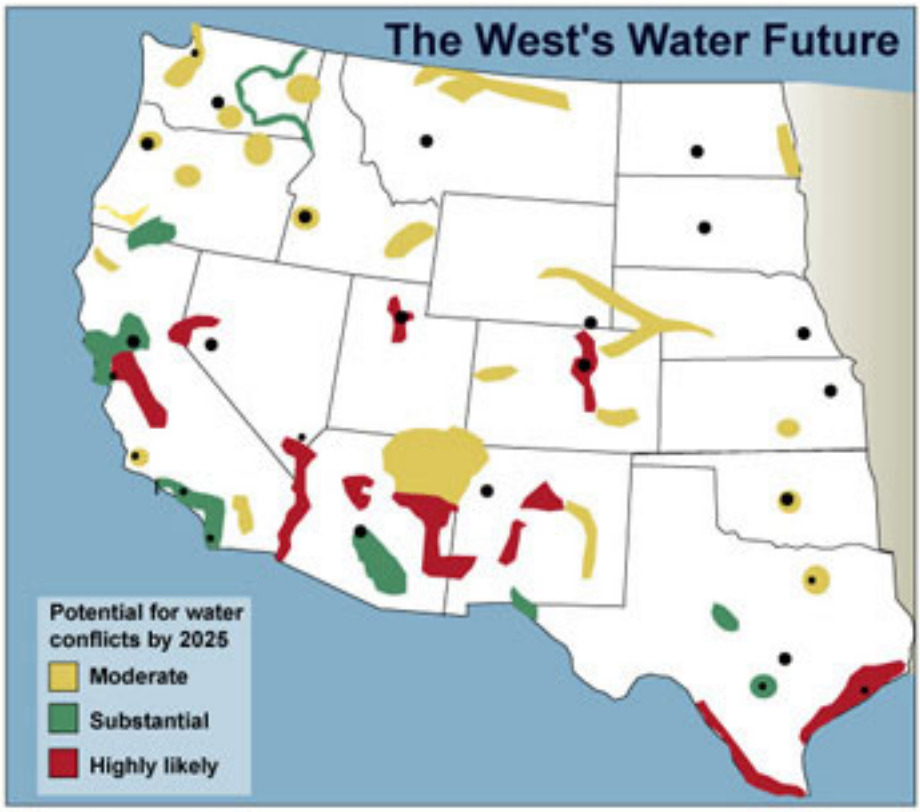
The growing thirst

Regarded one at a time, these incidents seem merely like business as usual in the drought-prone, semiarid West. Together, however, they form a pattern of warning signs, evidence of a system under profound stress.

Part of the problem is simple population growth: The West is the fastest-growing region of the nation, and strategies devised in the middle of the 20th century, when it was home to fewer than 20 million people, barely work now that it is home to nearly 69 million and are unlikely to suffice when that figure grows to more than 84 million, as it is projected to do by 2025.

Hammering that point home, the U.S. Department of Interior released a report in May 2003 titled "Water 2025: Preventing Crisis and Conflict in the West," in which the parent agency of the Bureau of Reclamation tries to lay out a blueprint for water development in the region over the next two decades. Perhaps the most striking component of that report is a map titled "Potential Water Supply Crises by 2025," which uses gradations of color to indicate the potential for shortages and conflict in various population centers and watersheds -- yellow for "moderate" potential, orange for "substantial," red for "highly likely."

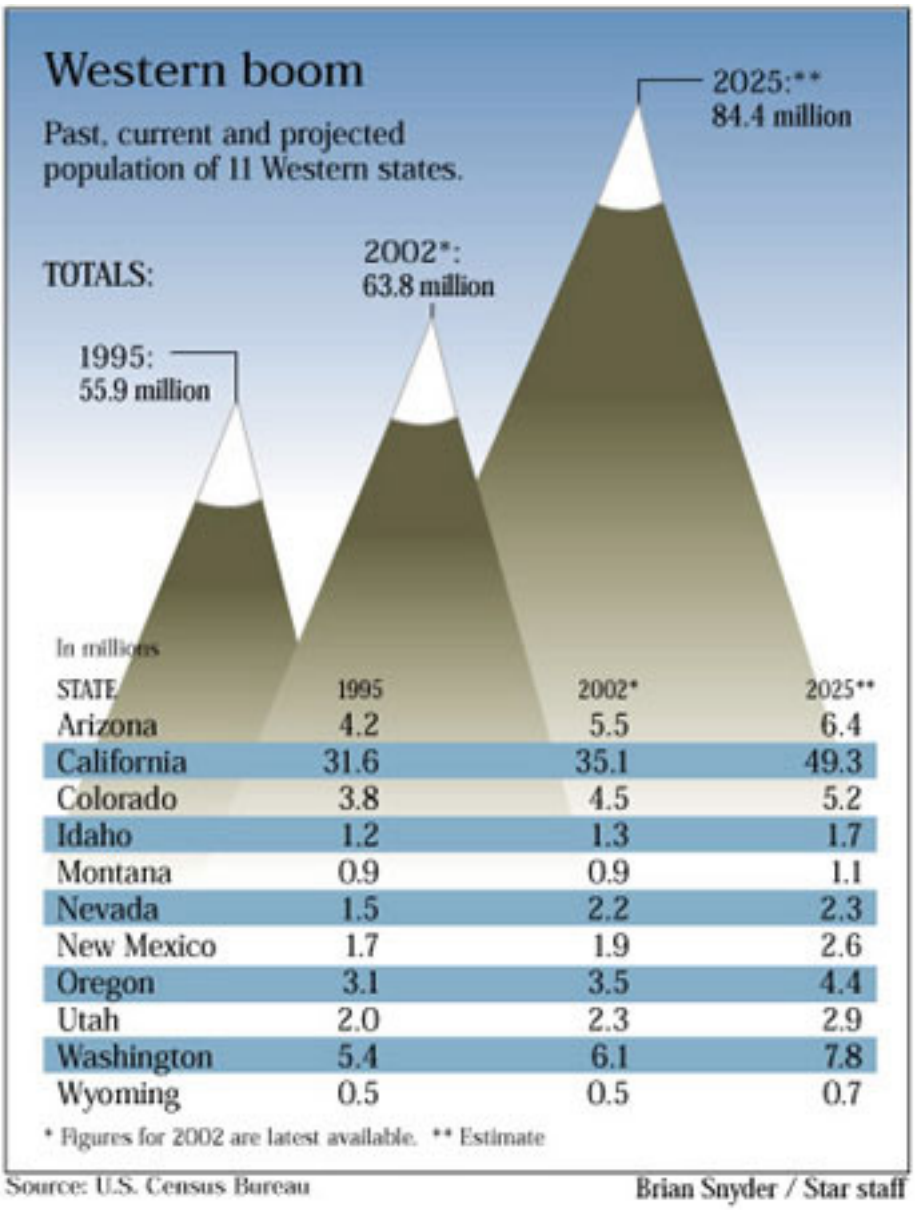
The map depicts a West lit up like a hellish Christmas tree: angry red blanketing Las Vegas and the



Source: U.S. Department of Interior Brian Snyder / Star staff

lower Colorado River, California's Central Valley, the Tahoe-Reno area, Salt Lake City, the entire Rocky Mountain foothills zone north and south of Denver, nearly the entire southern border of Texas, and huge swaths of Arizona and New Mexico; burnt orange for the San Francisco Bay area and the entire Southern California coastal region; sickly yellow highlighting nearly every other significant waterway and metropolitan area in the bureau's 17-state domain.

Besides population growth, the supply is being stretched thin by another factor: There are new water users in the West, although it's not really accurate to call them new. They've been around for a long time, but their needs were not factored into the allocation and distribution equations when American settlers and their descendents divvied up the region's waters.



Among those "new" users are endangered species, their peril the direct consequence of water development projects. Scores of them inhabit the rivers and wetlands of the West, and courts have ruled that their needs trump even seemingly ironclad delivery contracts and water rights. Also "new" to the water equations are American Indian tribes, many of them invigorated by newfound wealth from gaming, that are beginning to claim water rights guaranteed them generations ago in treaties but never exercised.

And finally, there is a novel factor in the water arena that has the potential to upend every assumption ever made about how rain, snow and rivers behave in the West: global warming, which climate experts say is already bringing a shift toward less winter snowfall and more winter rain throughout the mountain watersheds of the region. That's a pattern for which the region's multibillion-dollar network of flood-control dams, water-storage reservoirs, aqueducts and pumps was not designed, and it is not clear how the system will continue to function if the premise upon which it was built evaporates like a puddle on a hot driveway.

"By and large, reservoirs and water delivery systems and operating rules have been developed from historical hydrology on the assumption that the past is a good guide to the future," Maurice Roos, the state's former chief hydrologist, wrote in a paper prepared for a committee helping update the California Water Plan. "With global warming, that assumption may not be valid."

So here, in a sentence, is the future that faces the West: Its population is skyrocketing and its water supply is being squeezed by legal claims, the needs of imperiled wildlife and global climate change.

Now what?

Klamath Basin is an indicator of West's future

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KLAMATH FALLS, Ore. -- Don Gentry dipped a long-handled net into a plastic tank of cloudy water, and with a quick lunge snared a small fish, perhaps 10 inches long. He raised it from the tank and cradled it gently in his hands. The scales on its streamlined body gleamed metallic silver in the dim light, and its downturned mouth gasped silently against the sudden flood of oxygen.

"This is c'wam," he said, pronouncing the word as if it were spelled "schwaam," and with a tone suggesting reverence. Gentry, a natural resource specialist for the Klamath Tribes, held the fish for a few moments as if to invite admiration for it, then slipped it back into the tank, one of several arrayed on racks inside the tribal fish hatchery.

Jason Redmond / Star staff
Don Gentry, natural resource specialist for the Klamath Tribes, shows off a c'wam, or Lost River sucker, at the tribal fish hatchery.

C'wam is the Klamath name for what science recognizes as the Lost River sucker. White settlers in the region -- a high-elevation basin straddling the California-Oregon border -- called the fish "mullet" during the early 20th century. The descendents of those settlers more recently have called it many other things, some of them unprintable, but mostly just "sucker fish." As a rule, this is uttered in a tone of disdain.

The small fish is at the center of a very large political, cultural and legal battle that has widened beyond the Klamath Basin to entangle policymakers in Washington, D.C., corporate agribusinesses in the San Joaquin Valley, commercial fishermen on the Pacific Coast, lawmakers in Sacramento and environmental activists across the country. It is a messy and fiendishly complicated conflict that pits American Indian tribes against mostly white farmers, fish against people, fish against birds, those who make their living from the sea against those who make it growing crops, and wildlife lovers against wildlife refuge managers.

In essence, though, it's a fight over water. And in its complexity and bitterness, the fight in the Klamath Basin offers a troubling preview of battles looming in watersheds throughout the American West, the fastest-growing -- and driest --region in the nation.

"The convergence of issues here has created the perfect storm of conflict between the Endangered Species Act, tribal rights, farmers, refuges and drought," said Dan Fritz, environmental specialist in the U.S. Bureau of Reclamation's Klamath office. "If we can't find a solution here, I don't think that gives much hope for finding a solution in these other hot spots throughout the West."

The Klamath Basin's economy depends heavily on farming, and that farming depends almost completely on water diverted from the basin's lakes and rivers by an elaborate irrigation project built nearly a century ago by the federal government. In July 2001, the basin's lakes and rivers shriveled by drought, the bureau shut down that project in the middle of the growing season to ensure adequate water for three threatened and endangered fish species.

Besides c'wam, Upper Klamath Lake and its tributaries are home to a similar species, the shortnose sucker, which members of The Klamath Tribes refer to as "qapdo." This is pronounced "kawp-doo,"

uttered while swallowing the first consonant. Both the Lost River sucker and the shortnose sucker have been federally listed as endangered since 1988. Living in the Klamath River downstream from Upper Klamath Lake are coho salmon, which have been listed as threatened since 1997.

John Krist / Star staff
Designated a Wild and Scenic River in 1981, the Lower Klamath River flows through forested canyons as it makes its way to the Pacific Ocean near the town of Klamath. The fights over its water are a preview of what much of the West could face.

Battle begins

When the bureau shut off the irrigation system, halting water deliveries to about 85 percent of the basin's farms, a battle began. Hundreds of outraged farmers and their supporters surrounded the main irrigation canal's control structure and turned the water back on, retreating only when federal law enforcement agents arrived.

Protesters came from as far away as Nevada, Montana and Malibu. They included property-rights activists, disaffected ranchers, unemployed loggers, irate gun lovers, right-wing radio talk-show hosts, conspiracy-minded militia groups and assorted critics of liberal government and the environmental movement.

Among their props was a giant metal bucket, a symbolic water delivery to parched Klamath farms. Although the out-of-town horde drawn by the 2001 water shutoff has long since departed, the bucket -- with an American flag on top and the words "Klamath Bucket Brigade" painted on the side -- still stands in front of the Klamath County Government Center on Main Street in Klamath Falls. It is a not-so-subtle reminder that the political, social and economic upheaval ignited more than two years ago by the water shutoff has not really ended.

To understand why the conflict started -- and why it persists -- a good place to start is the Bureau of Reclamation's Klamath Basin Area Office, located in a nondescript cluster of buildings near Klamath Falls International Airport.

Klamath Falls is a small town, population just over 19,000, and feels even smaller than that. It's the kind of place where people say hello to strangers for no apparent reason and engage them in polite small talk in the checkout line of the grocery store. It occupies a scenic setting, surrounded by lush valleys and sage-covered benchlands.

The nights are often cold; Klamath Falls is about 4,000 feet above sea level, and a killing frost may come in July. Most of the basin is farmed or grazed, and it is ringed by mountains. Sixty miles away but clearly visible, Mount Shasta juts into the sky above the horizon like a snow-draped mirage.

Parting the waters

The basin floor receives just over 12 inches of rain a year -- about the same as Oxnard and less than downtown Los Angeles, which averages 14 inches. The surrounding mountains, however, receive a great deal of snow and rain each winter, and runoff drains from their slopes into the basin, where the natural topography historically allowed it to accumulate in prodigious quantities.

Jason Redmond / Star staff
An egret stands in the marshes of Upper Klamath Lake. The area's six wildlife refuges depend almost entirely on irrigation drainage for continued water supplies.

"Basically, we're in a swamp. That's how the place started out," said Cecil Lesley, chief of water and lands in the bureau's Klamath Office.

A 1906 topographic map hanging on the wall inside a conference room at the bureau office shows marsh and open water occupying nearly every flat acre in the basin. Three big, shallow lakes -- Upper Klamath, Lower Klamath and Tule -- sprawl across the landscape, each surrounded by a vast expanse of cattails, sedges and other wetlands plants.

It was by far the largest wetlands complex west of the Mississippi, about 350,000 acres in all, and as many as 6 million waterfowl could be found there at one time during the autumn migration. The lakes and their tributaries also supported huge populations of suckers, which grew to tremendous size and tasted as fine as salmon and trout, according to contemporary accounts. American Indians harvested them by the ton

Photo courtesy of the Klamath Tribes
This Klamath Basin photo from the 1920s shows a Klamath woman grinding the seeds of a wocus.

during the spawning season. They also hunted ducks and gathered the seeds of the wocus, a water lily, in the marshes.

For birds, fish and the indigenous people who took advantage of its natural abundance, the basin was a watery paradise. To the white settlers who arrived in the late 1800s and dreamed of farming, the aquatic landscape depicted on the old map was a nuisance -- and an opportunity.

They soon acquired the means to take advantage of that opportunity. In 1902, President Theodore Roosevelt signed the Reclamation Act, creating the Reclamation Service, a division of the U.S. Geological Survey. The new agency was charged with studying potential water projects in Western states containing federal lands, and one of the first places it looked was the Klamath Basin. In 1903, the bureau began devising a plan to drain the wetlands and some of the lakes, and then pump water back to the "reclaimed" land for irrigation.

Construction of a system of dams, diversions and canals began in 1906 and continued in phases over the next 20 years. In 1907 the Reclamation Service was removed from the Geological Survey, renamed the U.S. Bureau of Reclamation and made an independent agency within the Department of Interior. By the time the bureau was finished with its work, Tule Lake and Lower Klamath Lake had virtually ceased to exist, along with 80 percent of the basin's wetlands. The world depicted by the 1906 map in the bureau's office had been erased and its outlines redrawn.

Homesteaders began settling on the formerly submerged land in 1917, continuing until 1949. Many of the homesteaders were military veterans of the two world wars who'd been invited to claim that free land by Uncle Sam, injecting into the settlement process a sense of patriotic obligation that the descendants of those first claimants are not reluctant to call upon today when criticized over their farming methods.

About 1,400 farms, encompassing about 200,000 acres of cropland, now receive irrigation water from the bureau's Klamath Project under perpetual contracts that promise them as much as the project can deliver. Most of the farms are small, and they grow hardy crops suited to the short growing season: alfalfa, potatoes, grain, mint, horseradish, onions, even root stock bound for strawberry fields in California.

Jason Redmond / Star Staff
The marshes of the Upper Klamath Refuge along the Upper Klamath Lake are a small remnant of the wetlands that covered most of the Klamath Basin in the late 1800s. In 1902, President Theodore Roosevelt signed the Reclamation Act, creating the Reclamation Service, a sign the landscape would change.

"In the early development of the country, in the Western United States, people needed water," said Christine Karas, the bureau's deputy area manager. "And the mission of the Bureau of Reclamation was to get out there, drain areas to create productive farmland, and create projects that would deliver reliable sources of water. And we did an excellent job of that.

"Today, there are competing values amongst the American public. People today want recreation, and fish and wildlife benefits, and all these other things. Today, we struggle to balance all of the public's needs and values, and still maintain the benefits of the project."

According to its critics, the agency is failing to maintain that balance. They say that by diverting so much of the basin's water onto farms instead of allowing it to fill lakes, nourish marshes and flow downstream to the sea, the bureau and the Klamath Basin farmers are directly to blame for the demise of fish, birds and other water-dependent species.

A similar assertion has been made about nearly every major water project in the West.

Dueling demands

"It isn't that anybody is right or wrong," said Wendell Wood, the southern field representative for the Portland-based Oregon Natural Resources Council, which has been involved in numerous lawsuits over operation of the Klamath Project. "Very simply stated, it's just a matter of too many people putting too many demands on a very limited resource. The Klamath Basin really is relevant to the rest of the country because what happens here is really representative of the same issues we face in the arid intermountain West, where there's more people than there is water."

Jason Redmond / Star Staff
"It isn't that anybody is right or wrong. Very simply stated, it's just a matter of too many people. putting too many demands on a very limited resource. The Klamath Basin really is relevant to the rest of the country because what happens here is really representative of the same issues we face in the arid intermountain West, where there's more people than there is water," said Wendell Wood, southern field representative for the Portland-based Oregon Natural Resources Council.

About 450,000 acre-feet of water is diverted each year into the Klamath Project irrigation system (an acre-foot is 325,851 gallons, enough to cover a football field a foot deep, enough to supply two average Southern California households for a year). There also are 350 private water diversions upstream from the Klamath Project, withdrawing a similar amount. An additional 30,000 acre-feet on average is diverted each year from the Klamath Basin into the Rogue River Basin to serve the Medford area.

Only about 20 percent of Upper Klamath Lake's historical wetlands remain, Wood said, and by the end of summer even those remnants dry up as the lake level drops to feed the irrigation project. Nearly all the wetlands remaining in the Klamath Basin are managed by the U.S. Fish and Wildlife Service as a complex of six wildlife refuges. The remnant ponds and marshes in the refuges are sustained almost entirely by irrigation drainage, making wildlife managers dependent on farmers for the timing and quantity of water they receive. (One underappreciated irony of the 2001 water shutoff to save fish was that it also dried up the wildlife refuges, jeopardizing the survival of thousands of birds.)

Bird counts have dropped substantially since the Klamath Project was built, but the refuges still draw as many as 3 million birds a year and are a key refueling and resting stop for three-quarters of the migrating birds on the Pacific Flyway. They support the largest wintering population of bald eagles in the United States outside Alaska.

It isn't just birds and fish that are imperiled by Klamath Project water diversions, Wood said. On the Pacific Coast more than 200 river miles downstream from Klamath Falls, commercial fishermen once made a good living catching salmon that spawned in the Klamath River. But the collapse of the salmon has all but wiped out that industry. At the same time, the salmon's decline has eviscerated the traditional resource base of coastal Indian tribes such as the Yurok, Karuk and Hoopa, dealing a powerful economic blow to them as well.

"The commercial fishermen estimate that they've lost 3,150 family-wage jobs in a little over a decade, which was a loss of $75 million annually," Wood said.

The blame for declining salmon, suckers and birds lies with agricultural diversions, according to Wood and others. The best solution, Wood said, is for the federal government and private conservation groups to buy out Klamath Basin farmers who are willing to sell their land, and dedicate the water they were using to the needs of fish and wildlife.

"The solution is demand reduction," Wood said. "Who should give up the water? Those who are willing to. ... There's always going to be agriculture in the basin. Our point is simply that we've benefited one economy -- we would argue that the agricultural economy has been heavily subsidized all the way around -- at the expense of other economies."

Klamath Basin farmers don't think of themselves as being subsidized, arguing that they've paid for the project's construction and operations through their water bills. Nor do they readily accept blame for the plight of threatened and endangered species with which they share the Klamath watershed.

Competing explanations

"We're an easy target for those who don't like irrigated agriculture," said Dan Keppen, executive director of the Klamath Water Users Association.

Hitting that target became easier in September 2002, a year after the standoff at the canal headgates near Klamath Falls, when about 34,000 salmon and other fish washed up dead on the shores of the Lower Klamath River. The episode launched a series of dueling studies and reports by public agencies and private think tanks, further enlarging the already voluminous and frequently contradictory body of research, opinion and political hyperbole generated by the Klamath conflict.

One of those reports, issued Nov. 18 by the U.S. Fish and Wildlife Service, concluded that low river flow caused by Klamath irrigation diversions was partly to blame for the 2002 salmon deaths. An earlier report by the National Research Council found, however, that simply releasing more warm lake water into the river was unlikely to benefit salmon, which require not just more water but colder water to survive.

Keppen said the region's farmers are the victims of misinformation spread by environmentalists, native tribes and California Democrats, who have enlisted biased newspaper reporters, biased scientists and bogus economic studies in their campaign to force Klamath growers off the land by blaming them for the fish mortality.

"It's been exploited by extreme elements in the environmental community in a very coordinated attack against Klamath Project agriculture," Keppen said.

Victims of misinformation

Keppen said the association's fish biologist has concluded that it's the natural condition of Upper Klamath Lake -- warm and low in oxygen -- that causes suckers to die, and that the mass salmon mortality of 2002 was the result of an abnormally cool period that lured the spawning fish into the river unusually early in the season. That was followed by a sudden and uncharacteristic warming trend that drove water temperatures to deadly levels, he said. Klamath project operations, he contended, had nothing to do with it.

He also contends that the fate of salmon in the Klamath River has less to do with farms in the Klamath Basin than with farms more than 450 miles away in California.

Each year, as much as 90 percent of the flow in one of the Klamath River's main tributaries, the Trinity River, is diverted into a series of tunnels, pipelines and aqueducts that carry the water east through the Trinity Mountains and dump it into the Sacramento River. From there, it flows downstream to the Sacramento-San Joaquin river delta, where pumps near Tracy withdraw it for eventual delivery to the San Joaquin Valley through the Bureau of Reclamation's Central Valley Project.

In most years, that diversion removes 1 million acre-feet from the Trinity, which joins the Klamath River 41 miles from the sea. Had some of that water been available to salmon in the summer of 2002, Keppen said, they likely would have survived.

Many of Keppen's arguments sound plausible, and they clearly are comforting to the embattled farmers, but environmentalists counter that the assertions by the water-user association do not really address the irrefutable fact at the heart of the Klamath Basin controversy: There used to be a lot of fish in Upper Klamath Lake and its tributaries, as well as in the Klamath River, and now there aren't. Past conditions allowed them to survive and current conditions do not.

Jason Redmond / Star Staff
Water from a well supplements Klamath Project water to irrigate crops in the Tule Lake Irrigation District. Farmers consider themselves easy targets for those who want water for other uses such as fish and wildlife protection or urban dwellers.

Even if the solution is to take water from farmers, however, such a decision would impose its own costs, although they are social instead of biological. And perhaps this is the overriding lesson offered by the situation in the Klamath Basin: Every decision about water allocation in the West involves trade-offs.

Rob Crawford knows about some of those trade-offs.

"In 2001, I saw a lot of good farmers -- not marginal farmers -- go out of business," he said. "I saw people I loved destroyed by it."

The son of a farmer, Crawford grew up in the Klamath Basin and now grows onions, peppermint, potatoes and wheat. The cutoff of irrigation water two summers ago, he said, didn't just dry up fields of hay and grain but also people's gardens, the schoolyards, the cemeteries, the Little League fields. It didn't just put people out of business; it unraveled the social fabric of small farming towns throughout the basin.

According to an analysis by researchers at Oregon State University and the University of California, the curtailment of irrigation deliveries -- although partially offset by increased groundwater pumping and a late-season release ordered by Interior Secretary Gale Norton -- cost the region 700 jobs and $29 million in economic losses.

"You know, this is a pretty little community," Crawford said. "You'd see a thousand or 2,000 protesters, and I mean, it was amazing. They were saying, 'This is wrong.' You don't realize what you have till it's gone. We saw how it could go."

Klamath Basin farmers aren't the only ones who have seen how it could go.

Paying the price

Although it is only about 30 miles north of Klamath Falls, the small town of Chiloquin is on the other side of a social, cultural and racial divide. It is where the Klamath Tribes -- a confederacy comprising the Klamath and Modoc tribes, and the Yahooskin band of Snake Indians -- have their headquarters, along with a casino and other tribal enterprises.

The record of relations between Indians and the U.S. government in the Klamath region over the past 150 years is about what any careful student of American history would expect: Whites began moving into the area in the mid-1800s, and in 1864 the Klamath Tribes were pressured into signing a treaty under which they ceded more than 20 million acres of their ancestral lands to the U.S. government. Accepting confinement on a reservation of fewer than 2 million acres, they retained the right to hunt, fish, gather and trap on those lands in perpetuity. Against long odds, the tribes managed to become economically self-sufficient. But efforts to whittle away at their assets did not end in the Civil War era. In 1954, under a policy by which the U.S. government hoped to force American Indians to join the majority culture, the Klamath Tribes were "terminated" by congressional decree -- no longer recognized as a sovereign entity by the United States, federal social-service programs canceled, reservation lands seized and sold.

In essence, Congress declared that because the tribes had managed to become economically self-sufficient, they were ready for assimilation, which meant they no longer needed the reservation timber and ranch lands that had enabled them to become economically self-sufficient.

Twenty years later, the Klamath Tribes won a court ruling that they had not relinquished their traditional hunting, fishing and water rights when they ceded their lands, and in 1986 they regained federal recognition of their tribal status. They are still negotiating for return of the reservation lands lost through termination, most of which ended up in Oregon's Winema and Fremont national forests.

The tribes also are vocal advocates of efforts to restore fish populations. Suckers and salmon were once astonishingly abundant, and they fulfilled roughly the same role in Klamath culture that bison did in the native cultures of the Great Plains: both food and object of reverence, a sacred staple. Now, the tribes are allowed to catch only two suckers a year for ceremonial purposes.

Gentry, the tribes' natural resource specialist, remembers fishing with his father for c'wam and qapdo, and to him the loss of the fish strikes at the heart of his tribe's identity.

"It's kind of a sad thing, the changing times," he said. "Our lifestyle, our culture, our views and our values are threatened."

Farmers vs. Indians

The summer of 2001 was a difficult time for white farmers in the Klamath Basin, but it was also tough for members of the tribes. Because the halt in irrigation deliveries was intended to protect fish important mainly to American Indians, much of the anger among white farmers in the region was directed at tribal members.

"We weren't even considered a part of the community," Gentry said. "Anybody who stood up for the fish was less than patriotic. I'm just now starting to feel comfortable again going into Klamath Falls."

At the height of the tension, a carload of drunken white men drove through Chiloquin firing shots at signs and an outhouse, shouting racial slurs and harassing teenage boys on a school bus heading for a basketball game, singling out tribal members and calling them "stupid Indians." They also called out, "Sucker lovers come on out and fight," according to an Associated Press account of their trial, during which they pleaded guilty to felony charges of conspiracy to commit criminal intimidation and unlawful use of a weapon.

The suspicion continues more than two years later. Some in the white community allege the tribes are using the issue of water flows and endangered fish as leverage to force the Forest Service to return native lands, something the tribes hotly deny. The real source of the conflict, they say, is overallocation of the region's water supply by various government agencies.

"If we look at the whole Klamath Basin, the first commitment of water that was made was to the native people of the basin," said Carl "Bud" Ullman, the tribes' attorney. "There were similar deals made with the downstream tribes."

"Then the Klamath irrigation project comes on the scene, and people -- non-Indians mainly -- were recruited to come to the basin and help settle the basin. They were promised sufficient water to do that if they would come and do the hard work of homesteading in an arid land. ... The problem was there was no attempt made to reconcile the promise of water made to these people with the earlier promises that were made to the native people.

"Simply put, the promises of water in the basin far exceed what nature gives us to meet all the promises, even in an average water year ... the situation here is typical of what the West faces in a lot of instances."

So, again the issue comes down to many users fighting over a limited amount of water.

In the Klamath Basin, there are a number of things that can be done to improve survival of endangered species other than change the water allocation formula. The Bureau of Reclamation recently completed a $15 million fish screen on its main canal intake, to keep young suckers from being diverted into the irrigation system and stranded. The upper basin, however, still contains unscreened diversions that could easily be screened, as well as tributary streams too polluted to support fish -- many of them fouled by roaming cattle -- that could be restored to health. Efforts are under way to force removal of a dam that blocks .90 percent of the sucker spawning ground upstream. The water-user association has supported many of these proposals.

Jason Redmond / Star staff
When the Bureau of Reclamation stopped water deliveries to 85 percent of the Klamath Basin's farms in 2001, protesters came to Klamath Falls from as far away as Montana.

Disagreement on changes

But while such incremental changes might nibble around the edges of the problem, which took nearly a century to develop, even those seeking a resolution seem unable to agree on the more sweeping changes many believe are necessary.

"Despite all the attention that's been focused on the Klamath -- and this is my opinion -- are we in fact closer to a solution? I don't see it," said Fritz, the bureau's environmental specialist.

"There's competing needs for the water, and everybody has their own idea of what is needed," Fritz said. "You can talk to farmers and irrigators and they will say, 'To maintain a viable agricultural base, we have to have every drop of water that this project can possibly store and deliver.' Well, OK, then we have tribal interests, and they say, 'Our senior tribal water rights and our reliance on coho salmon and endangered suckers says every drop of water that's available should be put to meeting endangered species needs or the trust responsibility of the United States to the tribes.' Then the refuges come knocking on the door and say, 'We need a certain amount of water to keep these refuges healthy and strong. We have to have water for waterfowl.' "

Yet the need for resolution seems compelling, for it is not just fish and birds that face a grim future if the conflicting demands cannot be reconciled. And perhaps it is in the similarity between the recent pain of white farmers and old pain suffered by Indian fishermen that the faintest glimmer of hope for that resolution may lie. Whether they recognize it or not, they have something in common: the potential loss of a valued cultural heritage.

"An interesting thing that happened in 2001, when the farmers were deprived of a lot of their water, was how similar the complaints of the farmers were to what the Indians have (been saying)," Ullman said.

"The one that I found most poignant was a farmer saying, 'I can't pass my way of life on to my kids, and that hurts me.' Which is something I've heard around here" -- he gestured around the tribal headquarters building -- "for as long as I've worked here."

Part 2

Linked by a river

Mexican village's economy depends on events thousands of miles away

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By John Krist
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Juan Carlo/Star staff
Juan Butrón, who lives in Ejido Luis Encinas Johnson, is the unofficial caretaker and host for the Cienega de Santa Clara, where about 150 species of birds live. The land is owned communally by the ejido and is dependent on a continued flow of water from the United States.

EJIDO LUIS ENCINAS JOHNSON, Mexico -- To the casual eye, this small, dusty village seems to have little in common with glittering Las Vegas, sprawling Phoenix or the tidy suburban neighborhoods sprouting like so many stuccoed mushrooms along the Rocky Mountain foothills north and south of Denver.

There are no swimming pools in Ejido Johnson, no golf courses, no shopping malls. There also are no phones, no pavement, no piped water and no sewer lines. Outhouses provide sanitation, and drinking water must be hauled in from elsewhere in bottles. The homes are improvised affairs of wood and concrete blocks. Sixty-seven families live in the village, about 250 people in all, along with an indeterminable number of roaming dogs and penned livestock.

Yet the fortunes of this community are intimately entwined with events transpiring in cities and suburbs hundreds of miles away, on the other side of the United States-Mexico border. The thread that yokes together these disparate communities is a river, the Colorado River, the most manipulated and important waterway in the Southwest.

Nearly 30 million people in the United States and Mexico rely on the Colorado and its tributaries for all or part of their water and electricity. The Colorado provides half the water supply of the Metropolitan Water District of Southern California, which serves nearly 18 million people in six counties, including two-thirds of the population of Ventura County. The river irrigates more than 3.7 million acres of cropland.

It also sustains other resources that are less obviously commercial but important in their own way. One of them occupies the desert near Ejido Johnson: a vast wetland, providing critical habitat for wildlife and potentially serving as the catalyst for economic progress in an impoverished region. Yet that wetland's survival is threatened by the water appetite of growing communities in the American West.

To understand how the fates of Mexican villagers are linked with those of American suburbanites is to understand much about the price exacted by a century of water development in the West, as well as the complex nature of the choices facing water managers in coming years as they try to meet the needs of a fast-growing population. As becomes clear during a journey to Ejido Luis Encinas Johnson, decisions involving the appropriation and allocation of water in the region involve profound trade-offs, many of which are invisible to the general public.

The Colorado River might properly be said to begin in Wyoming's Wind River Range at Peak Lake, the first gathering of waters in the drainage of the Green River, which is the longest and therefore primary tributary of the Colorado. It is about 1,800 miles from the summits of the Wind River Range to the Colorado's mouth at the Gulf of California, a narrow arm of the Pacific squeezed between mainland Mexico and the Baja peninsula.

At the head of the gulf, the river has deposited a huge lens of silt. If you fly over the area, particularly at low tide, the deltaic sediments are visible as a glistening expanse of oddly ruddy mud, contrasting vividly with the salt-pale blankness of the surrounding desert.

The color seems somehow familiar, although at first you cannot put your finger on where you have seen it before. And eventually it hits you: What you are looking at is a sizable fraction of Utah and Arizona, the postcard landscape of the desert Southwest.

Over millions of years, the Colorado River and its tributaries have gnawed away patiently and relentlessly at the red-stained layers of sandstone that form the great plateaus of the canyon country. Most of the material eroded from the Colorado drainage once rode the running river all the way to the gulf. There, with one final, exhausted gesture, the Colorado shrugged this silty load off its broad back, creating beds of fine-grained debris thousands of feet thick.

What you are looking at when you fly over the Colorado River delta's reddish mudflats are the displaced guts of the Grand Canyon and thousands of lesser chasms. There is an estimated trillion tons of silt there, worn grain by grain from the rock of the river's 244,000-square-mile watershed.

Courtesy of the U.S. Bureau of Reclamation
When it was finished in 1953, Hoover Dam was the tallest structure of its kind in the world. At 726 feet from foundation to crest, it's still the tallest concrete dam in the United States.

The river created more than just a giant pile of mud at the edge of the sea. The rich silt deposited in its vast delta -- a triangular region with one point at Yuma, Ariz., another at Indio and the third at the Gulf of California -- is the foundation of a multibillion-dollar agricultural industry.

And as it wandered about the flat landscape abutting the gulf, the Colorado River also created a fantastically large and fantastically rich habitat for birds, fish and wildlife. The delta was a green oasis in the middle of the hottest and driest desert in North America.

The green lagoons

Pioneering ecologist Aldo Leopold explored the old Colorado River delta by canoe with his brother in 1922, and wrote about the experience in an essay titled "The Green Lagoons." It was, he wrote, a "milk-and-honey wilderness" thick with deer and birds and fish, prowled by jaguars and other predators. The river twisted and turned, leading through labyrinthine channels walled off from the surrounding desert by thick walls of mesquite and reeds.

This complex of brackish, freshwater, riparian and tidal wetlands encompassed 1.9 million acres, an area nearly three times the size of Rhode Island. It was a key breeding ground and nursery for gulf shrimp and fish, contained as many as 400 species of plants, and was a critical nesting and foraging spot for resident and migratory birds.

The delta wetlands began to disappear in 1930 with the construction of Hoover Dam on the Colorado River. For six years, while Lake Mead was filling, virtually no water reached the delta. The same thing happened between 1963 and 1980 as Lake Powell was filling behind Glen Canyon Dam.

There are now 10 major dams on the main stem of the Colorado, as well as scores of major diversions on its tributaries, and they capture and redirect almost the entire flow of the river in most years. On average, water flows into the delta have been reduced 75 percent. Almost all the silt the river once carried to its mouth now accumulates in upstream reservoirs.

John Krist / Star staff
The Colorado River passes through a wide range of contryside on its 1,500-mile journey from the Rocky Mountains to the sea, including the eroded Canyonlands National Park.

Predictably, both the delta wetlands and the land beneath them have shrunk, the vegetation starved of water and the land itself eroding instead of accreting. Less than one tenth of Leopold's "milk-and-honey wilderness" still exists, a collection of fragments encompassing about 150,000 acres. Some of the wetlands and riparian forests are sustained by the trickle of water that still makes its way down the Colorado River, and some are periodically revived in unusually wet years by flood releases from the big upstream dams.

An unintended creation

The largest single piece of the surviving Colorado River delta ecosystem -- Cienega de Santa Clara in the Mexican state of Sonora, containing about 14,000 acres of marsh and 25,000 acres of shallow, open water -- is the unintended creation of American engineers and

American farmers. It reappeared almost overnight about three decades ago in a desiccated landscape those same engineers and farmers had already transformed once from wetland into desert.

It could vanish again just as quickly if the appetite for water north of the international border continues to grow.

From the border crossing at San Luis Rio Colorado, the road to Ejido Johnson and Cienega de Santa Clara jogs through ramshackle suburbs before dropping into the Mexican portion of the Colorado River flood plain, which like its counterpart north of the border is given over to large-scale agriculture. Continuing south, the pavement ends and the road dissolves into a confusing tangle of dusty dirt tracks that are difficult to negotiate without a local guide, eventually ending in the village not far from the cienega. "Cienega" in Spanish means literally "hundred waters," and refers to a marsh or swamp.

Juan Carlo / Star staff
From left, Fernando Flores; Carlos flores, 10; Andres Hernandez, on bicycle; and Jesus Garcia Hernandez of San Luis, Mexico, celebrate El Dia de la Revolucion at Ejido Johnson.

Near the water's edge stand a few palapas, simple shade structures of timbers and palm fronds, and several picnic tables. The only other improvements are an observation tower overlooking the marsh, a small wooden dock, and a pair of outhouses, their seats merely wooden boards with hand-cut holes.

Juan Butron acts as a sort of unofficial caretaker and host for the cienega, which is on land owned communally by the ejido, leading canoe tours for visitors. He was born in the area, and moved to Ejido Johnson in 1973. There was no cienega then; the area was barren desert and the vegetation was dominated by tamarisk, a salt-tolerant invasive. Butron and the other men of the village fished in the Gulf of California, grew wheat and cotton, and labored for other farmers in the fields.

Then the water came, flooding thousands of acres.

Caught up in a dispute

Although the villagers had no way of knowing it, they had become caught up in a rancorous dispute involving the United States and Mexican governments, farmers on both sides of the border, and the U.S. Bureau of Reclamation.

Under a 1944 treaty, the United States guarantees Mexico 1.5 million acre-feet of Colorado River water a year. (An acre-foot is 325,851 gallons, enough to supply two average Southern California households for a year). The seven American states in the Colorado basin have agreed among themselves to share 15 million acre-feet, half going to the upper basin states of Wyoming, Colorado, Utah and New Mexico, and the rest being divided among California, Arizona and Nevada. If flows are sufficient, an additional 1 million acre-feet goes to the lower basin.

Juan Carlo / Star staff
David Hogan of the Center for Biological Diversity of San Diego is one of those trying to protect the Cienega de Santa Clara because of its importance as a habitat area.

The 1944 treaty did not specify, however, that the water flowing across the border into Mexico had to be usable.

The Colorado River drainage is high in naturally occurring mineral salts, which are leached from the soil when irrigation water passes through it. Most of the water diverted from the river for irrigation drains back into the river after it has been used, a process repeated over and over again as the water moves downstream. With each cycle of diversion, irrigation and return, the water grows saltier.

In the early 1960s, the salinity of the Colorado River as it reached Mexico soared to 2,000 parts per million. The U.S. Environmental Protection Agency limits drinking water to no more than 500 ppm, and most plants start to die when salinity of irrigation water reaches 1,200 ppm. Crops in the Mexicali Valley began to wither.

There were two reasons for the sudden spike in Colorado River salinity. The first was the 1961 commencement of a United States Bureau of Reclamation project in Arizona's Wellton-Mohawk Irrigation and Drainage District. The Wellton-Mohawk irrigation water leached salt from a shallow, saline aquifer and carried it back to the Gila River, which empties into the Colorado near Yuma. The salinity of the drainage reached 6,000 ppm, according to the bureau.

The second reason was that in 1963, Glen Canyon Dam was completed and the United States began impounding almost the entire flow of the river, releasing only enough to satisfy its treaty obligations to Mexico. That meant less water in the river to dilute the salty drainage from Wellton-Mohawk.

Outraged Mexicali farmers urged Mexico's leaders to do something, and the country filed a formal protest with the United States. The countries negotiated an amendment to the 1944 treaty requiring that the salinity of the Colorado River when it reached Morelos Dam, which diverts water to farmland in the Mexicali Valley in Mexico, be only a little higher than the level at Imperial Dam, which diverts water to the Imperial Valley in California. The allowed salinity is about 1,100 ppm -- just below the level that's toxic to plants.

Building a desalination plant

To meet the requirements of the new treaty, the bureau did two things. For the long term, the bureau began building a gigantic desalination plant near Yuma, intending to purify the drainage water before dumping it back into the Colorado River. For the short term, it constructed a concrete channel -- identified by the vaguely Orwellian acronym MODE, for main outlet drain extension -- to carry salty Wellton-Mohawk irrigation drainage across the Mexican border to the sea.

Juan Carlo / Star staff
Dan Smith, maintenance supervisor for Burns and Roe Services, checks on a leak at the Yuma Desalting Plant. Behind him is a reverse osmosis filter that would remove salt from the water entering the plant -- if the plant were operating.

The drainage channel did not, however, go all the way to the Gulf of California. It ended abruptly in the desert near Ejido Luis Encinas Johnson.

When the water started coming down the drain in 1977, it quickly resurrected the ancestral Colorado delta ecosystem, forming large expanses of standing water that soon were fringed by thick stands of cattails and reeds. Although the drainage water is too salty for crops, it is perfect to sustain a brackish marsh. That marsh, now known as Cienega de Santa Clara, is almost precisely where Leopold set out on his 1922 adventure in the green lagoons.

With about 90 percent of the coastal wetlands along the Pacific Coast of North America lost to urban development or conversion to agriculture, the waters of this resurrected marsh have become a critical resource for migratory birds.

Butron remembers when the water came. Speaking in Spanish, he said he initially was afraid the village would be flooded and that the salt in the water would contaminate the community's farmland. When those threats did not materialize, he decided the villagers should capitalize on the cienega by leading paying customers on tours to watch birds and enjoy the spectacle of a green wilderness in the middle of a desert.

It is not an empty wish. Wildlife is a big draw and the opportunity to observe it is a potent economic engine: According to a recent report by the U.S. Fish and Wildlife Service, Americans paid 35.5 million visits to the nation's 540 wildlife refuges in 2002, spending more than $809 million on recreation equipment, food, lodging, transportation and other related purchases. In a land of crushing poverty, ecotourism can offer the promise of economic salvation.

Business has been slow to develop, Butron said. In the previous six months, about 15 groups had come to canoe and watch birds. Butron hopes to expand it, but his dreams seem oddly circumscribed. Asked what he would do if money and logistics were no obstacle, he suggested building a few more palapas and buying nicer canoes. He made no mention of a water supply, better camping accommodations, toilets or improved outhouses, a boardwalk into the marsh, English-speaking guides or any of the other amenities a sophisticated commercial operation would provide to entice well-heeled birders to spend their time and money there.

Even without those luxuries, or perhaps because of their absence, the cienega is a mesmerizing place.

On an autumn afternoon, Butron ushered a quartet of visitors -- a reporter and photographer, environmental activist David Hogan of the Center for Biological Diversity, and biologist Helena Iturribarria of Pronatura, a Mexican conservation organization -- into a pair of aluminum canoes and pushed off into the cienega.

The Center for Biological Diversity is one of several American environmental organizations, including Defenders of Wildlife, that are trying to force the U.S. government to recognize the effect of its water diversions on the delta and to accept some obligation for preservation and restoration of the unique delta ecosystem. Pronatura does no direct advocacy on behalf of the delta but gathers information about its natural resources and passes it along to other groups for use in their campaigns.

Perfect weather

The weather was perfect: calm, warm but not hot, the sky clear. Slate-blue mountains shimmered in the distance. The silence was broken only by the rhythmic splash of paddles and the myriad voices of birds, some hidden and some not, some in the cattails, others paddling along the edge of the vegetation and still more flying overhead.

Butron stopped paddling often to point out particular birds using their Spanish names. Iturribarria, who is bilingual, translated Butron's remarks and identified birds in English: avocets, coots, white pelicans, grebes, moorhens, Caspian terns, Forster's terns, widgeons, gulls. A clapper rail, listed in the United States as an endangered species, announced its presence with a loud clattering call from within the dense vegetation.

The marsh is part of the Upper Gulf of California and Colorado River Delta Biosphere Reserve, a conservation area established by the Mexican government in recognition of its ecological value. Other rare or endangered species that call the delta home include the southwestern willow flycatcher, the desert pupfish and the Yuma clapper rail.

As the water wends its way through a labyrinth of channels toward a desultory mingling with the waters of the gulf, it eventually forms a tidal estuary that provides habitat for the vaquita porpoise, the world's smallest and rarest marine mammal, and the totoaba, a monster of a fish that can reach 7 feet and 300 pounds. Once abundant enough to support a commercial fishery, the totoaba is now nearly extinct.

Less rare inhabitants of the delta include ducks, geese and scores of seabird species, such fish as mullet, tilapia, catfish, carp and bass, and a number of mammals, including bobcats, raccoons, coyotes and muskrats.

As twilight approached, the cienega grew even more captivating: The colors of sunset set fire to the mirror-still water, and the cattails turned a rich golden hue in the low-angle light. Flight after flight of gulls began to pass overhead. The noise of birds in the reeds grew even louder and more varied, a cacophony of screeches, chirps, caws and cackles that sounded like a Hollywood movie's jungle soundtrack.

Asked if he had always been interested in birds, Butron told a story about how he had once been put in jail -- "for defending my property," he added -- and realized what it felt like to be a caged bird. When he was released he went home, where he kept birds in cages, and set them all free. He told the story with broad hand gestures that suggested birds soaring into the sky.

Although a few other residents of Ejido Johnson are interested in the cienega and its potential as a tourism destination, most are not, Butron said, because they are too young, too old or have other jobs.

John Krist / Star staff
Near Yuma, Ariz., Colorado River water is diverted from behind Imperial Dam into the All American Canal. From there, the water travels across the desert to the Imperial Valley.

Dreams for his village

Still, he has dreams of what ecotourism could bring to his village. Asked if he's worried about the possibility of the water being cut off by the American government, his reply was quick.

"Si, mucho," he said. If that happens, he said, "My dreams will all vanish into the air."

Butron's dreams, like the fate of Cienega de Santa Clara, are tethered to a bank of computers inside the control room of the Reclamation Bureau's Yuma Desalting Plant, which occupies a 60-acre compound five miles west of Yuma, Ariz.

Near the control room, a large window offers a view into a cavernous space housing hundreds of cylindrical tubes hooked together by a cat's cradle of pipes. Looking like the product of a plumber's feverish nightmare, it is the world's largest reverse-osmosis filtration system, designed to remove salt and other impurities from Wellton-Mohawk drain water.

The Yuma Desalting Plant cost about $250 million to build and was intended to be a permanent solution to the problem of unacceptably high salinity in agricultural drainage from Arizona cropland. At full capacity, the plant would be able to process 102.7 million gallons of salty drainage per day, producing about 72.4 million gallons of purified water.

Construction began in 1975, and the plant began operation in May 1992. It ran at one-third of capacity until flooding in January 1993 wrecked the Gila River intake for the canal that carried drain water to the plant. It never restarted.

Although the bureau keeps the plant in "ready reserve status" at a cost of between $2.2 million and $2.4 million a year, firing it up again would take a year and cost an additional $25 million, said Jack Simes, a spokesman for the bureau's Yuma Area Office.

"You don't walk over there, flip the switch and start watching the water come through," Simes said.

In the meantime, 108,000 acre-feet a year of salty irrigation drainage water bypasses the plant and flows through the MODE canal to Cienega de Santa Clara. If the plant were restarted, 85 percent of that water would be reclaimed, and only the remaining 15 percent -- a concentrated brine containing all the impurities removed by the desalting process -- would make it to the cienega. That water would have a salinity of 10,000 parts per million, instead of the current 3,000 ppm.

The combination of reduced flows and increased salinity would likely destroy the cienega ecosystem, according to the environmental and scientific organizations that have been trying to persuade the United States to assume responsibility for ecological conditions in the delta.

So far, those efforts at persuasion haven't had much success. The Center for Biological Diversity, Defenders of Wildlife and other environmental organizations sued the federal government in June 2000, arguing that the Endangered Species Act requires the bureau to consider the effect of its water projects on U.S.-listed species living in Mexico, but a federal court rejected that claim in March 2003.

"The court slapped us down," Hogan said. "We lost big time."

Since 1993, the bureau has been developing a habitat conservation plan for the Lower Colorado River region. The plan is intended to promote recovery of numerous threatened and endangered species. Numerous environmental organizations had been participating in the development of that plan, which is due out this year, but nearly all withdrew in protest when it became clear that the plan would not address habitat loss south of the border.

The decision to restart the desalting plant, Simes said, belongs to Congress, which hasn't authorized the funding because during most of the past decade there has been enough water to satisfy all the demands in the United States and still leave enough in the river to satisfy Mexico.

That is changing, however.

The fundamental problem is that the river has been over-allocated. The seven American states in its basin together claim legal entitlements to 16 million acre-feet a year, and Mexico claims 1.5 million acre-feet. But over the past century the river's annual flow has averaged 14 million acre-feet, not 17.5 million acre-feet, and scientists who have studied climate clues in ancient tree rings suggest the long-term average is more like 13.5 million acre-feet.

The state and federal governments made the mistake of allocating the Colorado during an unusually wet period in its long history, and made matters worse by impounding the water in huge lakes under a desert sun. The Reclamation Bureau has estimated 2 million acre-feet a year of Colorado River water simply evaporates from its reservoirs.

Not only is there too little water in the river to satisfy all the claims upon it, but there are also more users vying for a share of what's available. Some of that is the result of population growth in the basin states. But there are also 57 Indian reservations located either in the Colorado River basin or having traditional ties to it. And after decades in which the tribes lacked the legal and financial resources to wrestle some of that water away for their own uses, they are increasingly doing so.

Under long-established case law, the tribes' water rights date to establishment of their reservations. In most cases this makes Indian water rights older and therefore superior to all other rights. When the tribes decide they want to start using the water to which they are entitled, states, cities and irrigation districts will have to give up some of what they've been using or pay the tribes for it.

According to an analysis of Indian water-rights claims compiled for the president's Western Water Policy Review Advisory Commission, about 1 million acre-feet of water has been claimed through legal negotiations by Colorado River basin tribes since 1978, and an additional 3.3 million acre-feet in claims are being adjudicated.

The combined total of tribal claims is roughly equal to California's entire Colorado River entitlement of 4.4 million acre-feet a year.

Some water planners see the Yuma Desalting Plant as critical to help meet increased demands for Colorado River water; officials in Arizona have been particularly insistent, pressuring Congress to restart the plant to avoid water shortages in Phoenix and Tucson. They've been aided in their quest by the current drought in the Colorado basin, which has forced the bureau to release water from already shrunken Lake Mead and Lake Powell to meet American treaty obligations to Mexico.

Critics of the desalting plant, however, say it would be too expensive to operate -- the bureau has estimated annual maintenance and operations costs at about $30 million -- and argue that the most cost-effective way to replace the water now going to the cienega would be to buy it from willing American farmers, who would either switch to less-thirsty crops or retire some of their land. In a Nov. 5, 2003, letter to the governor of Arizona, a coalition of 28 U.S. and Mexican environmental groups argued that leasing would cost between $60 and $250 an acre-foot, whereas the fresh water produced by the Yuma Desalting Plant would cost between $305 and $480 per acre-foot.

Nevertheless, members of Congress inserted a provision in the 2004 energy and water appropriations bill, which President Bush signed on Dec. 1, directing the Bureau of Reclamation to "expedite its modifications of the plant" and to "accelerate the permitting and environmental compliance activities needed for operation."

Although it did not earmark any money specifically for plant startup, the bill directs the agency to report back to Congress within 180 days on the status of those efforts.

More rain, less snow means big trouble

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In the Cascade Range of the Pacific Northwest, the water content of the winter snowpack has been falling steadily since 1950, declining in some areas by as much as 60 percent.

In the Rocky Mountains, peak spring runoff in key streams occurs nearly two weeks earlier than it did 50 years ago, and winter stream flow has increased even though overall annual precipitation has not.

On the Sacramento River, which drains the northern Sierra Nevada, the share of the year's total runoff flowing downstream between April and July -- the critical period when reservoirs typically are refilled by snowmelt -- has declined 25 percent over the past century.

Rich Pedroncelli/AP
Frank Gehrke, left, a Department of Water Resources hydrologist, and Dave Hart weigh a snow sample near Echo Summit. Global warming is decreasing the snowpack.

At the Golden Gate, sea level has risen 2 inches in the past 30 years.

Although hardly the stuff of front-page headlines, to water planners this litany of seemingly arcane data represents the first faint signal of an approaching storm, like the swelling surf that heralds a distant hurricane. The changes in precipitation and runoff patterns are symptoms of a warming climate, according to atmospheric scientists and hydrologists, and the best available science suggests the trends will continue during the remainder of this century.

"The climate change prospects are really quite profound over the Western landscape," said Dan Cayan, a climate researcher at San Diego's Scripps Institution of Oceanography. "That has enormous implications for water resources throughout the West."

Changes in precipitation patterns will undermine key assumptions about climate and weather relied upon by the engineers who designed the vast plumbing systems of the semi-arid West. Having built hundreds of dams, thousands of miles of pipelines and aqueducts, and scores of gigantic pumping plants to support an urban civilization and a productive agricultural empire in a virtual desert, the region's residents

may find that nature -- perhaps with a helping hand from human beings -- has changed the rules of the game.

Already, water planners are trying to figure out what that will mean and how best to respond.

"By and large, reservoirs and water delivery systems and operating rules have been developed from historical hydrology on the assumption that the past is a good guide to the future," wrote Maurice Roos, the state's former chief hydrologist, in a background paper prepared for a committee helping update the California Water Plan. "With global warming, that assumption may not be valid."

Perhaps the best way to sum up what's happening in the mountains that feed the West's water systems is to put it this way: less winter snow, more winter rain. The ripples that have the capacity to disrupt water supplies from San Francisco to Denver and from San Diego to Seattle all flow from that seemingly modest change.

"We have to find alternative water supplies," said Donald Kendall, general manager of the Calleguas Municipal Water District, which serves two-thirds of Ventura County's population. "That's the bottom line."

Heating up

Although the science of climate change is dauntingly complex and filled with uncertainty, particularly with regard to the possible human role in global warming, there is widespread scientific agreement on the basic trends.

"Long-term observations confirm that our climate is now changing at a rapid rate," according to a report by the United States Global Change Research Program. "The science indicates that the warming in the 21st century will be significantly larger than in the 20th century."

Over the past century, the average annual temperature in the United States has risen by almost 1 degree, according to the research program. In California's Sierra Nevada, average winter temperatures rose 4 degrees during the second half of the 20th century, according to a report by the California Regional Assessment Group, a team of climate researchers at the University of California at Santa Barbara.

Snow cover has decreased 10 percent in North America since the 1960s, lake and river ice melts on average two weeks earlier than it did a century ago, and there's been a 40 percent reduction in arctic sea-ice thickness since 1958, according to the Intergovernmental Panel on Climate Change. The 15 warmest years in the 20th century all occurred after 1980, and the 1990s were the warmest decade of the entire millennium, records show.

The majority of climate scientists believe that human activity, if not responsible for the warming trend, is at least intensifying it, noting that it coincides with the start of the industrial age and the widespread combustion of fossil fuels.

The concentration of carbon dioxide in the Earth's atmosphere has increased 31 percent since 1750; the concentration of methane, another potent greenhouse gas, has risen 151 percent. (Greenhouse gases are known by that term because they trap solar energy beneath the Earth's atmosphere and keep it from radiating back into space, similar to the way glass panes in a greenhouse trap heat.)

Representatives of the industries most reliant on fossil fuels -- auto manufacturers, oil and coal producers, power plant operators -- often dispute the assertion that human activity is responsible for global warming, as do some climate researchers.

To water planners, however, the argument about whether industry is causing or contributing to climate change is beside the point.

"We don't care if it's natural," Kendall said. "It's there."

From the standpoint of water supply management, all that really matters is that North America has grown warmer over the past century, with measurable changes in precipitation and runoff patterns, and that the best available research models suggest it will continue to do so for the remainder of this century.

"Rather than get into the debate about what causes climate change, we just want to acknowledge that it is a real uncertainty," said Adan Ortega, the Metropolitan Water District of Southern California's vice president for external affairs. "We have to manage for uncertainty. It's part of our mission."

The most conservative scientific estimates, based on complex computer simulation models, suggest an increase of about 5 degrees in the average annual temperature in key watersheds such as the Sierra Nevada, the Rocky Mountains and the Cascades. What that means, according to a host of studies conducted over the past decade, is that the snow level will rise as much as 1,500 feet in elevation, diminishing the extent of the snowpack by up to 50 percent.

Yet at the same time, overall winter precipitation is not expected to change much; if anything, it might actually increase. That means more of the winter precipitation will fall as rain instead of as snow.

Cold storage

The reason the shift from snow to rain matters, particularly in California, is that key water storage and delivery systems depend on the mountain snowpack to hold back enormous quantities of water in frozen form during the winter and to release that water gradually as runoff during the long annual dry season. If it falls as rain, it runs off quickly, and there is no place to store it.

"Winter snowpack in the Sierra Nevada mountains functions as a major water storage system," Jonas Minton, deputy director of California's Department of Water Resources, told the Assembly's Select Committee on Air and Water during a 2001 hearing on climate change. "More water is stored as snow than is contained in the state's three largest reservoirs."

Most of California's reservoirs serve a dual function as both flood-control and water-storage facilities. In order to minimize downstream flooding during the wet season, reservoir levels are intentionally lowered by the end of the dry season. That makes room for anticipated flood flows in winter and early spring.

After the flood threat has diminished, the reservoirs are allowed to fill again with late spring and early summer runoff from the snowpack. That water is then released during summer and fall for downstream cities and irrigators.

If more precipitation falls as winter rain and less as winter snow, the added volume of runoff in the wet season will make it harder to capture enough water in reservoirs to prevent flooding in the vulnerable communities of the low-lying Central Valley -- coincidentally, the fastest-growing part of the state. And it means the reservoirs will not refill as readily before hot weather arrives and water demand soars.

For the first time, the California Water Plan is being updated to include a section addressing the effects of climate change. The water resources department is required by law to update the plan, a 25-year blueprint for managing and developing water sources statewide, every five years. The latest update is under way and is expected to be completed by the end of the year. A working draft is due out for public review in July.

"As a result of global warming, California hydrology will not be the same as we have experienced in the past century," according to a rough draft of the plan's first chapter released Dec. 12. "While many uncertainties remain, primarily on the degree and timing of change to be expected, the prospects of significant reductions to the Sierra snowpack warrant examination of how the state's water infrastructure and natural systems can accommodate or adapt to climate changes and whether more needs to be done to detect, evaluate and respond to water resource system effects. State agencies should develop hydrology scenarios for evaluating the ability of water projects to respond to future climate change impacts."

The plan also notes that "California has resources to meet many, but not all, of its water demands with its present population."

Add 17 million people, as the state is expected to over the next quarter-century, throw in a multiyear drought or two, and the result, in the plan's colorless terminology, is "a major challenge facing water managers."

Reduced river flows during the hot, dry season would have another important effect throughout the West: reduced electricity generation at the time of the year when demand is highest. The West relies more on hydropower for its energy than any other region of the country. California derives 27 percent of its electricity from hydro dams, according to the California Energy Commission, some of it imported into the state from big dams on the Colorado and Columbia rivers.

Reduced runoff will force managers of those projects to choose between keeping reservoir levels high to ensure sufficient water for the late summer and fall, and releasing water to meet rising electricity demand in the hot months when air conditioners in Phoenix, Riverside and Las Vegas work overtime.

The prospect of reduced regional power availability is also particularly worrisome to California's water managers because of the prodigious quantity of energy required to move water from the northern part of the state to the central and southern regions, and then to distribute it to customers. The big pumps that push water in the California Aqueduct more than 2,000 feet over the Tehachapi Mountains, for example, consume 850 million watts of electricity -- the output of an entire medium-size power plant.

A warmer climate would also introduce a threat to California's water supply that other Western states will not face: rising sea level.

Sea level rises as the oceans warm, because warm water takes up more space than cold water, and the oceans are growing warmer as the atmosphere warms.

Sea level also rises as glaciers and ice sheets melt. Climate experts predict a sea level rise of about 1.6 feet over the next century along the California coast, posing two major threats to the state's water supply: It

will increase the intrusion of salt water into shallow coastal aquifers, such as those under the Oxnard Plain, and it also might contaminate the state's most important source of water, the Sacramento-San Joaquin River delta.

That delta -- a vast complex of sloughs and marshes where the state's two largest rivers mingle and meet San Francisco Bay -- is the location of the huge pumping plants that serve the State Water Project and the Central Valley Project. The delta thus provides drinking water for two-thirds of the state's population and irrigation water for a $27-billion-a-year agricultural economy in the San Joaquin Valley.

Rising sea level, experts warn, would force salty sea water farther upstream into the delta, potentially as far as the state and Central Valley projects' pump intakes. The problem would be exacerbated in the summer if a warming-induced reduction of the snowpack reduced river flows that currently dilute the salt water and push it back toward the Golden Gate.

Rising sea level would also threaten to erode the fragile network of levees that protect thousands of acres of land in the delta -- much of it below sea level -- from flooding. Failure of those levees would "force a shutdown of the export pumps until the salt could be flushed out," according to the Natural Heritage Institute, a public-interest law firm that has pressed for improvements to the delta water system. "The shutdown might last for months or years or even become permanent."

Part 3

An agricultural hot spot

Imperial County's water decisions could foretell future of West's farms

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Juan Carlo / Star staff
Armando Cecena of Mexicali picks cantaloupes on Mike Morgan's fields in the Imperial Valley, which water-hungry cities target as another source of urban water.

EL CENTRO -- Imperial County was the last of California's 58 counties to be established, and with good reason, for it often is a very uncomfortable place to live. To say that Imperial is hot and dry is like saying Alaskan winters are cool and the Pacific Ocean is damp.

Carved out of San Diego County in 1907, Imperial County is a 4,958-square-mile rectangle in the most southeastern corner of the state, with Mexico to the south, Arizona to the east and the Colorado Desert all around. El Centro, the Imperial County seat, is 50 feet below sea level, and its civic motto is "Where the sun spends the winter." To the delight of air-conditioner distributors, it also is where the sun spends the spring, summer and fall. The average high temperature in July in El Centro is 106 degrees (the record is 121), and the average annual rainfall is 2.9 inches.

Few plants can thrive in this sort of environment, yet Imperial County is home to a farming empire that in 2002 produced $1.1 billion worth of crops. Though perhaps surprising to natives of the nation's moister regions, such verdant extravagance in a desiccated land conforms perfectly with the imaginative logic of Western settlement.

Like their counterparts elsewhere in a land of inconveniently arid geography, early white settlers in the Imperial Valley did not behave as if the countryside were worthless but as if nature merely had neglected to prepare it adequately for their prosperity. They set about to rectify this oversight, transforming desert into garden through the liberal application of water provided by a complex system of dams and aqueducts. In this way, Imperial County is a splendid example of how much of the country west of the Great Plains dreamed, wheedled and engineered itself into being, its big cities and big farms made possible only by big water projects built by big government agencies.

The hydraulic systems that made Imperial and the rest of the modern West possible are confronted today, however, by circumstances that challenge their ability to sustain the economic and demographic juggernaut they set in motion. Rapid population growth, increased requirements to sustain endangered species, and the runoff-reducing effects of global warming are threatening to plunge the region into a state of chronic water shortage.

As the U.S. Department of Interior described the situation in a recent report, "In some areas of the West, existing water supplies are, or will be, inadequate to meet the water demands of people, cities, farms and the environment even under normal water supply conditions."

And so the verdant desert in the loneliest corner of California has also become another kind of model. A living testament to the West's audacious past, Imperial County now offers a preview of the pitfalls and opportunities the region will encounter as it tries to chart its way into the perilous future.

A tempting target

To produce more than a billion dollars' worth of hay, melons, grain and other crops on about 450,000 desert acres in the Imperial Valley requires water -- almost unimaginable quantities of it -- yet the region has virtually none of its own. The water responsible for Imperial's bounty is taken from the Colorado River at Imperial Dam, an 85-foot-tall diversion that stretches 3,485 feet across the river about 18 miles north of Yuma, Ariz.

At Imperial Dam, the bulk of the river's flow is shunted through a sequence of sinuous channels and desilting ponds to remove suspended mud from the water before it is dumped into the All-American Canal. This 82-mile channel crosses burning desert sands near the international border and terminates at the southwest corner of the Imperial Valley.

Along much of its length, the canal is little more than a ditch scraped in the sand; so much water seeps through its porous bed that farmers on the Mexican side of the border have sunk wells to tap it, using this serendipitous supply to irrigate row crops in the rich Mexicali Valley.

The farmers of Imperial Valley have never worried much about leaks because they collectively hold the largest and one of the most senior rights to water from the Colorado River. They have taken delivery of an average of 3.2 million acre-feet a year over the past 10 years, which in round numbers is four times the annual consumption of the 3.7 million residents of Los Angeles and twice that of the 8 million inhabitants of New York City. (An acre-foot is 325,851 gallons, enough to cover a football field a foot deep and to supply two average Southern California households for a year.)

Imperial Valley farmers, in fact, consume more Colorado River water than has been allocated by law and contract to five of the seven states that share the river. (California has the right to 4.4 million acre-feet of Colorado River water; Colorado, 3.9 million acre-feet; Arizona, 2.8 million; Utah, 1.7 million; Wyoming, 1 million; New Mexico, 843,750; and Nevada 300,000.)

Other farming regions of comparable size get by on far less water, but Imperial Valley agriculture confronts a peculiar challenge born of its geography. The valley occupies the floor of an ancient inland sea, periodically filled by the meandering Colorado River and emptied through evaporation, and like all such dry lake beds the sediments that form its soil contain natural salts left behind over the millennia by the evaporating water.

There is salt, too, in the Imperial irrigation water. The Colorado River drainage is high in naturally occurring mineral salts, which are leached from the soil when irrigation water passes through it. Most of the water diverted from the river for irrigation drains back into the river after it has been used, a process repeated over and over again as the water moves downstream. With each cycle of diversion, irrigation and return, the water grows saltier. By the time it reaches Imperial Dam for diversion to the valley, the water of the Colorado River is approaching the limit of salinity tolerance for many plants.

Under the conditions found in the Imperial Valley, most irrigation methods would cause salt to build up in the soil very quickly, reaching levels lethal to crops and transforming the valley into a chloride-encrusted wasteland. Imperial Valley farmers avoid this by literally flooding their fields to flush out the salt, which is carried away in runoff from the fields through an elaborate system of underground drains.

There are 1,406 miles of these drains in the Imperial Irrigation District, along with 1,675 miles of delivery canals. A map of the irrigation district's plumbing system looks like a schematic drawing of a computer circuit board.

Their control over nearly three-fourths of California's Colorado River entitlement -- and the seeming profligacy with which they use it -- has made the Imperial Valley's agricultural landowners an irresistible

target for Southern California cities running short of water to supply their growing populations. If recent trends continue the way many water experts expect them to, the Imperial farmers will soon have lots of company as targets.

From farms to cities

In 1988, the Metropolitan Water District signed a deal with the Imperial district under which the MWD began paying to line irrigation district distribution canals with concrete and carry out other water-conservation projects in return for the water they saved; the deal has so far cost MWD $175 million and provides the agency's customers about 104,000 acre-feet a year.

More recently, the Imperial Irrigation District negotiated a complicated deal involving the MWD and several other agencies that will send 200,000 acre-feet of water a year to the San Diego County Water Authority, for which the authority will pay up to $50 million. The water will be made available by conservation measures undertaken in the Imperial Valley, including taking some land out of production.

The Imperial-San Diego deal is key to reducing California's use of Colorado River water to its basic entitlement of 4.4 million acre-feet a year. The state has been taking about 800,000 acre-feet more than that, the extra water mainly going to MWD and consisting of the unused portion of other states' allocations. With demand in those states rising and supplies in the river shrunken by drought, the federal government ordered California to live within its means.

"This agreement marks a historic turning point for California and the Colorado River Basin states," Interior Secretary Gale Norton said in October 2003 after signing the pact with officials of four California water agencies. "The economy and well-being of a large part of the growing West rely on critical agreements, such as this one, that allocate Colorado River water, provide assurances of long-term supplies, and clear the way for market-based transfers and other tools that are essential to meet the growing water needs of the region."

Department of Water Resources
Metropolitan Water District of Southern California has proposed an expansion of the H.O. Banks Pumping Plant near Tracy, but critics said it would be another water grab.

Water experts anticipate more such deals in coming years, noting that in the West, agriculture accounts for 80 percent to 90 percent of total water use. Transferring some of that water from farms to cities could more easily and cheaply meet rising urban demand than spending billions of dollars on more dams and aqueducts, and without the time-consuming and costly regulatory uncertainty that would accompany proposals to tap more streams or drown more canyons.

It is the Willie Sutton theory of bank robbery applied to water-resources development: Sutton is famously quoted as having said he robbed banks because that's where the money is; urban water agencies find their attention drawn inexorably toward the agricultural sector because that's where most of the water is.

Annual water trades in California alone, according to a 2003 study by the Public Policy Institute of California, exceed 1.2 million acre-feet -- a tenfold increase since the market was born in the drought of 1988-94 -- and are "firmly established as a component of California's water allocation process," the institute's report concluded.

A growing unease

Metropolitan has been particularly bold in approaching farmers in the hope of prying loose some of their water. From 1992 to 1994, MWD paid 63 farmers in the Palo Verde Irrigation District, which surrounds Blythe, not to irrigate 20,215 acres and in return obtained about 186,000 acre-feet. In 2003, MWD negotiated contracts with several irrigation districts serving primarily rice farmers in the Sacramento Valley, paying $105 an acre-foot for 147,200 acre-feet.

The prospect of farm-to-city water transfers makes many in the agricultural industry nervous. The California Farm Water Coalition has in recent months been conducting a low-key public relations campaign intended to downplay agriculture's share of the state's water supply and to emphasize the economic benefits of farm water use. Agriculture, coalition Executive Director Mike Wade has claimed (in a letter to the editor of The Star, among other venues), uses only 43 percent of the state's water, not 80 percent.

The higher figure is, Wade wrote, "a common myth."

The difference between Wade's claim and the 80 percent (or higher) figure used by nearly every water expert in the West, as well as by the California Department of Water Resources and the United States Bureau of Reclamation, is more a matter of semantics than of hydrology: Instead of comparing farm water use to the total amount being applied to all municipal, industrial and agricultural purposes, as most experts do, Wade and the California Farm Water Coalition express it as a percentage of the total amount of water flowing in all the state's rivers. Much of that water is not available for human use because it is needed for fish, runs off during floods, or flows through watersheds lacking storage and diversion projects.

Still, the coalition's effort to downplay agriculture as a potential source of water for thirsty cities suggests the paradoxical attitude many farmers hold regarding the water they use, which is critical to their operations yet is potentially the most valuable commodity they control. While many would like the opportunity to profit from water sales -- an easier and less chancy way of making money than the notoriously risky business of farming -- they are also cognizant of the broader economic implications of doing so.

These concerns have assumed tangible form in the Imperial Valley, where controversy and litigation over the Imperial-San Diego deal has demonstrated that farm-to-city water transfers will not be a politically painless panacea for the West's water woes.

Voices of dissent

Mike Morgan is a self-described Libertarian who grows loudly indignant -- his voice rises and he tends to bang on the steering wheel of his truck -- when he talks about the efforts under way to transfer water from the valley's farmers to urban areas on the coast. He farms 5,000 acres of melons, carrots, alfalfa, potatoes, lettuce, corn and other crops at the north end of the Imperial Valley, much of that acreage first planted by his grandfather, who homesteaded in the valley "and leveled the land with mules," Morgan said.

Juan Carlo / Star staff
Imperial Valley farmer Mike Morgan checks the alkalinity of water running off his fields into the Salton Sea. Farmers use the water to leach salts from the soil in addition to irrigation.

Morgan is a member of the Imperial Group, formed last year by about 100 dissident Imperial Valley farmers. The group sued the Imperial Irrigation District last November over the transfer deal, alleging that the district's board lacks the legal authority to sell Imperial Valley water without their approval.

"It's the guy who leveled the land, had the water right and built the irrigation district" who should control the terms of any sale, he said.

According to Morgan and the others, any water that's freed up through conservation isn't available for sale; it goes automatically to the other irrigators in the district. Likewise, any money that's realized from such a sale -- presumably after every district irrigator concludes that water isn't needed for irrigation and approves the deal -- should be divided among all the farmers instead of going to the irrigation district or the farmers who gave up that water, Morgan said.

An oddly socialist philosophy

It's an oddly socialist philosophy to be espoused by the politically conservative and doggedly independent individuals who dominate the Imperial Valley farming community. Essentially, they're taking the view that water is communally held property and that no individual should be able to profit from its use or sale at the expense of his neighbors.

That's hardly the ethos that "won" the West. In fact, the legal doctrine underpinning all Western water law is that of prior appropriation, which in essence holds that water belongs to whomever grabs it first and remains that user's property as long as the water is put to beneficial use.

That doctrine is the reason, for example, that a relative handful of farmers in the Imperial Valley, which contributes no runoff to the Colorado River, control more of its water than the entire state of Arizona, which contains nearly half the river's total watershed. Imperial's pioneering farmers and land speculators got there before nearly anyone else in California, diverting Colorado River water as early as 1901. (The oldest Colorado River water rights in California actually belong to the Palo Verde Irrigation District, under a formal appropriation notice filed by Thomas Blythe in 1877.)

Morgan said he is not opposed to selling water. But he clearly thinks there's a better deal to be made. He suggests that instead of allowing the Imperial district to negotiate a deal with a big urban water agency, the farmers be allowed to negotiate sales directly with land developers. If home-building magnate Eli Broad wants to construct a 500-unit project in Hemet, Morgan said, why not let him buy the water for that project directly from an Imperial Irrigation District farmer and then simply tack the cost onto the price of the new homes?

Juan Carlo / Star staff
Egrets flock to a runoff ditch on Mike Morgan's farm. He opposes the Imperial Irrigation District's water deal with the Metopolitan Water District.

There are a few hurdles in the way of that plan, such as the contention by the irrigation district that water rights do not reside with individual landowners but are held by the district itself, plus the current impossibility of delivering water directly to remote subdivisions absent cooperation from the public agencies that control the transmission and delivery systems.

Walter Holtz shares Morgan's skepticism about the water transfer. He's also a third-generation farmer, although his grandfather and father farmed in the Santa Ana region. He came to the Imperial Valley in 1972 because there was no place left to farm in increasingly urban Orange County.

"There was no future for me there," he said. "Now I'm beginning to wonder if there's a future for me here," he added gloomily.

Holtz farms about 1,400 acres in the valley, raising mostly grain and hay. He is Morgan's opposite in many ways: stout not lean, quiet rather than garrulous. But like Morgan, he is convinced the water rights are legally attached to the land and cannot be sold without the owners' consent. For the Imperial district board to approve the water sale without the approval of all of the landowners -- and without promising to share the proceeds with them -- strikes Holtz and others as a betrayal.

Holtz seems truly to love his way of life, though, and he seems likewise sincere in believing himself beleaguered by thirsty, greedy city-dwellers on the Southern California coast. When asked what it is he likes about living in the Imperial Valley -- a hot, dry, bleak place that so far has been bypassed by the population boom that's driving urban sprawl even in similarly inclement places such as Hemet -- he paused and then answered in a series of simple declarative sentences.

"It's open. It's not crowded yet. I like to farm and this is a good place to farm."

Outnumbered

Like Morgan and Holtz, Ronnie Leimgruber is a third-generation farmer; his grandfather came to the Imperial Valley in 1932 from Switzerland. It is hard to imagine a less Swiss place than the Colorado Desert, but Grandpa Leimgruber was drawn by the valley's free land, which was advertised widely in Europe, and promptly set to dairy farming, something they know a bit about in Switzerland. According to Leimgruber, the valley is filled with the descendants of immigrants who fled the Old World's economic and political turmoil after World War I.

Leimgruber is a burly guy whose build reflects his youthful prowess as a wrestler. He talks energetically, and his voice tends to rise and become forceful when talking about the water transfer to San Diego, a common suite of symptoms among those who didn't endorse it. He had recently been elected president of the local Farm Bureau, and his brother is a county supervisor. He farms about 2,000 acres, of which he owns 1,500, growing mostly alfalfa and grains.

Like his neighbors, Leimgruber is sensitive to allegations that Imperial Valley farmers waste water -- a topic that took on particular importance in the summer of 2003, when the Department of Interior determined that the Imperial district was squandering a prodigious amount of water and could therefore have its Colorado River allocation cut back. In part, the Interior Department report says, this is because Imperial farmers inefficiently continue to let water pour into the upper end of each field long after the initial flow has reached the lower end.

"How do you measure efficiency?" Leimgruber asked.

Sprinkler systems that rely on diesel or electric pumps might save water, he said, but they use more energy and contribute more to air pollution than the district's gravity-feed system. Sprinklers appear to be more efficient than flood irrigation, but on hot and windy days more of the water is lost to evaporation. Runoff from fields appears to represent waste, but nothing else leaches out the salt as effectively, and cutting off the flows too soon means the part of the field near the head ditch gets more water than the end near the tail ditch, leading to uneven crop growth.

Leimgruber clearly has a deep emotional tie to the farming life in which he was raised. During a drive around his fields, he stopped at the old dairy barn where his grandfather milked cows before electricity came to the farm; he still owns farm equipment used by his father and grandfather; he has meticulously restored three vintage tractors he takes to parades, including a gleaming black 1924 Farmall.

He comes alive when he talks about these things in a way he does not when reciting his long list of complaints about the implications of the water transfer. There are newspaper clips and photos on the wall in his small farm office depicting him as a high school Future Farmers of America member, winner of a prestigious state award.

Juan Carlo / Star staff
Imperial Valley farmer Ronnie Leimgruber, checking his alfalfa crop, is sensitive to charges that farmers in the Imperial Valley waste tremendous amounts of water on their crops. "How do you measure efficiency?," he asks, adding that many ideas presented to improve use would not accomplish the goals.

"We're down here because we like this lifestyle, we like this environment," he said.

It's a lifestyle that fewer and fewer Americans experience; farmers represent less than 2 percent of the population, compared with 38 percent at the start of the 20th century, according to the U.S. Department of Agriculture. And in those numbers lies a hint of what the future may hold.

The circumstances of the Imperial Valley are unique in one sense, for nowhere else in the West does so much water flow into so hot and dry a place to produce so much agricultural bounty. But as the population of the West continues to grow, threatening to outstrip the ability of existing urban water supplies to satisfy its growing thirst, Imperial's circumstances also contain an element that is universal -- one that perhaps foreshadows the future of resource allocation in the region and certainly one that explains the increasing nervousness of its farm communities.

Leimgruber summed it up in characteristically straightforward terms:

"We've got a very small group of people with a very valuable resource."

The ghost of Owens Valley

The prospect of a widespread shift of water from farms to cities inevitably conjures up the most famous Western water grab of the 20th century, one that has become a potent and enduring symbol of rural exploitation at the hands of wealthier, politically more influential and numerically superior urbanites.

When the Los Angeles Department of Water and Power quietly bought up land and water rights in the early 1900s in the Owens Valley, a sparsely populated farming and ranching area on the east side of the Sierra Nevada more than 200 miles away, it obtained a reliable and bountiful source of water to slake the growing city's thirst. It also caused the small but healthy faming communities of the valley to vanish gradually, as the fields that sustained their social and economic institutions returned to sagebrush.

The colonization of the Owens Valley by Los Angeles provides a philosophical template a century later for farming communities throughout California and the West, suggesting a shape for the jittery anxiety that runs through them when cities start talking about buying water from the agricultural sector. Raise the subject of ag-urban water transfers in a place like Imperial County or the Klamath Basin, and it won't be long before somebody brings up the subject of the Owens Valley and holds it out as an example of the dismal fate awaiting any water-rich farming community that succumbs to the lure of city money.

According to a 2003 report by the Public Policy Institute of California, at least 22 of the state's 58 counties have passed laws prohibiting the export of groundwater outside their boundaries, and most of those also prohibit pumping groundwater to replace surface water that's been exported.

Taking farmland out of production so its water can be sold to cities threatens to undermine the fragile economy of small farming communities, leading to higher unemployment and reduced sales of everything from fertilizer to tractors. Economists refer to these as "third-party impacts" and debate how they can best be addressed and minimized. Some recent water deals, such as the one executed by MWD with Sacramento Valley farmers, includes money ($5 per acre-foot) to be paid into a community development fund, intended to help offset the economic effects of the transfer. MWD's deal with the Palo Verde Irrigation District included setting up a $6 million fund to compensate the community for losses associated with the fallowing program there.

But the ghost of Owens Valley also materializes in circumstances when the analogy does not apply -- when, for example, the discussion is not about taking water away from anyone but of capturing and moving water that's currently not being used. In the view of some water planners, the ghost inhibits rational discussion of how best to allocate and manage the most valuable natural resources in the West.

MWD, for example, has suggested expanding the Banks Pumping Plant in the delta, not only to make it easier to transfer water from willing sellers in the north to urban customers in the south, but also to make it possible for the state to ship more water to off-stream storage reservoirs or to inject it into aquifers during periods of high flow. That proposal, however, has been greeted by indignant opposition in Northern California.

"Automatically, people raise up the old claim, 'Southern California wants to steal the water,' " said Adan Ortega, MWD's vice president for external affairs. "(That) debate, for all intents and purposes, is obsolete. We're only having it because it's the only thing people know how to talk about."

In the face of population growth, uncertainty regarding the needs of endangered species, and the effects of global climate change -- which already is causing a shift in rain and snow patterns that threatens to undermine the hydrological premise of the region's great plumbing systems -- the terms of the debate must change, or the growing cities of the drought-prone West are going to get very thirsty.

"Unless we get our act together, we're going to be in big trouble," said Donald Kendall, general manager of the Calleguas Municipal Water District. "Doing nothing isn't going to work."

Recycling increases water supply

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FOUNTAIN VALLEY -- In your kitchen sink sits a stack of dinner plates encrusted with the remnants of a holiday feast: crumbs of turkey dressing, a sheen of grease, dollops of coagulated gravy, a limp bouquet of lettuce leaves.

Delegated the task of cleanup, which you probably could have avoided had you volunteered to help cook, you turn on the faucet. A dependable and clean jet of water rinses away the debris and disappears down the drain, the eventual destination of that water as irrelevant to the act of dish washing as its source.

Each day, Californians send more than 4.5 billion gallons of water down sink drains and sewer lines this way. Most travels to wastewater treatment plants and is then dumped either directly into the sea or into rivers that ultimately lead there. Although some of that treated effluent is subsequently pumped back out of those rivers by municipal water plants downstream and, after purification, piped again into customers' homes, most of the freshwater consumed by people in cities and suburbs is destined to be used only once and then discarded.

To some in the water industry, that's inexcusably wasteful. And as the West finds itself struggling to satisfy the increasing thirst of its rapidly growing population, many water-supply planners and engineers believe the future lies not in the kind of big hydraulic projects that characterized the 20th century -- huge dams and long aqueducts -- but in finding ways to more efficiently use and reuse the water supply that's already been developed at enormous public expense.

"It's irresponsible to pay $400 an acre-foot to bring water here from Northern California and then dump it in the ocean," said Ron Wildermuth, communications director for the Orange County Water District.

At the water district's Fountain Valley headquarters, the future of Western water -- or at least an important part of it -- is taking shape. To fully appreciate the significance of the maze of pipes and pressure vessels being installed there, perhaps it is best to start with a journey, retracing the path followed by a squirt of water before it reaches that ignoble moment of indifferent discard in a Southern California sink.

A liquid odyssey

If you are among the half-million Ventura County residents receiving water from the Calleguas Municipal Water District, a member of the Metropolitan Water District of Southern California, your faucet dispenses water from the State Water Project. The state project provides half the water distributed by the MWD, and all of the water delivered by wholesaler Calleguas to 21 county agencies, including the cities of Oxnard, Camarillo, Thousand Oaks, Simi Valley, Moorpark and Port Hueneme, and the unincorporated areas of Oak Park, Santa Rosa Valley, Bell Canyon, Lake Sherwood, Somis, Camarillo Estates and Camarillo Heights.

If you live in any of these areas, the water that ran into the kitchen sink when you turned on the tap began its journey by falling as snow more than a year earlier, perhaps in the Sierra Nevada north of Lake Tahoe. Now a winter playground, formerly a bitter obstacle to California-bound emigrants from the East, the slopes of the northern Sierra pile up prodigious quantities of snow as they intercept the water-heavy storms rolling in from the Pacific each year.

There, on a bright spring day, that hypothetical handful of snow melted, joining innumerable droplets, rivulets, freshets and creeks in their exuberant dance across the springtime slopes. Splashing in the deep shade of pine-clad canyons, the new meltwater cascaded out of the Plumas National Forest, passed the remnants of Gold Rush-era diggings, and slipped into the South Fork Feather River, flowing through the foothills to the edge of the Sacramento Valley.

It stalled there, for the Feather River is blocked by the tallest dam in the United States, a chunky earthen behemoth 770 feet tall and containing 80 million cubic yards of clay, sand, gravel and cobbles. The water waited in the reservoir behind Oroville Dam until a hot summer afternoon, when air conditioners hummed to life up and down the sun-baked Central Valley and electricity began draining from the statewide power grid like air wheezing from a punctured automobile tire.

At the Oroville powerhouse, giant steel gates opened, and water began pouring from the reservoir through immense pipes into the bowels of the dam, where it spun massive turbines and generators to produce electricity. Emerging from the generating plant in a froth of spray and spume, the water gathered and quieted as it traveled through a canal to the Thermalito Forebay, a sort of lake below the lake. From there, it roared through another set of generator turbines, producing more electricity, before settling into the Thermalito Afterbay, yet another impoundment.

Trip through turbines

Late that night, when power demand fell and the price of electricity dropped to off-peak rates, the big turbines reversed their spin, burning juice instead of generating it, pumping water from the afterbay back uphill into the forebay. The next afternoon, demand and price peaked again, and the water repeated its trip through the turbines to produce more power and more money from power sales, the laws of economics nullifying the laws of physics.

Eventually freed from the generating cycle, the water flowed downstream into the Feather River. For a while it carried young salmon and steelhead reared in the giant Feather River Fish Hatchery, built in an effort to compensate for the spawning grounds destroyed or blocked by Oroville Dam. From the Feather it flowed into the Sacramento River, planting wet kisses on the hulls of oceangoing freighters as they journeyed upstream to the state capital, a seaport 70 miles from the sea.

The water then reached the state's liquid heart, the Sacramento-San Joaquin River delta, a vast cat's-cradle of sloughs and channels where the state's two major river systems mesh and then mingle with saltwater on the inland edge of San Francisco Bay.

Instead of flowing west through the Golden Gate, however, the Sierra snowmelt obeyed a powerful tug from the southeast, where the Harvey O. Banks Delta Pumping Plant sits at the edge of the delta near the town of Tracy. The plant's 11 pumps slurp 6.7 million gallons of water a day from the delta, creating an almost tidal tug that's strong enough to reverse the flow of the state's biggest rivers.

The pumps lifted the water 244 feet and spat it into the Gov. Edmund G. Brown California Aqueduct, more commonly known simply as the California Aqueduct. The aqueduct is the longest river in California, flowing 444 miles from Tracy to its terminus at Lake Perris near Riverside. Trapezoidal in cross-section, its largest segment is 110 feet wide at the bottom, 240 feet wide at the top and 35 feet deep, a concrete-lined channel large enough to float a cruise ship. From Tracy, the water flowed south, the aqueduct making sinuous curves as it followed the land's natural contours, a ribbon of blue in a landscape of green and gold, roughly paralleling Interstate 5.

Eventually, gravity met its match. The water's ultimate destination, the great Southern California metropolis, lies on the far side of a monumental natural barrier that closes off the south end of the Central Valley with blunt topographic decisiveness: the Tehachapi Mountains, a crumpled pile of rock heaved into the sky by the slow collision of tectonic plates along the San Andreas Fault.

The water followed the course taken also by motorists climbing over Tejon Pass, and like them it tackled the incline in stages. Buena Vista Pumping Plant raised the water 205 feet and the aqueduct resumed its gravity-powered course; at Wheeler Ridge there was another pump lift, this one 233 feet; and at Wind Gap pumps raised it an additional 518 feet.

Finally, near the town of Grapevine at the foot of the mountains, the water reached the A.D. Edmonston Pumping Plant. Inside the plant is a battery of 14 pumps, each weighing 220 tons and spun by an 80,000-horsepower motor that weighs an additional 200 tons and eats electricity the way football linemen chow down cheeseburgers. The pumps turned the horizontal aqueduct into a vertical thrill ride, lifting the entire flow of water 1,926 feet to the summit of the Tehachapis. It is the highest single water lift in the world.

At the summit, the water flowed through a sequence of tunnels and siphons more than 8 miles long, and then reached a division. The East Branch of the aqueduct heads across the Mojave Desert, climbing to Lake Silverwood in the San Bernardino Mountains and then dropping to Lake Perris near Riverside, the most distant terminus of the artificial river that began near Tracy. Lake Perris is 600 miles from Lake Oroville.

The West Branch climbs an additional 231 feet and then relies on gravity to send water to Pyramid Lake and finally to Castaic Lake, where MWD's system takes delivery. The water followed this route to the Joseph Jensen Filtration Plant near Granada Hills, and thence to the San Fernando Valley, West Los Angeles, Santa Monica, the Palos Verdes Peninsula and -- using a mile-long tunnel bored under the Santa Susana Mountains -- Ventura County.

After completing this odyssey -- a journey of hundreds of miles across valleys and over mountains, made possible by one of the most elaborate public works ever constructed, a system envisioned by bold politicians, designed by audacious engineers and powered by enough energy to light several states -- that water poured from your kitchen tap to sluice an overlooked lettuce leaf off your dinner plate.

And then you threw it away.

Getting a second use from that expensively stored and transported water -- and perhaps a third, a fourth and even more -- is the goal of a project under way at the Orange County Water District's Fountain Valley headquarters. It is the sort of project that, if replicated throughout the West, could help meet a significant share of the region's water demand.

The district, which serves 23 cities and water agencies, manages a 365-square-mile groundwater basin that contains between 700,000 and 1 million acre-feet, and which is replenished by the Santa Ana River. Water historically was pumped faster from the aquifer than the river and rainfall could replace it, dropping the water table below sea level and allowing the vacant storage space to be filled by saltwater pushing in from the adjacent ocean.

The district has been combating this threat to its water supply since 1975 by injecting 15 million gallons of purified wastewater a day into the aquifer. The water is purified at a state-of-the-art reverse-osmosis plant called Water Factory 21, which is the longest-operating reverse-osmosis treatment facility in the United States. This has granted it a certain fame in international water circles: Each year, more than 1,000 visitors from as many as 30 nations come to examine it.

Soon, however, it will be torn down and replaced.

The district anticipates that its water supply -- drawn from groundwater, MWD's Colorado River Aqueduct, the Santa Ana River and the State Water Project -- will fall 100,000 acre-feet short of annual demand by 2020. (An acre-foot is 325,851 gallons, enough to supply two average Southern California households for a year.)

To head off that shortage, the Orange County district has launched an ambitious expansion of its recycling program by building a $450 million treatment plant and pipeline that will take wastewater from the Orange County Sanitation District plant next door and pass it through a three-stage purification system: microfiltration to remove large impurities and contaminants such as cryptosporidium, reverse osmosis to remove salts and other minerals, and an ultraviolet light/hydrogen peroxide system that kills anything that made it through the first two stages.

Repeated testing, Wildermuth said, has shown that the purification process removes every known chemical and biological contaminant.

Pumped out of aquifer

That's a good thing, because after the water plant treats the sewage plant's output, it will either be pumped into the ground through one of the district's injection wells or piped 14 miles upstream along the Santa Ana River to Anaheim and released onto the spreading grounds there, where it will percolate into the aquifer.

Either way, once it's pumped back out of the aquifer again, that purified sewage will become drinking water for the district's customers. State health regulators would not allow the recycled water to be piped directly to homes without the intermediate underground stage, which is probably just as well.

"I don't think we're ready for that," said district engineer Shivaji Deshmukh, alluding to the "yuck factor" associated with pipe-to-pipe connections.

Few people like the idea of drinking toilet water, no matter how well purified, and citizen opposition has thrown roadblocks in the way of other such projects. In April 2000, for example, the Los Angeles Department of Water and Power put a similar recycling project on hold just days before it was to begin operation in the San Fernando Valley, despite having spent $55 million on a pipeline and related facilities.

As a reflection of the seriousness with which the Orange County district regards the matter of consumer perception, it spends $900,000 a year on public relations, selling the virtues of water recycling to a wide audience. It presents programs in schools and before community groups, conducts direct-mail campaigns, and has lined up an impressive list of endorsers of the project among health professionals, environmental groups and business organizations.

"This is the only (water) project in the state of California that has the support of environmental groups, agriculture and urban" agencies, Wildermuth said, cataloging the disputatious trio of interests that has warred for decades over California water projects.

The district already has diversions that pull water from the river and dump it onto the aquifer recharge basins. In summer, Wildermuth said, 80 percent of the Santa Ana River's flow is treated sewage, so water is already making its roundabout way from toilet to tap in Orange County.

A coy term

In truth, the same thing happens throughout the West, where water intakes for aqueducts and other municipal supplies often are downstream -- the Sacramento and Colorado rivers providing two notable examples -- from other communities' wastewater discharges. The water industry even has a coy term for this phenomenon, referring to it as "unplanned indirect reuse."

The Orange County groundwater replenishment system involves a symbiotic partnership with the Orange County Sanitation District, which releases its treated effluent through a five-mile-long ocean outfall and anticipates exceeding the capacity of that structure by 2020. Rather than spend $170 million to enlarge the outfall, it's giving that money to the water district -- along with the wastewater -- to help build the purification plant. An additional $92 million is coming from the state and federal governments.

Some of the cost also will be borne by customers, who will see their $30-a-month water bills go up by perhaps $4, Wildermuth said. Their bills would rise at least that much anyway if the water district had to buy more water from outside sources to meet demand. Local groundwater costs about $150 an acre-foot; imported water from the Colorado River Aqueduct is about $400. Water from the new plant will cost about $500 an acre-foot, which is comparable to the price of water from the state project.

When complete in 2007, the expanded plant will produce 72,000 acre-feet of purified water a year. The waste stream from the microfiltration system, which will have bacteria, viruses and other contaminants in it, will be sent back to the sanitation district for treatment and then be released through the ocean outfall.

The hypersaline brine left behind after the reverse-osmosis system removes salts and minerals from the water will be dumped directly into the ocean through that same outfall.

Wildermuth said the district regards such projects as the next phase in California water development. Instead of big dams and aqueducts, he said, the focus in the future will be on increased efficiency, agriculture-urban transfers, aquifer storage, purifying wastewater and, ultimately, desalinating seawater, although that will probably remain too expensive to consider until every cheaper drop has been wrung out of the state's plumbing system.

According to a June report by the state's Recycled Water Task Force, California could be recycling up to 1.5 million acre-feet per year of water by the year 2030, meeting as much as half of the increase in demand brought about by projected population growth during that time. To do so, however, the state will have to invest nearly $11 billion -- about $400 million annually -- for facilities needed to produce and deliver the recycled water, the task force concluded.

MWD also has taken the first tentative steps toward what has long been regarded as California's ultimate fall-back option, tapping the Pacific Ocean. In 2001, the agency announced a program under which it will subsidize the construction of ocean desalination plants and agree to purchase their output at a guaranteed price of $250 an acre-foot. Five agencies submitted applications: the cities of Los Angeles and Long Beach, the Municipal Water District of Orange County, West Basin Municipal Water District and the San Diego County Water Authority. The production capacity of those plants totals 126,000 acre-feet per year.

'Reframing' water talks

"We believe that now is the time to begin reframing the water conversation," said Adan Ortega, MWD's vice president of external affairs, describing his agency's efforts to concentrate on conservation and recycling rather than developing major new supplies in order to meet projected demand in its six-county service area.

Long before turning to the ocean, water agencies likely will focus on desalinating brackish groundwater, of which the state has a great deal, said Donald Kendall, general manager of the Calleguas Municipal Water District.

"We have not fully utilized our groundwater resources," he said.

It's cheaper to desalinate water that, while too salty to drink, is less salty than seawater, because it requires less energy to remove the impurities. Ventura County has a significant amount of brackish groundwater, Kendall said, underlying the plain between Moorpark and Simi Valley as well as in other areas. Making that water usable and pumping it out for consumption would also create underground storage space in those aquifers.

Water captured and transported in the state's existing system of dams and aqueducts could be stored in that aquifer space during times of high flow and low demand, such as the winter and early spring when runoff in the state's rivers is highest. Right now, there's no place to put that water, and pumping it into aquifers would be less environmentally damaging than constructing new dams and reservoirs.

Calleguas has been developing just such an underground reservoir in the Las Posas Basin, which underlies the Las Posas Valley. When the 10-year project is completed in 2009, it will be able to store 300,000 acre-feet.

Waste not, want not

The emphasis by some water planners on nontraditional strategies has not stifled the call for more dams and surface reservoirs, particularly from members of the agricultural and construction industries, but also from urban water agency managers who believe having more places to put water during wet years and flood season would improve the overall stability of the state's water supply.

A long-awaited report issued three years ago by CALFED, the state-federal partnership coordinating efforts to improve management of the Sacramento-San Joaquin river delta, offers several storage proposals. They include enlarging existing dams in the Sacramento and San Joaquin watersheds, as well as constructing new off-stream reservoirs. A bill introduced last year by Rep. Ken Calvert, R-Riverside, would authorize construction of any such project the Department of Interior deems feasible, even without a specific authorizing vote by Congress, but failed to make it out of committee.

There are other options, too. Municipal and industrial conservation alone, according to a recent report from the Pacific Institute for Studies in Development, Environment and Security, has the potential to meet all of California's projected water needs through the next two decades.

"Our best estimate is that one-third of California's current urban water use -- more than 2.3 million acre-feet -- can be saved with existing technology," the Pacific Institute researchers concluded in their November 2003 report. "At least 85 percent of this (more than 2 million acre-feet) can be saved at costs below what it would cost to tap into new sources of supply and without the many social, environmental and economic consequences that any major water project will bring."

Two million acre-feet is, in round terms, enough for about 16 million people -- or just about exactly the number of residents state and federal demographers expect California to add by 2030.