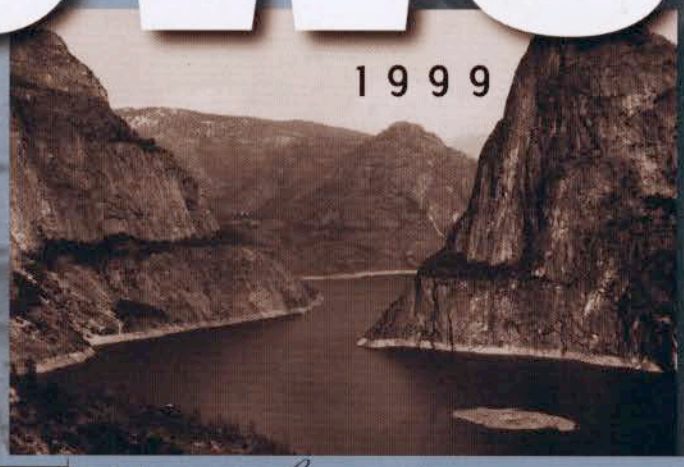
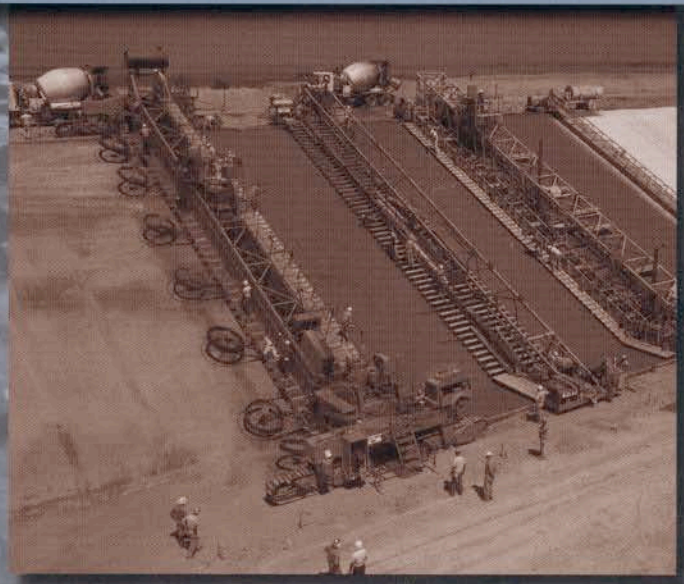
DEPARTMENT OF WATER RESOURCES

News

FALL ISSUE 1999



150 Years of California's Water History



1849

1999

mission statement

"To manage the water resources of California, in cooperation with other agencies, to benefit the State's people and protect, restore, and enhance the natural and human environments."

DWR News is published two times a year. Any questions, comments, or story ideas are welcomed by the **DWR News** editors.

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features

by Joyce Tokita

California's Sesquicentennial celebration commemorates the 150th anniversaries of the discovery of gold in 1848, the Gold Rush in 1849, and statehood in 1850. A look at the State's past, especially its history of water development, can help us understand the significant events that shaped California's evolution into one of the nation's most prosperous states.

150 Years of CALIFORNIA'S GOLD

One electrifying word brought thousands to California in hopes of striking it rich. They came by land in wagon trains, traversing thousands of miles of flatlands and mountains, or by ships that sailed around South America's Cape Horn, a journey that took months.

Whether they found the precious metal or not, many newcomers chose to stay in California. Some of these settlers turned to farming the land and discovered the state's enduring source of its wealth — its water. They began pumping groundwater aquifers to irrigate the land, turning desert areas into fertile fields that would eventually produce 11 percent of the world's agricultural market, making California the leading food producer in the nation.

California's healthy economy stems in part from its mild climate, fertile valleys, and long growing seasons but mainly from its ample water resources — its lakes, rivers, streams, creeks, and groundwater basins. Most water supplies are concentrated in its northern half, due to the State's climate conditions and geography. The construction of water conveyance projects, such as the State Water Project, helped transport this water to areas in need, including the San Francisco Bay area, the San Joaquin Valley, and Southern California.

The state's population of 33 million and its future growth, however, present new and more difficult challenges. DWR's Bulletin 160-98 forecasts a 2020 population of 47 million people, who could face water shortages of 2.4 million acre-feet in average years and

6.2 maf in drought years. Many water agencies are already seeking new water supplies, implementing conservation measures, and researching alternative sources such as water reuse and groundwater recharge projects to meet future needs. They recognize that water is the key to California's continued prosperity.

The timeline that follows features significant landmarks in California's history of water development and important milestones for the State Water Project. Also included are key State and federal events and laws that have changed the way DWR and other water agencies use their supplies and operate and maintain their water systems.

Water History

1848

In observation of the Sesquicentennial, the timeline begins shortly after the war with Mexico (1846 - 1848), which preceded the Gold Rush and helped assure California's bid for statehood.

Type Style Key:
California Events
Water Development Events
State Water Project Events
National & International Events

1848 Gold is discovered at Sutter's Mill. California population totals about 15,000.

1849 The Gold Rush begins. Prospectors build networks of ditches and flumes to carry water where it's needed.

Levee construction begins in the Sacramento-San Joaquin Delta.

The California Constitutional Convention meets and directs the Surveyor General to study irrigation, drainage, and navigation.

1850 California admitted to the Union as the 31st state.

Its population reaches 100,000.

Routine meteorological records begin.

1853 Hydraulic mining starts. The debris it creates clogs river channels, creating floods of greater magnitude. Hydraulic mining operations are shut down by a federal court decision in 1884.

Miles of canals and flumes were built to harvest the gold. Later hydraulic mining (below) used high-pressure water streams to break down hillsides in search of gold.

Floods were commonplace and devastating in the Central Valley as more people built homes and farmed land protected only by fragile levees.

1860

Downtown Sacramento flooded streets

1860 Reclamation of swamplands begins in the Sacramento Valley.

California ranks ninth in the nation's wheat production.

1861 **The Civil War breaks out.**

Massive flooding inundates Sacramento Valley.

1865 **Civil War ends.**

California population reaches 400,000.

Oil rigs were once used for extracting groundwater.

1869 First transcontinental railroad reaches the West, opening grain sales to the East Coast.

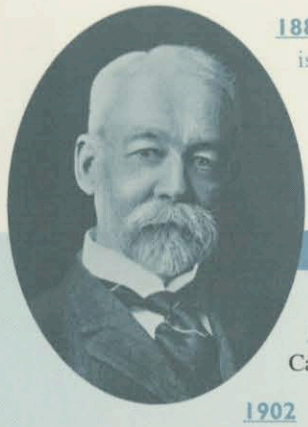
1870 Rudimentary drill rigs and pumps begin groundwater extraction.

The state's irrigated acres total 60,000

1873 President Grant appoints the Alexander Commission to study irrigation and reclamation in the Central Valley. In 1874 the commission's report proposes a Central Valley storage and distribution system.

1878 Under the first State Engineer, William Hammond Hall, the state launches its first comprehensive investigation into developing Central Valley water resources.

1880 Southern California begins its growth boom



William Hammond Hall

1887 The Wright Act is adopted, a State law enabling citizens to create local irrigation districts.

1889 1.1 million acres in California under irrigation

1902 California's irrigated lands increase to 2.6 million acres.

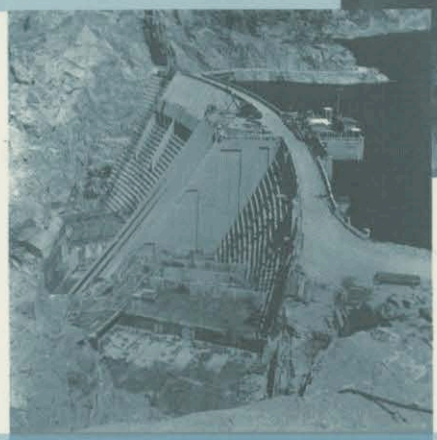
1902 Congress passes the Reclamation Act, which limits the number of acres a beneficiary of the act can irrigate with water from federal facilities to ensure a more equitable distribution of water. The U.S. Bureau of Reclamation is created.

1908 Construction begins on the Los Angeles Aqueduct to bring water from the Owens Valley to Los Angeles. Five years later, the first water deliveries flow into the San Fernando Valley.

Early irrigation canals drew their water from groundwater basins.

1910 The Hetch Hetchy water project is approved by Bay area voters. It creates a dam and reservoir in the Sierra near Yosemite Valley to provide a water supply for San Francisco. The project begins deliveries in 1934.

1914 **World War I begins. America enters the war in 1917. WWI ends in 1918.**



In 1919, construction began on the O'Shaughnessy Dam (above) in the Hetch Hetchy Valley (top right). The dam was dedicated in 1923.

"The 1928 mandate of reasonable and beneficial water uses removed a major hurdle to statewide water planning."

– from "The Great Thirst," Norris Hundley

1928 The California Legislature mandates, under the State's constitution, that water will not be wasted but put to reasonable and beneficial uses. The law sets the foundation for future water conservation regulations and loan programs.

Boulder Canyon Project Act passes to build Hoover Dam on the Colorado River. It is constructed from 1932-35.

St. Francis Dam, part of William Mulholland's water supply system for Los Angeles, collapses, killing at least 400 people.

1919 Lt. Colonel Robert Marshall of the U.S. Geological Survey publishes a plan for transferring water from the Sacramento River system to San Joaquin Valley and Southern California.

Lt. Colonel Robert Marshall

1927 East Bay Municipal Utility District begins building its first pipelines to tap the Mokelumne River. Deliveries start in 1929. Two more pipelines are completed in 1949 and 1963.

150 Years of California's Water History

1929

1929 Reacting to the St. Francis Dam disaster, State legislation creates a dam safety program which provides for supervision over nonfederal dams. The law is extended to new and existing offstream storage facilities after the 1963 failure of Baldwin Hills Dam.

Stock market crash sets the stage for the Great Depression era.

A cooperative effort by state, federal, and local agencies, along with utilities and water districts, begins collecting snowpack data to forecast water supplies.

1930 State's population reaches 5.5 million.

1931 **The State Water Plan proposes a system of dams, reservoirs, pumping and power plants to exchange water between the Central Valley's northern and southern portions.**

1932 A newly formed Metropolitan Water District of Southern California begins building the Colorado River Aqueduct, completed in 1945.

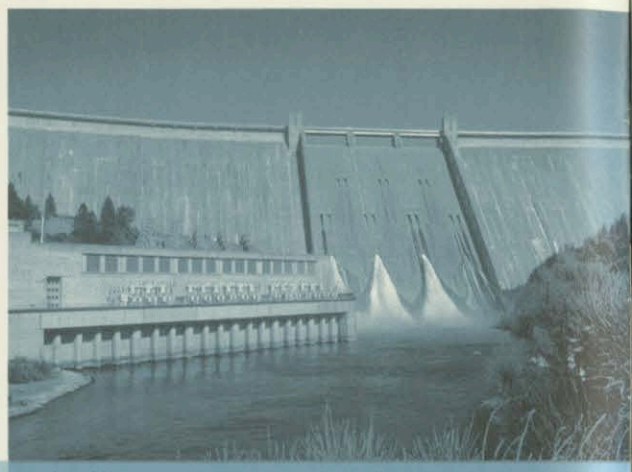
1933 **The State Legislature, and later voters, approves the Central Valley Project Act and a $170 million bond. But because of depressed economic conditions, the State is unable to pay for its construction.**

Snowpack data collection is vital for forecasting the year's water supply.

1936 The federal Flood Control Act of 1936 reflects a major policy transition to support the multi-use concept of flood control. The era of building dams as multipurpose structures begins.

1937 The federal government takes over the Central Valley Project as a public works project and begins building the Central Valley Project. The CVP provides up to 4 million acre-feet of water per year, mainly to agricultural water users in the Central Valley.

1938 Federal government begins work on Shasta Lake and Dam. The project is completed in 1945. A part of the federal Central Valley Project, it is California's largest reservoir.



The Shasta Dam Project was completed in 1945.

1940 The All-American Canal is completed, bringing Colorado River water to Imperial and Coachella valleys in Southern California.

1941 **U.S. enters World War II.**

1945 **World War II ends.** California's economy booms; water demands increase for the State's growing industries, cities, and farms.

1948 Construction of Folsom Dam begins. As part of the federal Central Valley Project, it provides water supply, recreation, and flood control. The lake is completed in 1956.

1950 **Korean War begins, ending three years later.**

California's population increases to 10.5 million.

About 80,000 pumps increase groundwater extraction, mostly for farms. Irrigated acreage totals 6.5 million.

1951 **Division of Water Resources (predecessor to DWR) publishes Bulletin 1, an inventory of California's water resources and water-related data.**

State Engineer A. D. Edmonston

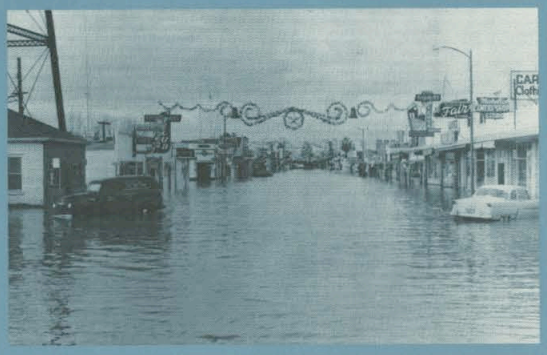
150 Years of California's Water History

State Engineer A. D. Edmonston proposes the Feather River Project which would include a multipurpose dam and reservoir on the Feather River near Oroville, a power transmission system, and an aqueduct to convey water from the Delta to the San Francisco Bay area, San Joaquin Valley, and Southern California.

CVP puts Delta-Mendota Canal and Tracy Pumping Plant in operation.

"The vicious Christmas storm of 1955 brought loss, suffering and death to people as far apart as Fortuna and Yuba City, Visalia and Santa Cruz."

– from "Aqueduct Empire," Erwin Cooper



Floods were commonplace in the Central Valley. The Flood of 1955 breached levees at Yuba City and caused widespread destruction and more than 60 deaths. Because the Oroville project would help control such floodwaters, the State Legislature quickly approved money in 1956 for its final design.

1955 **DWR's Bulletin 2 provides information on current water uses with forecasts of future needs.**

A record flood hits Northern and Central California, killing 67 people. The State Legislature makes an emergency appropriation of $25 million to begin work at Oroville.

1956 **The State Legislature creates the California Department of Water Resources to oversee development of the state's water resources and the construction of the State Water Project.**

1957 **The first California Water Plan outlines preliminary plans for full development of the State's water resources to meet its ultimate water needs. It includes local development projects and a system to transfer water from north to south. Work begins on the Oroville site.**

President John F. Kennedy and Governor Edmund G. Brown, Sr., headed the 1962 groundbreaking ceremony for the San Luis Reservior and other joint-use facilities.

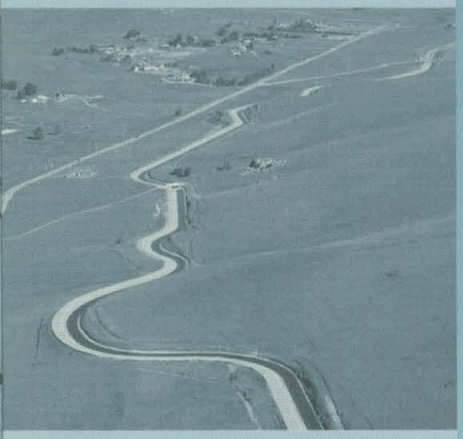
1959

1959 Governor Edmund G. "Pat" Brown advocates building the State Water Project. The Burns-Porter Act is passed, authorizing $1.75 billion in bonds to construct the SWP.

1960 Voters approve the $1.75 billion bond act.

California's population reaches 15.5 million. More than 8 million acres under irrigation.

The Metropolitan Water District of Southern California signs the first water supply contract with the state for supplemental water supplies from the SWP. (Today 29 agencies have long-term contracts for SWP deliveries.)



The SWP's South Bay Aqueduct was its first facility to deliver water to Alameda and Santa Clara counties in 1962 and 1965, respectively. Completed in 1969, the aqueduct supplies water to alleviate groundwater overdraft caused by the region's growing economic needs.

Congress authorizes construction of the San Luis Unit of the CVP. The unit also becomes part of the SWP. Groundbreaking is held in 1962.

Davis-Grunsky Act is enacted as part of the State Water Project. It provides funds for local water projects.

1961 Also part of the legislation affecting the State Water Project, the Davis-Dolwig Act is passed. It directs the SWP to provide recreation and fish and wildlife enhancement and provides money from the General Fund for such projects.

State and federal governments enter into an agreement to develop and construct the San Luis Joint-Use Facilities.

1962 A partially completed South Bay Aqueduct starts service to Alameda County and to Santa Clara County in 1965.

1963 Construction begins on San Luis Reservoir, which is completed in 1967 and filled in 1969. It is the nation's largest offstream reservoir.

Work begins on the California Aqueduct in the Delta.

California's population surges ahead of New York State and makes it the nation's most populous state.

1967 First SWP entitlement water delivered via the South Bay Aqueduct to Santa Clara Valley Water District.

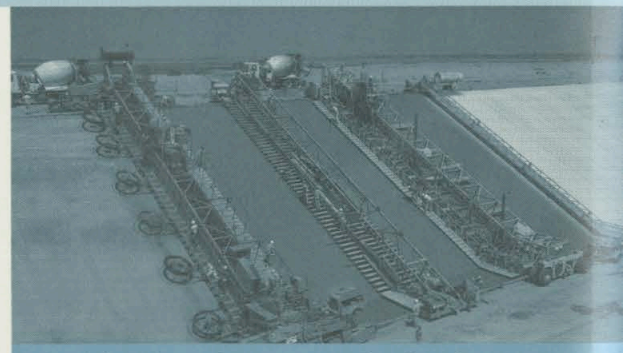
First salmon and steelhead enter Feather River Fish Hatchery.

Construction begins on the West Branch (completed in 1982) and on the East Branch (completed in 1996).

1968 Oroville Dam and Lake Oroville are dedicated by Governor Ronald Reagan. The reservoir is filled to its 3.5 million acre-feet capacity for the first time.

First SWP water deliveries are made to San Joaquin Valley contractors.

Phase 1 of the North Bay Aqueduct begins serving Napa County.



Special paving trains were created to line the California Aqueduct.

Feather River Fish Hatchery

Skinner Fish Facility begins operation to salvage fish before they enter the pumps at Banks Pumping Plant in the Delta.

National Wild and Scenic Rivers Act becomes law to keep designated rivers in their pristine natural state.

California's population reaches 20 million.

1969 Banks Pumping Plant is completed. Four pumps are added in 1986.

Harvey O. Banks Delta Pumping Plant

"At the time that Oroville was built, we included every environmental protection that was known, including a temperature control outlet that was very expensive and innovative for its day."

— DWR Director David N. Kenedy, 1998

Recreation pursuits, such as white-water rafting, can play a significant role in determining how California's waterways are used.

1970 **California Environmental Quality Act and National Environmental Policy Act take effect, requiring public agencies to prepare and submit for public review environmental documents for major projects that could impact the environment.**

California Endangered Species Act is enacted. It is amended in 1984 to more closely resemble the federal act.

1972 Edmonston Pumping Plant is dedicated. This pumping plant has the world's highest single lift of water, nearly 2,000 feet up and over the Tehachapi Mountains.

First water deliveries begin to Southern California.

State's Wild and Scenic Rivers Act is passed, prohibiting dams on many rivers, especially those along the North Coast.

The federal Clean Water Act is passed. Section 404 of this act protects wetlands.

150 Years of California's Water History

During the 1977 drought, California received only 45 percent of its average precipitation, causing storage in 155 major reservoirs to drop to 7.8 million acre-feet or 35 percent of the historical average.

1973

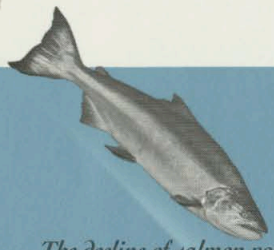
1973 **The federal Endangered Species Act is passed to protect both species and their critical habitat.**

1976 **Start of a two-year drought. SWP delivers nearly 1.4 million acre-feet of water to contractors.**

1977 **Driest year of record. SWP deliveries drop to less than 600,000 acre-feet.**

1978 The first water quality standards for the Sacramento-San Joaquin Delta are set by the State Water Resources Control Board. Known as D1485, the standards extend to San Francisco Bay and hold the SWP and federal CVP mainly responsible for meeting the standards.

Flood Emergency Action Team

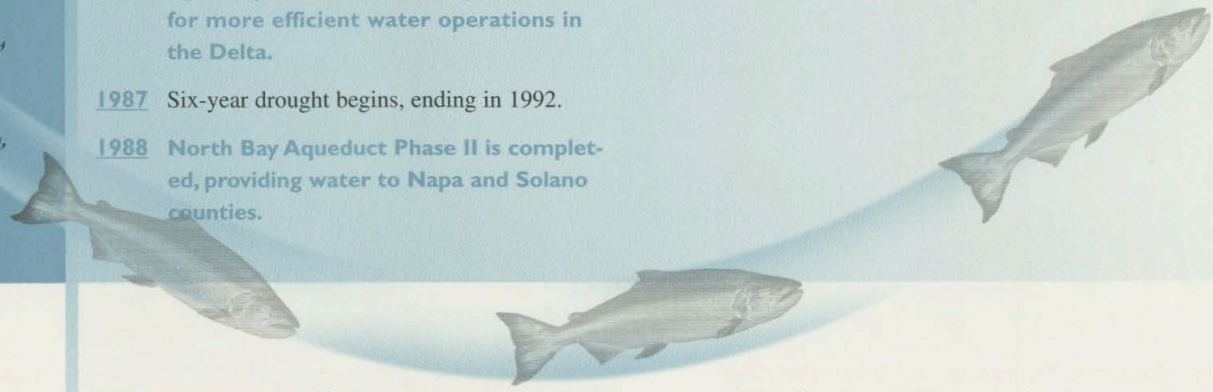


The decline of salmon populations are impacted by many factors including drought conditions, water exports, introduced species, water pollution, commercial overharvesting, unscreened diversions, and poaching.

1986 **The Coordinated Operation Agreement is signed by State and federal governments for more efficient water operations in the Delta.**

1987 Six-year drought begins, ending in 1992.

1988 **North Bay Aqueduct Phase II is completed, providing water to Napa and Solano counties.**



The North Bay Aqueduct, Phase II, was completed in response to the growing needs of the areas it now serves.

1989 **Winter-run chinook salmon is emergency listed as a threatened species under the federal Endangered Species Act. It is reclassified as endangered in 1994.**

The California act also lists the winter-run as endangered.

1991 Governor Pete Wilson creates a State Drought Water Bank, implementing a short-term water market to meet critical water needs brought on by the serious drought. The water bank is established again in 1992 and 1994.

1992 Governor Wilson enunciates a comprehensive water policy.

The Central Valley Project Improvement Act is passed by Congress. The law requires that 800,000 acre-feet be dedicated for environmental use.

1993 Delta smelt declared a threatened species under the California Endangered Species Act.

1994 The Delta Accord is signed, establishing the State-federal CALFED program to investigate and propose a long-term solution to problems in the Bay-Delta estuary.

"Water is inextricably tied to our State's success."

– Governor Gray Davis, November 19, 1998

1995 Widespread flooding affects most California counties.

1997 **The Coastal Branch, Phase II, is dedicated and begins water deliveries to San Luis Obispo and Santa Barbara counties.**

Flood flows set new records and cause widespread damage and loss of lives along the Sacramento and San Joaquin rivers. Losses reported in 48 of 58 counties. Damage estimates total $2 billion, including $300 million to the levee system. Eight people die; more than 100,000 evacuated.

2000 CALFED's final report is due. Initial efforts will focus on ecosystem restoration, alternative water management strategies such as water conservation, water reclamation, and groundwater recharge before new surface water projects are constructed.

DWR staff trained many local agencies in flood preparedness to ready for El Niño storms in 1998.

"I think 99 percent of the participants in this process want to see something good happen for everybody in the system."

– Lester Snow, CALFED Executive Director, 1996.

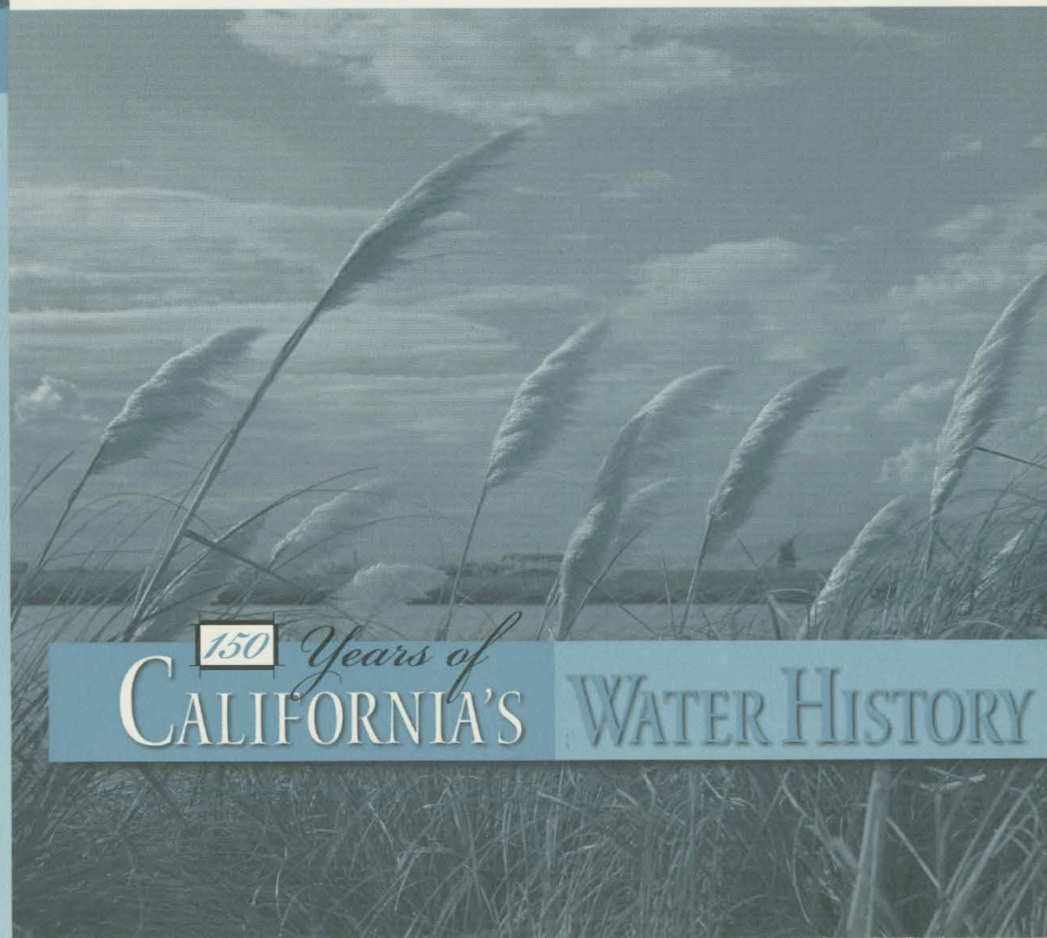
Governor Wilson appoints a Flood Emergency Action Team to recommend measures to prevent future floods.

1998 Preparation for El Niño pays off even though Southern California suffers much loss from storms and mud slides. Flooding along the Pajaro River causes levee failures and evacuations. Many urban and small stream floods damage roadways, businesses and homes in Central California. Numerous private levees in the Suisun Marsh are breached.

1999 **Construction begins on the East Branch Extension to expand service to the San Bernardino and San Gorgonio Pass areas.**

CALFED releases a draft environmental document which outlines its proposed long-term fix for the Bay-Delta.

Spring-run chinook salmon and coastal chinook salmon listed as threatened under federal Endangered Species Act and State ESA.

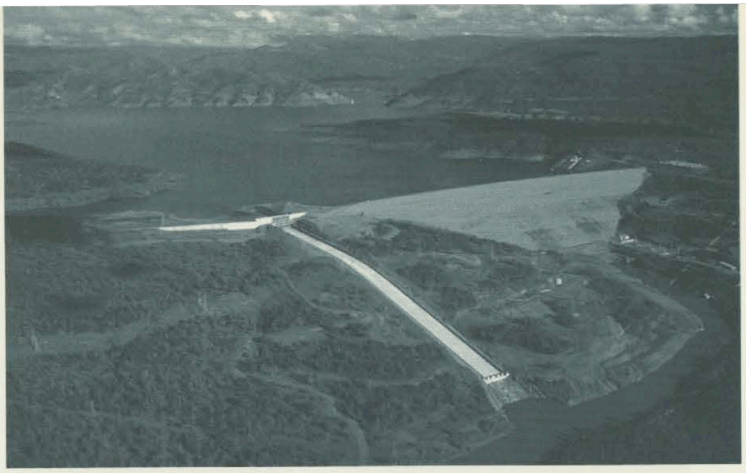


150 Years of California's Water History

RELICENSING THE HEART OF THE SWP

Hyatt Power Plant

Photo by Dale Kolke, Norm Hughes, DWR Photo Lab



Lake Oroville Dam

EDITOR'S NOTE:

A high DWR priority that will demand the attention of an increasing number of employees between now and 2007 is to renew the Department's federal operating license for Feather River Project No. 2100, the Oroville-Thermalito Complex hydroelectric facilities. DWR News examines the relicensing process and what it means to DWR.

A person standing atop Oroville Dam finds that the earth's curvature restricts his or her view of the vast area of California that depends on water stored in Lake Oroville.

The dam and reservoir are part of DWR's Oroville-Thermalito Complex in southern Butte County and the heart of the State Water Project (SWP).

Not many individuals are aware that DWR's federal license to operate the heart of the SWP, also known as Project No. 2100, must be renewed by Jan. 31, 2007. The licensing authority is the Federal Energy Regulatory Commission (FERC), which regulates nonfederal hydroelectric projects.

Hydroelectric projects?

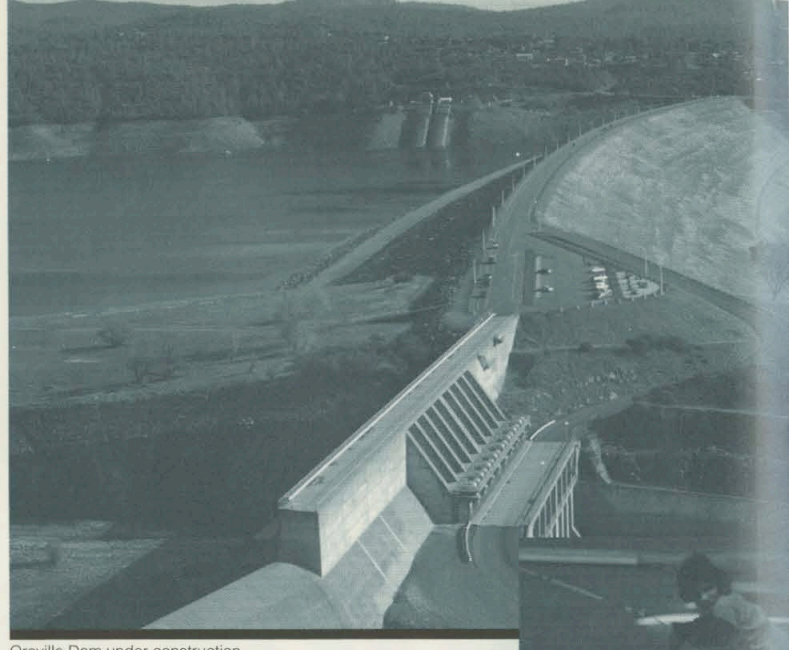
If few are aware that DWR's hydropower license is expiring, probably even fewer associate Oroville Dam with electricity.

While the SWP's main business is water, it takes a lot of power to move water to its destinations in Northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast and Southern California.

"The SWP is California's largest consumer of electricity," noted Viju Patel, DWR Executive Manager, Power Systems. "Because we produce much of the power ourselves (DWR purchases some power), we can keep our water delivery rates to our contractors affordable."

Deep beneath Oroville Dam is the Edward Hyatt Powerplant. Housed in a cavern carved out of bedrock, Hyatt's six generators can produce enough electricity to light the city of San Francisco. The combined Hyatt plant and Thermalito Powerplant generate about 2.2 billion kilowatt-hours in an average water year, while the Thermalito Diversion Dam Powerplant contributes another 24 million kilowatt-hours. DWR also produces electricity from hydropower plants along the California Aqueduct and is part-owner of the coal-fired Reid Gardner Powerplant near Las Vegas.

In short, DWR is a major producer as well as consumer of power and its hydroelectric operations cannot be separated from the SWP. Project No. 2100 is a hydroelectric as well as a water storage facility.



Oroville Dam under construction

Kids fishing

So, FERC relicensing is required.

Patel, the man spearheading DWR's relicensing effort, knows that the process will be expensive, time-consuming, and challenging. But he believes that it also will be rewarding.

"We will have the opportunity to document the benefits of the Oroville facilities and the SWP in general," Patel said. "It will be made clear to everyone that our project serves the public interest."

Project No. 2100 facilities were originally licensed in 1957. Since then, FERC has given increased consideration to environmental and other non-power impacts of projects. When licenses are renewed, typical conditions include instream flow requirements for fish protection and recreational enhancement requirements.

"Everything will be looked at," Patel said. "Instream flows, water temperature, recreational facilities, project impacts on Indian tribes, fish hatchery operations, everything."

Federal and State wildlife and natural resource agencies, have varying degrees of authority under the FERC process to impose license conditions.

"But don't forget that we routinely consult with these agencies," Patel said. "Many of the people sitting across the table from us will be familiar faces."

Among those across the table will be the Department of Fish and Game (DFG), State Water Resources Control Board, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and U.S. Forest Service. DWR's files of correspondence and agreements with these and other regulatory agencies will grow even fatter between now and 2007, but the issues will be familiar. Water quality, delta smelt, steelhead, chinook salmon, recreation, watershed management — all will be subjects of new rounds of discussion and study.

Recreation on and around Lake Oroville is being given a fresh look by DWR, which has funded boating, camping, horseback riding, hiking, bicycling, picnicking, and other facilities since construction of Oroville Dam in the 1960s.

Many recreational facilities within the Lake Oroville State Recreation Area are administered

Photo by Dale Kolke, Norm Hughes, DWR Photo Lab

Marina

Thermalito Diversion Dam

and operated by the Department of Parks and Recreation. DWR will update recreation plans with input from local government and community organizations.

The Feather River Fish Hatchery, operated by DFG with funding from DWR, recently was expanded by DWR. The hatchery, which stocks chinook salmon in Lake Oroville and provides both salmon and steelhead for the Feather River, was made more easily accessible to persons with disabilities, and was provided with disease-preventing fish quarantine facilities.

Studies are ongoing to achieve the optimum mix of sport fish in Lake Oroville, which offers fishing for salmon, bass, catfish, mackinaw, sturgeon, and brown trout.

DWR has held preliminary discussions with representatives of Oroville-area Indian tribes, who have an interest in Oroville-Thermalito Complex operations.

The Department has been working with the Oroville Area Chamber of Commerce to publicize local attractions and a new DWR web site (http://wwwdwr.water.ca.gov/LakeOroville) features recreational and sightseeing opportunities around Lake Oroville.

"The Department has not been idle," Patel said. "We want to be good neighbors with the people of the Oroville area."

DWR must submit its license application by January of 2005. By then, the Department will have conducted stakeholder meetings and the voluminous application package will be on FERC's desk. Even after the application has been filed, stakeholders can continue to negotiate license conditions.

DWR hopes that extensive, consensus-seeking discussions with all interested parties will prevent late challenges and secure the Project 2100 license on schedule. If a new, 30-year license is not secured by the deadline, DWR will operate on a year-by-year

license extension. This is not a desired option, as relicensing costs would continue accumulating.

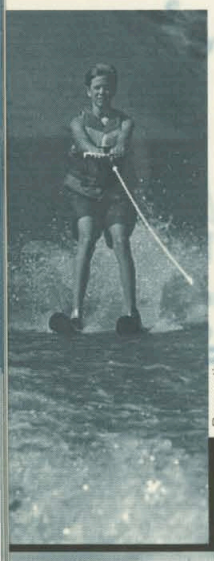
"At this point, we are getting organized for the effort," Patel said. "Our relicensing steering committee has been meeting regularly to learn the licensing process and map out our approaches to conducting stakeholder meetings and getting all the rest of the work done as smoothly as possible."

"If I want to emphasize one thing," Patel said, "it is that the Department is going to make a sincere effort to listen to, work with, and address the concerns of all stakeholders in a very proactive, open process."

DWR will hire a consultant or consultants to help guide the relicensing process, but will rely on its own employees for expertise in most areas. "We have the biologists, engineers, and others already here and working. That's a big advantage."

It's too early to put a price tag on DWR's next license, but the cost will be high. And it is possible that required changes in project operations could make increased costs permanent.

"We can just hope for the best," Patel said. "We have a good project and we look forward to sitting down with everybody who is interested in what we do. People will have a lot more knowledge about the Department and the benefits of the SWP."



Recreation

Flood control

FERC AND HYDROPOWER

Hydroelectric power regulation became the responsibility of the Federal Power Commission, the predecessor of today's Federal Energy Regulatory Commission (FERC), with passage by Congress of the Federal Water Power Act of 1920.

Subsequent statutes under which FERC regulates nonfederal hydroelectric projects, including DWR's Oroville-Thermalito Complex facilities, include the Federal Power Act (FPA), PURPA (Public Utility Regulatory Policies Act), the Electric Consumers Protection Act of 1986, and the Energy Policy Act of 1992.

FERC is an independent agency within the U.S. Department of Energy. In addition to regulating hydroelectric projects, FERC regulates key interstate aspects of the natural gas, electric power, and oil industries. FERC was created by the Department of Energy Organization Act on Oct. 1, 1977, to replace the Federal Power Commission. FERC is comprised of five members who are appointed by the President and confirmed by the U.S. Senate. Commission staff is headquartered in Washington, D.C. and regional offices.

Since DWR received its original license for Feather River Project No. 2100 (Oroville facilities) in 1957, FERC has been mandated by federal law to give equal consideration to power and non-power impacts of projects subject to its licensing authority. Environmental and recreational impacts, therefore, are a major factor.

Before the 1920 passage of the Federal Water Power Act, nonfederal developers needed a special act of Congress to build and operate hydroelectric plants on navigable streams or federal lands.

Photo by Dale Kolke, Norm Hughes, DWR Photo Lab

Ted Sommers (right, top photo) and Matt Nobriga, from DWR's Environmental Services Offices, began their fish surveys in 1995 to find out how the bypass's floodwaters impact different fish species.

During rainy Sacramento Valley winters, the Yolo Bypass is a sight to behold. If you've ever driven along Interstate 80 over the bypass, all you see is water that stretches to the horizon. It's no wonder that the valley was once called "an inland sea."

Beneath t

by Joyce Tokita
Jamie Cameron-Harley

The Flood

The Sacramento splittail was federally listed as threatened in 1999. The California native fish species lives largely in the Delta, Suisun Bay, Suisun and Napa marshes.

The bypass's history and role in flood control traces back to a time when floodwaters often inundated much of the Sacramento Valley. The settlers tried in vain to contain raging floodwaters between levee systems, but frequently the dirt embankments were overtopped or breached, and homes and farmlands were flooded.

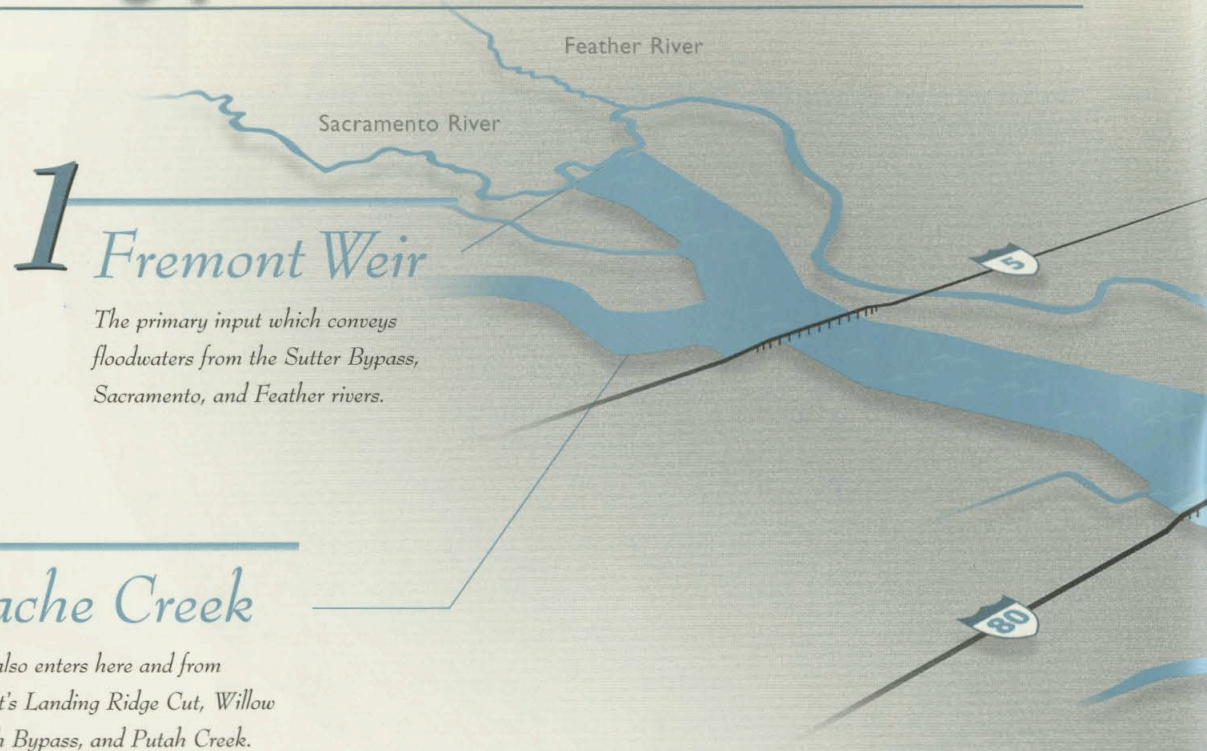
The situation worsened with the advent of hydraulic mining, with debris clogging river channels and limiting their capacity to carry water. More and more devastating floods occurred. But even with the demise of hydraulic mining operations, the situation remained grave.

Soon a new attitude began to emerge, one that acknowledged, during floods, the river needed more room.

In the early 1930s a flood management system was built by the U.S. Army Corps of Engineers that recognized the river's needs. The system included bypasses, areas set aside to carry or bypass excess floodflows, relieving the pressure on levees along the main river channels. The system now comprises the Sacramento River Flood Control Project.

As part of the project, the Yolo Bypass serves a vital role in protecting river cities such as Sacramento from winter and spring floods. But the bypass is more than an extra channel to carry excess floodflows to San Francisco Bay. Beneath the floodwaters' surface lies another world just recently explored.

Yolo Bypass And Its Sources

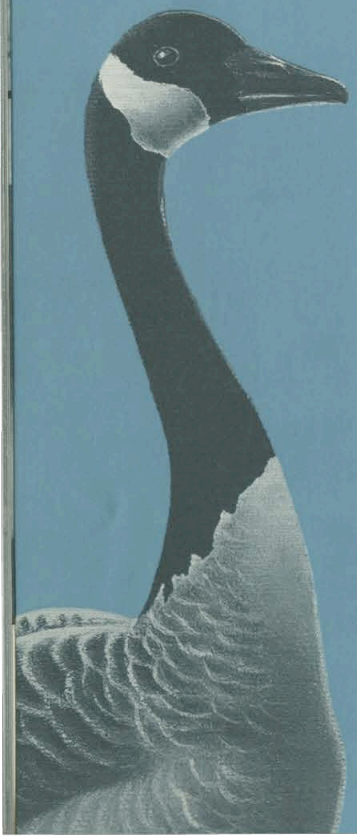


1 Fremont Weir

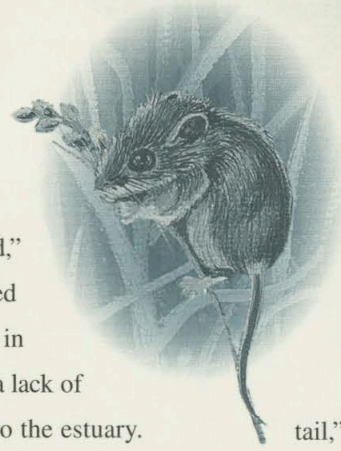
The primary input which conveys floodwaters from the Sutter Bypass, Sacramento, and Feather rivers.

2 Cache Creek

Flow also enters here and from Knight's Landing Ridge Cut, Willow Slough Bypass, and Putah Creek.



Canada goose is one of the migratory species at the wildlife area.



Floodwater Habitat

"The basin is totally unappreciated," says Environmental Specialist Ted Sommer, who became interested in studying the bypass after finding a lack of research linking the floodplain to the estuary. "It's a different place when there is water in it."

In 1995 – a very wet year – Sommer, with other DWR and DFG staff, began sampling and studying fish found in the bypass, focusing on chinook salmon and other native species.

What they found was the bypass served as a seasonal aquatic habitat for at least 40 fish species, including listed ones such as the delta smelt, steelhead trout, and spring-run and winter-run chinook salmon. Results also showed that habitat and fish diversity are higher in the floodplain than in the adjacent Sacramento River.

"The bypass is an especially important spawning grounds for splittail," says Sommer. Study findings show that the splittail, listed as threatened under the federal Endangered Species Act, move into the basin in winter and early spring to forage and spawn on flooded vegetation. Their young stay in the bypass until the floodwaters begin to recede.

Sommer also discovered that young chinook salmon were using the Yolo Bypass as a migration corridor instead of the mainstem Sacramento River. The basin offers extensive rearing habitat – vegetation along the shoreline and broad shoals, favored by the young salmon.

3 Sacramento Weir

DWR operates the weir to keep floodwaters within the Sacramento River channel's design capacity through the Sacramento/West Sacramento area and downstream.

The bypass occupies a critical link for waterfowl on the Pacific Flyway.

American River

Sacramento

Yolo Basin Wetlands Wildlife Area

N

Rio Vista

The wildlife area also attracts song birds and raptors.

Several of the study's results show that young salmon grow much faster in the Yolo Bypass floodplain than in the Sacramento River. The difference is likely due to the warmer waters of the bypass which also offer a more ample supply of insects to feed on.

The bypass however does have risks for the inhabiting fish as flows fluctuate in the basin. Fish can be stranded as the flows recede from the basin, although Sommer found that the majority successfully emigrate from the floodplain.

Sommer's bypass studies received an initial grant from CALFED for $225,000 in 1996. "That was the shot in the arm we needed to get started," he says.

A second CALFED grant in 2000 will enable DWR staff–working with a team of environmental groups, engineers, and biologists–to discover the full potential the bypass holds for fish and wildlife habitat. Study results will contribute to a long-term strategy to manage the habitat while maintaining the bypass's use for flood control and agriculture. Results will also contribute toward the ecosystem restoration of the Sacramento-San Joaquin Delta and in turn a long-term fix for the troubled estuary.

"We are just beginning to learn how the bypass benefits fish and wildlife," Sommer explains. "The bypass is a 'gold mine' of information, right in our own backyard."

How The Bypass Works

The Yolo Bypass is one of two primary bypass systems constructed in the Sacramento Valley (the other being Sutter). Excess floodwaters enter the bypass from the main river channel. This relieves pressure on the main levee system along the river channel and helps keep flows within the channel's design capacity.

This 3-mile wide, 40-mile long stretch of land extends from the confluence of the Feather and Sacramento rivers to a point above the city of Rio Vista, where it safely returns the excess flows to the Sacramento River. Water primarily enters the basin through the Fremont Weir in the north. The weir also allows inflows from the Sutter Bypass and the Feather and Sacramento rivers.

Water can also enter from the east via the Sacramento Weir, adding additional flows from the American and Sacramento rivers. From the west side, the basin receives water from Knights Landing Ridge Cut, Cache Creek, Willow Slough Bypass, and Putah Creek.

In more than half of all water years (from October 1 to September 30), the bypass is inundated, creating up to 60,000 acres of shallow water habitat. When completely flooded, the Yolo Bypass about doubles the wetted area of the Sacramento-San Joaquin Delta, covering an area equal to about one-third the size of San Francisco and San Pablo bays.

Water depths range from 10 feet in a heavy water year to around 6 feet in a normal year. During spring (as late as June), water in the basin empties through a riparian channel that borders the eastern edge of the Yolo Bypass called the "Toe Drain."

"Because the land has been graded for agricultural use, the bypass drains relatively well," says Pete Rabbon, General Manager of the State Reclamation Board. "Over the years, the bypass has done its job well and has prevented much property loss and saved lives for many of the communities along the Sacramento River system."

The Board, along with DWR, is responsible for maintaining the flood carrying capacity of the basin. The labor of keeping the Yolo Bypass (as well as the Sutter Bypass and Tisdale, Colusa and Moulton weirs) clear falls to DWR's Sacramento and Sutter Maintenance yards, while the Board, created in 1911 as part of the Central Valley's flood control plan, oversees its operations as part of the Sacramento and San Joaquin Drainage District. The Board also owns easements that allow the bypass to be flooded.

Other Floodplain Benefits

When dry, the bypass area's rich clay loam soils provide fertile cropland for tomatoes, safflower, sugar beets, rice, corn, and other grains. The land is privately owned.

The Yolo Bypass is also a place that wildlife enthusiasts and birders enjoy. Once a thriving wetland, the region and its marshy habitat supported an array of wildlife and birds. Then shortly after the Gold Rush, settlers began reclaiming the land and draining what was considered swamplands. In the process, much of the natural habitat was lost.

But thanks to a partnership between State (including DWR and the State Reclamation Board) and federal agencies, along with local conservation groups, a piece of the Yolo Bypass has been restored as a new state wildlife area. In 1991 the California Wildlife Conservation Board purchased 3,600 acres, now known as the Vic Fazio Yolo Wildlife Area.

The Corps of Engineers planned the habitat restoration and completed the on-site work, since the wildlife area will still serve as part of the Sacramento River Flood Control System. The altered landscape is now graced with grasslands, seasonal and permanent wetlands, and riparian woodland. Each habitat type was designed to be compatible with its primary function, flood control.

"The wildlife area will also help reverse a 20-year decline of bird populations that migrate along the Pacific Flyway," says David Feliz, the Yolo Bypass Wildlife Area Manager for the Department of Fish and Game, Region 2. "It will provide a vital resting and feeding spot for thousands of shorebirds and waterfowl along the migration corridor."

A Vision TOO BOLD

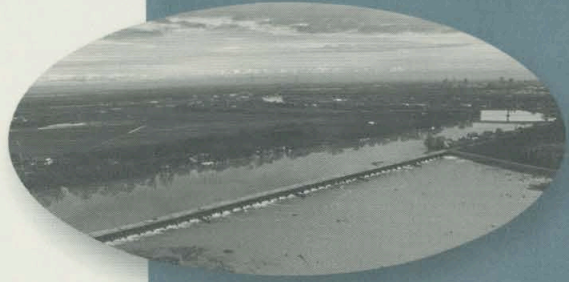
In 1870, General B.S. Alexander of the Army Corps of Engineers firmly believed that the waters of the Sacramento River had to be held within a single channel. This was based on a theory that it would increase its flood-bearing capacity so it could carry all flows into the delta without overflowing.

But Will Green, editor of the Colusa Sun, adamantly disagreed. Although he had limited formal education, Green knew this was impossible after watching the Sacramento River from the town of Colusa for about 10 years. Alexander's theory was based on experience along the Mississippi River, a waterway whose floodwaters built slowly, unlike the Sacramento River, whose devastating flows struck swiftly.

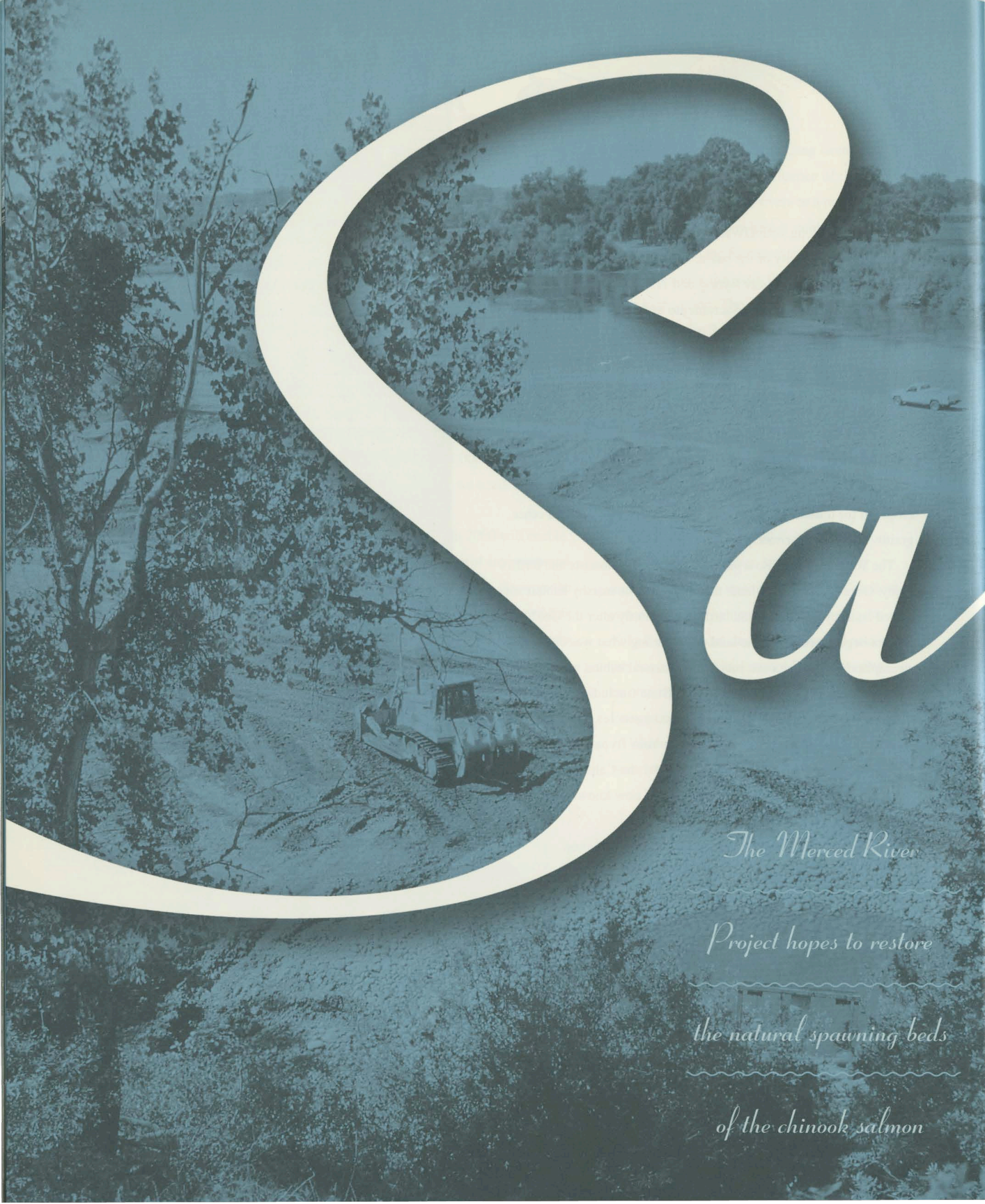
Green's vision was a system of weirs and basins into which the river could pass its excess flows. These flows would be contained in canals to allow the lowlands outside these channels to be occupied. During dry times, the holding basins could be farmed.

It wasn't until 1920 that the Corps turned around its flood control philosophy to embrace what Green envisioned 50 years earlier.

Fremont Weir overflow into the Yolo Bypass.



The Sacramento Weir

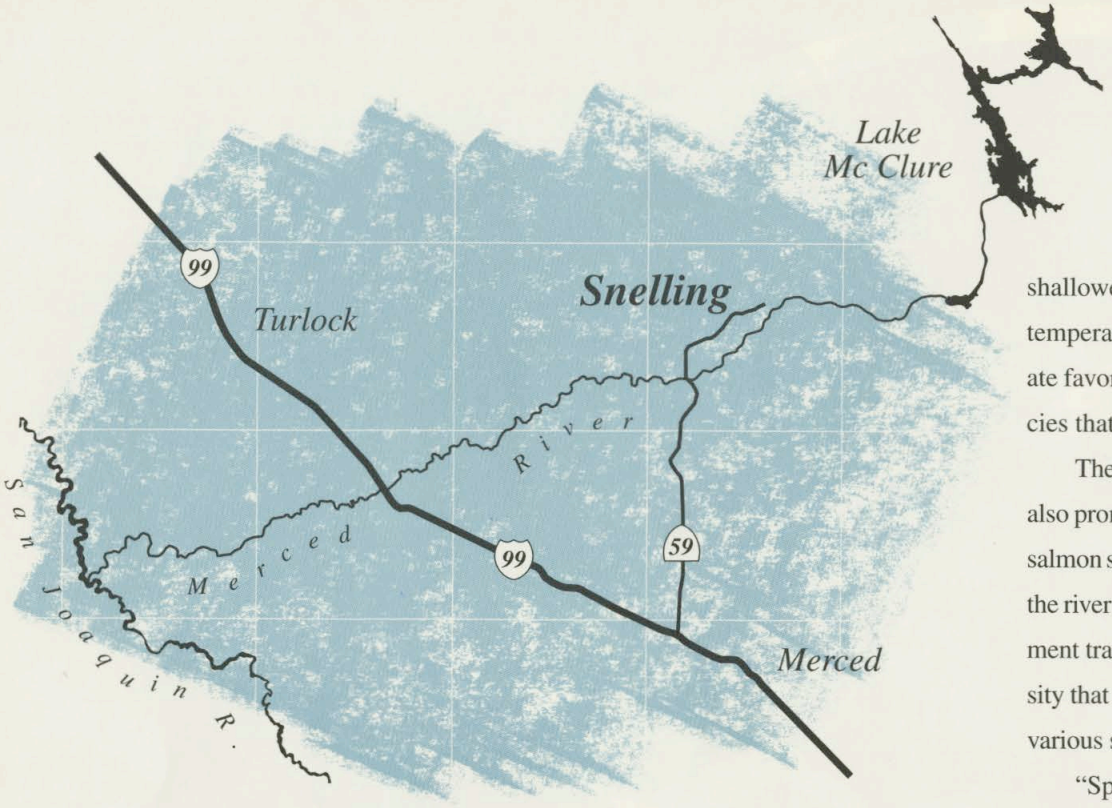

Sa
The Merced River
Project hopes to restore
the natural spawning beds
of the chinook salmon

THE lmon SPIRIT

By Dan Wightman

This summer, DWR and the Department of Fish and Game teamed up on an ambitious, $4.8 million project to recondition a mile-long stretch of the Merced River and reestablish its once-excellent salmon spawning conditions. Over the years, canals and dams have been constructed along the river to divert and store water, as well as to provide power, flood protection, and recreational opportunities. Mining activity has also influenced the river significantly. Large pits and tailing piles are numerous along its San Joaquin Valley corridor. These and other influences have led to habitat changes that have severely impacted the river's chinook salmon. Downstream, altered riverbed flows have diminished the quantity and quality of salmon habitat and underscored the need for river restoration. Upstream, dams have blocked the salmon's access to historic spawning grounds.

Photograph by Dale Kolke



Project Goals and Support

"Our main goal is to improve downstream spawning habitat for the salmon," says Kevin Faulkenberry, the DWR associate engineer directing this restoration effort. "We're also trying to improve river and floodplain hydraulics and enhance the river's riparian corridor."

Financial support for these improvements comes from a variety of State and federal sources. Moral support is also broad-based. It includes active involvement by members of California's Miwuk Indian tribe who were so enthused by the project's potential that they blessed the reconstruction site before reconstruction began (see "A Miwuk Blessing"). The stretch of the Merced River being restored is part of the Miwuks' ancestral fishing area. Tribal members are confident that the project will help replenish salmon and wildlife that have declined in this area over the years.

Project Site: First Phase

The project site is located west of Highway 59, about 6 miles southwest of the town of Snelling (see the map above). Reconstruction is occurring alongside a levee road owned by Calaveras Materials Company, whose company's owners are cooperating with the restoration effort.

The project is the first step in a three-phase effort to fill gravel pits dug and abandoned over the past 40 years. The pits are 15-20 feet deep and about 10 feet below the current low water level. Years ago, this reach of the river had a berm at its upstream end. When that berm failed during heavy runoff in 1983, the river changed course and began flowing in and over these pits, widening the river and slowing its velocity.

These impacts were bad news for the salmon, as well as some elements of the surrounding environment. Lower streamflow velocities along a wider and shallower water surface raised the river's temperature, which in turn helped generate favorable habitat for warmwater species that feed on young salmon.

The shallow depths of warm water also promoted algae growth that inhibited salmon spawning. What's more, the pits in the river acted as traps that disrupted sediment transport and reduced habitat diversity that is necessary to support salmon at various stages of their lives.

"Spreading 460,000 tons of gravel tailings in the riverbed and reconfiguring the channel's hydraulics should go a long way toward improving spawning conditions," says Faulkenberry. "If all goes well, in a few years the salmon will be back in this stretch of the Merced in good numbers."

The first phase of reconstruction was completed in October. Phases two and three will commence in 2001 and should be finished by 2002.

The Miwuk Indian tribe was so enthused about the restoration project they came to bless the construction site.

A Miwuk blessing

With pleasure, and without fanfare, seven Miwuk Indians gathered on June 9, 1999, to bless the site of the joint DWR-Department of Fish and Game restoration project along the Merced River.

The Miwuks began their blessing by individually purifying the 13 people in attendance with smoke from burning coastal sage plants. "Sage purifies participants and prepares them to receive the good medicine to come," according to tribal member and DWR employee, Ron Wermuth.

Next, Jay Johnson, of the Southern Sierra Miwuk Tribe, sang a gentle song to Mother Earth, while fellow tribe members Lois Martin and Bill Leonard clambered down a steep embankment and sprinkled crushed acorns and tobacco leaves on the water, as offerings to the River Spirit.

After a short pause, Wermuth offered a spoken prayer to the Creator -- or "Grandfather" -- and Johnson blessed the river in high-pitched song. Johnson's singing was accompanied by the sounds of frogs, birds, insects, and rustling cottonwood trees that are abundant along the road to the project site.

Following Johnson, Sandra Vasquez of the Mariposa Indian Council joined Frannie Gann, Lois Martin, and Sandra Chapman of the Southern Sierra Miwuk Tribe in a lilting song-blessing to the Salmon Spirit. Miwuks believe that salmon carry this blessing up and downstream, extending its influence to the mountains and the sea. Leonard and Johnson also appealed in song to the Eagle Spirit and the Bear Spirit -- asking them to spread the blessing across the land.

Wermuth sang the last song of the day—to the Water Spirit. Johnson accompanied him on an instrument called a clapstick (made from a split and dried elderberry branch), while everyone else gazed across the rippling water at two egrets stretching their wings near the far shore.

After the ceremony, the Miwuks joined four DWR staff members and two Department of Fish and Game employees on a walk along the levee. Conversation was easy, with topics ranging from the power of blessings, to the multiple uses of whiteroot plant (plentiful near the river), to the importance of beginning projects "the right way."

"Getting off to a good start means so much," commented Kevin Faulkenberry, the DWR associate engineer who's directing this restoration effort. "I can't imagine a better start than this, and it's great to have the Miwuks' support for what we're doing . . . I think everyone involved will be happy with the results when we're through."

Miwuk tribe members (left to right) Bill Leonard, Lois Martin, Sandra Chapman, Frannie Gann, and Sandra Vasquez bless the site in song, while Jay Johnson works the clapstick.

Photograph by Norm Hughes


MASTER

Preparing the New PLANS

by Pete Weisser

The biggest study of Central Valley flood systems ever launched is almost one-third finished. Project managers for the study partners—The Reclamation Board of California and the U.S. Army Corps of Engineers—say the effort so far is on schedule to produce new master plans early in the year 2002.

"We are on track to producing new flood management master plans for the Central Valley by the target year of 2002," says Steve Yaeger, State of California Project Manager for the Sacramento-San Joaquin River Basins Comprehensive Study. "We've completed all the tasks in Phase I of the study on schedule."

Phase I ended in April 1999 with completion of the post-flood assessment and the two-volume Phase I Documentation Report. An interim report, which summarized the two detailed reports, was forwarded to Congress by the Assistant Secretary of the Army for Civil Works. (For a summary of the report, read "The Challenge" starting on page 30.)

The satellite image (above) of the Delta shows the convergence of the Sacramento and San Joaquin rivers. The two rivers are California's first and second largest waterways.

THE Challenge

To give Congress and the State Legislature a clear vision of the Central Valley's flood challenges and how the comprehensive study can help meet them, State and federal study partners this year compressed three volumes of technical analysis into a succinct 35-page report.

This interim report documents the magnitude of flood risks along the Sacramento and San Joaquin rivers and tells how the five-year, $21 million study, partnered by the U.S. Army Corps of Engineers and The Reclamation Board of California, proposes to develop systemic improvements in flood management through a watershed approach.

"This report is descriptive," says Mike Bonner, Federal Project Manager for the comprehensive study. "It gives members of the State Legislature and Congress—some of whom may know little of our flood problems—an overview of the flood challenges here, describes how the study can identify solutions, and justifies investing significant Federal and State funds in a very worthwhile study."

A History of Floods

Historically, flooding has been a recurrent reality in the Central Valley. Between 1850 and 1900, the Sacramento River basin was affected by 12 major floods, the report states, while the San Joaquin River basin experienced 16 major floods.

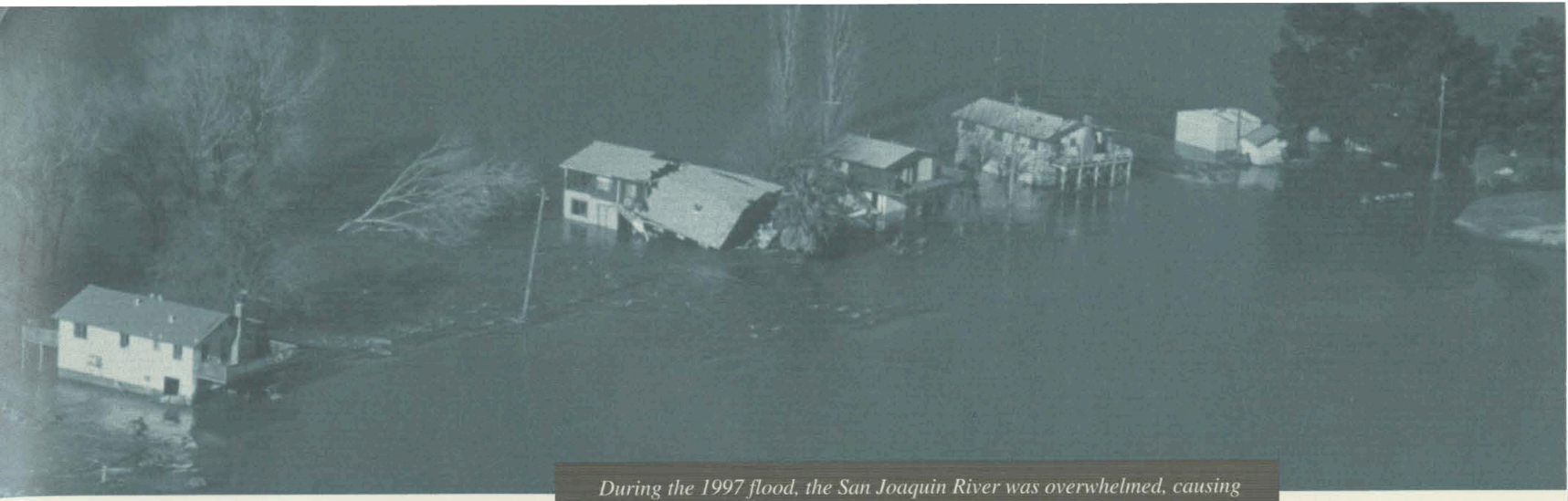
Flood management systems in the Central Valley were developed incre-

Biggest Study in the West

"This is the largest study of its kind in the Western United States, and so far we're making good progress," said Mike Bonner, Project Manager for the Corps of Engineers. "We now have more than a dozen engineers, hydrologists, environmental scientists, and modelers working full-time on Phase II of the study."

Tasks completed include a thorough assessment of four major recent floods—1983, 1986, 1995, and 1997—and identification of existing flood and environmental problems. The study team also has established study objectives, developed hydrologic and hydraulic models which are essential for analyzing flood potential on both river systems, and crafted a strategy to implement system improvements.

"Building on the flood data of recent years, the study team has constructed and calibrated 'state of the art' hydrologic and hydraulic models, which will allow us—for the first time—to address this Central Valley flood challenge system-wide." says Yaeger.



During the 1997 flood, the San Joaquin River was overwhelmed, causing nearly two dozen levee breaks in the system.

"We're midway through pilot studies to verify conceptual models of ecosystem functions which are related to flood flows. We are in good shape technically to develop and analyze the data we need to make improvements in the flood management systems of both rivers and their floodplains."

Customized analytical tools developed for the study include an Ecosystem Functions Model for the rivers and floodplains and Geographic Information Systems (GIS) data. New digitized topographic data has been developed for the main rivers and tributaries to support the hydrologic and hydraulic models.

"The prospect of developing an Ecosystem Functions Model on this scale which is linked to hydrologic and hydraulic models and driven by data from GIS is as exciting as it is cutting edge technology," says Jerry Ripperda, environmental lead for The Reclamation Board and DWR.

Flood and Environmental Issues

Taking an inclusive watershed approach, the study has identified and will address both flood problems and environmental issues.

Typical flood problems include:

- Flood management systems designed early this century lacked the capacity to convey peak floodflows experienced in the past two decades.
- Levee structural integrity is not reliable in some parts of the systems.

Environmental challenges include:

- Confining floodflows in reservoirs and between levees has caused loss of natural hydrologic and geomorphic processes, with degradation of fish and wildlife habitat.
- Funding has been often inadequate to mitigate for habitat loss.

What are Hydrologic/ Hydraulic Models?

These models are not the kind one builds from pieces of wood or plastic. They are computer programs constructed to analyze stream flows. They use historical data gathered over 100 years from stream gages and other river flow recording equipment.

The data is plugged into hydrologic and hydraulic equations that can predict such river behaviors as the maximum amount of water a river channel can carry, the water surface elevation in a channel, and the direction flood waters may follow if flows exceed channel capacity.

Accuracy of these models depend on the accuracy of the historical stream gage data and the accuracy and resolution of the topographic data.

Flooding along the Sacramento River and its major tributaries were common, often causing heavy property damage and loss of lives (photo: 1950 flood near Linda-Yuba River)

mentally over many years in response to these floods.

After widespread flooding in 1907 and 1909, the "Jackson Report," compiled by the California Debris Commission, proposed construction of the Sacramento River Flood Control Project, thus initiating coordinated construction of many levees, weirs, and bypasses in the Sacramento Valley.

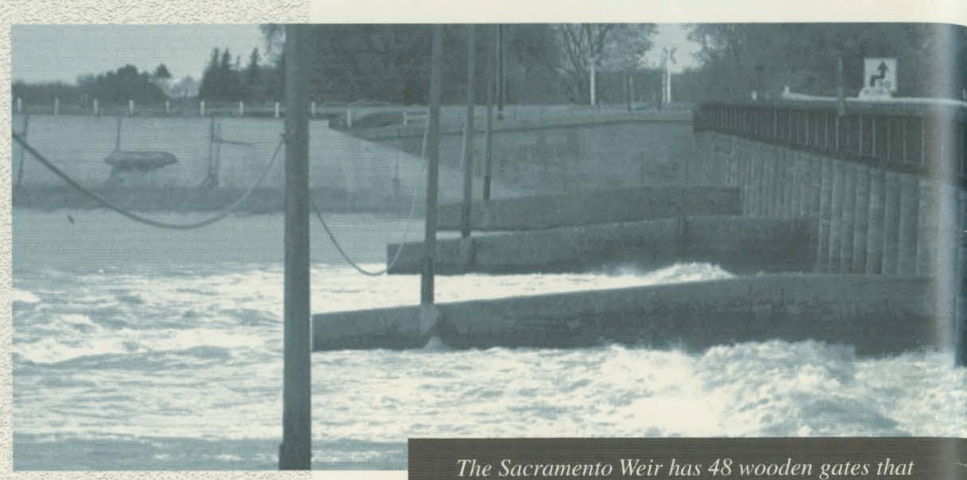
Starting in the 1940s, multipurpose dams and reservoirs began providing storage for flood protection, water supply, recreation, and power generation. The current flood management systems in both river basins reflect the incremental development of flood protection projects and require extensive coordination among several agencies to operate and maintain.

Devastating Recent Floods

Between 1900 and 1999, the Sacramento and San Joaquin river basins experienced 13 destructive floods. Four of the most severe occurred in 1983, 1986, 1995, and 1997. They showed that the Central Valley's farmlands and urban centers are at extreme risk.

"These four recent floods caused extensive damage in both basins and raised questions about the adequacy of the current flood management systems and land uses in the floodplains," the report states.

Existing flood management systems functioned, preventing over $20 billion in damages, but the systems were clearly overtaxed. Combined damages from these recent floods exceed $1.6 billion. During the



The Sacramento Weir has 48 wooden gates that must be manually opened and closed.

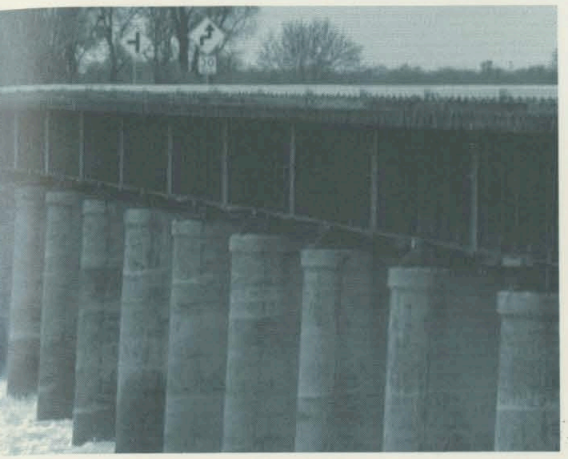
In developing flood damage reduction and integrated ecosystem restoration measures, the study team will consider a wide range of solutions and strategies, both structural and nonstructural.

These include creating or improving bypass and levee systems and meander belts, reconstructing channels, discouraging future floodplain development, protecting and re-establishing natural flow processes, and integrating restoration of riverine habitat into improvements of the flood management system.

Public Has A Say

Public involvement plays a vital role in the study. During Phase I, study team members met with technical support groups to identify problems and potential solutions and with policy focus groups to identify policy issues and needs for policy change. In the fall of 1998, local support group meetings were held at 11 locations throughout the Central Valley to identify local concerns.

Upon initiating Phase II in the summer of 1999, study team members met



with the general public at a series of meetings in the communities of Fresno, Modesto, Sacramento, Red Bluff, and Marysville.

Public and media interests were moderate, with modest attendance at most meetings and news coverage by valley newspapers including the *Marysville Appeal-Democrat, Modesto Bee,* and *Merced Sun-Star*. The format was that of an "open house" with exhibits and demonstrations, concluding with an "open mike" dialog, after initial briefings and poster sessions.

"I'd say the biggest surprise in the public meetings," said Yaeger," was that so many of the public were aware of the connection between flood management and ecosystem restoration. That nexus between flood protection and restoring the ecosystem is a major priority of our study and they seem to endorse that. They also seem to like the watershed approach taken by the study."

Plans for Phase II

The plan of action for Phase II focuses on encouraging further public involvement, conducting feasibility-level assessments, developing basin master plans and a programmatic environmental document to support implementation.

"We will be working hard throughout this next year to ensure completion of specific planning documents in 2001," says Yaeger.

Other Water Planning Studies

The Sacramento-San Joaquin River Basins Comprehensive Study is coordinated with other water planning programs, including:

- CALFED Bay-Delta Program, which is developing long-term plans to address water quality, water supply, Delta levee integrity, and ecosystem restoration issues in the Sacramento-San Joaquin Delta.
- Central Valley Project Improvement Act of 1992, which authorized modified operation of the Central Valley Project to restore and protect aquatic and waterfowl habitat in the Central Valley.
- Upper Sacramento River Fisheries and Riparian Habitat Management Plan, mandated by passage of SB 1086 and adopted by the State Resources Agency in 1989, to help restore fish and riparian habitat in the Upper Sacramento River.
- San Joaquin River Management Program, established in 1990, to resolve water use and environmental problems within the San Joaquin River system.

Keeping Congress Informed

Study leaders have made it a point to keep Central Valley flood control officials and State Legislators well-informed on the study. In September, they held a briefing in Washington, D.C. for members of California's Congressional delegation. Congressional familiarity with the study may become important when funding proposals are made for projects stimulated by the study in 2002 and beyond.

Future flood control improvements will be coordinated with ecosystem restoration projects along both rivers and in the Delta.

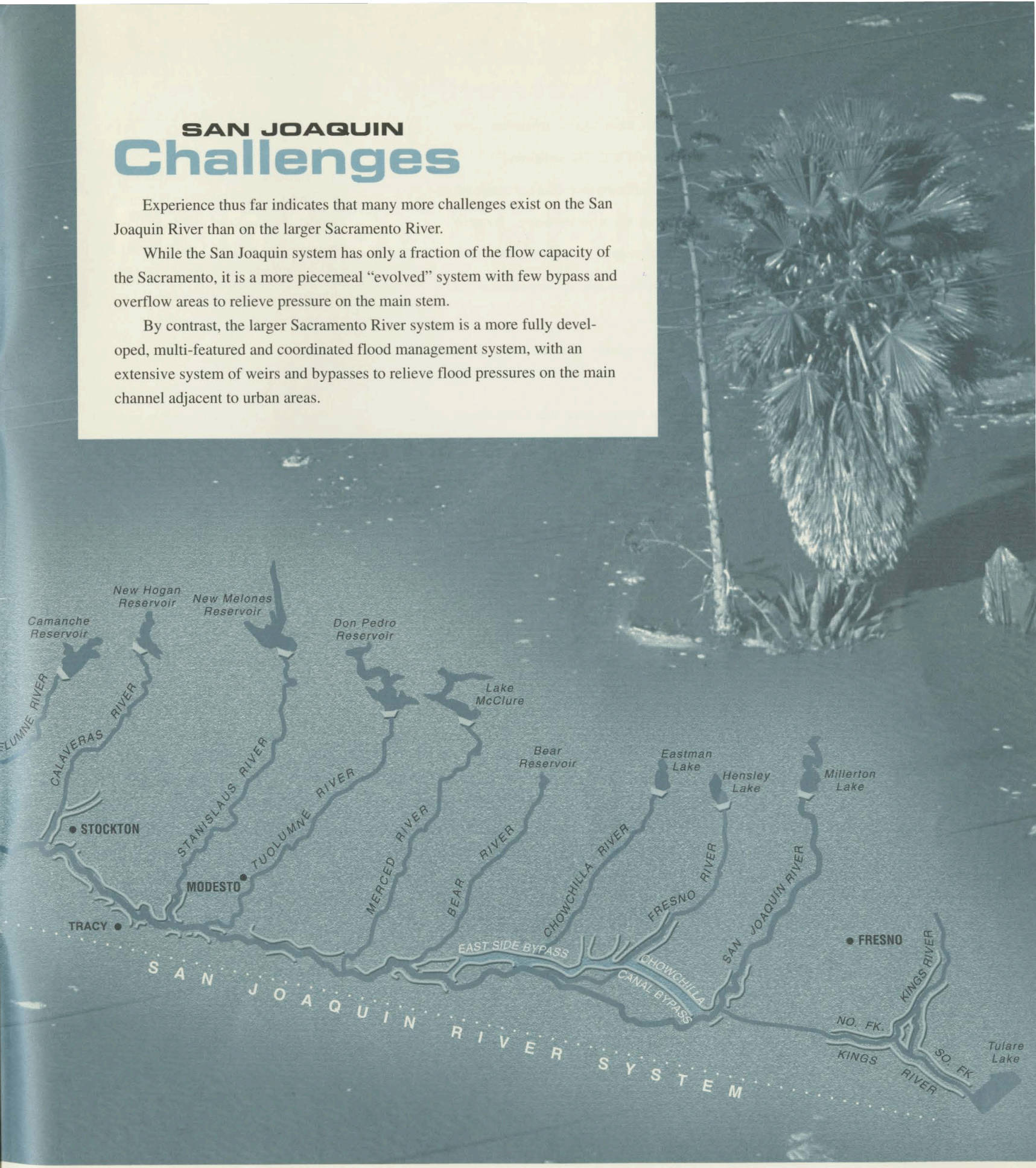

Shasta Lake
Keswick Res.
REDDING
N
RED BLUFF
Lake Oroville
OROVILLE
Bullards Bar Reservoir
YUBA RIVER
Englebright Reservoir
Thermalito Complex
SACRAMENTO RIVER SYSTEM
BUTTE BASIN
Moulton Weir
Colusa Weir
YUBA CITY
MARYSVILLE
Folsom Lake
SUTTER BYPASS
Lake Natoma
AMERICAN RIV
Tisdale Weir
Fremont Weir
SACRAMENTO
CONSUMNES RIV
Sacramento Weir
YOLO BYPASS
PROJECT LEVEES MAINTAINED BY:
State of California, Department of Water Resources
Reclamation, Levee, and Drainage Districts and Municipalities

SAN JOAQUIN
Challenges

Experience thus far indicates that many more challenges exist on the San Joaquin River than on the larger Sacramento River.

While the San Joaquin system has only a fraction of the flow capacity of the Sacramento, it is a more piecemeal "evolved" system with few bypass and overflow areas to relieve pressure on the main stem.

By contrast, the larger Sacramento River system is a more fully developed, multi-featured and coordinated flood management system, with an extensive system of weirs and bypasses to relieve flood pressures on the main channel adjacent to urban areas.



1997 floods alone, damages in the Sacramento and San Joaquin River basins totaled $524 million.

Major storms throughout California caused record flows on many rivers, according to the report. In the Central Valley, the flood management systems for the Sacramento and San Joaquin rivers were stressed to capacity and beyond.

Reservoirs were tested to their limits. Levees proved vulnerable.

"Levees on the Sacramento River and its tributaries sustained two major breaks," says the report, while many levees that survived needed major repairs. "On the San Joaquin River, levees failed in more than two dozen places."

The post-flood assessment clearly presented the challenges facing federal, State, and local flood control officials. When the final Sacramento-San Joaquin River Basins Comprehensive Study is completed in 2002, system-wide flood management solutions will provide added protection for those who live along California's two largest river systems.

Shared Funding

Of the comprehensive study's total $21 million cost, $16.5 million for the feasibility planning effort is shared equally by the State and federal governments. The initial $5 million cost for the post-flood assessment and early model development was funded entirely by the federal government.

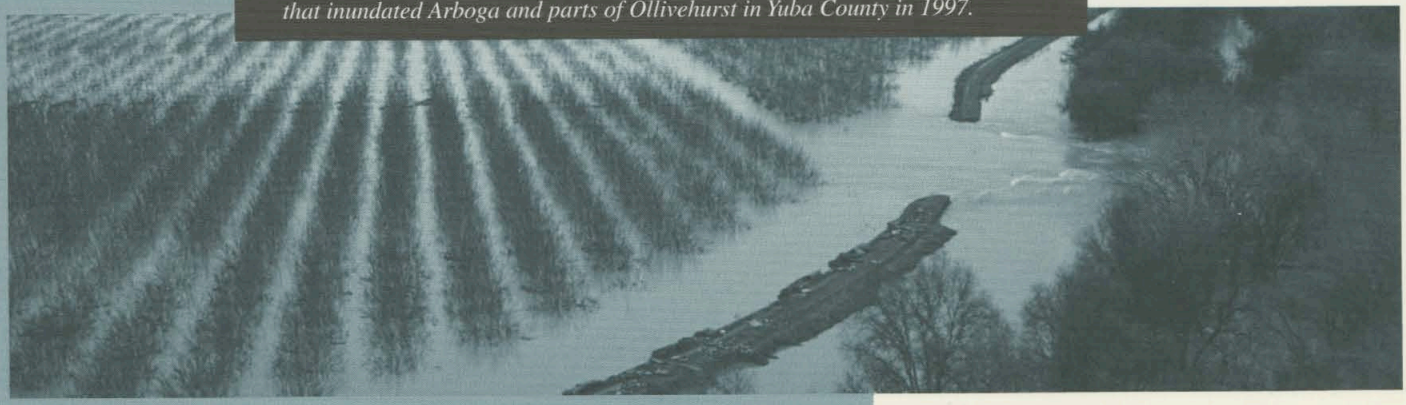
Final Result

After four years of research, analysis, and planning, the result in year 2002 is expected to be new master plans for flood management of both major river basins.

These master plans will be in the form of a programmatic environmental impact statement/environmental impact report for flood damage reduction and ecosystem restoration along both rivers. Subsequent documents on specific actions will address site-specific issues.

Specific actions which can produce immediate and effective flood damage reduction and ecosystem restoration results will be identified and recommended for early implementation.

Repairs have been made to levee breaks such as this one along the Feather River that inundated Arboga and parts of Ollivehurst in Yuba County in 1997.



Photography by Dale Kolke

If Fish Could Talk...

Who Knows what tales this male chinook salmon could tell a little girl of his younger days at the Feather River Fish Hatchery and his migration to the ocean where he lived for 2-3 years before returning to spawn the next generation.

The hatchery handles about 8,000 fall-run chinook salmon each year. This year's bountiful return kept Department of Fish and Game staff busy, artificially spawning the salmon from late September to mid-November. Their season opened on Saturday, September 25, during Oroville's Salmon Festival. It was the first time since the hatchery opened in 1967 that the operations were conducted on a weekend to let festival visitors see how the hatchery supports the sports and commercial fishery.

Although the artificial spawning operations occur only from September to November, the hatchery opens every day, from 8 a.m. to sundown. For more information, call (530) 538-2222.


DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA