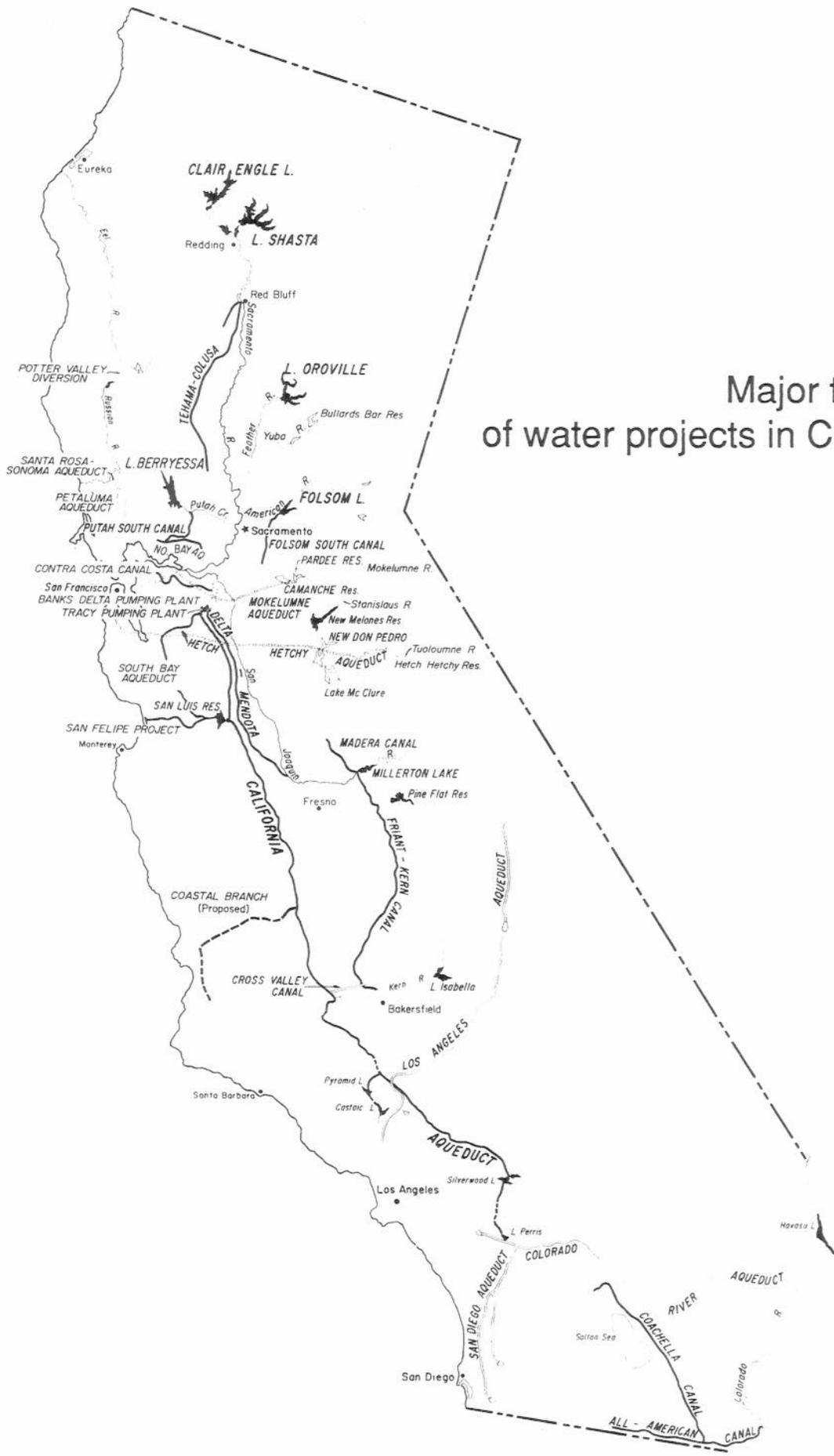


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CALIFORNIA'S CONTINUING **DROUGHT**



State of California
Department of Water Resources



Major features of water projects in California

CALIFORNIA'S CONTINUING
DROUGHT

State of California
Department of Water Resources

January 1991

Front cover: Lake Oroville in Butte County during August 1990. Lake level is 49 percent of average. Photograph by Robert Eplett, DWR.

Department of Water Resources

DAVID N. KENNEDY, Director

LAWRENCE A. MULLNIX

Deputy Director

ROBERT G. POTTER

Deputy Director

JAMES U. McDANIEL

Deputy Director

L. LUCINDA CHIPPONERI

Assistant Director

SUSAN N. WEBER

Chief Counsel

This report was prepared under the direction
of

SUZANNE BUTTERFIELD

Drought Response Coordinator

and

Acting Chief, Division of Local Assistance

Department of Water Resources

by the STATE DROUGHT CENTER

Douglas F. Priest

Manager, State Drought Center

Lawrence D. Joyce

Energy Resources Specialist II

Robert F. Fingado

DWR Retiree

R. Dean Thompson

DWR Retiree

with assistance from the

DIVISION OF LOCAL ASSISTANCE

Jonas Minton

Chief, Water Conservation Office

Carl Hauge

Supervising Engineering Geologist

Michael S. Weisser

Supervising Engineer, Water Resources

DIVISION OF FLOOD MANAGEMENT

Maurice D. Roos

Chief Hydrologist

Frank Gehrke

Senior Engineer, Water Resources

Larry L. Lee

Senior Engineer, Water Resources

DIVISION OF OPERATIONS
AND MAINTENANCE

Larry K. Gage

Chief, Schedules & Analysis Branch

James R. Snow

Senior Engineer, Water Resources

EDITORIAL AND PRODUCTION SERVICES

provided by

Gloria Abernathy

Office Technician

Paula Campbell

Editorial Assistant

Marilyne Dixon

Office Technician

Marilea Smith

Office Technician

Other contributing State departments:

Department of Fish and Game

PETER F. BONTADELLI

Director

Dick Daniel

Fish and Wildlife Program Manager

Department of Forestry and Fire Protection

HAROLD R. WALT

Director

Chris Difani

State Forest Ranger II

Department of Health Services

KENNETH W. KIZER

Director

Nadine M. Feletto

Senior Sanitary Engineer

State Water Resources Control Board

W. DON MAUGHAN

Chairman

Crystyl Sanzo

Water Resources Control Engineer

and all local water agencies providing drought contingency information for 1991

Executive summary

This report presents information on drought years 1987 through 1990, the likely impacts of a fifth consecutive year of drought, and how agencies expect to respond.

The drought years 1987 through 1990 are described in terms of precipitation, ground water, agricultural and urban impacts, water transfers, and the impacts of drought on energy, forestry, and fish and wildlife.

In addition, the water supply prospects for 1991 are assessed, potential impacts on natural resources are reviewed, and the options open to State government and water purveyors are noted.

Statewide drought conditions

Water year 1990 was the fourth in a series of substantially below-normal water years. As noted by the Sacramento River Index, three years were "critically dry" with only 1989 rated as "dry," still substantially below normal. Rainfall during the 1987 through 1990 period ranged from 61 percent to 86 percent and run-off from a high of 70 percent to a low of 45 percent. Water year 1991 began on October 1, 1990, and has been exceptionally dry with precipitation only about 25 percent of normal throughout the fall. With 40 percent of the wet season behind us, the probability for a normal or above normal water year is now only one in ten. It would now require 150 percent of normal precipitation from January through April to attain normal levels in 1991.

Water year 1991 began with storage in major reservoirs at 60 percent of average. By January 1991, storage had dropped to 54 percent of average, similar to that of January 1977, California's driest year of record.

Emergency proclamations

The identifiable impacts of four years of drought have not been equal throughout the State. The hardest hit region is the Central Coast, with only 9 percent of average run-off in 1990 and its driest four-year period of record. The Tulare

Lake and Southern San Joaquin Valley areas have also suffered from severely limited precipitation and run-off, but effects have been offset somewhat by extensive use of ground water.

To date, Santa Barbara, San Luis Obispo, San Benito, Kings, and Madera counties have declared drought emergencies. The governor proclaimed a state of emergency in the city of Santa Barbara, then later proclaimed an emergency countywide. In 1991, Glenn, Colusa, Sutter, Tulare, and Mendocino counties declared emergencies and all have asked the governor for a similar proclamation. Many other counties have experienced significant drought impacts, but have not declared emergencies. The State Water Project (SWP) reduced deliveries to agricultural customers by 50 percent in 1990, and the Central Valley Project (CVP) cut many customers by 25-to-50 percent. The only other time both agencies have reduced deliveries was in 1977. Water supply shortages have caused water rationing to be implemented in 39 of California's 58 counties.

Drought impacts

Considering the severity and duration of the drought and the State's increasing water demands created by industrial growth and a population growth of nearly 750,000 per year, California came through the fourth year of drought surprisingly well. The flexibility afforded by the SWP and the CVP enabled water to be moved from areas of surplus to areas of extreme shortage. This, along with increased dependence on ground water and effective conservation programs helped limit the severity of economic and social impacts in many areas.

Ground water. During the drought, more ground water has been extracted to replace limited surface supplies, and well construction and rehabilitation has been much higher than normal. Higher extractions raise fears of land subsidence and degradation of ground water supplies.

Economic impact on agriculture. During the first three years of the current drought, agriculture was not significantly impacted. In 1990,

prior to the December freeze, gross farm revenues were expected to reach a record \$18 billion. Nonetheless, estimates by DWR economists indicate direct drought losses to agriculture in 1990 of about \$455 million. Losses in 1991 will depend on the severity of this year's shortage of water.

Urban impact. Most metropolitan areas of the state were able to minimize the impact of the first four years of the drought through conservation and acquisition of additional supplies. Urban areas that have purchased imported supplies to get through the drought include Napa County (city of Napa), Santa Clara County, Santa Barbara County, and San Francisco.

Fish and wildlife. The fourth year of drought caused severe problems for fish and wildlife, which must compete with 30 million people and 9.5 million acres of irrigated agriculture for water. Wildlife habitat capacity has diminished, and water holes have dried up. Many fish species have suffered severe population decreases. Salmon, with a three-year spawning cycle, entered the fourth year of drought with already-reduced numbers of adult fish. Fish and wildlife will probably require years to recover from the effects of the drought once it has ended.

Forest lands. Drought has also had significant impact on forests and water shed vegetation. Fire potential, disease, and insect infestations increased during the drought. Since 1987, insect kills of merchantable timber total 12 billion board feet of timber. This is enough timber to build 1.2 million homes.

Electrical production. The drought has reduced hydroelectric energy production in California, increased electricity requirements for water delivery operations, and increased use of fossil fuels for electricity production. Hydroelectric energy typically accounts for as much as one-third of the state's electricity production, but from 1987-1989, it provided less than 20 percent of total production. Utilities have used oil- and natural-gas-fired power plants to make up most of the lost hydroelectric energy.

Urban water conservation. During 1990, Central Coast communities established the most stringent goals, ranging from 25-to-45 percent. San Francisco Bay Area communities cut back 15-to-25 percent, and most Southern California cities targeted 10 percent reductions.

Alternative sources. The drought has renewed interest in reclaiming water from waste treatment and industrial sources. Several coastal water agencies are considering sea water desalination as a possible supply source. Santa Barbara has contracted for design work for a 2,500-to-10,000 acre-foot per year system. Marin Municipal Water District is testing the value of a small pilot desalter as a standby for shortages.

Water transfers and exchanges. Water transfers and exchanges have helped to lessen the effect of the drought in some areas. They have occurred within irrigation districts, between neighboring agencies, and throughout the State via SWP and CVP transportation facilities. Some agencies have modified their water supply systems to facilitate transfers. San Francisco, for example, has connected to the SWP's South Bay Aqueduct to enable transfers from other sources.

Weather modification. Weather modification commonly is used to increase water supply. Usually 10-to-12 weather modification projects operate in California. During the drought, the number has increased to 15, and additional programs are being considered.

Prospects for 1991

Probability for recovery. After a dry start for the 1991 water year, the prospects of recovery from the drought this year are slim. This is very discouraging since it would take 110 percent of average run-off for most reservoir systems to recover. About 75 percent of average run-off is needed just to meet this year's water needs. Regional variations exist in precipitation, run-off, and storage, so the impact of continuing drought will vary throughout the State.

Central Coast and San Francisco Bay Area. The Central Coast is largely dependent upon local supplies, and even with near normal precipitation, the area could not be expected to avoid a fifth drought year. In the San Francisco Bay Area, the drought impact will depend largely upon what water is available for import from the Sierra watersheds, as well as those watersheds that are sources for CVP and SWP supplies.

Sacramento Valley. Communities in the Sacramento hydrologic region will be impacted by SWP cutbacks to the limited number of agencies contracting north of the Delta. CVP water users could be impacted if inflow into Lake Shasta falls below 3.1 million acre-feet, the point at which a 25 percent cutback is mandated to Central Valley Project contractors on the Sacramento River.

San Joaquin Valley. The Valley has already suffered significant surface water shortages, and faces agricultural cutbacks of 65 percent in State Water Project deliveries. Central Valley Project deficiencies are to be announced February 15. The severity of announced cutbacks will depend on water supply conditions at that time.

Tulare Lake. In the Tulare Lake area, surface storage is minimal as the calendar year begins making another year of severe short water supplies very likely.

Southern California. Southern California is largely dependent on water imported by The Metropolitan Water District of Southern California. A repeat of 1990 run-off probably would mean municipal and industrial deficiencies of at least 15-to-25 percent in State Water Project

supplies. Compounding problems in the area include an already reduced Colorado River allotment and continuation of reduced supplies from Owens Valley and Mono basin.

State Water Project. The State Water Project delivers water from Northern California to water agencies throughout the state. The initial delivery commitment for 1991 by the SWP indicates agricultural deliveries will be curtailed by 65 percent, and municipal and industrial deliveries will be curtailed by 15 percent. As the winter continues, water supply conditions will be reviewed and commitments updated.

Central Valley Project. The Central Valley Project is analyzing a range of different water supply scenarios in advance of a February 15 date for announcement of deficiencies. A below-normal year would probably result in deliveries of 50-to-75 percent of requests. A dry year would likely result in CVP deliveries of 25-to-50 percent of requests, and a critical year would likely result in 25 percent or less deliveries of requested water.

Local drought assistance needs

The need for drought assistance to local water agencies by the State was determined through surveys conducted in late 1990 by DWR and predictions of possible needs for financial assistance prepared by the Department of Health Services. Identified needs for drought assistance to local agencies generally can be grouped into four categories: (i) financial; (ii) water transfer/import capabilities; (iii) technical information; and (iv) regulatory/legislative needs.

In general, it was found smaller agencies had more limited resources and more need for financial and other assistance than did the larger agencies. Although need was frequently expressed for all four categories of assistance, financial assistance was the most needed. The Department of Health Services projected the need for 1991 drought relief pertaining to health and public safety in 875 water districts could exceed \$50 million.

Contingency plans for 1991

If 1991 continues dry, water shortages will be far more severe than in 1990, with greater impacts on the public, industry, agriculture, forests, and fish and wildlife. Even if we stretch supplies to the limit, many water needs will go unserved.

Planning for a fifth dry year. Many water agencies have developed contingency plans for dealing with a fifth year of drought. Their options and potential actions are described in this report. In general, plans call for more extensive implementation of water supply and conservation programs and practices now in place.

With continued drought, more stringent conservation and rationing programs will become widespread. Where voluntary programs have been used to balance demands, mandatory rationing or greater incentives to encourage conservation and discourage waste will be necessary.

Another dry year will mean greater surface water deficiencies for agriculture, requiring more dependence on ground water, changing of cropping patterns to less water-intensive crops, and more acreage left unplanted. Sharing of supplies through exchanges and transfers of any surpluses will be necessary to alleviate the most extreme shortages.

Coordination and preparedness. Continued drought in 1991 will require intensive planning and coordination among federal, State, and local water agencies to facilitate drought relief efforts. Every water agency should have a contingency plan prepared and ready for implementation.

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DROUGHT 1987-1990

Drought 1987-1990

Precipitation, run-off, and reservoir storage

Water year 1990 was the fourth in a series of substantially below-normal water years. As rated by the Sacramento River Index, three of the years during the 1987-1990 period were rated "critically dry" with only 1989 being rated as "dry," still substantially below normal.

The cumulative impact of four successive years of drought was indicated by the fact that five counties (Santa Barbara, San Luis Obispo, San Benito, Kings, and Madera) declared emergencies and, for the second time in their history, both the State Water Project (SWP) and the Central Valley Project (CVP) reduced deliveries. In 1990, the SWP cut deliveries to agricultural customers by 50 percent, and the CVP cut many customers by 25 or 50 percent. The first and only other such disruption in deliveries for both projects was in 1977, California's driest year of record. Many other water suppliers were also short of meeting needs, as indicated by active water conservation programs in 39 of California's 58 counties.

Drought severity during 1987 through 1990 is directly related to precipitation and run-off levels shown on figures 1 and 2 on pages 4 and 5 and reservoir storage shown on Table 1 on Page 2. The hardest hit region is the Central Coast, roughly from San Jose to Ventura. The drought is also severe in the southern end of the San Joaquin Valley and in the Tulare Lake Region, but the impact there is cushioned somewhat by local ground water supplies.

FOR Northern California, the historic "critical period" drought of 1929-34 was more severe than the 1987-90 period. The driest four-year period in the Sacramento River Basin was 1931-34 (Figure 3 on Page 6) which averaged 49 percent of average run-off compared to 56 percent in 1987-90. In the southern Sierra, this drought is almost identical to the worst previous four-year sequence in 1928-31. For the Central Coast and central Sierras, 1987 through 1990 is the most severe four-year period of record. It is worth noting there have been several sequences of below-average precipitation at Santa Barbara

longer than the present one. These earlier sequences include 1869-1874, 1894-1902, and 1945-51.

Prospects for 1991 year depend on two basic factors — the amount of water carried over in storage and the 1991 water crop. To better understand the effect of a drought, it may be useful to compare beginning of October storage in major reservoirs of the State. A summary of October 1 storage for 1990 and previous years is shown on Table 2.

Table 2 shows reservoir storage on October 1, 1990, which was about 13.6 million acre-feet (MAF), or about 60 percent of average for that date. It is somewhat more than 3 MAF below last year and about 1.3 MAF less than in 1988, but about 5.8 MAF over 1977 at the end of two severe drought years. Statewide storage, in fact, is very similar to 1976 after one year of drought. The statewide total picture masks some real problem areas. Central Coast storage is much lower than 1977, and Tulare Lake storage is somewhat lower. Storage at Warm Springs

(Lake Sonoma), New Melones, and Spicer Meadows reservoirs account for about 600,000 AF of carry-over storage this year. These reservoirs were completed after 1977. Since October 1, 1990, storage in the State's 155 reservoirs has decreased to 54 percent of average.

Run-off on the Colorado River for the last three years has been the lowest cumulative total on record. Fortunately, this follows some very wet years in the first half of this decade. Storage in lakes Mead and Powell is about 5 MAF less than last year, but still near average for this date

Table 1
Summary of storage in major reservoirs on October 1, 1990
(In 1,000s of AF)

Region	Number of Reservoirs	Total Capacity	Historical Average	1977	1989	1990	Jan 1991
North Coast	7	3,149	2,056	294	1,648	1,479	1,215
SF Bay	18	697	398	286	349	310	273
Central Coast	6	947	551	228	121	94	85
South Coast	29	1,979	1,120	840	1,141	1,202	1,144
Sacramento	43	16,012	10,308	4,221	8,877	6,647	5,826
San Joaquin	33	11,362	6,472	1,530	3,895	3,350	3,009
Tulare Lake	6	2067	699	200	243	171	177
No. Lahontan	5	1,072	585	36	221	107	107
So. Lahontan	8	403	299	154	200	206	206
Colorado River*							
TOTAL	155	37,688	22,497	7,789	16,731	13,566	12,042
% of Average				35	74	60	54

*No State reservoir facility in this region

Ground water impacts

California is fortunate to have large quantities of ground water available. This ground water resource is especially valuable when surface water is in short supply, as in the present prolonged drought. During a drought, more ground water is extracted than during a normal year. This extra ground water is used to replace surface water that is no longer available. The amount of water extracted above the normal amount is dependent on several variables. Those variables are:

- ▼ Availability of imported or local surface supplies;
- ▼ Effectiveness of agricultural and municipal and industrial conservation measures;
- ▼ Amount of reclaimed water used;
- ▼ Change in water demand of crops or acreage planted;
- ▼ Changes in crop patterns due to market prices for products; and
- ▼ Amount of government subsidy for specific crops.

Ground water levels. Ground water levels in California differ in every basin and in different parts of each basin. Those levels are affected by different combinations of the factors listed above, as well as the amount of recharge occurring in previous years and the total number of wells and amount of water extracted from the basin.

The San Joaquin Valley overlies an alluvial ground water basin, where the amount of ground water in storage has decreased considerably in all counties due to the lack of adequate recharge from 1987 through 1990.

The average ground water level in San Joaquin, Stanislaus, Madera, Merced, Fresno, Tulare, and Kings counties is close to or below the level of ground water at the end of the 1976-1977 drought. In Kern County, the average ground water level is still higher than the average level in 1978. The hydrographs in figures 4 and 5 on pages 7 and 8 show cumulative ground water level changes since 1970 for all counties within the San Joaquin Valley, except San Joaquin. The latest measurements on the hydrographs were made in spring 1990. Hydrographers will collect spring 1991 measurements during January through March 1991.

Undoubtedly, the hydrographs will show a continuing decline. Because ground water use has been quite extensive, and there has been so little precipitation and run-off in the first part of water year 1991, the decline from spring 1990 to spring 1991 will be greater than the decline during the previous year.

Table 2
Summary of statewide water-year data

As of October 1, 1990
(Percent of Average)

	1977	1986	1987	1988	1989	1990
Precipitation	45	128	61	82	86	69
Water year run-off	20	138	48	48	70	45
Reservoir storage	35	119	84	66	74	60
Sacramento River Index (MAF)	5.1	25.8	9.2	9.2	14.8	9.2
Year type	Critical	Wet	Critical	Critical	Dry	Critical

**The Sacramento River Index is the sum of unimpaired water year run-off from the Sacramento River above Bend Bridge near Red Bluff, Feather River inflow to Oroville, Yuba River at Smartville, and American River inflow to Folsom. The index annual average is 18.91 MAF.*

In northern Sacramento Valley, ground water levels are declining, but they are still higher than 1977 levels. However, because of the lack of precipitation and the lack of surface water supplies, ground water extraction will increase markedly during the coming irrigation season. This will probably result in faster decline of ground water levels than during previous years.

In coastal areas, where the total storage capacity of the ground water basins is small, ground water levels have declined significantly. Many of these ground water basins are in fractured hard rock, which are very similar to the ground water basins found in the Sierra foothills. Generally, ground water measurements are obtained in only a few areas of fractured hard rock. Where they are available, measurements show that wells in hard rock at higher locations on ridges have lower water levels than usual. Water levels in wells in hard rock in valleys are about normal.

Ground water in fractures at higher elevations normally drains into watercourses or fractures at lower elevations. DWR has received many reports of hard rock wells going dry and wells being deepened or replaced. It is not known whether the new wells are a result of the drought or the rapid growth that has been taking place in the foothill areas for the last ten years.

Impacts of the drought on wells and ground water use. As long as the amount of ground water extraction continues to increase, and recharge remains significantly below normal or

does not occur at all, ground water levels will continue to decline. As water levels continue to decline, the amount of energy required to lift the water to the surface will increase, adding to the landowner's or water agency's cost of producing a crop or providing a water supply. In many cases, this increased energy cost would force a farmer to either change to a higher value crop or let the land lie fallow.

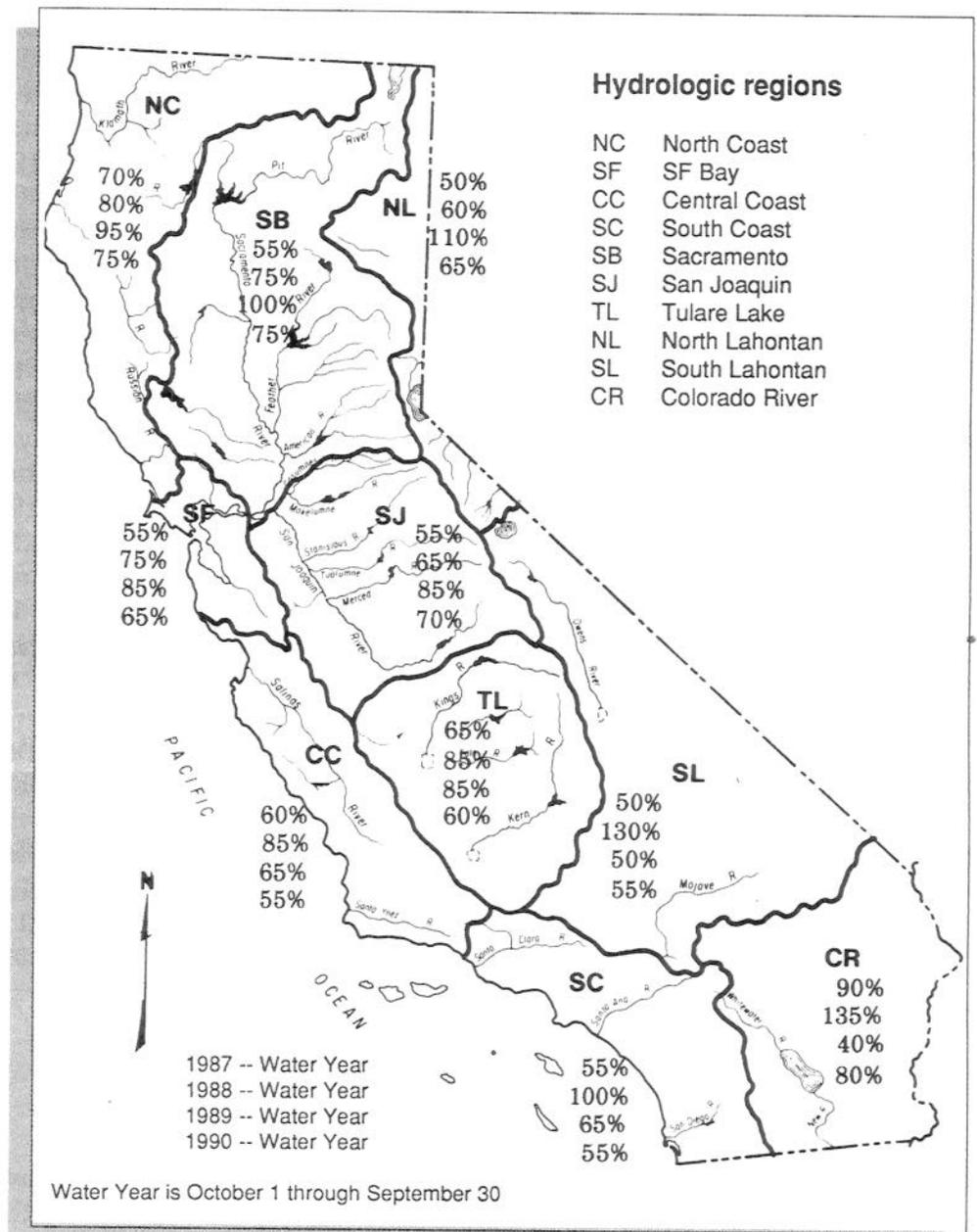


Figure 1. Seasonal precipitation in percent of average by hydrologic regions.

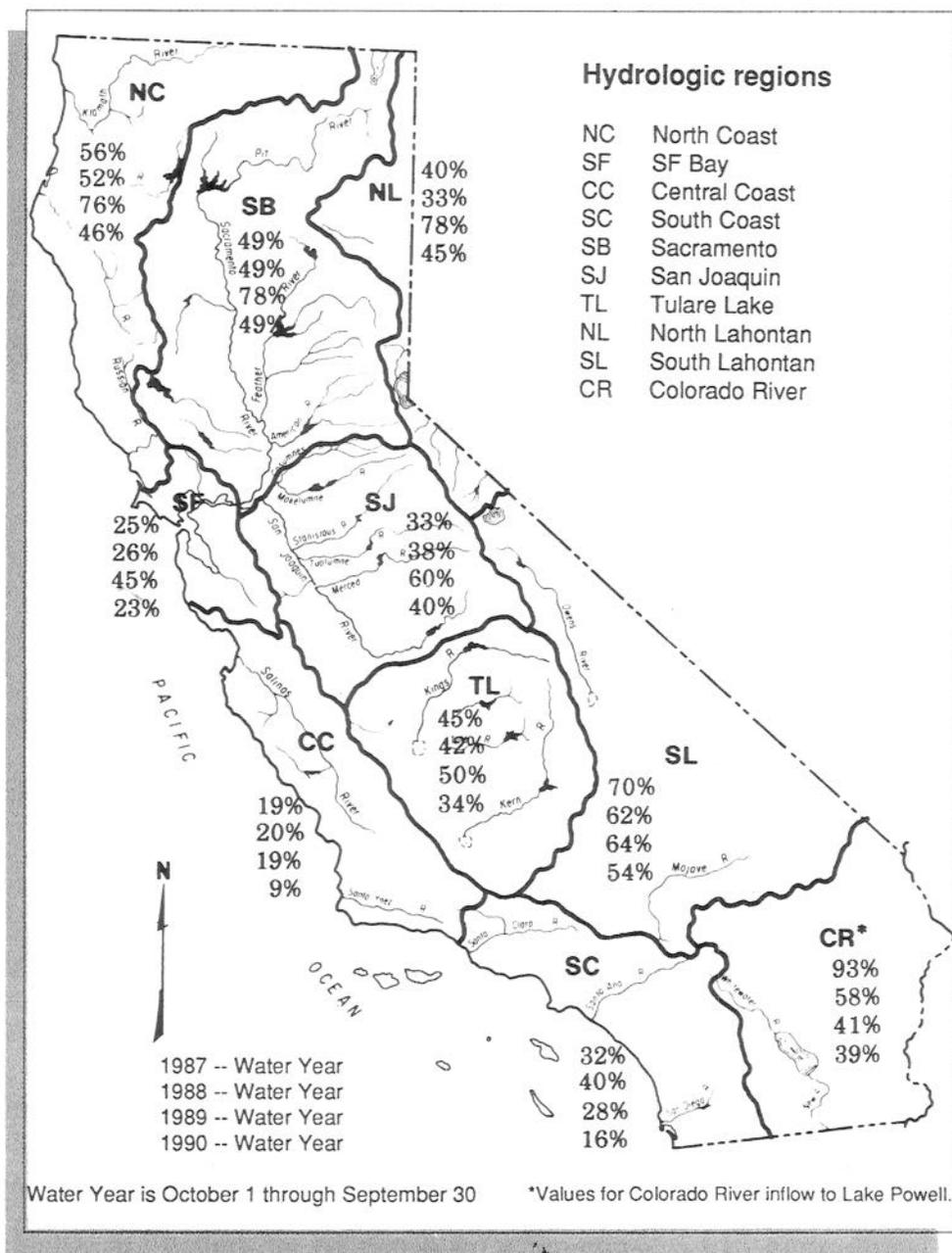


Figure 2. Water year run-off in percent of average by hydrologic regions.

Another effect of declining ground water levels is some wells will go dry. The wells will no longer contain ground water that can be extracted, or the ground water level will fall below the level of the pump. Again, the landowner may either deepen the well, lower the pump, or the farmer may let the land lie fallow.

Along the coast and in the Delta, declining ground water levels allow sea water intrusion into fresh water aquifers. Most agencies are watching these areas carefully to mitigate such

intrusion. In some coastal areas, sea water intrusion has moved considerably farther inland as a result of increased ground water extraction during 1987 through 1990. In other areas, there appears to be no change. In some areas where sea water intrusion has occurred, not enough data are available to differentiate between the effects of ground water extraction during normal years and the effects of increased extraction during drought years. Where no barriers exist and where ground water levels in coastal aquifers are being lowered significantly as a result of the drought, the sea water-fresh water interface is probably moving inland.

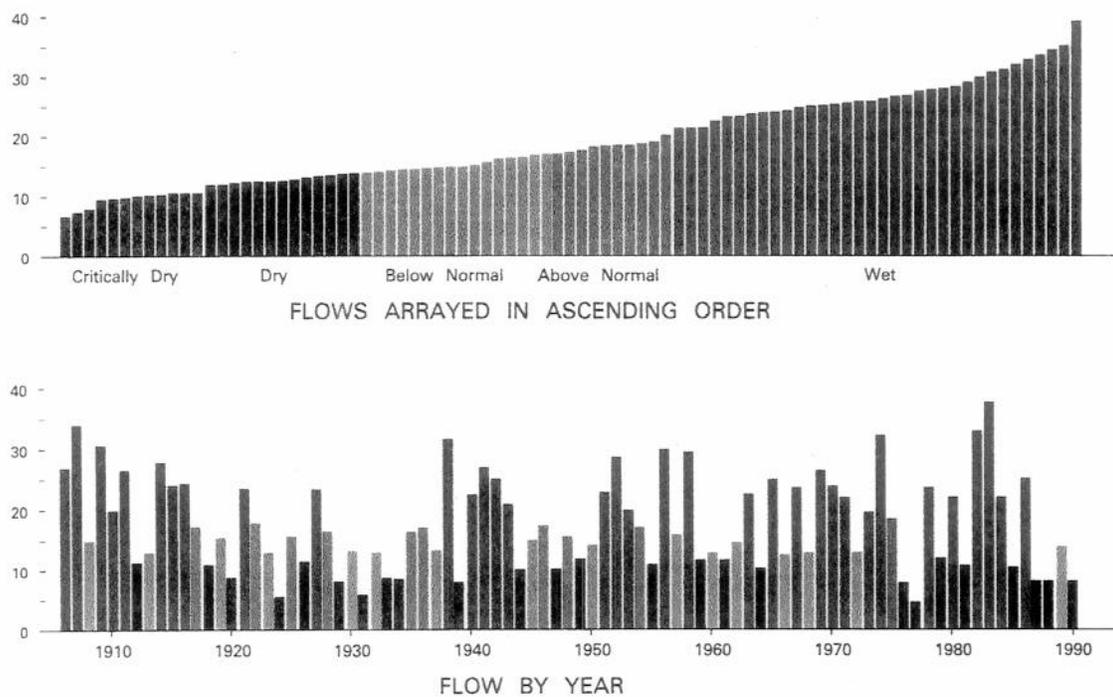
In parts of California, the extraction of ground water and lowering of ground water levels in the past has resulted in subsidence of the land surface. The effect of increased drought-related ground water extraction on land subsidence is unknown. Based on past experience, it is probably reasonable to assume subsidence is occurring in a number of locations. At the present time, accurate prediction of

subsidence is not possible, but localized subsidence is likely to occur when ground water levels decline, as they did in the San Joaquin Valley during 1977.

DWR has received no reports of increased subsidence as a result of increased ground water extraction from 1987 through 1990. However, most monitoring programs to detect subsidence have been discontinued for some time.

In some areas, naturally occurring chemicals may always have existed in the ground water so the ground water resource may

Figure 3. Water year classifications. Sacramento River Basin flows (in millions of acre-feet per year).



not have been developed for use. In other areas, where ground water levels are lowered significantly because of the increased extraction resulting from the drought, the change in ground water gradient may cause movement of undesirable contaminants toward water-producing wells.

In areas where the ground water has been contaminated by organic or inorganic chemicals, heavy metals, or pathogens, steeper ground water gradients can cause contaminant plumes to spread faster.

Ground water quality protection. The ready availability of California's ground water during normal years and during the 1976-1977 drought leads many people to believe there will always be an adequate supply of good-quality ground water. However, modern-day activities have and can contaminate the State's ground water supply and render the supply useless or expensive to treat. If an aquifer is contaminated, loss of the ground water source can create a hardship during a drought when surface water is no longer available.

Protecting the quality of the State's ground water supply is essential if ground water is to continue to serve as an important part of California's water supply and also as back-up during droughts. Ground water quality protection depends on many things, including the proper management and disposal of wastes, proper location of waste disposal sites and other operations that could adversely affect ground water basins, proper use of agricultural and industrial chemicals, control of sea water intrusion, and the proper construction, repair, alteration, and destruction of wells.

During droughts, well construction and alteration activities in the State usually increase over normal years. New wells typically are constructed during droughts to replace surface water supplies that have dried up and to replace dry wells. Many wells are repaired or reconditioned during droughts when they suddenly have to be put into service after being idle during wet years. Some wells are deepened during droughts to reach declining ground water levels. Finally, some wells must be destroyed during droughts after they fail to produce adequate yields or they go dry.

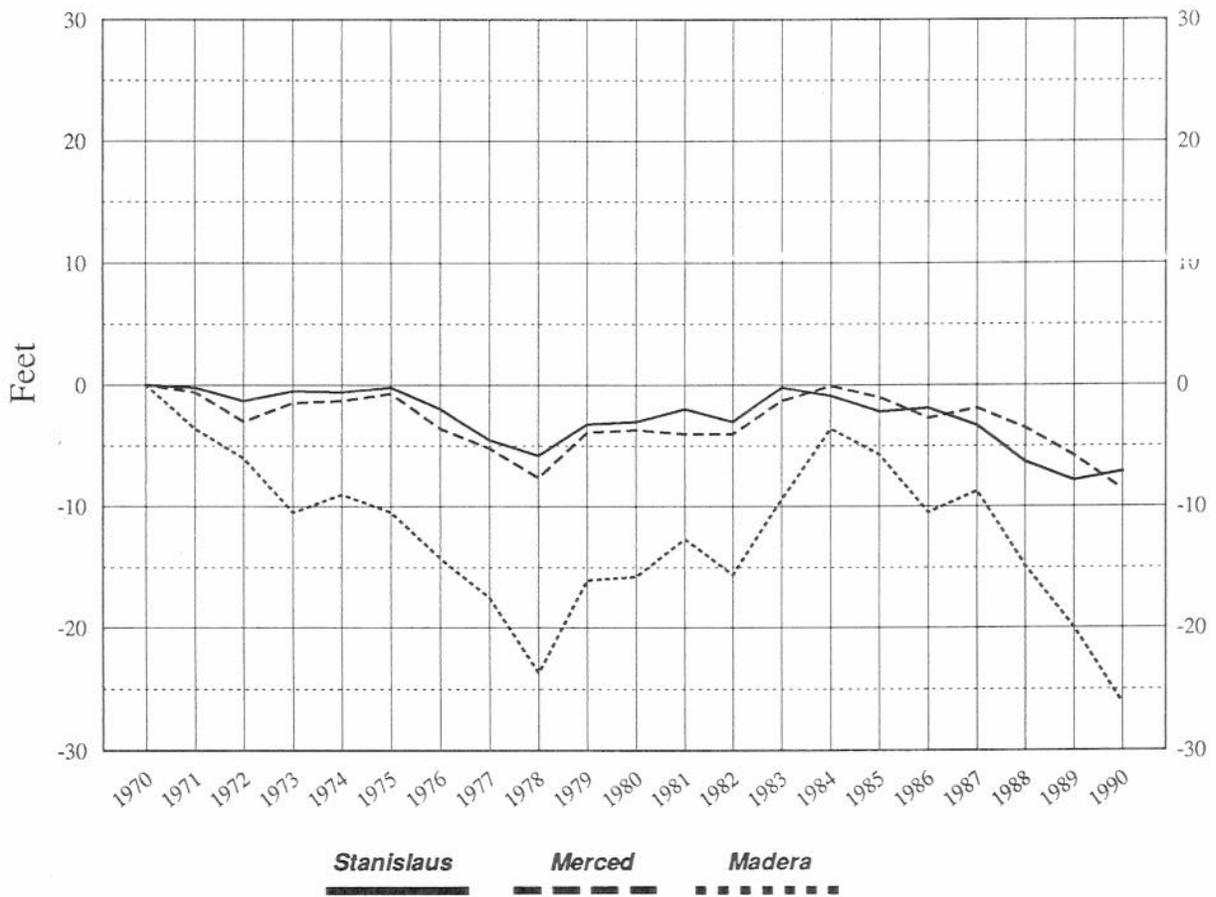


Figure 4. Cumulative ground water level change by county (San Joaquin hydrologic study area; August 3, 1990).

Improperly constructed, repaired, altered, or destroyed wells can provide a pathway for the movement of contaminants to aquifers. It is essential that long-term concerns of water-quality protection not be sacrificed when conducting well construction, repair, alteration, and destruction operations during a drought or any other time.

The Department has developed standards for the construction, alteration, repair, and destruction of wells to provide for ground water quality protection. California cities, counties, and in some cases, water districts are required to enforce well standards meeting or exceeding DWR's standards. The well construction industry and government must work together during droughts as in normal or wet years to protect the State's ground water, and ensure it will be available in the future.

For the same reasons, well standards are important, land use practices surrounding the wellhead and the aquifer recharge zone should be controlled to prevent contamination by agricultural or industrial chemicals, waste products, or pathogens. Many examples show keeping contaminants out of an aquifer is much easier than removing them once the aquifer is contaminated.

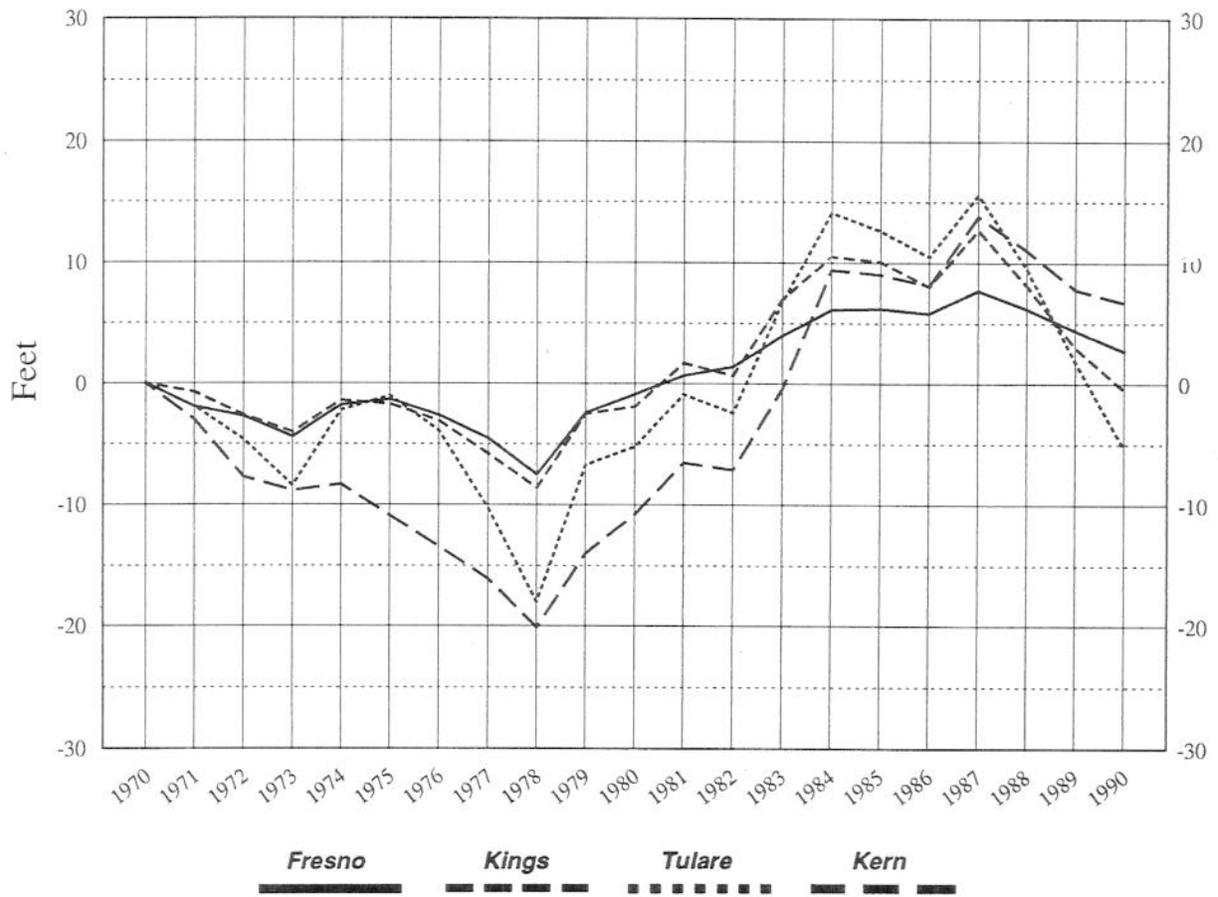


Figure 5. Cumulative ground water level change by county (Tulare Lake hydrologic study area; August 3, 1990).



Photo 1. Agriculture has been adversely affected by drought conditions. Range cattle were sold off, and crop lands remain fallow. (DWR photo.)

Agricultural impacts and response

California agriculture fared reasonably well from 1987 to 1989, the first three years of the drought, but impacts have become more severe as the drought continues. Exceptions to this are the Central Coast and southern San Joaquin Valley and areas that do not have ground water to substitute for rainfall or surface supplies. Some industries such as dry land farming and grazing of beef cattle have been impacted to varying degrees since the first dry weather in 1987.

Compared to the agricultural activity that would have occurred in 1990 if the drought had ended in 1989, there were many lost economic opportunities. According to the Department of Water Resources economists, the direct **economic**

cost to California agriculture of the 1990 drought is forecasted to be \$455 million. This is about 3 percent of the 1989 value of California's agricultural output. The farm sectors hit hardest by the drought are dry-farmed grains, hay, and grazing beef cattle. In irrigated agriculture, economic impacts are most severe on the Central Coast, as well as along the west side of the southern San Joaquin Valley. ✓ Throughout California, there were an estimated 194,000 acres idled by the drought. Most of that land would have been planted in cotton or grains. ✓

Urban impacts and response

Generally, California's urban areas only recently began to suffer the cumulative impact of four successive years of drought, but the impact has not been equally distributed throughout the State. In 1990, the impacts included:

- ▼ Cities supplied by the CVP were cut back 25-to-50 percent;
- ▼ San Francisco Bay Area communities were required to cut back use by 15-to-25 percent;
- ▼ Central Coast communities, for the most part, met goals ranging from 25-to-45 percent;
- ▼ Most Southern California cities implemented conservation programs to cut use by at least 10 percent;
- ▼ Limitations on new connections and moratoriums on construction have been instituted in scattered areas around the State; and
- ▼ Generally, cities from Sacramento north have had adequate supplies.

Probably the most severely impacted city in the State is Santa Barbara. With the local Gibraltar Reservoir empty, the city was conserving at a mandatory level of 45 percent. If the drought continues, Cachuma Reservoir, which is Santa Barbara's primary source, will also be empty sometime in 1992. To prepare for a dry 1992, the city signed a contract September 18, 1990, with Ionics, Inc., of Massachusetts, for preliminary work on a proposed 2,500-to-10,000 AF per-year-capacity reverse-osmosis desalter using sea water. The contract calls for environmental review, design, and permit work to proceed until June 1991, when a *Notice to Proceed with Construction* will be given, if needed. By that time, the size of the plant will be established, which will be partially dependent on winter rainfall and on whether the plant is to serve the city alone or to supply other local agencies. In the meantime, the city and other local Santa Barbara water agencies are going ahead with plans to bring limited State Water Project supplies to the area

via a complex series of exchanges (see Photo 2). This additional supply of a maximum of 3,700 AF is significantly less than Santa Barbara needs, but has enabled the city to modify its conservation goal to 35 percent.

In Southern California, the city of Avalon on Catalina Island (which has been under mandatory conservation for more than a year) has drilled two new wells and reactivated a third. A 45 AF reverse osmosis desalter will be put into operation by Southern California Edison Co. (SCE) in 1991 to augment supplies.

In the north, the level of Lake Tahoe dropped below its natural rim on September 15, 1990, jeopardizing water supplies for downstream communities for the second time during the four-year drought. In 1988, the lake level dropped below the rim on October 10 and remained there until March 6, 1989. On December 16, 1990, the level dropped to 6222 feet, one foot below the natural rim and lower than in 1977. Truckee River flows are limited to that provided by tributaries downstream from Lake Tahoe and dropped to 75 cubic feet per second (cfs) at the town of Farad on October 10, 1990.

The Central Valley city of Fresno has 34 wells out of service due to long-standing water-quality problems (DBCP, TCE, salt, or chloride) intensified by increased pumping brought about by drought conditions. The city is drilling six new wells and is exchanging reclaimed water for Kings River water. Although individual conservation goals are being met, overall demand increased about 10 percent from 1989 because of significant increases in population and in industrial water needs.

In addition to Fresno, agencies reporting water-quality problems with ground water included Mariposa Public Utility District, the city of Livingston, the city of Los Banos, the city of Merced, Planada Community Services District, and Winton Water Storage District, all in Merced County. Other agencies included the California Water Service Company in Salinas, Monterey Peninsula Water Management District users on the lower Carmel River, the Ramona Municipal Water District in San Diego County, Scotts Valley Water District, and the city of Ceres.

Among communities that turned to other water agencies to augment water supplies in 1990 or are planning to do so in 1991 are:

- ▼ Del Oro Water Company in Butte County is looking to Paradise Irrigation District to augment ground water if needed in 1991;
- ▼ Lime Saddle Community Service District in Butte County purchased 100 AF to augment ground water in 1990 from Sterling Bluffs Water Company and is planning the same if 1991 is dry;
- ▼ Magalia Community Water District will augment its ground water supply, if needed in 1991, by purchase from Paradise Irrigation District;
- ▼ Lower Lake County Water District in Lake County will try to interconnect with Highland Water District and is planning to install iron and manganese treatment and removal facilities to double the potable ground water yield;
- ▼ The city of Napa purchased 6,500 AF of water from the Yuba County Water Agency's Bullards Bar Reservoir and had it delivered via the SWP North Bay Aqueduct;
- ▼ In 1990, the city of San Francisco established a connection to the SWP South Bay Aqueduct and purchased water from Placer County Water Agency for transport through the SWP system in 1991 as supplies are not sufficient from its Hetch Hetchy Project;
- ▼ The Solvang Municipal Improvement District purchased 500 AF from the Santa Ynez River Water Conservation District;
- ▼ The Aldercroft Heights County Water District purchased water from the San Jose Water Company via Los Gatos Creek;
- ▼ The Chemiketa Mutual Water Company purchased water from the San Jose Water Company over the past three years; and

Photo 2. In December 1990, this 16-inch steel pipe became part of a three-mile Oxnard-to-Ventura connection to initiate exchanges and transfers to move State water to the city of Santa Barbara in 1991. The \$980,000 Santa Barbara Water Agency contract includes materials, construction, and maintenance for two years. (DWR photo.)



- ▼ The Santa Clara Valley Water District continued to take delivery of water purchased two years ago from the Yuba County Water Agency.

The drought has renewed interest in reclaiming water. Examples of new interest in reclamation include:

- ▼ The El Dorado Irrigation District is pursuing waste water reclamation to produce one-to-two million gallons per day to irrigate a golf course;
- ▼ The Monterey Peninsula Water Management District is working toward golf course irrigation with reclaimed water;
- ▼ The city of Santa Barbara and the Montecito Water District are requiring use of reclaimed water for golf course and public landscape irrigation;
- ▼ East Bay Municipal Utility District uses about 1,100 AF of reclaimed water for golf course and highway landscape irrigation. In five years, it is expected to increase to 1,800 AF per year, with another 6,000 AF per year to be used for refinery process cooling; and
- ▼ The Metropolitan Water District of Southern California member agencies currently participate in 22 reclaimed water projects with a total yield of 61,000 AF per year. The district is evaluating 10 proposed projects which, if implemented, would provide an additional 29,000 AF annually.

Among agencies considering desalting to solve current drought problems or as future stand-by drought responses are the city of Santa Barbara, the city of Avalon on Catalina Island, the Marin Municipal Utility District, the city of San Luis Obispo, La Cumbre Municipal Water Company, and Summerland Community Water District in Santa Barbara County.

Water transfers

Water transfers and exchanges are playing an increasingly important role in western water management and, during a drought, there is a particular interest in this strategy. Over the last decade, State and federal governments have passed a number of laws aimed at encouraging and facilitating the voluntary transfer of water and water rights. Water transfer incentives take many forms, and governmental action to promote transfers has focused on establishing a legal and institutional framework flexible enough to allow all plausible transfers to be pursued.

Though transfers are a means of making more efficient use of existing water storage and conveyance facilities, they are not entirely exempt from such essential considerations as economic and environmental impact assessment. In most cases, transfers of water or water rights must be approved by the State Water Resources Control Board (SWRCB) because a transfer is likely to involve some sort of change (place of use or type of use) of an existing water right. However, drought-related water transfers are usually temporary measures, and an expedited approval procedure has been established for temporary transfers that meet certain criteria.

Numerous drought-related water transfers are being negotiated or have taken place over the course of the current drought. Some of the transfers are small from a statewide perspective, but they are directly related to alleviating current drought-induced shortages and have great significance to the local water users. Other transfers, such as those from Yuba County Water Agency, involve large amounts of water.

A vast system of aqueducts and water distribution facilities exists in California. Increasingly, interconnections are being built to facilitate water transfers and exchanges. Many of these could again play an important role if the drought continues. They include the connection of the Putah South Canal to the SWP North Bay Aqueduct; the SWP South Bay Aqueduct to the Hetch Hetchy system at San Antonio Reservoir; the East Bay MUD Mokelumne River Aqueduct to the Contra Costa Canal; and the Kern County Water Agency Cross Valley Canal between the California Aqueduct and the CVP Friant-Kern Canal. Also, the potential exists to connect supplies in the same manner that the southern and eastern San Francisco Bay areas were connected with Marin County in 1977.

During the 1980s, a number of new laws were passed aimed at facilitating water transfers and temporary urgency permits and changes. As a result, the *California Water Code* has clarified some concerns associated with transfers and has identified policy and agency roles in carrying out water transfers and emergency water right actions.

The following summary highlights present administrative provisions related to water transfers during droughts:

- ▼ SWRCB may issue a conditional temporary permit to divert and use water (or change an existing permit or license) for as long as six months, if SWRCB finds that there is an urgent-though-temporary need; that such diversion and use can be made without injury to vested rights and without unreasonable effects on fish, wildlife, or other beneficial instream uses; and that the diversion is in the public interest;
- ▼ Cessation or reduction in use of appropriated water due to conservation efforts is a reasonable beneficial use, and no forfeiture of rights shall occur as a result;
- ▼ Under specified conditions, State and local agencies are prohibited from denying a transfer of water through unused capacity in a water conveyance facility; and

- ▼ Any local or regional public agency authorized by law to serve water to its customers may sell, lease, exchange, or otherwise transfer water that is surplus to its needs for use outside the agency service area.

In addition, Assembly Bill 982 (effective January 1989) establishes new, expedited procedures for temporary water transfers. The bill allows the SWRCB to exempt temporary transfers from the *California Environmental Quality Act*, but it still requires a finding by SWRCB about unreasonable effects on the environment, other legal users of water, and third parties.

DWR has been an active party to water transfers for a number of years. During the 1976-1977 drought, water transfers involving SWP reservoirs, pumping plants, aqueducts, and canals helped satisfy the urgent needs of urban and agricultural water users. Moreover, coordination of water transfer activities and facilities during the 1976 and 1977 drought demonstrated many interconnections already exist in California providing the capability to move water from areas of abundance to many areas of need in times of crisis.

In 1980, a State law was adopted directing water officials to ". . . facilitate the voluntary transfer of water and water rights where it is consistent with the public welfare of the place of export and place of import." The *Costa-Isenberg Act of 1986* directs DWR to facilitate the voluntary exchange or transfer of water and implement existing State laws pertaining to water transfers. Also, pursuant to 1986 legislation, the Department is prepared to make unused capacity in the SWP available for water transfers under specific conditions.

DWR facilitates water transfers by functioning as a water wholesaler through its management of the SWP, conveying water from sources of supply to areas of need through the SWP and interconnection with other water delivery systems and serving as a water transfer facilitator.

In March 1986, DWR established an in-house Water Transfers Committee to help:

- ▼ Evaluate and implement transfers;
- ▼ Review proposed water transfer legislation;
- ▼ Identify currently active transfer proposals; and
- ▼ Clarify DWR's role in water transfers.

Since the committee was formed, DWR has published two documents to facilitate the voluntary exchange or transfer of water within California:

- ▼ *A Catalog of Water Transfer Proposals*, evaluating proposals under consideration by various parties in 1986 (now being revised), and
- ▼ *A Guide to Water Transfers in California*, detailing the steps and considerations to be made by those interested in making a water transfer.

Table 3 sets forth some of the proposed and completed water transfers and their status for 1990 and 1991. Some other exchanges and transfers are noted in the urban impact text.

Table 3
1990 Water transfers as of January 7, 1991

Title of transfer	Source Agency	Destination Agency	Amt of Transfer (AF)	SWRCB Action?	SWP Wheeling?	Oroville Storage?	CVP Wheeling?	Status
Yuba-SWP	YCWA	DWR	200,000 (2)(3)	Yes	No	Yes	No	Deliveries completed
Yuba-Napa	YCWA	Napa City	7,000	Yes	Yes	No	No	Deliveries completed
OWID-Westlands	OWID	WWD	15,000 (1)(2)	Yes	Yes	No	No	Deliveries completed
Tulare-Westlands	TLBWS	WWD	1,500 (4)	Yes	Yes	No	No	Deliveries completed
ECCID-Westlands	ECCID	WWD	3,500 (4)	No	No	No	Yes	Deliveries completed
Byron-Bethany	BBID	DWR	5,000	No	Yes	No	No	In negotiation
Western Canal GW Program	WCWD	DWR	3,500	No	No	Yes	No	Deliveries completed
Western Canal Conservation	WCWD	DWR	1,500	No	No	Yes	No	Negtns delayed (1991)
Joint Board Conservation	JWDB	DWR	1,500	No	No	Yes	No	Negtns delayed (1991)
Placer-Westlands	PCWA	WWD	40,500 (1)(2)	Yes	No	No	Yes	Deliveries completed
Browns Valley	BVID	WWD	375 (1)(4)	No	No	No	Yes	Deliveries completed
Yuba-Tudor Mutual	YCWA	TMWC	1,500	Yes	No	No	No	Deliveries completed
Yuba-Feather River	YCWA	FRID	1,500	Yes	No	No	No	Deliveries completed
Placer-San Francisco	PCWA	SF City	15,000 (1)(2)	Yes	Yes	No	No	Deliveries into SWP
SCVWA-Oak Flat Exchange	SCVWA	Oakflat	200	No	Yes	No	No	In negotiation
Thousand Trails	TT	WWD	1,000(1)(2)(4)	No	No	No	Yes	Negotiations complete
Modesto-SF	MID	SF City	9,000	No	Yes	No	No	Deliveries being made

1991 Water transfers as of January 7, 1991

Title of transfer	Source Agency	Destination Agency	Amt of Transfer (AF)	SWRCB Action?	SWP Wheeling?	Oroville Storage?	CVP Wheeling?	Status
BVID-SWP	BVID	DWR	9,000 (2)	No	No	Yes	No	Negtns begin Feb 1991
Byron Bethany-SWP	BBID	DWR	3,000	No	Yes	No	No	Negtns begin Feb 1991
OWID-SWP	OWID	DWR	5,000 (2)	Yes	No	Yes	No	Negtns begin Feb 1991
Western Canal GW Prog	WCWD	DWR	10,000	No	No	Yes	No	Negtns begin Feb 1991
Western Canal Conservation	WCWD	DWR	1,500	No	No	Yes	No	Negtns begin Feb 1991
Joint Board Conservation	JWDB	DWR	1,500	No	No	Yes	No	Negtns begin Feb 1991
Calaveras	CCWD	MVWA	75,000 (2)	Yes	?	No	?	Negtns began Dec 1990
Berryhill-DWR	Berryhill	DWR	15,000 (2)	No	No	Yes	No	Negtns begin Feb 1991

(1) 30 percent allocated to Delta outflow
 (2) Refill impacts
 (3) Actual expected transfer is 119,000 AF
 (4) Transfer negotiated by and for individual farmers

Fish and wildlife impacts

A fourth year of drought created new problems for fish and wildlife and magnified the intensity of ongoing losses. Although drought is nothing new to California, and our native fish, wildlife and plants evolved with these climatic cycles, this current event is probably unprecedented due to population increase and increased industrial and agricultural need.

Recovery of fish and wildlife losses will require considerable time and the assistance of involved agencies within State and federal government and the private sector. Plans to mitigate the impacts of a fifth year of drought are being formulated.

The reduction of wildlife habitat capacity was particularly significant in 1990. In Southern California, broad-leaved plants in chaparral habitat communities have been attacked by a fungus. Loss of these plants may have long-term impacts to wildlife. It will also preclude use of fire as a near-term management tool due to the heavy fuel load. The loss of up to one-third of the coniferous trees in some forested areas due to an infestation of bark beetles will result in direct and indirect wildlife impacts. The direct losses involve dead trees; the secondary impacts are associated with necessary salvage harvesting of those trees by the timber industry.

In desert regions, natural water holes have dried up and artificial watering devices installed by the California Department of Fish and Game (CDFG) were not refilled due to lack of winter rain. The ability of CDFG to haul water to these remote sites has been limited. Whole populations of desert wildlife have been lost. Also, where wildlife are concentrated around available water, increased predation and incidence of disease have caused additional losses. The Carrizo Plain, a Central California area critical to a number of threatened and endangered species, is dry, and important springs have stopped flowing. Natural wetlands, vernal pools in particular, throughout the state have been dry for four years. It is estimated less than 75

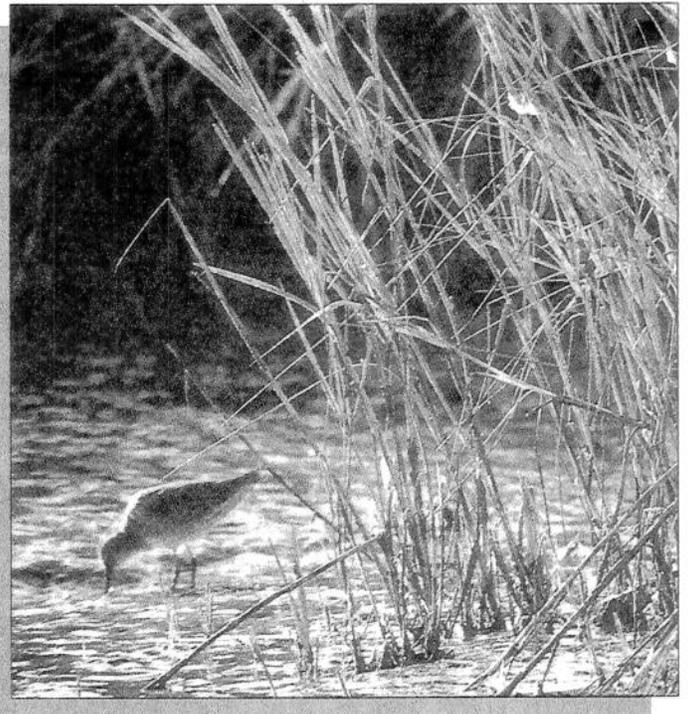


Photo 3. Wetlands and marshes provide food and cover for this dunlin. (Photo by B. "Moose" Peterson/Wildlife Research Photography.)

percent of the Central Valley's managed wetlands were flooded to accommodate autumn flights of migratory wildfowl.

A tidal barrier installed by DWR to protect the Suisun Marsh from excessive salt water intrusion is working, and that critical marsh appears to be protected. The US Bureau of Reclamation (USBR) allocated supplemental water to the State and federal refuges and grasslands on a hardship basis for 1990. This will mitigate problems in the Central Valley, but ground water supplies used for north-state marshes are dangerously low.

Impacts to fish have been most obvious. Many small streams have dried up completely, and many reservoirs are at or below the minimum pool necessary to support healthy fish populations. Many populations of native nongame fish species will require restocking and years of good flows to recover. Trout stocking has been shifted away from roadside streams, which are too warm or low, to larger lakes and reservoirs. Some fish hatcheries were closed due to lack of water and high water temperatures.

Salmon offer the best example of the cumulative effects of the drought. Dependent on a three-year spawning cycle, reduced numbers of adult fish, the progeny of the 1987-1988 start of the drought, are returning to spawning areas diminished by low flows in 1990 and lethal temperatures. A fifth year of drought or even moderate recovery from the drought will intensify this serious problem. Even when abundant rainfall returns, decimated spawning populations will not be able to recover for two or more generations. Spring-run chinook salmon populations are also dangerously low, winter-run salmon have been listed as a threatened species, and other localized populations of anadromous fish may not have spawned successfully in 1990.

Considerable effort and cooperation has been put forth by DWR, USBR, and other water agencies to mitigate these problems over the past four years. Power generation has been foregone at Shasta Dam in order to provide cold water for release to the Sacramento River. Water transfers from Yuba County Water Agency to DWR have been modified to accommodate fishery needs. DWR and USBR have both used operational flexibility to curtail Delta export during critical periods and to provide base-line minimum flows. These efforts have made a big difference in reducing salmon losses. In spite of those efforts, the striped bass index has fallen to its lowest point in recorded history.

Energy impacts

Drought in California reduces hydroelectric energy production, increases electricity requirements, and increases the use of fossil fuels to provide replacement energy.

Hydroelectric power plants make up roughly one-fifth of the electric generating capacity in the state, producing about one-third of the electricity used in a normal year and as much as 40 percent in a wet year. However, from 1987 through 1989, hydroelectric output was less than 20 percent of the state's total production, and in 1988, it accounted for only 17 percent, the lowest production during the 1987 through 1990 period. In 1990, hydroelectric generation was again much less than normal.

Drought is not likely to cause a shortage of electricity, but the cost of electricity does increase when utilities must replace lost hydroelectric generation from other sources. From 1987 through 1989, nuclear, fossil fuel, and out-of-state energy sources replaced most of the lost hydroelectric energy.

Drought effects differ from utility-to-utility, depending upon how much hydroelectric capacity a utility has, regional precipitation patterns, and what alternative energy sources are available. Pacific Gas and Electric Company (PG&E), which has more hydroelectric capacity than any other in-state utility, had 60-to-80 percent of normal hydroelectric output between 1987 and 1989, filling the deficit from out-of-state and natural-gas sources. Southern California Edison had 60-to-75 percent of normal hydroelectric output, but hydroelectricity is a smaller portion of SCE's total energy production so the deficit was less dramatic. DWR's hydroelectric generation the past three years was only 65 percent of normal. In 1990, three units of DWR's largest power plant were shut down due to low reservoir levels at Lake Oroville requiring the purchase of replacement capacity and energy. The Western Area Power Administration, which markets CVP power, estimates the replacement cost of energy lost since 1987 due to the drought to be nearly \$127 million. In addition to the loss of production due to reduced storage, the USBR has lost energy by releasing

water below the generators at Shasta Dam to lower downstream water temperatures for fish protection.

Drought can increase electricity requirements as water agencies and individual water users depend more on transfers or exchanges of imported water and increase ground water pumping. From 1987 through 1989, more electricity was used statewide for municipal water supply, crop production, and irrigation than before the drought, and for the first half of 1990, electricity use for crop production and irrigation was ahead of those years. Municipal water supply accounted for most of the increased use of electricity since crop and irrigation requirements were partially offset by reduced agricultural operations. The SWP, the single largest user of electricity in California, delivered more water and used more electricity each succeeding year for the first three years of the drought. In 1990, even though SWP water deliveries were reduced to agricultural users, energy use was higher due to more water being transported to Southern California, which requires more pumping. Some water agencies also are turning to more energy-intensive water supply sources, such as deeper ground water and desalination.

More fossil fuels are burned during a drought to replace lost hydroelectric generation and to secure additional water supplies. California utilities generally use oil- and natural-gas-fired power plants for replacing hydroelectric generation. Utility fuel consumption would be lower were it not for the drought. Increases in well drilling activities and trucking of water by some water agencies in response to the drought may have increased the consumption of gasoline and diesel fuel. Overall, the increase in fuel used for these activities may not be significant and to some extent is offset by reduced agricultural operations, but it adds to the cost of water for the affected agencies.

WATER SUPPLY PROSPECTS FOR 1991

ave. cost of ground water
 2.0 TBT/acre
 salvage value to FF Vendor = 50% of cost
 0

BB' Value of Salvage of new from FF is \$6.6 B / 100 TBT

$$150 \times 7M - \$100 \times .625 \times 9M = \$790 M$$

$$" \times 6M - " \times 6M = \$555 M$$

1st Entry Feasible Study

LBFF Mck P-8-507-01869

3rd Entry

322-01869

USFS Area to
 7.5 to 7.5 BBT/acre

job at
 San Pedro

job at
 San Pedro

a lot of water

the land, however

Water supply prospects for 1991

Outlook for 1991

Large-scale droughts have multiple causes and cannot be ascribed to any one factor or weather event in an area. Somehow they are linked with worldwide weather patterns in ways not really understood. Looking back in history, dry years and wet years seem to cluster slightly more than would be expected by chance. But no one so far has been able to develop a predictive model for California for next year from these irregular patterns. For a new year, the best we can do is look at the past record and assume that precipitation next water year has an equal chance to be like any of the past years. As the winter season begins, there may be some clues from atmospheric and ocean patterns which are used for 90-day, long-range weather forecasts.

For California, a broadly generalized estimate is that about 75 percent of average run-off will be needed in water year 1991 to meet most of the state's water needs, but would not significantly increase reservoir supplies. There would still be some shortages in problem areas and general lightness in many supplies. At the beginning of the water year, historical odds of this scenario were about 60 percent. The probabilities then of recovery for most reservoir systems was estimated to be about 40 percent (105 percent of average run-off). However, there is a lot of variation because individual streams and reservoirs vary significantly from regional figures due to differing carry-over storage and ratios of storage to average annual run-off. Since October 1, conditions have continued to be dry, which has reduced prospects of reservoir recovery to about 10 percent. The chance of getting adequate run-off to meet 1991 demands has been reduced to about 25 percent.

The statewide outlook is heavily influenced by Sacramento River Basin figures. To the south and in coastal areas, the probabilities of recovery are generally less. Extended droughts tend to be more common in the southern half of California. Some exceptions will be brought out in the following regional discussions.

Besides the areal variations, distribution of run-off within the climatic season is a factor. Since fall 1990 was dry, it is unlikely enough water can be exported from the Delta to meet SWP entitlement delivery requests (which are about 3.5 MAF in 1991, excluding The Metropolitan Water District of Southern California [MWD] Arvin Edison ground water recharge program) because of physical aqueduct and pumping plant limitations.

As mentioned before, the 1991 outlook for adequate surface water supply is mostly determined by just two factors — the amount of water carried over in storage from 1990 and the 1991 run-off. Carry-over storage is known, and the amount of run-off is unknown at this time. However, a useful range of possibilities for planning can be derived from the range of historical annual run-off figures and early-season forecasts.

The following sections relate to specific hydrologic regions in the State, and probabilities referenced are current as of early January 1991. Hydrologic regions are depicted on figures 2 and 3 (pages 4 and 5).

North Coast. The North Coast region has a wide range of climates ranging from lush forests of the northwest to near-desert in the interior. Late May 1990 rains produced significant run-off, so reservoirs on north coast drainages are generally above average. Inland, on the Shasta River, Dwinnell (Shastina) Reservoir is far below average, and on January 1, 1991, the Klamath Project reservoirs were about 55 percent of average storage. The regional picture is dominated by Clair Engle Lake storage, also about 55 percent of average. However, little surface water from Clair Engle Lake is used in the North Coast as most of it is diverted into the Sacramento Basin by the CVP. Restoration of normal water levels at Clair Engle Lake is less than a 10 percent chance as of January 1.

Many local agencies depend on small streams, springs, and shallow ground water wells. There are likely to be localized shortages, if the winter remains dry. Local supplies in the coastal portion of the North Coast, although down now, can be rapidly restored with a couple of major

Photo 4. New Hogan Reservoir, Calaveras County, August 1990. The reservoir is 17 percent of normal. (Photo by Robert Eplett, DWR.)



storms. With reduced carry-over storage in the upper Klamath River, risks of surface shortages in agricultural supplies are higher than usual. On the Russian River, major system supply outlook is good, bolstered by the 132,000 AF of storage at the relatively new Lake Sonoma (Warm Springs) Reservoir.

San Francisco Bay. Surface water provides for about 80 percent of the needs of the San Francisco Bay region, and about 80 percent of the surface water supply is imported, mostly from storage in Sierra reservoirs of the Central Valley basins. January storage within the area is about 20 percent less than last year and comparable to 1977. Storage in the Sierra reservoirs of the East Bay Municipal Utility District (EBMUD) and Hetch Hetchy systems is down about 20 percent from last year, but holds much more than in 1977 and is roughly comparable with 1976. The EBMUD system is better off than the city of San Francisco system. Marin County reservoirs have slipped considerably below 1988 storage levels, but held about three times 1977 amounts on January 1. Santa Clara Valley supplies depend heavily on whether normal SWP and CVP deliveries can be made this year. Solano County, which draws most of its surface water from Lake Berryessa, should have adequate supplies, although its decreasing storage levels are a source of concern for the future.

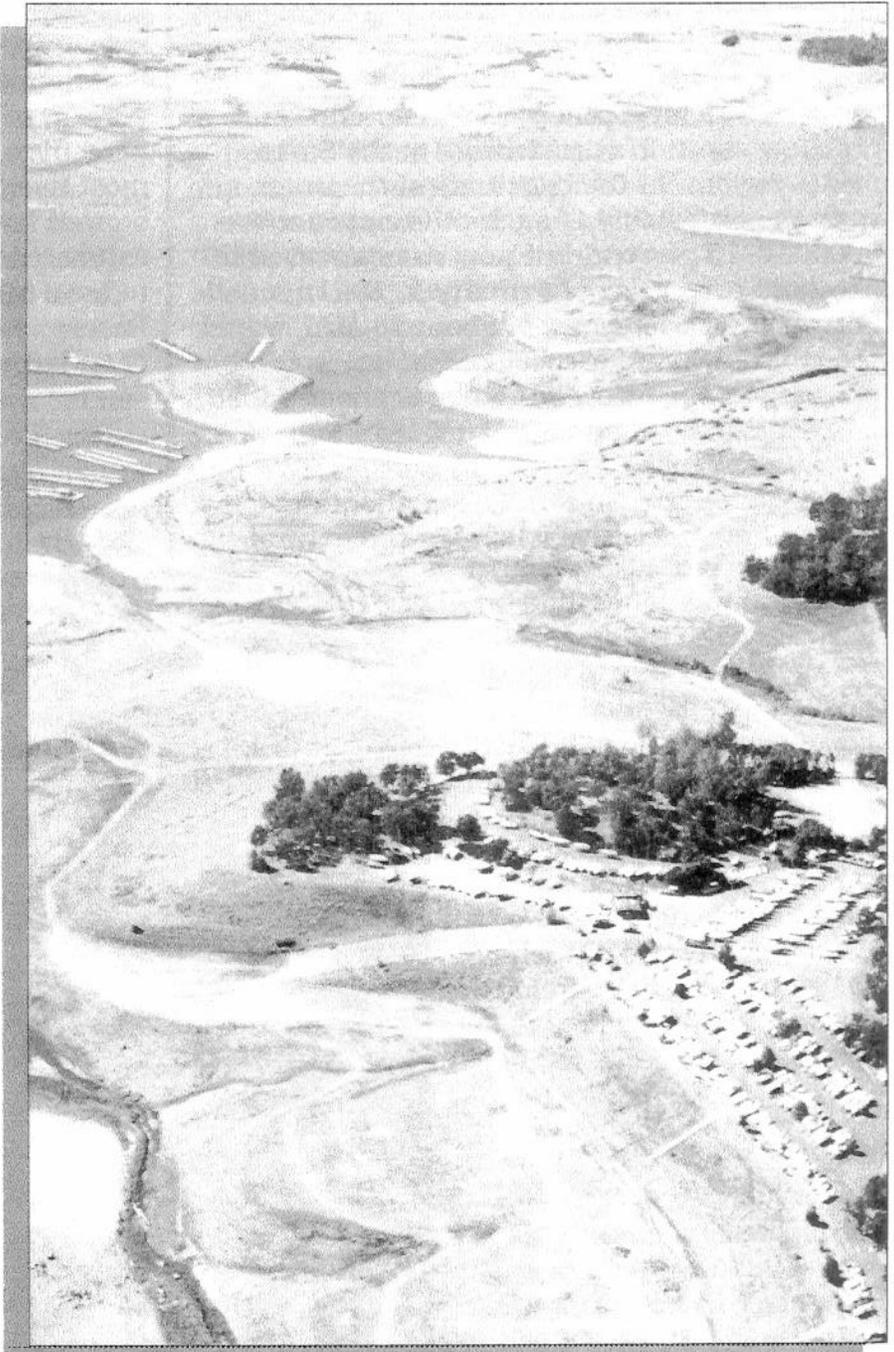


Photo 5. Folsom Reservoir, Placer County, August 1990. Level of the water is at 29 percent of normal. (Photo by Robert Eplett, DWR.)

As of January 1991, there is an estimated 50 percent chance supplies roughly equal to those of 1990 will be available. Dry conditions would mean progressively more cutbacks and rationing. Some estimates indicate rationing could increase to near the 50-percent level.

Sacramento. The Sacramento region has fared quite well so far. The late May rains of 1990 provided enough added run-off so scheduled cuts in Sacramento River water rights diversions were rescinded. No deficiencies in the SWP Feather River service area were applied either. There were curtailments in some CVP project service areas of up to 50 percent. Also, no local

surface water from Cache Creek was served in Yolo County. A decision was made to save the meager amount collected in Indian Valley Reservoir for 1991. A repeat of 1990 run-off would probably result in curtailments in the Sacramento region. At the beginning of the water year, the probability of such re-occurrence was about 10-15 percent, but now has increased to about 50 percent as of January 1, 1991. A Sacramento River Index of about 13 MAF would probably take care of most needs, but would not provide storage recovery. There is about a 25 percent chance of this occurring.

North Lahontan. In the North Lahontan region, Lake Tahoe water level fell below the natural rim of the lake in mid-September 1990 and was more than one foot below the rim in early January 1991 due to continued lake evaporation and use. Recovery of Lake Tahoe to near-normal levels next summer is not likely. It would take nearly an average year to take care of most estimated demands on North Lahontan streams. Much of the actual water use from the major rivers in the area is in Nevada.

San Joaquin. Storage in local reservoirs in the San Joaquin region serving the area is generally comparable with the fall of 1988. A major exception is Lake McClure (Exchequer) on the Merced River, which is holding only about 8 percent of capacity and about 15 percent of average. New Melones Reservoir provided about 1.6 MAF out of storage during the past four years and is now less than 20 percent of capacity. A repeat of 1990 run-off would probably result in reservoir storage at minimum power head of around 300,000 AF of storage at New

Melones. Surface irrigation supplies on the east side of the valley would then be 5-10 percent less than this year. The region needs about 65 percent of average run-off (compared to 40 percent in 1990) to assure adequate supplies for most users. Recovery to near-normal surface storage levels in the region would require an estimated 110 percent of average run-off, judged to have a 10-percent probability. New Melones Reservoir is not likely to refill this year because of its large draw down during the drought.

Photo 6. Lake Shasta, Shasta County, August 1990. Lake level is at 56 percent of normal. (Photo by Robert Eplett, DWR.)



Water supplies for the west side of the region are almost entirely furnished by the CVP. The exchange contract users, whose deliveries are linked to Shasta Reservoir inflow, have a better chance of normal deliveries than do Delta-Mendota Canal project water users. Shasta Lake (Photo 6) inflow in water year 1990 was around 3.6 MAF. As long as 1991 water year inflows exceed that amount, there would be no curtailments in exchange contract deliveries. Historical odds of Shasta Lake inflow being less than 3.6 MAF appear to be about 50 percent as of January 1. Deliveries to the other CVP water users, however, are less sure and depend more heavily on 1991 run-off since CVP storage has been severely depleted over the last four years.

Tulare Lake. The drought in the Tulare Lake region is nearly equal to the previous worst four-year period in 1928-31. It has been estimated 80 percent of average water year run-off would be needed in 1991 to break even on the local surface supplies (which has about a 20 percent chance of occurring). Recovery of normal surface reservoir levels would take an estimated 120 percent of average run-off; odds of that are

very slim. Friant Kern Canal supply potential is roughly comparable to that of the southern Sierra rivers in the Tulare Lake drainage. There is about a 50 percent probability of full "Class I" supplies. "Class I" water is the firm supply amounting to the first 800,000 AF of yield from the San Joaquin River and Millerton Reservoir. "Class II" water develops only after the "Class I" allotment has been fully met. The historical odds of reaching a more normal supply level with 50 percent "Class II" supply appear to be about one in four. On the west side of the valley, imported water supplies from the CVP and SWP account for about 40 percent of the average water supply for the region. Irrigation users on both projects were cut 50 percent in 1990.

Prospects for 1991 depend on supplies available to both projects. A repeat of 1990 would mean bigger cuts, probably with only one-third of contractual agricultural deliveries for SWP users and perhaps even less for CVP contractors. Because of export pumping limits, it

Photo 7. Lake Isabella, Kern County, September 1990. Water level is at 29 percent of normal. (Photo by Robert Eplett, DWR.)



will be difficult for SWP to refill San Luis Reservoir in 1991. With dry conditions through December, there may not be enough pumping and conveyance space later in the season to provide for all the preliminary 1991 SWP contractor requests even if the spring is wet.

Central Coast. Ground water is the primary water supply in the Central Coast region, accounting for about 90 percent of supply. Much of the ground water is recharged naturally, but natural recharge has been augmented by surface reservoirs that store storm run-off and release it more gradually for recharge in the natural channels and basins. With the exception of some small coastal water systems, most water supply systems have large carry-over capacity and can weather a drought of two-to-three years with little difficulty. The 1987 through 1990 drought, however, is the worst four-year period of record for this region with serious depletion of surface and ground water reservoirs (see Photo 8, Lake Lopez). The sea water-fresh water interface at some locations

along the coast has moved farther inland as a result of increased ground water extraction during the drought. At other locations, the effect of such increased ground water extraction is unclear.

Farther south, the outlook is gloomier. In Santa Barbara County, above median conditions would be required to ease the drought. Odds of returning Cachuma Reservoir (Photo 9) to normal levels are probably about 10 percent.

South Coast. Water requirements in the South Coast region outstripped local supplies long ago. About two-thirds of its water is imported from the Colorado River Aqueduct, SWP, and the Los Angeles Aqueduct from the eastern Sierra. Some recent reductions in historical diversions from the eastern Sierra have required Los Angeles to rely more on MWD for more of its water supplies, which in turn depends more on the availability of Colorado River and Northern California water.



Photo 8. Lake Lopez on the Arroyo Grande Creek in San Luis Obispo County, September 1990. (Photo by Robert Eplett, DWR.)

The lower Colorado River Basin allocation is 7.5 MAF — 4.4 MAF to California, 0.3 MAF to Nevada, and 2.8 MAF to Arizona. In addition, Mexico receives 1.5 MAF. For many years, California diversions were 5.0 MAF or slightly more because Arizona use was far under its allocation. Now that the Central Arizona Project is in operation, Arizona is expected to use its full entitlement within a few years, which will cause corresponding reductions in MWD Colorado River Aqueduct diversion at Lake Havasu. It looks like MWD 1991 Colorado River diversions may be limited to between 0.9 MAF and 1.0 MAF, compared to around 1.2 MAF in recent years. Efforts are underway to try to maintain diversions at 1.2 MAF for one more year in 1991 due to the severity of the California drought. Storage in the lower four interstate Colorado River reservoirs (Powell, Mead, Mohave, and Havasu) is slightly less than 38 MAF, down nearly 5 MAF from last year, but near the historical average. Run-off on the Colorado River has also been poor; the last three years were the lowest three-year sequence on record.

The shortfall in Colorado and eastern Sierra supplies will most likely fall on the SWP as additional demands by MWD. SWP capabilities are beginning to be limited by pumping, aqueduct constraints, and existing project yield. There is a high probability SWP will not be able to meet all entitlement requests for water in 1991, but under terms of its contracts, agriculture would again be curtailed first, up to 50 percent, as in 1990. Preliminary studies indicate full municipal and industrial (M&I) deliveries can be made if the Sacramento River Index exceeds about 12 MAF. The probability of this occurring is estimated to be about 25 percent. A repeat of 1990 run-off in 1991 would probably mean M&I deficiencies in the 15-25 percent range and corresponding agricultural deficiencies of 65-75 percent.

South Lahontan. The east slope of the southern Sierra Nevada Mountains in the South Lahontan region is a major source of water for the city of Los Angeles. The total historical yield of the aqueduct system has been about 480,000

Photo 9. Lake Cachuma, Santa Barbara County, September 1990. Level of the water is at 22 percent of normal. (Photo by Robert Eplett, DWR.)



AF per year, including about 100,000 AF from Mono Lake Basin. Mono Lake watershed exports have been curtailed by the court; none are expected to be permitted next year. With limits also on Owens Valley pumping, the Los Angeles eastern Sierra supplies in 1990 are likely to be only about one-fourth of historical yields. As a result, the major share of the Los Angeles supply is being taken from MWD. Lake Crowley, which was about 100,000 AF under its capacity in September, is not likely to fill in 1991 unless 1991 is wet. A normal year could, however, provide Los Angeles with nearly half of its historical supply.

Colorado River. In the hot, dry Colorado River region, the Colorado River will provide for 96 percent of water needs in the region, with the balance coming mostly from ground water and the SWP. No shortages are expected. Colorado River interstate storage is still near the historical average although down nearly 5 MAF from last year. California should get at least a 4.4 MAF allocation. Since the large desert agency users have priority, their diversions (up to 3.85 MAF) are assured.

State Water Project (SWP)

DWR uses a *Water Delivery Risk Analysis (WDRA)* procedure to determine the amount of SWP deliveries approved each calendar year. The *WDRA* procedure was developed over a number of years through extensive hydrologic probability analysis and discussions with SWP water contractors. It is a procedure defining the relationship between forecasted water supply at a certain level of probability for the current water year, current carry-over storage, target end-of-year carry-over storage, and total SWP delivery capability for the calendar year. The *WDRA* objective is to ensure sufficient carry-over storage will be maintained to meet next year's water-quality protection requirements in the Delta and to supply at least an emergency level of water deliveries the following year, without the need for extraordinary measures. Water delivery estimates for the current year are made using one-half of the active storage at Oroville and San Luis reservoirs and, estimates for subsequent years use the remaining half.

Use of the *WDRA* has enabled SWP to meet full contractual obligations during 1987, 1988, and 1989, even though these were the sixth driest consecutive three years since 1906. Fifty-percent reductions to agricultural deliveries were imposed in 1990, the fourth year of the fourth driest consecutive four-year period since 1906. If conditions continue to be dry, temporary facilities in the Delta may be installed to save water and improve water quality and circulation conditions, as was done in 1976 and 1977.

Operation of the SWP for 1991 has been analyzed under varied water supply conditions. That analysis is summarized in Table 4. The initial delivery commitment for 1991 by the SWP indicates agricultural deliveries will be curtailed by 65 percent and municipal and industrial deliveries will be curtailed by 15 percent. Each month, water supply conditions will be reviewed, and delivery commitments will be updated.

At this time, the *SWP Contingency Plan for 1991* consists of the following phased evaluations and decisions:

Flag Date	Action
Dec 1990	Established 1991 WDRAs and made initial delivery commitments
Jan 15, 1991	First monthly update of water supply and deliveries, using 99 percent probability of exceedance
February 15	Second monthly update of water supply and deliveries, using 99 percent probability of exceedance
March 15	Third monthly update of water supply and deliveries, using 99 percent probability of exceedance
April 15	Fourth monthly update of water supply and deliveries, using 99 percent probability of exceedance
May 15	Final monthly update of water supply and deliveries, using 99 percent probability of exceedance

Table 4
Summary of operational alternatives

State Water Project
(In MAF)

Hydrology January Estimates	Sacramento River Basin Index	Projected Deliveries	Projected Carry-Over Storage
Only 1 chance in 100 it will be this dry	4.8	Very large municipal reductions; amount depends on special drought measure implementation	0.3
9 chances out of 10 it will be wetter	5.6	Large agricultural & M&I reductions	1.1
3 chances out of 4 it will be wetter	6.7	Large agricultural & M&I reductions	1.1
50/50 chance of this	9.3	65% agricultural reductions & 15% M&I reductions	1.1*

**Minimum carry-over prior to approval of full deliveries. Supply in excess of demands will increase carry-over.*

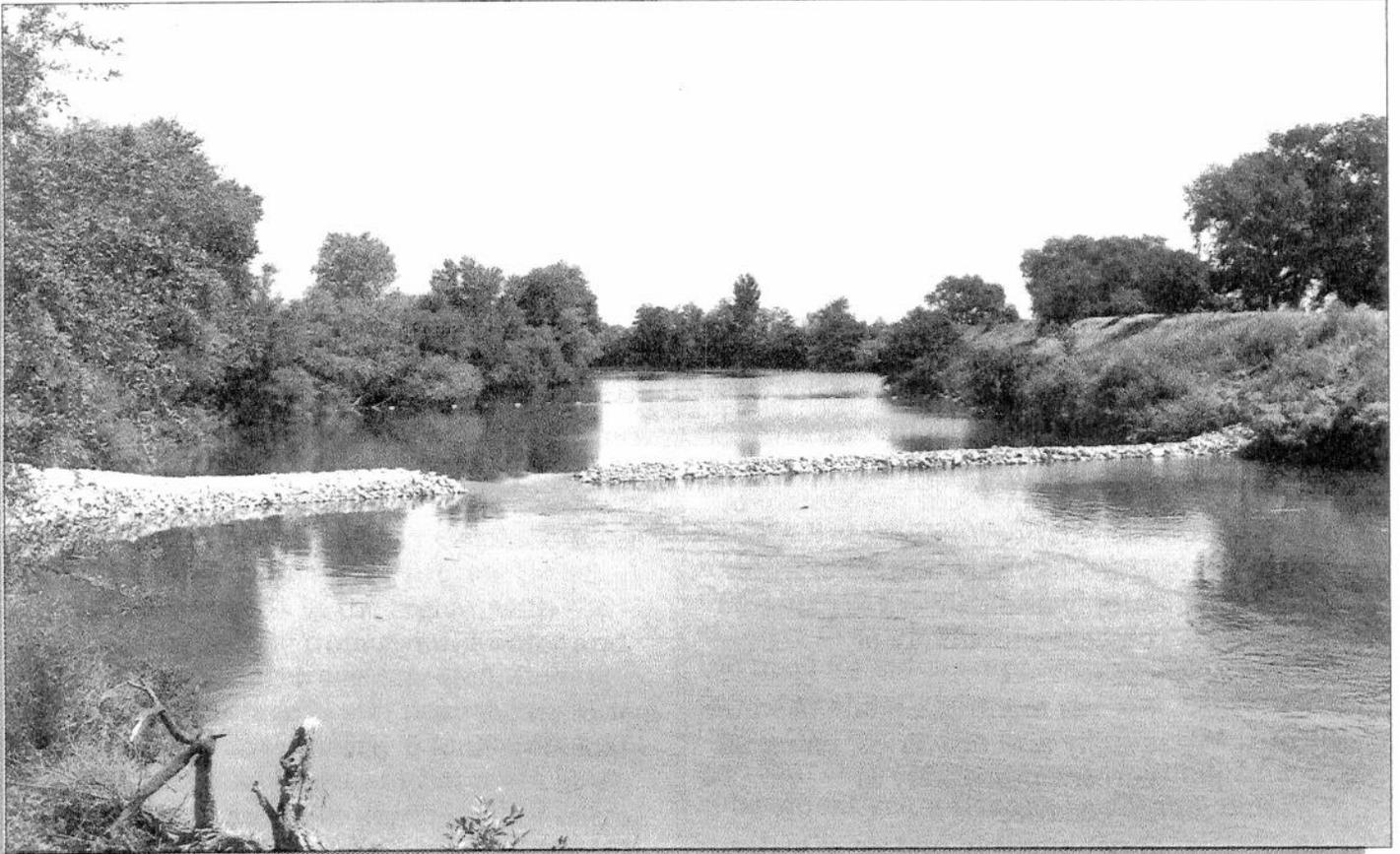


Photo 10. Sutter Slough rock barrier, placed in 1977 to improve water quality and conserve water. (DWR photo.)

Possible Delta drought facilities

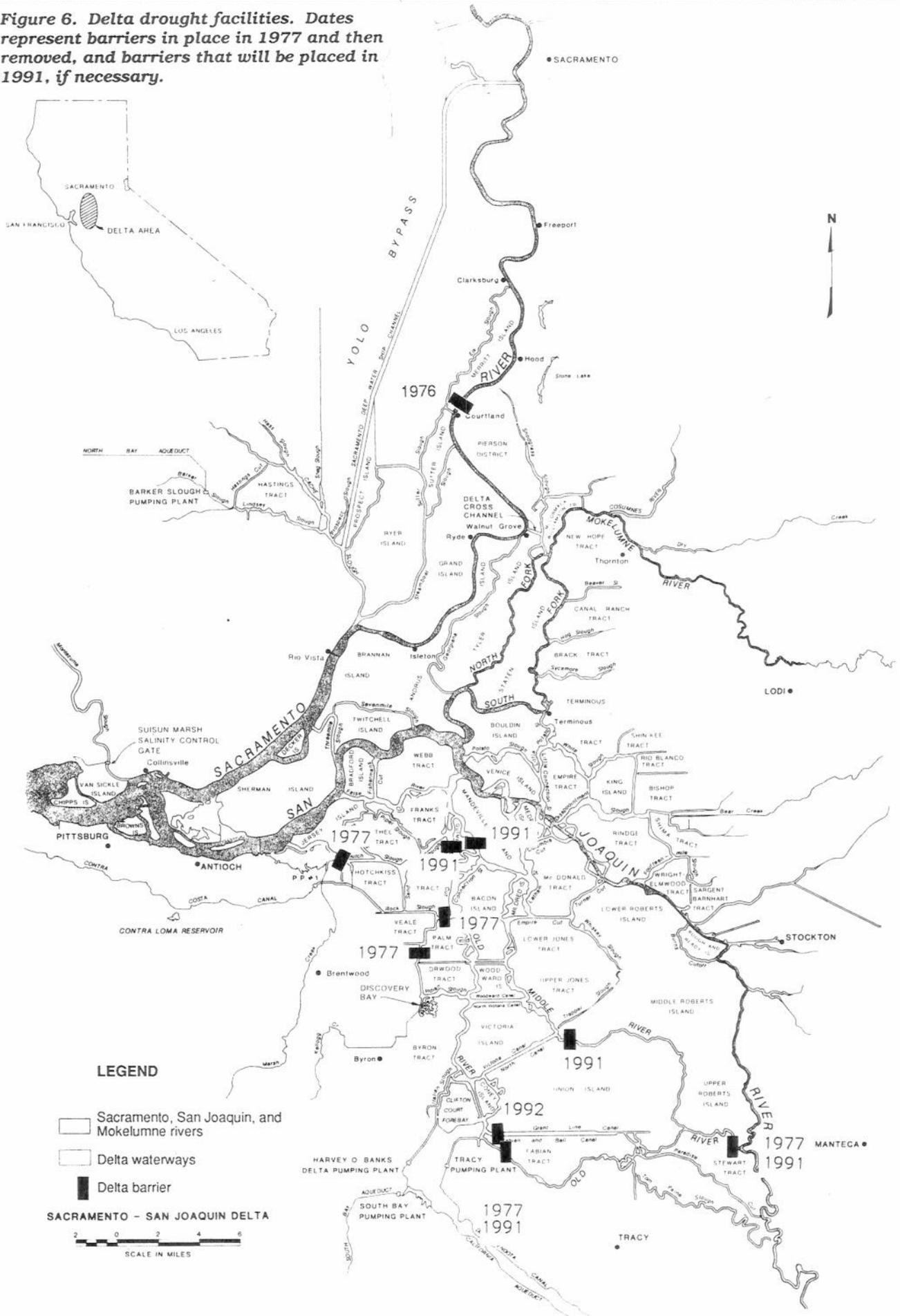
If conditions continue to be dry, temporary facilities could be built in the Delta that could save water and improve water quality and water circulation conditions, as was done in 1976 and 1977 (see Figure 6). The facilities described below will help to make the most use of Delta inflows by altering existing flow patterns and points of diversion to make Delta fresh-water barriers more efficient.

Sherman Island overland supply. The farmers on Sherman Island get water from various locations on the perimeter of the island. In general, the water-quality standards in the west Delta protect quality at all locations. The project purpose is to provide Sherman Island with a water supply from an intake on the eastern end of the island where water quality will still be adequate. Temporary facilities were constructed in 1977 and late 1988. If the drought continues in 1991, temporary facilities can again be constructed.

Rock barriers at Quimby Island. This facility would consist of two barriers: one in the channel between Quimby Island and Holland Tract and one in the channel between Quimby Island and Mandeville Island. The barriers would block ocean salts from moving into the Contra Costa Canal intake channel at Rock Slough and into other South Delta channels. This facility's purpose is the same as that of facilities in the Rock Slough area constructed in 1977; however, placing barriers at the Quimby Island locations should prove to be more effective. The amount of water conserved by these barriers would depend on time of installation and whether they are operating under existing Delta water-quality standards or possible water-quality standards relaxed due to drought conditions.

Rock barriers in the South Delta. Four barriers placed at several locations in the South Delta would be designed to improve water quality, water levels, and circulation. Three barriers may be installed in 1991.

Figure 6. Delta drought facilities. Dates represent barriers in place in 1977 and then removed, and barriers that will be placed in 1991, if necessary.



- ▼ The Middle River barrier has been placed during the last four years during irrigation season and then partially removed during winter. It has successfully improved water levels in the stretch of Middle River upstream from the junction of Old River to where the barrier is located.
- ▼ DWR is working on *California Environmental Quality Act* documents, specifically an *Initial Study/Negative Declaration* and various permits to install three other barriers in 1991 or later years:
 - ▼ A barrier in Old River near the San Joaquin River. This barrier has been installed for many years during fall to help upstream salmon migration on the San Joaquin River. The *Initial Study/Negative Declaration* proposes also to install this barrier in spring 1991 and later years for fishery purposes.
 - ▼ A barrier in Old River near the Delta-Mendota Canal intake. The *Initial/Negative Declaration* proposes to install this barrier in spring 1991 and later years to improve conditions in Old River south of Grant Line Canal. A similar barrier was installed in 1977.
 - ▼ A barrier near the western end of Grant Line Canal. The *Initial Study/Negative Declaration* proposes to install this barrier in spring 1992 and later years to improve conditions in Grant Line Canal.

Each barrier will be monitored and evaluated after installation to determine effectiveness in improving conditions in the South Delta.

Central Valley Project (CVP)

Operations alternatives for the CVP in 1991 are being developed for a range of possible water supplies. CVP reservoir storage at the end of the 1990 water year was just under 4.0 MAF, the lowest since 1977. (The desirable level of carry-over storage for the CVP is 8.0 MAF.)

Although carry-over storage in CVP reservoirs benefited from productive, winter-like storms of late May 1990, water supply availability for project customers will be mostly dependent on run-off in 1991, rather than water already in storage. Normal or wetter conditions will be required in order for CVP to meet full delivery requirements in the coming year. Most of the long-term water service contractors of CVP were subject to 50 percent shortages in their water supplies during the contract year March 1, 1990, to February 28, 1991.

Early analysis of a range of different water supply scenarios will assess CVP capabilities in the coming year and will identify possible operations concerns. However, no decision on next year's water deliveries is likely to be made until February 1991.

Beginning February 1991, water supply forecasts will be used to conduct CVP operations analyses to determine the availability of water for project customers, with consideration for carry-over storage needs for future years. These determinations will be updated in March, April, May, or even later as CVP water supply and other project commitments such as fishery releases, salinity control, and temperature control become better defined by the prevailing hydrologic year type.

Water customers in the CVP Friant Division have had deficiencies in "Class I" water supplies for four consecutive years. The period 1987 through 1990 has been the driest in this century with respect to run-off in the upper San Joaquin River above Friant Dam. The Friant Division has no significant carry-over storage, and, therefore, is entirely dependent on next year's run-off for water availability. In addition, the four consecutive dry years have increased pumping heads and reduced the availability of ground water, which has been used in lieu of surface supplies to mitigate shortages.

The memorandum presented at the right from CVP water association manager, Jason Peltier, to the membership summarizes some possible scenarios.

DATE: August 10, 1990

SUBJECT: WATER SUPPLY OUTLOOK FOR THE 1991 WATER YEAR

CVPWA members and their customers will soon begin making decisions for the 1991 crop year, many of which are directly dependent on the amount of surface water available from the CVP during the 1991 water year. This memo is intended to provide a basic understanding of the determining factors of next year's water supply and is not a scientific forecast.

This memo focuses on Sacramento Basin and Delta export districts. The deficiency percentages below are for a "standard" contract. Your conditions may be different.

Although the final 1991 water supply for CVPWA members from the Bureau of Reclamation is dependent on a number of factors, historical run-off probability (see table below) and forecasted carry-over storage (in the northern CVP reservoirs) implies a 50-percent chance of a full contract supply and a 15-percent chance of 25 percent or less. In any event, it is likely that the Bureau will declare something less than a 100-percent supply in its declaration on February 1, 1991, due to the anticipated low carry-over storage. Remember, on February 1, we are only 50 percent through the precipitation season.

Based on forecasted carry-over and historical run-off records, the Bureau has indicated that the following water supplies might be available under various water year classifications. You will note in this table that the year type categories change in the year after a critical year. The probability of any given water year classification should be considered independently and is not a cumulative probability.

For all practical purposes, the water supply will depend on two factors: carry-over storage available at the beginning of next year and the amount of run-off into CVP reservoirs such as Shasta, Trinity, Clair Engle, Folsom, and New Melones.

Additionally, the distribution of rainfall and run-off influences water supply. For example, a very dry year on the Sacramento River might result in shortages to the Sacramento River water rights entities or a wet year in the American River might result in just a lot of excess flow to the ocean because Folsom Reservoir will fill and spill in even a normal year (and this year because of dam safety work, extra space will be held vacant).

Because of last May's higher-than-expected rainfall and water-use patterns in June, projected September 30 carry-over storage was increased from 2.9 MAF to 3.5 MAF (compared to 5.1 MAF this last water year). However, this is still not sufficient to guarantee even a 25-percent water supply if next year is another critically dry year, such as 1990.

The amount of run-off the project will receive from precipitation next fall and winter is at best conjecture at this time because of the unpredictability of Pacific winter storm tracks and the dry condition of the watershed after the four-year drought.

Table 5
Sacramento River Index probabilities

Year Type Category	AF Inflow (MAF)	Year After Critical Year	Historic Probability of Occurrence	Water Supply Range
Critical	<10.2	Critical	15%	0-25%
Dry	10.2-12.5	Dry	15%	25-50%
Below Normal	12.5-15.7	Above Normal	20%	50-75%
Above Normal	15.7-19.6	Wet	30%	75-100%
Wet	19.6-22.5			
Wet	>22.5			

Local drought assistance needs

The needs of local water agencies for State assistance in resolving drought-related water supply problems have been evaluated by DWR and the Department of Health Services. Identified needs for drought assistance by local agencies generally can be grouped into four categories: (i) financial; (ii) water transfer/import capabilities; (iii) technical information; and (iv) regulatory/legislative needs.

Financial needs. In general, it was found the size of the agency was a significant factor in its need for financial assistance. Smaller agencies typically have more limited resources and more need for financial assistance than larger agencies. At the time of the survey (summer 1990), the greatest need was by agencies in Central California, but as the drought progresses, the need will likely spread to other areas.

The financial assistance needed by local agencies could be provided through loans, grants, tax credits, or other emergency relief mechanisms available through the State or federal government. The financial assistance would primarily be used to augment water supply, although some agencies also identified a need for funding to implement conservation programs and for environmental mitigation. Funds for water supply augmentation would be used for well drilling and rehabilitation, ground water recharge, purchases, reclamation, delivery system upgrades, and other supply improvements.

The estimated average cost per district for needed drought related assistance was \$100,000 to \$200,000. The Department of Health Services projected the need for 1991 drought relief pertaining to health and public safety in 875 districts could exceed \$50 million.

Water transfer needs. Local agencies have asked for State assistance to facilitate water transfers, identifying a need for greater cooperation and timely approval of water transfers. Agencies requested DWR to continue taking an active role in water purchases from entities throughout the state, as well as financial assistance being made available to enable local agencies to purchase needed water.

Information needs. Information and technical assistance is needed by many agencies to help make timely decisions on options for short-term emergency supply augmentation and conservation programs. Specific requests for technical information covered topics that included use of reclaimed water, cloud seeding, desalting of sea water, existing conservation ordinances, and the availability of financial or other drought-relief measures. In addition, a need for timely information on statewide water supply conditions was identified, particularly with respect to federal water.

Legislative/regulatory needs. Several agencies have requested some form of drought-relief legislation at either the State or federal level. It has been suggested by some local agencies a drought emergency should be declared for the entire state. The most frequently requested legislative drought relief action was financial assistance. Requests have also been made for an expedited *California Environmental Quality Act (CEQA)* process to allow prompt temporary use of supplemental water supplies.

Local agencies want maximum cooperation from State agencies (DWR, SWRCB, and DOHS, in particular) in expediting necessary drought-relief efforts at the local level.

Weather modification

Weather modification, commonly known as cloud seeding, has been widely practiced in California for many years. During the past decade, about 10-to-12 weather modification projects have operated in the State, with activity typically increasing in dry years and decreasing during wet years. In spring 1990, fifteen cloud seeding projects operated.

The best opportunities for seeding clouds occur in mountainous areas and in the northern part of California due to the combination of topography, meteorological conditions, and the number of seedable opportunities. The cost of the water, however, is higher in Southern California than elsewhere in the state, so some Southern California areas currently are covered by cloud seeding programs. Table 6 shows 1989-90 cloud seeding projects in California.

Weather modification projects are operated to increase water supply and/or hydroelectric power. Although precise evaluations of the amount of water produced by cloud seeding are difficult and expensive to conduct, estimates range from highs of about 15 percent increase in annual run-off to lows of 2-to-5 percent.

If 1991 is dry, the number of projects operating is expected to remain high. There are two additional areas in Northern California with potential for seeding. These are the northern rim of the upper Sacramento Valley, including the Shasta Lake area and the Trinity River Watershed above Trinity Dam. Since the USBR and the Western Area Power Administration would be the major beneficiaries of seeding efforts in these areas, they would be the likely sponsors of any possible projects in those areas. The SWP is continuing efforts to begin mountain-top cloud seeding in the Upper Feather River Basin.

Table 6
Weather modification projects
operating in California during 1989-90

Project	River Basin	Purpose	Sponsor
Almanor	Feather	Power	PG&E
Upper American	American	Power	SMUD
Tahoe-Truckee	Truckee	Water	Desert Research Institute of Nevada
Upper Mokelumne	Mokelumne	Power	PG&E
Calaveras	Calaveras	Water	Stockton East Water Dist
Carson-Walker	Carson-Walker	Water	Desert Research Institute of Nevada
Upper San Joaquin	San Joaquin	Power	SCE
Kings	Kings	Water Power	Kings River Conservation District
Kaweah	Kaweah	Water	Kaweah Delta Water Conservation District
Kern	Kern	Water	No Kern Water Storage District
Eastern Sierra	Mono-Owens	Water Power	LA Dept of Water & Power
Santa Barbara	Sta Barbara Co	Water	SB Co Flood Control & Water Conservation District
San Diego	Mid-San Diego	Water	City of San Diego
Yolo	Clear Lake- Indian Vly	Water	Yolo Co Flood Control & Water Conservation District
Monterey	Monterey Co	Water	Monterey County Water Resources Agency

In July 1990, the Los Angeles County Board of Supervisors directed the Los Angeles County Department of Public Works to investigate the feasibility of cloud seeding and report the results to the Board. If feasible and implemented, this may be an additional source of a small increase in Southern California water supply in 1991.

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STATE GOVERNMENT OPTIONS FOR 1991

State government options for 1991

Department of Water Resources (DWR)

DWR has an active program for drought, conservation, and water recycling assistance. The Department operates the Drought Center to keep apprised of current conditions, assist agencies to cope with drought, develop contingency plans for the possibility of continued drought, and inform the public through the media of current and possible future water supply conditions. This public information effort will be coordinated with local water suppliers in the context of *Water Awareness Month*, May 1991. Another mechanism for managing the drought is the Interagency Drought Task Force. This State-federal-local group provides a forum for discussing impacts of the drought, sharing methods used by various agencies to mitigate effects of water shortages, and to develop contingency options for the future.

In the areas of water conservation and water recycling, technical assistance and training are provided to urban water suppliers in landscape water conservation, industrial conservation, water management planning, distribution system water audits and leak detection, plumbing retrofit, and water recycling. Agricultural water suppliers are provided assistance in irrigation evaluations, irrigation scheduling, water management planning, flexible water deliveries, and drainage reduction.

In addition to operating the State Water Project, DWR assists local water agencies and environmental resource managers in meeting their water needs. The Department reviews options, including increasing conservation and recycling assistance, facilitating transfers, drilling wells to supplement surface water supplies, and administering emergency relief programs.

If the drought continues into 1991, all of the conservation and water recycling programs can be expanded to provide additional assistance, more technical assistance seminars and training classes can be scheduled, and more on-site water audits and leak detection audits can be performed. DWR is already using all available conservation staff and funding on

long-term and drought-related help. Expansion of these services would require additional funding and staffing.

Water transfers. In a fifth year of drought, there would be many more areas experiencing shortages. The Department can serve as a clearinghouse of information on the availability and critical need for additional water. This can include water needed for consumptive purposes as well as water needed for environmental resources. There are several ways DWR can facilitate water transfers.

Through coordination with CVP and other aqueduct systems, the SWP has the potential to move water to many areas of the state. This can include SWP and non-SWP water, depending on availability of capacity in the California Aqueduct. Even for areas outside the reach of the SWP, DWR can facilitate exchanges. This assistance can be in the form of bringing parties together, identifying opportunities, and negotiating agreements.

The Department can work out the necessary institutional arrangements for transferring supplemental supplies. It can also use existing facilities and supplemental funding to develop additional supplies. Such funding could require legislative action. If the drought becomes even more serious, the legislature could be requested to provide emergency funding to relieve critical water shortages, particularly for sanitary purposes. The Department could administer this program using expertise developed in response to other water-related emergencies.

The Department will monitor California's water supply situation and make appropriate recommendations to the administration and legislature.

Photo 11. Lake Shasta in Shasta County as it looked in August 1990. (Photo by Robert Eplett, DWR.)



State Water Resources Control Board (SWRCB)

SWRCB has conducted a number of drought-related activities during 1990 and has proposed a number of actions that would be taken in 1991 should California experience another drought year. The State board is responsible for the issuance and enforcement of water rights. The board's primary objective during a drought is to assure the available water supply is used in accordance with established rights. Currently, there are approximately 13,000 permits and licenses throughout the state. The following "Dry Year Program" of 1990 was conducted primarily by the SWRCB Division of Water Rights.

Letters of notification. In March 1990, when it became apparent it was going to be a dry year, the SWRCB Division of Water Rights began sending a series of notification letters to water right holders:

- ▼ Notices of curtailment of water use were sent to 88 water right permit or license holders on the San Joaquin River;
- ▼ Approximately 11,000 letters were sent to water right holders throughout California advising them of the drought, possible water cutbacks, and possible compliance inspections, as well as encouraging conservation and compliance with permits and licenses; and
- ▼ Approximately 3,600 letters were sent to all appropriate water right holders in the Sacramento-San Joaquin watershed and Delta channels with notification of curtailment of water use from July 1 through August 31.

Compliance inspection program. Division staff were reassigned to conduct drought-related inspections. The majority of the inspections were done in Colusa Basin Drain, Sutter Bypass/Butte Slough, Mokelumne River, and French Camp Slough/Lone Tree Creek. These areas were selected because they are water deficient, and violations were found during previous dry-year compliance inspections. Ap-

proximately 220 dry-year compliance inspections were conducted between July and September 1990.

Enforcement actions. The State board proposes to take appropriate enforcement action against illegal diverters in accordance with Water Code Section 1052(b):

"Civil liability may be administratively imposed by the board pursuant to Section 1055 for a trespass as defined in this section in an amount not to exceed five hundred dollars (\$500) for each day in which the trespass occurs. Administrative civil liability may be imposed only during years declared to be critical by DWR."

At present, SWRCB staff proposes taking administrative civil liabilities against 19 illegal diverters. Under the Section 1052 process, a hearing is held unless waived by the alleged illegal diverter.

Coordination. A drought information item was included on the State Board Workshop agenda on May 2, 1990, where other agencies were offered the opportunity to describe their drought activities. The division also participates in the activities of the Interagency Drought Task Force.

Other activities. SWRCB was involved in numerous other activities resulting directly from current drought conditions. These included:

Water transfers. The board took action on several water transfers, including major transfers on the Yuba and Feather rivers.

- ▼ *East Walker River.* A water rights hearing was held to address issues relating to potential impacts to fishery resources.
- ▼ *Mokelumne River.* SWRCB staff conducted an investigation relating to water quality and quantity issues as they affect fishery resources.
- ▼ *Lake Shasta.* A hearing was held and special releases were required to maintain temperatures to adequately protect the salmon fishery resource.

- ▼ *American River.* State board workshops were held to discuss emergency measures that could be taken to protect fishery resources.
- ▼ *Putah Creek.* Staff conducted an investigation of water rights and low-flow conditions in Putah Creek.

Planning for drought in 1991. SWRCB will continue with activities similar to those described above should 1991 be another drought year. However, State board staff will initiate the program earlier in the year and devote more resources to the program to provide more on-site inspections. Continuation of the drought will increase work load in several other water right programs, including complaints, temporary transfers, hearings, and actions to protect fishery resources.

Division staff is preparing a report to the board identifying other actions that could be taken if the drought continues. Those actions would include a substantial reduction of effort on nondrought-related routine work.

Department of Fish and Game (CDFG)

Most certainly a fifth year of critically low precipitation and run-off will compound existing problems and bring new ones. In October 1990, the California Department of Fish and Game (CDFG) and federal fisheries agencies met with a number of water agencies to begin developing plans for 1991. Operations for minimum flows and temperature control were discussed, and contingency plans are being prepared. Early in 1991, CDFG staff will evaluate conditions, and if necessary, will put into action its drought contingency efforts. These will include modification of harvest regulations for sport and commercial species where appropriate, emergency ground water pumping where possible, modified planting schedules, hauling of water to remote locations, and re-use of fish salvage operations developed in 1990. The purchase and transfer of water supplies will continue to be an option and will be used where practical.

In preparation for the continuing drought, CDFG will seek modification of existing instream flow requirements. If fish and wildlife are to be sustained at levels above a critical threshold during droughts, water must be allocated in a balanced manner during times of shortage.

The department also will pursue alternative water supplies. Water conservation, re-use, and the use of waste water for wildlife might reduce the severity of the continuing drought. Ground water is a source currently under-used for fish and wildlife management. New well fields and energy to operate them should be developed. Hatchery facilities will have to be modified to ensure adequate supplies of cool water to be productively used in the future.

Department of Forestry (CDF)

If the drought continues into 1991, the California Department of Forestry (CDF) anticipates a budget increase of \$10 million will be needed to meet the added threat of fire.

Likewise, a continued drought will probably expand the tree kill in California forests. Not only are living trees stressed more as the drought continues, thereby becoming more vulnerable to insect attack, but the damage does not become fully apparent until one or two years following attack. Hence, even an end to the drought will not immediately end the mounting toll of dead trees.

Department of Health Services (DOHS)

The Department of Health Services regulates all public water systems serving drinking water to 15 or more service connections. Local health departments enforce the department's regulations for water systems having 15-200 service connections. DOHS carries out its responsibilities through the adoption of drinking water standards and regulations, the issuance of domestic water supply permits, and a program of surveillance and enforcement. DOHS also enforces the *Federal Safe Drinking Water Act* through a delegation agreement with the Environmental Protection Agency.

In addition, DOHS establishes standards and criteria for waste water reclamation implemented by the regional water quality control boards. These requirements are spelled out in



Photo 12. Trees in California are stressed due to drought conditions and become more susceptible to insect, disease, and fire damage. (Photo by Jesse Rios, CDF.)

Title 22 of the *California Code of Regulations* and may vary, depending on the type of re-use.

Both DOHS regulations and permits contain requirements regarding adequate quantities and pressures to be maintained by public water systems. If DOHS determines adequate quantities of water are not available to prevent water outages or to meet consumer demands, the agency is empowered to impose a moratorium on new-service connections. These requirements and regulatory actions generally apply to normal water system operations. Situations involving unforeseen emergency drought conditions are usually dealt with on a case-by-case basis with considerably more flexibility.

During periods of emergency drought situations, DOHS has the flexibility to approve the use of alternative sources of water on a temporary basis. Sources of water of marginal quality can sometimes be used with approval of the department, depending on the situation. Where there are no alternatives, sources that may not meet drinking water standards may be approved by DOHS during the emergency. In such cases, the department may impose temporary requirements, such as emergency disinfection or consumer notification.

Legislative mandate

DWR has been operating a State Drought Center and has taken actions to minimize the impact of drought in California under the guidance set forth in Senate Bill 32 approved by the governor on September 16, 1988, and subsequently made Chapter 957 of the *California Water Code*.

The Assembly of the California legislature adopted Assembly Concurrent Resolution No. 180 on August 9, 1990. It requests DWR to submit a report to the legislature by March 15, 1991, containing specified information regarding the availability of water for 1991. SB 32 and ACR 180 are reproduced in the back of this report.

The legislature did not adopt any measures of financial assistance specifically for the drought in 1990, nor did Congress re-authorize the *Reclamation States Drought Assistance Act of 1988*, which was in force until December 31, 1990. Some federal farm programs exist which mitigate losses caused by drought, and some State programs can assist in water conservation programs extending beyond the drought. Proposition 148 on the November 6, 1990, ballot included \$20 million for drought assistance to public agencies. But that proposition failed to pass.

WATER SUPPLIER OPTIONS FOR 1991

Water supplier options for 1991

DWR conducted a survey of California water agencies to determine what water agencies are doing to prepare for 1991, should it be dry. Most of the major water agencies and others with unique or extreme problems were contacted. Each agency responded to five questions regarding their major supply sources, alternative supplies, conservation goals, need for assistance, and other drought issues. The following are their responses to the survey questions.

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**State Water Project (SWP)
Department of Water Resources
1416 Ninth Street
P.O. Box 942836
Sacramento, CA 94236-0001**

Donald R. Long
Chief 916/323-5690

Date of Response: January 10, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

Agencies that have long-term water supply contracts with the Department are to make their preliminary requests for 1991 entitlement water by October 1, 1990. The Department then evaluates the remaining carryover storage from 1990 and estimates the project's ability to meet the requests and in-basin demands before making the initial approval of 1991 delivery requests on December 1, 1990. The initial approval is based on a probability of exceedance of 90 percent as determined from the 1906-1990 historical values of the forecasted or computed unimpaired run-off of the Sacramento River. For 1991, this index will be fairly close to assuming a repeat of 1990. The final approval is made in the spring and is based on a probability of exceedance of 99 percent, which is slightly better than assuming a repeat of 1977.

If we experience another critically dry year, the Department would have the following alternatives: Reduce deliveries to contractors. Purchase water from outside agencies. Draw on ground water stored in prior years. Reduce surface reservoir carry-over storage.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

The Department was able to approve only 50 percent of the agricultural request for 1990 entitlement water. Full requested deliveries were made to municipal and industrial users, but project carry-over storage was reduced from a target of 1.7 million acre-feet to about 1.1 million acre-feet and the project was forced to buy over 200,000 acre-feet from outside sources. The reduced carry-over storage will impact the project's ability to meet 1991 demands. The Department's initial estimates indicate delivery requests will be reduced 65 percent for agricultural uses and 15 percent for municipal and industrial uses.

SWP, Continued

3. What assistance does your agency need?

Individual agencies that have long-term contracts for project water may need financial assistance, including Butte County and several agricultural contractors who are impacted by delivery reductions.

4. What are your major supply sources in normal and drought years?

The Department's major sources of water for the SWP are Oroville Reservoir on the Feather River and the surplus Sacramento-San Joaquin Delta flows. During periods of excess flows in the Delta, the Department pumps water for direct delivery to its long-term contractors and for off-stream storage in San Luis Reservoir. During times of balanced conditions in the Delta, the Department releases water from Oroville for export at the Delta, to satisfy in-basin demands and to help maintain Delta water quality.

5. Any comments or concerns on circumstances unique to your agency?

The Department has a major role in monitoring and maintaining water-quality standards in the Delta. Maintaining these water-quality standards determines how much of the excess flows the Department can divert, and how much water it is required to release from Oroville Reservoir.

**US Bureau of Reclamation (USBR)
Central Valley Operations
Coordinating Office
2800 Cottage Way
Sacramento, CA 95825**

Chet Bowling, Code MP-2810
916/978-5224

Date of Response: January 17, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

If 1991 is as dry as 1990, CVP customers can expect deficiencies similar to 1990 when agricultural contractors received deficiencies of 50 percent, and municipal and individual customers received 25-to-50 percent deficiencies depending on their contracts. Water rights contractors initially received 25 percent deficiencies, but deficiencies were later removed due to late May storms. If 1991 is as dry as 1977, contractors can expect more deficiencies. The first official water supply declaration will be made on or before February 15, 1991.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

Our goal was to provide a carry-over storage of 3.6 million AF in CVP reservoirs at the end of water year 1990. The final carry-over was 4 million AF. If 1991 is drier than 1990, it may be necessary to reduce this carry-over target or to increase deficiencies to users or a combination of both depending on the severity of the year.

3. What assistance does your agency need?

Technical. None

Financial. Appropriations associated with drought relief legislation if enacted

Other (policy/legislation). Legislation similar to *1977 Drought Act*.

USBR, Continued

4. What are your major supply sources in normal years and drought years?

The CVP's major sources of water are surface water supplies from the following rivers and surplus Sacramento-San Joaquin Delta flows (in MAF):

River	Reservoir	Median Inflow	Capacity	Storage as of 1/16/90	Percent of Average this date
Trinity	Clair Engle	1.0	2.4	1.0	58
Sacramento	Shasta	5.1	4.6	1.6	58
American	Folsom	2.6	1.0	0.2	33
Stanislaus	New Melones	1.0	2.4	0.4	30
San Joaquin	Millerton	1.4	0.5	0.2	62
	Fed San Luis	NA	1.0	0.5	84

5. Any comments or concerns on circumstances unique to your agency?

Reclamation, in conjunction with the California DWR, monitors and maintains water quality standards in the Delta. Maintaining these standards will require close monitoring to assure the standards are maintained with the minimum use of water possible from the upstream reservoirs.

East Bay Municipal Utility District (EBMUD)
P.O. Box 24055
Oakland, CA 94623

T.J. Linville
Manager of Water Operations
415/287-0800

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990? Please include the critical aspects in this section and the time frame by which the decisions must be made.

In the 1989-90 water year, the Mokelumne River run-off was 340,000 AF. If 1990-91 run-off is equal to or less than 340,000 AF, storage in the EBMUD system would decrease from the current projected end of season storage (September 30, 1990) of 460,000 AF (74 percent of average) to 400,000 AF (64 percent of average) or lower on September 30, 1991. Conservation measures would be extended another year with a goal of at least 15 percent.

In mid-April 1991, EBMUD staff will prepare its annual report on water supply availability. This report will project the runoff and resulting storage conditions in EBMUD reservoirs if critically dry conditions continue. The report will also assess and recommend alternative actions which include supplemental supply methods to increase the Mokelumne River yield, and conservation with ranges from 15 percent to 25 percent or greater.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

The EBMUD conservation goal of 15 percent for 1990 is being met with the existing voluntary program. During fall and winter, conservation is expected to decrease to 10 percent. By next spring, the conservation goal will be re-evaluated based on projected run-off.

3. What assistance does your agency need?

Technical and financial. None at this time.

Other (policy/legislation). The SWRCB should expand its monitoring of the Mokelumne River to assure diversions by riparians, and appropriators are according to current rights and agreements.

East Bay, Continued

4. What are your major supply sources in normal years and drought years?

Ground water

None

Reservoir

East Bay 30,000 AF (normal year); 0 (dry year)

Imported water

Pardee Reservoir 220,000 AF (normal year); 180,000-200,000 AF (depends on run-off)

Reclaimed water

1,100 AF (7,800 AF proposed by 1995)

5. Any comments or concerns on circumstances unique to your agency?

Maintaining chinook salmon fishery in the Mokelumne River; interim agreement with Department of Fish and Game in 1990-91 will result in increased releases above previous dry period amounts.

**El Dorado Irrigation District (EID)
2890 Mosquito Road
Placerville, CA 95667**

Dorine Kelly
916/622-4513

Date of Response: January 15, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

EID would accelerate its water conservation program and make a decision by late March or early April 1991. EID, if critical, would apply to the State Water Resources Control Board for more water to be conveyed through Pacific Gas and Electric.

Attached is EID's "Four Stage Water Supply Matrix and Temporary Water Shortage Response Measures" program. Currently Sly Park Reservoir is holding 27,361 acre-feet of water (when full Sly Park holds 41,033 acre-feet). According to the attached matrix, on February 1st, Sly Park Reservoir should be above 24,500 acre-feet of water to remain in a "normal range." I would be happy to discuss our water conservation program with you.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

EID did meet its conservation goals for 1990 with no enforced measures in effect. The District remained in a "normal range" of their water conservation program throughout 1990. However, there is nothing precluding the EID Board of Directors from modifying or adjusting the 4 Stage Program, should it become imperative.

3. What assistance does your agency need?

None at this time.

El Dorado, Continued

4. What are your major supply sources in normal years and drought years?

Local surface water. Firm yield is defined as the annual quantity of water a source can make available in 95 years out of 100, based upon historical hydrological conditions and restrictions.

Sly Park Reservoir (USBR)	18,500 AF
El Dorado Forebay (PG&E)	15,080 AF
Folsom Lake (USBR)	4,000 AF
Crawford Ditch	3,500 AF
Total	41,080 AF

Imported water. None routinely; however, per Question 1 above, imports may be necessary if permitted by the SWRCB.

Reclaimed water. Approximately 300 acre-feet pr year from the El Dorado Hills Reclamation Plant is transported to the El Dorado Hills Golf Course, and 200 acre-feet per year is used by Golden State Building Products.

EID will also be able to use approximately 600 acre-feet of reclaimed water per year from the Deer Creek Reclamation Plant in the near future.

5. Any comments or concerns on circumstances unique to your agency?

None.

**El Dorado Irrigation District
Temporary water storage response matrix**

First of month storage	Normal range	0 to 5* Stage I	5 to 15* Stage II	15 to 35* Stage III	35 to 70* Stage IV
Oct	Above 22,900	22,900	17,700	12,200	6,700
Nov	Above 22,500	22,500	17,100	11,800	6,600
Dec	Above 22,400	22,400	17,000	11,800	6,600
Jan	Above 22,800	22,800	17,200	11,900	6,600
Feb	Above 24,500	24,500	18,600	12,800	7,100
Mar	Above 27,500	27,500	20,800	15,200	9,500
Apr	Above 31,000	31,000	25,200	19,200	13,200
May	Above 32,400	32,400	26,800	21,000	15,200
Jun	Above 32,500	32,500	26,900	21,200	15,500
Jul	Above 31,800	31,800	25,800	20,200	14,500
Aug	Above 28,700	28,700	22,000	16,500	11,000
Sep	Above 24,800	24,800	19,400	13,700	8,000
Oct	Above 22,900	22,900	17,700	12,200	6,700

**Expected use reduction (percent)*

El Dorado Irrigation District

Four State water supply matrix and temporary water shortage response measures

Stage I: "Water Alert" (0-5 percent expected conservation)

1. EID to enlist public support for water conservation.
2. Potable district water shall not be used for dust control, earthwork, or road construction.
3. There shall be no washing of driveways, parking lots, or other surfaces with EID water.
4. Restaurant customers to receive water only on request.
5. Parks, golf courses, school grounds, and public grounds shall be watered at night only and/or by hand during the day.
6. Lawn, landscape, and pasture irrigation shall occur only between 6:00 p.m. and 12:00 noon.
7. Agricultural users to comply with IMS or present water conservation plans for EID approval within 30 days of Stage I declaration.
8. Domestic irrigation users shall submit a water conservation plan for EID approval within 30 days of Stage I declaration.

Stage II "Water Warning" (5-15 percent expected conservation)

1. All of the above; and
2. New construction customers shall be allowed water only for operation of living requirements. There shall be no potable EID water used for new external planting.
3. Golf courses to use other than potable water, if possible, and if not, to only irrigate fairways and greens at night and/or by hand during the day and submit a water conservation plan for EID approval within 30 days of Stage II declaration.
4. A "water patrol" shall be initiated by EID.
5. Lawn, landscape, and noncommercial pasture irrigation shall occur only between the hours of 7:00 p.m. and 8:00 a.m. from April 1 through September 15 and shall occur only between the hours of 5:00 p.m. and 10:00 a.m. from September 16 through March 31.
6. Ponds and lakes shall not be filled with potable EID water.

Stage III: "Water Emergency"
(15-35 percent expected conservation)

1. All of the above; and
2. EID to develop resolutions and ordinances concerning the emergency and solicit government and public support.
3. EID to solicit State and federal funding for emergency sources of water.
4. EID to develop citing/disconnect procedures for customers failing to comply with emergency measures.
5. Swimming pools shall not be filled with potable EID water.

Stage IV: "Critical Water Emergency"
(35-70 percent expected conservation)

1. All of the above; and
2. Water meter applications and hook-ups shall be suspended.
3. Agricultural growth shall be deferred.
4. Parks, golf courses, school, and public grounds shall be watered only with reclaimed water.
5. Lawn, landscape, and pasture irrigation with potable EID water shall be prohibited.

Friant Water Users Authority
854 N. Harvard Avenue
Lindsay, CA 93247

Richard M. Moss
General Manager
209/562-6305

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decision must be made.

In that there is little or no carry-over storage from one year to the next in the reservoir serving the Friant Division of the Central Valley Project (Millerton Lake), the response of the Friant districts to another year of drought will be consistent to the actions these districts have taken during the last four years of below-normal rainfall. Those districts with ground water will continue to draw heavily upon the ground water reservoir. Those districts without ground water will attempt to make up any shortages by purchasing water surplus to others_ needs or by calling upon reserves they have effectively banked in the ground water reservoirs of others.

The critical nature of the decisions in response to drought vary from district-to-district in that each district's hydrology, water supply, and cropping patterns are different. Generally, the earlier good information about the availability of the coming season's water supply is made available, the better. Where there is the ability to reduce the cropped acreage, these decisions need to be made during the first couple of weeks in April. The decision to just irrigate for the survival of permanent plantings can wait a while longer. Typically, there is more surplus water available to be purchased in the early spring, so the decision to hedge your bets, as to the final availability of the water supply by purchasing additional water, needs to be made in March and April.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

Each district has a water conservation plan with varying goals. To my knowledge there were no specific water conservation goals established in response to last year's drought. However, with a surface water supply averaging less than 40 percent of normal, the districts and their water users were implementing water conservation and rationing wherever and whenever possible.

3. What assistance does your agency need?

Technical. We are anticipating greater difficulty in accurately forecasting the actual surface water demands. Who will not be double cropping? Who has decided to reduce their planted acreage? What will be the impact to water needs caused by the devastating freeze of December 1990? Who will be irrigating for survival as compared to irrigating for full production? These things will all impact (either directly or indirectly) the demands for surface water and how much people are willing to pay for it.

We are seeking help from the farm advisor's office in answering these questions.

Financial. Some of our member district have indicated some concern over their financial integrity over the coming year if it should turn out to be another dry year. Operating reserves are low because of poor water sales while expenses are high because of high energy and water costs. Deferral of government loan payment and similar measures will be sought.

Similarly, water users are also concerned about having enough money to buy the needed water if it is available. The December freeze will have a major impact on the economic health of a number of our growers. Cash to deepen wells, install pipelines, or conservation measures or to buy expensive supplemental water supplies will be scarce.

Other (policy/legislation). Legislation to encourage not putting lands into full production this year will be needed. In 1977, the "Payment-in-Kind Program" (PIC) was successful in taking a significant amount of acreage in the San Joaquin Valley out of production. While the timing of the PIC Program and the 1977 drought were in coincidence, it proved to be fortunate in that in excess of 300,000 acres were taken out of production and the water otherwise used was available for other uses or remained in the underground.

If water becomes available north of the Delta, assistance in getting it wheeled across the Delta, pumped, and ultimately delivered via the State and/or federal system will be needed.

Friant, Continued

4. What are your major supply sources in normal years and drought years?

I have enclosed a publication we put together a couple of years ago describing the Friant Division districts and the water supply available to them. If more information is desired, please give me a call.

5. Any comments or concerns on circumstances unique to your agency.

Our agency is made up of member districts that are all unique in their own right. Their individual circumstances may not have been adequately addressed herein.

Because the Friant service area is broaching ground water depths heretofore unseen, we are very concerned about the ability of many of our water users to meet their demands through continued pumping of the ground water. We anticipate about one-third of the deep wells within the service area will experience the need for deepening, rehabilitation, and/or repair. Currently, there exists a six-month backlog to obtain the services of a well driller.

Glenn-Colusa Irrigation District (GCID)
P.O. Box 150
344 East Laurel Street
Willows, CA 95988

Robert D. Clark
916/934-8881

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

Our drought contingency planning for 1991 would remain the same as it has in prior years and was outlined in your Agricultural Drought Guidebook of March 1988. We will rely on our contract with the US Bureau of Reclamation for water supply from the Sacramento River. That contract requires a deficiency of 25 percent of the total water supply in critically dry years. The contract further provides that the District would be notified of the deficiency by February 15 and the decision would be reviewed periodically after that date should water supply conditions be changed.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

We began the 1990 irrigation season with an imposed deficiency of 25 percent as referred to above in item No. 1. Subsequent to the unusual storm period at the end of May, that restriction was lifted and a full supply was available to the district. After that relaxation, additional water was marketed within the district and 45,000 acre-feet of Central Valley Project water was offered to the Sacramento River Water Contractors Pool for transfer to others. We would anticipate the methods used in prior years would continue in effect should 1991 again be a dry year.

3. What assistance does your agency need?

The only area where technical assistance could be useful to us for 1991 would be in the prompt receipt of information regarding water conditions and supply in the Sacramento River water shed, specifically in regard to the projected inflow to Shasta Reservoir. We have always received this technical assistance from your Department in the past, and we would look forward to continuing to receive your cooperation. At this time, we do not anticipate other assistance being needed.

Glenn-Colusa, Continued

4. What are your major supply sources in normal years and drought years?

In accordance with the water rights settlement contract with the Bureau of Reclamation referred to in Question 1 above, the district's supply of water in normal years would come from a combination of Stony Creek and the Sacramento River for a total of 825,000 AF for the period of April through October. In drought years this amount would be reduced as stated above. An additional 100,000 AF might be diverted outside that period. Private landowners within the district have some limited ground water pumping capability, and we would anticipate it would be used should another dry year occur.

5. Any comments or concerns on circumstances unique to your agency.

We wish to point out the conditions of our deficiency clauses are the same as are common to numerous contractors with the federal government on the Sacramento River and Delta-Mendota Canal.

Imperial Irrigation District (IID)
PO Box 937
333 East Barioni Boulevard
Imperial, CA 92251

Jesse P. Silva
Manager, Water Department
619/339-9263

Date of Response: November 30, 1990

1. What are your alternatives if 1991 is as dry or drier than 1990? Please include the critical aspects in this section and the time frame by which the decisions must be made.

Imperial Irrigation District receives all of its water from the Colorado River and does not expect to have problems receiving enough water to meet consumptive demand. However, realizing the critical need for water conservation throughout the state, the district began an accelerated water conservation program in 1990.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

In 1990, IID greatly accelerated its water conservation program upon the finalization of an agreement with The Metropolitan Water District of Southern California in which IID constructs and implements water conservation projects, and MWD pays the total cost of each project in return for the conserved water. In dry years, IID may use the conserved water by paying a portion of the project cost.

The conservation goal for 1990 is approximately 33,000 acre-feet per year. Currently, it appears approximately 27,000 acre-feet per year will be conserved.

3. What assistance does your agency need?

Technical	No
Financial	Yes
Other (policy/legislation)	No

4. What are your major supply sources in normal years and drought years?

Ground Water
Quantity AF/Year - 0

Imperial, Continued

Any quality problems?

Yes, ground water salinity within the Imperial Irrigation District service area ranges from 2,000 to 15,000 parts per million.

Local surface water

None

Quantity AF/Year - 0

Streams

None

Reservoirs

Lake Mead/Hoover Dam

Imported Water

Quantity AF/Year - 2,562,000 AF/Yr to 3,184,000 AF/Yr (range at measuring station 60 from 1964-1989; average water for the same period was 2,861,000 AF/Yr

Project — Colorado River

Reclaimed Water

Quantity AF/Yr - 40,000 AF/Yr

Project — Seepage water recovery on the main canal system

5. Any comments or concerns on circumstances unique to your agency?

Imperial Irrigation District is located in a closed basin. The climate is arid with an average annual rainfall of less than three inches. Agricultural drainage water and operational losses from the IID service area flow to the lowest point in the basin, Salton Sea. Reducing the amount of relatively fresh drainage water flowing to the sea will cause Salton Sea salinity to increase at a more rapid rate. Therefore, water conservation within IID and the preservation of the Salton Sea are conflicting goals.

Kern County Water Agency
P.O. Box 58
Bakersfield, CA 93302-0058

Thomas N. Clark
General Manager
805/393-6200

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990, and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

Alternatives if 1991 is as dry as 1990

To answer this question, local supplies and 1991 State Water Project operations and supplies are assumed as follows:

▼ Based on the "Preliminary 1991 Risk Analysis," a repeat of 1990 hydrology will yield an SRI of about 9.2 MAF which has a 90 percent probability of exceedance. Agricultural shortages in 1991 would be 60 percent and municipal and industrial shortages would be 10 percent.

▼ La Hacienda water purchased by DWR is not being extracted, however, if conditions remain dry this spring DWR will do so.

▼ DWR would request about 60,000 AF of agency entitlement for SWP use as repayment under the 1990 demonstration programs.

▼ Friant-Kern, Central Valley Project Delta and Kern River supplies will likely be less than the 400,000 AF estimated to be delivered in 1990.

Ground water shortages. With a repeat of 1990 hydrology in 1991, about 670,000 of the total 858,000 irrigated acres in the agency service area would continue to use ground water to offset surface water shortages. From 1987-to-1990, it is estimated the cumulative ground water overdraft was about 2,700,000 AF and would increase again by at least 1,100,000 AF should 1991 prove to be as dry as 1990. Undoubtedly, ground water users will experience increased pumping costs and increased difficulties with ground water production rates of wells. However, it is anticipated the majority of surface water shortages over the ground water basin will continue to be offset with increased ground water pumping.

Nonground water area shortages. The remaining 188,000 acres overlying nonground water or limited ground water areas rely almost entirely on the SWP, and SWP deliveries in 1990 will total about 575,000 AF. Included in this area are about 101,000 acres of permanent crops requiring about 370,000 AF. Assuming a 60 percent SWP agricultural shortage in 1991, about 265,000 AF of additional supplies would be required to meet the same demand as in 1990.

Kern, Continued

With a 265,000 AF shortage and limited alternative supplies, it is likely part of this shortage would be reduced by a further decrease of row crop acreage over and above the decrease already experienced in 1990. Depending on the financial conditions of individual land owners, and interest rates, some row crops would not be economically feasible, especially when considering the fixed nature of SWP costs plus the additional cost of such large amounts of replacement water. Although impossible to predict, it would not be unreasonable to experience as much as 25,000 acre reduction from 1990 levels, which would reduce the shortage by about 65,000 AF for a total shortage in these critical areas of about 200,000 AF.

Water supply alternatives. The alternatives being considered by the agency to meet a 200,000 AF shortage in the nonground or limited ground water areas are:

- ▼ Early in 1991, the agency would activate five wells in the city of Bakersfield's 2,800-Acre Spreading Facility, which would yield about 15,000 AF. Another eight wells located in the 2,800 acres and owned by Olcese Water District and the city of Bakersfield could produce another 30,000 AF. If not needed by Olcese WD or the city, the agency would negotiate for the use of these wells to pump banked ground water. Operational agreements between the agency and the city must be in place prior to the activation of the wells. To be of maximum benefit, the wells would need to be activated prior to April 1, 1991.
- ▼ DWR is planning to rehabilitate about 23 wells in the Kern Fan Element of the Kern Water Bank to provide about 50,000 AF of extraction capability for the La Hacienda, Inc. ground water purchase. DWR and the agency should accelerate this activity to the extent needed to assure this well capacity is available for use during 1991. If not needed by DWR, the agency would consider using these wells to pump banked ground water. Developmental and operational agreements need to be in place as soon as possible, with well activation taking place prior to April 1, 1991.
- ▼ During 1990, the agency was able to transfer about 100,000 AF of SWP entitlement from ground water districts to nonground water districts via the agency's "1990 Dry Year Pool." In 1991, this potential would be reduced by 10,000 AF assuming a 60 percent SWP shortage. It is also assumed the potential for this type of transfer would be further

reduced by at least 60,000 AF which is the amount ground water districts have agreed to release to DWR to meet SWP shortages under the 1990 ground Kernwater demonstration programs. Thus, if ground water member units are agreeable, "1991 Dry Year Pool" supplies from entitlement transfers are expected to be about 30,000 AF. Such a pool could be made available to the nonground water areas by April or May in order to meet peak agricultural demands during the summer months. "Dry Year Pool" agreements between the agency and member units need to be in place prior to May 1, 1991.

▼ At best, assuming all of the above local water supply alternatives are maximized, about 125,000 AF would be available to meet a 200,000 AF shortage. The agency would attempt to offset the remaining 75,000 AF shortage by purchasing water from sources outside Kern County. Experience has shown that water purchases, particularly those involving water that must be transferred to areas south of the Delta, typically require such long lead time and/or water for the Delta as to make such purchases unusable by the time the transactions are finally approved. Therefore, if purchased water supplies of this type are to be of any value, it is imperative to identify immediately potential water purchases and begin the process of obtaining such supplies.

Alternatives if 1991 is as dry as 1977

SWP water supply assumptions. To answer this question, local supplies and 1991 SWP operations and supplies are assumed as follows:

▼ Based on the "Preliminary 1991 Risk Analysis," a repeat of 1977 hydrology will yield an SRI of about 5.1 MAF which has a greater than 99 percent probability of exceedance. As the 99 percent level of exceedance, 1991 agricultural shortages are estimated to be 82 percent and municipal and industrial shortages would be 32 percent.

▼ DWR would request about 45,000 AF of agency entitlement for SWP use as repayment under the 1990 demonstration programs.

▼ 50,000 AF of La Hacienda water purchased by DWR would be extracted.

▼ Friant-Kern, CVP Delta and Kern River supplies are assumed to be 320,000 AF, which were the deliveries in 1977.

Kern County, Continued

Ground water area shortages. With a repeat of 1977 hydrology in 1991, about 670,000 of the total 858,000 irrigated acres in the agency's service area would be almost totally dependent on the use of ground water to offset surface water shortages. It is estimated the 1991 overdraft would be about 1,250,000 AF should 1991 prove to be as dry as 1977. It is anticipated water shortages and crop losses would occur within the ground water basin due to pump failures and shortage of drillers.

Nonground water shortages. Assuming an 82 percent SWP agricultural shortage in 1991, about 440,000 AF of additional water would be required in order to meet the same demand as in 1990.

Given the unknown already mentioned above under a repeat of 1990 conditions, it would not be unreasonable to expect all row crop acreage would go fallow. The remaining total shortage for just permanent crop acreage in these critical areas would be approximately 235,000 AF.

Water supply alternatives. The alternatives being considered by the agency to meet a 235,000 AF shortage in the nonground water or limited ground water areas just to meet permanent crop demands would be the same as those mentioned above for 1990 conditions, except purchases outside of Kern County would increase from 75,000 AF under 1990 conditions to 155,000 AF under 1977 conditions.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

The Kern County Water Agency has always actively promoted the efficient use of water for agricultural and municipal and industrial purposes. During 1990, KCWA's SWP agricultural supplies were reduced by 50 percent or 516,900 AF, and if 1991 is a similar year, reductions are expected to be 60 percent. Surface water supplies from the Kern River during 1990 were only 24 percent of normal which equates to an estimated reduction of 530,000 AF. During 1990, reductions in surface water from federal water projects amounted to 320,000 AF. All of these reductions caused lands in excess of 10,000 acres to be left fallow.

In 1990, KCWA received 100 percent of its requested municipal and industrial entitlement deliveries. However, within the Bakersfield metropolitan area, a voluntary 7 percent reduction was achieved. At present, KCWA has been informed that requested municipal and industrial deliveries are anticipated to be reduced a minimum of 10 percent if water year 1991 is a repeat of 1990.

3. What assistance does your agency need?

Water supply. DWR must continue to take an active role in developing water purchases from entities throughout the state.

Technical. A continuation of the DWR technical assistance received during 1990.

Financial. Provide low-interest loans for water purchases, well drilling and rehabilitation for both water districts and individual landowners.

Other (political/legislative). For the long term, State and federal agencies must develop reasonable and responsible policies which will allow federal, State and local water managers to do their jobs in a responsible and cost-effective manner. In addition, better cooperation is needed from the State Water Resources Control Board in reviewing and approving water transfers and purchases. The SWRCB presently is creating a bottleneck which hinders rather than assists water management.

Kern County, Continued

4. What are your major supply sources in normal years and drought years?

	Quantity AF/Year	
	Normal	1990
Ground water (No indicated quality problems)	700,000	1,800,000 (Est)
Local surface water		
Stream		
Kern River	720,000	200,000 (Est)
Imported water		
SWP	1,153,000	640,000 (Est)
CVP	400,000	200,000 (Est)
Reclaimed water		
Sewage & Oil field	40,000	40,000 (Est)
TOTAL	3,000,000	2,900,000

5. Any comments or concerns on circumstances unique to your agency?

One of the agency's major concerns is that 188,000 acres of irrigated agriculture relies almost entirely on State Water Project supplies. Of the 188,000 acres, approximately 101,000 acres are comprised of permanent crops, some of which could suffer irreparable damage if water supplies cannot be obtained to make up for shortages in these areas.

**Los Angeles Department of Water and Power (LADWP)
111 No. Hope Street, Room 1348
Los Angeles, CA 90012**

Wayne E. Kruse
213/481-6157

Date of Response: January 16, 1991

1. What are the alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decision must be made.

The city of Los Angeles is fortunate because it receives its potable water supplies from three independent sources: eastern Sierra Nevada snowmelt and Owens Valley ground water via the Los Angeles Aqueduct (LAA) system; local ground water; and purchases from The Metropolitan Water District of Southern California (MWD) via the State Water Project and the Colorado River Aqueduct.

The critical factor for supply will be the availability of water from MWD.

A total demand of approximately 643,000 AF is projected for 1990-91 fiscal year, assuming a 10 percent conservation effort. Demand is projected to be met with about 400,000 AF from MWD, 130,000 AF from the LAA system, and local ground water of about 100,000 AF. Additional conservation, depletion of reserve storage, and additional MWD purchases will be used to make up a shortfall if it occurs. If the drought continues for a subsequent year, demand is projected to increase slightly and expected to be met by MWD, LAA, and local ground water deliveries.

Reservoir storage in the LAA system was only 70 percent of normal as of January 1, 1991. Aqueduct storage has decreased steadily over the past four drought years, but through positive efforts, storage is now being maintained. Storage available from Grant Lake and run-off in the Mono Basin is presently unavailable for export because of ongoing litigation.

The ability to use local ground water from the San Fernando Basin will be restricted between November 1990 and June 1992 due to reconstruction of a major ground water booster pumping station. During that period, local ground water production will be limited to about 100,000 AF/year, which is the city's long-term water right. Temporary over-extraction of ground water due to emergencies or drought can be resumed after June 1992.

Demand reduction or water conservation during drought conditions will continue to be a phased approach. The backbone of this effort is the city's Emergency Water Conservation Plan. A 10 percent voluntary demand reduction is now in effect. Additional measures can be phased in as the drought continues.

Los Angeles, Continued

Two alternatives are potentially available to the department to augment Los Angeles Aqueduct water supply during a continued drought:

Water supply can be augmented by additional purchases from MWD. The amount of water from MWD is uncertain because of MWD's limited supply and other agencies' needs. MWD will initiate a 17 percent cutback in deliveries effective February 1, 1991.

Further increases in local ground water production to about 150,000 AF per year will be possible after mid-1992 when operation of a major booster pumping station is restored.

The LADWP has also contracted with a weather modification contractor for a project to enhance precipitation over a portion of the eastern Sierra Nevada by a potential increase of about 5-to-10 percent per year by means of aerial cloud seeding. The primary objective of this project is to augment precipitation and snowpack during the current drought.

In addition, reclaimed water use is expected to increase from approximately 1,000 AF per year currently to at least 2,000 AF per year in 1991 and 3,500 AF per year in 1992.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or method of conservation?

A goal of 10 percent was set for 1990 and has been equaled or exceeded each month beginning in April through September 1990. During the fall and winter months of October to December 1990, the rate of conservation fluctuated between 7 and -9 percent due to the extremely low rainfall and above-normal temperatures combined with high winds. Phase II of the Water Conservation Plan, mandating a 10-percent conservation effort, is anticipated to be enacted on March 1, 1991.

3. What assistance does your agency need?

None at this time.

4. What are your major supply sources in normal years and drought years?

- ▼ Ground water quantity, and quality problems. Local surface water, imported water, and reclaimed water quantities.
- ▼ TCE and PCE contamination restricts use of many wells.
- ▼ Ground water conveyance will be limited to about 100,000 AF per year from November 1990 through June 1992 due to reconstruction of a major booster pumping station.
- ▼ No local surface water is available.
- ▼ Imported water from MWD and LAA is available.

The city of Los Angeles holds an entitlement to approximately 26 percent of MWD's total supply. Historically, the city has used approximately 15 percent of MWD's total supply. The amount of water from MWD is uncertain because of MWD's limited supply and other agencies' needs.

Continuing drought conditions and ongoing litigation limits the availability of supply from the Los Angeles Aqueduct system to approximately 25 percent of normal.

Reclaimed water projects include:

Project	Quantity	Use
Griffith Park Golf Course	900 AF/Yr	Irrigation
CalTrans 134 & 5 freeways	100 AF/Yr	Irrigation
LA Greenbelt (Nov 1991)	1,000 AF/Yr*	Irrigation
	1,600 AF/Yr**	Irrigation

* Initially

**Ultimately

Los Angeles, Continued

5. Any comments or concerns on circumstances unique to your agency?

Litigation has restricted exports from the Mono Basin and Owens Valley. This is likely to continue for the duration of the drought.

**Marin Municipal Water District (MMWD)
220 Nellen Avenue
Corte Madera, CA 94925**

Ron Theisen
415/924-4600

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

Our district receives 70 percent of our rainfall in the four-month period from December 1 through March 31. In mid-January, we make projections on which to base board actions in the event that reservoir is low, and the year has been dry.

Because fall 1990 was dry, the District continued to encourage voluntary 25 percent use reduction. If 1991 is as dry as 1977, MMWD will need a 45 percent reduction in demand and a mandatory program will be required. MMWD is looking to develop a plan for a mandatory use reduction.

Our district has again requested additional water from Sonoma County Water Agency and the cooperation of North Marin Water district to facilitate deliveries.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

Due to rains in late May which made an improvement in our local water supply storage, the district went from a program of mandatory 25 percent use reduction to a voluntary 25 percent use reduction. MMWD issued reduction goals to all consumers and then monitored their progress. Based on our production figures, our consumers have been maintaining a use reduction of between 20 percent and 25 percent consistently for the past six months.

District staff is developing a mandatory use reduction program for review and implementation by District's Board of Directors. Implementation may be made as early as February 1, 1991.

Los Angeles, Continued

3. What assistance does your agency need?

Assistance in the event of a dry year in 1991 is envisioned to be limited to policy matters which include the expediting of water transfers and the maximum use of reclaimed water. A statewide public information program regarding the drought and water use will also help to drive home the need for use reductions at this time.

4. What are your major supply sources in normal years and drought years?

Major water supply sources

	Normal Years	Drought Years
Local surface water	30,000 AF	15,000-21,000 AF
Imported water from SCWA	4,300 AF	4,300- 6,500 AF

Reclaimed waster use is on the increase with the upgrading of our Las Gallinas Reclamation Plant. Currently, 250 AF is on-line, and another 150 AF of use is being converted from our potable system.

5. Any comments or concerns on circumstances unique to your agency.

Our district has limited potential to develop additional local water supplies. We are currently studying the feasibility of importing additional water supplies or desalinating bay water

**Metropolitan Water District
of Southern California, The (Metropolitan)
P.O. Box 54153
Los Angeles, CA 90054**

Don Adams
213/250-6627

Date of Response: January 15, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

Metropolitan has adopted an "Incremental Interruption and Conservation Plan," which uses a combination of conservation with monetary incentives and the interruption of some water deliveries in response to the continued drought. Metropolitan also is actively seeking ways to increase the amount of water available to us from the Colorado River and the State Water Project.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

Metropolitan, which only wholesales water, offered rebates to retail agencies in its service area that reduced demand by more than 5 percent compared to the previous year. This and other programs helped to reduce retail demands in Metropolitan's six-county service area between 5 and 10 percent. Metropolitan has implemented Stage 3 of the "Incremental Interruption and Conservation Plan" which will reduce water deliveries by 17 percent. Metropolitan will continue to pursue programs to increase the water available from imported sources.

A summary describing the plan follows.

3. What assistance does your agency need?

Technical

Financial

Other (policy/legislation)

None

Metropolitan, Continued

4. What are your major supply sources in normal years and drought years?

Ground water	NA
Local surface water	NA
Stream	
Reservoir	NA

Imported water

Project — Colorado River Aqueduct; 917,000 acre-feet (1991 estimates)

State Water Project

1,835,000 acre-feet (1991 order)

Reclaimed water

5. Any comments or concerns on circumstances unique to your agency?

None.

The Metropolitan Water District of Southern California

“Incremental Interruption and Conservation Plan”

Summary

For Metropolitan, the 1991 water supply situation is uncertain at best. The State project reservoirs will be critically low starting the year, and although we are working on several supply augmentation plans, we could have less than a full Colorado River Aqueduct. Because of this, Metropolitan has developed an “Incremental Interruption and Conservation Plan” which begins using water in the interruptible program, in concert with conservation, to meet needs during the remainder of the drought. It is a meld of our successful 1977 drought conservation program and our “Interruptible and Seasonal Storage” programs.

The plan assigns a monthly conservation target of water from Metropolitan to each member public agency. Agencies using less than the target quantity would receive an incentive payment for water used under their target quantity. In Stages II through V, agencies exceeding the target quantity would face a disincentive charge on the amount of Metropolitan water used over their target. It is recommended the disincentive charge be twice the noninterruptible rate (\$394 per acre-foot) and the conservation incentive payment be one-half the noninterruptible rate (\$98.50 acre-foot). Adjustments would be made to the target quantities to reflect population growth, changes in local water supplies, and significant conservation programs. An appeal process would be provided whereby member public agencies could request our board review the agency's assigned monthly conservation target.

Detailed report

Background. On a statewide basis the water situation is serious. Storage in Oroville and San Luis reservoirs on December 31, 1990, is less than 1 million acre-feet, which is far lower than the previous year. The Department of Water Resources estimates there may be a 60-to-70 percent reduction of agricultural deliveries and a 10-to-20 percent reduction of municipal and industrial deliveries next year.

On the Colorado River, the US Bureau of Reclamation's Annual Operating Plan projects 917,000 acre-feet of Colorado River water available for Metropolitan in 1991. Through several efforts, we expect to have more Colorado River water than the bureau now projects. However, for planning purposes, we must take note of the bureau's projections.

Over the longer term, we recognize our water sources are going to be less reliable for at least the next few years. The Central Arizona Project likely will be operating at full capacity within two years. State Water Project

Metropolitan, Continued

water is clouded by the Bay-Delta hearings and restrained by lack of facilities in the Sacramento-San Joaquin Delta.

Because of the uncertain immediate water supply picture for next year and the diminished long-term reliability of our water sources, it is necessary to make plans for another year of drought and prepare ourselves for future shortfalls. The philosophy behind the presented plan, which is called the "Incremental Interruption and Conservation Plan," is to begin using water in the interruptible program, in concert with conservation, to meet needs during shortfalls, such as the present drought. It is structured to be staged or phased, always holding as much water in reserve as possible for the eventuality of a longer drought. It is intended to meld a drought conservation program, similar to the one implemented in 1977, with our "Interruptible and Seasonal Storage" programs.

"Incremental Interruption and Conservation Plan"

The "Incremental Interruption and Conservation Plan" establishes a monthly target quantity of water available from Metropolitan for each member public agency. The target quantity would be calculated for each member public agency based on a percentage of the total amount of water taken from Metropolitan in the base year. It is envisioned the program would be implemented in stages by further reducing the target quantities for each member public agency. Metropolitan's board (based on expected aqueduct flow, demands, and storage conditions) would determine in the future, by specific action, the appropriate stage. All interruptible classes of water (agricultural, ground water replenishment, sea water barrier, and reservoir storage) would be reduced uniformly. Similarly, water delivered under the "Seasonal Storage Program" and used for long-term storage would be reduced. Adjustments would be made to target quantities to reflect population growth, changes in local water supplies, and significant conservation programs. The plan provides that all adjustments would be subject to your board's approval.

In Stages II through V, the target water quantity for agencies receiving nonfirm water ("Interruptible Service" and "Seasonal Service" for long-term storage) in the base year would be further reduced in proportion to the amount of non-firm water received. In Stages II through V, agencies exceeding the target quantity would face a disincentive charge for water used over a target quantity, plus the applicable water rate, while agen-

cies using less than their target quantity would receive an incentive payment. It is recommended the disincentive charge be twice the non-interruptible rate (\$394 acre-foot) and the conservation incentive payment be one-half the noninterruptible rate (\$98.50 acre-foot). In all cases, the conservation payment and charges would apply only to deliveries from Metropolitan and not to total water usage.

Stage I of the "Incremental Interruption and Conservation Plan" would be voluntary. Member public agencies reducing use of water from Metropolitan below 95 percent of use in the base year and certifying they did not increase use of local water to do so, would be eligible to receive the incentive payment. In Stage I, there would be no disincentive charge.

The program is illustrated in the following table and example.

Reductions from base year

Stage	Reduction in Interruptible Deliveries	Plus Conservation Noninterruptible Deliveries	Expected Savings (AF/Yr)
I	Voluntary Goal	10%	100,000
II	20%	5%	260,000
III	30%	10%	430,000
IV	40%	15%	600,000
V	50%	20%	770,000

For example, if a member public agency (in a certain month in the base year) received 100 acre-feet of water from Metropolitan of which 10 acre-feet were in interruptible service, the agency's target quantity under Stage II would be 100 acre-feet, minus 2 acre-feet, minus 4.5 acre-feet, or 93.5 acre-feet. If the agency took less than 93.5 acre-feet, the agency would avoid not only purchase of this water, but in addition, Metropolitan would provide an incentive payment of \$100 per acre-foot. On the other hand, if the agency took more than 93.5 acre-feet, a disincentive charge of \$394 per acre-foot would be applied to the amount taken over the target quantity in addition to the applicable water rate. However, an agency exceeding the target quantity in a single month would be given a total of six months to reduce its use to below its target and offset the overage before becoming liable for the disincentive payment.

Metropolitan, Continued

Adjustments

To account for changes in local water supplies, growth and development, and significant conservation programs, Metropolitan is working with the member agencies on guidelines to be used in making target quantity adjustments. Because of the wide variety of circumstances, we expect a meeting will be necessary with a number of agencies to complete the adjustments. In all cases, adjustments to target quantities will be subject to Metropolitan board's approval. The following outlines the guidelines staff proposes to use in recommending adjustments.

Local water supply. Adjustments to local water supplies will be recommended if:

- ▼ A well, reclamation plant, aqueduct, reservoir, pipelines fails;
- ▼ There is less surface water because of drought; and
- ▼ Court order, regulatory order, or negotiated agreement limits the use of local supplies.

Note. *We do not envision making any adjustments to account for routine or elective maintenance.*

Conservation. Agency uses less water in the base year because of a significant conservation effort consisting of:

- ▼ A mandatory water conservation program; and
- ▼ A major water management program with demonstrated results.

Growth and development. Agency base year will be adjusted for growth based on:

- ▼ The number of new service connections;
- ▼ A demonstrated change in the mix of service connections toward larger-sized connections; and
- ▼ The establishment or expansion of a major industrial water user after the base year.

Stages II through V constitute an implementation of service interruptions in conjunction with a requirement for increasing conservation by the member public agencies. In Stage II, for example, conservation at 5 percent would be mandated in conjunction with a 15 percent service interruption, thereby reducing future interruptible obligations by 15 percent.

By requiring increased conservation as interruptions are implemented, we ensure depletion of Metropolitan's interruptible storage reserves is accompanied by austerity in water use. This balanced use of conservation and interruptions recognizes the potential for continued shortages. Although the prospects for shortages in 1991 are a matter of concern, there is still a need to maintain regional storage reserves under the long-term seasonal storage and interruptible water service programs to protect against more serious supply deficiencies. Not only would demands likely increase in later years of a continuing drought, but dry conditions in 1991 causing a potential shortfall in supplies would substantially worsen prospective water supplies for later years.

On the State Water Project, for example, potential serious shortages to Metropolitan in 1991 are lessened by the ability to impose 50 percent deficiencies on agricultural contractors prior to imposing deficiencies on municipal and industrial contractors. However, if such a deficiency were imposed on agricultural contractors in 1991, municipal and industrial contractors collectively would be on equal footing with agricultural contractors to share in any deficiencies in 1992 through 1996. This is because the combined 1990 and 1991 deficiencies to agricultural users would have reached one year's entitlement which is the maximum for any seven-year period. Thus, preserving regional storage reserves under the interruptible and seasonal storage service programs for potential use in 1992 and later years is a primary consideration in developing mitigation plans for 1991.

**Monterey Peninsula Water Mgmt District
187 El Dorado, Suite E
P.O. Box 85
Monterey, CA 93940**

Michael Ricker
Water Demand Manager
408/649-4866

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

If 1991 is as dry as 1990, very likely we will remain in our current water rationing program of 20 percent reductions for all water users. This assumes we sustain a savings of over 30 percent as we have over the past two years. If water reductions fall from the 30 percent now being achieved and 1991 is as dry as 1990, then rationing laws may get tighter.

If 1991 is as dry as 1977, likely the district would go to a 40 percent rationing reduction and pump areas of the Carmel River aquifer heretofore not pumped. The upper aquifer zone has not been pumped for environmental reasons. This would likely change if 1991 is very dry. If 1991 is very dry, and we pump the upper aquifer zone, the district board may impose a moratorium on all new water uses growth control for the duration of the drought emergency.

Timing. A decision to go to a tighter water ration would likely be made in early March, but no later than the end of May when the majority of the rainfall should have occurred. Changes to the water ration could occur earlier if we get significant rainfall.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

The district's rationing goal for 1990 (the second full year of water rationing on the Monterey Peninsula) is a 20 percent savings from the base year (October 1987 to September 1989). The community has saved over 32 percent since the start of 1990. In 1989 (the first year of rationing), the community saved approximately 27 percent.

No major changes are expected at this time, other than water rationing for golf courses, that are expected to be reduced to 73 percent of the base year rather than 80 percent as they now stand.

Should 1991 remain dry, a reduction of 40 percent is likely. Irrigation-only meters may be required to reduce water usage by 40 percent. Commercial accounts may be asked to retrofit to 1.6 gallons-per-flush toilets, but maintain a 20 percent savings. The board is expected to act on the proposal by March 1991.

The district requires retrofit (to 1.6 gallon toilets, instant access hot water and other best management practices) upon sale of property or property expansion.

3. What assistance does your agency need?

Technical. Technical assistance is desired regarding desalination, cloud seeding, and a variety of water-augmentation projects, as well as riparian restoration works.

Financial. We will be seeking loan money for water augmentation projects, water conservation activities (retrofit/rebates), and ground water recharge.

Other (policy/legislation). Support for legislation providing tax credits for retrofitting with water efficient plumbing fixtures including small water systems such as cisterns (see answer to No. 2 above).

4. What are your major supply sources in normal years and drought years?

Ground water. We recently commissioned a study on the Carmel River Valley watershed regarding long-term reliable yield. This was in the form of an EIR. Results show less storage than believed before. There were no quality problems.

Normal Year Use
16,700 AF/year

Water Year 1990
13,600

Monterey Peninsula, Continued

Local surface water

Stream

Carmel River Normal Year — 5,200 AF/Year
Water Year 1989-90 — 2,900 AF/Year

Reservoir

San Clemente Reservoir (point of diversion for Carmel River) and Los Padres Reservoir are on the Carmel River. Total capacity — 2,500 AF.

Imported Water Project	Quantity AF/Year
None	None

Reclaimed water project

Del Monte Forest Golf Course application. Projected for 1993 — 800 AF/Year

5. Any comments or concerns on circumstances unique to your agency?

All water supplies are locally obtained. The riparian corridor has shown signs of stress prior to the drought of 1989. Continued drought is a major concern regarding ecology of the Carmel River area.

**City of Morro Bay
Department of Public Works
595 Harbor Street
Morro Bay, CA 93442**

G.H. Nichols
Director of Public Works
805/772-1214

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

Continued drought would mean another year with less-than-average rainfall to replenish aquifers from which the city of Morro Bay draws its municipal water supply. This would result in continued degradation of the quality of water reaching the city's wells and the potential for various wells to go out of service due to reduced ground water levels. To overcome degraded water quality due to sea water intrusion and increased TDS, the city will continue to use temporary rented reverse osmosis treatment units on specific wells. To meet diminishing supply, the city will reduce the community's water demand by continued mandatory water conservation regulations, up to and including rationing. If the quantity of water available from the city's wells diminishes beyond the ability to reduce demand, the city will obtain emergency supplemental supplies from other sources, including agricultural wells, brackish city wells, the borrow/purchase of surface supply water from a neighboring agency with a surface storage reservoir (Whale Rock Commission), and potentially up to and including temporary sea water desalination.

As of mid-January 1991, minimal rainfall has occurred, and there has been absolutely no recovery in the ground water aquifers. Wells which became depleted during the summer of 1990 are still out of service, and aquifer degradation is continuing. The City is making plans to implement additional water conservation measures and to construct an emergency seawater desalination project by July 1991 to replace temporarily "lost" ground water supplies.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

The goal of water conservation in the city of Morro Bay is to reduce the community's demand for water to the volume the city's wells are currently able to produce. Because the wells are in the riparian underflow of coastal-tributary streams, there is no storage. Water conserved now is not "saved," but flows out to the ocean. Therefore, early conservation does not protect the city's municipal water supply in subsequent months. The city's mandatory water conservation program is a

Morro Bay, Continued

five-level program established in the municipal code. This program restricts the ways water may be used, but not the amount. True rationing of water is considered a last-ditch mechanism to be used only after the first four levels have not been successful in reducing the demand to meet diminished well production. City staff does not anticipate changing the basic program to meet a continued drought, but may recommend increasingly restrictive rationing measures.

3. What assistance does your agency need?

Money is always welcome. The cost of 1990's emergency measures to protect our water supply (reverse osmosis treatment of brackish ground water plus emergency outside sources) will exceed \$500,000, which represents a 40 percent increase in the city's total water budget. The cost of the proposed 1991 emergency seawater desalination project is expected to exceed \$2.4 million, which would require nearly tripling the city's annual water budget.

4. What are your major supply sources in normal years and drought years?

The city of Morro Bay's municipal water supply is entirely ground water drawn from shallow riparian aquifers underflowing two coastal-tributary streams. The aquifers are recharged annually by winter rains with no storage or carry-over from one year to the next. To develop a supply sufficient to meet the normal-year demand, we must receive at least the average amount of winter rainfall (16 inches). Increased agricultural use of the same ground water has resulted in documented overdraft conditions in both aquifers in average dry year (two-year drought). In drought years, the city must depend on this same resource. There are no alternative dependable water resources at this time.

Ground water

Normal year	1723.5 AFY (permit limit)
Extreme drought year	1500-1550 AFY

Normal year

Seasonal quality degradation. Increased TDS in wells near ocean, and increased nitrates and selenium in isolated wells in agricultural area.

Extreme drought year

Significant sea water intrusion requiring reverse osmosis treatment of wells near ocean. Increased nitrates in specific wells requiring turning off of well.

Local surface water	None
Imported water	None
Reclaimed water	None

5. Any comments or concerns on circumstances unique to your agency.

The city of Morro Bay has had a progressive water conservation program in effect for a number of years and has succeeded in reducing this year's demand about 20 percent below the "unconstrained" demand. Unfortunately, the prolonged drought coupled with increased agricultural demand on the ground water basins has reduced water availability below this level.

As the ground water level in the basins continues to decline, degraded quality becomes a problem. Some of the city's wells habitually develop problems with increased levels of nitrates or selenium when the water drops below certain elevations. These wells may have to be turned off if concentrations exceed MCLs. Increased TDS is also a problem in wells closer to the ocean.

Several city wells are located within 3,000 feet of the ocean, and sea water intrusion has become a severe problem. The city has implemented temporary reverse osmosis treatment of these wells to keep them in service. However, one or more of these wells may go out-of-service anyway due to low-water level of the aquifer.

As of mid-January 1991, eight of the city's 12 municipal water wells remain out of service due to unacceptable quality or depleted aquifer conditions. Wells being treated with reverse osmosis are showing air, and may go out of service at any time. It does not appear there will be rainfall-recharge of the ground water this winter, and continued water rationing together with implementation of expansive emergency water supply projects at great cost to the community appear probable at this time.

Palo Verde Irrigation District (PVID)
180 West 14th Avenue
Blythe, CA 92225

Gerald M. Davisson
General Manager
619/922-3144

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

PVID will have ample water from the Colorado River storage reservoirs if 1991 is as dry or drier than 1990.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

PVID always uses its water in the most beneficial manner possible as prescribed in our water contract with the federal government. We do not anticipate changing our methods of the most beneficial use.

3. What assistance does your agency need?

We do not need any technical or financial assistance.

4. What are your major supply sources in normal years and drought years?

The Palo Verde Irrigation District's water supply is the Colorado River. We have the number one priority within California's annual 4.4 MAF share of the river.

5. Any comments or concerns on circumstances unique to your agency?

The Colorado River has significant storage reservoirs to carry over the dry periods.

**San Diego County Water Authority (SDCWA)
3211 Fifth Avenue
San Diego, CA 92103-5718**

Gordon A. Hess
Senior Civil Engineer
619/297-3218

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990? Please include the critical aspects in this section and the time frame by which the decisions must be made.
2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

Both questions 1 and 2

The San Diego County Water Authority supplied 95 percent of the water used within its boundaries during FY 1989-90. All of the authority's supplies were from the Colorado River Aqueduct and State Water Project through Metropolitan Water District of Southern California.

The authority has in place, through its 23 member agencies, water conservation ordinances restricting the uses of water through a four-stage conservation alert program. In 1990, nearly all agencies declared a Stage II alert. In addition, a drought response plan was developed. The plan consisted of the following:

- ▼ Distribution of conservation devices and conservation education materials;
- ▼ Hiring of conservation coordinators;
- ▼ Developing response tracking software;
- ▼ Technical assistance to member agencies and large water users;
- ▼ Use of an aggressive media campaign;
- ▼ Employee education on water supply conditions, conservation ordinances, and drought response plan; and
- ▼ \$100 conservation incentive rebates through MWD on water conserved above 5 percent.

The 1990 water conservation goal for the period June-to-September was 10 percent. It appears this goal will be attained. Changes to existing water conservation ordinances may be recommended pending an evaluation of the effectiveness of the 1990 program. This evaluation is scheduled for the fall of 1990.

San Diego, Continued

A drought response plan similar to that used in 1990 will be developed in 1991. The plan may be expanded to include financial penalties for excessive water use by member agencies.

3. What assistance does your agency need?

Timely information on statewide water supply conditions.

4. What are your major supply sources in normal years and drought years?

In 1989-90, water use in San Diego County was as follows:

Local supply. 33,200.8 acre-feet. 80-to-90 percent of the local supply is from local run-off, the balance from ground water.

Imported supply. 613,444.4 acre-feet. 70-to-75 percent of this water was from the Colorado River Aqueduct, and the balance from SWP.

Normal years. In normal years, 50,000 acre-feet of local water is expected. The balance of the demand is imported water from Metropolitan Water District. 60-to-70 percent of this imported water is from the Colorado River Aqueduct and 30-to-40 percent is from the State Water Project. Imported water use has increased from 411,579 acre-feet in 1985 to 613,444.4 acre-feet in 1990.

5. Any comments or concerns on circumstances unique to your agency?

None.

**San Francisco Water Department (SFWD)
City and County of San Francisco
425 Mason Street, 4th Floor
San Francisco, CA 94102**

Norm Lougee
415/923-2467

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

If 1991 is as dry or drier than 1990 or 1977, a rationing program (in conjunction with the possible purchase of water) to reduce normal use by up to 50 percent may be necessary to avoid running out of water if 1992 is also dry. SFWD will seek to purchase water from any district or agency that has surplus water and that could wheel water through DWR facilities to San Francisco to help maintain or reduce the 25 percent rationing level or to minimize any increase above this level, if possible, and to avoid catastrophic, economic, and social impacts.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

Current rationing goal is 25 percent below normal (1987) usage.

3. What assistance does your agency need?

Our agency may need continued State assistance in obtaining additional water outside our jurisdiction if 1991 is dry. The State may also be asked for assistance in continuing other emergency relief.

4. What are your major supply sources in normal years and drought years?

Major sources in both normal and dry years are Hetch Hetchy 80 percent and Bay Area 20 percent.

(Storage figures in acre-feet)

Reservoir	Normal Years	Drought Years
Hetch Hetchy	213,000	250,000
Calaveras	49,200	17,100
San Antonio	11,500	13,100
Crystal Springs	44,100	32,250
San Andreas	46,700	30,000
Pilarcitos	3,200	1,400

Notes: "Normal" is the average of FY 1982-83 to 1985-86. "Drought" is the average of FY 1986-87 to 1988-89.

San Francisco, Continued

5. Any comments or concerns on circumstances unique to your agency?

San Francisco's Hetch Hetchy share of run-off is not proportional to precipitation. In dry years, most of the Hetch Hetchy runoff is released to satisfy the Modesto and Turlock Irrigation districts.

**Santa Barbara County Water Agency
122 West Figueroa Street, Suite B
Santa Barbara, CA 93101**

Robert B. Almy
Water Agency Manager
805/568-3540

Date of Response: January 17, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

The alternatives for drought management vary by the nature of supplies provided in areas of Santa Barbara County. The northern part of Santa Barbara County relies strictly on ground water sources for water supply. Water supplies have, therefore, been relatively unaffected by water shortages. Water quality degradation is the principal drought-related water supply problem in this area.

For areas receiving the majority of supply from surface water sources, the drought has created a more serious water shortage condition. Principally, this is applicable to the Cachuma Project in the Upper Santa Ynez and South Coast areas of Santa Barbara County.

Surface reservoirs in the Santa Ynez drainage have been affected severely by the drought. Gibraltar Reservoir has been drained since November 1989, and a program to pump water from the underlying silts and gravel in the reservoir has been initiated. Cachuma Reservoir has reached an elevation where water must be pumped by an emergency system to the majority of the Cachuma users.

Using a statistical analysis of the inflow to Cachuma Reservoir, there is a significant probability the reservoir could go dry by spring 1992, even with significantly reduced water deliveries. The key dates for decisions are, therefore, a reflection of this critical date, which potentially could affect the principal water supply for over 180,000 persons. An intermediate-term supplemental water source must be available by this date, which affects the planning process for intermediate-term supplies.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

Conservation goals vary by service area of individual water purveyors within Santa Barbara County and are set by each individual district. For the Cachuma Project service area, conservation goals vary from approximately 10 percent to in-excess of 45 percent of normal anticipated water demands. The Goleta Water District and the city of Santa Barbara have

Santa Barbara, Continued

the most restrictive conservation goals incorporated in their production plans, with a 45 percent reduction (approximate) from normal demand.

The goals for 1990-91 have been tracked closely by both districts, and results are published in the local newspaper periodically, along with the status of water storage at Lake Cachuma. All districts have been able to meet or exceed conservation goals. The availability of additional water supplies in the short-term likely will result in conservation goals being reached with a slightly less aggressive conservation program resulting in the city of Santa Barbara. The Goleta Water District has announced it will meet its expected water demands for the coming winter from its remaining Cachuma entitlement and is expected to suspend ground water pumping to reserve available supplies for a protracted drought.

Projected conservation goals for 1991-92 are based on a case of little or no runoff to surface reservoirs in the Santa Ynez River system. It is expected conservation goals can be maintained at approximately 35 percent with the addition of temporary supplemental sources of water, including the water wheeling agreement for State water through the Metropolitan Water District and Casitas Water District.

Conservation methods on the South Coast may change slightly as a result of these additional supplies. For instance, the city of Santa Barbara is revising its rate schedule to reduce extremely high water rates for users in its "fourth tier" (highest users), while maintaining other disincentives for water use.

The county water agency has initiated a conservation program to coordinate efforts among districts and facilitate new district programs.

3. What assistance does your agency need?

Technical. Technical assistance needed includes assistance in developing short-term (0-2 years) and intermediate term (2-5 years) supplemental water supplies to provide protection against the contingency of Cachuma Reservoir going dry by the spring 1992. To date, DWR and other regional water suppliers have supported Santa Barbara County in setting up water wheeling agreements. Because wheeling agreements use excess capacity available only in the short-term, the focus of technical assistance will shift to permit assistance necessary to construct and

operate intermediate-term water supplies, such as desalination and reclamation projects.

Financial. The financial impacts of drought have been substantial. For instance, the combined effects of reduced supplies have required one South Coast district to triple its rates for delivered water. Financial assistance to spread these short-term costs (loans or grants) over a longer term would reduce the effects of the drought. Significant economic impacts have occurred to the agricultural industry. Long-term impacts may include loss of orchards if conditions worsen.

Other (policy/legislation). One potential source of water not used during the current drought is a temporary transfer of agricultural water for urban users. Urban users have proposed to purchase water based on the value of crops not produced. This has not been successful because of the lack of a State policy or legislation in this area. In addition, as surface supplies are depleted, the ability of such schemes is reduced.

A second area where water policy has frustrated local efforts has been in the expanded use of waste water reclamation using advanced treatment technology. Information provided by State regulatory agencies has resulted in resistance to reclamation water use by members of the agricultural community.

4. What are your major supply sources in normal years and drought years?

The following information is provided for both the county as a whole and for Cachuma project member units as a subset. The surface water sources, including the Cachuma project, are severely constrained, while areas served by ground water have not been as severely impacted by drought.

Santa Barbara, Continued

The major supply sources for Santa Barbara County are
(all quantities are in acre-feet per year):

Sources	Normal Conditions	Drought Conditions
Ground Water		
Natural recharge	123,000	63,000
Return flows	41,000	41,000
Twitchell Res recharge	20,000	0
Ground water overdraft	50,000	130,000
Subtotal	234,000	234,000
Current Sources		
Local Surface Water		
Jameson/Doulton	2,100	600
Gibraltar/Mission	5,700	600
Cachuma/Tecolote	29,100	13,100
Subtotal	36,900	14,300
Imported Water		
State Water Project (Coastal Aqueduct Sched- uled deliveries 1996)	0	0
Reclaimed Water		
City of Santa Barbara	500	500
Other Indirect Reclamation	3,500	3,500
Subtotal	4,000	4,000
TOTAL	274,900	252,300

Major Supply Sources for Cachuma Project Service Area (in acre-feet per year):

Sources	Normal Conditions	Drought Conditions
Ground Water		
Natural Recharge	21,000	0
Return Flows	1,000	1,000
Ground Water Overdraft	7,000	28,000
Subtotal	29,000	29,000
Local Surface Water		
Jameson/Doulton	2,100	600
Gibraltar/Mission	5,700	600
Cachuma/Tecolote	29,100	13,100
Subtotal	36,900	14,300
Imported Water		
SWP (Water Wheeling 1991-92)	0	3,000
Subtotal	0	3,000
Reclaimed Water		
City of Santa Barbara	500	500
Subtotal	500	500
TOTAL SUPPLIES	66,400	46,800

**Santa Clara Valley Water District (SCVWD)
5750 Almaden Expressway
San Jose, CA 95118**

John H. Sutcliffe
408/265-2600, Ext. 345

Date of Response: January 16, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made. 1991 drought alternatives.

If 1991 is as dry or drier than 1990, the district anticipates implementing a water conservation program similar to the one carried out in 1989 and 1990. The 1990 program included a 20 percent conservation goal in northern Santa Clara County. The goal is 25 percent in southern Santa Clara County since that part depends solely on ground water for supply. The district recommended its retail water agencies implement excess use penalties or rate incentives to achieve these goals. The cities and county also implemented ordinances restricting water use and prohibiting water waste. The district developed and carried out an aggressive public information campaign, costing \$500,000 in 1989, and \$600,000 in 1990. Finally, the district promoted the use of reclaimed water for construction dust control and other appropriate purposes. In October 1990, the district approved a \$350,000 campaign to continue through the winter months.

The district is currently recruiting a full-time water conservation coordinator who will evaluate other conservation measures, such as low-flow toilet rebates and incorporate these into the district's 1991 conservation program. Funds have been earmarked in the 1990-91 budget for implementation of additional elements of the water conservation program.

In addition, the district purchased 90,000 acre-feet of surplus water from Yuba County Water Agency in 1989. To-date, two-thirds of the water has been delivered to Santa Clara County through the South Bay Aqueduct, and the remainder will be delivered in the early months of 1991. The district is pursuing Warren Act amendments in the federal legislature that would allow non-USBR water to be conveyed through the San Felipe Division of the Central Valley Project. This would greatly enhance the district's ability to bring additional purchases of imported water into the county.

Regarding the timing for implementing water conservation goals, the district generally does not have sufficient information to assess the current year's water supply until the March snowpack survey in the Sierra has been evaluated. Then the district has a fairly good idea of

whether we will receive full entitlement of imported water. The district also considers its own local reservoir storage and the level of storage in the Santa Clara County ground water basin. The district board must adopt any water conservation goals by mid-March at the latest, in order for the retail water agencies to implement rationing programs and excess use penalties by the April billing cycle.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

1990 conservation goals. In 1990, the district recommended 20 percent conservation in north Santa Clara County and 25 percent conservation in south Santa Clara County, effective April 1 through October 31. This level of conservation was extended through the winter months with an effective annual conservation rate of 18.5 percent.

Through December 1990, a conservation level of 19 percent was obtained as compared with 1987 levels.

The water supply situation, both statewide and local, will be monitored closely during the winter months, and the current conservation goals may change in 1991.

3. What assistance does your agency need?

Assistance. The district needs technical assistance in evaluating and implementing water conservation measures. The current drought has encouraged other agencies to implement new and innovative water use reduction programs, and we need detailed information about what measures are most effective. The district also needs technical assistance regarding acceptable uses of gray water and reclaimed water.

Helpful legislation. The amendments to the Warren Act to allow the transport of non-USBR water through the San Felipe Division of the Central Valley Project are currently well into the federal legislative process. There is also a Drought Relief Bill sponsored by US Representative Vic Fazio which would give some relief to the bureau's Central Valley Project contractors from operations and maintenance deficits induced as

Santa Clara Valley, Continued

a result of the 1990 drought. Support for this legislation would help the district.

Other assistance. The district may need an extension of its time limit to import Yuba County water. Due to capacity limits of the South Bay Aqueduct and other constraints, the district may not be able to import all of the Yuba County water by March 1991.

4. What are your major supply sources in normal years and drought years?

Major supply source	Normal Conditions	Drought Conditions
Natural ground water yield		
Santa Clara Valley	58,200	32,000
Coyote	4,400	1,200
Llagas	45,200	27,000
Surface water		
Stevens Creek*	4,910	3,798
Regnart Creek	101	36
Calabazas	567	383
Rodeo Creek	25	2
Saratoga Creek	1,955	1,861
San Tomas Creek	1,151	524
Los Gatos Creek	21,102	9,686
Ross Creek	672	341
Guadalupe Creek*	5,080	4,731
Alamitos Creek*	10,435	7,259
Coyote Creek*	37,232	11,229
Silver Creek	299	152
Thompson Creek	221	76
Penitencia Creek	1,994	995
SJWW Diversions	14,653	8,000
Uvas Creek*	12,840	11,949
Llagas Cree*	11,228	3,098
Imported water		
State Water Project	92,000	69,000
CVP, San Felipe Division	152,500	76,250
Hetch-Hetchy	76,000	57,000
Reclaimed water	1,000	1,000
TOTAL	553,765	327,570

*Local reservoirs

Santa Clara, Continued

Quality. The quality of local sources is good, with the exception of very infrequent taste and odor problems from algae blooms in local reservoirs. The quality of imported sources taken from the Delta is variable.

5. Any comments or concerns on circumstances unique to your agency.

None.

**Westlands Water District (WWD)
P.O. Box 6056
Fresno, CA 93703**

Stephen H. Ottemoeller
Chief of Operations
209/ 224-1523

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

Westlands receives its surface water supply from the US Bureau of Reclamation's Central Valley Project. Bureau personnel have indicated a critically-dry water year varying from a year like 1990 to a 1977-type year would result in water supplies to CVP contractors from a probable high of 50 percent to as low as less than 25 percent of contract amounts. A full-contract supply for Westlands is 1,150,000 acre-feet which still results in shortages in parts of the district.

The district water year runs from March 1 through the end of February. WWD initially allocates to its water users whatever amount of water has been declared by the bureau prior to the beginning of the water year. Any later additions to the water supply are passed on to the farmers as they become available.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

The district has ongoing regulations for the allocation of its agricultural water supplies. Water is allocated to each farmer, based on his irrigable acres, and that farmer can use his supply at any time during the water year. All deliveries are metered and water allocation accounts are maintained such that when a farmer has exhausted his allocation, he may no longer take delivery of district water. The regulations are designed to work with any level of water supply deficiency and include provisions for protection of permanent crops.

WWD's water conservation program is ongoing and provides assistance to all water users to achieve the best possible irrigation efficiency no matter what type of water supply year occurs.

Westlands, Continued

3. What assistance does your agency need?

Since the district tries to deal with water supply shortages in large part through transfers from other districts, our most significant need for assistance is the timely cooperation by State agencies in processing and approving water transfers. It would appear the appropriate legislation exists to facilitate such transfers, but at times, agency policies or staff actions tend to inhibit the process.

4. What are your major supply sources in normal years and drought years?

Ground water. All ground water pumping within the district is done by individual farmers. Total pumping in years of full-contract supplies is estimated to be around 100,000 acre-feet, depending on the ability of the district to obtain additional supplies. Ground water pumping during the 1990-91 crop year is unknown, but could be in the vicinity of 400,000 AF. The pumping depth varies considerably from 100 to 500-plus feet. The quality of the water varies considerably from adequate to poor. Surface water.

Surface water. The district has no local surface water supplies or reclaimed water. Imported supplies are from the federal CVP. A full-contract supply is 1,150,000 AF, which is allocated to two different priority areas within the district. Westlands Water District(Continued)With a full supply the higher priority area receives about 2.7 AF per acre, and the second priority area (about one-third of the district) receives about 1.3 AF per acre. Any reduction in supply is applied proportionately to both priority areas.

Water transfers. Transfer from other districts are needed in any year the CVP does not have surplus (interim) water supplies. Transfers can be either for the district as a whole or for individual farmers who have access to water in other districts. Transfer activity increases significantly in drought years.

5. Any comments or concerns on circumstances unique to your agency.

None.

**Yolo County Flood Control
and Water Conservation District
34274 State Highway 16
Woodland, CA 95695**

Mrs. Christy Barton
916/662-0265

Date of Response: January 14, 1991

1. What are your alternatives if 1991 is as dry or drier than 1990 and if 1991 is as dry as 1977? Please include the critical aspects in this section and the time frame by which the decisions must be made.

The district had no water available for sale from winter 1989-90. If winter 1990-91 is as dry as either 1990 or 1977, the district will again have no water available for sale. The district's financial position after four years of drought is such that it will require the layoff of all noncritical personnel (approximately two-thirds of our employees).

At the January 1991 Meeting of the Board of Directors, the Board authorized layoff of all non-critical employees effective March 1, 1991.

2. What are your conservation or rationing goals and did you meet these goals in 1990? Do you anticipate changing either the level (percent) or methods of conservation?

NA

3. What assistance does your agency need?

The district could use financial assistance to complete a study and possible project developing an additional increment of water now lost to the Pacific Ocean during flood flows.

The district also needs the policies of the State Water Resources Control Board and the State legislature to protect the sources of supply that the district has been able to develop but that do not currently provide an adequate supply. Our existing water resources should not be further reduced to provide water outside our service area. e.g., proposed Bay-Delta discharges.

In the broad picture, the State legislature needs to actively support the development of environmentally safe water storage projects through the policies of the various responsible agencies and financial participation.

Yolo, Continued

4. What are your major supply sources in normal years and drought years?

Our major sources of supply are all surface supplies. The average quantity of water available for release from storage:

	Average Year
Clear Lake Storage	138,500 AF
Indian Valley Reservoir since 1974 construction	201,000 AF

Cache Creek direct diversions are not quantified.

The district picks up all waters that reach its diversion structure on Cache Creek. Cache Creek flows are co-mingled with water releases into Cache Creek from both Clear Lake and Indian Valley Reservoir. The district has appropriated all Cache Creek water not diverted by riparians or prescriptive users above our diversion structure.

5. Any comments or concerns on circumstances unique to your agency.

The district is unique in that its stored water must flow down more than forty miles of a natural creek prior to reaching the diversion structure into the canal system. The losses of our stored water to the creek and illegal diversions are extremely high and cannot feasibly be controlled.

Assembly Concurrent Resolution No. 180

RESOLUTION CHAPTER 166

Assembly Concurrent Resolution No. 180—Relative to water resources.

[Filed with Secretary of State September 14, 1990.]

LEGISLATIVE COUNSEL'S DIGEST

ACR 180, Cortese. Water resources: California drought.

This measure would request the State Department of Water Resources to submit a report to the Legislature by March 15, 1991, containing specified information regarding the availability of water in the State of California for 1991. The measure would urge the Department of Fish and Game to report to the Legislature on the water needs of fish and wildlife measures.

The measure would support all feasible efforts to reduce the impacts of the drought in California and would urge the Department of Water Resources, including the Drought Center and Interagency Drought Task Force, to provide local agencies with drought information, and technical and financial assistance in the development of efficient water management programs.

WHEREAS, The State of California is in a fourth year of drought with the last three years being critically dry; and

WHEREAS, The drought resulted in mandatory and voluntary conservation programs statewide, with the Santa Barbara area reducing its water use by 45 percent; and

WHEREAS, The agriculture served by both the State Water Project and the federal Central Valley Project will face reductions of 25 to 50 percent in surface water deliveries in 1990 and groundwater overdraft situations will be exacerbated; and

WHEREAS, The drought has resulted in low stream flows, low reservoir levels, high water temperatures, and poor water quality severely affecting the viability of California's fish and wildlife resources; and

WHEREAS, The water supplies in the State of California have not increased to reflect the increased water demands with the addition of an estimated 772,000 new residents in 1989, 45 percent from natural increase; and

WHEREAS, If the 1990-91 water year is dry, or even normal, there will be widespread areas of water shortage adversely affecting the economy and the environment, including the fish and wildlife resources in California; and

WHEREAS, Water management and conservation is primarily implemented at the local level, with state technical and financial assistance; and

WHEREAS, The Department of Water Resources has established a Drought Center to provide technical and financial information to lessen impacts of the drought and an Interagency Drought Task Force consisting of representatives from the Department of Water Resources, the Department of Fish and Game, the State Water Resources Control Board, and the State Department of Health Services, to identify and coordinate drought assistance measures; and

WHEREAS, A Drought Action Committee has been established, consisting of representatives of local, state, and federal agencies to act as a forum where participants can receive and exchange information on assistance available to local agencies regarding the drought; now, therefore, be it

Resolved by the Assembly of the State of California, the Senate thereof concurring, That the Legislature supports all feasible efforts to reduce the impacts of the drought in California, including the conservation and reclamation efforts of state and local agencies and the citizens of California; and be it further

Resolved, That the Legislature urges the Department of Water Resources, including the Drought Center and Interagency Drought Task Force, to provide local agencies with drought information, and technical and financial assistance in the development of efficient water management programs to lessen the adverse impacts of current and future drought; and be it further

Resolved, That future efforts to minimize the adverse impacts of a drought include actions to encourage additional water conservation, water development, water reclamation, water transfers, conjunctive use, and groundwater quality protection, while protecting natural riparian and fishery populations; and be it further

Resolved, That the Legislature urges the Department of Water Resources to consult with the Interagency Drought Task Force and other water purveyors and submit a report to the Legislature by March 15, 1991, containing the following information: (1) the status of the water supply in California for 1991 based on the criteria of critically dry, or dry year runoff as indicated by the Sacramento River Index; (2) the contingency measures, by region of the state, to mitigate effects of water shortages in 1991; and (3) the current and future plans of the Department of Water Resources to conserve and augment the state's water supplies while protecting the quality of the state's natural resources; and be it further

Resolved, That the Legislature urges the Department of Fish and Game to report to the Legislature by March 15, 1991, on the water needs of fish and wildlife resources and how those needs can be met; and be it further

Resolved, That many of these drought measures are presently required pursuant to Chapter 957 of the Statutes of 1988, and should be implemented expeditiously; and be it further

Resolved, That the Chief Clerk of the Assembly transmit copies of

this resolution to the Department of Water Resources, the Department of Fish and Game, the State Water Resources Control Board, and the State Department of Health Services.

O

Senate Bill No. 32

CHAPTER 957

An act relating to drought assistance, and declaring the urgency thereof, to take effect immediately.

[Approved by Governor September 16, 1988. Filed with Secretary of State September 19, 1988.]

LEGISLATIVE COUNSEL'S DIGEST

SB 32, Ayala. Water resources: drought assistance.

Under existing law, the Department of Water Resources has various powers and duties relating to ensuring adequate supplies of water within the state.

This bill would direct the department to identify the areas of the state in which a 3rd year of drought could impose severe health, economic, and environmental hardship and to develop options for addressing those water supply shortages and for protection of fish and wildlife. The bill would require the department to report its findings to the Legislature by January 21, 1989.

The bill would direct the department to assist, as prescribed, local representatives in the areas identified in implementing the emergency water supply options which are currently authorized.

The bill would become inoperative upon specified determinations or findings by the department.

The bill would make legislative findings and declarations.

The bill would declare that it is to take effect immediately as an urgency statute.

The people of the State of California do enact as follows:

SECTION 1. The Legislature hereby finds and declares as follows:

(a) 1987 and 1988 have been successive critically dry years and water shortages are now occurring in some areas of the state.

(b) If 1989 is also dry, there will be widespread areas of water shortage. These shortages, especially shortages affecting urban areas, agricultural areas with permanent crops, and fisheries would have a serious impact on California's economy.

(c) The Department of Water Resources is taking action to assist areas of water shortage this year. The department has established a statewide Drought Center as a clearinghouse of the technical and financial assistance information which is available to address and lessen drought impacts and has formed an Interagency Drought Task Force to identify and coordinate existing drought assistance measures. The department is now beginning to concentrate on actions that may be needed in 1989 should the current drought

continue.

SEC. 2. The Legislature directs the Department of Water Resources to identify the areas of the state in which a third year of drought could impose severe health, economic, and environmental hardship. The department, in coordination with local representatives and other state and federal agencies, including the Department of Fish and Game, shall develop options for addressing the water supply shortages in the identified areas of potential need, and for protection of fish and wildlife. In its consideration of water supply options, the department shall consider, among other things, water conservation, expanded use of local groundwater supplies, emergency and temporary water quality protection facilities such as temporary barriers in the Sacramento-San Joaquin Delta, water transfers of developed supplies, and temporary interconnections that facilitate exchanges between surface water distribution systems. The department shall also identify the need for legislative or regulatory actions that may be needed to implement the emergency water supply options in a timely manner. The department should consider, in consultation with appropriate local, state, and federal agencies, regulatory or legislative actions including, but not limited to, reevaluating existing drinking water standards where those standards hamper implementation of emergency water supply options; accelerating regulatory processes; implementation of the California Environmental Quality Act; the processing of applications by existing water rights permit holders or licensees for temporary changes; and establishing an emergency financial assistance program that could include loans, loan guarantees, or grants to assist drought-stricken areas. The financial assistance could be used to finance the construction of temporary distribution system interconnections, the drilling of new wells, or other temporary drought related programs. The department shall report to the Legislature on its findings by January 21, 1989.

SEC. 3. The Legislature directs the Department of Water Resources to assist local representatives in the areas identified as potentially having severe shortages next year in implementing the emergency water supply options developed pursuant to Section 2 which are currently authorized. The department shall provide assistance through the department's Drought Center to any water user needing help implementing an emergency drought related action. The department shall provide technical and financial expertise and shall assist water users through the state's regulatory system so necessary drought emergency actions are not unreasonably slowed by that system. All state agencies shall cooperate fully with the department in this effort.

SEC. 4. This act shall become inoperative if the May 1, 1989, forecast in the Department of Water Resources' Bulletin 120 indicates that the 1988-89 hydrologic year in the Sacramento River Basin is an above normal or wet year or upon a subsequent finding

by the Director of Water Resources that the drought is over.

SEC. 5. This act is an urgency statute necessary for the immediate preservation of the public peace, health, or safety within the meaning of Article IV of the Constitution and shall go into immediate effect. The facts constituting the necessity are:

In order to provide effective drought relief at the earliest possible time, it is necessary that this act take effect immediately.

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