REPORT OF THE COMPTROLLER GENERAL OF THE UNITED STATES

California Drought Of 1976 And 1977-- Extent, Damage, And Governmental Response

With the drought persisting through 1976 and 1977, surface water supplies in some parts of California dwindled sharply, and large quantities of groundwater were extracted to make up the shortage.

The drought did the most damage to California's agriculture, especially the livestock industry. Federal, State, and local government response has been generally adequate to cope with the drought.

Because of the potential, significant adverse effects of continued groundwater extraction without adequate replenishment, delays in completing water projects, and concerns for protecting and preserving water resources, it is questionable whether the water developments and proposals covered in the State water plan will meet projected water demands. GAO therefore recommends that the Federal and State Governments re-examine how to best meet future water demands.

CED-77 137

OCTOBER 19, 1977

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-190188

The Honorable Leo J. Ryan, Chairman
Subcommittee on Environment, Energy,
and Natural Resources
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

In accordance with your March 10, 1977, letter and subsequent arrangements with your office, here is our report which describes our findings on the nature, extent, and impact of the 2-year California drought, the governmental response to cope with the emergency, and California state planning to meet future water demands.

To expedite this report you requested that we not obtain formal written comments from the various Federal agencies involved in our review. However, the matters in this report were discussed with agency officials.

Our report contains a recommendation to the Secretary of the Interior (See p. 71.) which involves water resources planning in California.

As you requested distribution of this report to the California congressional delegation and State agencies and departments will be handled by your staff. Furthermore, as agreed with your office, general report distribution will occur five working days after you have received it.

Sincerely yours,

Comptroller General
of the United States

REPORT OF THE
COMPTROLLER GENERAL
OF THE UNITED STATES

THE CALIFORNIA DROUGHT OF 1976 AND 1977--EXTENT, DAMAGE, AND GOVERNMENTAL RESPONSE

D I G E S T

California is among the western States hardest hit by the 1976 and 1977 drought. Since California provides about 10 percent of the Nation's agricultural output and 25 percent of its table needs, the drought there concerns everyone.

At the request of the Chairman, Subcommittee on Environment, Energy, and Natural Resources, House Committee on Government Operations, GAO obtained information on the extent and impact of and governmental response to the drought, as well as information on water supply planning and management. GAO visited many Federal, State, and local agencies, including 11 local municipal and irrigation water agencies. Conditions found in the 10 areas are described in appendix II.

EXTENT AND DAMAGE OF THE DROUGHT

Because of the diversity in rain and snowfall and the distribution of State water resources, some areas were harder hit than others.

California agriculture, especially livestock, was expected to lose in 1977 $2.4 billion in gross farm income and related industries as a result of the drought. Losses in 1976 were estimated at $500 million. Losses to urban and industrial areas were considered minimal.

As 1977 progressed farmers switched to crops requiring less water, pumped groundwater extensively, and took advantage of rising crop prices. Consequently, State officials expect losses to be lower than predicted. (See p. 30.)

The impact on employment, recreation, and electric power generation was not considered large. The State reported in August 1977 unemployment because of the drought at less

than 1,500. While many recreational resorts and related businesses suffered considerable losses, other types of recreation were expected to benefit. (See p. 32.)

Hydroelectric power, which normally furnishes about 28 percent of State needs, was cut back by about one-third as a result of low reservoir levels. However, major power producers compensated for such losses by shifting to power generated from fossil fuels; "brownouts" are not anticipated, and requirements should be met in 1977.

The switch to more expensive fossil fuels will require about 50 million additional barrels of oil costing about $650 million. Whether further increases in such power are possible, should the drought continue, is questionable because major suppliers said that their powerplants were operating at capacity in 1977. (See p. 33.)

- State officials predicted the possibility of a devastating 1977 fire season, and their fears came true. By August 1977 some 7,000 fires throughout the State burned about 420,000 acres. Fire fighting costs and property damages are reported at about $425 million. (See p. 34.)

In addition, the water shortage causes the quality of some water supplies to deteriorate, and become more salty, which affects farm productivity and fish stocks.

GOVERNMENTAL RESPONSE

Generally, governmental response to the drought has been adequate, reducing the effect of the drought in the State. The overall effectiveness of governmental actions, however, will depend on the duration of the drought. (See p. 36.)

Specific State, Federal, and local government actions included:

--State and Federal legislation passed early in 1977 to help improve water supply systems, purchase and transport

water, provide immediate drought relief, and promote water conservation.

--As of July 1977 about $4.5 million in State funds and about $55 million in Federal loans and grants was available for drought-related emergencies. Most counties in the State were designated emergency drought areas and thus are potentially eligible for Federal assistance. (See p. 38.)

--Establishment of a task force to deal with the immediate and the long-range implications of the drought and to coordinate the relief efforts of State, Federal, local, and private organizations. (See p. 45.)

--Emphasis on water conservation, especially at the local level. Some local water agencies instituted stringent mandatory conservation measures, others voluntary measures. In some districts water usage was reduced by more than 50 percent. Water rates, however, increased. (See p. 53.)

--Reduction of the amount of water delivered for agriculture by the two major water projects (which provide about 25 percent of State needs) by about 60 to 75 percent. Should 1978 also be a drought year, the two projects may have to stop delivering water to most agricultural customers in the Central Valley. As a result the agricultural community would have to rely more on groundwater, already depleted by extensive pumping in 1977. (See p. 47.)

Thinking ahead to possible drought in 1978, the State relaxed water quality standards so that less water would be released from State and Federal reservoirs to counter saltwater intrusion in the Sacramento-San Joaquin Delta. Much fresh water is needed to maintain water quality for municipal, industrial,

agricultural, recreational, and fish and wildlife purposes in the Delta area. (See p. 52.)

PLANNING FOR THE FUTURE

The State water plan shows that dependable water supplies will not provide for State needs through the year 2000, even if certain conditions are met. The conditions include completion of planned Federal, State, and local surface and groundwater projects, as well as reclamation and re-use of wastewater. To compensate, more groundwater will have to be extracted than is replaced. (See p. 61.)

Continued, excessive extraction of groundwater can lead to land subsidence, poor water quality, and high energy costs as pumping depths increase. In the San Joaquin Valley depletion of groundwater over an extended period could result in the loss of about a million acres of California's most productive agricultural land which depends on groundwater for irrigation. (See p. 61.)

State-proposed alternatives to drawing more groundwater--capturing more Delta surplus winter flows and developing new supplies in a river basin protected by the State Wild and Scenic Rivers Acts--could make up much of the projected deficit. However, whether such alternative supplies can be made available or the planned water projects will be developed is questionable. (See p. 69.)

In view of the water supply realities brought to the forefront by the drought and the questionable capability of the State to meet future water demands, GAO believes that a re-examination of the State plan is desirable and that the Federal Government should take part in such a re-examination because substantial Federal investment in water resources development is required to implement the plan.

GAO recommends that the Secretary of the Interior request the State and other applicable agencies, as they consider necessary, to establish a task force to re-examine the

the State plan to determine the best ways to meet the projected future water demands. (See p. 71.) The re-examination should be designed to consider the questions and issues listed on p. 71.

To expedite issuance of the report the Subcommittee requested that GAO not obtain written comments from Federal, State, and local agencies. However, the matters in the report were discussed with the agencies in informal conferences.

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ABBREVIATIONS

EDA	Economic Development Administration
SBA	Small Business Administration
SCS	Soil Conservation Service

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CHAPTER 1

INTRODUCTION

California is one of the western states hit hardest by the drought in 1976 and 1977. The water shortage affected its urban, industrial, and agricultural sectors, especially its agricultural Central Valley. California provides about 10 percent of the Nation's agricultural output; consequently, the drought concerns also those parts of the Nation depending on its agriculture.

In March 1977 Congressman Leo J. Ryan, Chairman of the Subcommittee on Environment, Energy, and Natural Resources, House Committee on Government Operations, requested that we examine the emergency in California to assess the:

--Extent of the drought.

--Damage and dislocation caused to date and the anticipated full extent of that damage.

--Adequacy of drought emergency planning by governmental agencies and others responsible for managing and storing water.

--Adequacy of the governmental response to the emergency.

--Adequacy of water storage and diversion systems.

--Need for additional systems or the modification of existing systems.

--Full potential for water storage and management to meet foreseeable needs and to cope with foreseeable drought periods.

In later discussions with the Congressman's staff, we agreed that the issues concerning adequacy might be difficult to determine within the time allowed to complete this assignment. Also, in some cases, criteria might not be available to evaluate performance by governmental agencies.

We agreed to select several districts for review of governmental response at the local level, inquire about water quality, and explore the coordination between the U.S. Bureau of Reclamation and the U.S. Department of Agriculture.

Throughout this review we obtained voluminous information on the drought from State, Federal, and local agencies. It was agreed that we would not be required to verify this information.

SCOPE OF REVIEW

We contacted the following agencies and organizations at the State, Federal, and local levels.

State of California--
- Department of Finance
- Department of Water Resources
- Department of Food and Agriculture
- Employment Development Department
- Water Resources Control Board
- California Crop and Livestock Reporting Service

Department of Agriculture
Bureau of Reclamation
Corps of Engineers
National Oceanic and Atmospheric Administration
Scripps Institute of Oceanography, La Jolla, California

We also met with the California Drought Emergency Task Force appointed by the Governor in March 1977 to coordinate the efforts of the various agencies responding to the drought. Along with State and Federal agencies, task force participants include the University of California, Farm Bureau Federation, Association of California Water Agencies, and the Pacific Gas and Electric Company.

To determine the extent and effects of the drought at the local level and to gather information on local water management--particularly water conservation measures employed to cope with the emergency--we visited water service agencies in 8 of the State's 11 hydrographic or water basin areas. These water service agencies manage water supplies in their communities.

Hydrographic area	Name of water service agency visited	County
North Coastal basins	Humboldt Bay Municipal Water District	Humboldt
San Francisco Bay area	Marin Municipal Water District	Marin
	California Water Service Company	San Mateo/ Salinas
Central Coastal basins	Monterey Flood Control and Water Conservation District	Monterey
South Coastal basins	Los Angeles Department of Water and Power	Los Angeles
	Metropolitan Water District of Southern California	(Various)
	San Diego County Water Authority	San Diego
Sacramento Basin	Orland Unit Water Users Association	Glenn
San Joaquin Basin	Westlands Water District	Fresno
Tulare Lake Basin	Wheeler Ridge-Maricopa Water Storage District	Kern
Colorado Desert	Imperial Irrigation District	Imperial

CHAPTER 2

CALIFORNIA WATER PICTURE

GEOGRAPHIC CHARACTERISTICS

California covers 158,000 square miles and has more than 1,200 miles of coastline. The coastal mountains extend for nearly 600 miles; their numerous ridges range from 2,000 to 7,000 feet and are separated by valleys, rivers, and small streams. The State is divided into 11 district water basins.

The Central Valley is an alluvial plain, 400 miles long and 50 miles wide, drained on the north by the Sacramento River and on the south by the San Joaquin River. Both rivers meet in the center of the Valley and form the Sacramento-San Joaquin Delta, which flows into the San Francisco Bay.

The Sierra Nevada range, 385 miles long and 85 miles wide, is a series of high peaks, deep gorges, and canyons. About 12 major rivers, such as the Feather, American, Stanislaus, Tuolumne, and Merced, traverse the western slope of the range and flow into the Sacramento and San Joaquin Rivers. The north-coastal area is densely timbered and is supplied water by rivers such as the Klamath and Trinity. South of the Central Valley lie the Los Angeles-Long Beach metropolitan area and San Diego; to east and south the Colorado Desert.

WATEP CHARACTERISTICS

About 65 percent of California's average annual precipitation--200 million acre-feet--1/ is lost through evaporation and consumption by trees, plants, and other vegetation. What is left, about 71 million acre-feet, is the yearly runoff that can be tapped to meet State water needs.

If the State could count on this runoff each year, and retain all of the water for use, it would have an abundance of water. However, several factors prevent this:

--Climatic conditions vary greatly throughout the year.

1/ One acre-foot is the amount of water required to cover 1 acre with 12 inches of water. It is equal to about 325,900 gallons.

--Much of the water does not originate where it is needed.

--Rivers which carry about one-fourth of the average runoff, some 18 million acre-feet, are protected by the State Wild and Scenic Rivers Acts which prevent the storage of water from those rivers.

In addition, about 40 percent of California is underlain by groundwater basins. Their total storage capacity is 1.3 billion acre-feet, of which the useable capacity is estimated to be 143 million acre-feet. About 40 percent of the State water needs--about 15 million acre-feet--are derived from this source.

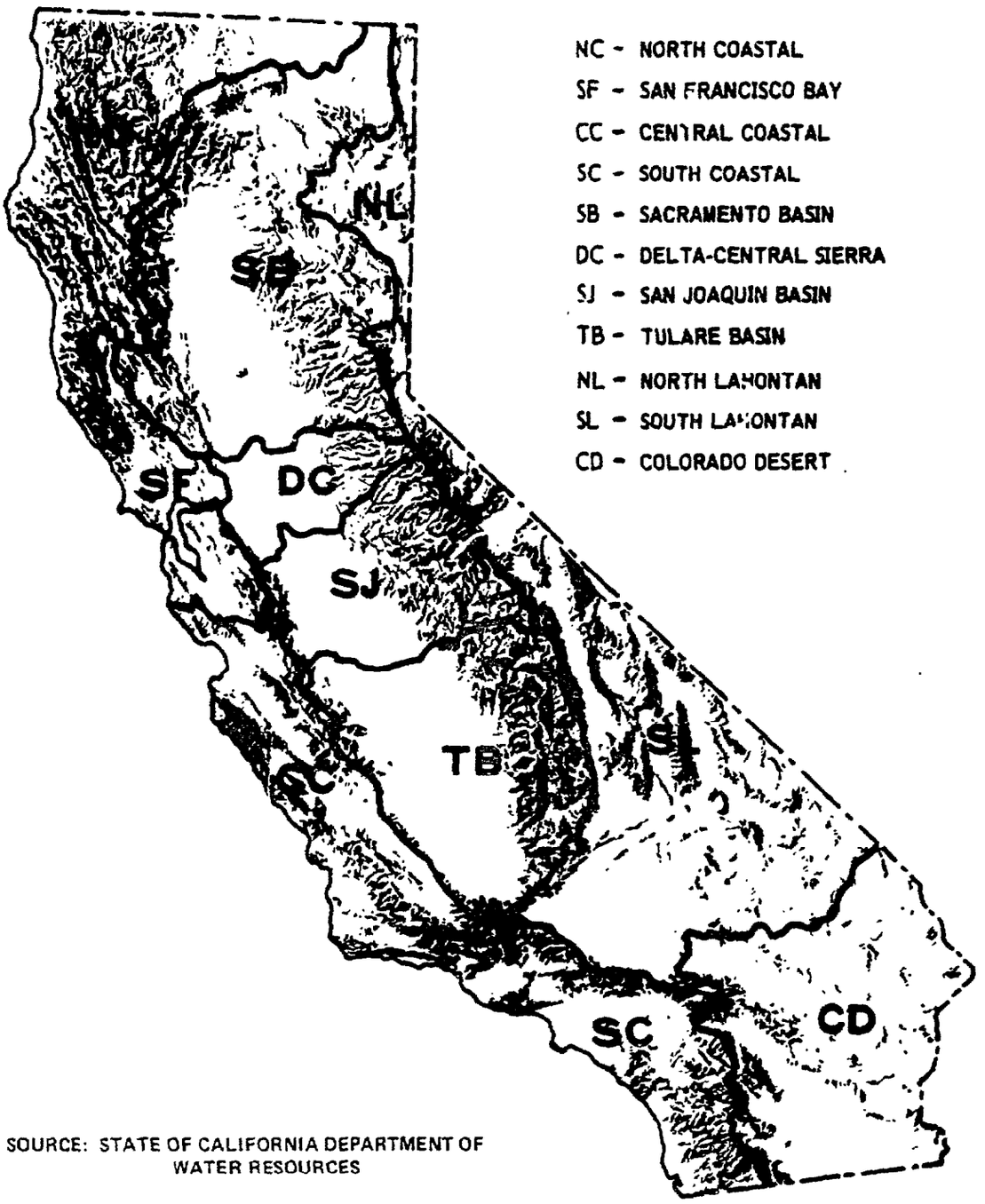
Climate and precipitation

The State has recorded temperatures ranging from 134 to -45 degrees Fahrenheit. Most of the State has two seasons--a cool, wet winter and a warm, dry summer. Coastal areas have warm winters, cool summers, and little changes in daily and seasonal temperatures. Inland, especially in the Central Valley, there are warmer summers and colder winters, with greater changes in daily and seasonal temperature, and the humidity is lower.

Coastal and inland weather pattern changes control the amount and distribution of precipitation. Most of the northern ranges average annual precipitation of 50 inches or more; the northern Central Valley averages 20 inches; the southern part of the Valley gets 10 inches or less. In northern California, most annual precipitation occurs between October and April and between November and March in the south.

Snow falls at elevations of 2,000 feet and above in the Sierra Nevada foothills but does not remain on the ground below 4,000 feet. The zone of heavy snowfall is from 7,000 to 8,000 feet. It is the melting of the normally deep snowpack in these and higher elevations which provides continuous flow for most Sierra Nevada streams in spring and summer. Occasionally, persistent dry winter weather creates drought conditions.

HYDROLOGIC STUDY AREAS OF CALIFORNIA



SOURCE: STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES

Much water is not where it is needed

California's basic water problem is maldistribution. The State's average annual runoff greatly exceeds its water requirements. The runoff, however, does not occur at the right places.

The greatest amount of runoff are in the Sacramento Basin and North Coastal areas which receive about 50 million of the average annual runoff of 71 million acre-feet. Yet 80 percent of State water requirements, agriculture and urban areas, lie south of Sacramento.

California Wild and Scenic Rivers Acts

The State designated eight rivers for protection under its Wild and Scenic Rivers Acts.

With certain exceptions, the rivers are to be preserved in a free flowing state and their scenic, recreational, and other qualities enhanced. The acts preclude State agency participation in the planning and construction of projects such as dams and reservoirs which would directly affect the rivers' natural conditions.

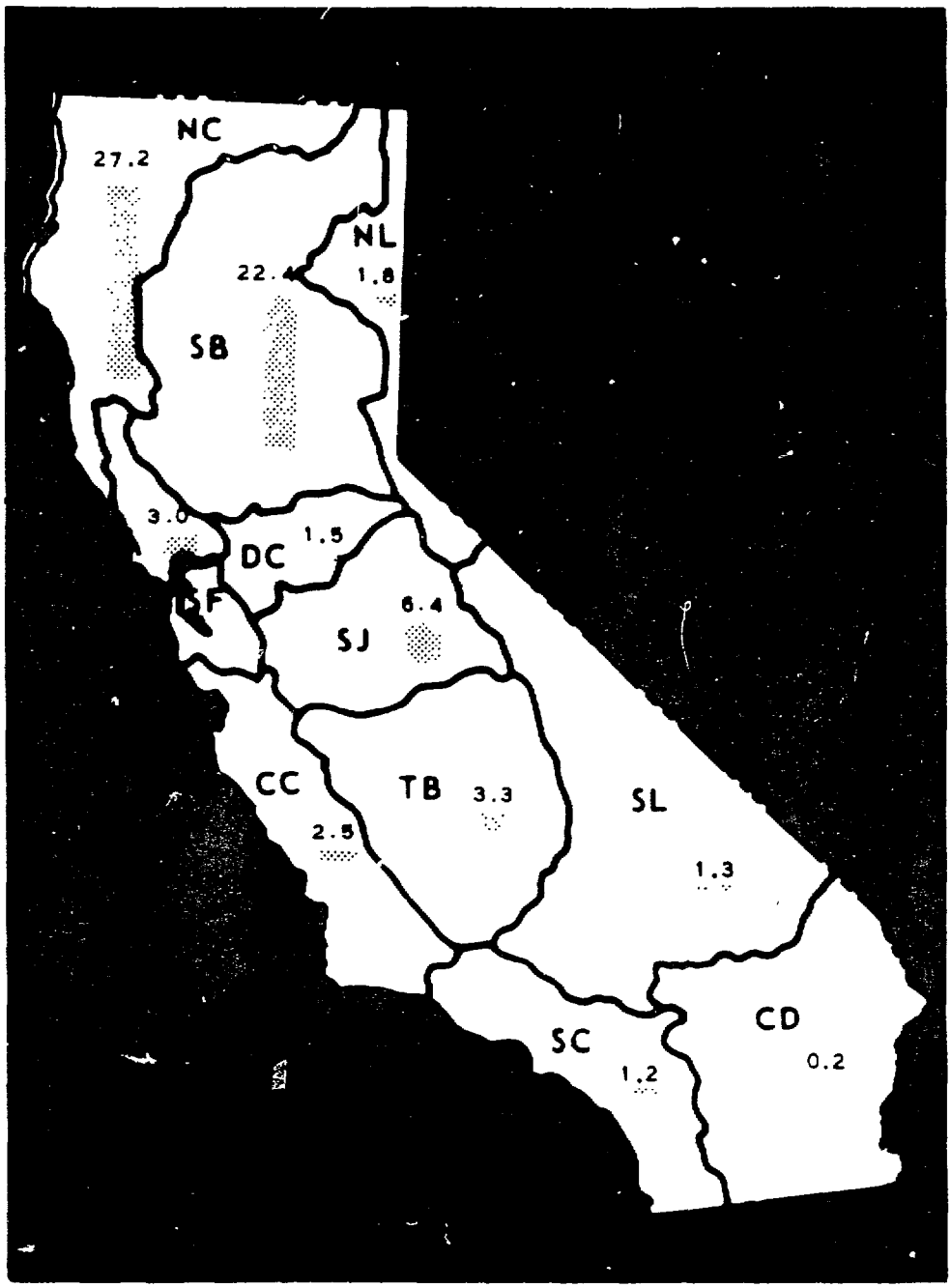
About 18 million of the annual runoff of 71 million acre-feet are protected by the acts. Included are the Smith, most of the Klamath and its tributaries, the Eel and tributaries, the North Fork, and lower mainstem of the American Rivers.

Groundwater is a significant State resource

About 15 million acre-feet of water are drawn from the ground yearly. In its September 1975 Bulletin No. 118 entitled "California's Ground Water, 1975," the State Department of Water Resources noted:

> "By using ground water and surface water supplies together in a planned manner, more complete management of the total water resources is possible. Although both surface and underground water sources are being utilized in many areas of the State today, much of this activity is not providing the maximum benefits that are possible from conjunctive ground and surface water management. Use of storage capacity of ground water basins

AVERAGE ANNUAL RUNOFF IN MILLION ACRE-FEET



has a great potential to increase the dependability of presently developed surface water supplies if the two supplies are used conjunctively."

Usable, underground storage capacity in California is about 143 million acre-feet. While much of this storage is not used, in areas such as the San Joaquin Basin, groundwater pumping exceeds the annual recharge rate, which results in an overdraft of 1.5 million acre-feet yearly.

Much of the State's underground capacity is located in the Sacramento Basin (22 million acre-feet), the San Joaquin Basin (80 million acre-feet), and the South Coastal basins (10 million acre-feet). Since these basins encompass most of the populated and agricultural lands of the State, underground capacity is better located than surface water. Most surface water originates in less developed parts of the State. According to the bulletin, concern is increasing about the protection of State groundwater basins and more effective use of their capacity. During the 1977 drought much of the shortage in surface water was alleviated through intensive pumping of groundwater.

AGENCIES AND ORGANIZATIONS SUPPLYING WATER

In the State a multitude of entities oversee, monitor, or manage water or the organizations which are involved in supplying water. State and Federal agencies focus primarily on supplying surface water. Water use at the local level, including groundwater, is controlled by individual water supply districts and organizations.

Water rights and quality are regulated by the State Water Resources Control Board. The Department of Water Resources provides overall planning to meet statewide, foreseeable water needs and manages and operates the State Water Project, which is designed to shuttle surface water from the northern to the southern part of the State.

At the Federal level the Bureau of Reclamation manages and operates the Central Valley Project, which is primarily designed to shuttle surface water from the northern to the southern part of the State. The Corps of Engineers, although not directly involved in water supply, constructs projects for flood control and maintains navigable streams.

The last time the State attempted to identify water supply entities at the local level there were about 3,700 different organizations, about 900 publicly owned and about 2,100 privately owned. The public organizations are municipal water works or water districts. Private water organizations--commercial water companies--number about 700, and incorporated or unincorporated mutual companies number about 1,400.

Municipal waterworks are city-owned and -operated utilities which provide water service to city residents and possibly to surrounding vicinities. One major class of publicly owned State water service organizations are water works, most commonly operated as self-supporting city departments which derive revenue from retail sales and are subject to city regulation. Cities such as Los Angeles, San Francisco, and San Diego own and operate their water agencies.

Public water districts are organizations established by the State legislature to meet specific community needs relating to water supply such as development, conservation, use, and disposal. There are over 30 types of districts that can be formed under a general legislative provision. The most prominent of the general districts are State, county, and municipal water districts; irrigation, public utility, and reclamation districts; and county waterworks. In addition, about 85 water districts were formed by special acts of the State legislature to handle unique situations arising as a result of increasingly complex water problems.

Commercial water companies are privately owned, profit-oriented organizations operating under the State Public Utilities Commission and are required to serve all applicants within their franchised area. The commission identified about 700 in February 1977.

Mutual water companies are private corporations or associations that deliver water solely to their stockholders or members at cost. These companies are not under the Public Utilities Commission's jurisdiction, do not have eminent domain, and cannot tax as can some public water districts.

Numerous other miscellaneous entities, aside from individuals, supply the public water incidental to their principal function. They include railroads, public agencies, trailer courts, wayside commercial establishments, apartment houses, and others.

State Water Project

The project was authorized by the State legislature in 1951, and construction began in 1957. It commences in the upper Feather River region where three of five authorized dams have been constructed. Their reservoirs primarily provide for recreation with minor irrigation and domestic water uses.

Downstream from these dams (about 90 miles) are the Oroville facilities. Dominant among these facilities is Lake Oroville, which provides the major conservation storage for the project. Other primary benefits from these facilities include flood control, electric energy generation, recreation, and enhancement of fisheries and wildlife habitats.

Water released from the Oroville facilities flows down the Feather River until it joins the Sacramento River and continues to the Sacramento-San Joaquin Delta. An aqueduct branches from the Delta to serve the north San Francisco Bay area.

The California Aqueduct is the primary conveyance feature of the project for delivery of water to the southern San Francisco Bay area, San Joaquin Valley, and central and southern California. The Aqueduct begins southernmost in the Delta, extends southward along the western side of the San Joaquin Valley, crosses the Tehachapi Mountains, follows the northern flank of the San Gabriel and San Bernardino Mountains, crosses the San Bernardino Mountains, and terminates in Riverside County, a total distance of 444 miles from the Delta. Also, branch aqueducts carry water to the southern San Francisco Bay area, certain coastal counties, and Los Angeles metropolitan area.

The project currently delivers about 2 million acre-feet of water each water year to its customers. By the year 2020 it is expected to deliver about 4.5 million acre-feet.

Central Valley Project

The Congress authorized the Central Valley Project in 1937, and construction began in October of that year. It was conceived to overcome the natural maldistribution of the water supply in the Central Valley. Shasta Dam, key to the project, was begun in 1938.

The initial units of the project consisted of Friant and Shasta Dams and the Contra Costa, Delta-Mendota, Friant-Kern, and Madera Canals. Its first water deliveries were made from the Contra Costa Canal in 1940. Recent water deliveries average about 6.5 million acre-feet.

The American River Division, authorized in 1949, provided for the construction of the Folsom and Nimbus Dams, reservoirs, and powerplants. In 1950 the Sacramento Canals Unit was authorized; in 1955 the Trinity River Division, including Trinity Dam and Powerplant, Lewiston Dam, Whiskeytown Dam, Judge Francis Carr Powerhouse, and Spring Creek Powerplant; in 1960 the San Luis Unit; in 1965 the Auburn-Folsom South Unit; and in 1967 the San Felipe Division. New Melones Dam on the Stanislaus River is nearing completion.

The project's main, multiple functions are to provide a dependable, ample, year-round supply of water for Central Valley irrigation and municipal and industrial uses. The facilities which store and deliver this water provide, however, many other benefits, including electric power operation, flood control, navigation, fish and wildlife enhancement, recreation, water quality control, and environmental protection and preservation.

Much of the project's capacity is located in the northern part of the State with large dams and reservoirs, such as Shasta, Trinity, and Folsom, which release water down several rivers to the Sacramento River. This water flows through the Sacramento-San Joaquin Delta. Water is conveyed south to the Central Valley by the Delta-Mendota Canal. The project also supplies the east side of the Central Valley water by way of the Friant Dam, powerplant, and other facilities and the Friant-Kern Canal.

Several additional units are to be constructed to complete the project; most notable is the Auburn Dam on the American River. Auburn is a multipurpose project involving irrigation, power, recreation, municipal and industrial water, fish and wildlife, and flood control. Dam construction has been delayed pending the results of a seismic hazard study. In August the Congress appropriated $39.7 million for the Auburn-Folsom South Project under Public Law 95-96.

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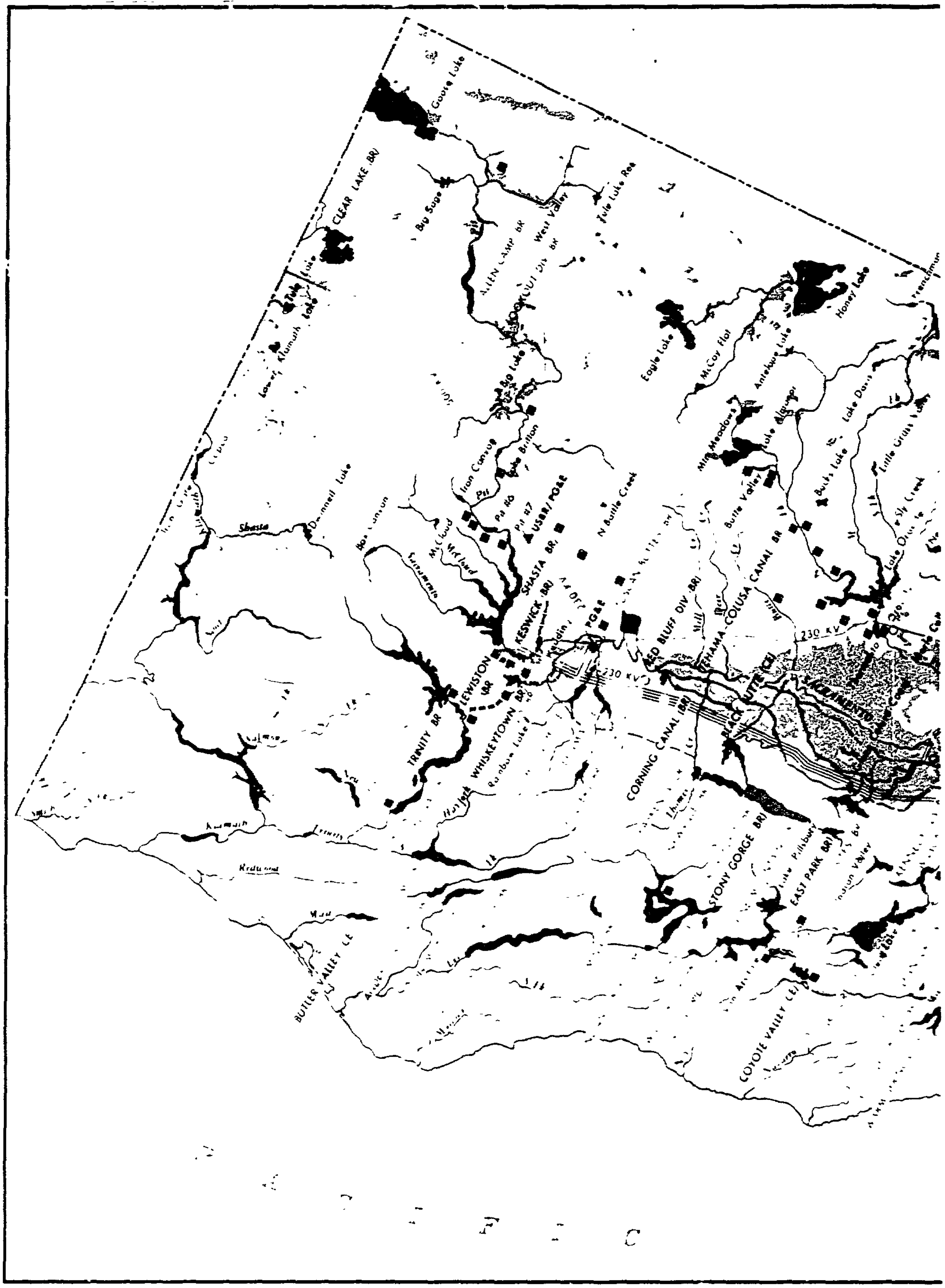
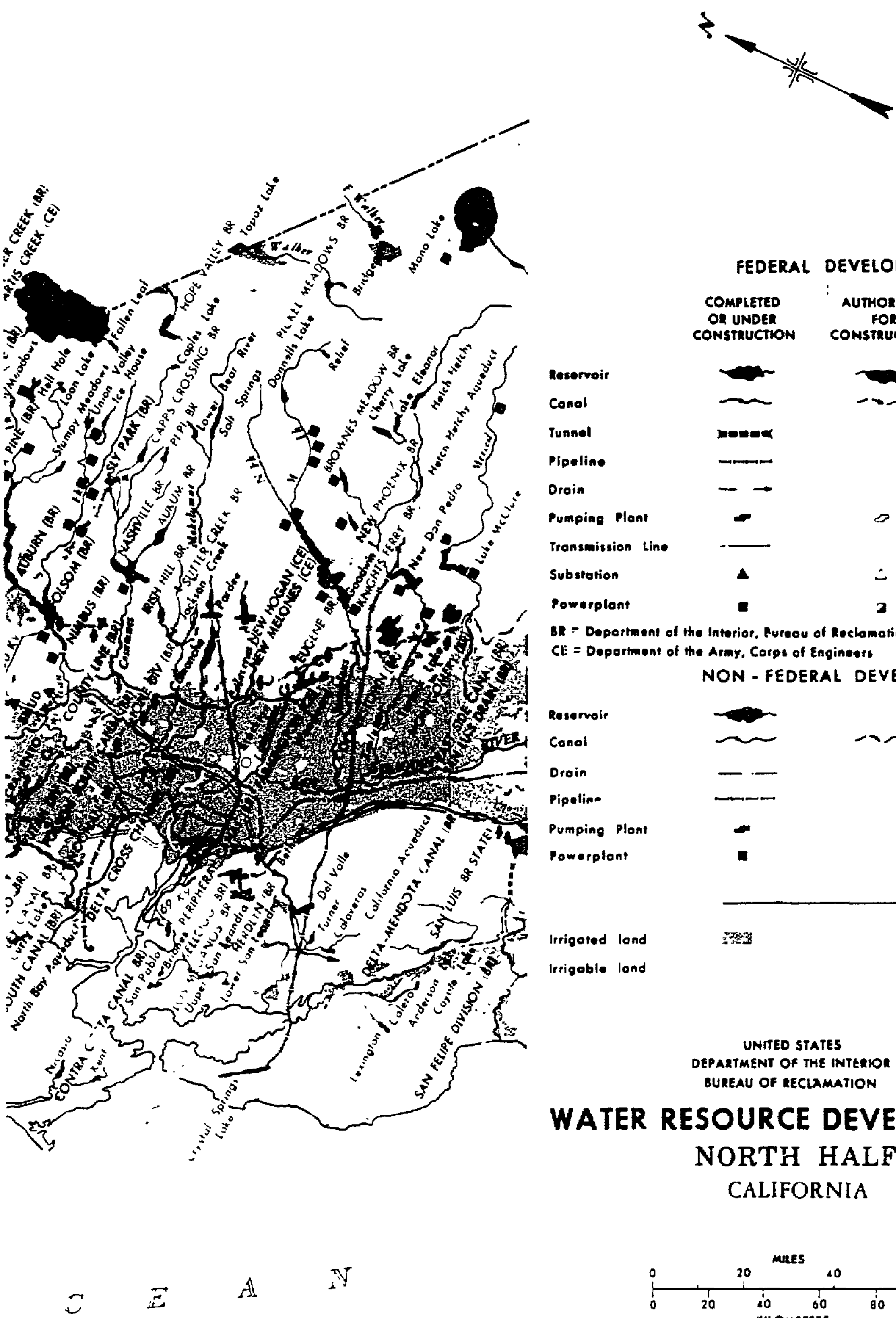


Goose Lake
CLEAR LAKE (BR)
Big Sage
West Valley
Tule Lake Res
Honey Lake
Eagle Lake
McCoy Flat
Antelope Lake
Lake Davis
Bucks Lake
Butte Valley
Mtn Meadows
Lake Almanor
Lake Britton
Iron Canyon
Pit
Pit 5
Pit 6
Pit 7
USBR/PG&E
N Battle Creek
Dunsmuir Lake
Shasta
McCloud
Sacramento
SHASTA (BR)
KESWICK (BR)
PG&E
LEWISTON (BR)
TRINITY (BR)
WHISKEYTOWN (BR)
Rainbow Lake
RED BLUFF DIV (BR)
TEHAMA-COLUSA CANAL (BR)
CORNING CANAL (BR)
BLACK BUTTE (CE)
SACRAMENTO
230 KV
STONY GORGE (BR)
EAST PARK (BR)
Lake Pillsbury
COYOTE VALLEY (CE)
BUTLER VALLEY (CE)
Klamath
Trinity
Redwood
Mad



FEDERAL DEVELOPMENT

	COMPLETED OR UNDER CONSTRUCTION	AUTHORIZED FOR CONSTRUCTION	POTENTIAL
Reservoir			
Canal			
Tunnel			
Pipeline			
Drain			
Pumping Plant			
Transmission Line			
Substation			
Powerplant			

BR = Department of the Interior, Bureau of Reclamation
CE = Department of the Army, Corps of Engineers

NON - FEDERAL DEVELOPMENT

Reservoir
Canal
Drain
Pipeline
Pumping Plant
Powerplant

Irrigated land
Irrigable land

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

WATER RESOURCE DEVELOPMENT
NORTH HALF
CALIFORNIA

MILES
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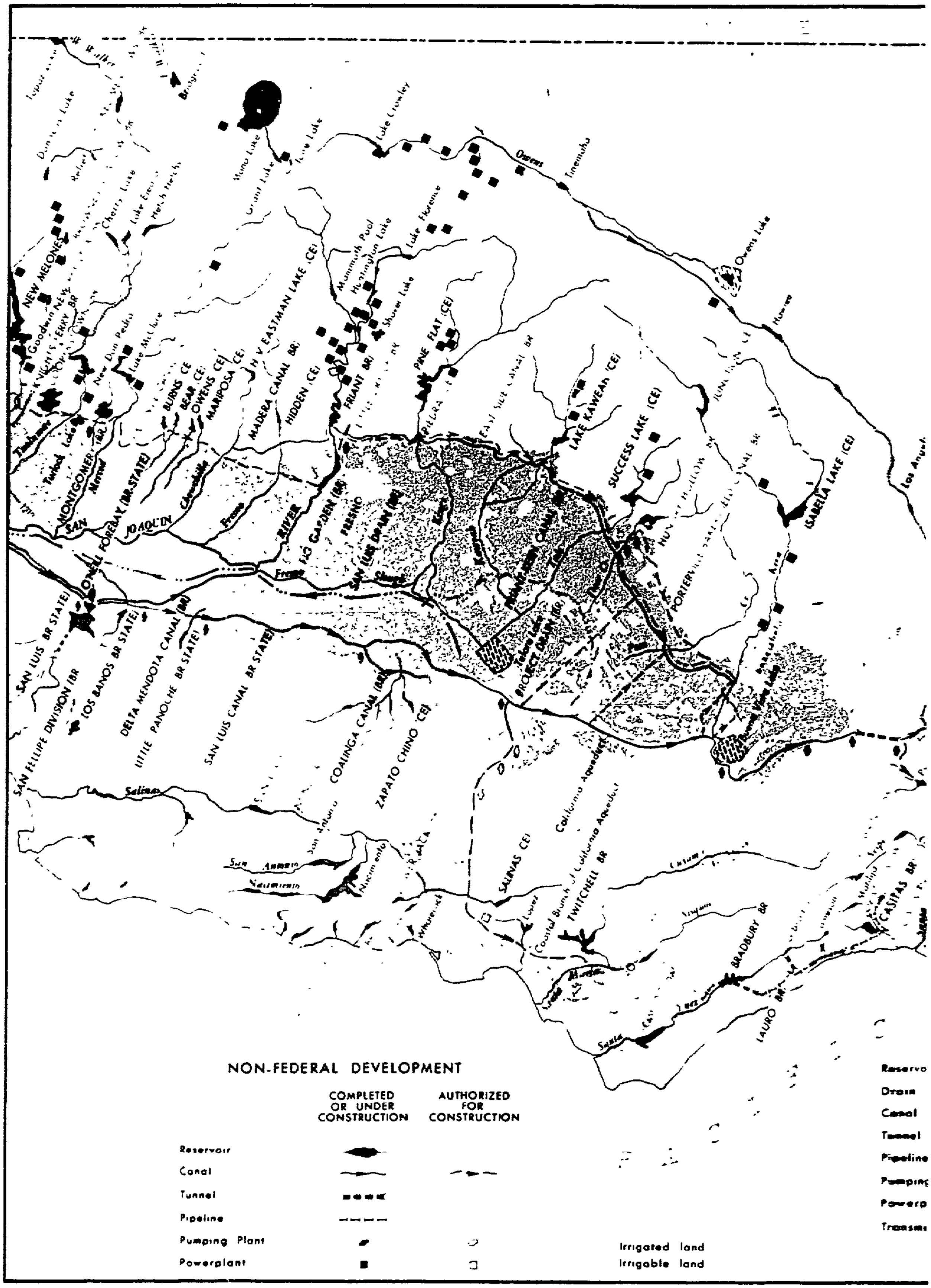
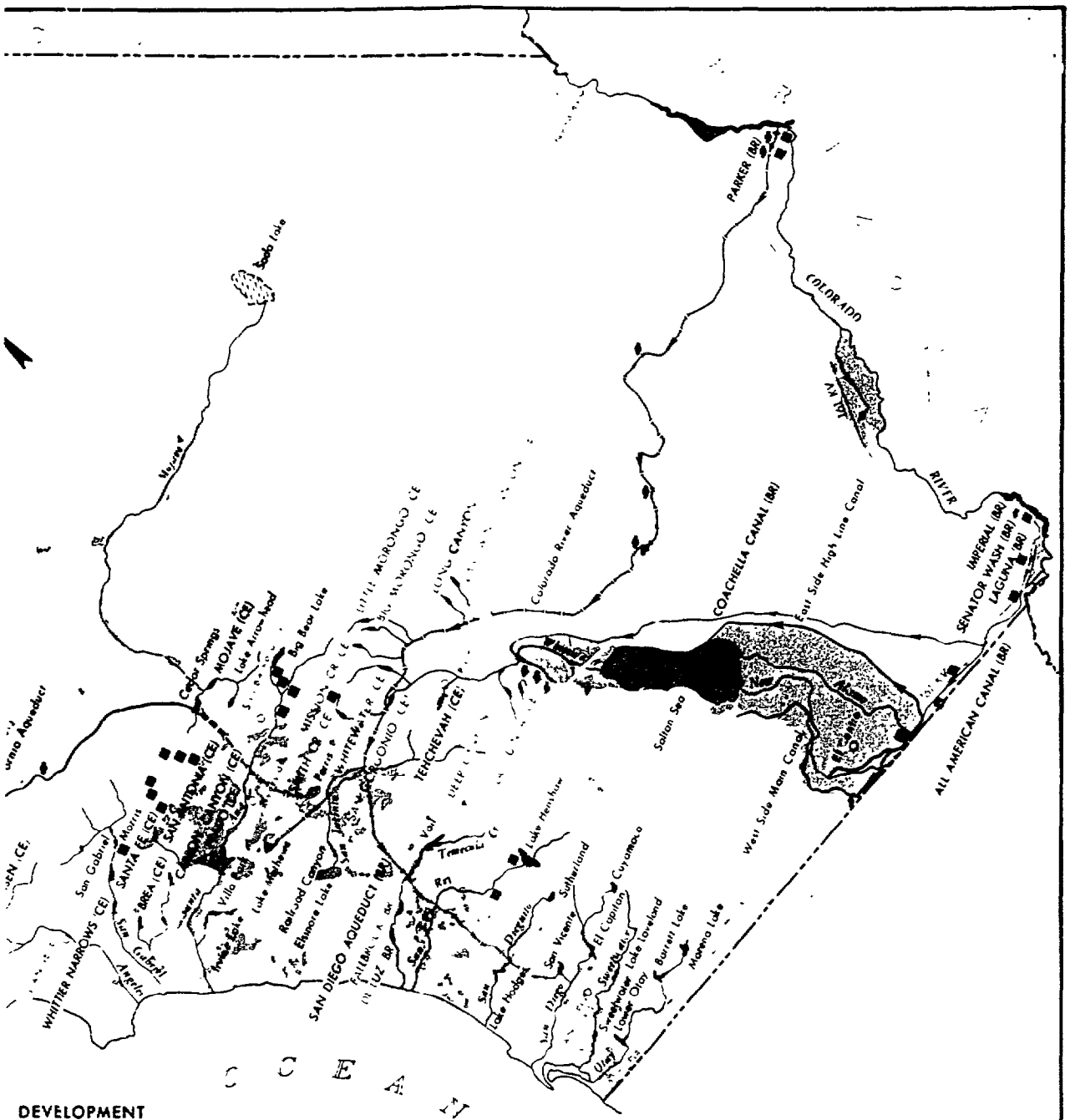
0 20 40 60 80
KILOMETERS

F~BRUARY 1976 65-208-816


NEW MELONES
MONTGOMERY (BR)
SAN JOAQUIN RIVER
O'NEILL FOREBAY (BR STATE)
SAN LUIS BR STATE
LOS BANOS BR STATE
DELTA MENDOTA CANAL (BR)
LITTLE PANOCHE BR STATE
SAN LUIS CANAL BR STATE
SAN FELIPE DIVISION (BR)
COALINGA CANAL (BR)
ZAPATO CHINO (CE)
H V EASTMAN LAKE (CE)
MADERA CANAL BR
HIDDEN (CE)
FRIANT BR
PINE FLAT (CE)
OWENS CE
MARIPOSA CE
BURNS CE
BEAR CE
HOG GARDEN (BR)
FRESNO
SAN LUIS DRAIN (BR)
LAKE KAWEAH (CE)
SUCCESS LAKE (CE)
ISABELLA LAKE (CE)
PROJECT DRAIN (BR)
SALINAS CE
TWITCHELL BR
BRADBURY BR
CASITAS BR
LAURO BR
California Aqueduct
Coastal Branch California Aqueduct
Salinas
Mono Lake
Lake Crowley
Owens Lake
Owens
Mammoth Pool
Huntington Lake
Lake Florence
Shaver Lake
Lake McClure
New Don Pedro
Cherry Lake
Turlock Lake
Merced
Chowchilla
Fresno
Fresno Slough
San Antonio
Nacimiento
NON-FEDERAL DEVELOPMENT
COMPLETED OR UNDER CONSTRUCTION
AUTHORIZED FOR CONSTRUCTION
Reservoir
Canal
Tunnel
Pipeline
Pumping Plant
Powerplant
Irrigated land
Irrigable land



DEVELOPMENT

COMPLETED OR UNDER CONSTRUCTION	AUTHORIZED FOR CONSTRUCTION	POTENTIAL

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

WATER RESOURCE DEVELOPMENT
SOUTH HALF
CALIFORNIA

MILES
0 20 40 60
0 20 40 60 80
KILOMETERS

e Interior, Bureau of Reclamation
e Army, Corps of Engineers

FEBRUARY 1976

65-208-817

BLANK

Water drawn from the Colorado River

The Colorado River is an important State source of water, providing about 5 million acre-feet annually. About 4.4 million acre-feet represents the State's share according to a U.S. Supreme Court allocation of the Colorado water among States of the Colorado River Basin. The remainder was slated for the Central Arizona Project.

Colorado River water is used for agriculture in the Blythe and Yuma areas along the River and the Imperial and Coachella Valleys. It is put to municipal and industrial use in the coastal drainage area between Ventura and San Diego Counties.

CHAPTER 3

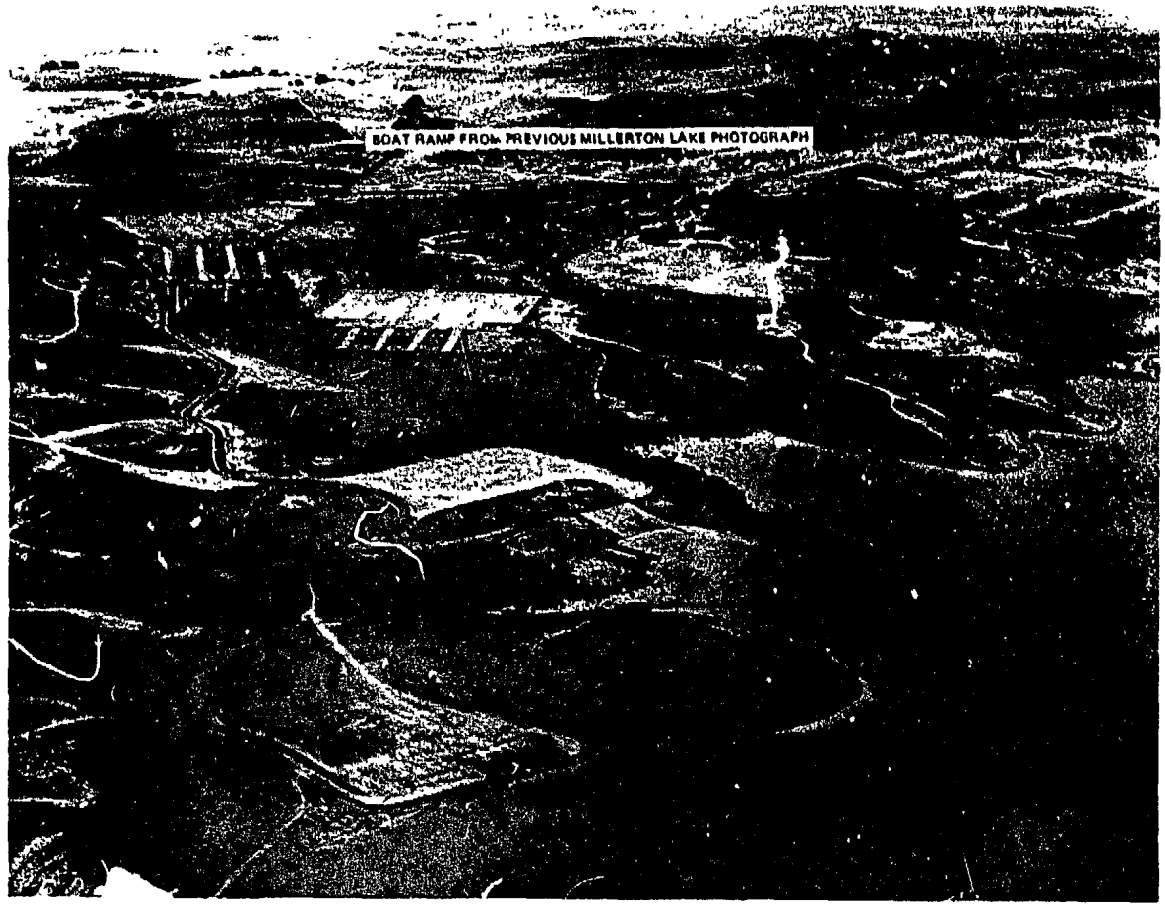
EXTENT AND IMPACT OF THE DROUGHT

Since late 1975 a persistent high atmospheric pressure area off the California coast has dominated winter weather, preventing normal precipitation in most parts of the State. Rain and snowfall were sparse enough in 1976 to qualify that year as one of the driest in State history. During the summer of 1976 reservoirs throughout the State were drawn down to record lows. (See the photos on the following pages.) Groundwater in many areas was depleted because of intensive pumping. By July 1977 this situation continued, although most State water needs were being met. Should 1978 prove to be as dry, even more serious shortages of water are expected, especially for agriculture. If the drought continues, the Bureau of Reclamation predicts curtailment in service to most agricultural users in the Central Valley and limited service to municipal and industrial users. The State is also expecting curtailment of water deliveries.

The diversity in rain and snowfall and the distribution of water resources throughout the State caused some areas to be harder hit than others. The coastal ranges and the Sierra foothills--solely dependent on rainfall--were immediately affected. Large parts of the Central Valley, dependent on surface water from reservoirs, found their supplies dwindling. Conversely, in southern California, the impact was minimal because the area gets much of its water from the Colorado River, which had sufficient carryover storage in its upstream reservoirs.

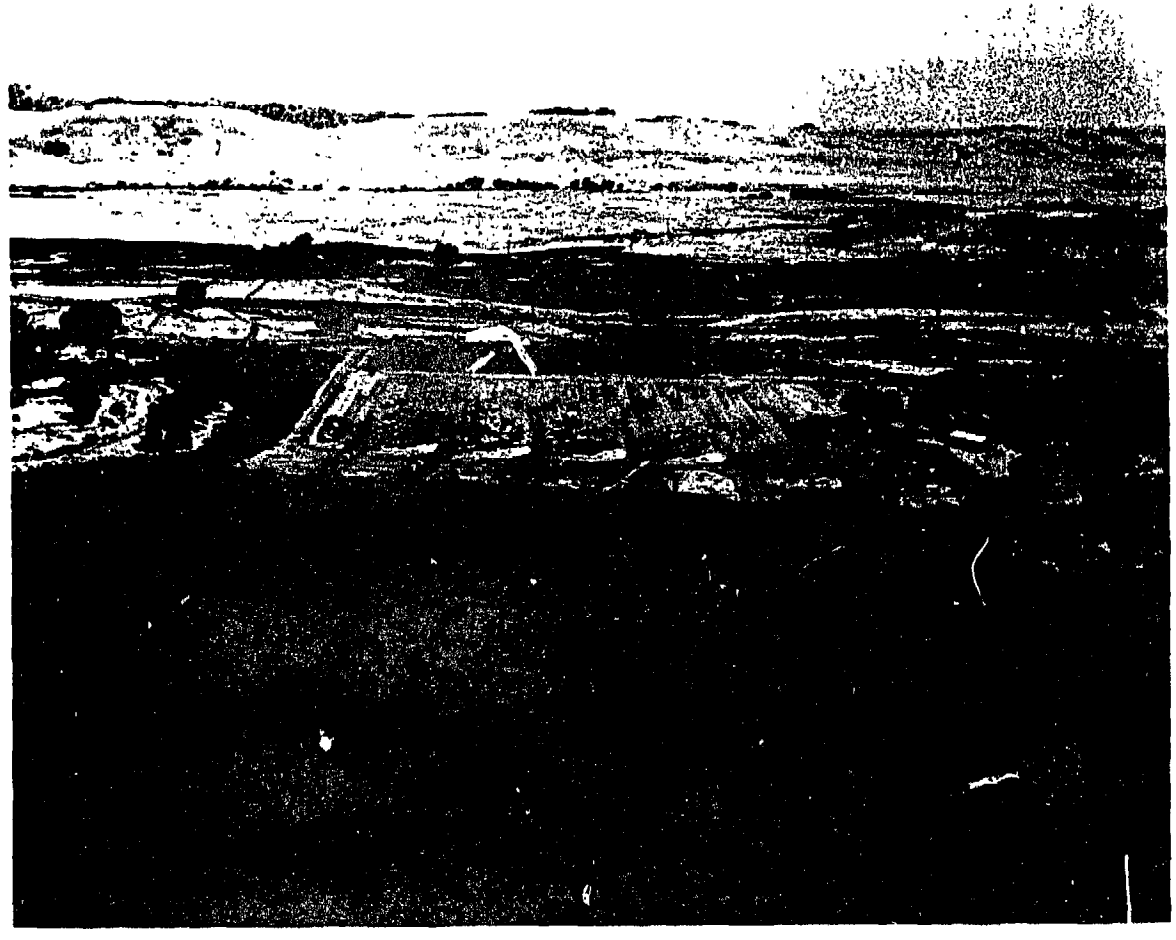
The drought has affected the agricultural sector most, especially livestock and dryfarming, because they depend heavily on rainfall. Since the State produces over 10 percent of the Nation's total agriculture and 25 percent of the its table needs, the impact of the drought in California, if it continues, is likely to increase consumer food prices nationwide.

Agricultural losses were estimated at about $500 million in 1976. Although urban and industrial area losses were not estimated, they were generally considered to be minimal. Predictions of multibillion dollar losses in 1977 farm production and agriculturally related industries made



MILLERTON LAKE OF THE CENTRAL VALLEY PROJECT IN SEPTEMBER 1976
WITH ONLY 219,000 ACRE FEET OF WATER

SOURCE. BUREAU OF RECLAMATION



MILLERTON LAKE OF THE CENTRAL VALLEY PROJECT AT CAPACITY WITH 520,000 ACRE FEET OF WATER

SOURCE: BUREAU OF RECLAMATION

early in the year were lowered by State agencies as the farming community switched to crops needing less water, and markets for such crops became favorable. Some crops such as tomatoes and cotton increased; others such as wheat and rice decreased. By August 1977 the most probable loss estimates dropped from $4.1 to $2.4 billion. The State's chief economic forecaster said, however, that losses may be even lower because as production declines, farm prices should rise. Overall, crop acreage was reduced only by about 1.6 percent.

The State expected large drought-related losses in recreation. The State, however, would not be greatly affected because of offsetting increases in recreational activities in other parts of the State.

Statewide unemployment due to the drought was reported at 1,461 in August 1977; this is negligible for a State with a work force of about 9.7 million. Affected occupations, in addition to those in agriculture, included those in industries such as ski resorts, nurseries, swimming pool construction, roofing, gardening and related occupations, and hotels. The well drilling industry boomed.

Hydroelectric power generation normally furnishes 28 percent of the State's power. Major power suppliers said that although hydroelectric power production has reduced, they do not anticipate electric power shortages in 1977. They expect to meet consumer demand by shifting from hydroelectric to fossil fuel-generated power. The Governor's Emergency Drought Task Force estimates that 50 million barrels of oil must be burned at a cost of $650 million to make up the hydroelectric power shortage. Should the drought continue, greater reliance would have to be placed on fossil fuel, and power suppliers said that increased use of fossil fuels would result in higher power costs to consumers. Whether increased fossil fuel generation could be achieved was doubtful because powerplants were already operating at full capacity. One company said that if the completed Diablo Canyon Nuclear Powerplant becomes operational by spring of 1978, the situation could be greatly alleviated.

The State predicted that the 1977 wildland fire season could be one of the most devastating in terms of damage to life, property, and natural resources. Fire suppression costs and property damage were predicted to exceed three-fourths of a billion dollars ($750,000,000). During the summer of 1976 fire damage was minimal, partly because of unexpected summer rains and higher than normal air moisture and humidity.

To evaluate the effects of the drought, we reviewed data on its extent, damage, and dislocation within the following definitions:

--Extent--the decrease in the amount of water California received in 1976 and 1977 as compared to previous years and the impact on rivers, reservoirs, and groundwater aquifers.

--Damage--economic losses directly attributable to the drought.

--Dislocation--agricultural, industrial, commercial, and personal life patterns changed because of the drought and its effects.

CAUSE AND EXTENT OF THE DROUGHT

The severe drought in California was caused by a persistent high atmospheric pressure area that has remained off the west coast for most of the past 2 years. The high pressure area has diverted Pacific winter storms further north and east than normal and deposited them in the Midwestern United States, depriving the State of its normal precipitation.

In higher atmosphere low pressure zones or troughs extend from the subpolar and are interspersed with ridges of high pressures building northward from the subtropics. The relative positions of these ridges and troughs govern weather conditions for a midlatitude region such as the United States.

During the winter of 1976 a stationary low pressure trough over the Hudson Bay and a high pressure ridge off the California coast dominated the United States weather pattern. The upper winds drove Pacific storms far north of their usual tracks over the coast but then propelled them southward into the Midwest, causing record snowfall and low temperatures. Not only California but Oregon, Washington, and most of the Pacific watershed were severely affected by these conditions because this is normally the period when they receive most of their precipitation. Likewise, much of the Northern Hemisphere experienced abnormal weather due to entrenched pressure patterns--China, Hawaii, and parts of Russia also reported drought.

Most reservoirs in California contained ample water supplies at the beginning of the 1976 water year (October 1, 1975), and State water needs were expected to be easily met. In December 1975 the flood control reservoirs were drawn down to safe levels, as is normally done each year, in anticipation of winter runoff.

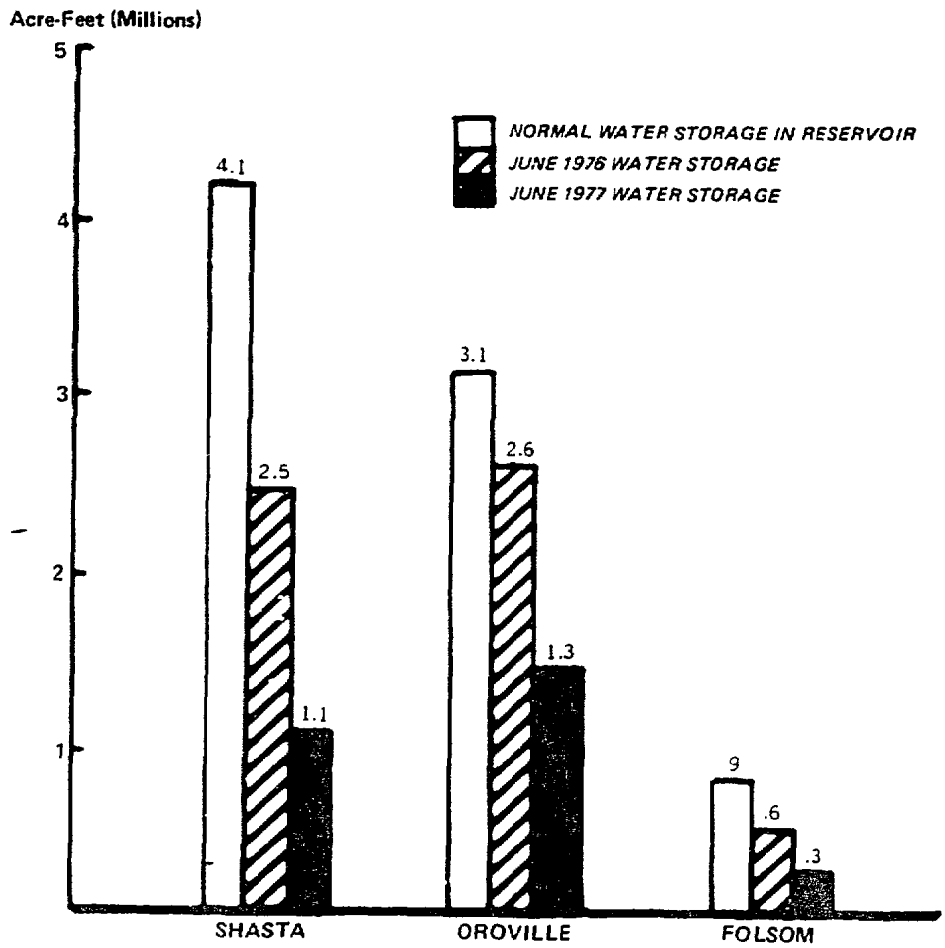
By April 1976 heavy winter storms had failed to materialize, and runoff into the rivers and reservoirs was about 45 percent normal. The snowpack, which normally provides continuous runoff, was sparse, so that by May 1976 new record lows were set for many central State streams and rivers. In the Central Valley's Sierra basins, runoff ranged from 43 percent of normal for the Feather River to a low of 16 percent for the Consumnes. On the central coast streams levels were about 10 percent normal.

Inflows into many State reservoirs were among the lowest on record. Inflows into the State's largest reservoirs--Shasta, Oroville, Clair Engle, and Folsom--totaled about 7 million acre-feet in the 1976 water year as compared to about 15 million in 1975. The yearly median inflow for the four reservoirs is usually about 13 million acre-feet.

During the 1976 water year the Bureau's Central Valley Project made full water deliveries to customers from its storage reservoirs; the State Water Project also met full deliveries during 1976. However, the lack of precipitation and snowmelt during the year caused the major State reservoirs to be at or near alltime lows by October 1976, the beginning of the 1977 water year. Because of the availability of surface water in most areas, groundwater levels were not significantly affected in 1976. However, in areas where surface water was not available, the water table was lowered because of increased pumping.

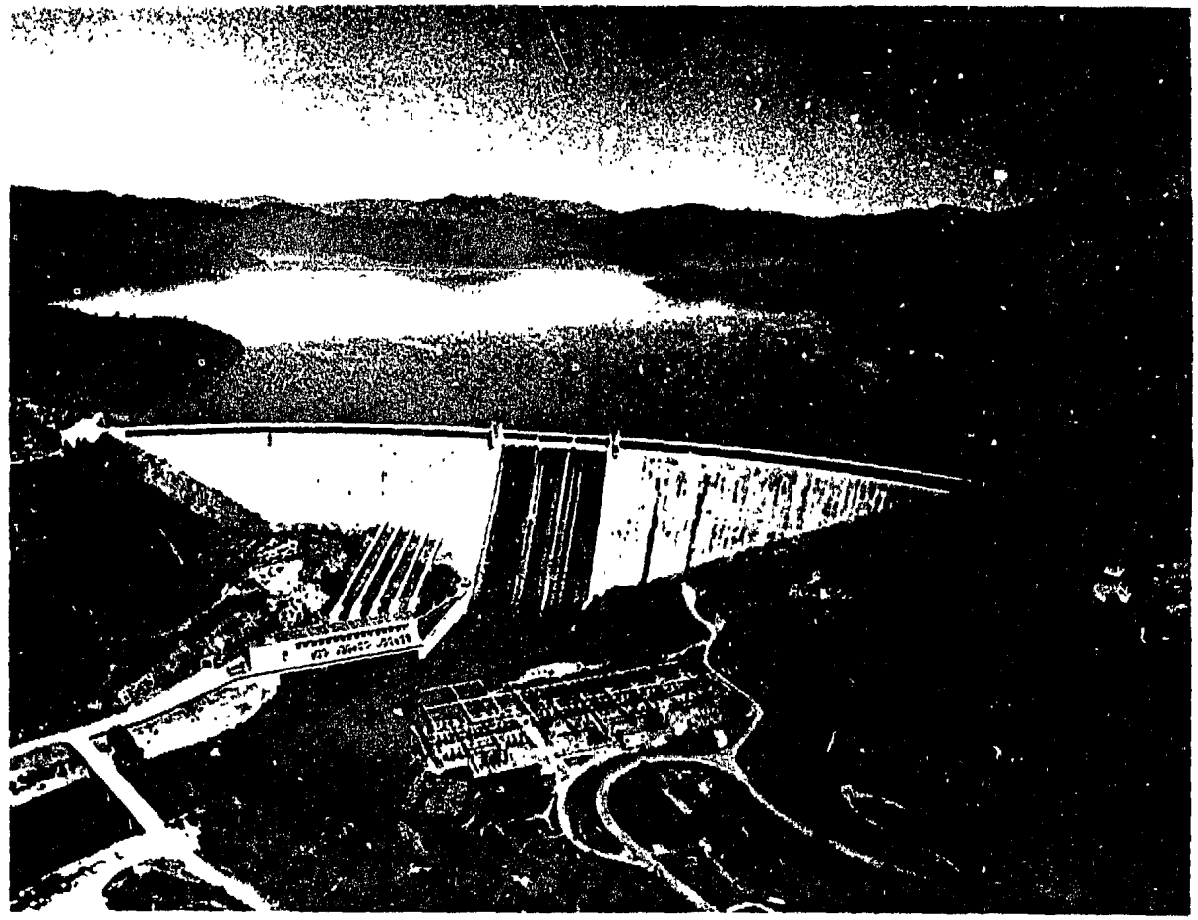
By April 1977 winter precipitation was less than 35 percent normal, and snowpack water storage in most areas was the lowest in 47 years.

The reservoirs, already drawn down in 1976, were depleted further. A comparison of normal, annual water storage at the Shasta, Oroville, and Folsom Reservoirs by June 1976 and and June 1977 (see the following chart and photos) illustrates the severity of 2 continuous years of drought.


Acre-Feet (Millions)
5
4
3
2
1
NORMAL WATER STORAGE IN RESERVOIR
JUNE 1976 WATER STORAGE
JUNE 1977 WATER STORAGE
4.1
2.5
1.1
3.1
2.6
1.3
.9
.6
.3
SHASTA
OROVILLE
FOLSOM

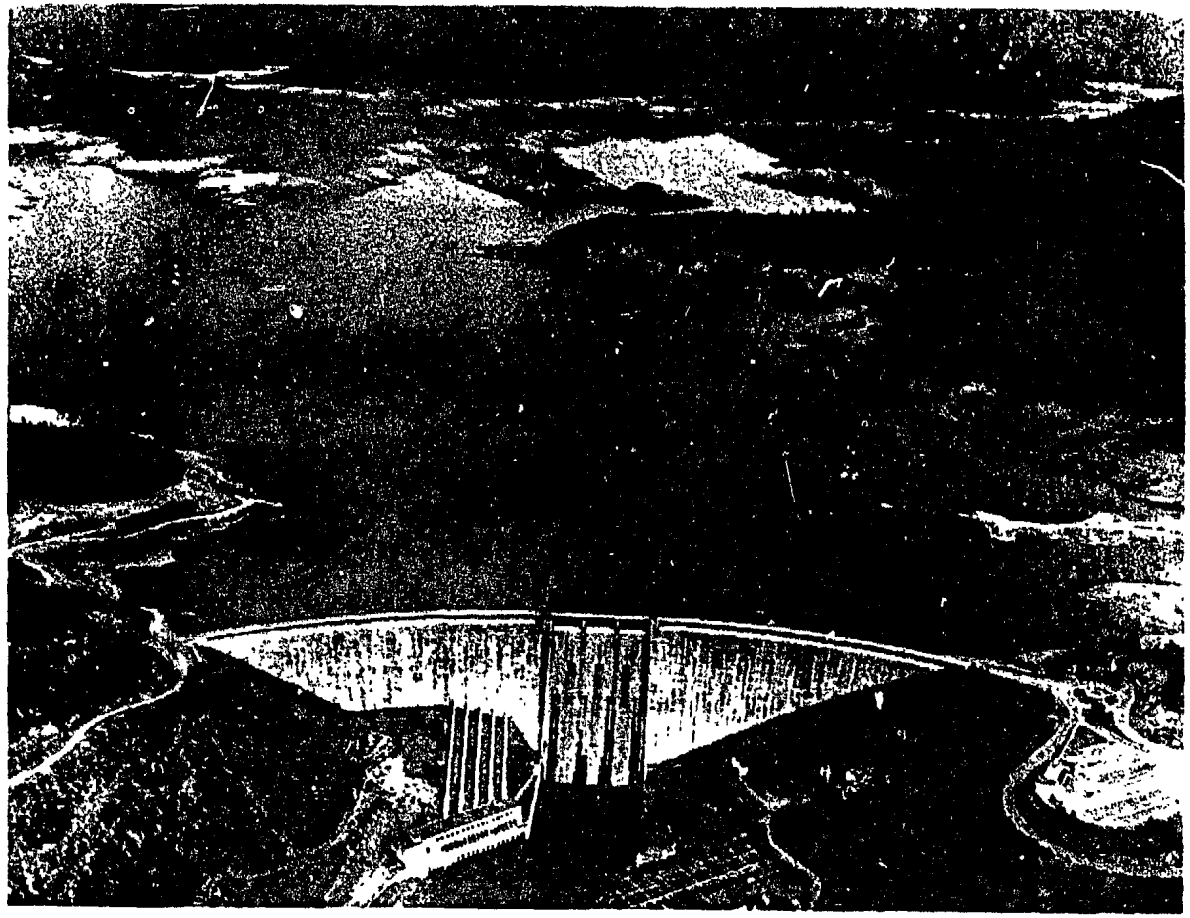
OROVILLE RESERVOIR WITH 1.6 MILLION ACRE FEET OR ABOUT 44% OF CAPACITY IN APRIL 1977

SOURCE UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION SERVICE



SHASTA RESERVOIR WITH ABOUT 4.5 MILLION ACRE FEET OF WATER IN MAY 1975

SOURCE: BUREAU OF RECLAMATION

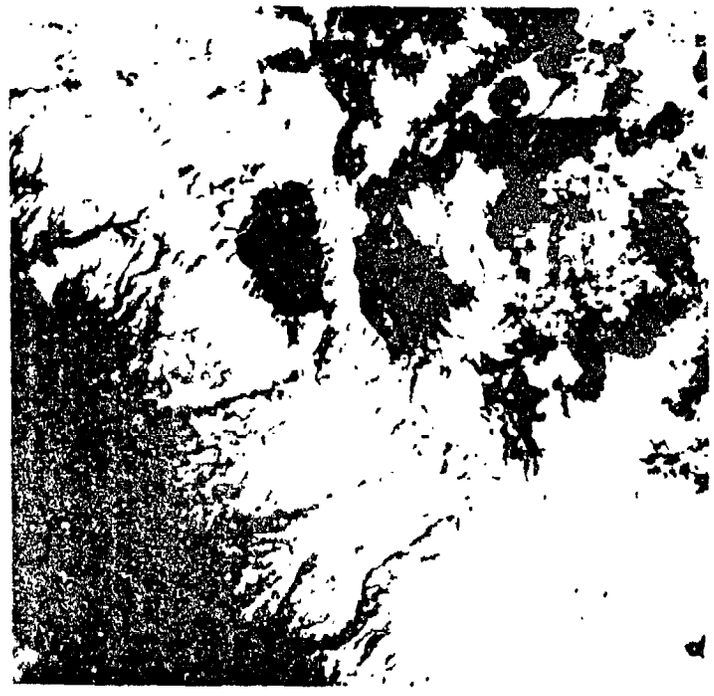


SHASTA RESERVOIR WITH ABOUT 1.5 MILLION ACRE FEET OF WATER IN MARCH 1977

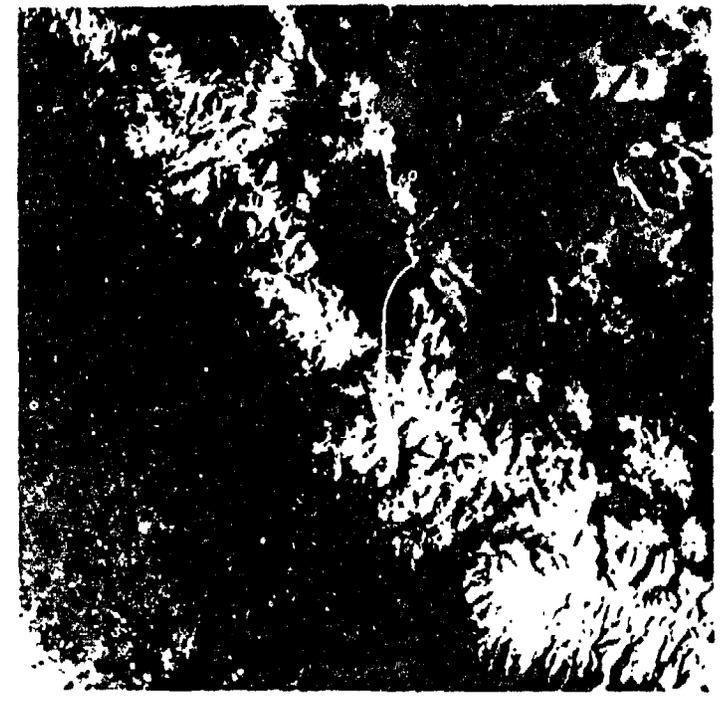
SOURCE BUREAU OF RECLAMATION

A comparison of snowcover between a near-normal runoff season (1975) and a drought year (1977) graphically portrays the diminishing snowfall. (See the following photos.)

Snowcover differences between a near normal runoff season (1975) and a drought year (1977) in the Sierra Nevada Mountains near Lake Tahoe, California as observed by LANDSAT.



25 February 1975
Average Snowline Elevation 4500 ft.



14 February 1977
Average Snowline Elevation 6500 ft.

DAMAGE AND DISLOCATION

In 1976 the State Department of Food and Agriculture estimated agricultural losses, primarily livestock, at about $510 million. In August 1977 the Department forecasted losses of about $800 million for 1977; about $500 million for livestock and $300 million for crops. The Department tripled the $800 million to $2.4 billion to account for the expected impact on industries related to agriculture.

A State Department of Finance official said that the impact on industries other than agriculture had not been measured but was likely to be small because economic losses in some parts of the State were being offset by economic increases in other parts. For example, losses from decreases in water or snow-related recreational opportunities would possibly be offset by increases in recreational visits to ocean beaches and golf courses. Although total statewide losses for industries affected by the drought may be relatively small, they can be substantial for specific businesses within those industries. For example, the State in April 1977 reported that 628 recreational resorts and related businesses may have suffered losses exceeding $37 million.

How agricultural losses were determined

In August 1977 the Department of Food and Agriculture revised its forecast of agriculturally related losses from $4.2 to $2.4 billion for 1977 to account for shifts in crops, improved commodity market conditions, and more extensive development of groundwater. Additionally, the State's earlier forecasts did not consider that southern California would increase water deliveries from the Colorado River and be able to double crop as usual. In fact, because of the drought, the State received about 500,000 more acre-feet of water than it had planned to take in 1977--88,000 acre-feet over its annual entitlement. This allowed the State Water Project to divert about 320,000 acre-feet of water to northern California and the Central Valley instead of southern California where it would have normally been delivered.

We met with a representative of the Department of Food and Agriculture to determine how the forecast was prepared and why estimated economic losses were reduced. The staff member explained that the forecast was initially designed to depict agriculturally related drought losses under three scenarios--pessimistic, realistic, and optimistic--on the basis of the following assumptions:

Pessimistic--Rainfall would be minimal through the remainder of the rainy season, some wells drying up or collapsing, along with rolling blackouts of electrical energy.

Realistic--Rainfall and well water would be be available in the same quantity as in 1976, electricity adequate for pumping demands, and no double cropping.

Optimistic--Well water supplies would increase through new drilling, electricity abundantly available, rainfall normal through the remainder of the rainy season, and plantings almost identical with those of 1976.

On the basis of the estimated amount of water available under each scenario, crop production was estimated and losses forecasted in February 1977. However, the estimate of gross income loss was revised downward in August 1977. We compared the February and August estimates as follows:

	Pessimistic		Realistic		Optimistic	
	Feb.	Aug.	Feb.	Aug.	Feb.	Aug.
	(billions)					
Crops	$1.6	$1.0	$0.9	$0.3	$0.3	-
Livestock	0.5	0.5	.5	.5	.5	0.5
Gross farm income loss	2.1	1.5	1.4	0.8	0.8	0.5
Total State agriculturally related economic loss a/	$6.3	$4.5	$4.2	$2.4	$2.4	$1.5

a/ The State estimates that for each dollar lost in agricultural production, the total loss to the State agriculturally related economy is $3. Related includes such industries as slaughterhouses and food processing.

It was estimated in February that about $500 million in damages would be suffered during 1977 by livestock producers. Cattle owners would be hit the hardest--about $462 million--while the sheep and dairy industries would lose about $46 million. As shown in the table above, estimated livestock losses did not change. Crop loss estimates, however, have been greatly reduced since the initial estimates in February. It appears that this reduction was due primarily to favorable market prices and increased acreage; a discussion of tomatoes and cotton provides an illustration.

While the growing of processing tomatoes requires more water per acre than most vegetable crops, the market price increased from $47 to $55 a ton, thus making them a favorable crop. Tomato acreage increased by about 13,000 acres over the 1976 level to about 280,000 acres. Cotton acreage increased by about 270,000 acres also because of a favorable market. Further, cotton requires less and lower quality water, and its deep roots use moisture deep in the soil.

Other factors which led to the lower estimates included more well drilling and, therefore, more use of groundwater than expected, and the availability of additional water from the Colorado River. The State estimated in early 1977 that well drilling would increase the amount of groundwater available by about 5 percent, and that many new wells would be drilled. As of August 1977 an estimated 10,000 wells had been drilled, and the groundwater supply increased by much more than the 5 percent originally estimated. By the end of 1977 groundwater should account for 53 percent of all water used by agriculture.

Also, an additional 320,000 acre-feet, normally diverted to southern California, was made available to northern California and the Central Valley through a reallocation agreement with the Metropolitan Water District in Los Angeles. The district imported about 500,000 acre-feet more than its planned requirements from the Colorado River, including 88,000 acre-feet over its annual entitlement. The additional water was available because the Bureau's (as noted earlier) Central Arizona Project, which will eventually use this water, is not complete.

Regarding the estimate of the livestock losses, State officials recognized that the cattle industry was suffering the second year of drought, but they indicated that part of the losses could be attributed to the national cattle market in the process of liquidating or selling cattle, thus resulting in depressed market prices. In other words, even in the absence of the drought, livestock industry losses would still have occurred.

The livestock industry and dryfarming operations will suffer the bulk of agricultural losses this year because the drought has dried up State rangelands, causing cattlemen to substitute higher cost hay and grain feed for lower cost grazing. To compound the problem, the dryfarming operations, which grow much of the hay and grain, are being adversely affected by the drought. Hay and grain prices have increased; cattlemen are selling their cattle before they are normally brought to market.

The chief agricultural statistician in the California Crop and Livestock Reporting Service, a joint State Department of Food and Agriculture and Department of Agriculture activity, estimates that 1977 gross farm receipts might be about the same as last year, but production costs might be somewhat increased. The Service does not make economic forecasts; it collects agricultural data and reports actual conditions after they have occurred.

Effects on farm acreage

Intended plantings reported by farmers to the Service in February 1977 indicate that the acreage of all major field crops, vegetable crops, and fruits and nuts will be about the same as in 1976, as follows.

	1976 acreage	1977 acreage
Field crops	7,200,000	7,000,000
Processing vegetables	306,500	326,100
Fresh vegetables	517,310	497,710
Fruits and nuts	1,637,656	1,685,520
Total	9,661,466	9,509,330

A net decrease of 200,000 acres is expected in field crops. Wheat acreage is being reduced by about 250,000 acres; acreage of crops that use much water such as rice and sugar beets should also decrease by about 209,000 acres; cotton acreage should increase by about 270,000 acres to a record 1.4 million acres.

According to the Service most crops should have good yields. Cotton, with its increased production, should have a very good market. Hay yields will decrease because growers will not be able to obtain the usual several cuttings. As

noted earlier, however, prices have increased. Dryland grain producers will suffer, but since most grain is irrigated, overall, grain should not do poorly.

Fruit and nut crops have had good blooms and sets and and have not been bothered by frosts, so they should do very well in 1977. The almond crop is also expected to be very good this year. Cash receipts from fruits and nuts may not vary much from 1976.

On the whole vegetable prices should be higher than in 1976. Lettuce had a poor start this year because of unseasonal weather, which caused too much of it to mature too soon; some acreages were plowed under because the market was saturated. Tomato sales are expected to increase over 1976 because of the cannery strike and late rains which caused much of the crop to spoil.

The Service estimates that the cattle industry will continue to suffer losses at least through 1977. Cash receipts in 1976 were about the same as in 1975 because more cattle were sold for less.

Impact on unemployment

Since early February 1977 the State Employment Development Department has reported the effects of the drought on employment. The State labor market should increase slightly less than what would have occurred in the absence of the drought. Unemployment will reduce marginally less than otherwise would have occurred.

The Department initiated a Daily Energy and Drought Report of Unemployment Insurance Claims in February 1977. The report was designed to identify and tabulate the number of individuals who lost their jobs as a result of an energy or water shortage and were filing claims for unemployment insurance benefits. From February to September 6, 1977, the net number of individuals out of work as a result of energy shortages was 1,150, while the number of jobless because of the drought was 1,429. The California labor force numbers about 9.7 million persons.

Most drought-related job losses occurred in such agriculturally related occupations as harvesters, weeders, trimmers, heavy machine operators, and closely related fields, such as farm machinery sales, crop dusting, and meat packing. Ski resorts, nurseries, swimming pool construction, roofing and garden supply firms, gardeners, landscapers, hotels, and flood control agencies were also adversely affected.

Department officials cautioned us that drought unemployment figures could be slightly low because the the reporting system does not count persons laid off at the end of the prior harvest season but not rehired this year because of the drought. However, they did not believe that this number was significant.

Impact of drought on electric power generation

Because of inadequate reservoir water levels, California has experienced decreasing hydroelectric power production for the last 2 years. In 1977 hydroelectric generation in northern and central California will be about 9.8 billion kilowatt hours compared to the 15.9 billion for 1976 and the 24 billion this area would normally generate.

This shortage has prompted power producers to increase the use of fossil fuels for power generation. Hydropower is less expensive than fossil fuel power, thus the switch has increased costs which are passed on to customers through rate increases. The Pacific Gas and Electric Company estimates, for example, that its fuel costs will increase by $360 million in 1977. These increases will eventually be borne by the consumer. In March 1977 the State reported that the increased use of fuel would require some 50 million barrels of oil at costs exceeding $650 million.

Officials of three California power producers--Pacific Gas and Electric Company, Southern California Edison, and Bureau of Reclamation--said that they will be able to meet customer load requirements this year. They also said that unless a major powerplant failure occurs, no brown-outs in California are anticipated.

Should the drought continue, more reliance would have to be placed on fossil fuels. Pacific Gas and Electric Company officials said they were already operating fossil fuel facilities at capacity and, therefore, additional effort would be limited.

The officials added that they could increase power production if Unit 1 of the Diablo Canyon Nuclear Power-plant becomes operational by March 1978. Questions re-garding the safety of this unit under seismic conditions have delayed operations thus far.

Fire damage and the drought

In April 1977 the Governor's task force reported that the 1977 wildland fire season could be one of the most devastating in terms of damage to life, property, and natural resources. Fire suppression costs and property damage is reported at about $425 million, and moisture-starved vegetation had dramatically increased the danger of fire.

In August 1977 the State activated the Sacramento Multi Agency Command to fight fire in the State by allocating and deploying interagency resources such as people, air tankers, and bulldozers when and where needed. Members include the State Departments of Forestry and Corrections, National Guard, Fire Marshall's Office, U.S. Forest Service, and Bureau of Land Management.

By August 1977 over 7,000 fires throughout the State had burned over 420,000 acres; 347,000 areas burned during the first two weeks of August. Between July 23 and August 11, 1977, the State recorded for the Department of Forestry and Forest Service fire suppression costs over $45 million.

As of August 16, 1977, fires in Klamath National Forest involving 16,700 acres, Sequoia National Forest involving 2,000 acres, and the San Benito-Monterey Ranger Unit involving Marble Cone and 152,900 acres, were partially contained. Over 8,000 persons fought these fires.

Water quality

A State Assembly report noted in July 1977 that generally the reduced water supply caused the Central, San Joaquin, and Southern California Districts water agencies' water quality to deteriorate. No agency interviewed during our survey reported any great impact on health as a result of the degradation. However, agriculturalists were concerned with an increase in water salt content affecting farming productivity. Industrial and domestic consumers in the southern California area were experiencing increased costs for using Colorado River water because of the high concentration of dissolved solids. Also, industries in southern California have required greater quantities of water because Colorado River water cannot be recycled as many times as water normally obtained from the State Water Project and Owens Valley.

We contacted the Water Resources Control Board, which is responsible for and monitors water quality statewide through district offices. An assistant to the board said that although data on the quality of water in the Sacramento-San Joaquin Delta was available, statewide data had not been developed.

Regarding the Delta he said that fish are being affected by poor quality water; it will take several years before water quality returns to normal and the adverse impact on the fish can be assessed. For Delta agriculture it would be a year or two before adverse impacts could be corrected, assuming normal or above normal water flows during that time.

CHAPTER 4

GOVERNMENT RESPONSE AND DROUGHT EMERGENCY PLANNING

In March 1977 the President outlined to the Congress a program for responding to the Western and Plains States drought. The Congress had also introduced much drought-related legislation. Some became law and, in addition to existing programs, were implemented primarily by the Departments of Agriculture, Commerce, and the Interior and the Small Business Administration (SBA). By April 1977 the President had declared 43 of the State's 58 counties emergency areas.

As of July 1977 about $55 million in loans and grants under Federal programs had been approved in California to mitigate the impact of the drought and promote conservation. Much of the financial assistance--some $22 million--was provided under the Community Emergency Drought Relief Act of 1977 (Public Law 95-31). The act authorizes loans and grants to eligible applicants to augment community water supplies, improve water supply systems, purchase and transport water to provide immediate drought relief, and promote water conservation. Federal agencies coordinated their activities by forming a Drought Emergency Coordinating Committee.

The Governor created a Drought Emergency Task Force in March 1977 to deal with the immediate and the long-range implications of the drought and to coordinate the total relief effort of the operating agencies. Task force members include State, Federal, and private organizations involved in water management and operations. Additionally, the State legislature made into law legislation providing for loans and dealing also with such issues as water conservation and well drilling.

The two major water agencies in the State, the Department of Water Resources and Bureau of Reclamation, delivered about 8.2 million acre-feet of water in 1976. The Bureau also voluntarily released 800,000 acre-feet of water above its operational commitments to meet Delta water quality requirements. By October 1976 carryover storage in the State and Federal reservoirs was seriously depleted. With the continuing inadequate precipitation during the winter of 1976, the State Water Project could not meet commitments for 1977 and had to reduce deliveries to agricultural users by 60 percent. The Bureau's Central Valley

Project reduced deliveries to its water rights contractors 1/ by 25 percent and to other agricultural users by 75 percent. Should the drought continue into 1978, the Bureau estimates it will only be able to deliver about 2 million acre-feet to its customers. It contemplates great reductions in deliveries to agricultural, municipal, and industrial users. The State also expects to reduce deliveries but as of September 1977 had not computed the amount.

To buffer the impact of the drought on water users and to save water should 1978 also be a drought year, the State Water Resources Control Board relaxed water quality standards in the Sacramento-San Joaquin Delta so that less water would be released from State and Federal reservoirs to counter salt water intrusion from the San Francisco Bay.

At the local level response varied significantly depending on the impact of the drought. Some areas experienced little or no shortage of water, while others were drastically short. Some water districts imposed strict conservation measures; others fostered voluntary conservation. In some areas water use was reduced by more than 50 percent. Water rates were increased to encourage conservation or compensate for reduced revenues, as water conservation measures resulted in less use of water.

In some agricultural water districts, especially those in the Central Valley, available surface water was allocated to users on a prorata-share basis. Land without supplemental groundwater available was removed from production. In other districts, especially those in the Imperial Valley, agriculture was essentially unaffected as adequate water supplies were available. Many districts offset shortages of surface water by extensive use of groundwater.

LEGISLATION AT THE FEDERAL LEVEL

In outlining to the Congress his program for responding to the drought, the President proposed a variety of temporary assistance measures designed to mitigate short-term drought problems. Some proposals entailed modifications to or increased funding for existing programs; others required new legislation.

By summer of 1977, the Congress had enacted the Emergency Drought Act of 1977 (Public Law 95-18), the Community Emergency Drought Relief Act of 1977 (Public Law 95-31), and

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1/Contractors with priority rights to water based on law.

had passed the Supplemental Appropriations Act of 1977 (Public Law 95-26) to bolster existing drought assistance programs. These laws provide financial assistance to eligible applicants to mitigate the impact of the drought through such steps as water conservation and improvement to existing water systems. The funds must be obligated by December 31, 1977. The drought package, including prior legislation approved by the Congress, authorized over $800 million in short-term loans and grants nationwide.

The agencies primarily involved in drought assistance are the Departments of Agriculture, Commerce, and the Interior and SBA. Responding to the President's message, these agencies formed a Drought Emergency Coordinating Committee in April 1977 which established a uniform procedure for the designation of Emergency Drought Impact Areas--areas potentially eligible for Federal assistance. As of June 1977, 24 States and 1,406 areas were designated eligible areas. In California 43 of the 58 counties were designated emergency areas by the President by April 1977.

By May 31, 1977, the President's proposals were implemented through legislative or administrative actions, except for the SBA loan program. This program calls for $50 million in loans to small businesses in drought areas.

Funds for drought assistance were also available through existing programs. We identified 16 agencies involved in such programs. For instance, the Farmers Home Administration, under its existing Soil and Water Loan Program, loaned about $900,000 to farmers in California from October 1976 to June 1977. In view of the many agencies and drought-related programs involved, we limited our review to the programs included in the 1977 drought package.

Impact of Federal programs at the State and local levels

We contacted the principal agencies responsible for administering the programs included in the executive package to determine the extent of assistance provided in California. As of July 1977 requests for assistance totaled about $68.7 million in loans and $47.6 million in grants; about $37.5 million in loans and $17 million in grants was approved.

California Assistance as of July 1977 Under the Programs Included in the Executive Package

Authority, department, and program	Requested Loans	Requested Grants	Approved Loans	Approved Grants
	(millions)		(millions)	
Public Law 95-18:				
Interior--Drought Emergency Program	$27.6	$ 1.4	$10.4	$ 1.4
Public Law 95-31:				
Commerce--Community Emergency Drought Relief Program	14.8	7.2	14.8	7.2
Public Law 95-26--Supplemental Appropriations:				
Interior--Drought Emergency Program (1948 act)	6.1	0.5	3.4	0.5
Agriculture--Emergency Loan Program	8.4	-	8.4	-
Agriculture--Community Facilities Program	11.9	10.0	0.5	0.9
Agriculture--Emergency Drought Conservation Program	-	28.5	-	7.0
Total Public Law 95-26	26.3	39.0	12.3	8.4
Total drought package	$68.7	$47.6	$37.5	$17.0

As of July 1977, a $50 million appropriation for emergency, 5-percent interest loans to small businesses (originally part of the drought package) had not been passed by the Congress.

Emergency Drought Act of 1977 (Public Law 95-18)

The Emergency Drought Act of 1977 authorized funds to the Bureau to increase water supplies by making interest-free loans for water supply and conservation programs and establishing a water bank for redistribution of water. In August 1977, Public Law 95-107 was enacted to extend the act through January 1978.

Under the water banking program the Bureau purchased about 41,000 acre-feet of water for about $2,173,000 from eight water agencies. This water was sold to 23 other water service agencies on a priority basis. Priority I water (about 26,000 acre-feet) was sold to maintain trees and vines; priority II water (8,000 acre-feet) for livestock and pasture use; priority III water (7,000 acre-feet) for crops.

The Bureau also made several loans to Federal water service agencies in the State to purchase water from private sources. About 20,000 acre-feet of such water was purchased by these contractors for about $500,000.

A Bureau report listed 35 requests from Federal water contractors in the State for loans to drill wells, line canals and for other purposes amounting to about $24 million. As of July 1977, 10 of these requests were approved, totaling about $7 million. The Bureau also reported it provided the State Department of Fish and Game and the U.S. Fish and Wildlife Service grants of $950,000 and $480,000, respectively, for mitigation of the drought's impact on fish and wildlife.

Community Emergency Drought Relief Act of 1977 (Public Law 95-31)

As of July 1977 the Economic Development Administration, (EDA) Department of Commerce, through its Community Emergency Drought Relief Program provided funds to State and local governments with populations over 10,000 to

--improve, expand, or construct water supply systems;

--promote water conservation; and

--purchase and transport water to provide immediate drought relief.

Some examples of loans and grants under this program follow.

--A $5.6 million loan and a $1.4 million grant to the Marin Municipal Water District to help defray the cost of a pipeline installation on the Richmond-San Rafael Bridge and to buy 3.4 billion gallons of Colorado River water formerly designated for southern California. The pipeline was installed to carry water from the State Water Project and temporarily supplement the district's domestic water supplies because the drought left its reservoirs drastically depleted.

--A $2.3 million loan and $2.4 million grant to the El Dorado Irrigation District to provide additional water for domestic use, assure the El Dorado National Forest fire protection, and to supply orchards, vineyards, and cattle pasture lands.

--A $85,000 loan and a $85,000 grant to the Placer County Water Agency for an emergency program to supply water for domestic uses. New pumps were required to draw water from the American River where the water flow was below the old pumps' intake structures.

An EDA official told us that as of July 1977 the Department of Commerce approved 7 loan applications, 9 were in process, and 34 had not yet been submitted. It is estimated that the program will allocate funds totaling about $85 million before it expires in September 1977.

Supplemental Appropriations Act of 1977 (Public Law 95-26)

The Supplemental Appropriations Act of 1977 provides funds to supplement several existing emergency assistance programs. In California these programs are administered by the Bureau, Farmers Home Administration, and the Department of Agriculture's Agricultural Stabilization and Conservation Service.

Bureau of Reclamation Programs

The Emergency Fund Act of 1948 (Public Law 80-790) provides funds for emergency irrigation loans in a drought. It includes loans for such projects as conservation activities, pumps, dikes, lining, and pipes as well as water banking programs for non-Federal irrigation projects. It also makes grants available to States for water resource agency programs.

By July 1977 the Bureau received nine requests for loans to construct conservation facilities in the State which amounted to $3,080,000 and approved one for $440,000. Other loans, totaling $3 million, were made to various water agencies to purchase 148,000 acre-feet of water from private sources. The Bureau also gave the Department of Water Resources a grant for $501,000 to construct rock barriers in the Sacramento-San Joaquin Delta to reduce salt water intrusion from the San Francisco Bay.

Farmers Home Administration Programs

The Consolidated Farm and Rural Development Act (Public Law 92-419) provides funds for low-interest loans to cover farmers' and ranchers' prospective losses and loans and grants to rural communities with populations of 10,000 persons or less for short-term water supply assistance.

By July 1977 about 300 applications were received in California for loans under the emergency loan program and 90 for loans and grants under the Community Water Facilities program. The Department of Agriculture approved 176 emergency loans totaling about $8.4 million. We were told that the emergency loan program will provide about $15 million in assistance before it expires in September 1977.

Two loans and four grants were approved in California under the Community Facilities Program, amounting to $454,900 and $926,200, respectively. More loans and grants were expected to be approved now that the agency has gained experience in making them.

Agricultural Stabilization and Conservation Service programs

The Soil Conservation and Domestic Allotment Act (Public Law 74-46) provides funds for grants to help ranchers and farmers implement approved soil and water conservation practices. Grants are made under the Emergency Drought/Flood Conservation Program.

The emergency program in California has been used primarily to provide funds for such improvements as well drilling and rehabilitation and reorganizing irrigation systems, etc. Of the $11 million allocated for California, about $7 million was obligated by July 1977. Requests for grants totaled $28.5 million, and it is estimated that about $25 million would be approved if funds were available.

The executive drought package also included a proposal to provide emergency, low-interest loans to small businesses affected by the drought. These loans were to remedy the effects of actual or prospective substantial economic injury and to improve water conservation projects or repair, replace, or improve water supply facilities.

As of late August 1977 congressional action on the SBA drought relief bill was pending. To serve small businesses affected by the drought, SBA provides assistance through existing programs--the Economic Injury Disaster Loan Program and the Physical Disaster Loan Program. According to an SBA

official, requests for loans under the two programs totaled about $30 million by July 1977.

Between February and July 1977 the SBA office in California received 394 applications for physical disaster loans; it approved 301 which totaled $2.6 million. Of that amount, $584,000 has been disbursed. Also, SBA received 324 applications for economic injury loans and approved 162 for about $11 million, of which $4.5 million was disbursed.

COORDINATION BETWEEN THE BUREAU AND DEPARTMENT OF AGRICULTURE

We inquired about Department of Agriculture and Bureau coordination for drought aid programs and the efficient use of water by farmers.

At the Federal level the Departments of Agriculture and the Interior became part of the Drought Emergency Coordinating Committee in April 1977. As members of the Committee these agencies review State requests for drought relief and discuss and exchange data concerning their drought relief programs. The Assistant Coordinator for Land, Air, Water, and Waste, Department of Agriculture, said that such coordination was necessary to avoid duplication of programs and to orient others to the nature and extent of existing programs.

Bureau officials in Sacramento said that when the Drought Emergency Act was passed, the Bureau joined the Governor's task force. The Department of Agriculture, through its Soil Conservation Service (SCS), is also a member of the task force.

SCS provides the farming community planning and technical assistance on soil and water management through soil and water conservation districts. The Agricultural Stabilization and Conservation Service provides grants to farmers under its drought and flood conservation, emergency feed, disaster payments, and various other programs. Additionally, the Department of Agriculture funds the Cooperative Extension Service which gives technical assistance to farmers throughout the State.

Bureau officials said that they have cooperated with SCS and Cooperative Extension Service under the Irrigation Management Service Program. This program began in 1972 to advise irrigators of proper times to irrigate and proper amounts of water to apply to improve the efficiency of irrigation of Federal water projects. As of July 1977 the Westlands, El Dorado, Solano, James, and Tranquility water districts participated in the program. In the El Dorado Irrigation District

the Bureau reported in July that the program had improved interest and cooperation among SCS, Cooperative Extension Service, and local growers.

In our June 1976 report entitled "Better Federal Coordination Needed to Promote More Efficient Farm Irrigation" (RED-76-116), we discussed the need to accelerate voluntary implementation of the Irrigation Management Services Program through the integration of the unique capabilities of the Bureau, SCS, and Cooperative Extension Service to educate farmers desiring to improve the efficiency of their irrigation.

As a result of the report Bureau officials met in April 1977 with SCS officials, Department of Water Resources, and other agencies to discuss better ways to coordinate the irrigation management system. Discussions centered around many of the technical and institutional problems of re-directing present irrigation practices as they relate to the overall basin water management of the Central Valley. Also covered were (1) possible benefits from improved irrigation, (2) factors limiting implementation, and (3) the establishment of incentives to foster the program. Another meeting was scheduled.

In August 1977 Bureau officials recommended to the Director, Mid-Pacific Region, that the Irrigation Management Service be expanded and noted that the Bureau was developing regional policy to promote better irrigation management, including close cooperation with other State and Federal agencies.

Regarding the merits of the program the Bureau concluded:

> "* * * In our opinion, water savings may amount to 10% in California, but because of basin-wide reuse, large water savings cannot be expected. Water savings for individual farmers, though, are more important, especially in dry years. We believe, however, that significant amounts of energy can be saved by reducing excessive ground water pumping and reducing return flow pumping of excessive runoff. Some estimates have shown that $20 to $40 million dollars of energy savings can be realized in the Central Valley each year if the IMS principles were followed on all irrigated acreage. Reduced water handling will also lower O & M operation and maintenance costs by reducing system wear and tear. * * *"

THE GOVERNOR'S DROUGHT EMERGENCY TASK FORCE

This interagency task force was created to deal with immediate and long-range implications of the drought and to coordinate the total relief effort. It began its work early in March 1977. Task force participants include:

State Departments:
- Food and Agriculture
- Water Resources
- Water Resources Control Board

Federal agencies:
- Department of Agriculture and its Soil Conservation Service
- Bureau of Reclamation
- Corps of Engineers
- Geological Survey

Other organizations:
- University of California
- Farm Bureau Federation
- Association of California Water Agencies
- Pacific Gas and Electric Company

The task force's mission is to coordinate the whole relief effort among the operating departments to insure that the State approach does the most good for the most people. One task force objective is to gather hard data relating to the drought to enable it to respond to questions on pending State and Federal legislation, as well as requests for assistance from individuals and organizations most affected by the drought. One information gathering technique is conducting regional meetings whereby task force members have the opportunity to hear first-hand those most affected. By May 1977 regional meetings were held in Modesto, Fedding, Bakersfield, San Diego, and Santa Rosa.

As a result of these regional meetings and close work with county agricultural commissioners and others at the local level, the task force is publishing a booklet which assesses the drought on a county-by-county basis, providing information relating to municipal and industrial water supply, agriculture, energy, fire, fish and wildlife, and recreation.

In addition, the task force is working with Federal officials on drought legislation.

LEGISLATION AT THE STATE LEVEL

The California Legislature, by July 1977, had introduced over 40 proposals for drought-related legislation, 9 of which became law. The legislation pertains to such things as requiring statewide water conservation, public notice before well drilling, and water meters throughout the State.

A State emergency loan program--the Davis-Grunsky Fund--was expanded through this legislation in June 1977. The program provides loans to public agencies for emergency water supply facilities needed to relieve drought situations. The legislation extended the program's authorization through calendar year 1978, increased to $200,000 the maximum amount of a loan to a public agency with a maximum population of 200,000, and ended the $2 million loan limit on the total amount of loans. It is estimated that about $4.5 million will be available for drought-related emergency loans. The other eight enacted legislative proposals were designed to:

--Implement a system to measure allocation of water to crops during drought years.

--Initiate a pilot program to determine the feasibility and public acceptance of certain water conservation devices.

--Expand the State government code to include severe energy shortages as states of emergency.

--Request local water agencies to evaluate water needs and institute appropriate water conservation measures.

--Allow persons affected by drought in one district to obtain special assessment rates.

--Extend the filing date for groundwater conversion statements.

--Improve the conditions for water shortage districts to sell revenue warrants.

--Exempt livestock owners from head-day tax during drought emergency periods.

SURFACE WATER MANAGEMENT BY THE DEPARTMENT OF WATER RESOURCES AND THE BUREAU

The Department of Water Resources and Bureau control a large portion of the surface water in the State. About 8.2 million acre-feet is normally delivered through the State

Water Project and the Bureau's Central Valley Project. The remainder is managed locally by water service agencies. In view of the large quantities of water delivered by the two projects, we concentrated our review efforts on drought emergency planning by the two agencies responsible for these projects and their response to the drought.

In 1976 inflows into State and Federal reservoirs amounted to the lowest in recorded history. Only two other years since 1924 were drier. However, neither the State nor the Bureau reduced deliveries during the 1976 water year.

The State delivered over 2 million acre-feet of water in 1976, the largest delivery in project history, exceeding by 15 percent the previous high of 1.77 million acre-feet delivered in 1974 and 1975. Early in 1976 the State suggested to its agricultural water users that the Water Project should carry over to 1977 a portion of the water projected to be available as surplus for 1976. The water users decided against it, and the State delivered 626,407 acre-feet of surplus water to them.

The Bureau met all its contractual commitments in 1976 and delivered about 6 million acre-feet. This included delivery of 1 million acre-feet of interim water--water committed to customers who do not have as yet the capability to receive it. The Bureau allocated 200,000 acre-feet of this water to the Westlands Water District and 800,000 acre-feet to meet water quality standards in the Sacramento-San Joaquin Delta. The Central Valley Project's congressional authorization does not require providing water for the maintenance of Delta water quality, other than that necessary to provide quality water at the Bureau's pumps for export south.

As a result of State and Federal water deliveries in 1976, water left in the reservoirs for the 1976 and 1977 water year was at record low by September 1976. With the lowest precipitation on record during the 1976 winter, the reservoirs were seriously depleted by February 1977 and the State and Bureau had to curtail deliveries for 1977 by as much as 60 and 75 percent, respectively, to agricultural users--who use about 85 percent of all water in the State. Water for municipal and industrial users was cut back by 10 to 50 percent.

Storage in Major State and Federal Reservoirs at the End of Water Year 1976 and February 1977 (note a)

Reservoir	September		February	
	Normal	1976	Normal	1977
	(million acre-feet)			
Oroville (State)	b/2.25	1.83	2.40	1.61
Shasta (Federal)	3.60	1.31	3.40	1.53
Trinity (Federal)	1.95	1.50	2.03	1.16
Folsom (Federal)	0.77	0.45	0.60	0.29
Total	8.47	5.09	8.43	4.59

a/October to September

b/Estimated

Should 1978 prove to be as dry as 1977, the Bureau anticipates delivery of 75 percent to water rights contractors, 25 percent to municipal and industrial users, and none to other agricultural users.

Elements which trigger drought conditions

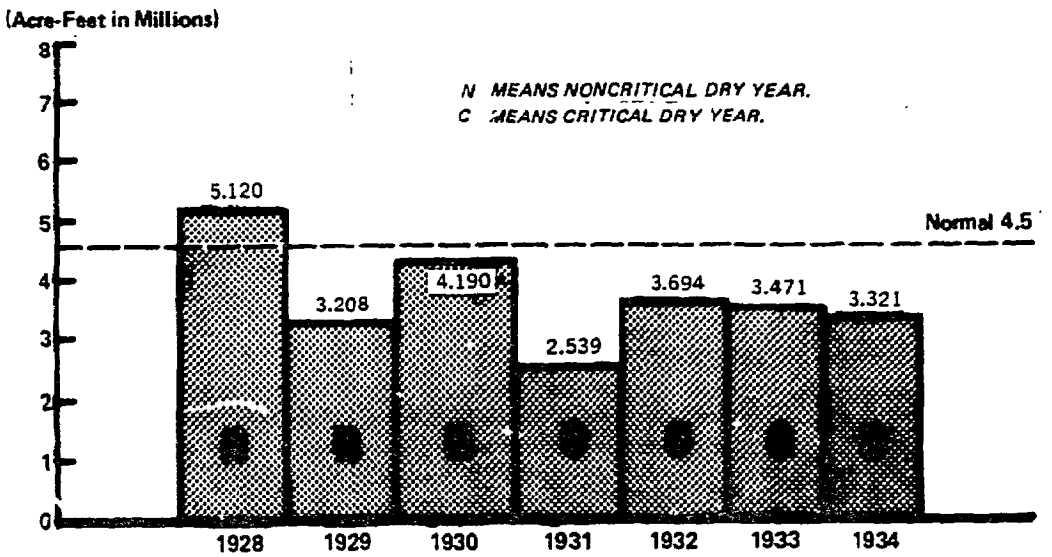
A critical or drought year is defined by the Bureau as follows:

--The forecasted full natural inflows to Shasta Lake for the water year are equal to or less than 3.2 million acre-feet.

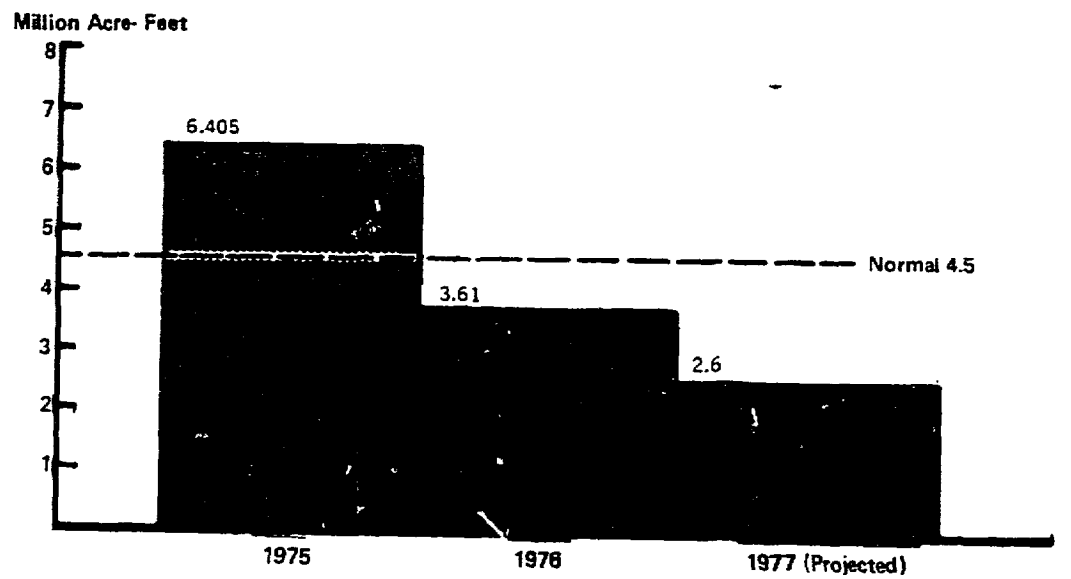
--The total accumulated actual deficiencies of inflows below 4 million acre-feet in the immediately prior water years or series of successive water years, each of which had inflows of less than 4 million acre-feet, together with the forecasted deficiencies for the current water year, exceed 800,000 acre-feet.

The drought experienced between 1928-34, the driest period recorded in California since 1850, is used as a model to project the risks of drought conditions. Whether the current drought will be worse than the 1928-34 period is still unknow.

The model assumes that at the beginning of the dry period in April 1928, the main Central Valley Project reservoirs were full, and by December 1934 they were nearly empty (actually project reservoirs were not built until the 1940s). Shown below are the inflows which would have drained into Shasta in each of these years.



Here is a comparison using 1975-1977 inflows into Shasta.



Under the criteria there was no drought year until the 1977 projection was made that inflows would be about 2.5 million acre-feet or below. By coincidence 1976 and 1977 exceeded 800,000 acre-feet below 4.0 million. Therefore, 1977 qualified as a critical dry year under both criteria.

In a critical dry period, contracts between the Bureau and water rights contractors allow the Bureau to curtail deliveries by no more than 25 percent of 1 year's supply. The Bureau used this provision in 1977 and would use it in 1978, if necessary, to reduce deliveries to those agricultural users. Municipal, industrial, and some agricultural users are not subject to the Shasta inflow criteria but are subject to reductions if water shortages occur.

State contracts with water users do not specify what inflow levels determine reduced deliveries. The contracts provide for reduced deliveries should a shortage of water or drought occur in any 1 year; the State used this provision to reduce water deliveries in 1977.

As noted earlier full deliveries were made by the Water Project in 1976 after the potential for curtailment of deliveries was discussed with agricultural users early in 1976. It appears that users were already committed for some crops at the time, and they decided they wanted full water deliveries while water was available.

Bureau officials said that they had no other choice but to make full deliveries to water rights contractors in 1976 because contractual arrangements are based on Shasta inflow criteria only. Because the reservoirs had sufficient water in storage in 1976, the Bureau decided to make full deliveries to municipal and industrial, as well as other agricultural users. Bureau officials also said that current contracts with water rights contractors have from 10 to 40 years to run and, unless they are re-negotiated, the Shasta inflow criteria for imposing deficiencies would prevail until then.

Regarding the release of about 200,000 acre-feet of interim water to Westlands and 800,000 acre-feet to meet water quality standards in the Sacramento-San Joaquin Delta, the director stated that, in hindsight, this water should have been held in the reservoirs for use in 1977. However, at the time, the Bureau estimated on the basis of historical experience that it was not likely that 1977 would be as dry as 1976. Therefore, the region opted to release this water. At the time there was also much pressure on the Bureau to help the State meet water quality standards in the Delta. However, the Director informed us that the water was not released to meet State quality standards but to meet public health standards

for the Bureau's municipal and industrial users in the western Delta. By fulfiling this objective, water qualtiy was enhanced throughout the Delta.

WATER QUALITY IN THE SACRAMENTO-SAN JOAQUIN DELTA

Because of their configuration, the State Water and Central Valley Projects use the same means of conveyance to bring water from the northern to the southern part of the State. Water flows from major reservoirs such as Oroville and Shasta through the Sacramento River and the Sacramento-San Joaquin Delta where most is diverted to the California Aqueduct by the State and to the Delta-Mendota Canal by the Bureau. Salt water intrusion from the San Francisco Bay into the Delta requires that the State and Bureau maintain quality water if they are to deliver adequate, quality project water to be pumped south.

The Delta is triangular in shape and located at the confluence of the Sacramento and San Joaquin Rivers. These two main rivers enter from two corners of the Delta triangle; the outflow is through the third corner, which opens as a narrow channel into Suisun Bay and subsequently the Pacific Ocean.

The Delta covers an area of about 737,500 acres, interlaced with 700 miles of meandering waterways which form about 50 separate islands or tracts. In its original state the Delta consisted of swamp and overflow lands covered with tules, willows, and cottonwoods. At present nearly all the Delta is reclaimed and used for agriculture. Its inherent advantages for farming include highly productive soil, easy access to water and thus freedom from drought, miles of navigable channels, and nearness to markets in San Francisco, Sacramento, and Stockton.

About 425,000 acres of the central land area, commonly known as the Delta lowlands, lie between an elevation of 5 feet above and 15 feet below mean sea level. These lands are composed of peat, organic sediments, and alluvium 5 to 80 feet deep. They are protected from high tides and floods by man-made levees. The levees were built to enclose vast tracts of overflowed land; the water was then drained, leaving islands ranging from 1,000 to 23,000 acres. The Delta channels, in addition to providing a convenient source of water for local agricultural and industrial needs, are used to convey flood-waters of the Central Valley for commercial navigation and recreational activities, as well as a conduit to convey waters of the State Water and Central Valley Projects. Also, these channels provide a varied environment that supports many kinds

of fish to the extent that a large portion of California's fishery resource depends on the Delta.

In 1971 the Water Resources Control Board required greater outflows into the Delta to protect municipal and industrial water supplies, agriculture, and fish and wildlife.

The board expected that the State Water and Central Valley Projects would provide about 40 to 60 percent of the water outflows required to meet these standards. The board's decision required flows to the Delta and ultimately the Pacific Ocean greater than was assumed in the Bureau's operational model. To meet these increased outflow requirements, the State and Bureau will have to release more water from storage, which will reduce the quantity of water available for export to project customers served by the State Water and the Central Valley Projects.

In good water years the standards can be met without much impact on the amount of water to be delivered to users; in critical or drought years they cannot. A proper balance between achieving Delta water quality and exporting enough water south must be achieved. On achieving this balance, the State and Bureau disagree.

In January 1977 the Water Resources Control Board issued an Interim Water Quality Control Plan for 1977. The plan's objective was to provide the Delta sufficient protection and to also recognize the limitations of existing project facilities to satisfy all demands for Delta users. The board:

--Suspended requirements to provide quality water to municipal and industrial users in the Antioch and Pittsburgh areas.

--Reduced the quality objective at the Contra Costa Canal intake at Rock Slough, which is used to convey water to municipal and industrial users, and also at Cache Slough.

--Retained certain quality objectives for agricultural users at Jersey Point, Emmaton, Blind Point, and Vernalis.

--Retained fish and wildlife objectives recommended by the Department of Fish and Game, in concurrence with the U.S. Fish and Wildlife Service.

In June 1977 the board adopted emergency regulations to conserve and protect water in the Sacramento-San Joaquin Delta and its tributary streams. The board felt that the end of the

drought could not be predicted with confidence. By reducing quality objectives further, less fresh water was to be released from the reservoirs to the Delta thereby conserving it for use in 1978. Therefore, there was an urgent need to conserve water for emergency municipal, domestic, and other essential uses, including protection against the massive intrusion of sea water into the Sacramento-San Joaquin Delta should 1978 be a low runoff year. The board essentially suspended water quality requirements in the Delta for the remainder of the 1977 water year.

The board plans to hold hearings by October 1977 to review water supply needs and the status of the Delta's water quality.

RESPONSE AT THE LOCAL LEVEL

The drought's impact varied greatly among the 11 State areas we visited. The variance largely influenced the extent and types of responses at the local level.

The cities of San Diego and Los Angeles, and the Salinas and Imperial Valleys experienced little or no reduction in water deliveries, although voluntary conservation resulted in water savings. Marin, Humboldt, San Mateo, Orland, Westlands, and Wheeler Ridge-Maricopa (south of Bakersfield) saw their sources of water drastically reduced and had to impose strict conservation measures. Water rates increased as consumption reduced, thus enabling water districts to cover their fixed financial obligations. In some areas such as Marin rates were also increased to encourage conservation.

Most districts, however, had few alternatives in responding to the drought, other than to impose some form of rationing or water allocation. The Metropolitan Water District of Southern California was able to shift its demand from the State Water Project to the Colorado River Aqueduct. Some agricultural water users had the alternative of drilling their own water wells where groundwater was available.

Urban districts

The Metropolitan Water District of Southern California is the largest contractor for water from the Water Project. The project makes northern California water available to southern California through an extensive system of storage reservoirs, aqueducts, and pumping plants. At maximum development the project will make about 2.0 million acre-feet of water available to Metropolitan. On February 28, 1977, project deliveries to Metropolitan were halted, and its 1977 entitlement of 755,000 acre-feet of water was reduced greatly. Within 9

hours Metropolitan began pumping more water over its Colorado River Aqueduct to make up for the loss.

Metropolitan also implemented an incentive program to encourage a 10-percent reduction in the consumption of water by its 27 member agencies. It also increased its deliveries to Los Angeles by 197,000 acre-feet, to compensate for the decreased supply from the city's Owens Valley Water Facility.

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The California Water Service Company is the primary supplier to domestic and industrial water users in the city of San Mateo and the Salinas area. The company serves 23,500 water users in San Mateo and depends soley on the San Francisco Water Department for its San Mateo water supply. Economic drought damage in the San Mateo area has been minimal; no unemployment can be attributed to the drought. There is, however, some concern as to the possibility of rolling energy blackouts due to the decrease of hydroelectric power.

On April 26, 1977, the California Public Utilities Commission approved the company's water rationing plan which allocates to each user 75 percent of the prior year's water use for the same billing period. An excess use penalty of $2 is charged for each 100 cubic feet of water used over the allotment. Customers who recycle water are allowed 90 percent of the prior year's use. However, we were told that water recycling equipment is expensive. For example, this equipment would cost about $25,000 for a car wash establishment.

The company's water consumption decreased as much as 42 percent in May 1977, and as a result it requested and received approval for a rate increase. Thus, San Mateo water users are using less but paying more for their water.

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In the Salinas area the company relies on 21 wells to supply domestic and industrial water users. This well system is recharged with water from the Monterey County Flood Control and Water Conservation District. Economic damage in the Salinas area is minimal to date, according to officials at the Employment Development Department. However, the company and Monterey have recommended that water users voluntarily decrease water consumption by 10 percent.

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The Marin Municipal Water District serves about 170,000 water users or about 75 percent of Marin County's water demand

in the southern portion of the county. Water is supplied for residential and commercial use only. Several years ago the county decided not to expand water storage systems.

To stretch available water supplies, Marin implemented a water rationing program requiring a reduction of 57 percent in water use through restriction of nonessential use. The district's extensive conservation effort included the distribution of free water conservation devices to customers.

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The Humboldt Bay Municipal Water District provides water for domestic and industrial use to seven communities in Humboldt County. The primary water users are two area pulp mills which use 86 percent of the water. Humboldt's sole source of water is the Mad River, with one related storage reservoir.

The district general manager said that Humboldt has suffered no significant drought damage as of June 1977. Humboldt meets district needs through a water conservation program and gives domestic water use first priority over the pulp mills. The pulp mills, in fact, were cut short 30 percent from prior years' usage. There was concern, however, that the pulp mills, which employ several hundred persons, may be forced to shut down.

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The San Diego Water Utilities Department provides water to the city of San Diego, which has a population of about 774,100. The area's normal annual rainfall is only 9.63 inches. For all practical purposes, San Diego totally depends on Colorado River water imported by Metropolitan and delivered through the San Diego County Water Authority.

According to state and local officials, there has been no great damage, unemployment, or lifestyle changes in San Diego as a result of the drought. San Diego initiated a promotional campaign, using films, literature, television announcements, and mailers, to foster voluntary water conservation.

Agricultural districts

Several water agencies were directly dependent on the State Water or Central Valley Projects for much of their water supply. For example, the Wheeler Ridge-Maricopa Water Storage District is solely dependent on the Water Project for water which is obtained through the Kern County Water Agency. The district manager said that in response to a decrease of 65

percent of its available water supply, it allocated each acre in the district an equal amount of water. The district also sought and obtained additional water relinquished by Metropolitan. The manager observed that there was little potential for area water conservation. Area water is used too efficiently and not enough water is being returned to the ground to flush the soil. The Department of Water Resources suggested that more water be returned to the ground to prevent salinity problems.

The Westlands Water District provides its water users surface water only, and it depends on the Central Valley Project for this supply. In 1976 Westlands delivered about 1,238,000 acre-feet of water to its users. This year Westlands apportioned its available 252,000 acre-feet of water on a per-acre basis. Westlands negotiated and obtained about 5,700 acre-feet of water from Metropolitan and purchased 11,000 acre-feet of northern California rice water at a cost of $68.25 per acre-foot to keep trees and vines alive. An indeterminate amount of water was obtained by resuming well drilling and mining groundwater.

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The Orland Unit Water Users Association provides only surface water obtained from the Bureau's Orland Project. Orland apportioned its available water on a per-acre basis so that each district acre would receive 0.43 acre-foot instead of the normal 3.0 acre-feet. Orland also attempted to drill a deep water well system as a supplement. The project was dropped according to an association official because it was not popular with district water users. Orland turned down the purchase of 1,000 acre-feet of water offered by the Bureau at $67.00 per acre-foot because the price was considered excessive.

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The Imperial Irrigation District is the primary water supplier for the Imperial County area. The area is normally dry, having an annual rainfall of only 3 to 4 inches. Therefore, Imperial depends completely on the Bureau's Colordao River Storage Project. A district official said that Imperial has not suffered from the drought because sufficient water is available. Nevertheless, Imperial implemented a program to eliminate excess water use by tripling the normal water price to the user when surface water runoff exceeds 15 percent of water delivered each 24 hours.

The extent and damage of and response to the drought at the 11 districts we visited are further described in appendix II.

CHAPTER 5

WATER PLANNING AND DEVELOPMENT

California's ability to meet foreseeable water needs at or beyond the year 2000 is questionable. The State plan for water development recognizes that even with (1) the completion of all planned State and Federal projects, (2) local surface and groundwater development, (3) anticipated wastewater reclamation and re-use, and (4) conservation practices, the State will still have to rely on substantial groundwater overdrafting 1/ to meet requirements.

The State's current solution to the overdrafting situation--capturing more Delta surplus winter flows and developing new supplies in a river basin protected by the Wild and Scenic Rivers Acts--could make up much of the deficit. Whether these supplies and the water development measures discussed above could be fully implemented to provide additional water resources by the year 2000 in the quantities projected is questionable.

WATER DEVELOPMENT IN CALIFORNIA

The Water Resources Control Board and Department of Water Resources are responsible for the development and use of State water resources. The board regulates activities affecting water quality and rights. The Department updates the State water plan and operate a planning program which involves the:

--Periodic reassessment of existing and future demands for water for all uses in each of the hydrologic study areas.

--Periodic reassessment of local water resources and uses as well as the magnitude and timing of the need for additional water supplies that cannot be provided locally.

--Appraisal of various alternative water sources--groundwater, surface water, reclaimed wastewater, desalting, geothermal resources, etc.--to meet future demands in areas short of water.

--Determination of the need for protection and preservation of water resources in keeping with protection and enhancement of the environment.

1/Extracting more water from the ground than is replaced.

--Evaluation of water development plans.

The first State water plan was issued in 1957; it is updated every 4 years to reflect the most current data and projections available. It encompasses planning and development by Federal, State, and local entities and serves as a guide to coordinating the use and development of water resources. The main facilities of the State Water Project were constructed in the 1960s as a key feature of this plan.

STATE WATER PLAN

The latest update of the water plan was issued in 1974, and the Department of Water Resources is now preparing the 1978 update.

The Department staff member responsible for updating the plan said that the 1978 water plan demand projections for the year 2000 will be about the same as the 1990 projections shown in the 1974 plan. This is due to increased emphasis on water conservation, which has the effect of reducing demand for water. Therefore, conservation will stretch the water supplies projected for 1990 to meet State growth anticipated between 1990 and 2000.

The staff member also said that present, dependable water supplies 1/ are still about the same as they were in 1974. He said no new, significant projects have been implemented since that time.

Because State supply and demand projections for 1990 presented in the 1974 plan are about the same as those the State will use in its 1978 plan for the year 2000, we used them in our analysis of the State ability to meet foreseeable needs to the year 2000.

Establishing water demand

To ascertain the amount of water needed by 1990, the plan projected growth in population and agricultural and urban acreage. California's population reached about 21 million in 1974, reflecting a downward trend in growth rates. By 1990 the population is projected to increase to about 24 to 27 million persons. Urban development and use comprised about 2.6 million acres of the State's 100 million acres in 1974; by

1/Water which can be expected to be delivered yearly with allowable deficiencies during drought periods.

1990 this figure is projected to range from 2.9 to 3.3 million acres.

Irrigated agriculture covered about 8.5 million acres in 1967 and in 1972 had increased by 60,000 acres a year to about 8.8 million acres. By 1990 irrigated acreage is projected to increase to about 10 million.

Annual urban water use was about 5 million acre-feet in 1974 and is expected to increase to 6 or 7 million acre-feet in 2000. Urban use currently accounts for about 13 percent of the State's total water consumption.

Irrigated agriculture used about 32 million acre-feet of water annually in 1974, or about 85 percent of the State water supply. Annual demands for water for agriculture in 2000 are estimated to reach 34 to 38 million acre-feet. Annual water demands for all purposes are projected to increase from the 1974 total of 37 million acre-feet to about 41 to 46 million acre-feet in 2000.

These figures reflect the re-use of return flows and conveyance losses. For planning purposes the State uses net demand figures (the amount of water available at the source for use) because they are more readily measured. Because it includes re-use, the annual water demand is about 6 to 7 million acre-feet greater than net demand.

Water supplies

In 1974 about 60 percent of the State water supply was derived from surface developments, and 40 percent was met through groundwater pumping. Most of this supply was considered dependable--permanent water sources that can be relied on even under drought conditions. About 2.5 million acre-feet of water was overdrafted or mined from the ground to make up the deficit between useable dependable supplies and net demend. About 2.1 million acre-feet of dependable supply was unuseable because of the lack of accumulated demand where it was located, or it was not available to other areas because of a lack of facilities such as canals and/or institutional arrangements such as exchange agreements.

Future water picture

The 1974 State water plan presented four scenarios depicting the future water situation at the year 2000.

Water Resource Supply and Demand Scenarios

(millions of acre-feet)

		Scenario			
	Present	I	II	III	IV
Dependable supply	30.7	35.7	35.7	35.7	35.7
Unuseable supply	2.1	1.2	1.7	2.3	2.9
Net dependable supply	28.6	34.5	34.0	33.4	32.8
Net demand	31.0	38.3	36.9	35.4	34.4
Total deficit	2.4	3.8	2.9	2.0	1.6

These scenarios were based on various population and urban and agricultural growth projections developed by the Departments of Finance and Water Resources. The State water resource planner said scenario II is used for planning purposes because it presents a conservative supply and demand picture.

MEETING FORESEEABLE NEEDS

California plans to increase its useable water supplies primarily through the construction of new water storage and conveyance facilities. Some increase is anticipated through further development of groundwater safe yield, 1/ reclamation and re-use of wastwater, and conservation.

Even with the development discussed above, the State water plan projects that dependable water supplies will continue to fall short of meeting demands through the year 2000. The deficit is expected to be made up through continued groundwater overdrafting.

The State's chief water resource planner said that overdrafting causes serious problems over an extended period of time. He added that continued overdrafting causes land subsidence and results in poorer quality water and higher energy costs as pumping depths increase. Further, he estimated that if the overdrafting situation in the east San Joaquin Valley is not remedied within the next 20 to 25 years by restricting groundwater use and importing surface supplies, over a million

1/Water extracted from the ground that is replaced annually.

acres of California's most productive agricultural land could be lost.

Most of the demand for State water supplies is projected to increase in the areas served by the State Water and Central Valley Projects. While the State Water Project was constructed short on supply and long on conveyance facilities, the Central Valley Project was constructed using the opposite approach. Consequently, future planned development for the State Water Project focuses on developing additional water supplies, while future development of the Central Valley Project focuses on facilities to transport already developed water supplies.

State development

In June 1977 the Department of Water Resources gave the State legislature a $3.4 billion proposal for developing 2.7 million additional acre-feet of water supplies. This development is estimated to increase the State Water Project yield by about 2.2 million acre-feet and add about 0.5 million acre-feet of yield to the Central Valley Project. The Governor announced the proposal would provide enough new water supplies to meet growing needs to 2000. The facilities included in the proposal follow.

Facility	Estimated costs (millions of dollars)	Additional yield (millions of acre-feet)	Completion date
Cottonwood Creek Reservoir (mainstream)	$ 320	0.14	1989
Glenn Reservoir (offstream)	1,160	1.00	1993
Peripheral Canal (joint State and Federal)			
Stages 1 and 2	315	0.35	1984
Stage 3	200	0.65	1988
Contra Costa Canal Intake Relocation	16	a/	1984
Suisun Marsh Protection	42	a/	1984
South Delta Water Quality Improvement	25	a/	1984
Underground storage (south-central valley)	360	0.40	1987
Los Vaqueros Reservoir (offstream)	540	0.16	1986
Mid-Valley Canal (joint State and Federal)	440	a/	1985
Total	$3,418	2.70	
Central Valley Project share of the Peripheral Canal additional yield		0.50	
Total additional yield to State Water Project		2.20	

a/Conveyance facilities do not increase yield.

Only 140,000 acre-feet of the additional yield described in the proposal is derived from a traditional mainstream water storage facility--Cottonwood Creek Reservoir. About half of the anticipated yield is expected to accrue from surplus winter flows originating in the Sacramento Basin. Glenn and

Los Vaqueros offstream storage facilities are almost completely dependent on winter surpluses to obtain their yield, as are the underground storage facilities in the South-Central Valley.

The Mid-Valley and Peripheral Canals are designed to deliver water supplies already developed. The Mid-Valley Canal will deliver water to the east side of the San Joaquin Valley to partially offset the severe groundwater overdrafting occurring there. The Peripheral Canal is designed to more efficiently transport Sacramento River water through the Delta. River water previously lost to the Pacific Ocean because of salt water intrusion is now expected to be available for export to the southern part of the State.

The State proposal depends on re-authorization of (1) the Central Valley Project to allow it to operate under Delta water quality criteria as adopted by the Water Resources Control Board (see p. 52) and (2) considerable Federal funding estimated at about $2 billion. The proposal emphasizes that Federal participation in the project is required by December 31, 1980, or the Peripheral, Mid-Valley, and Contra Costa Canals' extension cannot be constructed.

Federal development

In its March 1976 working document projecting future supply and demand for the Central Valley Project, the Bureau estimated its deliveries of water would increase by about 3.3 million acre-feet by 2000. This projection is about 1.6 million acre-feet higher than that presented by the State for the project in its current plan for State water development.

Bureau and State planning officials said that the discrepancy reflects (1) disagreement as to how the Central Valley Project should be operated to maintain water quality in the Sacramento-San Joaquin Delta, (2) differences in accounting for return flows 1/ and surplus Delta flows, 2/ and (3) State exclusion of some Federal facilities. These differences complicate an attempt to reconcile State and Federal data for purposes of analyzing the State's planning process and ultimately in knowing whether an adequate water supply will be available to meet foreseeable needs.

1/Water that has been applied once but not consumed and thus is available for re-use.

2/Water that could become a dependable supply if adequate conveyance and offstream storage facilities are constructed.

Following is a list of projects that the Bureau believes are necessary to achieve the yield projected for 2000. Some projects are designed to increase the current yield, but most are designed to convey water supplies already developed.

Facility	Estimated costs (millions of dollars)	Additional yield (millions of acre-feet)	Completion date
Tehama-Colusa Canal	$ 283.8	c/	a/1976
New Melones Dam and Reservoir	306.0	.21	a/1979
Folsom South Canal	188.7	c/	a/1980
Forresthill Divide Unit	16.5	c/	a/1980
San Felipe Unit	189.4	c/	a/1981
Molby Unit	25.6	c/	b/1985
Mid-Valley Canal	458.5	c/	b/1985
Auburn Dam and Reservoir	900.7	.32	a/1985
Peripheral Canal	553.4	.50	b/1985
Marysville Dam and Reservoir	1,041.0	.15	b/1986
West Sacramento Canal	357.2	c/	b/2000
Total	$4,320.8	1.19	

a/ Under construction

b/ Not authorized by the Congress

c/ No-yield conveyance systems

As shown in the chart above several Bureau-proposed facilities have not yet been authorized. Further, according to the Bureau's Chief of Planning, funding problems and environmental concerns have caused numerous delays on some of the authorized facilities. He said that it is unlikely that such facilities can be completed by the dates scheduled. Furthermore, should the Central Valley Project be re-authorized to meet Delta water quality standards as envisioned in the State proposal, the Bureau's marketable water supply would be reduced.

Considerable mining of groundwater occurs on the east side of the San Joaquin Valley within the Bureau's service area. About 10 years ago it was proposed that an East Side Canal be constructed to alleviate this condition, but it was never authorized. The Mid-Valley Canal is another attempt to alleviate conditions there, but because it is a smaller facility than the proposed East Side Canal, it will only partially solve the problem.

ALTERNATIVE DEVELOPMENT

The Department of Water Resources' chief planner said that three alternatives are being considered to make up some of the expected 2.9 million acre-feet deficit projected for 2000.

The first alternative is estimated to extend supplies by about 1.5 million acre-feet and would be derived from surplus water flows. Such flows would be in addition to those already committed to meet State needs contained in the current $3.4 billion proposal. Like the proposal, it envisions taking surplus water from the Delta when available and storing it offstream or underground south of the Delta for later use.

The second alternative envisions the construction of several small reservoirs in the mountains above the Sacramento Valley to provide water during peak demand periods. Such reservoirs, according to the chief planner, would also serve to better time the release of surplus flows into the Delta for export south. The quantity of water that could be obtained through this alternative was not ascertained but estimated to be quite small.

Alternative three would require the construction of dams and reservoirs on the Eel River in northern California. The projected yield from this alternative is about 1 million acre-feet; however, since the river is currently part of the State wild and scenic river system and is protected from development, this alternative is presently questionable.

To meet the year 2000 demand projections, it would take the development of all three alternatives and construction of adequate conveyance systems to make up the projected deficit, provided they could be operational by 2000. Further, additional supplies would have to be developed and/or stricter conservation measures implemented if State growth continues beyond the year 2000.

Conservation, reclamation, and re-use

Estimates vary as to how much yield might be available through conservation, reclamation, and re-use. In May 1976 the Department of Water Resources issued a report entitled "Water Conservation in California." While the term "conservation" has traditionally meant storage of surface flows in reservoirs, this report emphasized that it now means increasing the efficiency of water use to delay the need for more storage. The report focused on the potential for and methods of conserving State water.

It was estimated that the potential existed to conserve about 3 million acre-feet of water by 2000. Over a third of this could come from increased residential water savings through the installation of such equipment as water-saving commodes and showers. Increased agricultural water conservation would account for 1.2 million acre-feet and would result from improving conveyance and distribution systems, selecting low water using crops, and more efficient onfarm irrigation systems and practices. About 700,000 acre-feet was assumed to come from urban water savings, leak detection and repair programs, and increased commercial and governmental water savings.

We believe that the drought has increased the level of awareness and, therefore, the amount of water saved in the State. As we noted in our visits to districts, water conservation is being practiced. Also, the Bureau emphasizes agricultural conservation in its irrigation management program which has been used by many irrigation districts since 1969.

In December 1976 the Water Resources Control Board issued a report entitled "Policy and Action Plan for Water Reclamation in California." In that report the State estimated the potential for reclaiming wastewater for re-use by 2000 at 3.2 million acre-feet. However, in 1976 only bout 200,000 acre-feet of water was being reclaimed and re-used--primarily for agriculture and recreation.

San Diego is evaluating a plan for additional research and pilot demonstrations with the goal of reclaiming 110,000 acre-feet annually to begin after 1990. The Bureau is also conducting

a study for developing alternative plans for total water management in Ventura County, with an emphasis on the reclamation and re-use of municipal wastewater. The plans include the potential development of about 122,000 acre-feet of reclaimed water by 2000.

The State's $3.4 billion proposal for water development assumes that only 700,000 acre-feet of water will come from conservation, reclamation, and re-use by 2000. This represents the water available from the three coastal areas served by the State Water Project, which supply two-thirds of the urban water demand. The 700,000 acre-feet is considerably less than the 3 million projected for conservation and the 3.2 million projected for reclamation in earlier reports. State water planners believe that the proposal more accurately reflects that which could be conserved, reclaimed, and re-used because:

--Uncertainties exist as to energy costs, adequacy of technology, health considerations, and public acceptance.

--Not all conservation or reclamation achieved in the three areas should be considered direct reductions in demand.

--The exact proportion between conservation and reclamation is difficult to predict because, if conservation is large, reclamation potential becomes smaller and vice versa.

OTHER SOURCES OF WATER

According to the State water resources planner, large-scale desalting of sea water does not currently appear practical because of high costs and extremely large energy requirements. However, desalting may be applied on a smaller scale over the next 10 to 30 years, particularly to treat brackish water for use as cooling water in powerplants. In coastal communities requiring supplemental water supplies, there may exist limited possibilities for desalting sea water. Inland communities with brackish groundwater supplies may also find desalination practicable.

The planner also said that geothermal resources in the Imperial Valley could possibly provide the State additional energy and a small quantity of water. This water could help meet local municipal and industrial water demands or be

blended with Colorado River water to reduce its salinity. To date, however, the feasibility of developing geothermal water supplies has not been demonstrated, from an economic or environmental point of view.

Further, the planner said there are several operational weather modification programs in effect in California. It has not been possible to determine the extent to which a consistent increase in precipitation and streamflow can be attained. Several studies and pilot projects are underway, but their success is problematical. Consequently, it may not be prudent at this time to rely on weather modification as a feasible source of future water supply. In addition, there are unresolved problems of environmental effects and legal questions.

CAN FORESEEABLE WATER NEEDS BE MET?

Even with the completion of all planned State and Federal water projects, local surface and groundwater development, anticipated wastewater reclamation and re-use, and conservation practices, the State will be forced to rely on substantial groundwater overdrafting to meet its needs to the year 2000.

State alternatives to overdrafting could make up much of the deficit projected for 2000; however, the alternatives rely mainly on already heavily taxed surplus winter flows and the development of new supplies in the currently protected wild and scenic rivers system. Whether these supplies could be developed and available for use by 2000 in the quantities projected is questionable.

The State ability to meet foreseeable needs in 2000 through the construction of new facilities is questionable because:

--Some projects being constructed and others authorized but not yet under construction have been and are being delayed because of funding problems and environmental concerns.

--Substantial and further development of mainstream storage reservoirs would require reversing current trends of maintaining wild and scenic rivers in the northern part of the State.

--Further development is premised on the Federal projects' meeting State water quality criteria, which is currently not an authorized purpose of the Central Valley Project.

--Further development is also premised on considerable Federal funding, most of which the Congress has not approved.

Greater reliance on wastewater reclamation and re-use, as envisioned in the State plan, would face major obstacles such as energy costs, public acceptance, and public health standards. Further, should the dependable water supply continue to be based on the lowest recorded drought, the current drought, if it persists, could result in decreasing projections for dependable water supply and thereby result in the need for more development than that envisioned in the State plan.

CONCLUSIONS AND RECOMMENDATION

If adequate water supplies for future needs are not developed, the drought in California dramatically illustrates a potential for limited growth and economic development--particularly for irrigated agriculture which uses the largest amount of water.

The drought also highlighted the reliance being placed on the overdrafting of groundwater to mitigate water shortages and pointed to the importance of conjunctive management and use of ground and surface water, as well as the need for effective integration of water supply and quality programs.

Because of the potential, significant adverse effects of continued overdrafting, delays in completing water developments, and concerns for protecting and preserving water resources and maintaining water quality, it is questionable whether the developments and proposals envisioned in the State plan will meet projected water demands.

A large part of the water plan depends on substantial Federal investment in water resources development, mostly through the Department of the Interior's Bureau of Reclamation. Because of substantial investment and concern with conservation, development, and use of national waters and related land resources, the Federal Government has a vital interest in the plan and related problems and issues affecting the feasibility of proposed water developments and alternatives for meeting future demands. The President and the Congress must also be able to effectively evaluate proposals for Federal project authorizations and funding.

We believe that a re-examination of the plan is desirable and that the Federal Government should take part in such a re-examination. Accordingly, we recommend that the Secretary of the Interior request the State and other applicable agencies, as they consider necessary, to establish a task force to re-examine the State plan to determine the best ways to meet future water demands. The re-examination should be designed to consider the following matters:

1. Is the projected 1-million-acre increase in irrigated agricultural lands consistent with estimated future demands for California food and fiber products? Will the increased agricultural land produce sufficient benefits to warrant the cost of additional irrigation water resources development, or are there less costly alternative ways to increase the yield from existing agricultural lands?

2. If, as indicated by the State planner, continued overdrafting of groundwater will lead to the loss of substantial agricultural land, is it realistic for the State to rely on overdrafting to meet future water demands?

3. In view of the potential, significant adverse effects of continued overdrafting of groundwater, are adequate actions being taken to protect groundwater resources, as well as to maximize the benefits of conjunctive management and use of surface and groundwater?

4. Because of the considerable success of conservation measures during the drought emergency and their potential for permanent water savings, should planning for additional water developments rely on more efficient water use and conservation measures during low water periods rather than basing the size of developments on the most severe drought periods of record?

5. To promote water-use economies, as well as to minimize the size of water developments, should the water users of planned projects be required to have effective conservation programs as a prerequisite to construction of water supply projects or delivery of water to them?

6. One alternative being considered to make up the expected water supply deficit is the development of water storage from projected surplus water flows. If the current drought persists, it could materially affect the future water run-off and snow melt projections; therefore, is it realistic to consider the use of such projected surplus flows as a viable alternative for meeting future demands?

7. If further water data analyses support the reasonableness of planning to capture surplus water flows, how long, even with good water years, will it be before the storage reservoirs are operational and what actions will be taken to meet the interim demand?

8. In view of the public concerns and the responding governmental actions for protecting our water resources, should reliance be placed on the Eel River, which is to be preserved under Wild and Scenic Rivers Acts, as a realistic alternative for planning development of future water supply sources?

9. If, as proposed by the State, the Central Valley Project is re-authorized to divert water for maintaining higher water quality in the Sacramento-San Joaquin Delta, will additional Federal water development be required to offset such diversions so that the project can meet existing water deliveries commitments? If such development is necessary, what are the tradeoffs between the economic costs and environmental effects involved to achieve various levels of water quality so that decisionmakers can consider the merits of each level of development?

10. In view of continuing delays in completing projects under construction, is it reasonable for the State plan to assume that projects will be operational in time to meet projected demand? What alternatives are available to meet such demand until the projects are complete?

11. If the water developments in the State plan are not constructed as planned and overdrafting of groundwater continues, what would be the impact of a drought of the magnitude being experienced when the projected water demand for the year 2000 is reached?

APPENDIX I

NINETY-FIFTH CONGRESS

Congress of the United States

House of Representatives

ENVIRONMENT, ENERGY, AND NATURAL RESOURCES
SUBCOMMITTEE
OF THE
COMMITTEE ON GOVERNMENT OPERATIONS
RAYBURN HOUSE OFFICE BUILDING, ROOM B-371-B-C
WASHINGTON, D.C. 20515

March 10, 1977

Mr. Elmer B. Staats
Comptroller General of the United States
441 G Street, N. W.
Washington, D. C. 20548

Dear Mr. Staats:

The continuing drought in California and throughout much of the West threatens the prosperity, productivity and well-being of one of the Nation's richest and most productive agricultural areas. It now seems abundantly clear that the management of water storage and water resources, and the planning for drought emergencies has been inadequate. That inadequacy apparently contributed to the deepening agricultural, industrial and social disaster.

Therefore, I ask the General Accounting Office to examine the drought emergency in California. In particular, I request that the examination explore: The extent of the drought, the damage and dislocation it has caused to date and the anticipated full extent of that damage, the adequacy of drought emergency planning by governmental agencies and others with responsibility for the management and storage of water, the adequacy of the governmental response to the emergency the adequacy of water storage and water diversion systems, the need for additional systems or the modification of existing systems, and an assessment of the full potential for water storage and management to meet foreseeable needs and to cope with foreseeable drought periods.

Because of the immediacy of the problem, I ask that the report be expedited, and that it be available to us within five months, if at all possible. In the interest of time my request

APPENDIX I

has been limited to California and I would ask that Agency comments not be required in advance of the report release to the subcommittee. Any questions that your staff may have concerning this request may be directed to David A. Schuenke, Subcommittee Counsel at 225-6427.

Sincerely yours,

LEO J. RYAN
Chairman

EXTENT AND DAMAGE OF AND RESPONSE TO THE DROUGHT AT 11 MUNICIPAL AND IRRIGATION WATER DISTRICTS

This appendix discusses information obtained at 11 municipal and irrigation water districts. At each district we inquired about the extent and damage of and the district's response to the drought. Also, when practicial, we inquired about district water planning. Following is a presentation of what we were told during our visits.

URBAN WATER DISTRICTS

Marin Municipal Water District

Background

The Marin Municipal Water District supplies 75 percent of Marin County's water demand, serving a 140 square mile area in the southern part of the county. Water use is municipal and industrial, with most customers being private home owners.

Until May 1976 rainfall stored in five reservoirs was the district's sole source of water. At that time the district completed a pipeline to obtain additional water from the Russian River. In June 1977 the district also imported State water by way of a pipeline on the San Rafael Bridge.

Extent and damage of the drought

As of January 1, 1977, storage levels were as follows:

	Storage (acre-feet)
1976	27,089
1977 (Estimated)	12,914
Average	50,824

The drought's impact on the business comm is primarily revealed in the form of drastic rate es in the price paid for water. Restaurants, hot tels, laundromats, and car washes were some of the bu es especially affected. For example, one motel's wa er bill increased from $400 for the 2-month period ending March 31, 1976, to $3,700 for the same period in 1977--actual water use was about the same. Water bills for other businesses could be expected to show similarly large increases because Marin's rationing program penalizes water use in excess of allotments. These businesses had, however, little direct control over water usage.

Damage in residential areas is primarily evidenced by the loss of landscaping and increased water rates. The district has not yet estimated the extent of landscaping losses.

There have been no detrimental effects noted in water quality because of the drought.

Marin's response to the drought

To prolong available water supplies, Marin (1) implemented a water rationing allotment program with a target reduction of 57 percent of water use along with a penalty rate system, (2) restricted the use of water for nonessential purposes, (3) used about 40,000 gallons per day of treated wastewater to irrigate landscaped areas, (4) continued work on the development of two wastewater reclamation facilities, (5) completed two pipelines to import additional water, (6) drilled additional wells, (7) distributed free water conservation devices, and (8) planned a new reservoir to increase water storage facilities.

In addition, to foster more conservation and to meet fixed financial obligations, Marin doubled water rates in February 1977. Water rates were increased from 61 cents to $1.22 per hundred cubic feet. Penalties of $10 and $50 per hundred cubic feet of use for exceeding allotments were also in effect.

Marin Municipal Water District had the most austere water conservation program of the districts we visited. Use of water was severely restricted for lawns, shrubbery, trees, vegetable gardens, and other vegetation. Washing of sidewalks, driveways, parking lots, motor vehicles, boats, and

trailers, etc., by using a water hose, was also restricted. Customers who let water run into the gutter could have their water disconnected after two warnings. Water could be restored after a $35 charge was paid.

California Water Service Company in San Mateo and Salinas

Background

San Mateo is a residential community located in the San Francisco Bay area. Salinas is an agricultural/residential community located south of San Francisco. The California Water Service Company is a primary water supplier to municipal and industrial users in the San Mateo and Salinas areas. The company serves 23,500 water users in San Mateo and 14,500 in Salinas.

The company's sole source of water in the San Mateo area is the San Francisco Water Department; in the Salinas area, the company relies on 21 wells to provide its customers water. These wells are annually recharged by the Monterey County Flood Control and Water Conservation District, which controls the county's groundwater supplies by storing water in two reservoirs and releasing it in the spring each year to recharge the groundwater basin.

Extent and damage of the drought

While water storage levels have been drawn down by as much as 47 percent since 1976, water use in 1977 is expected to be down only 19 percent in the San Mateo area and 6 percent in the Salinas area. (See data below.)

San Mateo

a. Storage (San Francisco Water Department)--1976, 340,360 acre-feet; March 1, 1977, 212,770 acre-feet.

b. Water use (California Water Service Company)--normal, 13,500 acre-feet; 1976, 14,270 acre-feet; estimated for 1977, 11,535 acre-feet.

Salinas

a. Storage 1968-77 (Monterey County Flood Control and Water Conservation District) average, 455,842 acre-feet; 1976, 477,907 acre-feet; estimated for 1977, 251,575 acre-feet.

b. Water use (California Water Service Company)--normal, 9,500 acre-feet; 1976, 9,800 acre-feet; estimated for 1977, 9,200 acre-feet.

Damage to the San Mateo and Salinas areas has been minimal, according to officials we contacted. State Employment Development Department officials in both areas said that there had been no increase in unemployment that could be directly attributed to the drought. In fact, overall unemployment decreased in 1977. Total agricultural production acreage has not been affected; instead, it has risen since 1976. In the San Mateo area one large industrial water user was concerned about the possibility of rolling energy blackouts in late July because of the lack of hydroelectric power. The California Water Service Company was trying to foster conservation by limiting industrial water users in San Mateo who did not recycle water to 75 percent of their 1976 water use as compared to a 90 percent allotment for those who did recycle water. We were told that it may be difficult to foster recycling because water recycling equipment is expensive. For a car wash operation it may cost $25,000.

For residential water users in the San Mateo area, the primary effect has been a large reduction in water use, about 42 percent for the month of May, and an increase in water rates. The company told us that such a reduction in water use required great changes in residential lifestyles regarding water usage, such as prohibiting washing cars, boats, trailers, and other vehicles by water hose and filling new or existing swimming pools. The company also prohibited the irrigation of lawns, gardens, parks, cemeteries, golf courses, and other outside areas in excess of 50 percent of the quantity of water used during the comparable billing period in 1976.

California Water Service Company response to the drought

In San Mateo the company imposed a mandatory water allocation plan where residents are allotted 75 percent of their 1976 water use and charged an excess-use penalty of $2 for each 100 cubic feet of water used over their allotment. The plan also prohibits using water for such purposes as indicated above,

which are considered nonessential. In addition, the company promoted water conservation by giving residents free water-saving kits, which consisted of plastic bottles for the commode tank and dye tablets to detect water leaks in the tanks as well as flow restrictors for showers.

In the Salinas Valley area, the Monterey County Flood Control and Water Conservation District and the company have recommended that water users voluntarily cut back water use by 10 percent.

City of Los Angeles, Department of Water and Power

Background

The Department of Water and Power provides water service to Los Angeles' population of about 2,820,000 persons. Water consumption during 1976 was 606,000 acre-feet as follows.

	Acre-feet	Percent
Residential	327,000	54
Commercial and industrial	176,000	29
Other	103,000	17
Total	606,000	100

The city's sources of water for 1976 and projected sources for 1977 are shown in the following schedule.

	Acre-feet	
	1976	1977
Owens Valley	467,000	200,000
Local groundwater	102,000	142,000
Metropolitan (Colorado River)	37,000	234,000
Total	606,000	576,000

As the schedule shows, in 1976 the city received about 80 percent of its water from Owens Valley through the city-owned, 340-mile-long Owens River Aqueduct. During the drought more reliance was placed on Colorado River water.

Extent and damage of drought

Since rain is minimal, even in normal years, in the Los Angeles Basin area, most of the water used must be imported. Because of the drought, water deliveries from Owens Valley are expected to be only 200,000 acre-feet rather than the normal 467,000. While the 200,000 acre-feet could be supplemented by pumping an additional 114,000 acre-feet from Owens Valley, local property owners have filed suit to prohibit this. As of July 1977 the case was still in litigation, and the city could not pump from the Valley.

Los Angeles estimates that the drought will cost it nearly $34 million, as follows:

Increased purchases of water	$15,000,000
Increased well and booster pumping	1,000,000
Fossil fuel replacement of lost hydroelectric generation along the aqueduct system	15,000,000
Conservation program	1,600,000
Miscellaneous	1,000,000
Total	$33,600,000

The city expects these increased costs to be passed on to water and power users.

Los Angeles' response to the drought

A voluntary conservation program designed to achieve a 10 percent water savings was established for Los Angeles in February 1977. On May 12, 1977, the city council enacted a water conservation program consisting of a voluntary program and a five-phase mandatory program of increasingly restrictive elements. Consumption reduction goals vary from 10 to 25 percent of water use during the 1976 base period. Phase one of the five-phase program, effective July 1, 1977, prohibits certain outside uses of water and provides for distribution of conservation devices.

Metropolitan Water District of Southern California

Background

The Metropolitan Water District of Southern California supplies 1.5 million acre-feet of water per year to 27 member agencies and has 10 percent of that quantity in reservoir storage space. The area served by Metropolitan includes almost all of the developed area of the southern California coastal plain. The area extends from the Ventura-Santa Barbara area to 200 miles south to the Mexican border and about 100 miles inland. The coastal plain is a semiarid area with an average annual rainfall of 14 inches.

In the early 1930s Metropolitan constructed the 242-mile Colorado River Aqueduct. Under a contract with the Federal Government, Metropolitan is entitled to 1,212,000 acre-feet of water per year from that source. In 1960 Metropolitan signed a contract with the State for 1,500,000 acre-feet of water annually from the State Water Project, which was later increased to 2,011,500 acre-feet. This increase was intended to offset the expected loss of Colorado River water to Arizona in the mid-1980s when Metropolitan's entitlement could be reduced to 550,000 acre-feet annually in anticipation of Central Arizona Project completion. Metropolitan expects that addition of State water will take care of coastal plain water demands well into the 21st century. The annual payment by Metropolitan to the State for 1977 will total about $70 million.

Extent and damage of the drought

Metropolitan does not anticipate short-term financial problems due to the drought. It contemplates passing on any higher costs incurred to the water users. However, problems in the service area include:

1. Water is not available for replenishment of underground basins.

2. The West Branch service area will not have enough water to meet 1978 demands.

3. The Castaic-Pyramid power generation complex will close because of low water levels.

4. Metropolitan will not be able to maintain its 90-day emergency water supplies.

5. Groundwater pumping levels have been lowered, and pumping costs at some locations have increased.

6. Metropolitan can pump up to 800,000 acre-feet from the Colorado River with power from the Hoover and Parker Dams at a cost of $5 per acre-foot. Additional water, up to the entitlement of 412,000 acre-feet must be pumped with power procured from Southern California Edison at a cost of $42 per acre-foot.

Metropolitan's response to the drought

To mitigate the drought shortage, Metropolitan has:

1. Agreed to give up 320,000 acre-feet of Water Project water so that it can be used in central and northern California.

2. Increased Colorado River diversions from 800,000 acre-feet to 1,300,000 acre-feet.

3. Established a water conservation program by discouraging excess water usage through a water rate surcharge.

4. Requested member agencies overlying groundwater basins to increase pumping of groundwater. It is estimated that this increased groundwater pumping will make available an additional 75,000 acre-feet.

5. Curtailed its groundwater replenishment program.

Humboldt Bay Municipal Water District

Background

The Humboldt Bay Municipal Water District is the water service organization providing water to Humboldt County in coastal northern California. The primary water users are two pulp mills, which use 86 percent of the district's water. The district's sole source of water is Mad River, which has one reservoir of 52,000 acre-feet for storage.

Extent and damage of the drought

The reservoir water level was down 52 percent in April 1977 as compared to 1976. To retain what little was left, the district sought relief by maintaining Department of Fish and Game minimum streamflow requirements.

The Humboldt County economy has not yet been damaged by the drought. The district has been able to meet most water users' needs through a rationing and re-use program. There is concern that, if the drought continues, the pulp mills will be shut down, and several hundred people will lose their jobs.

Humboldt's response to the drought

The district reduced releases from the storage reservoir and implemented a water rationing program. It also gave the Humboldt community priority for water over the pulp mills. As a result the pulp mills were cut from 55,000 acre-feet of water in 1976 to 40,000 acre-feet in 1977.

The district recognizes the potential for future droughts. However, it does not believe that this warrants the costs of additional storage reservoirs because the need might not arise more than once every 50 years.

Current water storage facilities are designed to handle greater than Humboldt County's current maximum needs and have a second stage expansion built into the reservoir to meet future needs. Plans contemplate increasing the reservoir capacity to 120,000 acre-feet by adding 38 feet to the existing dam.

San Diego Water Utilities Department

Background

The San Diego Water Utilities Department provides about 167,000 acre-feet of water annually primarily to city municipal and industrial users whose rapidly growing population is presently estimated at 774,100. The average daily water consumption per capita is 193 gallons. San Diego depends on Colorado River water imported by Metropolitan and delivered through the San Diego County Water Authority.

Extent and damage of the drought

The city and county suffered no shortage of water, and none is expected. Deliveries of water from the Colorado River are normal. San Diego reservoir storage levels are down 14 percent from last year. However, county and Metropolitan's deliveries were 17 percent higher than during 1975 and 1976. Water use in 1976 was normal, and 1977 usage is estimated to be only 3 percent lower.

Except for voluntary conservation, no city or county damage, unemployment, or lifestyle changes have occurred because of the drought. As a result of conservation the Water Utilities Department has cut back its capital improvement program by $2 million and raised water rates in 1977 by 6 percent to make up for lower water sales.

San Diego's response to the drought

San Diego initiated a promotional compaign, using films, literature, television announcements, and mailers, to encourage water users to voluntarily decrease water use by 10 percent.

AGRICULTURAL WATER DISTRICTS

Wheeler Ridge-Maricopa Water Storage District

Background

The Wheeler Ridge-Maricopa Water Storage District, located southwest of Bakerfield in Kern County, covers about 81,000 acres under contract for water from the State Water Project. Crops grown in the district include cotton, sugar beets, safflower, melons, potatoes, grapes, alfalfa, grains, citrus, vetetables, and nuts. Water deliveries to the district commenced about 6 years ago from the Water Project through the Kern County Water Agency. The district contracted for about 25 percent of Kern County's surface water supply. Kern County is the largest Water Project agricultural contractor and the second largest Water Project contractor (the Metropolitan Water District of Southern California is the largest). Currently, Kern County is the district's only source of surface water.

Wheeler Ridge's 1977 surface water entitlement is 190,400 acre-feet; the maximum annual entitlement is 302,900 acre-feet; and it will be reached in 1990. At full development, part of the district will be served solely from private wells.

Extent and damage of the drought

Rainfall in the southern end of the San Joaquin Valley is very limited and insufficient to support large-scale farming operations. Before the availability of surface water through the Water Project, area farming was somewhat limited because of the low quantity and poor quality of local groundwater. The State advised Wheeler Ridge that, if next year is as dry as this year, agricultural water will not be provided. Wheeler Ridge believes that if this occurs, potential district losses could be substantial.

While entitled to 190,400 acre-feet of surface water, the district will receive an estimated 79,000 acre-feet from the Water Project in 1977. As a result the district estimates that lands to be farmed will decrease from 81,000 in 1976 to 58,900 acres in 1977. Wheeler Ridge estimates a loss in productivity, at $850 per acre, of $18.7 million for the 22,000 acres not farmed this year. If Water Project water is not available in 1978, Wheeler Ridge estimates that only about 25,000 acres could be irrigated with groundwater and the remaining district acreage would remain idle. District officials said that more permanent crops would be lost, some farms perhaps the entire district abandoned, and thousands of jobs lost.

Because of the water shortage, district farmers uprooted about 1,000 acres of permanent trees and vines because they chose to use available water for higher cash crops. Had these farmers chosen to keep these permanent trees and vines alive, it would have been at the expense of a profit on other crops.

The normal cost of district water to the water users is $44 per acre-foot. Because Water Project customers pay a pro rata share each year regardless of how much water is delivered to them, only about one-third of normal supplies will be available this year, the cost will average about $123 per acre-foot. This means that the cost of water for a crop requiring 3 acre-feet would amount to about $369 per acre.

One farmer has enough water for one-third of his 3,100 acres, yet his water bill was the same as if he received his normal allocation. He operates one well and is drilling another at a cost of $80,000. He also said that he was putting all his acreage in cotton because he anticipates a favorable market and expects to meet all his financial obligations this

year, providing his cotton "comes in." He had to release 10 of his 16 permanent employees. He said that because the last 3 years have been good, he is able to continue operations this year.

Another farmer who normally farms 2,000 acres said that he is farming 1,700 acres this year. He told us that he has one well and has recently drilled three others; these wells are producing sufficient water to supplement his surface water allocation to enable him to farm most of his acreage. He said his district water bill is fixed, making it extremely difficult for him to break even.

Wheeler Ridge's response to the drought

The reduced surface water allocation from the Water Project is forcing district farmers to develop wells. The district is also attempting to develop a groundwater program but may be hampered by financial and environmental restrictions.

Other than reductions in planted acreage, crop yields, and farm labor employment, Wheeler Ridge believes that there is no additional potential for water conservation within the district. There exists no potential for conservation through re-use of water. In fact, the Department of Water Resources noted that overall basin efficiency in the area is too high (not enough water is being returned to the ground to flush the soil) and should be decreased to prevent salinity problems.

Wheeler Ridge's contract for State water requires an annual payment whether or not water is delivered. In January 1977 the district asked the State to defer at least a portion of the 1977 water payment. As of June the district did not know the State's response. To help its water users finance high water costs, Wheeler Ridge negotiated a $1 million loan.

Westlands Water District

Background

The Westlands Water District, located on the west side of the Central Valley in the Fresno-Kings County area, encompasses about 575,000 acres. In 1976, 467,300 acres of fruits, nuts, grains, fiber, and vegetable crops were irrigated. Westlands relies entirely on the Bureau of Reclamation for its surface water. In 1976 the district delivered about 1,238,000 acre-feet of project water to water users. This was supplemented by about 151,000 acre-feet of groundwater. Westlands' distribution and drainage systems,

constructed under a reclamation program, are not yet completed. The Bureau estimates that from 300,000 to 400,000 acre-feet of supplemental groundwater can be pumped from district lands without decreasing groundwater levels. From 1971 to 1976 groundwater levels rose because there was no great amount of pumping, which was due to an adequate supply of better quality Central Valley Project surface water.

Extent and damage of the drought

Westlands' surface water supply in 1977 will be 252,000 acre-feet or 20 percent of its 1976 allocation. However, the district anticipates that groundwater pumping of about 453,000 acre-feet will increase its supply to 50 percent of the water available in 1976. The district estimates that irrigated acreage will decrease by 108,238 or 23 percent, causing a reduction of about $78 million in gross farm income. Also, Westlands estimates that about $13.4 million will have to be spent for additional wells, $12 million for water management facilities, and $9 million for increased groundwater pumping.

To determine the drought's impact on the farmers, we visited several farming operations. One family farm which normally operates on 1,920 acres was allocated 5,000 acre-feet of water in 1976 and 1,132 in 1977. The farm has no underlying groundwater and relies wholly upon the Westlands to provide surface water. Cotton, rice, wheat, barley, and alfalfa are normally grown. This year the farmer estimates losses of (1) 150 acres of wheat to which 10 to 12 inches of water had already been applied, (2) 150 acres of alfalfa, and (3) 150 acres of barley. In addition, the farm will have only two cuttings this year on the remaining acreage of alfalfa instead of the usual seven cuttings. Each cutting has a market value of about $30,000.

Safflower and cotton were the main crops the farmer planted this year. Cotton was increased from 450 to 600 acres in anticipation of a good market. The farmer believes that he will be able to break even this year if the cotton does well. Arrangements were made with creditors to defer payments this year should the farm be unable to meet its financial obligations. Farm personnel told us that if the farm does not receive surface water next year they do not know what they will do, but that they are confident something will work out.

Another farm we visited normally operates 9,500 acres. In 1977 it was allocated 17 percent of the 28,500 acre-feet of surface water received in 1976. The farm operator told us that he is farming only one-third of his acreage. Because of the drought, high-water-use crops were eliminated. For example, 300 acres of sugar beets were taken out, and 150 acres of onions and 75 acres of peppers were not planted.

This farm has 13 old wells which were used before the delivery of surface water. Eight were rehabilitated at a cost of $40,000 per well. If surface water is not available next year, the farm operator anticipates that half of the farm acreage can be irrigated with groundwater from all 13 wells. However, groundwater is inferior in quality to surface water.

The principal crop planted this year is cotton because of an anticipated good market and because it is salt tolerant. The farm operator said that a good cotton crop would generate sufficient income to break even on all farm operations this year. This farm reduced its permanent work force from 85 to 74 this year; the temporary work force will also be reduced.

The Bureau informed Westlands that, if the 1977 to 1978 water year is as dry as the 1976 to 1977 year, the district will not receive agricultural water.

Increased reliance on groundwater has caused the following problems:

--Subsidence, which was a problem in the past until groundwater became available and pumping was halted.

--Higher costs of pumping groundwater at depths of 400 to 800 feet.

--Salt water intrusion from the connate (upper) layer of water.

--Difficulty in obtaining enough pumps, motors, transformers, and powerline construction in time to provide water for irrigation.

Westlands' operation and maintenance costs are paid from water user charges. The 1977 user charges were based on an anticipated delivery of 1,300,000 acre-feet of water. Since the actual deliveries will be only 252,000 acre-feet, only 20 percent of the estimated operation and maintenance income

will be collected. However, Westlands decided not to increase the user charge this year and expects to make up the difference by

--reducing expenditures by $632,500 and

--using $3.5 million available from prior years' operation.

Westlands' responses to the drought

Westlands officials said that the district is embarking on an experimental pilot program of groundwater pumping to supplement surface water deliveries. Also, Westlands was encouraging individuals to transfer water from their lands in other districts to their lands in the district. Apparently, this has not proved to be practicable in some cases. For example, one farmer we visited attempted to transfer 1,500 acre-feet of water from his lands in the adjacent Columbia Irrigation District. He told us that in spite of an adequate supply of groundwater in the district, Columbia would not allow the export of water outside the district, fearing that it would prove detrimental in any future water rights adjudication.

Westlands is also importing 5,723 acre-feet of water from the Metropolitan Water District of Southern California and has arranged to purchase 11,523 acre-feet of water at a cost of $68.25 per acre-foot. This water will be made available as needed for the survival of trees and vines.

Imperial Irrigation District

Background

The Imperial Irrigation District is the primary supplier for Imperial County, the State's fourth largest agricultural county. Imperial County is located in the southeastern portion of California adjacent to the Mexican border. Ninety-nine percent of Imperial's water is used for agricultural purposes, and about 502,248 acres are irrigated, including some 154,800 acres which were double cropped or farmed more intensively. Imperial's sole source of water is the Colorado River, which is delivered to Imperial through the All-American Canal. It does not depend on rainfall, which usually amounts to less than 3 inches annually.

Extent and damage of the drought

The impact of the drought on the Imperial County area has been minimal. In fact, as opposed to other districts we visited, we were told that unemployment was lower, and more land was irrigated in 1977 than in 1976.

Imperial's response to the drought

In spite of the minimal impact, Imperial implemented a program to curb excess water use through increased water rates. The increased rate applies where Imperial determines that more than 15 percent of water delivered over a 24-hour period is permitted to run off the land. Imperial permits a runoff of 15 percent because it aids in leaching off excess surfce salt deposits.

Imperial also allocates $2 million a year for the concrete-lining of irrigation canals to reduce water loss and erosion.

Orland Unit Water Users Association

Background

The Orland Unit Water Users Association is located in northern California surrounding the city of Orland. It encompasses about 18,230 acres, of which about 5,000 are devoted to tree crops and the remainder to dairy operations. There are 749 farmers in the districts, including 441 part-time farmers.

Completed around 1910, the Orland Unit is one of the oldest Bureau projects in California. The project consists of three dams and reservoirs, 39 miles of canals, and about 100 miles of laterals. The conveyance system is in marginal condition because of leakage; for every acre-foot of water delivered to the farm, one acre-foot is lost.

Extent and damage of the drought

On April 1, 1977, Orland had about 15 percent of its normal water requirements in storage. This might be enough for two irrigations. The gravelly soils of the area's Stoney Creek Fan require about 15 irrigations annually. We were informed that many orchards and alfalfa stands will be severely damaged or lost without supplemental water. In addition, the water shortage has lowered the underground water reservoir

because of increased reliance on well water pumping. Many of the area's domestic wells are shallow or are now dry. Deeper wells for irrigation will result in higher pumping costs.

As of June 1977 the two smaller district reservoirs were dry, and the larger reservoir contained 16,000 acre-feet of water. The Bureau will permit Orland to drain this reservoir dry this year; it is estimated that this will occur by September 1977.

The district does not expect financial damage this year because users pay a flat fee regardless of how much water they use. Since less water than usual is available, the rate per acre-foot will increase by more than six times.

Orland's response to the drought

Orland tried to get its annual payment for project water to the Bureau deferred. It did not receive the deferment because it submitted the application after the annual payment was made. The Bureau told Orland that the 1977 payment could be applied as the 1978 payment.

In 1976 the city of Orland, with a population of about 5,000, lost about 40 percent of its business because of a lack of water. This year the city estimates that losses will be greater. Orland estimates that agricultural crop income will drop from a normal level of $4 million to $2 million this year.

One farmer said that the cost of feeding his herd would increase by about $140 per day because he could not grow his own alfalfa after his water ran out. He told us that, as a result of the drought, people are leaving the community, farmers are selling out, and dairies are liquidating. In 1976 and 1977, 16 dairies went out of business.

During our visit we were shown many dry alfalfa fields, for which we were told there was no water. We were told that, except for those farmers with their own wells, the entire district would be dry by August 1977.

With a Federal loan, Orland attempted to drill a 40-foot well system to supply part of the district water. However, the drilling contractor was unable to obtain adequate bonding, and the project was dropped.

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