



Western Region Technical Attachment

No. 91-17

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SPECIAL CLIMATE SUMMARY

[Editor's Note: This article appeared in the March 30, 1991 edition of the "Weekly Climate Bulletin", prepared by the Climate Analysis Center. It is reproduced here for offices which do not have access to that publication.]

The good news is that California had a lot of rain in March. The bad news is that it still wasn't enough. A parade of storms lashed California since February 27, bringing badly needed rain and snow and easing critical water shortages. Many reservoirs, however, remain well below average as hydrological drought continues unabated. The month's rain and snowfall totals throughout the state are reminiscent of the "miracle March" of 1978 that ended California's last serious drought, but the state has 7 million more people than it did 13 years ago and officials stressed it takes more than a month of heavy rain to make up for more than 5 years of drought, particularly in agricultural areas. Nonetheless, the month of March has brought about a somewhat curious situation where water managers are quite happy to be facing merely a serious shortfall.

The area of greatest need, the central coast, received the most rain relative to average conditions. From Monterey southward to Ventura County, most locations received 400 to 500 percent of normal March precipitation (see Figure 1). For example, Paso Robles had only 1.05 inches from October 1 (the start of the "water year") through the 26th of February; by the end of March the total stood at 11.91 inches, essentially normal for the season (see Table 1). Santa Barbara received 12.33 inches, exceeding the old March record of 11.73 inches set in 1885, and 507 percent of the 2.43 inches average. As the result of a 2-day deluge of 15 inches near mid-month, the formerly empty Gibraltar Reservoir rose 34 feet in two hours and spilled water into the next (and much larger) reservoir downstream, Lake Cachuma, source of most of Santa Barbara's water. Water supplies which at the end of February were expected to be depleted by mid 1992 had increased by the 10th to an extent that supplies were expected to be enough until at least 1993. Santa Maria, which averages 1.85 inches in March, received 9.41 inches, exceeding the old March record of 7.84 inches in 1941. Sacramento measured 7.48 inches (average is 2.04), the 5th wettest March in a record extending back to 1850. Full hydropower for Sacramento is now expected, so that planned rate increases to buy expensive coal-powered electricity have been shelved. About three feet of rain fell in higher portions of the Coast Range near Paso Robles.

Because most water supplies in this portion of California are local, without connection to the elaborate statewide distribution system, and because the area had in a relative sense been the driest part of the state, the central coast had the worst water supply prospects and was in the greatest need of water. Despite the improvement in water supplies, none of the central coast communities are planning to relax rationing programs, which have been in place for several years.

The water plan for San Francisco and 30 surrounding communities calls for a 45 percent reduction compared with 1987. To do this will require 33 percent cuts in residential use and 90 percent cuts in outdoor use. San Francisco itself will cut allocations by 32 percent. No single family home will receive more than 300 gallons per day. In Marin County residents began an even more strict rationing program on April 1st of a maximum of 50 gallons per person per day. San Francisco's Hetch Hetchy Reservoir held 0.34 million acre-feet (MAF) on March 19, 34 percent of average and 12 percent of capacity.

For the first time in four years, the Carmel River (near Monterey) flowed to the sea, which should allow salmon to return to spawn in the river of their birth. Concerns about salt-water intrusion into the Sacramento Delta groundwater supply, a result of insufficient fresh water outflow to keep out sea water, were reduced, but not gone.

At Lake Shasta in northern California, water year totals rose from 9.48 inches in later February to 31.91 inches by the end of March. At mile high Blue Canyon, a long-term National Weather Service site along I-80 in the central Sierra, the water year total rose from 8.76 inches on February 26 to 35.04 inches on April 1. Other March

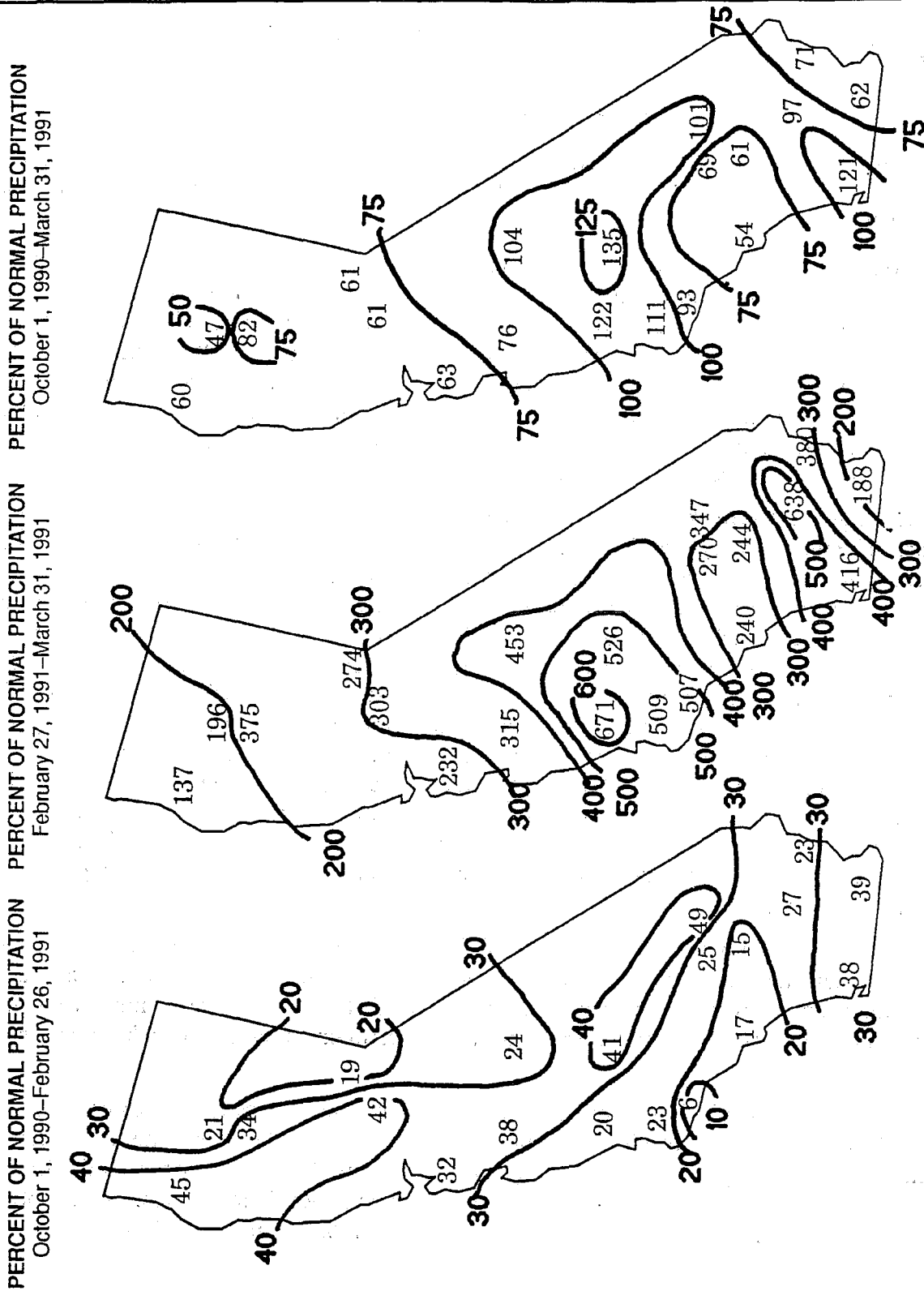


Figure 1. Percent of Normal Precipitation at selected locations across California during this season's dry spell (Oct 1 - Feb 26), wet spell (Feb 27 - Mar 31), and for the season as a whole to date. Note that the heavy precipitation of late February and March completely alleviated this season's accumulated departures across the south-central and portions of the extreme southern sections of the state; however, only minimal recovery came to the northern tier and parts of the central and southeastern coast, where March precipitation was heavy but unspectacular compared to the aforementioned areas.

WET SEASON PRECIPITATION SUMMARY ACROSS CALIFORNIA

October 1 – February 26 (Dry Period), February 27 – March 31 (Wet Spell), and October 1 – March 31 (Season to Date)

Table 1. Complete breakdown of measured precipitation during this season's dry spell (Oct 1 – Feb 26), wet spell (Feb 27 – Mar 31), and for the season as a whole to date.

CITY	10/01/90 – 02/26/91				02/27/91 – 03/31/91				10/01/90 – 03/31/91			
	Total	Normal	Dep. Nml.	% Nml.	Total	Normal	Dep. Nml.	% Nml.	Total	Normal	Dep. Nml.	% Nml.
Bakersfield	1.42	3.51	-2.13	40.5	4.47	0.85	+3.62	525.9	5.89	4.36	+1.53	135.1
Blue Canyon	8.76	47.44	-38.68	18.5	26.28	9.60	+16.68	273.8	35.04	57.04	-22.00	61.4
Blythe	0.36	1.59	-1.23	22.6	0.95	0.25	+0.70	380.0	1.31	1.84	-0.53	71.2
Daggett	0.85	1.73	-0.84	49.1	1.25	0.36	+0.89	347.2	2.10	2.09	+0.01	100.5
Eureka	11.95	26.58	-14.63	45.0	6.90	5.04	+1.86	136.9	18.85	31.62	-12.77	59.6
Fresno	1.69	6.97	-5.28	24.2	7.25	1.60	+5.65	453.1	8.94	8.57	+0.37	104.3
Imperial	0.54	1.38	-0.84	39.1	0.47	0.25	+0.22	188.0	1.01	1.63	-0.62	62.0
Los Angeles	1.51	8.72	-7.21	17.3	4.18	1.74	+2.44	240.2	5.69	10.46	-4.77	54.4
Paso Robles	1.76	9.00	-7.24	19.6	11.28	1.68	+9.60	671.4	13.04	10.68	+2.36	122.1
Red Bluff	4.87	14.45	-10.49	33.7	8.89	2.37	+6.52	375.1	13.76	16.82	-3.06	81.8
Redding	6.11	28.93	-22.83	21.1	9.71	4.96	+4.75	195.8	15.82	33.89	-18.07	46.7
Sacramento	4.77	12.64	-7.87	42.3	7.48	2.04	+5.44	366.7	12.25	14.68	-2.43	83.4
Salinas	2.80	9.22	-6.42	37.7	5.48	1.74	+3.74	314.9	8.28	10.96	-2.68	75.5
San Diego	2.34	6.13	-3.79	38.2	7.20	1.73	+5.47	416.2	9.54	7.86	+1.21	121.3
San Bernadino	1.71	11.09	-9.38	15.4	6.74	2.76	+3.98	244.2	8.45	13.85	-5.40	61.0
San Francisco	4.70	14.55	-9.85	32.3	6.07	2.62	+3.45	231.7	10.77	17.17	-6.40	62.7
Santa Barbara	0.75	11.65	-10.90	6.4	12.33	2.43	+9.90	507.4	13.08	14.08	-1.00	92.9
Santa Maria	1.97	8.43	-6.46	23.4	9.41	1.85	+7.56	508.6	11.38	10.28	+1.10	110.7
Thermal	0.44	1.63	-1.19	27.0	1.34	0.21	+1.13	638.1	1.78	1.84	-0.06	96.7
Victorville	0.92	3.70	-2.78	24.9	2.21	0.82	+1.39	269.5	3.13	4.52	-1.39	69.2

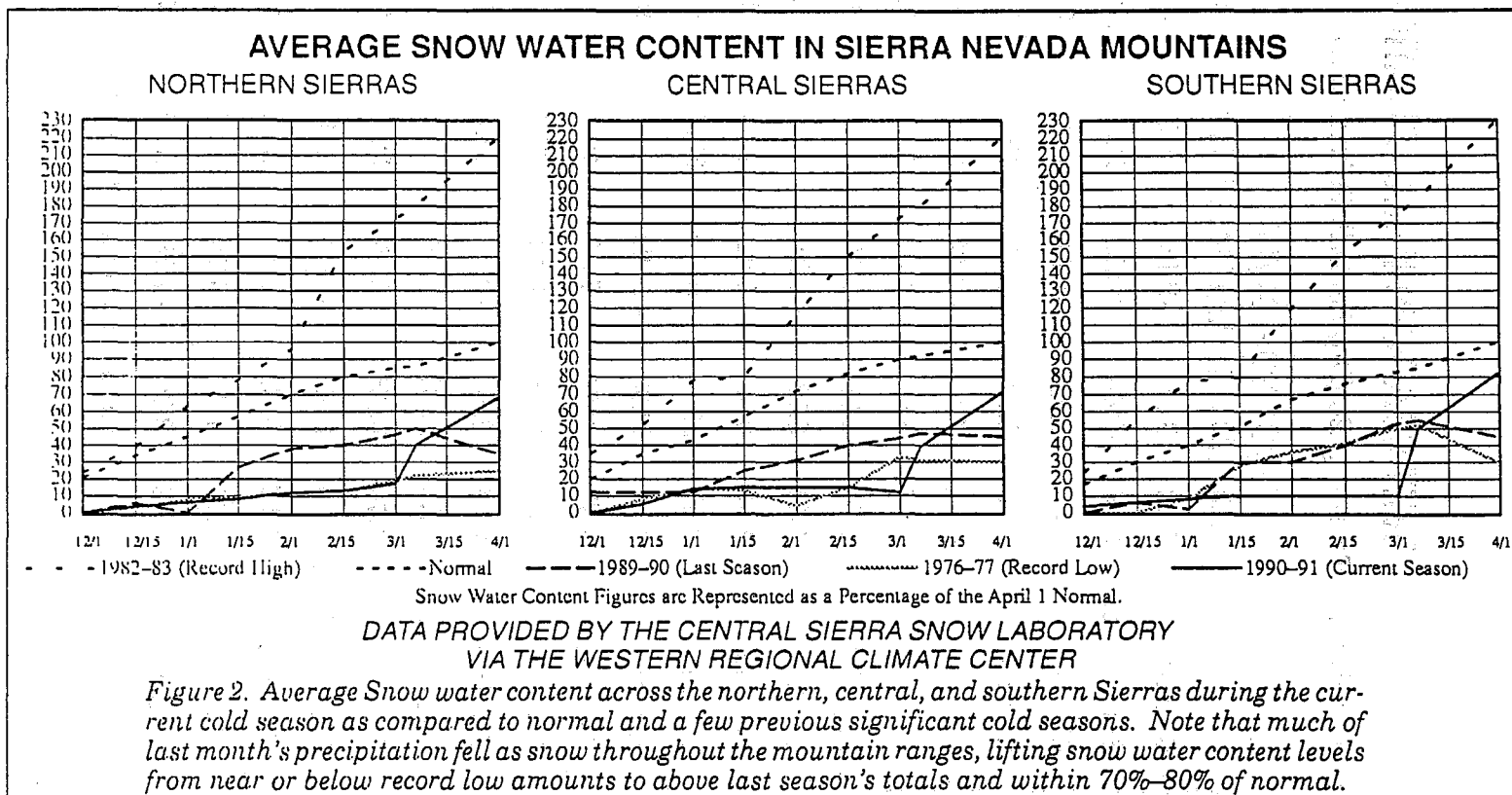
NOTE: Bold numbers in columns 1 and 5 mark stations that received more precipitation during 2/27 – 3/31 than during 10/1 – 2/26.

precipitation totals included 16.67 inches at the outlet of Lake Tahoe, 19.23 inches at Tahoe Meadows (the wettest March in a 21 year record), and 24 inches at Squaw Valley and at Grant Grove in the southern Sierra.

The first storm at the start of the month brought copious tropical moisture and had high freezing levels. The subsequent storm track from the Gulf of Alaska was much colder, which has two effects: cooler temperatures slow immediate runoff and more precipitation falls as snow. Alpine Meadows ski area recorded 186 inches of snow, their snowiest month in their 20 year history. A monthly snowfall of 201 inches was recorded near Donner Pass while Echo Summit just south of South Lake Tahoe recorded 219 inches of snowfall, containing 22.82 inches of water. Some very heavy snows fell toward the end of the month. Iron Mountain, at 7000 feet, noted 116 inches of snow in 4 days (23rd–26th), and Kirkwood ski area not far from there measured 42 inches in a 24-hour period. One snowboarder there suffocated when he fell headfirst into deep powder.

The month's storms brought about a dramatic increase in the snow water content in the Sierra Nevadas (see Figure 2). The largest increase was in the southern Sierra where amounts jumped from 10 percent of average at the start of the month to 82 percent at the end of the month. The snow water content in the northern, central, and southern Sierras are all currently well ahead of last season and the record low season of 1976–77. Relatively less precipitation fell in the northern Sierra (currently 68 percent of average) where much of the water supply for California (including Los Angeles) originates.

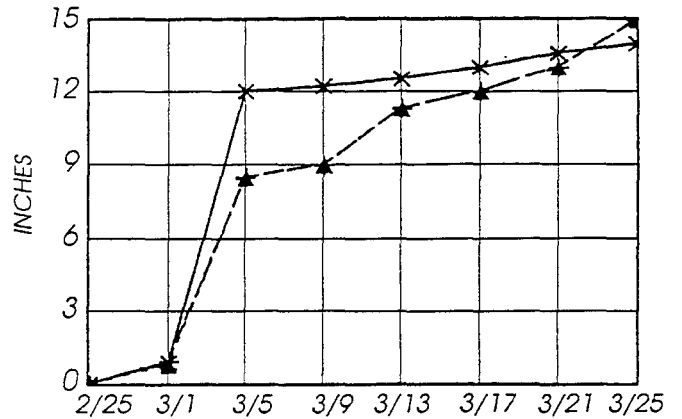
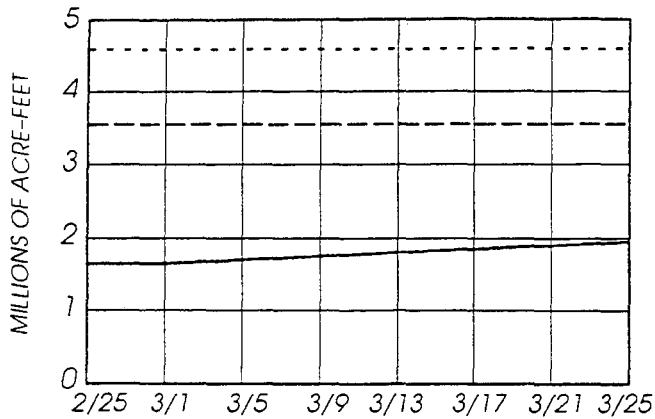
At the start of the month, reservoir storage in California stood at about half of last year's values. Reservoir storage increased by about 2 MAF during the month, eliminating about a third of the difference between this year and last. In most locations in California, previously announced strict controls on the use of water will remain in place. Most of the unexpected runoff will be retained in reservoirs to provide a greater cushion in the event of a sixth dry winter. Stockton's reservoir, however, rose from 22 percent full on February 27th to brim full at month' end. Rationing goals of 100 gallons per single person per day (plus 50 gallons for each additional person) were doubled in response. Lake Tahoe rose about 7 inches from precipitation falling directly on the lake, and may be able to briefly rise to the rim (8 more inches) this summer. Some marinas are nearly unusable and owners are petitioning for relaxation of strict environmental standards to dredge the bottom deeper.



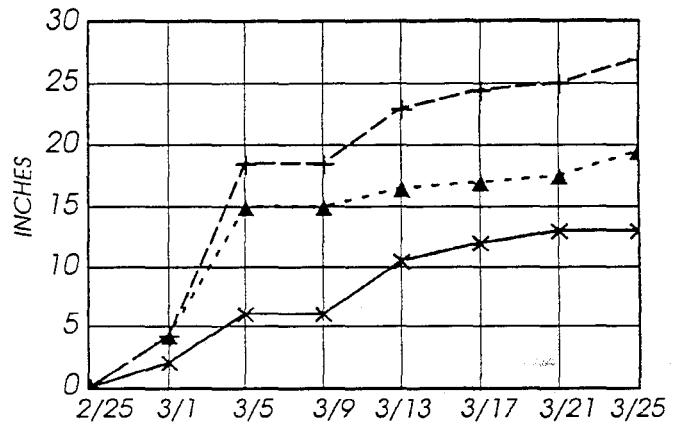
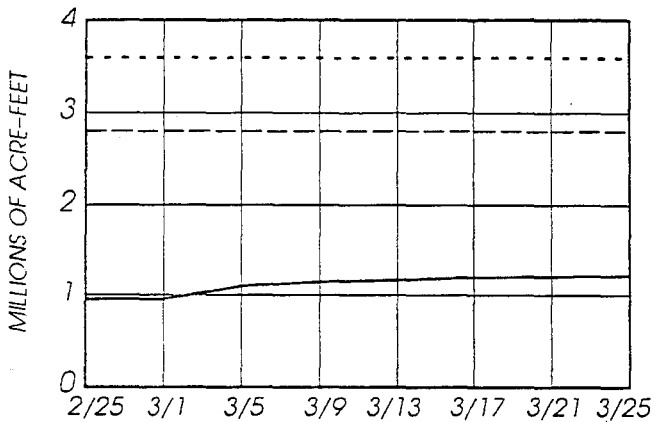
**TIME SERIES GRAPH OF RESERVOIR LEVELS (Left) AND
CUMULATIVE PRECIPITATION AT AND UPSTREAM OF RESERVOIR (Right)**

February 25 - March 25, 1991

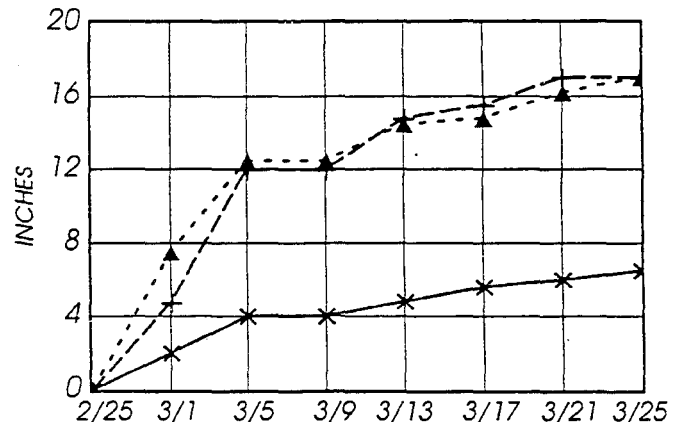
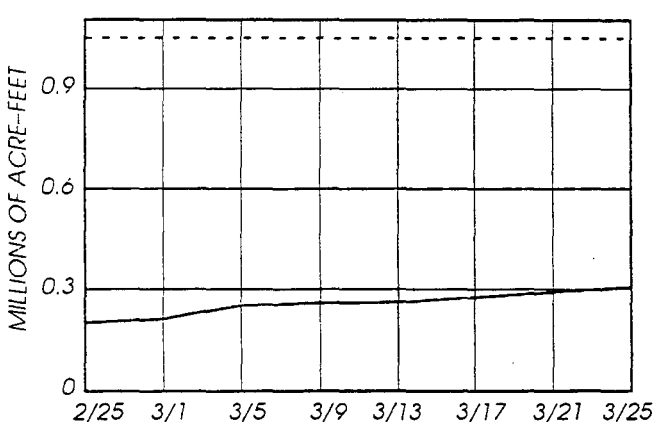
SHASTA DAM



OROVILLE DAM



FOLSOM LAKE DAM



----- CAPACITY
 ----- NORMAL
 ——— OBSERVED

———— PRECIPITATION AT DAM SITE
 ----- UPSTREAM LOCATION #1
 (Lakeshore, Bush Creek, and Pacific House, respectively)
 ----- UPSTREAM LOCATION #2
 (Hirz, Strawberry Valley, and Georgetown RS, respectively)

DATA PROVIDED BY THE OFFICE OF HYDROLOGY

Figure 3. Observed reservoir levels at three California dams vs. accumulated precipitation at the dam site and at two upstream locations. Despite heavy precipitation at each dam site and, especially, upstream of the dams, reservoir levels recovered only very slowly from the extremely low levels that have been produced by five consecutive wet seasons of substantially below normal precipitation.

Figure 3 shows recent observed storage in three of California's largest reservoirs as well as their average storage and capacity (on left). All three reservoirs were and continue to hold much less water than normal. Cumulative precipitation amounts for selected stations in the reservoir drainage are also shown (on right). At each reservoir, there is an precipitation observation for the dam site and others located in the drainage upstream from the inflow point. Presumably these latter stations are indicative of the precipitation being collected by the reservoirs. At each reservoir, two striking features are demonstrated. First is the extreme magnitude of the precipitation amounts at these station. Second is the disappointing response of the reservoir levels for precipitation of such magnitude. This can be attributed to parched soils absorbing much of the water and decreasing the amount of expected runoff flowing into the reservoirs. These conditions are typical of most major reservoirs in California.

Farmers still face severe water shortages as cutbacks in irrigation water continue. Expected acreage for cotton plantings is down 14 percent, to 940,000 acres, while a 23 percent drop in rice acreage and a 13 percent drop in sugar beet acreage is expected.

The active March weather brought a number of funnel clouds and even a few tornadoes, unusual weather but not unheard of in California. On Sunday the 24th, the 4th tallest tree in the world came crashing to the earth along the Avenue of the Giants near Eureka, creating a 362-foot log. A number of windstorms throughout the month toppled other trees, held up traffic because of downfall and avalanches, and killed several people in homes and cars. Four children were killed on the 27th when they were swept away in the rushing waters of the rain-swollen Calaveras River near Stockton.

In other parts of the West, March brought much needed precipitation. Snow water content rose from 64 percent of average on February 25 to 80 percent of average on April 1. Arizona in particular experienced a dramatic turnaround. Precipitation since the start of the year is above average nearly everywhere in the state, with values of 100-200 percent of average prevailing. Water manager concerns changed from conservation to flood reduction during the height of activities about mid-month. Reservoir storage on March 1 was above average in New Mexico, Washington and Colorado and below normal elsewhere (see Figure 4). Nevada's reservoirs were in far worse condition than any other state, many nearly dry.

Fire danger is once again expected to be high in many portions of the West, continuing a pattern seen for the last 5 years. Drought has produced a large amount of standing dead timber, especially in the Sierras.

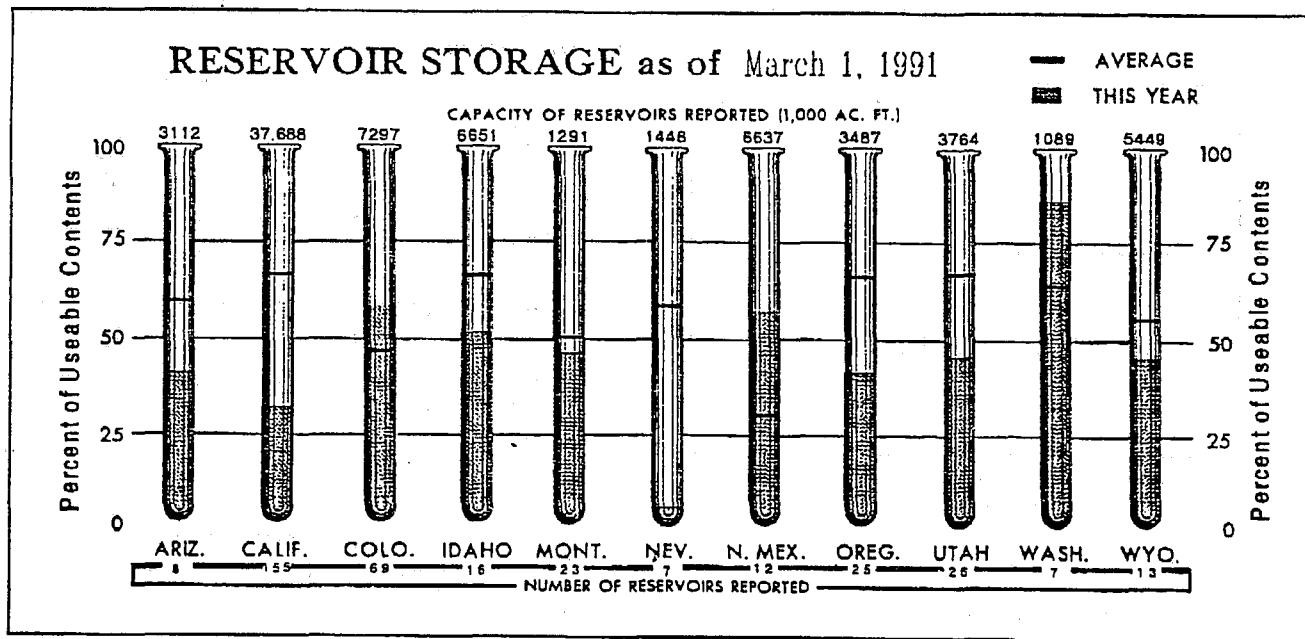


Figure 4. Statewide average reservoir storages as of March 1, 1991, taken from the *Water Supply Outlook for the Western United States*, a publication of the Soil Conservation Service. Note that most western states have below half of normal reservoir storage, with Nevada at a critically low 3%-5%.