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The Resources Agency

DEPARTMENT OF WATER RESOURCES
Division of Operations and Maintenance

STATE WATER PROJECT ANNUAL REPORT OF OPERATIONS 1989

August 1993

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The Resources Agency

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Governor
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This is the sixteenth in a series of annual reports summarizing the water and energy operation of the California State Water Project. This report summarizes the operation of Project facilities during 1989, and includes any revisions to data previously published in the monthly "State Water Project, Operations Data".

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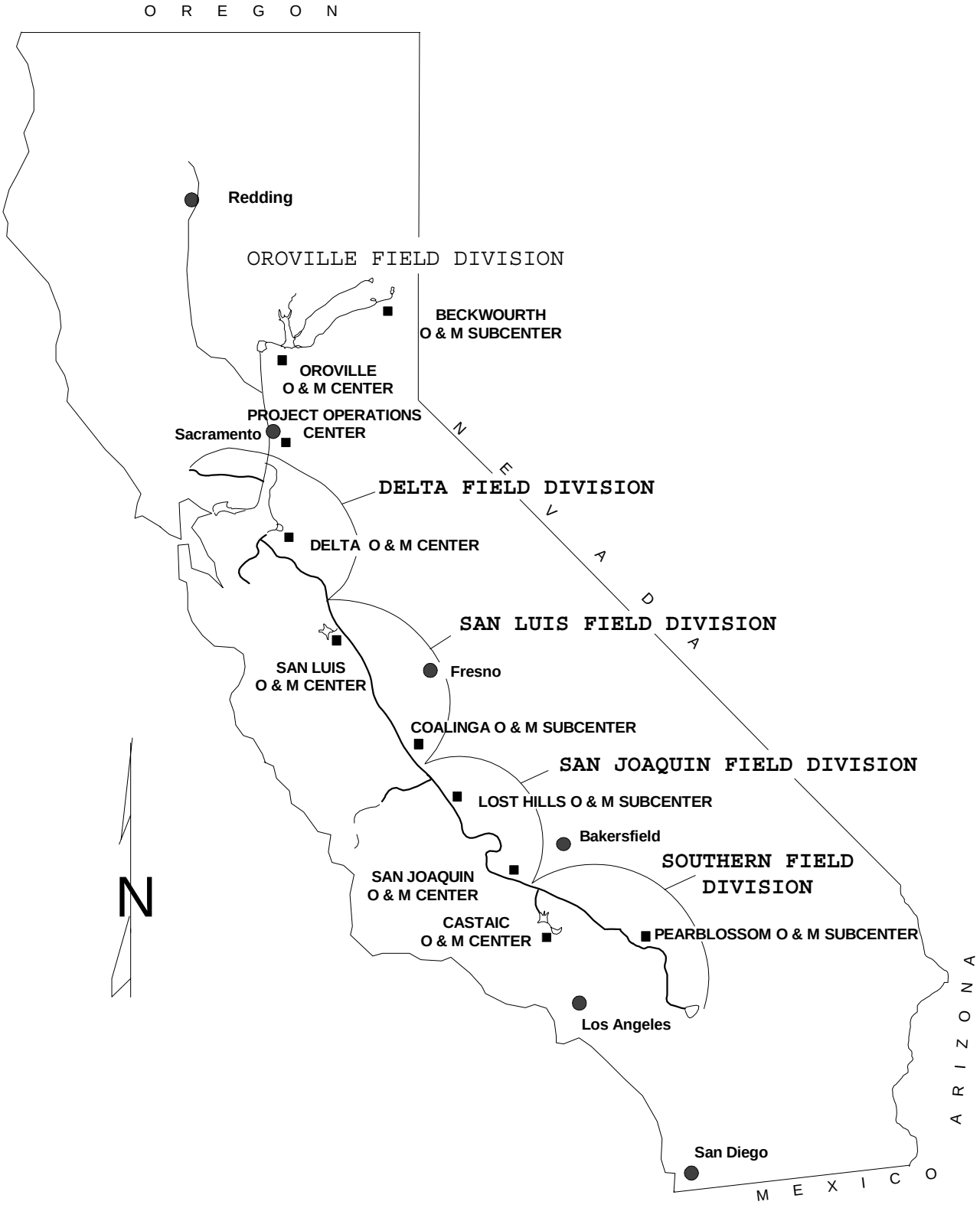
UNITS AND ABBREVIATIONS

The following names, terms, and units commonly used throughout this report are defined here and when first used in the text.

AF	acre-feet
CVP	Central Valley Project
cfs	cubic feet per second
DOI	Delta Outflow Index
DWR	Department of Water Resources
DO	dissolved oxygen
EC	electrical conductivity
ft	feet
California Aqueduct	Governor Edmund G. Brown California Aqueduct
Banks	Harvey O. Banks Delta Pumping Plant
Kv	kilovolt
KW	kilowatt
KWh	kilowatt-hour
MW	megawatt
MWh	megawatt-hour
μg/L	micro grams per liter
mg/L	milli grams per liter
mmhos/cm	milli mhos (Siemens) per centimeter
PGE	Pacific Gas and Electric Company
SCE	Southern California Edison
SWP	State Water Project
SWRCB	State Water Resources Control Board
USBR	U.S.Bureau of Reclamation
D-1485	Water Rights Decision 1485

MAP 1
FIELD DIVISION BOUNDARIES



Introduction

The 1989 Annual Report of Operations for the State Water Project (SWP) is divided into eight parts. The first two parts, "Introduction and Highlights of 1989 Operation" and "Project Status in 1989," cover conditions and events of state-wide significance. The following four sections cover water quality, water conditions, water operations, and energy operations in 1989. The seventh part, "Sacramento-San Joaquin Delta Operations," gives special emphasis to Delta operations, a key aspect of the SWP. The last part, "Project Operations By Field Division," provides further detail on operational conditions and activities by field division.

The report also includes two appendices, tabulating and depicting Project operations in 1989. Appendix I covers operations of the Aqueduct. Appendix II covers various types of water quality measurement analyses for selected stations throughout the Project.

Highlights of 1989 Operation

Total precipitation was below average for the 1988-89 water year (October 1, 1988, through September 30, 1989) in California. In terms of percentage, precipitation was lowest in the Colorado River area at 38% of average and highest in the North Lahontan area at 112% of average.

The two main watersheds for determining the Sacramento River Index for unimpaired runoff are the Upper Feather River and Lake Shasta areas. Unimpaired runoff to Lake Oroville was greater than that of the 1987-88 water year for all months except December, January, and August. Unimpaired runoff to Shasta Lake was 5.0 million acre-feet (AF) for the year (about 80% of average).

The Department of Water Resources (DWR) and the United States Bureau of Reclamation (USBR) declared balanced water conditions in the Delta six times during 1989: from January 5-8, January 23-24, January 31 - March 4, May 7 - September 18, October 6-26, and from October 31 through December 31. This was the sixth consecutive year, and the eighth of the ten years in this decade, in which balanced water conditions were declared. Balanced water conditions exist when upstream reservoir storage releases, plus other inflows, approximately equal the water supply needed to (1) satisfy Sacramento Valley and Sacramento-San Joaquin Delta in-basin needs, including Delta water quality requirements, and (2) meet export needs. During balanced water conditions, DWR and USBR adjust their reservoir storage releases and Delta exports to enable each agency to meet its share of in-basin uses and Delta outflow.

There are eighteen pumping plants within the SWP. The combined pumping for the year totaled 18,219,965 AF, including 2,672,838 AF of Federal pumping, 15,165,431 AF of State pumping, and 381,696 AF at Castaic for the City of L.A. Plants used for Federal pumping are Banks, Gianelli, and Dos Amigos. A detailed list of all project pumping is shown in Table 1 on page 2.

Total State contract deliveries in 1989 were 3,156,490 AF; including 2,853,747 AF of entitlement water and 302,743 AF of other water. Total Federal and prior water right deliveries are shown on Map 2 on page 11. See the table below for a breakdown of contract deliveries in 1989:

Entitlement Water in AF		Other Water in AF	
Municipal	1,165,933	Federal Wheeling	173,129
Agricultural	1,052,699	Purchased	71,398
Municipal Ground Water	228,814	General Wheeling	33,958
Bypass	189,726	Local Supply	15,597
Carryover	147,489	Recreation	8,543
Transfer	47,800	Vallejo Permit	108
Benecia	11,091	Sales	10
Vallejo	6,165		
Transfer Carryover	2,391		
Agricultural Ground Water	1,550		
Advance	89		
TOTAL	2,853,747	TOTAL	302,743
TOTAL WATER		3,156,490	

Total water conveyed through SWP facilities in 1989, as shown on Table 2, page 12, was the second highest on record at just over 5.2 million AF. This amount includes prior water right and Federal deliveries. The SWP conveyed over 5.3 million AF in 1981. The lowest in the last ten years was 3.1 million AF in 1983.

Energy resources totaled 9,190,207 megawatt hours (MWh). This includes generation of 5,891,740 MWh of energy at SWP locations (see Figure F on page 18). Energy loads totaling 9,190,207 MWh include sales of 1,078,813 MWh and 7,821,408 MWh used to deliver water to SWP contractors (see Figure H on Page 22).

TABLE 1: PROJECT PUMPING BY PLANT
1989

(in acre-feet)

PUMPING PLANTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
Hyatt	61,408	25,271	45,836	33,852	2,482	5,333	0	15,841	36,049	29,609	7,229	171	263,081
Thermalito	66,154	28,495	58,047	45,175	3,978	6,773	0	16,464	33,750	28,995	7,721	265	295,817
Barker Slough	1,871	1,456	1,392	1,663	2,873	3,288	4,429	4,034	2,981	1,441	1,473	1,374	28,275
Cordelia	1,613	1,386	1,390	1,587	2,788	3,183	4,299	3,969	2,952	1,419	1,434	1,339	27,359
South Bay	8,704	11,536	17,037	17,164	17,391	16,902	17,375	17,072	10,247	11,023	9,222	11,802	165,475
Del Valle	0	2,174	4,841	2,478	1,698	0	0	0	0	0	0	0	11,191
Banks													
State	347,385	204,594	365,671	375,072	184,079	119,981	175,162	300,626	365,131	339,249	254,878	377,498	3,409,326
Federal	13,824	15,108	4,943	0	0	0	103,754	89,864	0	34,991	106,201	4,524	373,209
Total	361,209	219,702	370,614	375,072	184,079	119,981	278,916	390,490	365,131	374,240	361,079	382,022	3,782,535
Gianelli 1/													
State	222,611	80,025	193,353	117,771	0	0	0	21,618	92,868	145,037	80,452	195,488	1,149,223
Federal	128,077	37,345	107,265	7,075	0	0	0	9,025	104,950	125,568	189,493	187,426	896,224
Total	350,688	117,370	300,618	124,846	0	0	0	30,643	197,818	270,605	269,945	382,914	2,045,447
Dos Amigos 1/													
State	120,984	124,370	156,256	231,223	237,077	363,296	380,552	301,966	246,623	217,532	207,196	168,526	2,755,601
Federal	107,332	170,952	55,960	120,685	131,584	245,552	259,694	169,185	32,924	31,596	46,687	31,254	1,403,405
Total	228,316	295,322	212,216	351,908	368,661	608,848	640,246	471,151	279,547	249,128	253,883	199,780	4,159,006
Las Perillas	2,167	4,666	8,061	10,227	15,879	22,178	25,344	18,025	9,188	7,527	1,630	4,220	129,112
Badger Hill	2,178	4,642	8,061	10,214	15,879	22,178	25,162	17,612	9,133	7,527	1,619	4,219	128,424
Buena Vista	76,209	42,079	93,771	166,181	141,099	138,540	146,692	125,595	158,336	160,811	155,997	103,583	1,508,893
Wheeler Ridge	74,021	31,494	80,089	156,898	128,774	112,623	117,811	103,274	155,388	159,689	156,121	102,179	1,378,361
Ira J. Chrisman Wind Gap	73,040	28,906	75,807	151,847	122,607	105,615	109,688	97,984	151,363	155,876	154,686	100,920	1,328,339
A.D. Edmonston	72,391	29,061	74,775	149,099	119,673	102,960	106,637	96,411	149,874	154,323	152,694	99,087	1,306,985
Oso	48,970	7,016	24,121	81,880	39,808	27,167	30,194	18,172	72,567	74,908	81,676	99,747	606,226
Castaic 2/	77,557	30,302	35,625	46,789	3,232	34,874	59,981	16,228	33,146	3,802	12,432	27,728	381,696
Pearblossom	22,037	21,561	50,314	67,223	77,189	68,189	68,586	70,191	74,875	77,872	75,475	231	673,743

1/ Joint State-Federal Facility.
2/ Pumping at Castaic Pumping Plant is for the City of Los Angeles.

Total State:	15,165,431
Total Federal:	2,672,838
Total City of L.A.	381,696
Total Project:	18,219,965

Project Status In 1989

Project Facilities

SWP facilities in operation during 1989 included: 28 water storage facilities with a gross capacity of 6,768,792 AF; seven power plants with a total output capacity of 1,686 megawatts (MW); 16 pumping plants housing 112 units with a total motor rating of 2,768 MW; and 537 miles of aqueduct.

During 1989, water was delivered from SWP facilities to forty-eight agencies including twenty-six long-term water service contractors and twenty-two other agencies. In addition, SWP facilities were used to deliver a total of 1,476,378 AF of federal water to USBR customers.

Significant Operational Activities

Major outages and operating limitations of SWP facilities during 1989 were:

- In January, several units were returned to service including those at Wheeler Ridge Pumping Plant, Pine Flat Powerplant, and Ira J. Chrisman Wind Gap Pumping Plant.

- Continuing through the month of February, Thermalito Pumping/Generating Plant Units 1 and 2 remained out of service for stator rewinds. These outages reduced Southern California Edison's (SCE) share of Oroville Complex entitlement

- On February 26, Reid Gardner Power Plant Unit No. 4 was returned to service after an outage that began on January 30 for preventative maintenance and connection of the new cooling tower.

- Energy transmission south to north on the Pacific Gas & Electric Company (PGE) system between Midway and Los Banos substations continued to be curtailed by approximately 50 MW during off-peak hours in March. This transmission restriction severely constrained SWP operations during off-peak hours. Pumping adjustments were made as needed and exchanges were received from PGE during off-peak hours to help relieve the impact of this restriction.

- In March, DWR took delivery of exchange energy from Bonneville Power Administration (BPA) during on-peak hours to be returned to BPA by September 30, 1989. In addition, DWR purchased energy from several northwest utilities and from PGE during on-peak hours. (A detail of all energy purchases is shown on Figure F on page 18) This energy was needed to support on-peak pumping requirements and meet firm energy commitments.

- Other significant events in March included the de-watering of the Santa Ana Pipeline to repair cracks, the closure of the Delta Cross Channel gates to minimize cross-Delta movement of Salmon, and the return to service of Unit 11 at A.D. Edmonston Pumping Plant that had been out since July 13, 1987, for a complete overhaul.

- In May, September, and October, water was bypassed around Thermalito Powerplant to meet electrical system capacity commitments from Edward Hyatt Powerplant.

- On May 12, two hundred people attended the renaming ceremony of the San Luis facilities to B.F. Sisk San Luis Dam and William R. Gianelli Pumping Generating Plant.

- Preliminary testing of the Automatic Generation Control (AGC) system began during June. This new system will allow DWR to meet the requirements of a single electric utility control area.

- The transfer of 200,000 AF of water purchased from the Yuba County Water Agency's (YCWA) New Bullard's Bar Reservoir by DWR was completed in 1989.

Water Quality Standards

SWP and Sacramento-San Joaquin Delta water quality conditions are summarized below. Detailed water quality reports appear in Appendix E to Bulletin 132. They are also published separately as Water Operations in the Sacramento-San Joaquin Delta, and in DWR's monthly SWP Operations Data.

Water quality and SWP operations in the Delta are governed by the State Water Resources Control Board's Decision 1485 (D-1485). This water rights decision protects beneficial uses of Delta water by establishing water quality standards, which are based on the water year type. Under the Sacramento River Index (formerly the Four-Basin Index) of D-1485, the 1988-89 water year was classified as "dry" for fish and wildlife needs and "below normal" for agricultural, municipal, and industrial needs.

The Delta Outflow Index (DOI) is a calculated approximation of the Delta freshwater outflow past Chipps Island near Pittsburg. The average Delta outflow was only about 5,600 cfs during January and February, due to subnormal precipitation. In 1989, the highest average monthly DOI value (34,309 cfs) and the highest daily DOI value (64,709 cfs) occurred in March. Abnormally dry conditions during the following months gradually decreased flows. The lowest average monthly DOI value (3,571 cfs) and the lowest daily DOI value (about -931 cfs), both occurred in October. Late October precipitation, twice the normal level, resulted in increased flows, with DOI levels averaging about 5,700 cfs during November and December. (See Figure J on page 27.)

During 1989, the SWP met all D-1485 mandated standards for minimum flow in the Delta. A sampling of electrical conductivity (EC) data at various SWP locations is shown on Figure B on page 6. Figure I on page 26 summarizes water quality conditions monitored by DWR at key locations throughout the Delta. Also shown are water quality objectives set forth in Article 19 of the water supply contracts. These water quality objectives are based on the expected construction of an efficient cross-Delta water transfer system. During 1989, the SWP water supply contract's Article 19 objective for the percentage of sodium to total salt content was exceeded at all points south of the Delta. The chloride objective was exceeded often in nearly all water south of the Delta. The average monthly totals of dissolved solids, hardness, sulfates, and boron remained below contract objectives at all locations.

D-1485 salinity standards were exceeded for three brief periods during 1989, despite SWP operational efforts, described as follows:

- The mean daily chloride standard, maximum of 250 mg/L (milli grams per liter) at the Contra Costa Canal intake, was exceeded from February 9-13 (as illustrated in Figure A on page 5), because of high winds and rising tides.

- EC exceeded the 14-day running average water quality standard of 0.45 mmhos/cm (milli mhos per centimeter) at Emmaton by 0.01 mmhos/cm from June 7-9 (as shown on Figure I on page 26), due to high winds and rising tides.

- The 14-day average EC standard at Jersey Island (0.74 mmhos/cm) was exceeded from July 17-29 (as shown on Figure I on page 26). Delta Outflow was operationally increased to meet the standard. Reducing Delta exports to help meet the standard was constrained by the combination of two factors: (1) the need to deliver water for meeting agricultural demands during the peak irrigation season and (2) the inability to release stored water from San Luis Reservoir to the California Aqueduct, because of a failure at the San Luis Switchyard.

A February 1969 joint agreement between DWR, the U.S. Fish and Wildlife Service (USFWS), and the Department of Fish and Game (DFG) allows DWR to install a temporary rock barrier on Old River during years when fall flows are forecast to be low. This barrier aids survival of migrating salmon and steelhead by increasing fall flows in the lower San Joaquin River and alleviating dissolved oxygen (DO) depression, less than 5 milli grams per liter (mg/L), in the Stockton Ship Channel. The Old River barrier was installed in late September 1989. Three weeks later, DO was above 5 mg/L. The barrier was removed in late November.

A rock barrier on Middle River, constructed under the October 1986 South Delta Agreement, was installed in early April 1989. The barrier, with specific Clifton Court Forebay operations, permits Middle River flows to be stored during high tide for use during low tide, thereby keeping the water

FIGURE A: MEAN DAILY CHLORIDE LEVELS AT DELTA STATIONS
1989

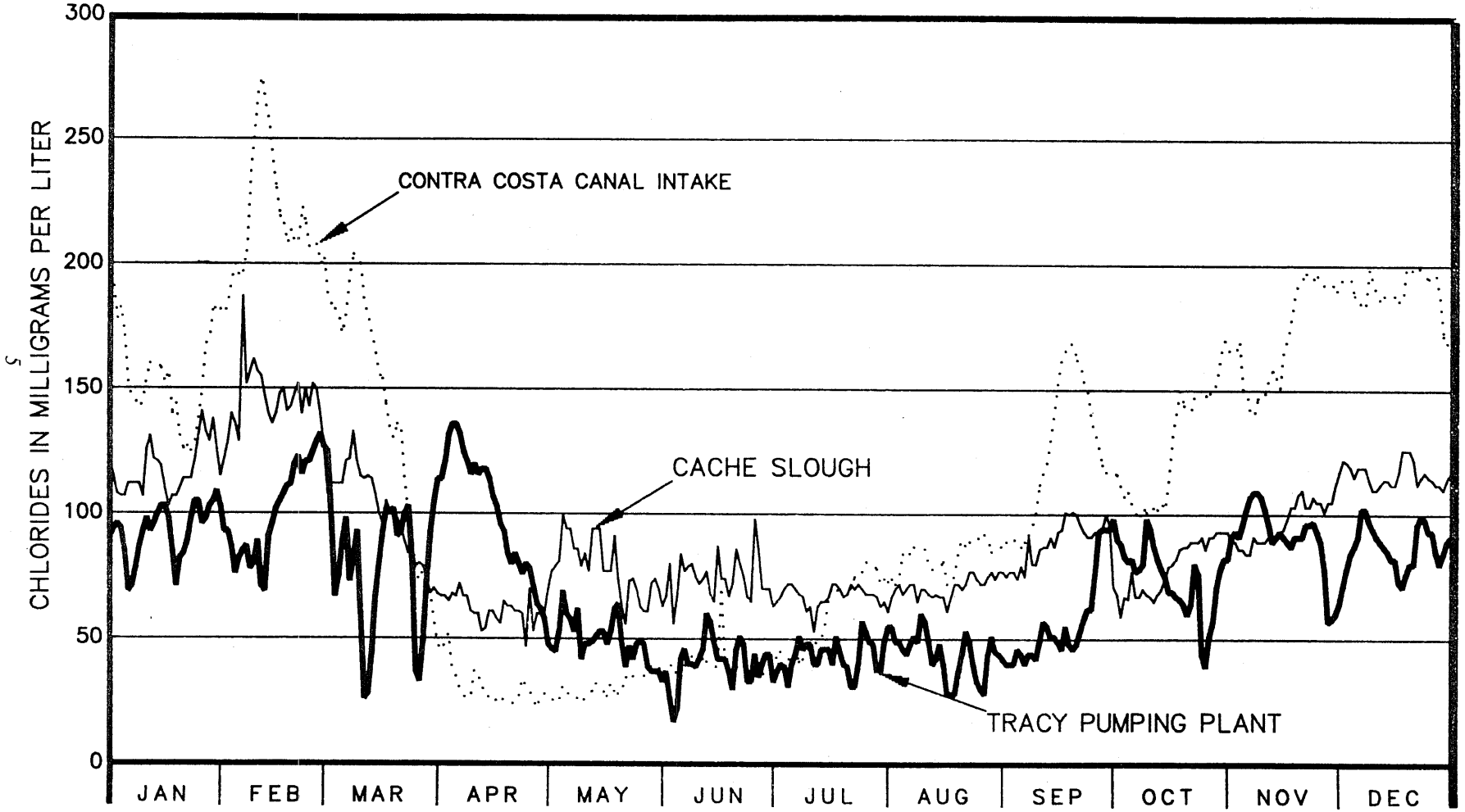
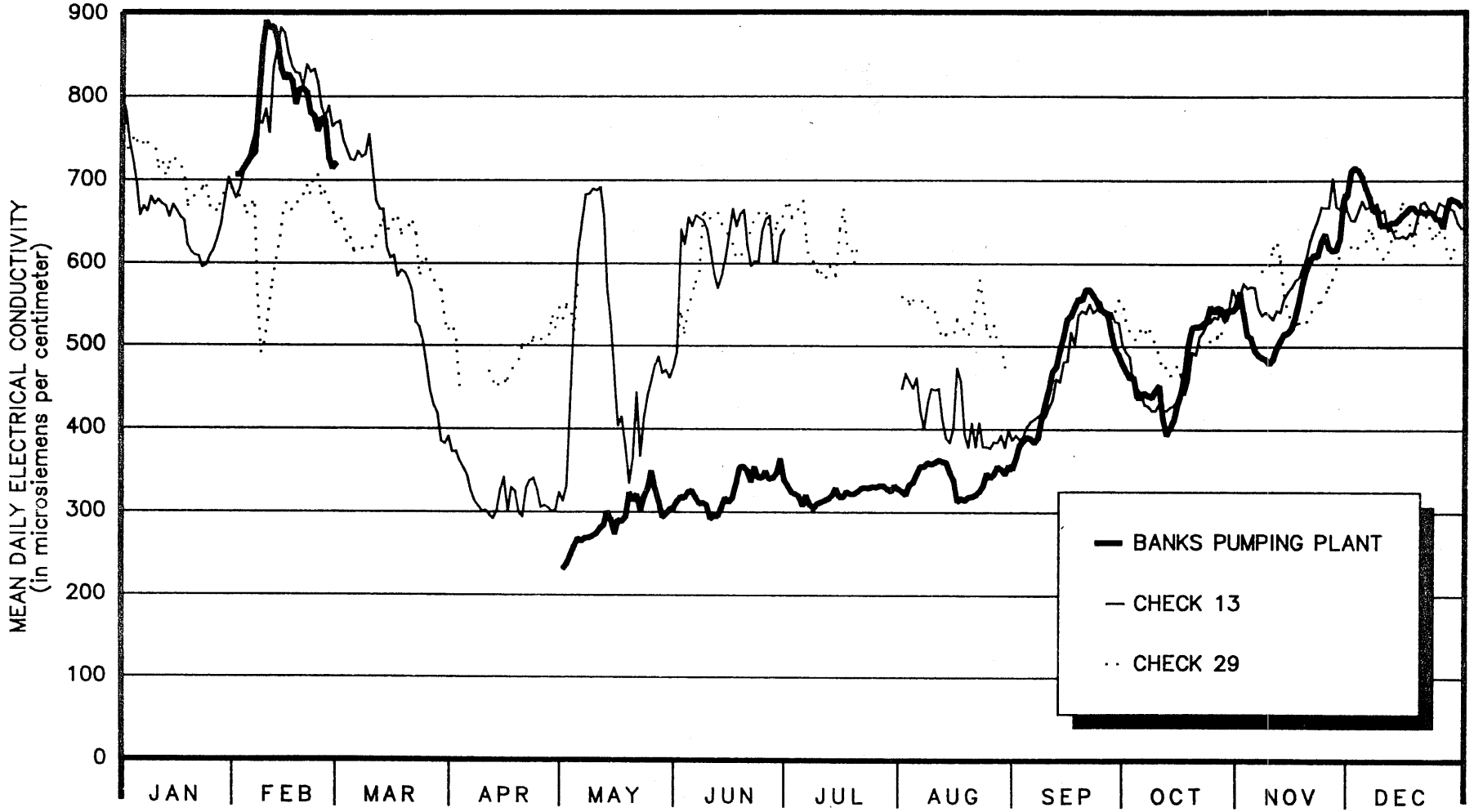


FIGURE B: MEAN DAILY ELECTRICAL CONDUCTIVITY AT SWP LOCATIONS
1989



Note: Missing data points are unavailable because of the replacement of old meters and calibration of new equipment.

elevation of Middle River high enough to allow agricultural water diversion. The Middle River barrier remained in place during the irrigation season and was removed on September 27.

From May 2-9, Clifton Court Forebay gates were closed continuously, reducing exports drastically to evaluate the impact of SWP operational alternatives on the passage of juvenile salmon from the San Joaquin Basin through the Delta. Hundreds of thousands of tagged young salmon were released at locations throughout the Delta and San Joaquin River system with fish flush water (increased Delta outflow) from Keswick Reservoir and Lake Oroville. The tagged salmon, which will be collected in two-and-one half years, should provide information on potential benefits from reducing fish diversions and from installations of partial or full barriers on Old River. Despite the temporary reduction in exports, maximum allowable exports were achieved in May.

In mid-June, testing was conducted to find the relationship between water temperature and salmon survival. Tagged salmon were released upstream under varying temperature regimes and with increased flows from Lake Oroville. Water temperature downstream of Lake Oroville was reduced to 53°F by the third week in June. The recapture of the tagged salmon smolt in two-and-one-half years should help verify temperature modeling.

The striped bass index is used by DFG as an indicator of the number of young bass (averaging 1.5 inches in length) in the Sacramento-San Joaquin Delta. In 1989, the index increased to 5.1 from the 1988 index of 4.6, which was the lowest in 29 years. The striped bass index averaged 66.6 and 24.8 for the years 1958-76 and 1977-87, respectively. Fishery experts continue to investigate possible causes for the decrease in the striped bass population.

Federal and State laws provide for the listing and protection of threatened and endangered species. In 1989, two Delta fish species, the winter-run salmon and the Delta smelt, were listed or proposed for listing. These species have been salvaged from the Skinner Fish Facility near Banks Pumping Plant. DWR is working with the DFG and USFWS to assess SWP impact.

Vegetation surveys were conducted in the central and south Delta during May and November to augment the Department of Food and Agriculture's annual search for the aquatic weed Hydrilla verticillata. The surveys also documented long-term and seasonal changes in aquatic vegetation. Results showed a stable littoral zone assemblage with offshore margins remaining stable between seasons. The assemblage is predominantly submersed aquatic species, although much of the biomass is composed of the emergent common tule (Scirpus acutis) and water hyacinth (Eichorina crassipes). Hydrilla verncillata was not detected. Concurrent secchi depths (measurements of water transparency) were deeper and water temperatures colder in November than in May.

Besides routine benthic surveys, a special study was conducted with the DFG in Montezuma sloughs and Suisun Marsh to find the extent of invasion by the recently introduced Asian clam, Potomacorbula amurenesis. The clam is thought to impact striped bass numbers through removal of the zooplankter Eurytemora ainis, a primary bass food item.

Operation of the Suisun Marsh Salinity Control Gates at Montezuma Slough decreased salinity during the 1989-90 control season. Operational tests held December 8-15 simulated an opened-gate operational breakdown, which resulted in the rapid decline of water quality. Water quality quickly improved when the normal gate operation schedule was resumed.

From January through May 1989, water quality standards identified in the "Plan of Protection for the Suisun Marsh" were in effect at internal marsh stations (Beldon's Landing, National Steel, and Collinsville). From October through December 1989, EC standards referenced in D-1485 for the internal marsh locations were in effect. No test standards were exceeded in either control season.

The Interagency Health Aspects Monitoring Program (IHAMP) expanded it's Delta water quality sampling by adding more agricultural drainage and urban runoff stations at upstream locations. Water samples were analyzed for total and constituent trihalomethane formation potential (THMFP), also for specific minerals, minor elements, and pesticides.

IHAMP, which began in 1983, primarily addresses human health and drinking water concerns in the Delta. The principal focus of IHAMP is the detection of THMFP in Delta water (trihalomethanes are potential carcinogens). Program results showed THMFP values consistently higher at certain agricultural drainage stations than at the channel stations. Agricultural

drainage values were higher in the first six months of 1989 than in the same period of 1988. They also showed distinct peak periods in March and in late summer/early fall for THMFP of bromides. Urban runoff samples from six Sacramento locations showed that THMFP can be nearly as high in urban stream runoff as in agricultural drainage. THMFP values are higher at south Delta locations, partially due to the high organic content of the area's peat substrate.

Other results of IHAMP in 1989 show that sodium levels are well below the recommended drinking water standard (100 mg/L) at the Sacramento River, Barker Slough Pumping Plant, and Middle River stations, and at all agricultural drainage stations except Empire Tract. Sodium levels occasionally exceeded the standard at Banks Pumping Plant and Clifton Court Forebay. Sodium levels at south Delta locations on the Old River and San Joaquin River system (the Contra Costa Canal and Delta Mendota Canal intake stations) frequently exceeded recommended sodium levels.

Selenium was consistently below the level of detection at most sites sampled and was well below the Environmental Protection Agency standard of 0.10 mg/L where it was detected. Most detected selenium at export locations comes from the San Joaquin River. Selenium levels typically increase during the late fall and winter, when agricultural drainage and ground water seepage make up most of the San Joaquin River flow.

Overall during 1989, the best SWP water quality was found upstream of the Delta and in the four Southern California reservoirs.

Water Supply Conditions

On the basis of criteria in D-1485, the 1988-89 water year was classified as a "dry" year for fish and wild life needs and "below normal" for agricultural, municipal, and industrial needs. The final determination of year classification is made in May, on the basis of current water year forecasts of the "Sacramento River Index" (formerly known as the "Four Basin Index"), which is the sum of the Sacramento Valley's unimpaired runoff at the following four locations: Sacramento River above Bend Bridge, near Red Bluff; Feather River, total inflow to Lake Oroville; Yuba River at Smartville; and the American River, total inflow to Folsom Lake. The May 1 forecast designated the water year as a "subnormal snowmelt" year, because the April through July forecast of unimpaired runoff of 5.34 million AF was less than the 5.90 million AF specified in D-1485.

Actual unimpared runoff for the 1988-89 water year was 15.0 million AF, only 79% of average. In the Feather River basin, the primary source of water supply for the SWP, water year total precipitation was 102% of average.

State-wide precipitation, as shown below in three representative hydrographic areas, was below average during the 1988-89 water year.

San Francisco Bay 83% of average
San Joaquin Valley 85% of average
Tulare Lake 83% of average

As of May 1, 1989, the end of California's precipitation season, state-wide precipitation was 80% of average, compared to 82% of average for the corresponding 1987-88 period. Snowpack water content usually increases until about April 1 when melt begins. This year, however, the snowpack water equivalent peaked in early March. Measurements in the San Joaquin and South Lahontan drainages held less than half their April 1 averages. Sacramento Valley water-sheds were only about a third of average.

Water Operations

Reservoir Operations

Lake Oroville and San Luis Reservoir are the two conservation facilities for SWP water supplies. Table 8 on page 34 and Table 12 on page 43 summarize the operations of these reservoirs during the 1988 and 1989 calendar years.

Lake Oroville began 1989 with 727,741 AF less than it held at the beginning of 1988. Storage for January, February, and early March continued to be less than that of the same periods in 1988. However, heavy precipitation and runoff in late March and April brought 1989 storage well above 1988 levels. Storage in Lake Oroville peaked at

3,361,879 AF (96% of normal maximum operating capacity) on May 9 and dropped to 1,888,799 AF (54% of normal maximum operating capacity) by December 31.

The following tabulation compares normal operating capacity in the principal SWP reservoirs with year end storage for 1988 and 1989:

Reservoir	Normal Maximum Operating Capacity	End-of-year Storage 1988	End-of-year Storage 1989
Lake Oroville	3,537,577	1,660,266	1,888,799
Lake Del Valle	40,000	24,532	28,486
San Luis Reservoir*	1,062,000	247,952	616,001
Pyramid Lake	171,196	157,630	157,126
Silverwood Lake	74,970	71,720	56,391
Lake Perris	131,452	115,734	110,247
Castaic Lake	323,702	258,455	216,770
Totals	5,340,897	2,535,289	3,073,820

*State Share

At the start of 1989, San Luis Reservoir held 43% of its normal maximum operating capacity, although the SWP share was only 24% of its maximum. SWP storage at the end of 1989 was 616,001 AF (58% of maximum State storage), Federal storage was 612,223 for a total of 1,228,224 AF.

At the beginning of 1989, Lake Del Valle held 25,190 AF of water (63% of normal maximum operating capacity). Storage then increased to 37,350 AF (94% of normal maximum operating capacity) on May 22. By December 31, storage in Lake Del Valle was 28,486 AF (71% of normal maximum operating capacity).

SWP southern reservoirs (Silverwood, Perris, Pyramid, and Castaic) held 88% of their combined normal maximum operating capacity at the beginning of the year and held 78% of their combined normal maximum operating capacity by December 31, 1989.

Aqueduct Operations and Water Deliveries

SWP entitlement deliveries for 1989 totaled 2,853,747 AF. A graph showing the annual total deliveries from SWP facilities is shown on Figure C on page 10. The amounts shown by field division on Map 2 on page 11 include the amounts of entitlement water, permit water, local supply, recreation, purchases, wheeling, and water transfers. Totals by agency are shown in Table 2 on page 12.

DWR operates and maintains the joint-use facilities, including 102 miles of aqueduct between O'Neill Forebay and Kettleman City.

Significant operational activities during 1989 were as follows:

- On February 2, releases from Lake Oroville were increased from 1,200 cfs to 3,700 cfs, and exports from the Delta were decreased to counteract increased salinity in the Delta resulting from high tides. The CVP also decreased exports and increased upstream reservoir releases. Releases from Lake Oroville were gradually reduced from 3,700 cfs to 1,800 cfs beginning on February 25.

- On March 5, the Box Springs Turnout from the Santa Ana Pipeline was dewatered for inspection after seepage was observed above the turnout. The inspection revealed two prominent cracks in the 96-inch-diameter pipe section, one at the valve vault and the other at the meter vault. Crews from The Metropolitan Water District of Southern California (MWDSC) installed temporary internal seals, and the turnout was returned to service on March 10. On March 23, the turnout was taken out of service to replace the damaged pipe and returned it to service on April 6.

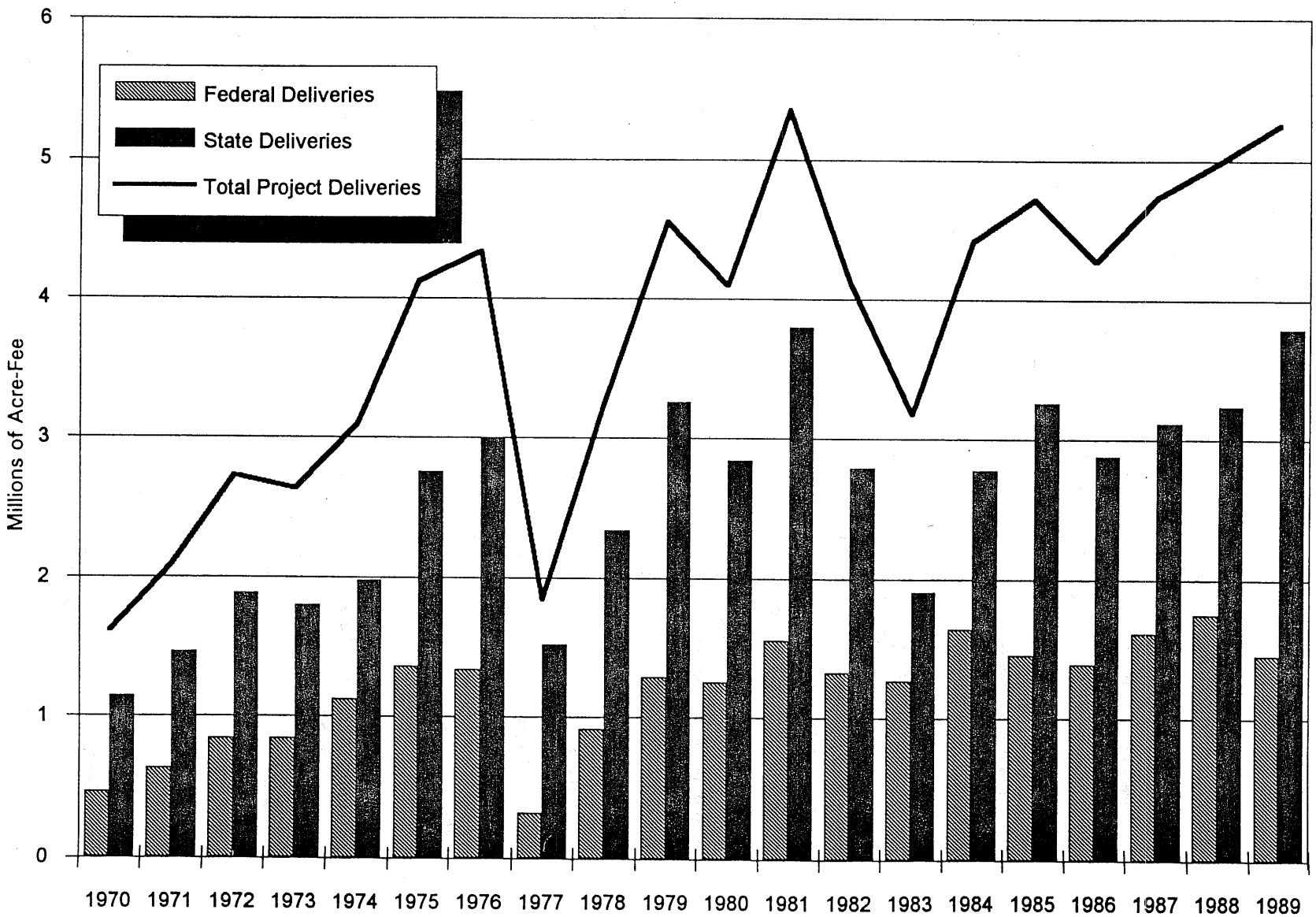
- On March 17, MWDSC began refilling the Foothill Feeder out of Castaic Lake. The Feeder had been out of service since December 2, 1988, for placement of 3,000 ft of steel liner in the Newhall Tunnel.

- From May 2-9, the SWP and CVP coordinated their operations to assist the USFWS with the first of two salmon survival tests conducted in the Delta during the year. Both the SWP and CVP curtailed exports from the Delta on May 2 and coordinated upstream water releases to minimize water losses to San Francisco Bay. Because of this salmon survival test, fishery experts hope to determine any benefits that could be achieved by the construction of partial or full barriers at the head of Old River and/or by the installation of a fish diversion facility at the head of Old River.

- In June, DWR and USBR coordinated operations to enhance fish habitat. During the second week of June, Sacramento River flows

FIGURE C: TOTAL DELIVERIES FROM SWP FACILITIES

ANNUAL TOTALS

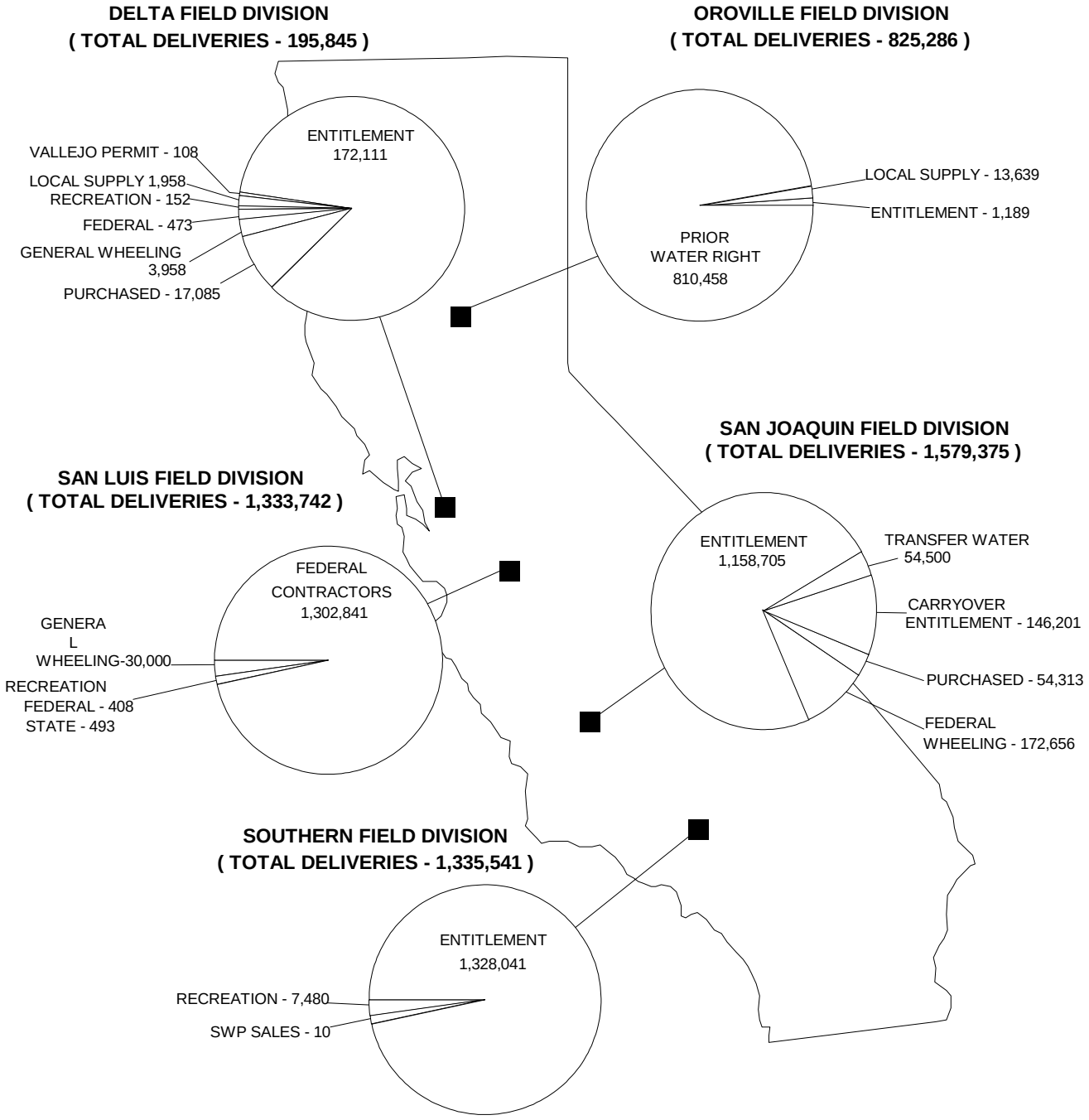


MAP 2

WATER DELIVERIES

1989

(in acre-feet)



Total Deliveries
5,269,789

TABLE 2: WATER DELIVERIES 1962-1989

(in acre-feet)

AGENCY	1962-1984	1985	1986	1987	1988	1989	TOTALS
OROVILLE FIELD DIVISION							
LAST CHANCE CREEK W.D. (Local Supply)	129,145	13,117	14,379	9,444	6,988	11,487	184,560
PLUMAS CO. F.C. & W.C.D.	5,152	254	317	452	523	486	7,184
PALERMO CANAL 1/	129,426	7,195	7,970	8,612	8,374	7,546	169,123
COUNTY OF BUTTE	4,249	308	313	459	385	300	6,014
THERMALITO I.D. (Local Supply)	10,481	2,229	2,051	2,338	2,417	2,152	21,668
THERMALITO AFTERBAY 1/	13,198,371	861,554	786,489	825,905	822,164	801,091	17,295,574
UPPER FEATHER RIVER LAKES 1/	108,894	2,019	2,041	2,203	2,248	1,821	119,226
YUBA CITY	108	62	328	88	303	403	1,292
DELTA FIELD DIVISION							
NAPA CO. F.C. & W.C.D.	79,303	4,039	3,519	7,693	7,038	10,153	111,745
ALAMEDA CO. W.D.	373,125	22,289	21,170	25,475	33,464	26,042	501,565
A.C.F.C. & W.C.D., ZONE 7	285,895	21,773	23,468	26,397	27,252	28,185	412,970
PLEASANTON TOWNSHIP W.D.	674	0	0	0	0	0	674
SANTA CLARA VALLEY W.D.	946,489	101,938 4/	90,595	94,949	87,961	107,085	1,429,017
MARIN W.D.	4,594	0	0	0	0	0	4,594
SAN FRANCISCO W.D.	4,345	0	0	0	0	0	4,345
SKYLONDA M.W.D.	10	0	0	0	0	0	10
OAK FLAT W.D.	97,328	6,197	5,354	5,880	4,412	6,391	125,562
MUSTANG W.D.	4,256	0	0	0	0	0	4,256
TRACY GOLF & COUNTRY CLUB	2,325	463	454	491	590	466	4,789
GRANITE CONSTRUCTION	120	0	0	0	0	0	120
LAKE DEL VALLE (E.B.R.P.D.)	1,121	152	130	137	142	152	1,834
ORESTIMBA CREEK	100	0	0	0	0	0	100
MUSCO OLIVE (C.V.P. water)	10	18	9	19	30	7	93
SOLANO CO. F.C.W.C.D.	0	0	1,400	1,550	13,452	17,364	33,766
SAN LUIS FIELD DIVISION							
DEPT. PARKS & REC. (STATE)	546	10	10	8	7	64	645
DEPT. FISH & GAME (STATE)	3,957	485	440	590	380	429	6,281
FED. CUSTOMERS (REC.+ JOINT-USE)	16,315,801	1,295,647	1,371,722	1,462,359	1,421,166	1,294,249	23,160,944
FED. CUSTOMERS (MISC.)	61,059	28,000	0	9,335	149,192	30,000	277,586
SAN JOAQUIN FIELD DIVISION							
TULARE LAKE BASIN W.S.D.	1,720,610	206,678	92,143	144,290	94,316 12/	182,863	2,440,900
EMPIRE WEST SIDE I.D.	56,699	5,197	2,300	4,401	3,475	3,000	75,072
COUNTY OF KINGS	30,800	3,400	3,700	4,000	4,000	4,000	49,900
HACIENDA W.D. 2/	75,895	0	0	0	0	0	75,895
KERN CO. W.A.	11,473,241	1,083,749	929,278 6/	1,028,124	1,009,520	1,146,062	16,669,974
KERN WATER BANK	0	0	0	7,501 8/	0	0	7,501
DUDLEY RIDGE W.D.	931,849	62,009	51,152	46,288	47,994	57,049 10/	1,196,341
DEVILS DEN W.D.	256,753	18,194	17,271	14,394	11,534	14,645	332,791
J.G. BOSWELL	117,430	0	0	0	0	0	117,430
SHELL CAL PROD. 3/	84,311	0	1,603	0	0	0	85,914
GREEN VALLEY W.D.	10,888	166	0	0	0	0	11,054
FEDERAL WHEELING	423,412	130,763	17,050 7/	137,289	153,211	172,656	1,034,381
WHEELER RIDGE W.S.D.	92	0	0	0	0	0	92
SOUTHERN FIELD DIVISION							
A.V.E.K. W.A.	442,852	37,064	32,449	34,089	34,079	45,280	625,813
M.W.D. OF S.C.	5,750,914	729,209 5/	708,840	712,424	902,564	1,156,698	9,960,649
LITTLEROCK CREEK I.D.	4,839	0	163	1,085	419	971	7,477
MOJAVE W.A.	57,589	0	0	17	9	200	57,815
DESERT W.A.	177,300	27,000	29,000	31,500	34,000	36,500	335,300
COACHELLA VALLEY W.D.	113,577	16,989	18,210	19,431	20,652	21,873	210,732
CRESTLINE-LAKE ARROWHEAD W.A.	12,958	1,422	1,506	1,849	2,006	2,170	21,911
SAN GABRIEL VALLEY M.W.D.	54,883	5,028	9,454	10,630	8,948	12,839	101,782
SAN BERNARDINO VALLEY M.W.D.	148,454	7,390	6,421	19,075 9/	21,386	20,782	223,508
RECREATION AND FISH ENHANCEMENT	14,971	3,386	3,285	6,937	4,360	7,490	40,429
PIRU CREEK RECAPTURE AGREEMENT	2,915	0	0	0	0	0	2,915
CASTAIC LAKE W.A.	37,447	12,401	13,928	16,167	18,904	21,719	120,566
PALMDALE W.D.	0	1,558	3,096	5,379	1,770	9,009	20,812
UNITED WATER C.D. (Local Supply)	0	0	998	0	0	0	998
LILICO PICTURES	0	0	0	0	0	10	10
TOTALS	53,767,563	4,719,352	4,274,006	4,729,254	4,961,635	5,261,689	77,713,499

1/ Prior water right entitlement.
2/ Hacienda Water District was annexed by Tulare Lake Basin W.S.D. in 1981.
3/ Repayment of preconsolidation water.
4/ Includes 4,300 acre-feet of C.V.P. exchange water.
5/ Includes 45,584 acre-feet of Local-Out.
6/ Includes 1,703 acre-feet transferred to Tulare Lake Basin W.S.D.
7/ Includes 6,500 AF to KCWD., 6,500 AF to Lakeside IWD., and 50 AF to Green Valley WD.
8/ Advance storage of ground water, by agreement between K.C.W.A. and D.W.R.
9/ Includes 324 acre-feet of Local-Out.
10/ Includes 2,500 acre-feet of transferred Entitlement water.

were modified as part of an experiment to determine salmon survival in warm water. During the third week of June, the temperature of releases from Lake Oroville was reduced as part of the modeling verification for salmon survival studies.

- Beginning July 17, the SWP decreased pumping at Banks Pumping Plant and increased releases from Lake Oroville (in coordination with increased releases from USBR's Keswick Reservoir) to meet electrical conductivity standards established by D-1485. Releases were gradually reduced, beginning in early August. Releases from the Oroville facilities decreased from 7,000 cfs on July 17 to 2,500 cfs on August 31.

- On July 25, the transfer of 200,000 AF of water from YCWA's New Bullard's Bar Reservoir to the SWP began. The water had been purchased by DWR for two SWP contractors: Santa Clara Valley Water District, which purchased 90,000 AF, and Tulare Lake Basin Water Storage District, which purchased 110,000 AF.

- During the first week of September, rising salinity levels in the Delta prompted adjustments in upstream releases to stabilize Delta water quality. Releases from Lake Oroville September 9-18 varied from 3,500 cfs to 4,000 cfs. On September 16-18, a heavy storm resulted in excess conditions in the Delta, which allowed releases from Lake Oroville to be reduced. Releases were decreased to 2,500 cfs on September 20 and remained at 2,500 cfs through September 30.

- From October 16-26, Thermalito Afterbay was restricted to elevation 125.00 ft to allow DWR civil maintenance personnel to construct a cofferdam for a new waterfowl brood pond.

- On October 17, 1989, a magnitude 7.1 earthquake occurred near Santa Cruz. SWP facilities were not significantly damaged by the quake. A cooling fan tripped off at Bottle Rock Powerplant, and power generation at Oroville was altered in reaction to high system frequency. Inspections of SWP facilities following the earthquake revealed no situations requiring repair.

- In November, the East Branch of the California Aqueduct was closed and dewatered downstream of Pearblossom Pumping Plant for East Branch Enlargement construction. During this outage silt and debris were cleared from the canal, a section of the Mojave Siphon near Silverwood Lake was lined, the outlet structure of Pearblossom Pumping Plant was modified for the third and fourth discharge lines, and the San Bernardino Tunnel outlet bifurcation was modified to accommodate the enlargement of Devil Canyon Powerplant. Also, pools upstream of Pearblossom Pumping Plant were lowered for Antelope Valley-East Kern Water Agency to install two new turnouts and to convert two existing turnouts from temporary to permanent. The outage ended in early February 1990.

- On November 29, a 10-cfs leak was discovered at mile 35.34 of the South Bay Aqueduct. The Aqueduct was shut down below the Del Valle check, the pipe was dewatered, and a seal was installed inside the pipeline. After the seal cured for twelve hours, the aqueduct was refilled and returned to normal operation.

- On December 1, drawdown of pool 15 to elevation 321.0 was begun to permit construction of a turnout for Panoche Water District at mile 97.46. A coffer dam was then installed around the work area, and the water was returned to the normal minimum pool elevation of 326 ft.

Energy Operations

Energy Sources

Energy generation from SWP's seven hydroelectric plants (Hyatt, Thermalito, Gianelli, William E. Warne, Castaic, Alamo and Devil Canyon) during 1989, totaled 3,778,442 megawatt hours (MWh), as illustrated in Figure D on page 15.

Edward Hyatt and Thermalito Power plants supplied 1,914,185 MWh in 1989, which is 23% above the amount generated in 1988. Generation at Edward Hyatt and Thermalito Power plants is shown in Figure E on page 16.

The combined energy generation at the SWP energy recovery plants (Gianelli, William E. Warne, Castaic, Alamo and Devil Canyon) totaled

1,864,257 MWh in 1989. This is a 20% increase over the amount generated in 1988.

Bottle Rock Powerplant, a 55-MW geothermal plant, began commercial operation on February 26, 1985. The powerplant supplied the SWP with a total of 112,412 MWh in 1989, which is a 21% decrease over the amount supplied in 1988. Reid Gardner Unit No. 4 supplied the SWP with 1,709,195 MWh of energy in 1989, a 5% increase over the amount supplied in 1988.

The future operating level of the Bottle Rock plant is uncertain. Lower-cost energy resources are available and drilling for new steam is uneconomical. If a new entity is not found to take over the plant, DWR may place it in long-term storage. In September 1989, the California Energy Commission began hearings on the unexpected steam decline throughout the Geysers area. DWR is an active paticipant in the committee set up to investigate the decline.

Under a 50-year contract with the Kings River Conservation District, DWR receives all of the output of the 165-MW Pine Flat Powerplant. The plant furnished 111,200 MWh to the SWP in 1989, a 15% decrease below that furnished in 1988. All SWP energy sources in 1989 are illustrated in Figure D on page 15.

The SWP receives energy under contract from five small hydroelectric facilities (total capacity of 30 MW) owned and operated by MWDSC. In 1989, these plants furnished 177,496 MWh of energy to the SWP. DWR has exchange arrangements with Southern California Edison (SCE) and the Los Angeles Department of Water and Power (LADWP) to provide transmission of this energy.

The DWR-SCE Power Contract has been in effect since April 1983. Under this contract, part of the Hyatt Thermalito Power plants' generation and all of the output of Devil Canyon Power Plant and Alamo Power Plant are delivered to SCE. The energy is generally delivered during on-peak periods and a greater amount of energy is returned during off-peak periods. SCE combined return and additional to the SWP during 1989 was 2,145,493 MWh.

Long term contracted energy purchases such as TERA Corp. and MWD Hydro are itemized separately in Table 3 on page 17. Other purchases totaled 995,168 MWh from various utilities such as Portland General Electric and Idaho Power Co.

Energy Loads

DWR has operated as a bulk power agency since April 1983. As such, DWR uses a combination of owned, contracted, and purchased power resources to meet SWP needs via contracted transmission capacity. DWR also sells and exchanges temporary resource excesses to other bulk power agencies and utilities.

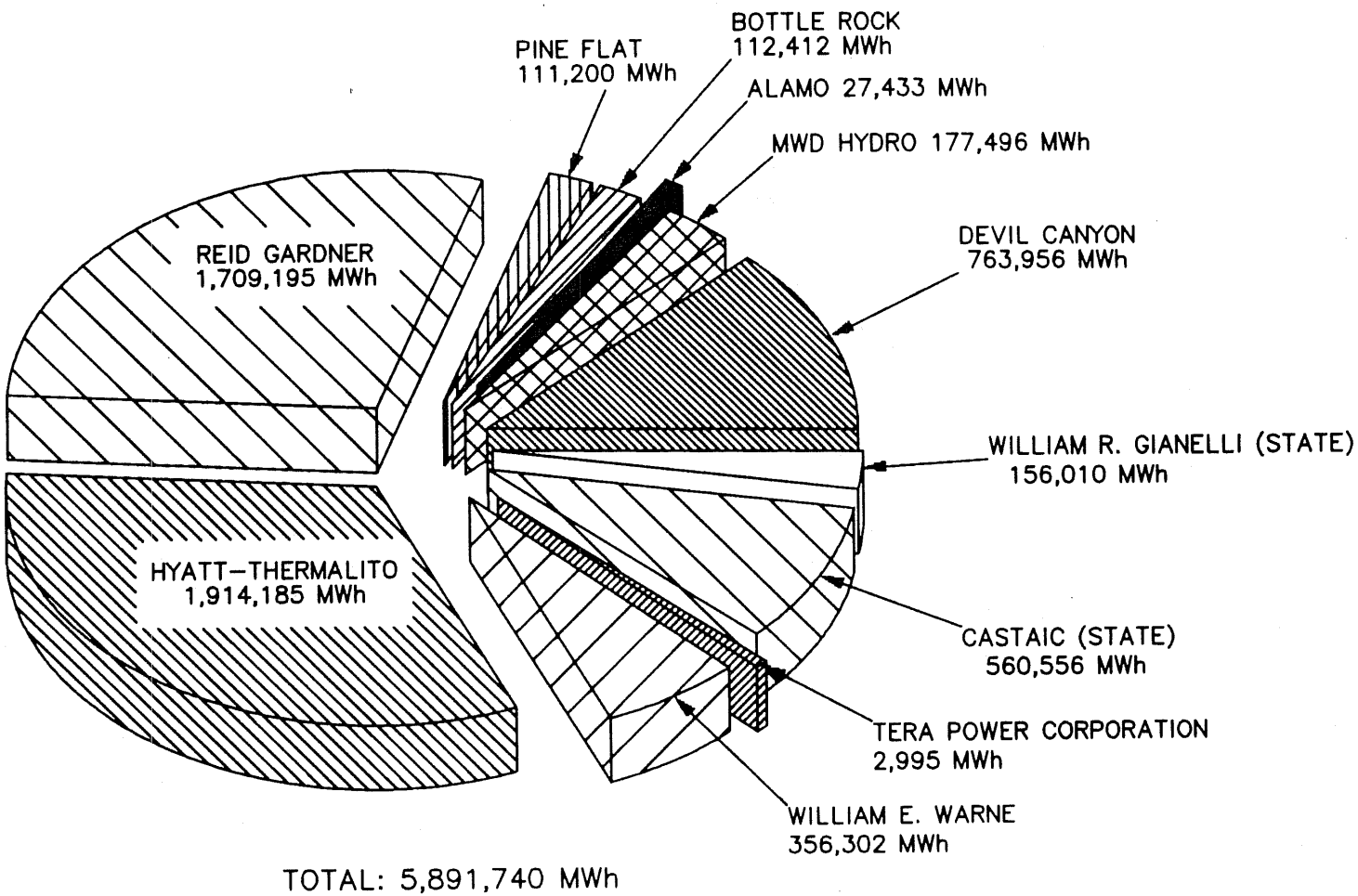
Energy loads during 1989 totaled 9,190,207 MWh, approximately 11% more than the corresponding amount for 1988. This includes 7,821,408 MWh of SWP loads as shown by field division in Figure G on page 20. Also included are losses, sales, and deviation adjustments as shown in Table 4 on page 21. Repayment of transmission losses, through the major transmission networks to the SWP plants, is included as part of the annual SWP energy use at the SWP plants in Figure H on page 22. Increased water deliveries to MWDSC (28% increase), a large pumpback water operation at the Hyatt-Thermalito facilities, and increased pumping at Gianelli Pumping-Generating Plant were the major reasons for higher SWP energy use in 1989. Energy losses on the major transmission line networks in California for the SWP pumping plants and powerplants were 0.28 million MWh in 1989.

Under various water conveyance contracts and exchange agreements, some CVP water is pumped through SWP facilities at Banks, Dos Amigos, Gianelli, and Las Perillas pumping plants. USBR furnishes the energy for this use of SWP pumping facilities.

During 1989, SWP energy supplies (including purchases under contractual obligations) exceeded SWP needs, and DWR sold the excess energy under power sale contracts to fifteen utilities at market rates. The total sale of energy during 1989 was 1,078,813 MWh. In finding the most advantageous time to sell the power, DWR considers projected SWP operations and changes in the power market as well as energy losses, transmission costs, and dispatching costs. System energy loads in 1989 are illustrated in Figure H at the end of this section.

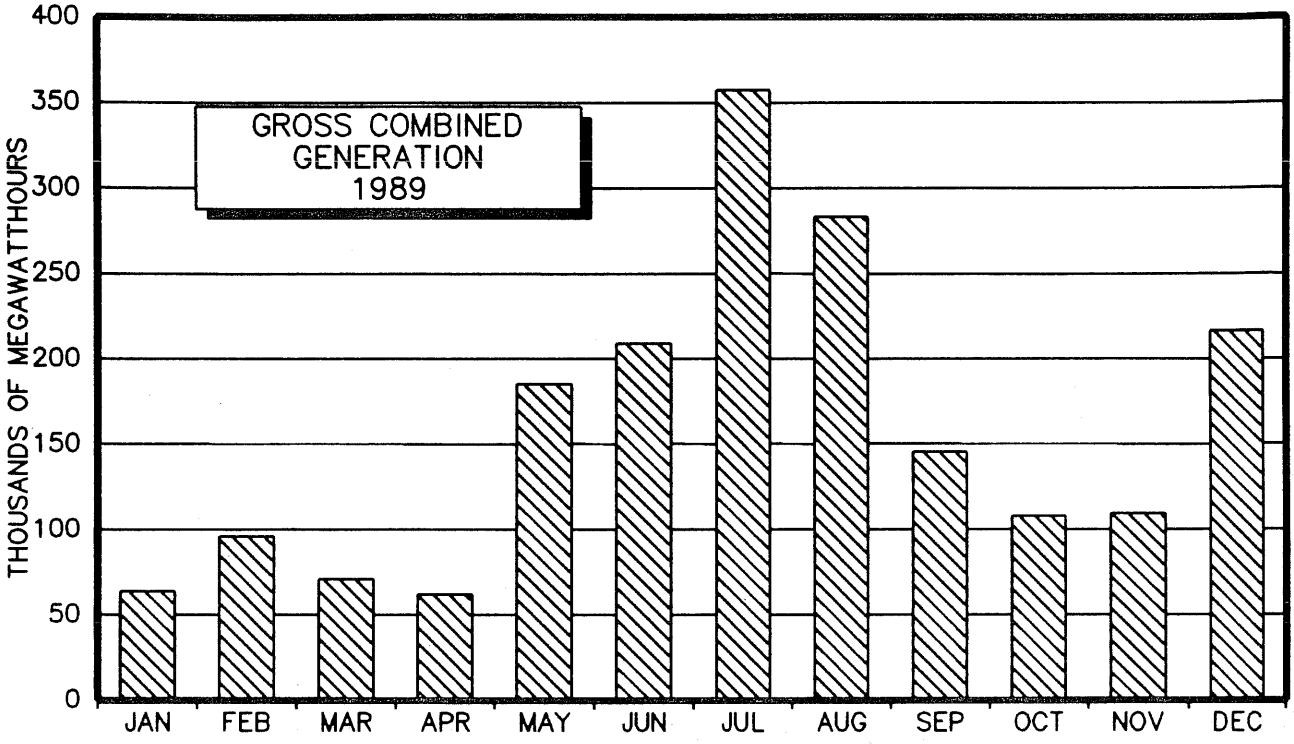
Existing SWP resources together with short-term power purchase contracts, sales contracts, long-term power contracts, and transmission contracts ensure that the SWP has enough energy and capacity to meet future needs. DWR has contracts to sell any excess capacity and

FIGURE D: SWP ENERGY RESOURCES
1989



Note: These are SWP sources only. Purchases, Other Sources, and SCE Return Additional are not shown here. All values are metered readings at plants and are not adjusted for transmission losses.

FIGURE E: OPERATION OF EDWARD HYATT AND THERMALITO POWERPLANTS



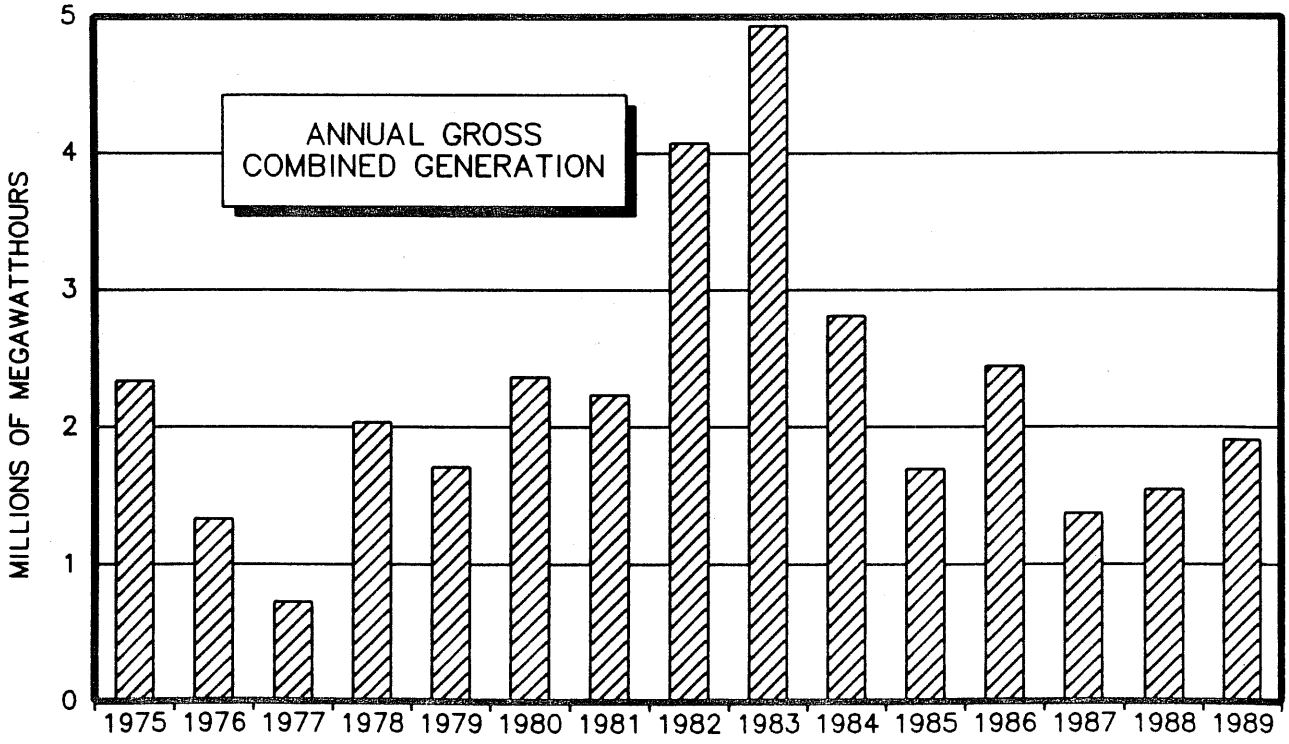


TABLE 3: TOTAL ENERGY RESOURCES

1989

(in megawatthours)

RESOURCE (Includes Station Service)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
Hyatt-Thermalito	64,461	96,394	71,345	62,779	185,708	209,653	358,240	284,111	146,058	108,406	109,782	217,248	1,914,185
Bottle Rock	12,445	11,011	11,591	10,857	11,275	10,043	9,254	8,608	8,016	7,987	3,388	7,937	112,412
William R. Gianelli													
State	0	6,536	-4	-133	41,147	62,569	38,302	7,566	0	0	0	27	156,010
Federal	0	10,134	558	15,922	12,043	52,522	17,651	1,324	0	0	0	0	110,154
Total	0	16,670	554	15,789	53,190	115,091	55,953	8,890	0	0	0	27	266,164
William E. Warne	29,281	3,535	15,351	47,048	25,490	16,601	17,537	12,258	42,436	42,558	47,854	56,353	356,302
Castaic	43,776	5,016	23,256	75,939	36,912	24,480	23,832	18,096	68,808	71,361	75,408	93,672	560,556
Alamo	1,683	1,206	2,119	2,764	2,936	2,272	2,921	2,977	2,907	2,916	2,732	0	27,433
Devil Canyon	25,874	32,339	60,075	61,379	84,339	78,974	82,149	84,683	79,282	85,427	83,100	6,335	763,956
Tera Corp.	65	90	172	228	553	522	455	422	291	169	26	2	2,995
MWD Hydro	7,416	8,784	12,832	19,126	20,472	18,936	17,280	16,536	16,584	14,016	15,146	10,368	177,496
Reid Gardner	134,528	5,935	163,010	141,983	129,913	140,590	172,527	162,782	154,790	161,843	168,528	172,766	1,709,195
Pine Flat	0	977	8,365	9,595	21,938	58,487	11,838	0	0	0	0	0	111,200
Purchases 1/	19,194	28,080	48,857	278,499	162,438	72,832	1,710	51,367	124,356	138,136	68,164	1,535	995,168
Other Sources/Exchanges 2/	39,721	10,391	36,148	23,650	10,212	7,228	2,463	7,758	2,009	5,509	5,771	6,946	157,806
SCE Return Additional	290,514	175,308	206,659	201,955	26,309	17,804	33,125	52,496	271,260	279,672	289,750	300,641	2,145,493

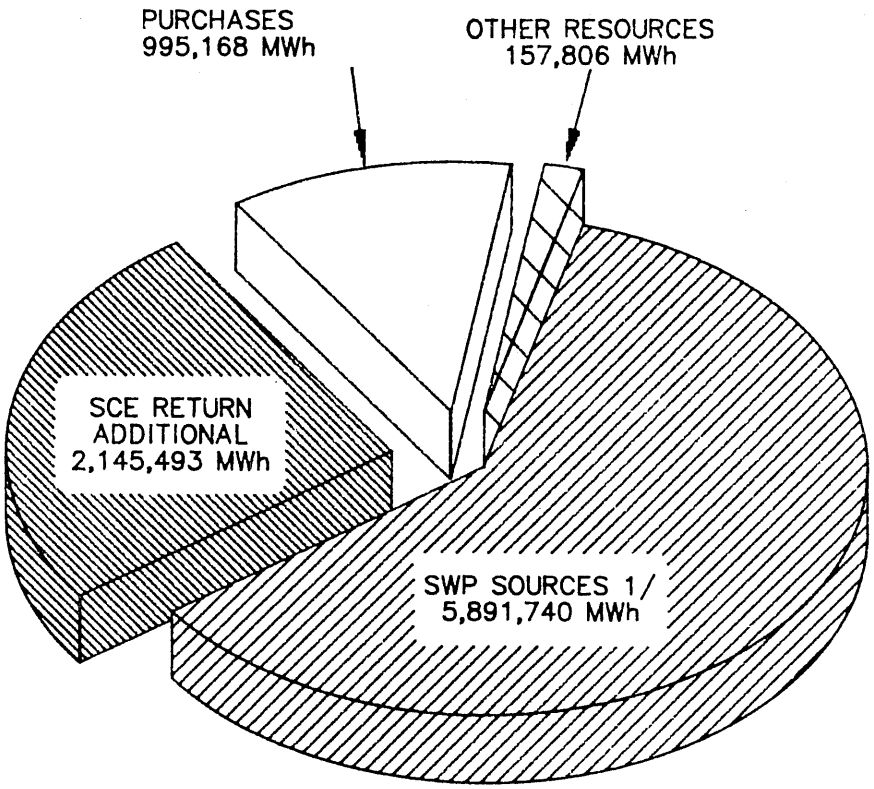
1/ Includes Salt River Project, Portland General Electric, British Columbia Hydro Authority, Southern California Edison, Bonneville Power Authority, Pacific Gas and Electric, Washington Water & Power Co., Montana Power Co., Idaho Power Co., Arizona Public Service Co., Pacific Power & Light, Puget Sound Power and Light,. Eugene Water and Electric Board, Los Angeles Dept. of Water and Power, and Northern California Power Agency.

2/ Includes Southern California Edison, Western Area Mid-Pacific, Los Angeles Dept. of Water and Power, Bonneville Power Authority, City of Vernon, and Pacific Gas & Electric.

State:	9,190,207
Federal:	110,154
Total Project:	9,300,361

FIGURE F: TOTAL ENERGY RESOURCES
(STATE ONLY)

1989



TOTAL: 9,190,207 MWh

PURCHASES

1. Idaho Power Company	210,306 MWh
2. Pacific Gas & Electric Co.	146,708 MWh
3. Salt River Project	118,640 MWh
4. Bonneville Power Authority	107,562 MWh
5. Portland General Electric	102,570 MWh
6. Washington Water and Power Co.	97,108 MWh
7. Montana Power Company	80,065 MWh
8. Puget Sound Power and Light	52,695 MWh
9. Pacific Power & Light	51,590 MWh
10. Arizona Public Service Company	9,555 MWh
11. Southern California Edison	9,234 MWh
12. British Columbia Hydro Authority	7,800 MWh
13. Eugene Water & Electric Board	800 MWh
14. Los Angeles Dept. of Water & Power	300 MWh
15. Northern California Power Agency	235 MWh
	995,168 MWh

OTHER RESOURCES

1. Southern California Edison	110,402 MWh
2. Pacific Gas & Electric	27,166 MWh
3. City of Vernon	11,159 MWh
4. Bonneville Power Authority	4,376 MWh
5. Los Angeles Dept. of Water & Power	2,918 MWh
6. Western Area Mid Pacific	1,785 MWh
	157,806 MWh

SCE RETURN ADDITIONAL

1. Total Received from SCE	3,843,811 MWh
2. SCE Hyatt–Thermalito Entitlement	–729,433 MWh
3. SCE Devil Canyon Entitlement	–763,956 MWh
4. SCE Alamo Entitlement	–27,433 MWh
5. MWD Hydro Entitlement	–177,496 MWh
	2,145,493 MWh

1/ See Figure D for a breakdown of this source.

energy, within the limits of the SWP's contractual transmission capabilities, at Malin, Tesla, Vincent, Sylmar, and El Dorado substations.

Also in Figure H, on page 22, is a summary of DWR's power sales in 1989. Total energy sold to fifteen utilities was nearly 1.10 million MWh, for a revenue of $29.11 million. DWR also received a total of $12.86 million in revenues for peaking-capacity payments from Nevada Power Co., peaking-capacity-foregone payments from LADWP, interruptible transmission payments from SCE and the City of Vernon, and capacity payments from Northern California Power Agency, Turlock Irrigation District and the cities of Azusa, Anaheim, Riverside, Banning, Colton, and Vernon.

Sacramento - San Joaquin Delta Operations

Operations of upstream water developments for flood control and water management affect the Delta in many ways. Operation of storage reservoirs such as Lake Oroville alters seasonal flows to the Delta by retaining a portion of the Feather River flow during winter rain and spring snowmelt season for later release during summer and fall to satisfy SWP export and Delta consumptive needs, and to enhance Delta water quality. Flood control operations at Oroville during the winter flood season (October-April) dampen extreme flood peaks, thereby affecting the timing of flood waters entering the Delta.

The Delta is an estuary subject to large daily tidal flows and water level fluctuations. Delta flows reverse direction twice daily from downstream to upstream in response to the immense tidal forces of the Pacific Ocean. SWP and CVP pumping plants are located in the south Delta, an area within these tidal influences. Banks pumps water from Clifton Court Forebay, a 31,260 AF capacity reservoir, into the California Aqueduct.

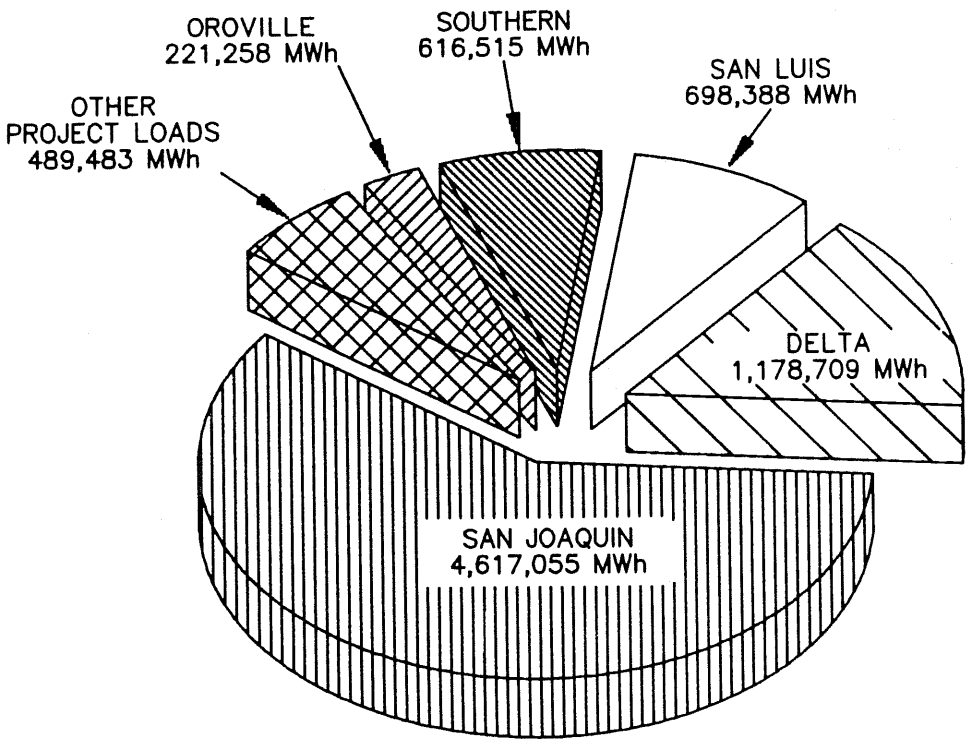
The Clifton Court control gates normally divert water daily from Old River into the forebay on a priority basis as specified in the 1986 South Delta Water Agency (SDWA) agreement. The SDWA agreement addressed the impact of SWP operations on South Delta water supply, water levels, and circulation. Most Clifton Court inflow occurs during the priority one condition which is from one hour after low-high tide to one hour before low-low tide in order to minimize tidal water intrusion and maintain South Delta water levels sufficient for local agricultural pumping. Table 11 on page 42 summarizes and compares Clifton Court operations in 1988 and 1989. A daily summary of operations (showing actual gate opening and closing times) is published in the monthly SWP Operations Data report.

Delta flow patterns are altered by the operations of the SWP and CVP pumps. The magnitude and timing of the pumping plant impact is conditioned in part by specific D-1485 operational constraints that change with water-year type. When in operation, the SWP and CVP export pumps pull Sacramento River flows southward from the North Delta via the CVP's Delta Cross Channel and through Georgiana Slough. Sacramento River flows not diverted south in the North Delta continue westward to converge with the San Joaquin River near Antioch in the western Delta. During operation of the export pumps, the inner North Delta channel network of sloughs and rivers often cannot carry the water volume for export and Delta consumptive use. When these conditions prevail, the net seaward flow of the San Joaquin River near Antioch can reverse and be pulled southward toward the export pumps. This is known as reverse flow. Under these conditions, export water supplies become more brackish as western Delta water under greater tidal influence is drawn southward toward the export pumps. In order to protect export water supplies during periods of reverse flow, additional water called "carriage water" is released from upstream storage to repel seawater intrusion from the Pacific Ocean. See Table 5 on page 24 for a summary of Delta inflow, uses, and exports.

Balanced water conditions are periods when upstream reservoir storage releases, combined with other Delta inflows, approximately equal the water supply needed to meet Sacramento Valley and Delta in-basin uses, Delta exports, and D-1485 water quality requirements.

In 1989, "balanced water conditions" were declared on six separate occasions; from January 5 through 7; January 23 through 24; January 31 through March 3; May 7 through September 17; October 6 through 25; and October 31 through the end of the year. "Excess flows" conditions were declared after a heavy September storm. This ended the longest stretch of balanced conditions, 136 days, begun four months earlier in May. Figures K, L, and M (pages 28 through 30)

FIGURE G: SWP ENERGY LOADS
(BY FIELD DIVISION)
1989



TOTAL: 7,821,408 MWh

OROVILLE FIELD DIVISION	
1. Hyatt–Thermalito Complex (Pump–back and Station Service)	221,258 MWh
DELTA FIELD DIVISION	
1. North Bay	16,098 MWh
2. South Bay	143,763 MWh
3. Del Valle	695 MWh
4. Harvey O. Banks Delta	1,017,314 MWh
5. Bottle Rock (Station Service)	839 MWh
SAN LUIS FIELD DIVISION	
1. William R. Gianelli	320,829 MWh
2. Dos Amigos	376,028 MWh
3. Pine Flat (Station Service)	1,531 MWh
SAN JOAQUIN FIELD DIVISION	
1. Las Perillas	9,406 MWh
2. Badger Hill	24,940 MWh
3. Buena Vista	369,611 MWh
4. Wheeler Ridge	382,568 MWh
5. Wind Gap	852,989 MWh
6. A.D. Edmonston	2,977,541 MWh
SOUTHERN FIELD DIVISION	
1. Oso	165,323 MWh
2. Pearblossom	450,785 MWh
3. William E. Warne (Station Service)	407 MWh
OTHER PROJECT LOADS	
1. Southern California Edison	420,523 MWh
2. Bonneville Power Authority	30,583 MWh
3. City of Vernon	22,587 MWh
4. Pacific Gas and Electric	11,159 MWh
5. Nevada Power	4,376 MWh
6. South Bay Station Service	255 MWh

TABLE 4: TOTAL ENERGY LOADS

1989

(in megawatthours)

SOURCE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
Hyatt-Thermalito Pumpback and Station Service	46,678	19,769	38,675	34,284	2,790	5,521	58	13,523	29,777	23,953	5,935	295	221,258
North Bay 3/	1,518	0	0	0	1,800	3,600	3,720	3,720	1,740	0	0	0	16,098
South Bay	7,468	9,668	14,756	14,877	15,262	14,959	15,164	15,319	9,077	9,225	7,709	10,279	143,763
Del Valle	25	126	284	126	92	6	5	5	5	7	7	7	695
Banks													
State	104,169	61,742	109,019	111,598	55,276	36,284	52,351	89,126	108,416	100,861	75,742	112,730	1,017,314
Federal	4,106	4,488	1,468	0	0	0	30,816	26,688	0	10,555	31,541	1,344	111,006
Bottlerock 1/	24	0	18	50	0	83	159	121	161	27	196	0	839
San Luis													
State	64,697	24,466	62,038	40,183	326	71	122	4,011	16,560	29,338	21,872	57,145	320,829
Federal	36,114	11,220	34,109	2,387	0	0	0	1,500	18,400	25,355	51,037	54,442	234,564
Dos Amigos													
State	16,780	17,133	21,162	31,657	32,521	49,869	52,734	41,567	32,835	29,147	28,124	22,499	376,028
Federal	14,904	23,521	7,594	16,506	18,045	33,627	35,946	23,307	4,353	4,229	6,342	4,152	192,526
Pine Flat 1/	146	178	14	0	0	0	109	191	199	211	220	263	1,531
Las Perillas	168	328	572	750	1,148	1,621	1,847	1,320	676	543	127	306	9,406
Badger Hill	408	843	1,497	2,030	3,034	4,349	4,941	3,576	1,752	1,446	299	765	24,940
Buena Vista	18,875	10,479	22,995	40,564	34,408	33,836	35,915	30,836	38,637	39,351	38,143	25,572	369,611
Wheeler Ridge	20,733	8,937	22,368	43,543	35,679	31,350	32,720	28,633	42,827	44,102	43,080	28,596	382,568
Wind Gap	47,238	19,133	48,880	97,440	78,853	67,929	70,647	63,152	96,630	99,745	98,663	64,679	852,989
A.D. Edmonston	165,709	65,888	169,972	340,930	272,261	233,321	242,983	217,439	341,588	351,637	349,286	226,527	2,977,541
Oso	13,559	2,218	6,751	22,125	10,970	7,570	8,378	5,093	19,576	20,167	21,981	26,935	165,323
Pearblossom	15,358	14,761	33,507	44,507	51,096	45,861	46,196	46,998	49,844	51,856	50,283	518	450,785
Wm. E. Warne 1/	35	110	71	2	2	31	62	85	1	7	1	0	407
Sales	84,468	81,688	56,200	43,527	83,869	100,414	138,219	92,779	77,450	63,285	49,621	207,293	1,078,813
Losses	19,728	10,823	9,492	29,358	41,301	30,869	17,732	14,537	14,466	15,360	38,854	38,735	281,255
Actual Deviation	124	-614	278	1,750	1,371	60	546	-354	1,482	2,187	1,184	717	8,731
Other Project Loads 2/	41,047	37,924	41,229	36,368	37,584	53,388	45,527	39,483	33,096	35,544	38,321	49,972	489,483

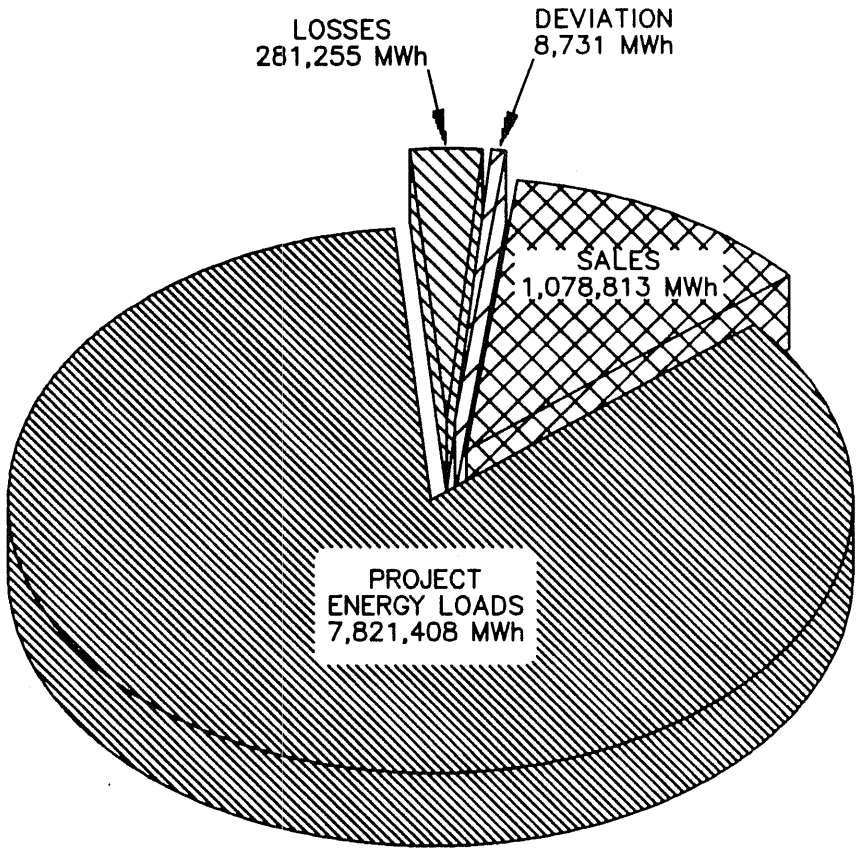
1/ Station Service only.

2/ Includes Southern California Edison, Bonneville Power Authority, City of Vernon, Pacific Gas & Electric, Nevada Power Company, Project Emergency Service, and Deviation Adjustment for Pacific Gas and Electric.

3/ Includes scheduled energy paid back to Pacific Gas and Electric at Barker Slough and Cordelia Pumping Plants.

Total State:	9,190,207
Total Federal:	538,096
Total Project:	9,728,303

FIGURE H: TOTAL ENERGY LOADS
1989



SALES

1.	City of Vernon	376,042 MWh
2.	Turlock Irrigation District	186,196 MWh
3.	Nevada Power	136,504 MWh
4.	Pacific Gas and Electric	124,738 MWh
5.	Modesto Irrigation District	50,306 MWh
6.	Northern California Power Agency	48,515 MWh
7.	City of Riverside	33,377 MWh
8.	City of Anaheim	31,254 MWh
9.	City of Colton	26,193 MWh
10.	City of Azusa	22,582 MWh
11.	Bonneville Power Authority	18,725 MWh
12.	Metro. Water Dist. of So. California	14,190 MWh
13.	City of Banning	5,841 MWh
14.	Salt River Project	3,250 MWh
15.	Southern California Edison	1,100 MWh

TOTAL: 9,190,207 MWh

Note: See Figure G for breakdown of Project Energy Loads.

illustrate various Delta operations during periods of balanced water conditions.

Delta Outflow Index

Direct measurements of net Delta outflow is impractical because of huge tidal flows. However, since net outflow is one of the primary factors in controlling Delta water quality, a calculated value known as the Delta Outflow Index (DOI) has been developed. The DOI represents the daily mean net flow of Delta water into Suisun Bay. Table 6 on page 25 shows the daily DOI for 1989.

Several surface inflows, notably the Cosumnes, Mokelumne, and Calaveras Rivers, and the Yolo Bypass flood control channel, are not included. Furthermore, the precipitation and channel depletion factors in the calculation are based on daily increments of long-term averages, whereas Delta inflow estimates represent mean flows for that entire day. DOI is calculated daily from the sum of Sacramento and San Joaquin River inflows minus gross channel depletion, and water exports by the SWP and CVP. A comparison of Delta Inflow and DOI is plotted on Figure J on page 27. Gross channel depletion is the sum of evapo-transpiration and net increase in soil moisture of Delta lands plus evaporation from Delta channels.

Delta outflow during 1989 exceeded 1988 DOI for all months from March through October. March 1989 had the years highest monthly Delta outflow (34,479 cfs) resulting from large winter storm inflow. March rains in the Sacramento basin averaged about 250 % of normal causing seasonal runoff to increase from 40% up to 80% of seasonal average by April 1. March 1989 was the wettest March since 1983 for the area north of the American River with a Delta outflow double the highest previous year's monthly flow (January, 1988).

The months of March and April 1989 were the only months with average outflows over 10,000 cfs. The highest daily outflow occurring on March 28 (64,707 cfs) was augmented by higher end-of-month Oroville reservoir releases, let in part for power production to offset energy purchases for SWP pumping. March had 18 days of Delta outflow over 30,000 cfs, whereas the entire year of 1988 had none.

After mid April, with the return of dry conditions, the DOI exceeded 10,000 cfs for only six days during the remainder of the year, two days each in May, September, and October. The lowest DOI flows were measured in September and October when negative DOI values occurred with export pumping exceeding river flow for one day in September and three days in October. October 7 had a value of -933 cfs. However, negative values may not reflect actual physical conditions as DOI is not a measured flow but a calculated index.

D-1485 standards set a minimum DOI at Chipps Island for the environmental requirements of young striped bass and for adequate water quality in Suisun Marsh. In 1989, SWP operations augmented the DOI during June, July, and August. The largest monthly augmentation took place in July (3,688 cfs) during peak irrigation season. The largest daily augmentation occurred on August 17 concurrent with drastic curtailment of Delta export pumping in response to rising Delta salinity.

The DOI was reduced during nine months of 1989. In all, SWP operations reduced the DOI a total of 291 days during 1989, about 80% of the time. The greatest reduction of DOI resulted from Oroville reservoir conservation of high March and April storm flow and snowmelt during a period of limited downstream demands. Average March and April monthly flow reductions were 24,034 cfs and 14,460 cfs respectively. The largest daily reduction of DOI occurred on March 12 (74,266 cfs) with rapid reservoir fill.

TABLE 5: SACRAMENTO BASIN AND SACRAMENTO-SAN JOAQUIN DELTA OPERATIONS
1989

(in thousands of acre-feet except as noted)

MONTH	UPSTREAM RESERVOIR RELEASES TO RIVER			SACRAMENTO RIVER IN-BASIN USE	DELTA INFLOW			DELTA USES			DELTA EXPORTS		
	KESWICK 1/	OROVILLE 1/	NIMBUS	2/	SACRAMENTO RIVER AT SACRAMENTO 3/	SAN JOAQUIN RIVER AT VERNALIS 4/	TOTAL 5/	DELTA CONSUMPTIVE USE	DELTA OUTFLOW INDEX TOTAL	DELTA OUTFLOW INDEX AVERAGE CFS	TOTAL EXPORTS	EXPORTED BY DWR	EXPORTED BY USBR 6/
JAN	212	73	31	502	798	76	897	-56	324	5,274	626	347	279
FEB	281	166	28	231	671	68	746	-37	326	5,874	455	205	250
MAR	211	95	287	2,029	2,675	128	2,742	-10	2,120	34,479	631	366	265
APR	234	72	162	870	1,264	113	1,462	63	779	13,090	622	376	246
MAY	625	141	213	-62	852	122	991	121	484	7,874	381	184	197
JUN	694	168	204	-216	797	92	899	191	391	6,575	312	120	192
JUL	777	397	269	-275	1,157	81	1,236	268	378	6,151	586	175	411
AUG	727	290	179	-105	1,128	74	1,234	252	282	4,582	696	301	395
SEP	390	168	116	272	974	86	1,076	174	259	4,350	641	365	276
OCT	298	178	183	226	879	89	987	118	219	3,569	644	339	305
NOV	439	146	177	168	883	83	971	55	297	4,989	618	255	363
DEC	270	352	114	198	846	82	1,038	2	392	6,377	644	378	266
TOTAL	5,158	2,246	1,963	3,838	12,924	1,094	14,279	1,141	6,251	---	6,856	3,411	3,445

1/ Time lagged values (Keswick: 5 days; Oroville: 2 days, Nimbus: 1 day).
2/ Positive values are accretions; negative values are depletions.
3/ These values are a measured daily average taken from the Sacramento River at Freeport.
4/ These values are based on daily 6 a.m. readings. Columns 1, 2, 3, 12, and 13 are based on measured total daily flow.
5/ Includes Sacramento County Regional Wastewater Treatment Plant.
6/ Includes any USBR water pumped at Harvey O. Banks Delta Pumping Plant.

TABLE 6: CALCULATED TOTAL DELTA OUTFLOW
INCLUDES YOLO BYPASS FLOWS
1989

(in cfs-days except as noted)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	4,799	5,367	5,886	41,278	8,365	7,080	4,465	8,008	553	1,848	1,768	5,876
2	5,312	6,586	7,228	34,186	11,193	6,820	4,531	7,862	811	756	2,750	6,081
3	6,490	7,006	6,850	28,842	10,890	7,496	4,548	7,894	550	625	2,871	5,384
4	6,388	6,023	19,315	25,991	9,209	7,953	4,140	7,327	516	512	3,455	5,288
5	7,958	6,051	19,212	22,620	8,093	7,947	4,647	8,533	400	-488	2,014	6,105
6	7,214	8,308	17,767	20,982	7,903	8,479	4,607	6,887	-75	-676	3,074	6,822
7	6,283	7,526	14,036	18,904	7,239	8,601	2,967	7,016	83	-933	4,693	6,927
8	7,760	7,158	15,582	16,537	7,096	8,114	3,041	6,182	37	48	4,099	6,893
9	10,232	6,017	18,377	14,726	7,024	7,541	3,329	6,193	2,306	798	4,200	7,260
10	8,796	6,041	20,445	13,349	7,416	7,615	3,086	6,627	5,057	1,785	3,417	8,207
11	6,410	5,951	29,835	12,681	8,480	7,402	4,144	6,075	6,505	1,725	3,182	8,759
12	7,661	6,116	45,661	11,747	8,038	7,069	4,601	6,321	7,031	1,781	3,374	8,887
13	7,860	5,616	52,245	11,053	8,087	7,021	5,006	5,638	4,952	3,016	3,549	7,472
14	8,845	7,070	53,735	10,070	7,567	6,902	6,939	5,201	4,566	3,387	4,462	5,999
15	8,241	6,460	52,205	8,319	7,034	6,310	8,039	4,961	3,347	3,868	4,720	6,504
16	6,307	6,500	49,363	7,354	6,897	7,508	7,604	4,618	3,661	4,333	5,063	6,171
17	4,511	5,555	43,581	6,560	7,861	7,552	6,018	3,853	3,970	4,269	4,334	6,007
18	4,061	5,528	36,418	7,713	8,181	7,490	7,919	3,098	7,563	3,781	7,516	6,766
19	2,916	6,161	32,573	5,637	7,089	7,718	8,212	5,214	7,715	2,984	6,144	6,148
20	2,396	5,592	33,767	5,101	7,022	6,579	7,977	3,421	9,424	3,063	7,785	5,996
21	2,083	4,774	38,406	5,362	7,134	5,356	6,907	3,387	12,485	4,106	7,143	5,171
22	1,628	4,537	37,793	5,470	8,057	5,467	7,206	2,890	10,882	4,508	6,910	5,475
23	2,766	4,512	33,866	5,880	7,994	4,993	8,083	2,458	7,827	4,933	6,159	4,788
24	2,758	4,513	28,980	6,566	8,287	5,159	7,615	2,468	6,691	6,705	5,798	4,602
25	2,352	4,709	28,968	6,800	8,392	5,677	7,461	1,767	6,166	7,282	5,584	4,608
26	4,464	4,663	41,985	7,390	7,044	4,639	7,487	1,614	4,726	9,759	5,926	4,493
27	4,667	4,495	62,085	8,401	6,920	4,048	8,056	1,597	4,477	10,615	7,913	5,129
28	4,548	5,645	64,707	8,625	6,694	4,593	7,970	1,686	3,172	10,053	8,106	6,472
29	2,330		58,119	7,616	8,229	3,652	8,057	1,315	2,350	6,931	7,497	7,539
30	2,016		52,362	6,934	7,746	4,479	7,917	950	2,766	3,825	6,162	7,897
31	3,430		47,502		6,910		8,103	978		5,436		7,957
TOTAL	163,482	164,480	1,068,854	392,694	244,091	197,260	190,682	142,039	130,514	110,635	149,668	197,683
AVE.	5,274	5,874	34,479	13,090	7,874	6,575	6,151	4,582	4,350	3,569	4,989	6,377
MAX.	10,232	8,308	64,707	41,278	11,193	8,601	8,212	8,533	12,485	10,615	8,106	8,887
MIN.	1,628	4,495	5,886	5,101	6,694	3,652	2,967	950	-75	-933	1,768	4,493
TOTAL IN AF	324,267	326,246	2,120,072	778,909	484,154	391,265	378,218	281,734	258,875	219,445	296,866	392,104

FIGURE I: WATER QUALITY CONDITIONS AT SELECTED DELTA STATIONS 1989

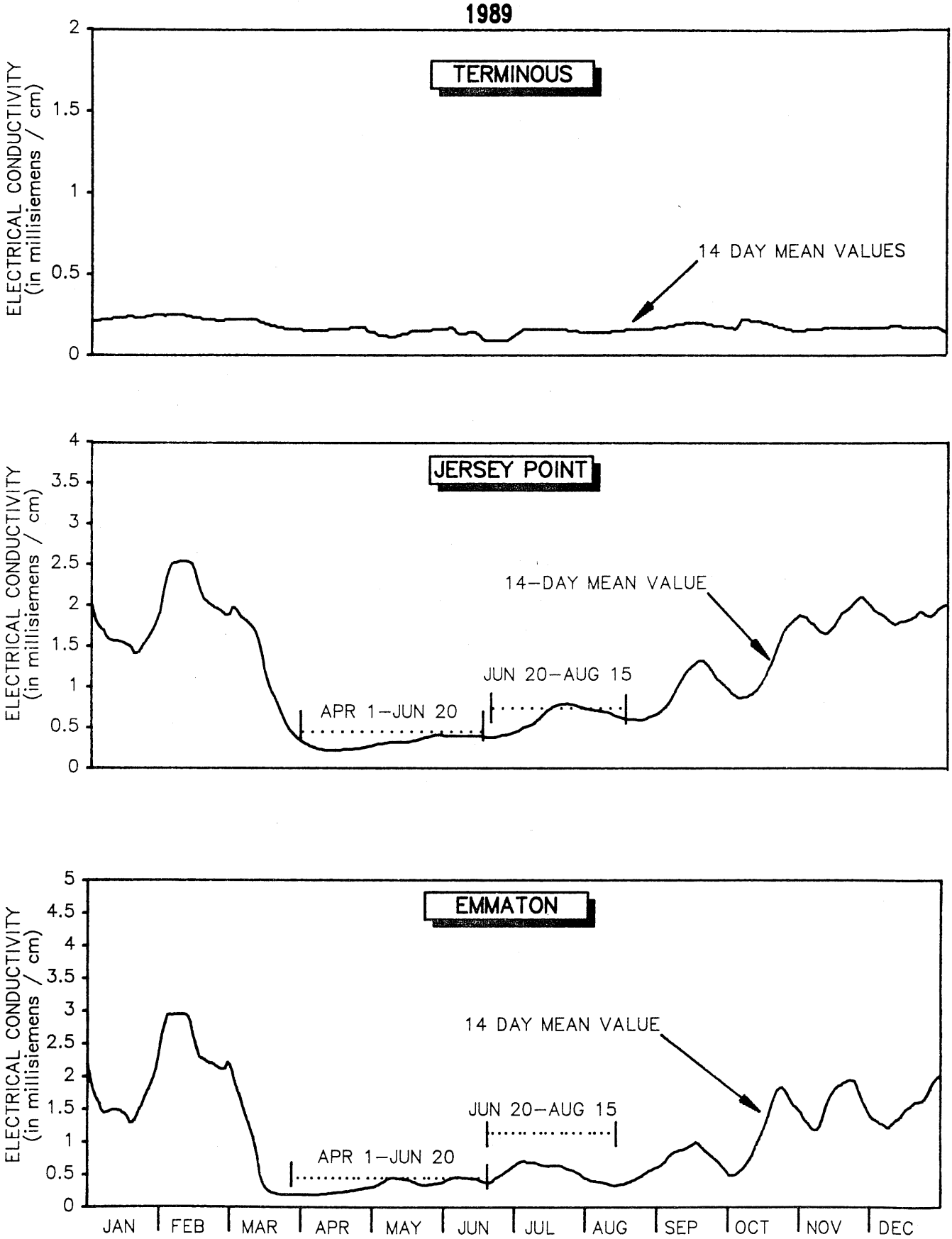


FIGURE J: DELTA TIDE, INFLOW, AND OUTFLOW INDEX
1989

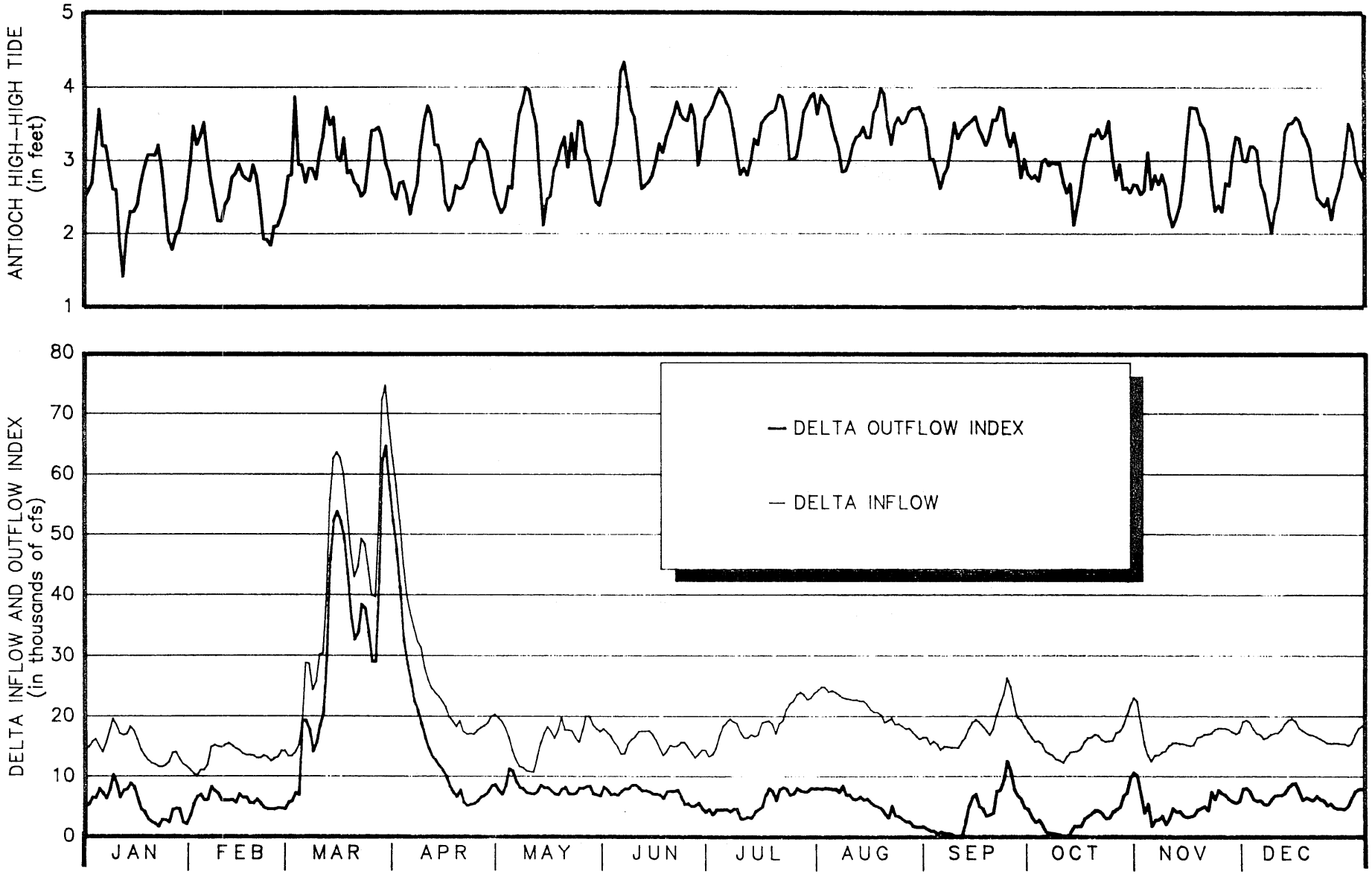
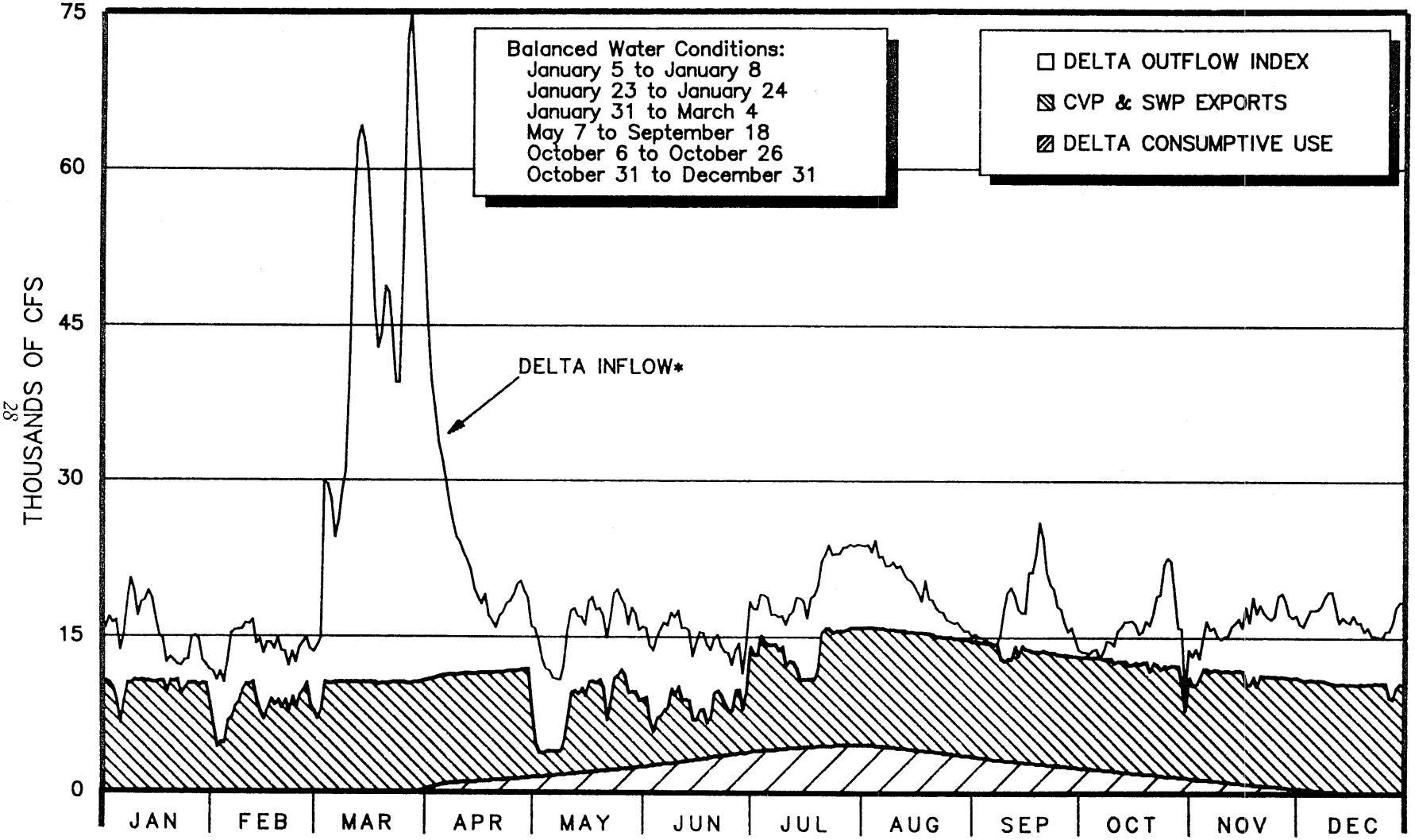


FIGURE K: COORDINATED DELTA OPERATIONS
1989



* Delta inflow = Exports + Outflow + Consumptive use.

FIGURE L: COORDINATED DELTA OPERATIONS
LAGGED STORAGE WITHDRAWALS
1989

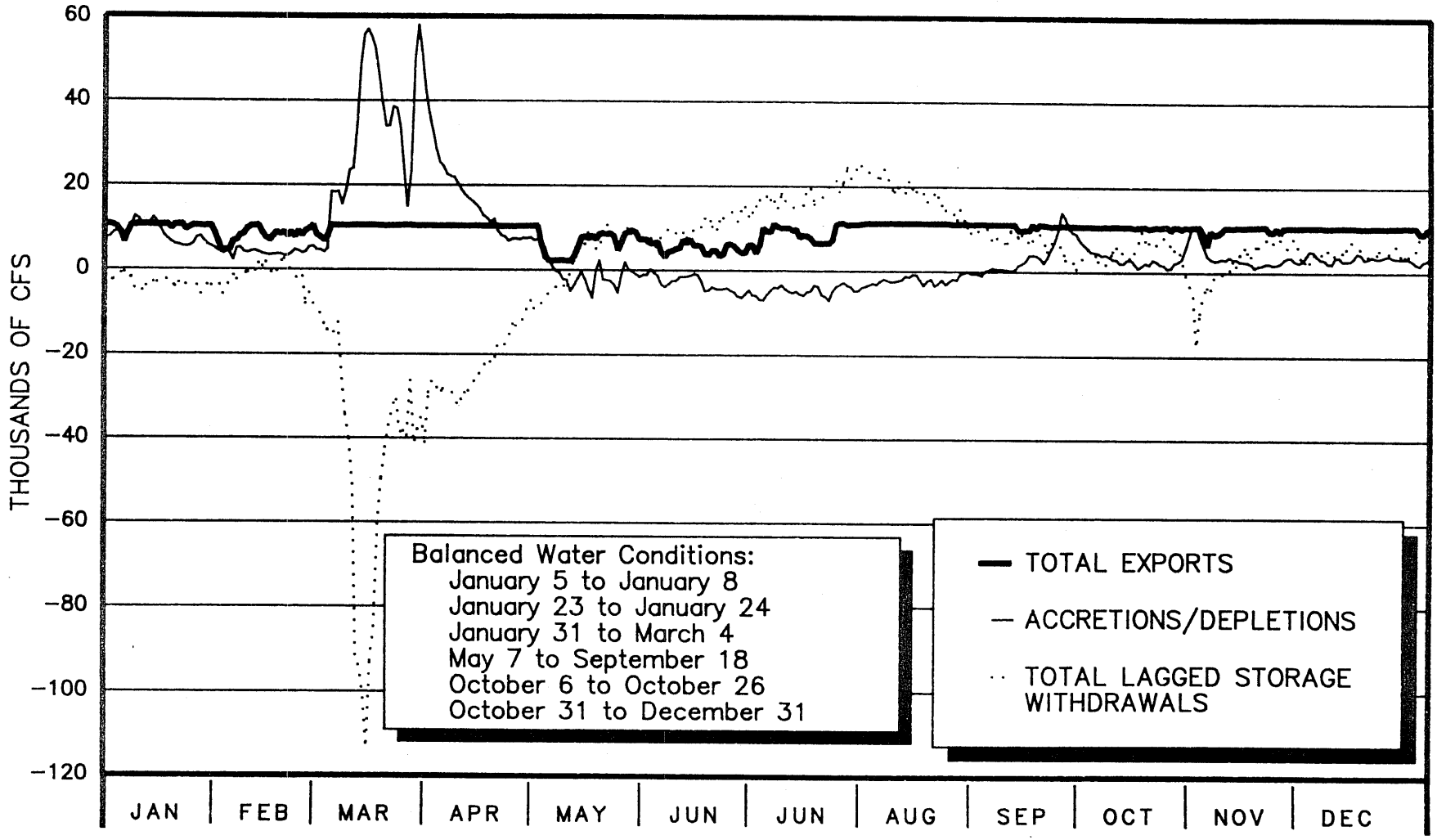
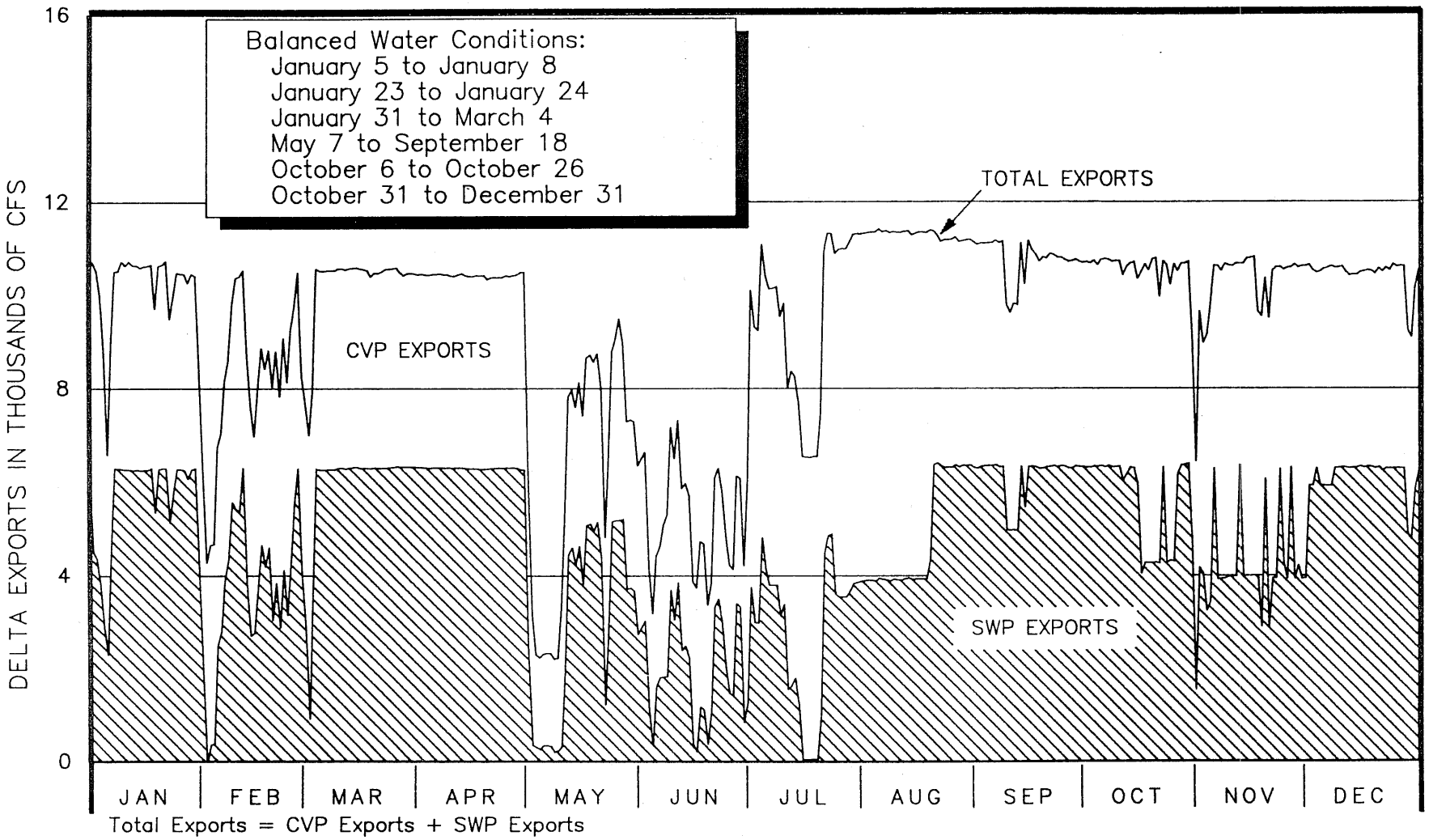


FIGURE M: COORDINATED DELTA OPERATIONS
DELTA EXPORTS
1989



Total Exports = CVP Exports + SWP Exports

Project Operations By Field Division

Oroville Field Division

Water Storage

SWP water storage facilities north of the Delta include Lake Oroville, Thermalito Forebay and Afterbay (Oroville-Thermalito Complex) and upper Feather River reservoirs consisting of Lake Davis, Frenchman Lake, and Antelope Lake. Lake Oroville operations are for storing winter and spring runoff for later SWP use which includes power generation, flood control, recreation, fish and wildlife enhancement in addition to water supply.

The Upper Feather River Reservoirs have a combined capacity of 162,000 AF. Of these reservoirs, Antelope Lake was the only one to spill in 1989. Monthly operations for the three upper Feather River reservoirs are presented in Table 7 on page 33. The table below compares storage capacity with the largest end of month storage for each reservoir for the last five years:

	Antelope	Frenchman	Davis
	(all values in acre-feet)		
Capacity	22,566	55,477	84,371
1989	(May) 23,125	(Apr.) 37,031	(Apr.) 61,015
1988	(Apr.) 16,344	(Apr.) 32,002	(Jan.) 55,043
1987	(May) 19,285	(Apr.) 41,909	(Apr.) 69,815
1986	(Mar.) 23,886	(Mar.) 57,344	(Mar.) 84,250
1985	(Apr.) 23,371	(Apr.) 52,877	(Apr.) 79,462

Lake Oroville's computed inflow is tabulated in Table 8 on page 34 and plotted along with releases and diversions on Figure N on page 35. March's total inflow of just over 1.2 million AF is the highest since February 1986 (which totaled nearly 2.4 million AF). A ten-year historical summary of Lake Oroville's storage and inflow is illustrated on Figure O on page 36. Figure N clearly shows which months (eight for 1989) of the year required withdrawals from storage.

During 1989, inflow into Lake Oroville was insufficient to cause the actual storage to encroach into the lake's "Required Flood Control Reservation" space (see Figure P on page 37). The lake was not operated for flood control, and no water was released from the Oroville Dam spillway.

Water temperature on and below the lake's surface is monitored very closely throughout the year at various locations around the lake. Two intake structures to the powerplant have shutters that control the depth from which water enters the plant. Temperatures of water entering the fish hatchery can then be controlled by adding or removing shutters as necessary. A complete illustration of water temperature and intake structure operation is shown on Figure Q on page 38.

Water Deliveries

Water conveyed totaled 825,286 AF which includes contract deliveries of 14,828 AF and prior water right deliveries of 810,458 AF. Most prior water right deliveries (as shown below) were made downstream from Lake Oroville except 1,821 AF which was made from Lake Davis. Detailed operations data for all three Upper Feather Area Lakes is shown in Table 7 on page 33.

Water stored in Lake Oroville is released to Palermo Canal and into the Thermalito Diversion Dam Pool, from which specified quantities are released into both the Feather River and the Thermalito Power Canal. The Power Canal supplies water first to the Thermalito Forebay and then to Thermalito Afterbay. From the Thermalito Afterbay, additional water is released to the Feather River and several local distribution systems used to deliver water to prior water right holders. These deliveries are collectively called the Feather River Service Area (FRSA) diversions and flow through the Sutter-Butte, P.G.&E., Western, and Richvale Canal outlets. FRSA diversions are not considered SWP benefits as they predate the SWP construction and would have occurred in the absence of the SWP to the limit of available natural river flows. Nearly all FRSA diversions are for agricultural uses and totaled 808,637 AF in 1989 as shown below:

Sutter Butte	482,053
P.G.&E.	3,784
Richvale	84,746
Western Canal	230,508
Palermo Canal	7,546
TOTAL IN AF	808,637

A comparison of 1989 and 1988 Diversion Dam, Forebay, and Afterbay water surface elevations and storages is presented on Table 9 on pages 39.

MAP 3
PROJECT FACILITIES

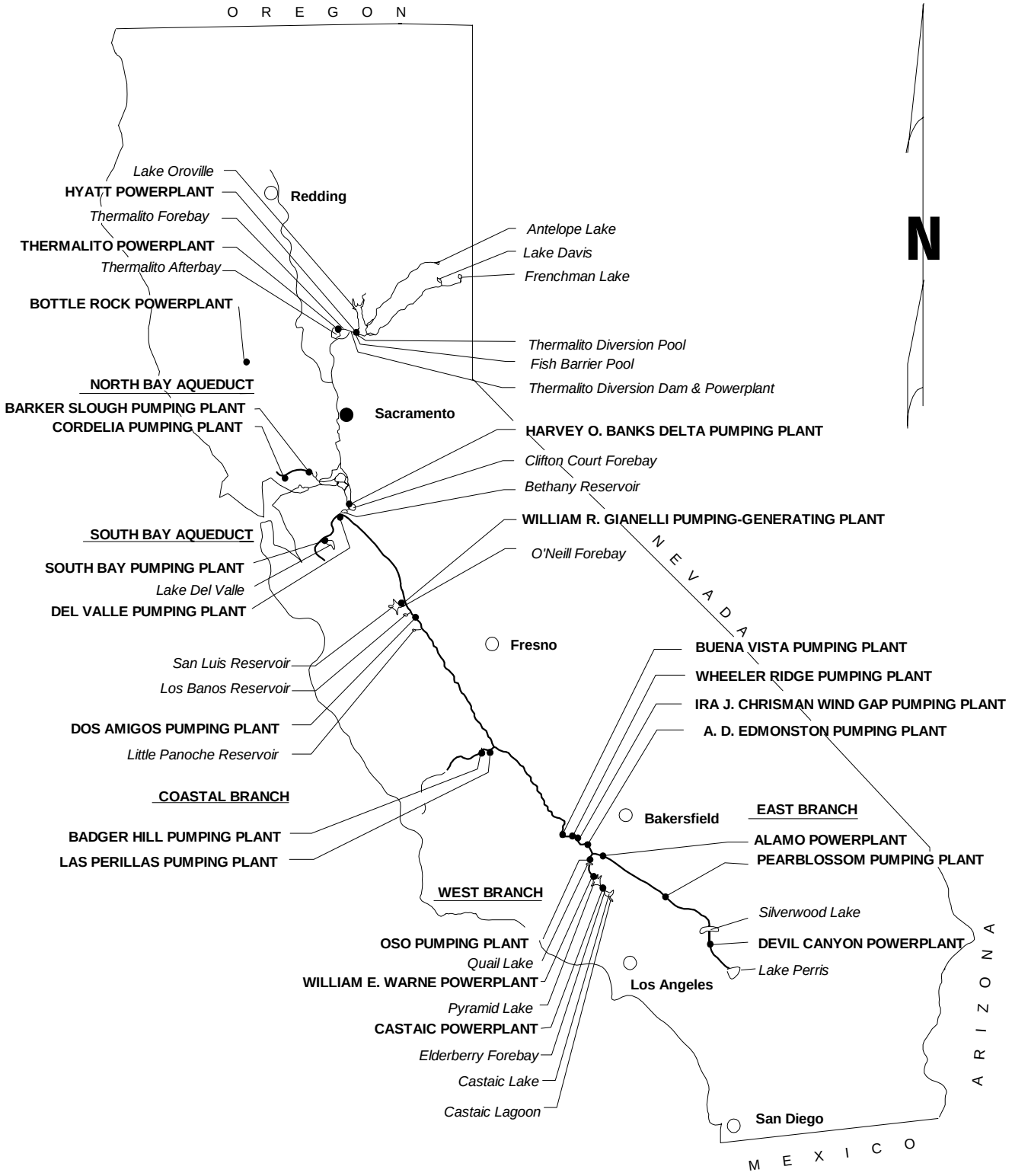


TABLE 7: UPPER FEATHER AREA LAKES MONTHLY OPERATION
1989

(in acre-feet except as noted)

MONTH	LAKE STORAGE			OUTFLOW							INFLOW
				REGULATED RELEASE							
	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	STREAM-FLOW MAINT.	WATER SUPPLY CONTRACT	PRIOR WATER RIGHTS	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
ANTELOPE LAKE			Capacity 22,566 acre-feet								
JAN	4,991.25	13,824	111	307	0	0	307	0	49	356	467
FEB	4,992.35	14,602	778	278	0	0	278	0	56	334	1,112
MAR	5,001.93	22,499	7,897	307	0	0	307	0	100	407	8,304
APR	5,002.60	23,125	626	35	0	0	35	7,839	189	8,063	8,689
MAY	4,902.51	23,041	-84	0	0	0	0	2,973	301	3,274	3,190
JUN	4,901.58	22,176	-865	544	0	0	544	911	466	1,921	1,056
JUL	4,999.62	20,409	-1,767	1,230	0	0	1,230	0	808	2,038	271
AUG	4,997.73	18,787	-1,622	1,230	0	0	1,230	0	604	1,834	212
SEP	4,996.28	17,596	-1,191	1,051	0	0	1,051	0	393	1,444	253
OCT	4,994.92	16,522	-1,074	1,220	0	0	1,220	0	79	1,299	225
NOV	4,993.67	15,570	-952	1,190	0	0	1,190	0	121	1,311	359
DEC	4,992.14	14,451	-1,119	1,230	0	0	1,230	0	80	1,310	191
TOTAL	---	---	738	8,622	0	0	8,622	11,723	3,246	23,591	24,329
FRENCHMAN LAKE			Capacity 55,477 acre-feet								
JAN	5,562.30	23,555	315	23	0	0	23	0	65	88	403
FEB	5,563.86	25,033	1,478	111	0	0	111	0	66	177	1,655
MAR	5,571.65	33,226	8,193	123	0	0	123	0	136	259	8,452
APR	5,574.85	37,031	3,805	130	5	0	135	0	240	375	4,180
MAY	5,573.29	35,143	-1,888	0	2,505	0	2,505	0	432	2,937	1,049
JUN	5,570.96	32,441	-2,702	0	2,454	0	2,454	0	546	3,000	298
JUL	5,567.35	28,528	-3,913	0	3,080	0	3,080	0	1,015	4,095	182
AUG	5,564.56	25,713	-2,815	0	2,364	0	2,364	0	645	3,009	194
SEP	5,563.46	24,649	-1,064	0	805	0	805	0	461	1,266	202
OCT	4,963.14	24,345	-304	0	221	0	221	0	256	477	173
NOV	5,563.30	24,497	152	88	53	0	141	0	152	293	445
DEC	5,563.28	24,478	-19	123	0	0	123	0	67	190	171
TOTAL	---	---	1,238	598	11,487	0	12,085	0	4,081	16,166	17,404
LAKE DAVIS			Capacity 84,371 acre-feet								
JAN	5,762.80	42,976	-53	615	18	0	633	0	193	826	773
FEB	5,763.21	44,111	1,135	555	20	0	575	0	194	769	1,904
MAR	5,767.64	57,524	13,413	615	3	0	618	0	366	984	14,397
APR	5,768.69	61,015	3,491	595	23	0	618	0	670	1,288	4,779
MAY	5,768.45	60,203	-812	246	44	369	659	0	1,111	1,770	958
JUN	5,767.81	58,080	-2,123	238	74	357	669	0	2,060	2,729	606
JUL	5,766.89	55,107	-2,973	246	120	369	735	0	2,361	3,096	123
AUG	5,766.22	52,999	-2,108	246	84	369	699	0	1,579	2,278	170
SEP	5,765.71	51,397	-1,602	238	58	357	653	0	1,329	1,982	380
OCT	4,965.63	51,181	-216	615	17	0	632	0	304	936	720
NOV	5,765.62	51,157	-24	595	14	0	609	0	485	1,094	1,070
DEC	5,765.33	50,275	-882	615	11	0	626	0	333	959	77
TOTAL	---	---	7,246	5,419	486	1,821	7,726	0	10,985	18,711	25,957

* At end of month.

TABLE 8: LAKE OROVILLE MONTHLY OPERATION

(in acre-feet except as noted)

Capacity 3,537,577 acre-feet

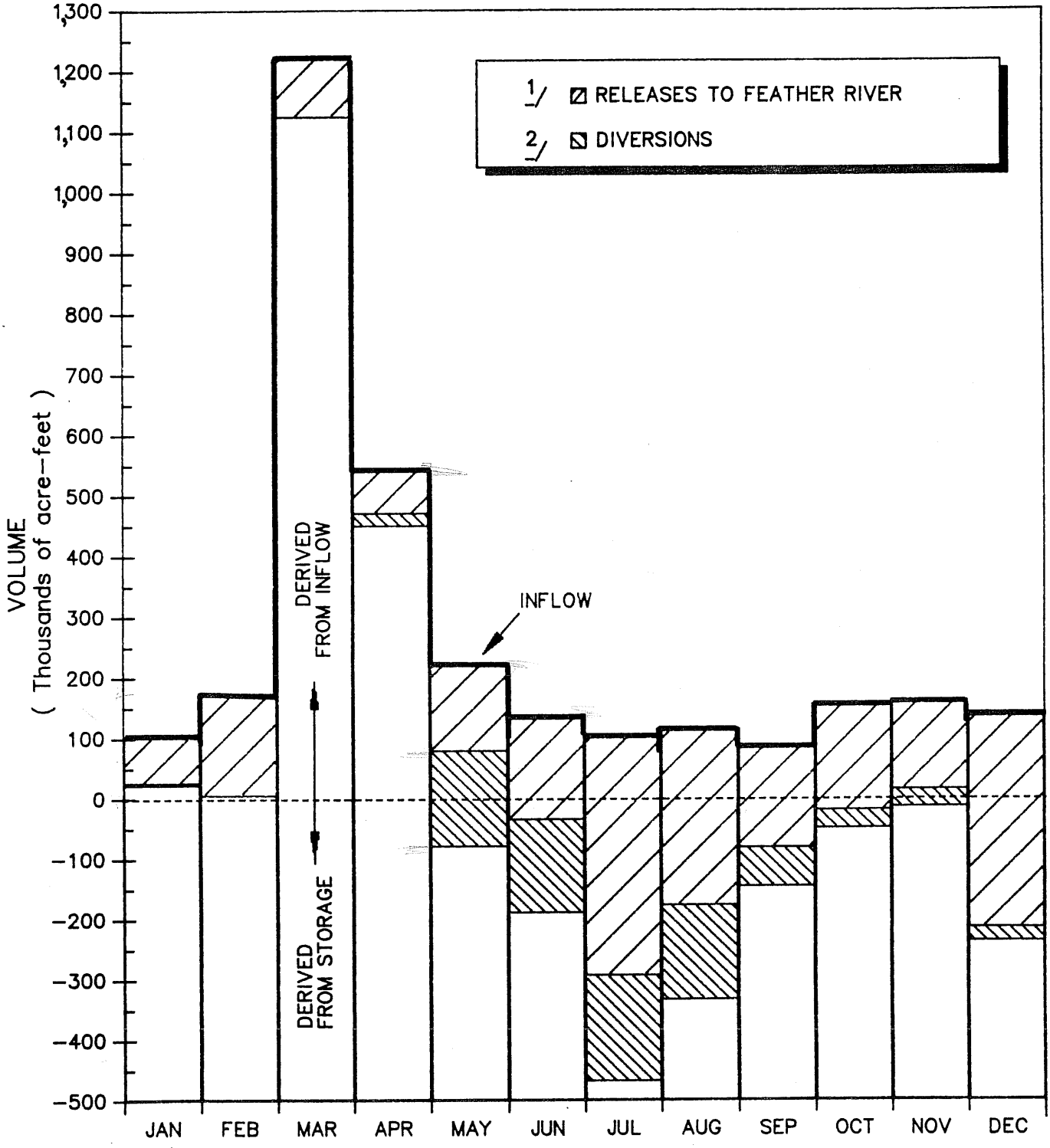
MONTH	YEAR	WATER SURFACE ELEVATION	STORAGE	STORAGE* CHANGE	OUTFLOW						PUMPBACK	COMPUTED TOTAL INFLOW (excluding pumpback)
					POWER	PALERMO CANAL	SPILLWAY LEAKAGE	EVAP-ORATION	SPILL	TOTAL OUTFLOW		
JAN	1989	752.37	1,699,766	39,500	123,728	202	0	809	0	124,739	61,408	102,831
	1988	837.90	2,649,289	261,282	93,046	143	63	862	0	94,114	50,879	304,517
FEB	1989	754.14	1,716,489	16,723	182,385	182	0	1,009	0	183,576	25,271	175,028
	1988	841.94	2,701,689	52,400	104,469	174	149	2,505	0	107,297	33,140	126,557
MAR	1989	854.35	2,867,122	1,150,633	118,712	202	107	1,521	0	120,542	45,836	1,225,339
	1988	838.86	2,661,680	-40,009	223,005	383	214	3,733	0	227,335	10,852	176,474
APR	1989	887.50	3,343,930	476,808	98,069	284	635	4,510	0	103,498	33,852	546,454
	1988	830.31	2,552,740	-108,940	266,187	715	36	3,481	0	270,419	399	161,080
MAY	1989	883.18	3,278,807	-65,123	280,510	1,019	785	6,940	0	289,254	2,482	221,649
	1988	824.37	2,478,918	-73,822	217,213	901	0	4,934	0	223,048	3,828	145,398
JUN	1989	870.49	3,092,775	-186,032	317,675	1,190	657	7,185	0	326,707	5,333	135,342
	1988	804.14	2,238,794	-240,124	316,193	1,018	0	6,468	0	323,679	8,162	75,393
JUL	1989	836.25	2,628,087	-464,688	558,326	1,180	357	9,188	0	569,051	0	104,363
	1988	769.62	1,867,685	-371,109	422,182	1,115	0	8,068	0	431,365	1,033	59,223
AUG	1989	808.02	2,283,529	-344,558	466,441	1,166	0	7,001	0	474,608	15,841	114,209
	1988	746.51	1,645,221	-222,464	297,805	1,107	0	6,460	0	305,372	19,731	63,177
SEP	1989	796.30	2,150,283	-133,246	251,139	1,040	0	4,646	0	256,825	36,049	87,530
	1988	733.54	1,528,900	-116,321	247,354	1,115	0	5,296	0	253,765	47,504	89,940
OCT	1989	795.89	2,145,723	-4,560	190,376	456	0	2,726	0	193,558	29,609	159,389
	1988	731.01	1,506,898	-22,002	202,590	1,008	0	3,359	0	206,957	64,316	120,639
NOV	1989	794.02	2,125,012	-20,711	188,651	328	0	1,654	0	190,633	7,229	162,693
	1988	742.21	1,605,991	99,093	195,712	491	0	863	0	197,066	86,799	209,360
DEC	1989	771.71	1,888,799	-236,213	377,625	297	0	832	0	378,754	171	142,370
	1988	748.14	1,660,266	54,275	150,037	204	0	969	0	151,210	70,616	134,869
TOTAL	1989	- - -	- - -	228,533	3,153,637	7,546	2,541	48,021	0	3,211,745	263,081	3,177,197
	1988	- - -	- - -	-727,741	2,735,793	8,374	462	46,998	0	2,791,627	397,259	1,666,627

*At end of month

FIGURE N : OROVILLE-THERMALITO COMPLEX

INFLOW, RELEASES AND DIVERSIONS

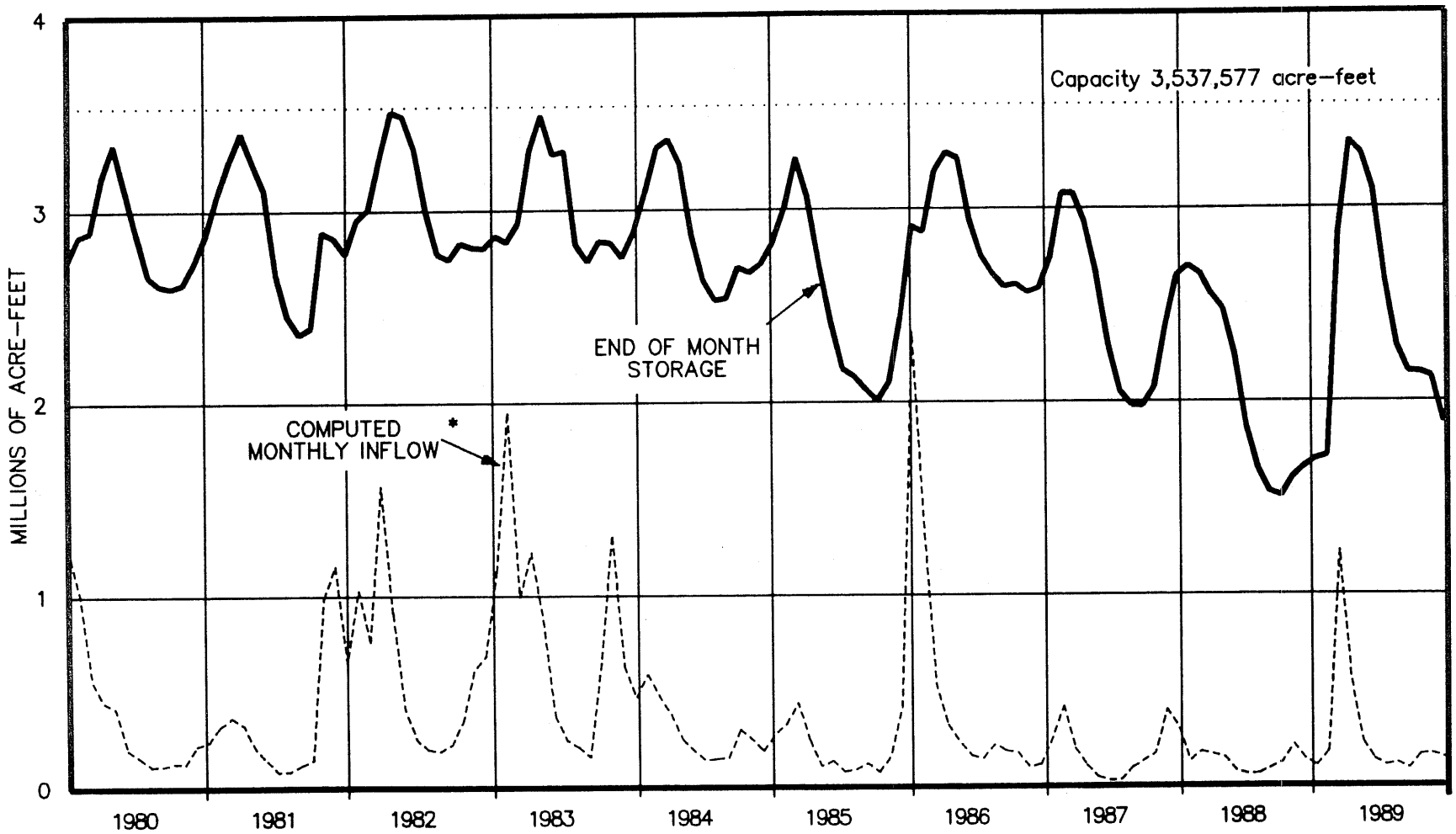
1989



1/ Total of Fish Barrier Dam, Fish Hatchery, and Thermalito Afterbay River Outlet releases.

2/ Total of Palermo Canal, Butte Co., Thermalito Irrigation District, Western Canal, Richvale Canal, P.G.& E. Lateral, and Sutter Butte diversions.

FIGURE O: LAKE OROVILLE OPERATION



* Excludes pumpback.

FIGURE P: OPERATION OF LAKE OROVILLE FOR FLOOD CONTROL
1988-89

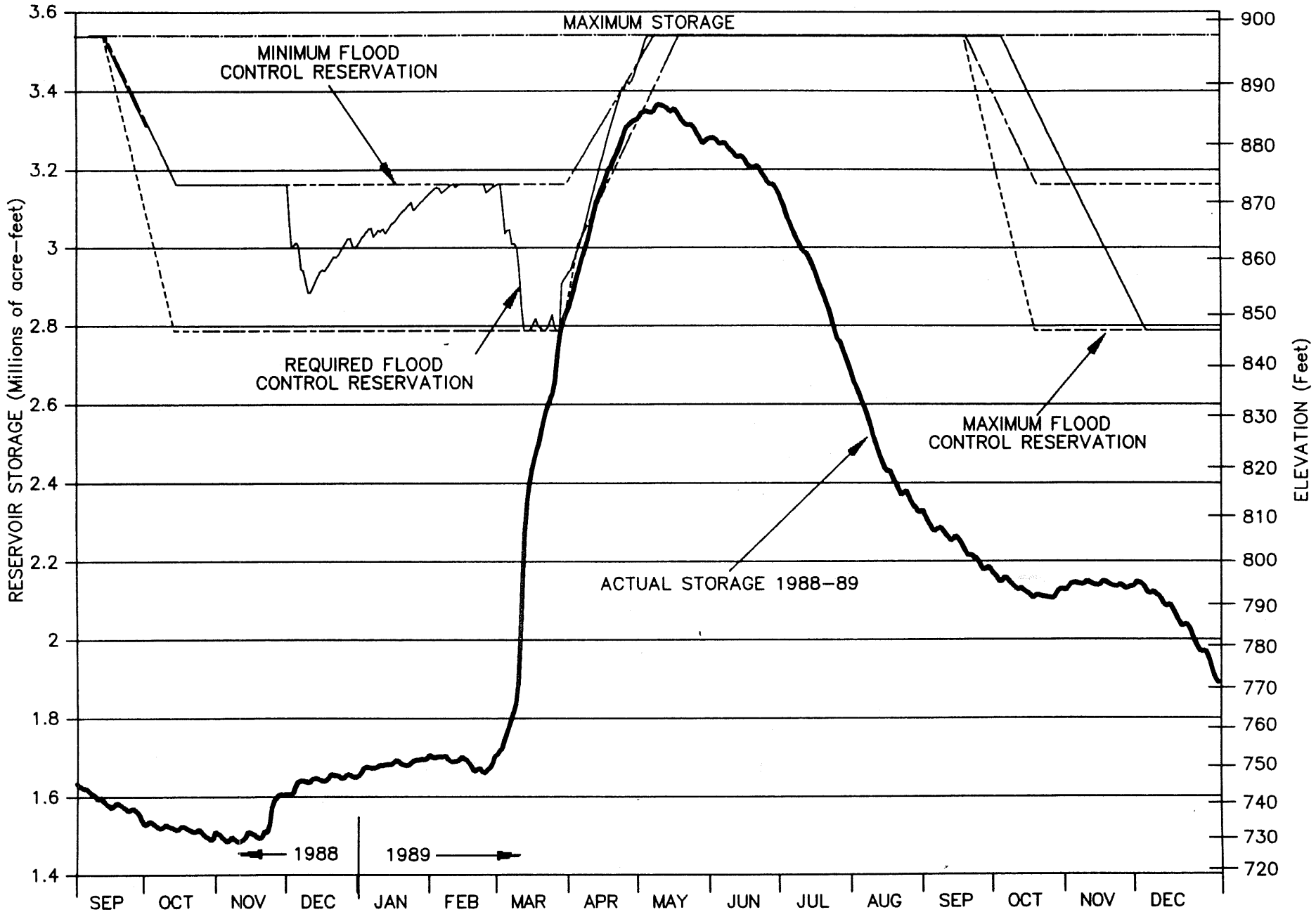
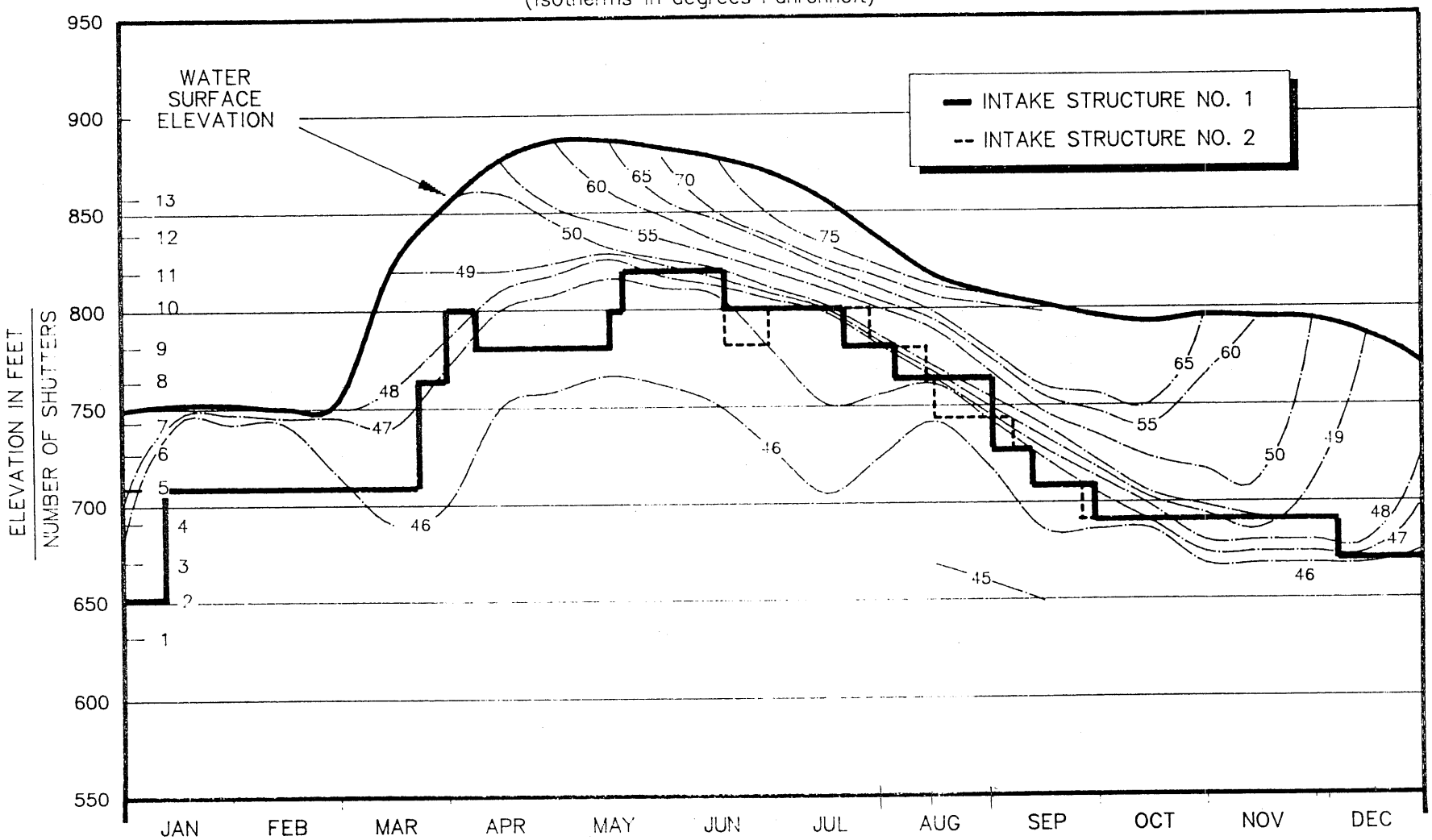


FIGURE Q: LAKE OROVILLE TEMPERATURES
1989
(isotherms in degrees Fahrenheit)



Note: Temperature data is obtained once per month, approximately every 25 to 30 days, and averaged for the rest of the year.

TABLE 9: OROVILLE-THERMALITO COMPLEX MONTHLY STORAGE

(elevations in feet, end of month storage in acre-feet)

MONTH	YEAR	THERMALITO DIVERSION DAM POOL		THERMALITO FOREBAY		THERMALITO AFTERBAY	
		ELEVATION	STORAGE*	ELEVATION	STORAGE*	ELEVATION	STORAGE*
JAN	1989	222.27	12,485	222.10	9,995	132.92	42,538
	1988	223.17	12,945	223.88	11,071	126.75	22,216
FEB	1989	223.59	12,901	223.52	10,850	133.01	42,880
	1988	223.11	12,749	223.00	10,534	131.20	36,256
MAR	1989	223.33	12,818	223.10	10,594	133.15	43,414
	1988	223.41	12,844	223.30	10,716	133.66	45,384
APR	1989	221.83	12,348	221.78	9,806	129.14	29,353
	1988	222.89	12,679	222.72	10,365	131.78	38,322
MAY	1989	223.48	12,866	223.60	10,899	128.35	26,889
	1988	223.62	12,910	223.46	10,813	129.58	30,770
JUN	1989	223.51	12,875	222.90	10,474	132.06	39,339
	1988	223.48	12,866	223.60	10,899	129.49	30,478
JUL	1989	223.59	12,901	223.66	10,935	129.25	29,705
	1988	222.64	12,601	222.60	10,293	131.04	35,685
AUG	1989	222.31	12,497	222.90	10,474	134.82	50,005
	1988	228.22	12,703	223.00	10,534	130.04	32,285
SEP	1989	222.67	12,610	222.72	10,365	133.78	45,854
	1988	223.22	12,783	222.96	10,510	133.43	44,491
OCT	1989	223.19	12,774	223.32	10,728	124.20	15,628
	1988	223.99	13,028	224.04	11,169	128.42	27,104
NOV	1989	223.37	12,831	223.52	10,850	132.55	41,148
	1988	223.30	12,809	223.08	10,582	132.85	42,274
DEC	1989	223.19	12,774	223.26	10,692	129.97	32,052
	1988	223.66	12,923	223.66	10,935	132.01	39,156

*At end of Month.

Delta Field Division

Water Storage

The Delta Field Division consists of the North Bay Aqueduct, the South Bay Aqueduct, and the California Aqueduct from Clifton Court Forebay to Check 8. Along these waterways, storage change data are maintained for Clifton Court Forebay, Bethany Reservoir, Travis Tank, Napa Terminal Tank, California Aqueduct, and Lake Del Valle. South Bay Aqueduct storage changes are assumed to be zero for operational purposes.

Lake Del Valle, as an off-stream storage facility, normally receives inflows from the South Bay Aqueduct in the spring. Releases back into the Aqueduct usually occur in the fall and are detailed in Table 10 below. Inflow and storage changes for the last ten years at Lake Del Valle are shown on Figure R on page 41.

Project water flows from the Delta into Clifton Court Forebay through the Clifton Court control gates. A schedule of daily gate operation is published in the SWP Monthly Report of Operations. Monthly inflows to Clifton Court Forebay along with corresponding storage changes are shown in Table 11 on page 42.

Water Deliveries

Totaled water conveyed in the Delta Field Division was 195,845 AF for 1989. Entitlement and Local Supply deliveries totaled 172,111 and 1,958 AF. Federal and Recreation deliveries totaled 473 and 152 AF. Under Vallejo's water right claim, 108 AF of non-SWP water was conveyed to the City of Vallejo's delivery structure. Napa County Flood Control and Water Conservation District took 3,958 AF of non-SWP YCWA water wheeled through the Aqueduct. DWR purchased 17,085 AF of YCWA water and delivered it to Santa Clara Valley Water District. These and other deliveries are summarized in Table 2 on page 12.

Pumping Plants

Delta Field Division pumping plants include Barker Slough Pumping Plant and Cordelia Pumping Plant on the North Bay Aqueduct, Banks on the California Aqueduct, and South Bay and Del Valle Pumping Plants on the South Bay Aqueduct. Monthly pumping data is summarized for the year in Table 1 on page 2.

There was 373,209 AF of Federal pumping at Banks in 1989. Below is a five year summary of Federal, State, and total pumping at Banks in AF:

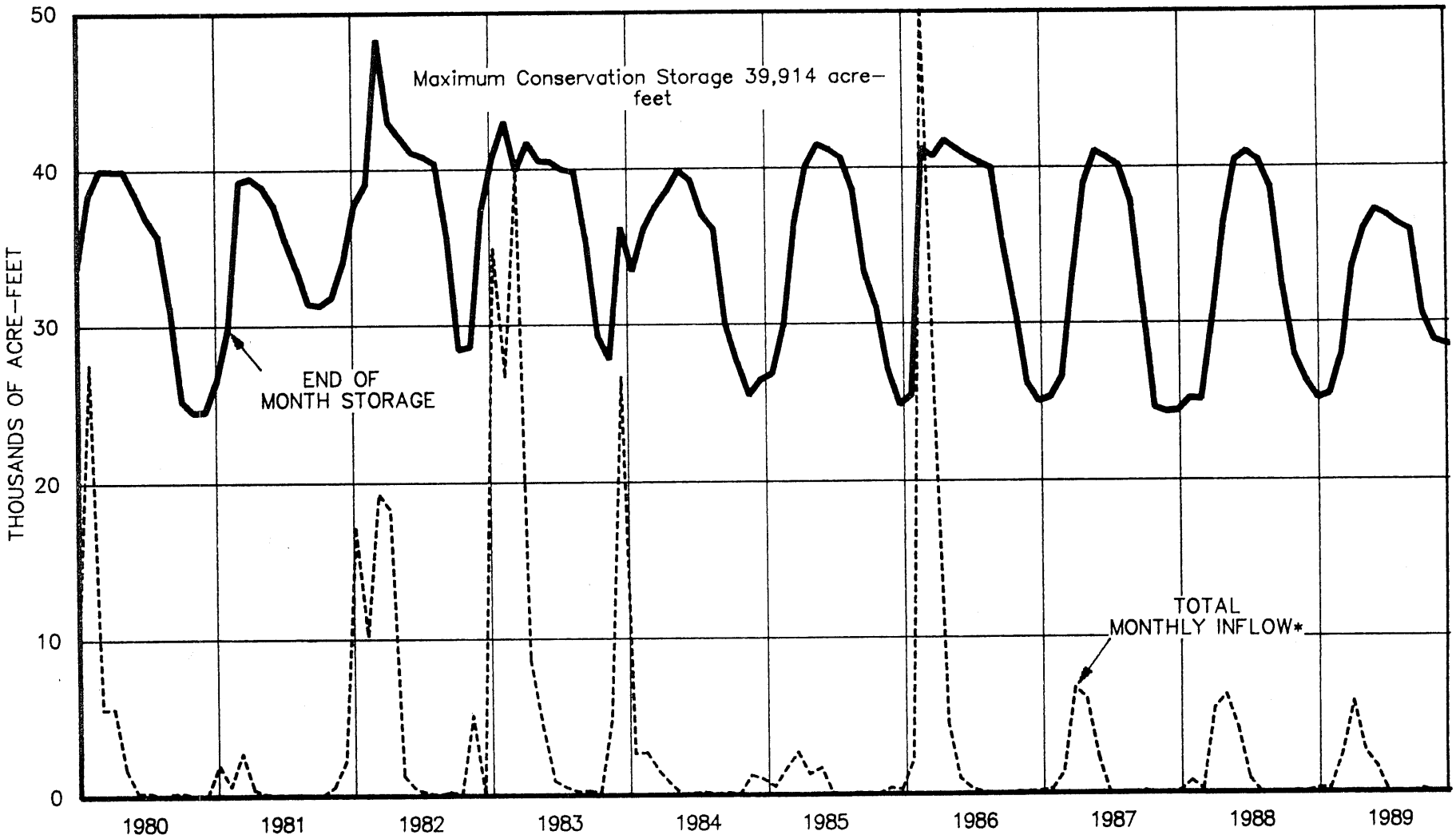
PUMPING AT HARVEY O. BANKS DELTA P.P.			
Year	Federal	State	Total
1989	373,209	3,409,326	3,782,535
1988	488,027	2,166,266	2,654,293
1987	337,069	1,857,714	2,194,783
1986	25,647	696,131	721,778
1985	432,606	2,412,898	2,845,504

TABLE 10: LAKE DEL VALLE MONTHLY OPERATION 1989

(In acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE	STORAGE CHANGE	INFLOW		OUTFLOW					PRECIP-ATATION (in inches)
				NATURAL	SOUTH BAY AQUEDUCT	SOUTH BAY AQUEDUCT	RECREATION	ARROYO VALLE	EVAP-ORATION	TOTAL	
JAN	679.37	25,462	272	318	0	0	3	0	43	46	1.39
FEB	684.02	27,924	2,462	339	2,174	0	5	0	46	51	1.36
MAR	693.67	33,653	5,729	984	4,841	0	7	0	89	96	3.17
APR	697.39	36,067	2,414	143	2,478	0	8	0	199	207	0.89
MAY	699.20	37,282	1,215	-23	1,698	159	15	0	286	460	0.11
JUN	698.63	36,897	-385	-4	0	0	20	0	361	381	0.12
JUL	697.80	36,340	-557	-61	0	14	21	0	461	496	0.00
AUG	697.19	35,934	-406	10	0	0	25	0	391	416	0.00
SEP	688.68	30,591	-5,343	207	0	5,127	19	129	275	5,550	1.08
OCT	685.66	28,841	-1,750	-34	0	1,502	13	0	201	1,716	1.60
NOV	685.18	28,570	-271	79	0	174	8	45	123	350	0.95
DEC	685.03	28,486	-84	-8	0	0	8	0	68	76	0.33
TOTAL			3,296	1,950	11,191	6,976	152	174	2543	9,845	11.00

FIGURE R: LAKE DEL VALLE OPERATION



* Natural and pumped inflows.

TABLE 11: CLIFTON COURT FOREBAY MONTHLY OPERATION

(elevation in feet, storage in acre-feet)

MONTH	YEAR	WATER SURFACE ELEVATION*	STORAGE*	STORAGE CHANGE	INFLOW
JAN	1989	-1.41	15,231	-22	361,187
	1988	-0.69	16,778	-301	382,824
FEB	1989	-1.10	15,897	666	220,368
	1988	-0.36	17,488	710	333,721
MAR	1989	-1.21	15,661	-236	370,378
	1988	-1.42	15,210	-2,278	260,315
APR	1989	-0.90	16,327	666	381,261
	1988	-1.61	14,802	-408	259,541
MAY	1989	-0.19	17,854	1,527	191,881
	1988	1.21	20,872	6,070	195,740
JUN	1989	0.57	19,491	1,637	128,131
	1988	-1.77	14,458	-6,414	165,733
JUL	1989	-0.11	18,026	-1,465	284,921
	1988	-2.07	13,815	-643	207,183
AUG	1989	-0.07	18,112	86	396,673
	1988	-1.22	15,639	1,824	253,500
SEP	1989	-0.73	16,692	-1,420	367,180
	1988	-1.29	15,489	-150	201,403
OCT	1989	0.63	19,621	2,929	378,057
	1988	-0.46	17,273	1,784	118,272
NOV	1989	0.38	19,082	-539	360,540
	1988	-0.80	16,542	-731	139,144
DEC	1989	-0.45	17,295	-1,787	380,235
	1988	-1.40	15,253	-1,289	176,522
TOTAL	1989	---	---	2,042	3,820,812
	1988	---	---	-1,826	2,693,898

*At end of month.

San Luis Field Division

Water Storage

San Luis Reservoir total storage reached it's maximum of the year, 1,548,016 AF on April 12. Maximum operating storage capacity is 2,027,835 AF. Drawdown to the minimum total storage for the year, 160,927 AF, occurred on August 24. The State's share of San Luis Reservoir storage reached the maximum of 824,005 AF on April 31, while the minimum of 106,720 AF was reached on August 20. Table 12 (below) and Figure S on page 44 show San Luis Reservoir operations during 1989. Table 13 on Page 45 shows the monthly operation of O'Neill Forebay during 1989.

Pumping and Generating Plants

Total pumping in 1989 at Willam R. Gianelli Pumping-Generating Plant was 2,045,447 AF. Total water released from San Luis Reservoir to O'Neill Forebay for generation was 1,455,905 AF. Total pumping at Dos Amigos Pumping plant in 1989 was 4,159,006 AF. Table 14 on page 46 summarizes joint-use plant activity on a monthly basis.

Water Deliveries

Water delivered in the San Luis Field Division during 1989 totaled 1,333,742 AF. This includes deliveries to Federal Contractors totaling 1,302,841 AF; 30,000 AF of independently purchased water from YCWA, conveyed by DWR through the California Aqueduct from Banks Pumping Plant to O'Neill Forebay for waterfowl enhancement; 603 AF of State and Federal deliveries to the DFG and the Department of Parks and Recreation (DPR) from the O'Neill Forebay area (Reach 3). Similar deliveries out of Reach 5 totaled 298 AF. The following tabulation details the components of these recreation deliveries:

O'Neill Forebay (Reach 3)			
	D.P.R.	D.F.G.	Total
State	64	267	331
Federal	53	219	272
Sub-total	117	486	603
Pools 16, 17, & 18 (Reach 5)			
	D.P.R.	D.F.G.	Total
State	0	162	162
Federal	4	132	136
Sub-total	4	294	298

TABLE 12: SAN LUIS RESERVOIR MONTHLY OPERATION 1989

(In acre-feet except as noted)

MONTH	RESERVOIR STORAGE			INFLOW	OUTFLOW			COMPUTED GAIN (+) LOSS (-)	EVAPORATION	PRECIPITATION (in inches)
	WATER SURFACE ELEVATION (in feet)	STORAGE	STORAGE CHANGE	GIANELLI P-G PLANT PUMPING	GIANELLI P-G PLANT GENERATION	PACHECO TUNNEL	SPILL			
JAN	470.35	1,180,796	326,743	350,688	0	11,508	0	-12,437	1,119	0.55
FEB	473.02	1,209,118	28,322	117,370	79,574	5,971	0	-3,503	1,656	1.15
MAR	498.59	1,491,534	282,416	300,618	2,662	5,368	0	-10,172	3,723	0.70
APR	501.94	1,529,993	38,459	124,846	65,694	15,805	0	-4,888	7,268	0.03
MAY	479.27	1,276,306	-253,687	0	230,789	19,540	0	-3,358	9,703	0.00
JUN	417.79	671,333	-604,973	0	595,475	17,775	0	8,277	10,507	0.00
JUL	364.10	268,174	-403,159	0	385,804	18,787	0	1,432	9,840	0.00
AUG	350.28	188,453	-79,721	30,643	95,613	12,580	0	-2,171	5,655	0.03
SEP	378.81	364,771	176,318	197,818	0	9,495	0	-12,005	4,007	1.47
OCT	410.15	605,895	241,124	270,605	0	6,249	0	-23,232	3,180	0.40
NOV	439.50	870,050	264,155	269,945	0	2,434	0	-3,356	1,682	0.39
DEC	474.81	1,228,224	358,174	382,914	294	13,821	0	-10,625	692	0.17
TOTAL			374,171	2,045,447	1,455,905	139,333	0	-76,038	59,032	4.89

FIGURE S: SAN LUIS RESERVOIR OPERATION

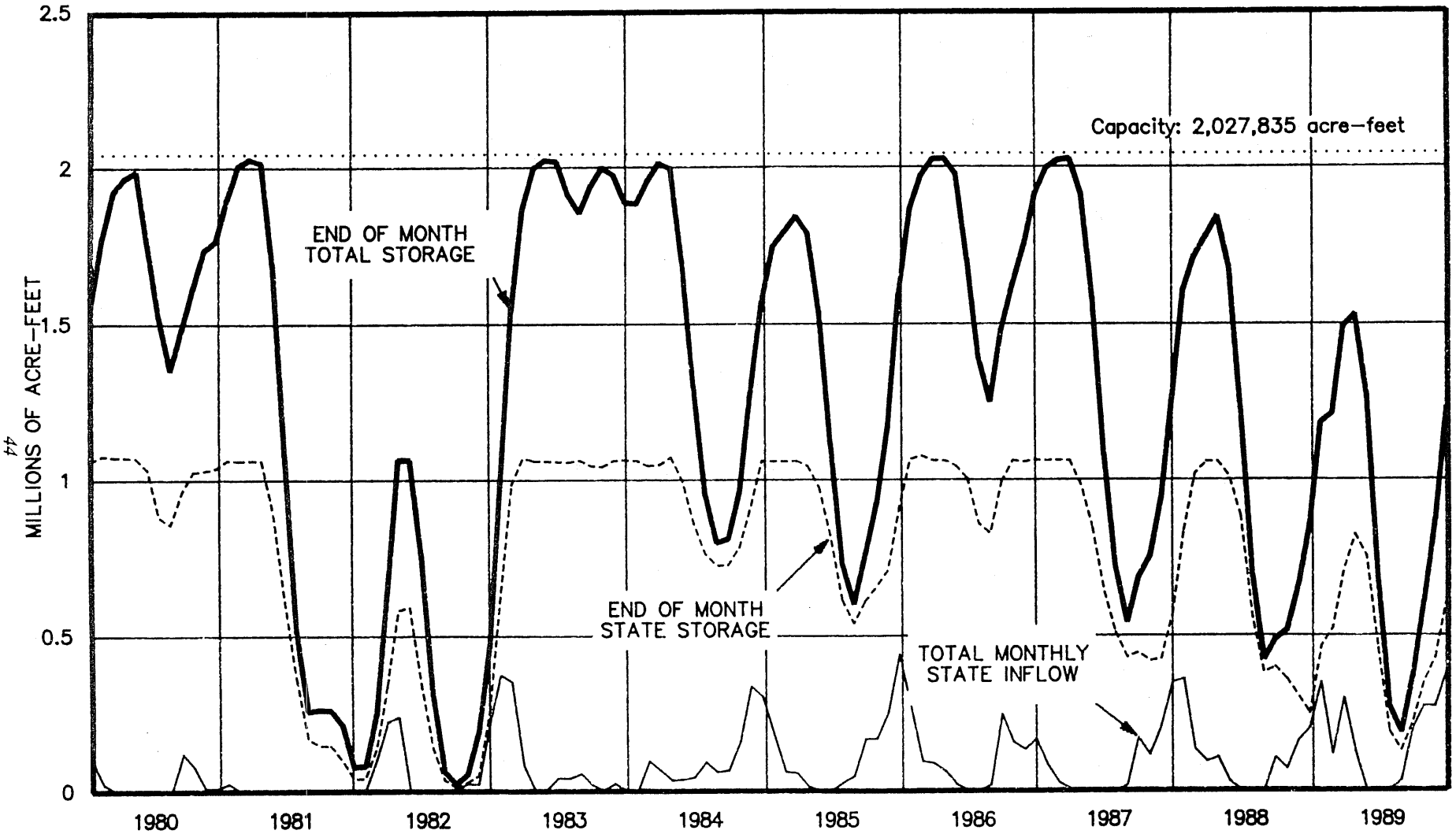


TABLE 13: O'NEILL FOREBAY MONTHLY OPERATION 1/

(in acre-feet except as noted)

MONTH	YEAR	RESERVOIR STORAGE 2/			INFLOW				OUTFLOW			COMPUTED GAIN (+) LOSS (-)
		WATER SURFACE ELEVATION (in feet)	STORAGE	MONTHLY STORAGE CHANGE	O'NEILL P-G PLANT PUMPING	GIANELLI P-G PLANT GENERATION	CALIFORNIA AQUEDUCT CHECK 12	O'NEILL P-G PLANT GENERATION	GIANELLI P-G PLANT PUMPING	DOS AMIGOS PUMPING	DELIVERIES 3/	
JAN	1989	218.53	39,398	-11,381	218,957	0	349,256	0	350,688	228,316	429	-161
	1988	220.20	43,671	-6,362	212,011	0	376,162	0	361,117	233,053	47	-318
FEB	1989	221.98	48,334	8,936	137,746	79,574	205,938	0	117,370	295,322	2,226	596
	1988	222.29	49,155	5,484	128,212	11,536	325,408	60	132,381	321,549	1,052	-4,630
MAR	1989	221.62	47,388	-946	157,534	2,662	350,457	0	300,618	212,216	1,040	2,275
	1988	220.64	44,818	-4,337	117,366	16,406	241,343	36	93,576	273,403	3,277	-9,160
APR	1989	221.17	46,206	-1,182	63,803	65,694	353,044	656	124,846	351,908	3,273	-3,040
	1988	222.93	50,859	6,041	112,710	36,654	238,702	0	107,108	268,728	2,550	-3,639
MAY	1989	220.11	43,437	-2,769	2,693	230,789	164,955	27,801	0	368,661	3,682	-1,062
	1988	221.14	46,128	-4,731	17,589	174,860	165,534	24,278	29,681	304,102	2,935	-1,718
JUN	1989	222.64	50,086	6,649	295	595,475	99,490	69,343	0	608,848	4,509	-5,911
	1988	221.52	47,125	997	0	449,181	148,823	67,918	0	520,107	4,892	-4,090
JUL	1989	220.75	45,106	-4,980	11,829	385,804	256,508	8,457	0	640,246	5,311	-5,107
	1988	223.07	51,233	4,108	1,423	533,540	181,331	31,698	0	663,134	6,409	-10,945
AUG	1989	220.29	43,905	-1,201	51,699	95,613	367,040	1,741	30,643	471,151	4,808	-7,210
	1988	221.29	46,521	-4,712	25,504	256,983	228,540	4,069	0	501,543	5,772	-4,355
SEP	1989	220.88	45,446	1,541	119,572	0	351,708	0	197,818	279,547	1,479	9,105
	1988	219.85	43,023	-3,498	107,007	27,241	185,500	0	106,984	211,076	2,796	-2,390
OCT	1989	219.20	41,093	-4,353	142,123	0	358,755	0	270,605	249,128	814	15,316
	1988	218.70	39,825	-3,198	88,557	30,332	100,513	0	70,197	159,358	731	7,686
NOV	1989	221.08	45,970	4,877	184,904	0	348,758	0	269,945	253,883	529	-4,428
	1988	221.69	47,572	7,747	180,855	7,758	123,678	0	162,060	146,063	736	4,315
DEC	1989	220.91	45,525	-445	212,825	294	365,748	0	382,914	199,780	661	4,043
	1988	222.90	50,779	3,207	229,849	0	162,444	0	202,371	182,491	189	-4,035
TOTAL	1989	---	---	-5,254	1,303,980	1,455,905	3,571,657	107,998	2,045,447	4,159,006	28,761	4,416
	1988	---	---	746	1,221,083	1,544,491	2,477,978	128,059	1,265,475	3,784,607	31,386	-33,279

1/ Includes canal from Check 13 to Dos Amigos Pumping Plant.

2/ At end of month.

3/ Includes 117 AF delivered to Parks and Recreation.

TABLE 14: MONTHLY OPERATIONS SUMMARY,STATE-FEDERAL SAN LUIS JOINT-USE FACILITIES
1989

(In acre-feet except as noted)

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
Check 12													
State	335,432	190,830	345,514	353,044	164,955	99,490	152,754	277,176	351,708	323,764	242,557	361,224	3,198,448
Federal	13,824	15,108	4,943	0	0	0	103,754	89,864	0	34,991	106,201	4,524	373,209
Total	349,256	205,938	350,457	353,044	164,955	99,490	256,508	367,040	351,708	358,755	348,758	365,748	3,571,657
O'Neill P-G Plant Amount Pumped													
State	0	0	0	0	0	0	0	0	0	0	0	0	0
Federal	218,957	137,746	157,534	63,803	2,693	295	11,829	51,699	119,572	142,123	184,904	212,825	1,303,980
Total	218,957	137,746	157,534	63,803	2,693	295	11,829	51,699	119,572	142,123	184,904	212,825	1,303,980
Released for Gen.													
Federal	0	0	0	656	27,801	69,343	8,457	1,741	0	0	0	0	107,998
O'Neill Forebay Storage*													
State	20,398	28,839	20,619	16,891	15,649	14,768	18,195	1,116	10,510	20,255	9,686	27,771	xxxxxx
Federal	19,000	19,495	26,769	29,315	27,788	35,318	26,911	42,789	34,936	20,838	36,284	17,754	xxxxxx
Total	39,398	48,334	47,388	46,206	43,437	50,086	45,106	43,905	45,446	41,093	45,970	45,525	xxxxxx
San Luis Reservoir Storage*													
State	463,761	520,637	708,418	824,034	754,217	455,476	188,069	129,521	215,786	348,045	426,651	616,001	xxxxxx
Federal	717,035	688,481	783,116	705,959	522,089	215,857	80,105	58,932	148,985	257,850	443,399	612,223	xxxxxx
Total	1,180,796	1,209,118	1,491,534	1,529,993	1,276,306	671,333	268,174	188,453	364,771	605,895	870,050	1,228,224	xxxxxx
Gianelli P-G Plant Amount Pumped													
State	222,611	80,025	193,353	117,771	0	0	0	21,618	92,868	145,037	80,452	195,488	1,149,223
Federal	128,077	37,345	107,265	7,075	0	0	0	9,025	104,950	125,568	189,493	187,426	896,224
Total	350,688	117,370	300,618	124,846	0	0	0	30,643	197,818	270,605	269,945	382,914	2,045,447
Released for Gen.													
State	0	31,222	-23	-533	179,970	325,293	268,195	79,972	0	0	0	294	884,390
Federal	0	48,352	2,685	66,227	50,819	270,182	117,609	15,641	0	0	0	0	571,515
Total	0	79,574	2,662	65,694	230,789	595,475	385,804	95,613	0	0	0	294	1,455,905
San Felipe Project													
Federal	11,508	5,971	5,368	15,805	19,540	17,775	18,787	12,580	9,495	6,249	2,434	13,821	139,333
Dos Amigos P.P. Amount Pumped													
State	120,984	124,370	156,256	231,223	237,077	363,296	380,552	301,966	246,623	217,532	207,196	168,526	2,755,601
Federal	107,332	170,952	55,960	120,685	131,584	245,552	259,694	169,185	32,924	31,596	46,687	31,254	1,403,405
Total	228,316	295,322	212,216	351,908	368,661	608,848	640,246	471,151	279,547	249,128	253,883	199,780	4,159,006

*At end of month.

San Joaquin Field Division

Water Deliveries

A total of 1,579,375 AF of deliveries were made in the San Joaquin field Division in 1989. There were six SWP water service contractors who took delivery of 1,406,719 AF. Water types include entitlement water, transfer entitlement, carryover entitlement, purchases, and transfer water. Kern County Water Agency (KCWA) represented 81 percent of the total SWP water delivered within the Division.

In addition to SWP deliveries, 172,656 AF of Federal water was wheeled through SWP facilities to KCWA's Cross Valley Canal to be delivered to Cross Valley Canal contractors. The table below itemizes Total Wheeling:

FEDERAL WHEELING	
Agency	Agency Total
Cawelo Water District	2,882
Fresno County	3,000
Green Valley Water District	857
Hills Valley Irrigation District	2,639
Kern-Tulare Water District	40,000
Kings County Water District	8,691
Lakeside I. W. D.	13,690
Lower Tule River	31,102
Pixley Irrigation District	43,102
Rag Gulch Water District	13,300
Tri-Valley Water District	885
Tulare County	5,308
USFWS	7,200
TOTAL FEDERAL WHEELING	172,656

Map 2 on page 11 and Table 2 on page 12 break down water deliveries by agency and water type with totals.

The San Joaquin Field Division is the only field division in the SWP with no water storage facilities. All deliveries are made from the aqueduct and are summarized in Appendix I, Table 20, pages 58 to 65.

Pumping Plants

Pumping plants in the San Joaquin Field Division include Las Perillas and Badger Hill on the Coastal Aqueduct, and Buena Vista, Wheeler Ridge, Ira J. Chrisman, and A.D. Edmonston on the California Aqueduct. A complete monthly summary of amounts pumped at all of these plants is shown on Table 1 on page 2. A summary of energy used to pump at each plant is shown on Table 4 on page 21.

Just over 2.9 million AF (2,753,271 AF State inflow and 172,656 AF Federal inflow) of project water flowed past Check 21 into San Joaquin Field Division during 1989. Approximately 1.3 million AF was pumped south by A.D. Edmonston.

Southern Field Division

Water Storage

There are five storage reservoirs in the Southern Field Division with a combined capacity of 717,251 AF. Combined storage at the beginning of the year was 628,362 AF. End of year combined storage was 571,136 AF. Complete monthly operation tables for all five reservoirs along with historical inflow and storage data for the last ten years is summarized on pages 48 through 56.

Water Deliveries

SWP deliveries in the Southern Field Division totaled 1,335,541 AF. Fourteen agencies received the water which was nearly all entitlement water. The only exceptions were 7,490 AF of recreation water to L.A. County Recreation Department and 10 AF sold to Lilico Pictures. Metropolitan Water District of Southern California received the largest single total delivery for 1989 from the SWP at 1,156,698 AF. In order to meet all deliveries, 35,000 AF of storage withdrawals were required.

Pumping and Generating Plants

Pumping plants in the Southern Field Division include Oso on the West Branch, and Pearblossom on the East Branch. Just over 1.3 million AF of SWP water was pumped into the Southern Field Division in 1989. A complete monthly summary of amounts pumped is shown on Table 1 on page 2. A summary of energy used to pump and station service energy at each plant is shown on Table 4 on page 21.

Generating plants include William E. Warne and Castaic (a pump-generating plant owned and operated within DWR water constraints by LADWP) on the West Branch, and Alamo and Devil Canyon on the East Branch. Energy available from each generating plant is summarized in Table 3 on page 17. Combined generation at all four plants totaled 1,708,247 MWh.

TABLE 15: PYRAMID LAKE MONTHLY OPERATION
1989

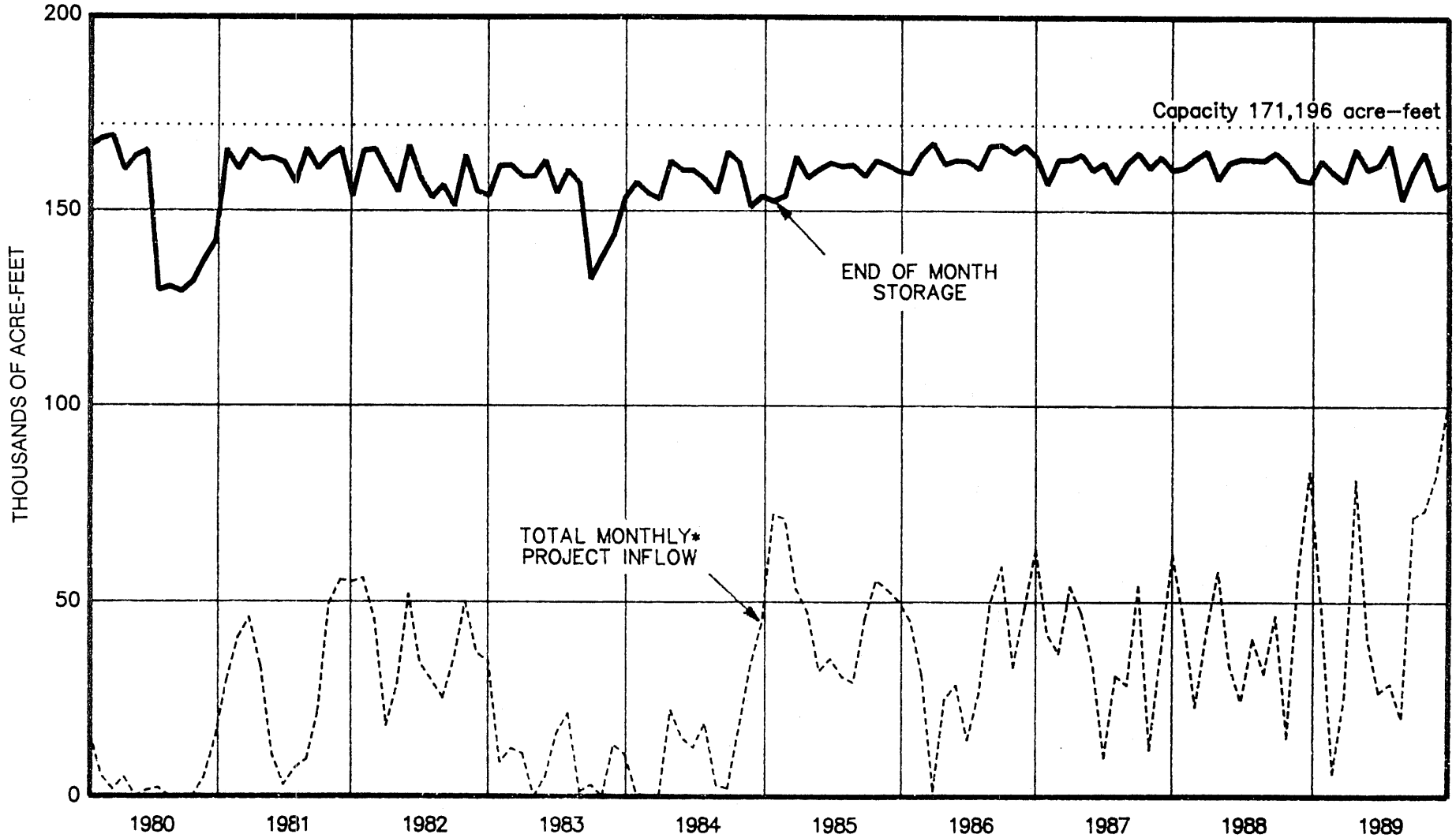
(in acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	TOTAL STORAGE	NATURAL INFLOW STORAGE SHARES	STORAGE CHANGE	INFLOW			OUTFLOW				COMPUTED LOSSES (-) GAINS (+)
						PROJECT			TO PIRU CREEK			
					NATURAL	WARNE POWER-PLANT	PUMPBACK 1/	ANGELES TUNNEL	NATURAL INFLOW RELEASE 2/	RECREATION DELIVERIES	PROJECT WATER FOR FISH ENHANCEMENT	
JAN	2,572.62	163,048	-59	5,418	606	48,310	77,557	119,737	905	0	0	-413
FEB	2,570.17	159,989	1,277	-3,059	2,359	5,887	30,302	39,773	1,023	0	0	-811
MAR	2,568.31	157,691	687	-2,298	1,621	25,257	35,625	61,921	2,211	0	0	-669
APR	2,574.74	165,973	625	8,282	565	81,242	46,789	115,462	627	0	0	-4,225
MAY	2,570.75	160,710	336	-5,263	365	40,839	3,232	46,865	654	8	0	-2,172
JUN	2,571.64	161,820	0	1,110	190	26,748	34,874	57,524	526	9	221	-2,422
JUL	2,575.69	166,936	0	5,116	96	29,130	59,981	80,917	96	9	743	-2,326
AUG	2,564.54	153,099	0	-13,837	100	19,860	16,228	47,709	100	8	691	-1,517
SEP	2,570.30	160,150	0	7,051	139	71,808	33,146	95,067	139	8	659	-2,169
OCT	2,574.27	165,130	0	4,980	271	73,396	3,802	69,964	271	6	435	-1,813
NOV	2,566.89	155,951	0	-9,179	331	82,111	12,432	99,806	331	3	121	-3,792
DEC	2,567.85	157,126	45	1,175	369	99,844	27,728	122,273	324	1	0	-4,168
TOTAL	- - -	- - -	- - -	-504	7,012	604,432	381,696	957,018	7,207	52	2,870	-26,497

1/ Pumpback by Los Angeles Department of Water and Power (LADWP) from Elderberry Forebay through Castaic powerplant.

2/ Portion of these amounts used to satisfy fishery enhancement agreement.

FIGURE T: PYRAMID LAKE OPERATION



* Excludes pumpback by LADWP through Castaic Powerplant.

TABLE 16: ELDERBERRY FOREBAY MONTHLY OPERATION
1989

(in acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	TOTAL STORAGE	STORAGE CHANGE	INFLOW		OUTFLOW		PUMPBACK TO PYRAMID LAKE 1/	COMPUTED LOSSES (-) GAINS (+)
				CASTAIC POWERPLANT GENERATION	NATURAL	TO CASTAIC LAKE			
						NATURAL	PROJECT		
JAN	1,516.76	22,216	-3,536	119,737	7	7	44,843	77,557	-873
FEB	1,529.42	27,715	5,499	39,773	58	58	4,154	30,302	182
MAR	1,513.33	22,314	-5,401	61,921	24	24	30,762	35,625	-935
APR	1,530.30	21,224	-1,090	115,462	1	1	67,719	46,789	-2,044
MAY	1,519.58	23,313	2,089	46,865	0	0	41,467	3,232	-77
JUN	1,511.56	22,548	-765	57,524	0	0	24,001	34,874	586
JUL	1,513.72	20,049	-2,499	80,917	0	0	24,069	59,981	634
AUG	1,509.44	26,014	5,965	47,709	0	0	25,367	16,228	-149
SEP	1,509.01	20,532	-5,482	95,067	0	0	62,869	33,146	-4,534
OCT	1,523.49	18,859	-1,673	69,964	0	0	67,995	3,802	160
NOV	1,522.24	25,377	6,518	99,806	0	0	81,604	12,432	748
DEC	1,523.08	27,602	2,225	122,273	0	0	92,617	27,728	297
TOTAL	- - -	- - -	1,850	957,018	90	90	567,467	381,696	-6,005

1/ Pumpback by Los Angeles Department of Water and Power (LADWP) through Castaic Power Plant.

TABLE 17: CASTAIC LAKE MONTHLY OPERATION
1989

(in acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	TOTAL STORAGE 1/	NATURAL INFLOW STORAGE SHARES	STORAGE CHANGE	INFLOW			OUTFLOW		COMPUTED LOSSES (-) GAINS (+)	CASTAIC LAGOON MONTHLY OPER. (RELEASE)
					NATURAL	FROM ELDERBERRY FOREBAY		DELIVERIES	RELEASED TO CASTAIC LAGOON		DISPOSITION OF NATURAL INFLOW
						NATURAL	PROJECT				
JAN	1,504.32	300,343	108	41,908	142	7	44,843	1,164	218	-1,702	121
FEB	1,505.49	302,851	296	2,508	256	58	4,154	963	565	-432	126
MAR	1,507.90	308,057	334	5,206	164	24	30,762	24,532	0	-1,212	150
APR	1,509.71	312,002	138	3,945	59	1	67,719	66,927	566	3,659	256
MAY	1,500.54	292,322	0	-19,680	25	0	41,467	61,525	265	618	163
JUN	1,481.18	253,180	0	-39,142	6	0	24,001	62,792	764	407	6
JUL	1,459.21	212,404	0	-40,776	0	0	24,069	64,767	301	223	0
AUG	1,433.60	169,610	0	-42,794	0	0	25,367	68,207	169	215	0
SEP	1,442.64	184,128	0	14,518	0	0	62,869	52,358	445	4,452	0
OCT	1,442.55	183,980	0	-148	0	0	67,995	67,313	0	-830	0
NOV	1,448.80	194,380	6	10,400	6	0	81,604	70,916	0	-294	0
DEC	1,461.66	216,770	20	22,390	14	0	92,617	70,508	0	267	0
TOTAL	- - -	- - -	- - -	-41,665	672	90	567,467	611,972	3,293	5,371	822

1/ At end of month.

FIGURE U: CASTAIC LAKE OPERATION

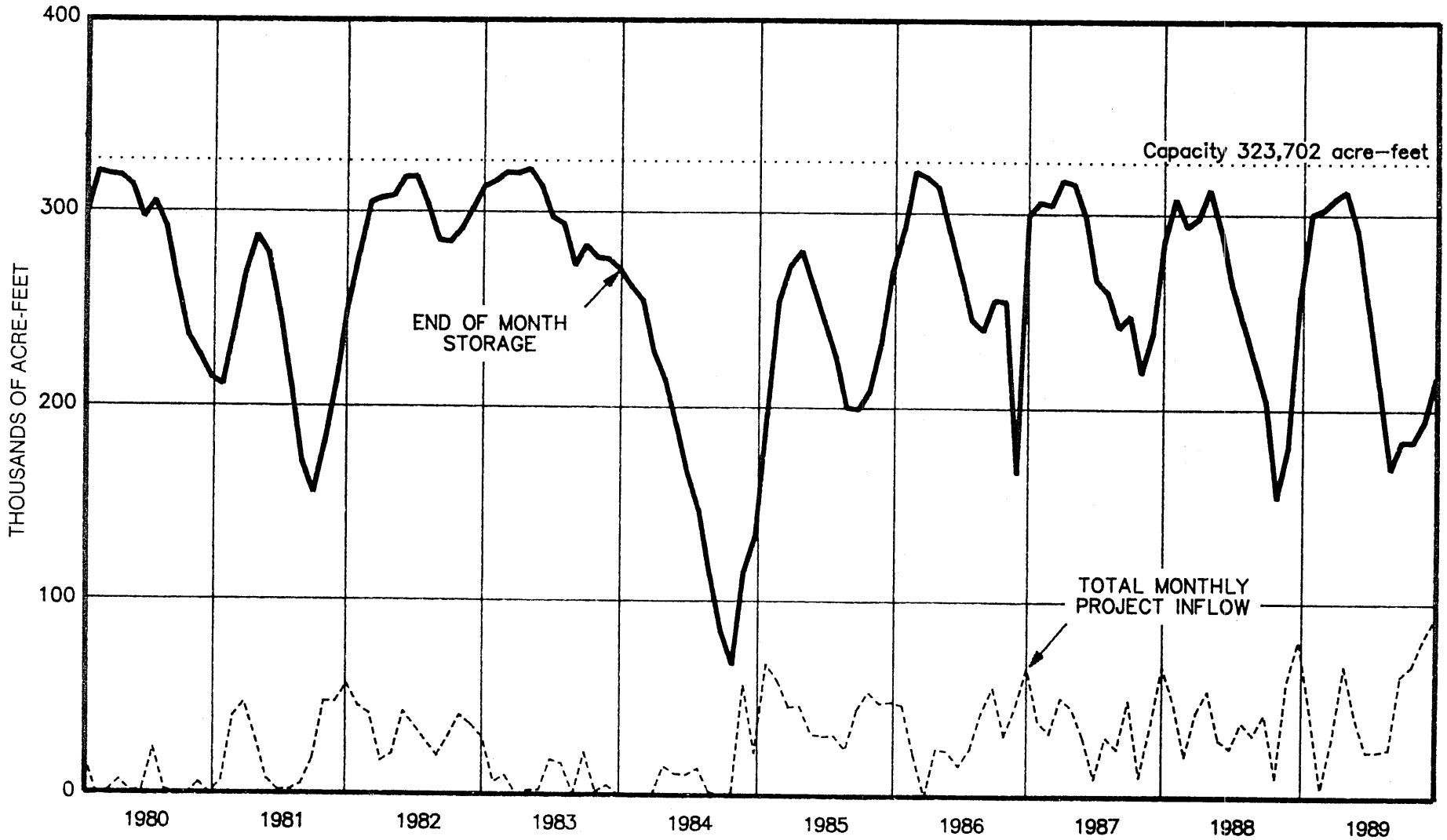


TABLE 18: SILVERWOOD LAKE MONTHLY OPERATION

1989

(in acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE	NATURAL INFLOW STORAGE SHARES	STORAGE CHANGE	INFLOW		OUTFLOW			COMPUTED LOSSES (-) GAINS (+)	NATURAL INFLOW EXCHANGED OR RELEASED 1/
					NATURAL	PROJECT	SAN BERNARDINO TUNNEL	AT TURNOUT (CLAWA)	NATURAL INFLOW TO MOJAVE RIVER		
JAN	3,352.10	72,168	538	438	641	21,000	21,174	188	11	170	747
FEB	3,346.46	66,887	1,058	-5,281	1,886	21,462	27,025	169	715	-720	1,366
MAR	3,341.48	62,402	1,144	-4,485	696	48,660	51,940	118	264	-1,519	610
APR	3,352.00	72,073	414	9,671	249	64,330	53,165	159	10	-1,574	979
MAY	3,351.40	71,501	227	-572	103	75,220	74,069	192	11	-1,623	301
JUN	3,349.44	69,650	231	-1,851	16	68,630	68,859	209	11	-1,418	12
JUL	3,344.94	65,500	212	-4,150	0	69,320	71,525	270	10	-1,665	20
AUG	3,338.04	59,400	203	-6,100	0	70,189	74,484	266	9	-1,530	9
SEP	3,340.60	61,688	194	2,288	0	74,020	69,793	244	9	-1,686	9
OCT	3,339.54	60,699	185	-989	0	78,170	76,188	163	9	-2,799	9
NOV	3,339.84	60,961	188	262	12	75,830	74,002	144	9	-1,425	9
DEC	3,334.50	56,391	193	-4,570	14	1,220	5,436	154	9	-205	9
TOTAL	- - -	- - -	- - -	-15,339	3,617	668,051	667,660	2,276	1,077	-15,994	4,080

1/ Total releases made from Mojave Siphon to Las Flores Ranch Co., in exchange for natural inflow stored in lake, and from Silverwood Lake to Mojave River from outlet for Mojave W.W. The difference between this total column and the natural inflow released to Mojave River equals the Las Flores Ranch.

FIGURE V: SILVERWOOD LAKE OPERATION

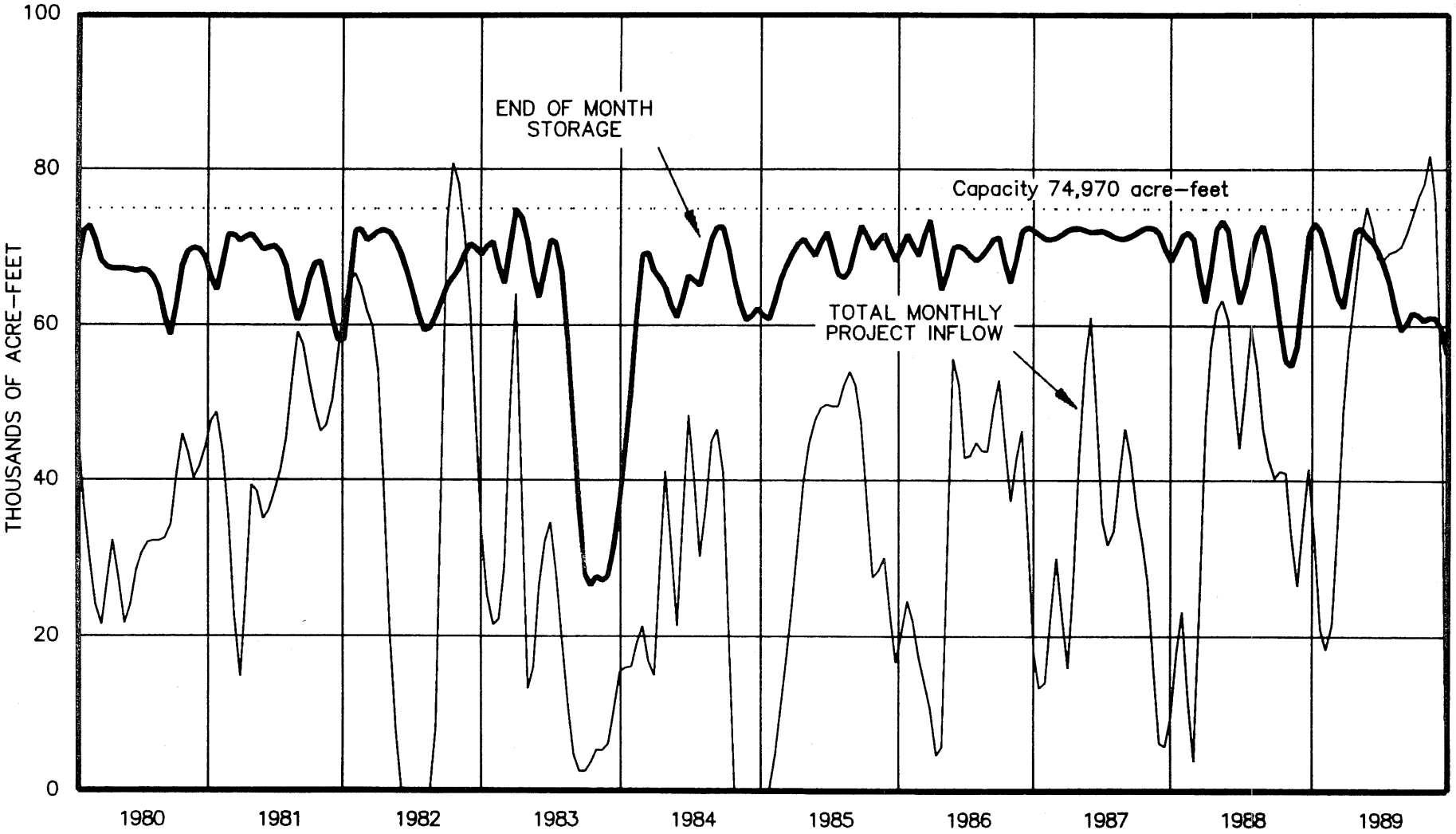


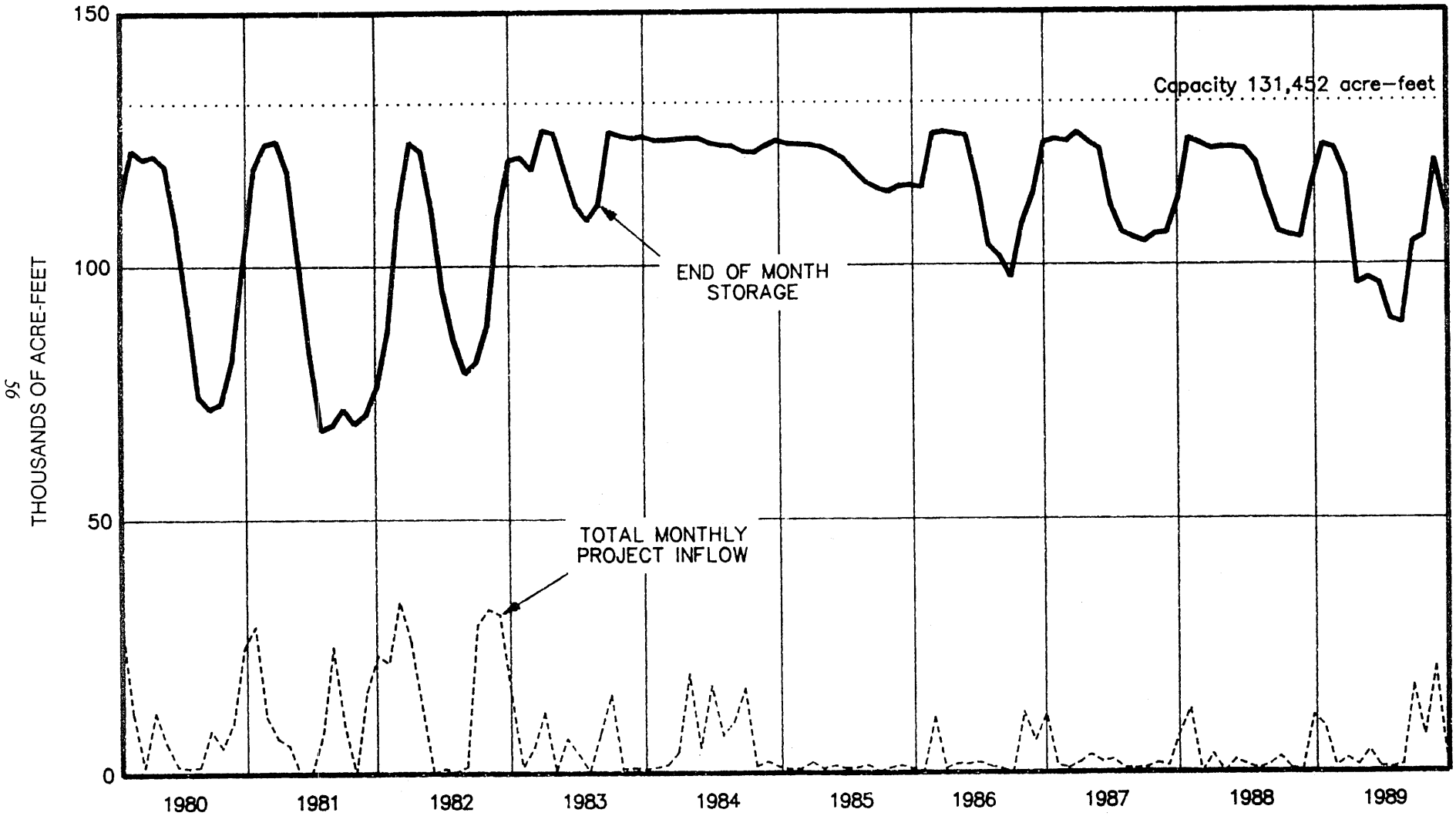
TABLE 19: LAKE PERRIS MONTHLY OPERATION
1989

(in acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	TOTAL STORAGE	STORAGE CHANGE	INFLOW	DELIVERIES	COMPUTED LOSSES (-) GAINS (+)
JAN	1,586.43	123,261	7,527	9,097	446	-1,124
FEB	1,586.09	122,491	-770	1,136	1,059	-847
MAR	1,583.74	117,220	-5,271	2,618	5,632	-2,257
APR	1,573.92	96,117	-21,103	947	21,220	-830
MAY	1,574.48	97,281	1,164	4,295	2,166	-965
JUN	1,573.93	96,138	-1,143	950	1,188	-905
JUL	1,570.58	89,279	-6,859	755	6,365	-1,249
AUG	1,570.15	88,412	-867	1,309	749	-1,427
SEP	1,577.75	104,172	15,760	17,115	361	-994
OCT	1,578.31	105,368	1,196	4,970	2,529	-1,245
NOV	1,585.08	120,215	14,847	20,803	3,972	-1,984
DEC	1,580.57	110,247	-9,968	1/ -3,598	7,076	706
TOTAL	---	---	-5,487	60,397	52,763	-13,121

1/ Pumback into Reach 28 H.

FIGURE W: LAKE PERRIS OPERATION



SUMMARY OF AQUEDUCT OPERATIONS

APPENDIX I

TABLE 20: SUMMARY OF GOVERNOR EDMUND
1989
(in acre-feet)

DESCRIPTION	JAN	FEB	MAR	APR	MAY	JUN
DELTA FIELD DIVISION						
		Note: North Bay Aqueduct, South Bay Aqueduct, and Lake Del Valle				
North Bay Aqueduct					they are shown here	
Pumped at Barker Slough Pumping Plant	1,871	1,456	1,392	1,663	2,873	3,288
Delivery (Travis Turnout)	5	3	3	0	0	0
Pumped at Cordelia Pumping Plant	1,613	1,386	1,390	1,587	2,788	3,183
Deliveries	1,756	1,388	1,394	1,580	2,784	3,188
Change in Storage, Napa Terminal Tank	-3	-2	-4	7	4	-5
Computed Losses (-), Gains (+)	-113	-67	1	-76	-85	-105
California Aqueduct						
Pumped at Harvey O. Banks Delta Pumping Plant	361,209	219,702	370,614	375,072	184,079	119,981
Pumped at South Bay Pumping Plant	8,704	11,536	17,037	17,164	17,391	16,902
Delivered to Contracting Agencies	11	391	323	810	733	1,101
Change in Storage	17	67	-155	1,453	-1,068	114
Outflow at Check 12	349,256	205,938	350,457	353,044	164,955	99,490
Computed Losses (-), Gains (+)	-3,221	-1,770	-2,952	-2,601	-2,068	-2,374
South Bay Aqueduct						
Pumped at South Bay Pumping Plant	8,704	11,536	17,037	17,164	17,391	16,902
Inflow from Lake Del Valle	0	0	0	0	159	0
Outflow (Pumped into Lake Del Valle)	0	2,174	4,841	2,478	1,698	0
Outflow, Deliveries	8,374	9,013	11,202	14,533	15,842	16,892
Outflow, Natural Inflow Exchanged	318	339	984	143	0	0
Computed Losses (-), Gains (+)	-12	-10	-10	-10	-10	-10
Lake Del Valle Operation:						
Natural inflow	318	339	984	143	-23	-4
Inflow from South Bay Aqueduct	0	2,174	4,841	2,478	1,698	0
Releases to South Bay Aqueduct	0	0	0	0	159	0
Delivered to EBRP District	3	5	7	8	15	20
End-of-Month Storage (State)	25,462	27,924	33,653	36,067	37,282	36,897
Change in Storage	272	2,462	5,729	2,414	1,215	-385
Evaporation Losses	-43	-46	-89	-199	-286	-361
SAN LUIS FIELD DIVISION						
O'Neill Forebay (Including Pool 13)						
End-of-Month Storage	39,398	48,334	47,388	46,206	43,437	50,086
Inflow, California Aqueduct	349,256	205,938	350,457	353,044	164,955	99,490
Inflow, O'Neill P.- G. Plant	218,957	137,746	157,534	63,803	2,693	295
Inflow, Gianelli P.- G. Plant	0	79,574	2,662	65,694	230,789	595,475
Delivered to Federal Customers	429	2,225	1,037	3,234	3,663	4,485
Delivered to Dept. of Fish and Game (State)	0	0	0	28	0	0
Delivered to Dept. of Parks and Rec. (Federal)	0	1	2	5	8	10
Delivered to Dept. of Parks and Rec. (State)	0	1	1	6	11	13
Outflow, O'Neill P.- G. Plant	0	0	0	656	27,801	69,343
Outflow, Gianelli P.- G. Plant	350,688	117,370	300,618	124,846	0	0
Outflow, Dos Amigos P.P.	228,316	295,322	212,216	351,908	368,661	608,848
Change in Storage	-11,381	8,936	-946	-1,182	-2,769	6,649
Computed Losses (-), Gains (+)	-161	597	2,275	-3,040	-1,062	-5,912
San Luis Reservoir Operation						
State End-of-Month Storage	463,761	520,637	708,418	824,034	754,217	455,476
Total End-of-Month Storage	1,180,796	1,209,118	1,491,534	1,529,993	1,276,306	671,333
Inflow, Gianelli P.- G. Plant	350,688	117,370	300,618	124,846	0	0
Outflow, Gianelli P.- G. Plant	0	79,574	2,662	65,694	230,789	595,475
Pacheco Tunnel Diversion	11,508	5,971	5,368	15,805	19,540	17,775
Change in Storage (Total)	326,743	28,322	282,416	38,459	-253,687	-604,973
Computed Losses (-), Gains (+)	-12,437	-3,503	-10,172	-4,888	-3,358	8,277

G. BROWN CALIFORNIA AQUEDUCT OPERATION
1989
(in acre-feet)

JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	DESCRIPTION
							DELTA FIELD DIVISION
are not within the Edmond G. Brown California Aqueduct, for completeness.							North Bay Aqueduct
4,429	4,034	2,981	1,441	1,473	1,374	28,275	Pumped at Barker Slough Pumping Plant
0	0	0	0	0	0	11	Delivery (Travis Turnout)
4,299	3,969	2,952	1,419	1,434	1,339	27,359	Pumped at Cordelia Pumping Plant
4,299	3,973	2,949	1,422	1,432	1,341	27,506	Deliveries
0	-1	3	-3	2	-2	-4	Change in Storage, Napa Terminal Tank
-130	-62	-29	-22	-39	-35	-762	Computed Losses (-), Gains (+)
							California Aqueduct
278,916	390,490	365,131	374,240	361,079	382,022	3,782,535	Pumped at Harvey O. Banks Delta Pumping Plant
17,375	17,072	10,247	11,023	9,222	11,802	165,475	Pumped at South Bay Pumping Plant
1,489	862	357	282	263	242	6,864	Delivered to Contracting Agencies
-66	1,077	-1,492	1,206	-934	-138	81	Change in Storage
256,508	367,040	351,708	358,755	348,758	365,748	3,571,657	Outflow at Check 12
-3,610	-4,439	-4,311	-2,974	-3,770	-4,368	-38,458	Computed Losses (-), Gains (+)
							South Bay Aqueduct
17,375	17,072	10,247	11,023	9,222	11,802	165,475	Pumped at South Bay Pumping Plant
14	0	5,256	1,502	219	0	7,150	Inflow from Lake Del Valle
0	0	0	0	0	0	11,191	Outflow (Pumped into Lake Del Valle)
17,379	17,062	15,364	12,515	9,386	11,792	159,354	Outflow, Deliveries
0	0	129	0	45	0	1,958	Outflow, Natural Inflow Exchanged
-10	-10	-10	-10	-10	-10	-122	Computed Losses (-), Gains (+)
							Lake Del Valle Operation:
-61	10	207	-34	79	-8	1,950	Natural inflow
0	0	0	0	0	0	11,191	Inflow from South Bay Aqueduct
14	0	5,256	1,502	219	0	7,150	Releases to South Bay Aqueduct
21	25	19	13	8	8	152	Delivered to EBRP District
36,340	35,934	30,591	28,841	28,570	28,486	- - -	End-of-Month Storage (State)
-557	-406	-5,343	-1,750	-271	-84	3,296	Change in Storage
-461	-391	-275	-201	-123	-68	-2,543	Evaporation Losses
							SAN LUIS FIELD DIVISION
							O'Neill Forebay (Including Pool 13)
45,106	43,905	45,446	41,093	45,970	45,525	- - -	End-of-Month Storage
256,508	367,040	351,708	358,755	348,758	365,748	3,571,657	Inflow, California Aqueduct
11,829	51,699	119,572	142,123	184,904	212,825	1,303,980	Inflow, O'Neill P.- G. Plant
385,804	95,613	0	0	0	294	1,455,905	Inflow, Gianelli P.- G. Plant
5,309	4,708	1,382	730	524	651	28,377	Delivered to Federal Customers
0	98	82	49	0	10	267	Delivered to Dept. of Fish and Game (State)
1	1	6	17	2	0	53	Delivered to Dept. of Parks and Rec. (Federal)
1	1	8	20	2	0	64	Delivered to Dept. of Parks and Rec. (State)
8,457	1,741	0	0	0	0	107,998	Outflow, O'Neill P.- G. Plant
0	30,643	197,818	270,605	269,945	382,914	2,045,447	Outflow, Gianelli P.- G. Plant
640,246	471,151	279,547	249,128	253,883	199,780	4,159,006	Outflow, Dos Amigos P.P.
-4,980	-1,201	1,541	-4,353	4,877	-445	-5,254	Change in Storage
-5,107	-7,210	9,104	15,318	-4,429	4,043	4,416	Computed Losses (-), Gains (+)
							San Luis Reservoir Operation
188,069	129,354	215,786	347,319	426,481	615,825	- - -	State End-of-Month Storage
268,174	188,453	364,771	605,895	870,050	1,228,224	- - -	Total End-of-Month Storage
0	30,643	197,818	270,605	269,945	382,914	2,045,447	Inflow, Gianelli P.- G. Plant
385,804	95,613	0	0	0	294	1,455,905	Outflow, Gianelli P.- G. Plant
18,787	12,580	9,495	6,249	2,434	13,821	139,333	Pacheco Tunnel Diversion
-403,159	-79,721	176,318	241,124	264,155	358,174	374,171	Change in Storage (Total)
1,432	-2,171	-12,005	-23,232	-3,356	-10,625	-76,038	Computed Losses (-), Gains (+)

TABLE 20: SUMMARY OF GOVERNOR EDMUND
1989
(in acre-feet)

DESCRIPTION	JAN	FEB	MAR	APR	MAY	JUN
SAN LUIS FIELD DIVISION (Cont.)						
California Aqueduct (Pools 14 thru 21)						
Inflow, Dos Amigos P.P.(State)	120,984	124,370	156,256	231,223	237,077	363,296
Inflow, Dos Amigos P.P.(Federal)	107,332	170,952	55,960	120,685	131,584	245,552
Total Inflow, Dos Amigos P.P.	228,316	295,322	212,216	351,908	368,661	608,848
Non-Project Flow into Aqueduct	3,713	322	999	0	0	0
Delivered to Dept. of Fish and Game (State)	14	25	6	17	16	17
Delivered to Federal Customers	114,564	167,040	45,325	99,762	125,679	228,071
Outflow, Check 21 (State)	112,373	127,690	163,666	239,994	237,716	370,658
Outflow, Check 21 (Federal)	4,819	8,220	7,347	18,409	12,174	15,826
Change in Storage	135	567	-748	549	-747	-243
Operational Losses (-), Gains (+)	-124	7,898	2,381	6,823	6,177	5,481
Evaporation Losses	-186	-260	-545	-1,031	-1,432	-1,751
Computed Losses (-), Gains (+)	62	8,158	2,926	7,854	7,609	7,232
SAN JOAQUIN FIELD DIVISION						
California Aqueduct, Check 21 to Buena Vista Pumping Plant						
Inflow, Check 21 (state)	112,373	127,690	163,666	239,994	237,716	370,658
Inflow, Check 21 (Federal)	4,819	8,220	7,347	18,409	12,174	15,826
Inflow, Kern River Intertie (State)	0	0	0	0	0	0
Delivered to Contracting State Agencies	29,135	76,205	57,260	55,425	74,852	197,993
Delivered to Federal Customers	4,819	8,162	7,347	18,409	12,174	15,826
Delivered for Repayment of Pre-consolidation Water	0	0	0	0	0	0
Outflow, Buena Vista P.P.	76,209	42,079	93,771	166,181	141,099	138,540
Coastal Br. Diversion	2,167	4,666	8,061	10,227	15,879	22,178
Change in Storage	-278	-16	-130	519	-724	48
Computed Losses (-), Gains (+)	-5,140	-4,814	-4,704	-7,642	-6,610	-11,899
California Aqueduct, Buena Vista P.P. to Wheeler Ridge P.P.						
Inflow, Buena Vista P.P.	76,209	42,079	93,771	166,181	141,099	138,540
Delivered to Contracting State Agencies	3,360	10,961	14,333	10,982	13,884	27,176
Outflow, Wheeler Ridge P.P.	74,021	31,494	80,089	156,898	128,774	112,623
Change in Storage	69	-167	25	150	-117	81
Computed Losses (-), Gains (+)	1,241	209	676	1,849	1,442	1,340
California Aqueduct, Wheeler Ridge to Ira J. Chrisman Wind Gap P.P.						
Inflow, Wheeler Ridge P.P.	74,021	31,494	80,089	156,898	128,774	112,623
Delivered to Contracting State Agencies	341	1,825	4,176	4,768	4,884	6,130
Outflow, Ira J. Chrisman Wind Gap P.P.	73,040	28,906	75,807	151,847	122,607	105,615
Change in Storage	-22	22	-49	-21	15	32
Computed Losses (-), Gains (+)	-662	-741	-155	-304	-1,268	-846
California Aqueduct, Ira J. Chrisman Wind Gap P.P. to A.D. Edmunston P.P.						
Inflow, Ira J. Chrisman Wind Gap P.P.	73,040	28,906	75,807	151,847	122,607	105,615
Delivered to Contracting State Agencies	164	140	586	828	1,904	2,026
Outflow, A.D. Edmunston P.P.	72,391	29,061	74,775	149,099	119,673	102,960
Change in Storage	42	7	-65	-76	48	16
Computed Losses (-), Gains (+)	-443	302	-511	-1,996	-982	-613
Coastal Branch, California Aqueduct						
Inflow, Las Perillas P.P.	2,167	4,666	8,061	10,227	15,879	22,178
Delivered to Contracting State Agencies	1,890	4,349	7,493	9,626	15,187	19,112
Delivered to Federal Customers	0	58	0	0	0	0
Change in Storage	-5	-11	15	9	-20	10
Computed Losses (-), Gains (+)	-282	-270	-553	-592	-712	-3,056

G. BROWN CALIFORNIA AQUEDUCT OPERATION
1989
(in acre-feet)

JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	DESCRIPTION
							SAN LUIS FIELD DIVISION (Cont.)
							California Aqueduct (Pools 14 thru 21)
380,552	301,966	246,623	217,532	207,196	168,526	2,755,601	Inflow, Dos Amigos P.P.(State)
259,694	169,185	32,924	31,596	46,687	31,254	1,403,405	Inflow, Dos Amigos P.P.(Federal)
640,246	471,151	279,547	249,128	253,883	199,780	4,159,006	Total Inflow, Dos Amigos P.P.
0	0	0	0	0	0	5,034	Non-Project Flow into Aqueduct
19	24	17	6	1	0	162	Delivered to Dept. of Fish and Game (State)
241,154	147,406	29,174	20,427	33,400	52,817	1,304,819	Delivered to Federal Customers
395,890	311,419	235,951	202,151	209,904	145,859	2,753,271	Outflow, Check 21 (State)
13,448	25,938	19,866	29,971	12,777	3,861	172,656	Outflow, Check 21 (Federal)
1,130	-562	-137	-912	1,430	-2,840	-2,378	Change in Storage
11,395	13,074	5,324	2,515	3,629	-83	64,490	Operational Losses (-), Gains (+)
-2,174	-1,726	-1,097	-688	-303	-117	-11,310	Evaporation Losses
13,569	14,800	6,421	3,203	3,932	34	75,800	
							SAN JOAQUIN FIELD DIVISION
							California Aqueduct, Check 21 to Buena Vista Pumping Plant
395,890	311,419	235,951	202,151	209,904	145,859	2,753,271	Inflow, Check 21 (state)
13,448	25,938	19,866	29,971	12,777	3,861	172,656	Inflow, Check 21 (Federal)
0	0	0	0	0	0	0	Inflow, Kern River Intertie (State)
215,718	160,137	58,915	33,070	45,857	33,267	1,037,834	Delivered to Contracting State Agencies
13,226	25,468	19,799	22,469	11,672	3,828	163,199	Delivered to Federal Customers
0	0	0	0	0	0	0	Delivered for Repayment of Pre-consolidation Water
146,692	125,595	158,336	160,811	155,997	103,583	1,508,893	Outflow, Buena Vista P.P.
25,344	18,025	9,188	7,527	1,630	4,220	129,112	Coastal Br. Diversion
-51	526	485	-523	-366	477	-33	Change in Storage
-8,409	-7,606	-9,094	-8,768	-7,891	-4,345	-86,922	Computed Losses (-), Gains (+)
							California Aqueduct, Buena Vista P.P. to Wheeler Ridge P.P.
146,692	125,595	158,336	160,811	155,997	103,583	1,508,893	Inflow, Buena Vista P.P.
31,281	24,850	5,678	3,139	2,210	2,172	150,026	Delivered to Contracting State Agencies
117,811	103,274	155,388	159,689	156,121	102,179	1,378,361	Outflow, Wheeler Ridge P.P.
61	-27	126	-166	-20	172	187	Change in Storage
2,461	2,502	2,856	1,851	2,314	940	19,681	Computed Losses (-), Gains (+)
							California Aqueduct, Wheeler Ridge to Ira J. Chrisman Wind Gap P.P.
117,811	103,274	155,388	159,689	156,121	102,179	1,378,361	Inflow, Wheeler Ridge P.P.
7,056	4,414	2,564	3,410	1,525	2,148	43,241	Delivered to Contracting State Agencies
109,688	97,984	151,363	155,876	154,686	100,920	1,328,339	Outflow, Ira J. Chrisman Wind Gap P.P.
-13	25	-28	14	14	-46	-57	Change in Storage
-1,080	-851	-1,489	-389	104	843	-6,838	Computed Losses (-), Gains (+)
							California Aqueduct, Ira J. Chrisman Wind Gap P.P. to A.D. Edmunston P.P.
109,688	97,984	151,363	155,876	154,686	100,920	1,328,339	Inflow, Ira J. Chrisman Wind Gap P.P.
2,220	1,670	728	734	101	216	11,317	Delivered to Contracting State Agencies
106,637	96,411	149,874	154,323	152,694	99,087	1,306,985	Outflow, A.D. Edmunston P.P.
26	-41	115	-46	-99	138	65	Change in Storage
-805	56	-646	-865	-1,990	-1,479	-9,972	Computed Losses (-), Gains (+)
							Coastal Branch, California Aqueduct
25,344	18,025	9,188	7,527	1,630	4,220	129,112	Inflow, Las Perillas P.P.
22,303	16,439	8,406	7,367	1,256	3,373	116,801	Delivered to Contracting State Agencies
222	470	67	0	7	33	857	Delivered to Federal Customers
16	-21	9	-48	32	-3	-17	Change in Storage
-2,803	-1,137	-706	-208	-335	-817	-11,471	Computed Losses (-), Gains (+)

TABLE 20: SUMMARY OF GOVERNOR EDMUND
1989
(in acre-feet)

DESCRIPTION	JAN	FEB	MAR	APR	MAY	JUN
SOUTHERN FIELD DIVISION						
California Aqueduct, A.D. Edmonston P.P. to Junction of East & West Branch						
Inflow, A.D. Edmonston P.P.	72,391	29,061	74,775	149,099	119,673	102,960
Outflow, West Branch	48,962	7,017	24,034	81,684	39,695	27,111
Outflow, East Branch	23,432	22,043	50,769	67,479	80,015	75,867
Change in Storage	-2	1	-5	-2	8	-7
Computed Losses (-), Gains (+)	1	0	23	62	45	11
East Branch California Aqueduct, Junction of East & West Branch to Pearblossom P.P.						
Inflow (Aqueduct)	23,432	22,043	50,769	67,479	80,015	75,867
Delivered to Contracting Agencies	1,370	1,089	2,832	4,667	6,011	8,226
Outflow, Pearblossom P.P.	22,037	21,561	50,314	67,223	77,189	68,189
Change in Storage	80	-586	-669	206	129	283
Computed Losses (-), Gains (+)	55	21	1,708	4,617	3,314	831
East Branch California Aqueduct, Pearblossom P.P. to Silverwood Lake						
Inflow, Pearblossom P.P.	22,037	21,561	50,314	67,223	77,189	68,189
Deliveries (Exchange of Natural Inflow)	0	0	0	0	0	0
Exchange of Natural Inflow (Los Flores T.O.)	736	651	346	969	290	1
Outflow to Silverwood Lake	21,000	21,462	48,660	64,330	75,220	68,630
Change in Storage	33	-101	249	0	-79	36
Computed Losses (-), Gains (+)	-268	451	-1,059	-1,924	-1,758	478
Silverwood Lake Operation						
Inflow, Project	21,000	21,462	48,660	64,330	75,220	68,630
Inflow, Natural	641	1,886	696	249	103	16
Delivered to Contracting Agencies	188	169	118	159	192	209
Outflow, Natural Inflow Released	11	715	264	10	11	11
Outflow, Project Water at San Bernardino Tunnel	21,174	27,025	51,940	53,165	74,069	68,859
Change in storage	438	-5,281	-4,485	9,671	-572	-1,851
Computed Losses (-), Gains (+)	170	-720	-1,519	-1,574	-1,623	-1,418
East Branch California Aqueduct, Silverwood Lake to Lake Perris						
Inflow, San Bernardino Tunnel	21,174	27,025	51,940	53,165	74,069	68,859
Inflow, Pump-in	0	0	0	0	0	0
Delivered to Contracting Agencies	12,102	25,858	49,320	52,216	69,770	67,925
Outflow to Lake Perris	9,097	1,136	2,618	947	4,295	950
Change in Storage	-26	30	0	0	2	-19
Operational Losses (-), Gains (+)	-1	-1	-2	-2	-2	-3
Lake Perris Operation						
Inflow	9,097	1,136	2,618	947	4,295	950
Delivered to Contracting Agencies	446	1,059	5,632	21,220	2,166	1,188
Outflow, Pump-back	0	0	0	0	0	0
Outflow	0	0	0	0	0	0
Change in Storage	7,527	-770	-5,271	-21,103	1,164	-1,143
Computed Losses (-), Gains (+)	-1,124	-847	-2,257	-830	-965	-905

G. BROWN CALIFORNIA AQUEDUCT OPERATION (Continued)
1989
(in acre-feet)

JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	DESCRIPTION
							SOUTHERN FIELD DIVISION
							California Aqueduct, A.D. Edmonston P.P. to Junction of East & West Branch
106,637	96,411	149,874	154,323	152,694	99,087	1,306,985	Inflow, A.D. Edmonston P.P.
30,148	18,155	72,407	74,835	81,514	99,653	605,215	Outflow, West Branch
76,504	78,261	77,519	79,512	71,233	-534	702,100	Outflow, East Branch
5	0	-8	12	2	-9	-5	Change in Storage
20	5	44	36	55	23	325	Computed Losses (-), Gains (+)
							East Branch California Aqueduct, Junction of East & West Branch to Pearblossom P.P.
76,504	78,261	77,519	79,512	71,233	-534	702,100	Inflow (Aqueduct)
9,195	7,975	5,744	4,026	2,668	1,368	55,171	Delivered to Contracting Agencies
68,586	70,191	74,875	77,872	75,475	231	673,743	Outflow, Pearblossom P.P.
172	461	126	269	-2,822	-459	-2,810	Change in Storage
1,449	366	3,226	2,655	4,088	1,674	24,004	Computed Losses (-), Gains (+)
							East Branch California Aqueduct, Pearblossom P.P. to Silverwood Lake
68,586	70,191	74,875	77,872	75,475	231	673,743	Inflow, Pearblossom P.P.
0	123	171	4	1	0	299	Deliveries (Exchange of Natural Inflow)
10	0	0	0	0	0	3,003	Exchange of Natural Inflow (Los Flores T.O.)
69,320	70,189	74,020	78,170	75,830	1,220	668,051	Outflow to Silverwood Lake
100	-86	5	71	-1,237	-803	-1,812	Change in Storage
844	35	-679	373	-881	186	-4,202	Computed Losses (-), Gains (+)
							Silverwood Lake Operation
69,320	70,189	74,020	78,170	75,830	1,220	668,051	Inflow, Project
0	0	0	0	12	14	3,617	Inflow, Natural
270	266	244	163	144	154	2,276	Delivered to Contracting Agencies
10	9	9	9	9	9	1,077	Outflow, Natural Inflow Released
71,525	74,484	69,793	76,188	74,002	5,436	667,660	Outflow, Project Water at San Bernardino Tunnel
-4,150	-6,100	2,288	-989	262	-4,570	-15,339	Change in storage
-1,665	-1,530	-1,686	-2,799	-1,425	-205	-15,994	Computed Losses (-), Gains (+)
							East Branch California Aqueduct, Silverwood Lake to Lake Perris
71,525	74,484	69,793	76,188	74,002	5,436	667,660	Inflow, San Bernardino Tunnel
0	0	0	0	0	3,598	3,598	Inflow, Pump-in
70,753	73,165	52,674	71,215	53,204	9,066	607,268	Delivered to Contracting Agencies
755	1,309	17,115	4,970	20,803	0	63,995	Outflow to Lake Perris
14	7	1	1	-7	-33	-30	Change in Storage
-3	-3	-3	-2	-2	-1	-25	Operational Losses (-), Gains (+)
							Lake Perris Operation
755	1,309	17,115	4,970	20,803	0	63,995	Inflow
6,365	749	361	2,529	3,972	7,076	52,763	Delivered to Contracting Agencies
0	0	0	0	0	3,598	3,598	Outflow, Pump-back
0	0	0	0	0	0	0	Outflow
-6,859	-867	15,760	1,196	14,847	-9,968	-5,487	Change in Storage
-1,249	-1,427	-994	-1,245	-1,984	706	-13,121	Computed Losses (-), Gains (+)

TABLE 20: SUMMARY OF GOVERNOR EDMUND
1989
(in acre-feet)

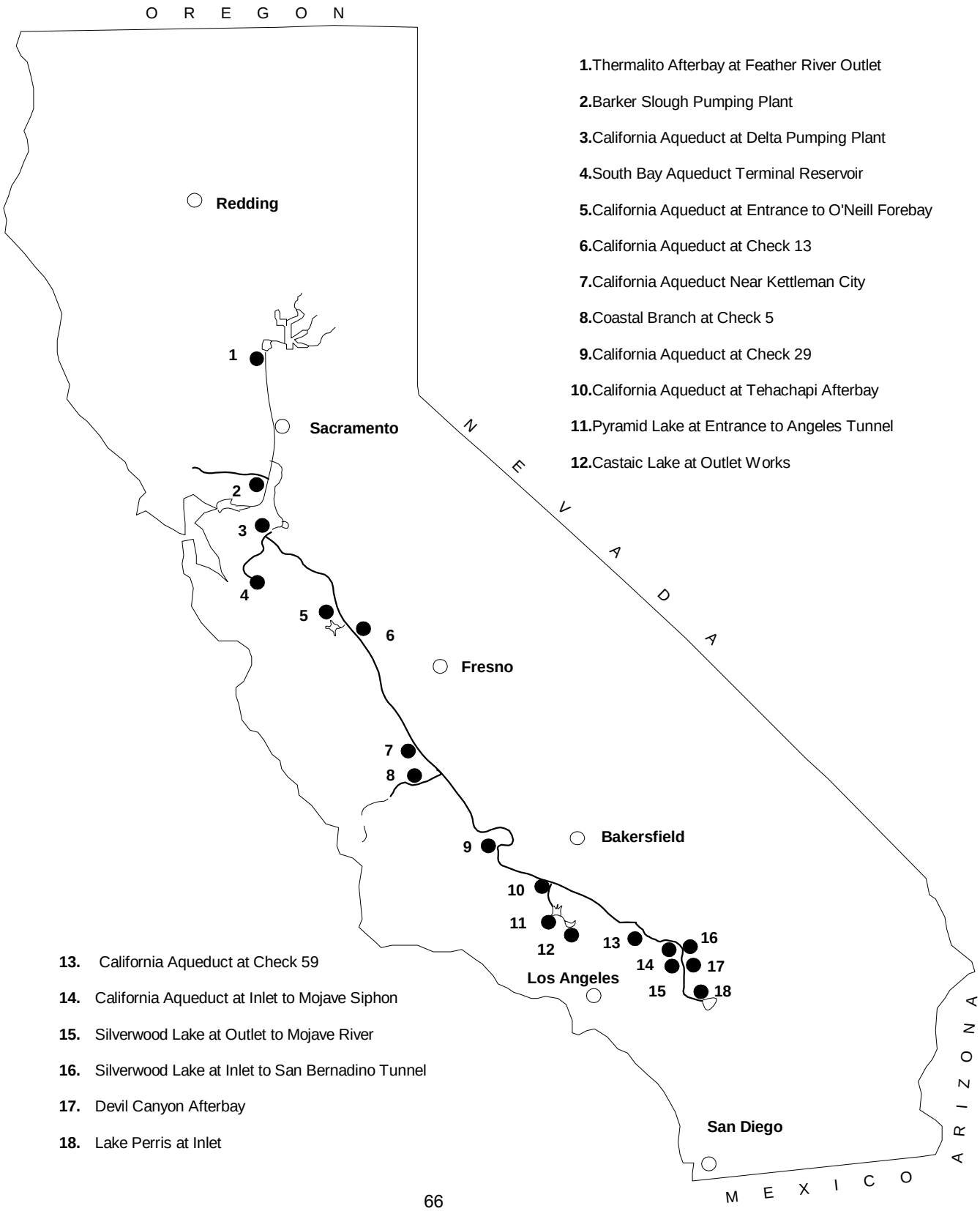
DESCRIPTION	JAN	FEB	MAR	APR	MAY	JUN
SOUTHERN FIELD DIVISION (Cont.)						
West Branch California Aqueduct						
Tehachapi Afterbay to Oso P.P.						
Inflow	48,962	7,017	24,034	81,684	39,695	27,111
Outflow, Oso Pumping Plant	48,970	7,016	24,121	81,880	39,808	27,167
Change in Storage	-6	2	-16	-5	24	-22
Computed Losses (-), Gains (+)	2	1	71	191	137	34
West Branch California Aqueduct						
Oso P.P. to Pyramid Lake						
Inflow, Oso P.P.	48,970	7,016	24,121	81,880	39,808	27,167
Outflow through William E. Warne P.P.						
to Pyramid Lake	48,310	5,887	25,257	81,242	40,839	26,748
Change in Storage	880	1,215	-1,155	626	-952	360
Operational Losses (-), Gains (+)	220	86	-19	-12	79	-59
Pyramid Lake Operation						
Inflow, Project	48,310	5,887	25,257	81,242	40,839	26,748
Inflow, Natural	606	2,359	1,621	565	365	190
Inflow, Pumpback from Elderberry Forebay	77,557	30,302	35,625	46,789	3,232	34,874
Recreation Deliveries	0	0	0	0	8	9
Piru Creek Fish Enhancement Releases	0	0	0	0	0	221
Outflow, Pyramid Diversion	905	1,023	2,211	627	654	526
Outflow, Angeles Tunnel	119,737	39,773	61,921	115,462	46,865	57,524
Change in Storage	5,418	-3,059	-2,298	8,282	-5,263	1,110
Computed Losses (-), Gains (+)	-413	-811	-669	-4,225	-2,172	-2,422
Elderberry Forebay Operation						
Inflow, Project through Castaic P-G Plant	119,737	39,773	61,921	115,462	46,865	57,524
Inflow, Natural	7	58	24	1	0	0
Outflow, Pumpback to Pyramid Lake	77,557	30,302	35,625	46,789	3,232	34,874
Outflow, Project Water Released to						
Castaic Lake	44,850	4,212	30,786	67,720	41,467	24,001
Change in Storage	-3,536	5,499	-5,401	-1,090	2,089	-765
Computed Losses (-), Gains (+)	-873	182	-935	-2,044	-77	586
Castaic Lake Operation						
Inflow, Project	44,850	4,212	30,786	67,720	41,467	24,001
Inflow, Natural	142	256	164	59	25	6
Delivered to Contracting Agencies	1,164	963	24,532	66,927	61,525	62,792
Outflow, Castaic Afterbay	218	565	0	566	265	764
Change in Storage	41,908	2,508	5,206	3,945	-19,680	-39,142
Computed Losses (-), Gains (+)	-1,702	-432	-1,212	3,659	618	407
Castaic Lagoon Operation						
Inflow (Includes recreation inflow)	218	565	0	566	265	764
Outflow	121	126	150	256	163	6
Deliveries to Recreation	58	32	80	88	282	354
Change in Storage	39	407	-230	222	-180	404
Computed Losses (-), Gains (+)		0	0	0	0	0

G. BROWN CALIFORNIA AQUEDUCT OPERATION (Continued)
1989
(in acre-feet)

JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	DESCRIPTION
							SOUTHERN FIELD DIVISION (Cont.)
							West Branch California Aqueduct
							Tehachapi Afterbay to Oso P.P.
30,148	18,155	72,407	74,835	81,514	99,653	605,215	Inflow
30,194	18,172	72,567	74,908	81,676	99,747	606,226	Outflow, Oso Pumping Plant
15	-1	-25	37	7	-25	-15	Change in Storage
61	16	135	110	169	69	996	Computed Losses (-), Gains (+)
							West Branch California Aqueduct
							Oso P.P. to Pyramid Lake
30,194	18,172	72,567	74,908	81,676	99,747	606,226	Inflow, Oso P.P.
29,130	19,860	71,808	73,396	82,111	99,844	604,432	Outflow through William E. Warne P.P. to Pyramid Lake
1,079	-1,829	782	-25	-450	-25	506	Change in Storage
15	-141	23	-1,537	-15	72	-1,288	Operational Losses (-), Gains (+)
							Pyramid Lake Operation
29,130	19,860	71,808	73,396	82,111	99,844	604,432	Inflow, Project
96	100	139	271	331	369	7,012	Inflow, Natural
59,981	16,228	33,146	3,802	12,432	27,728	381,696	Inflow, Pumpback from Elderberry Forebay
9	8	8	6	3	1	52	Recreation Deliveries
743	691	659	435	121		2,870	Piru Creek Fish Enhancement Releases
96	100	139	271	331	324	7,207	Outflow, Pyramid Diversion
80,917	47,709	95,067	69,964	99,806	122,273	957,018	Outflow, Angeles Tunnel
5,116	-13,837	7,051	4,980	-9,179	1,175	-504	Change in Storage
-2,326	-1,517	-2,169	-1,813	-3,792	-4,168	-26,497	Computed Losses (-), Gains (+)
							Elderberry Forebay Operation
80,917	47,709	95,067	69,964	99,806	122,273	957,018	Inflow, Project through Castaic P-G Plant
0	0	0	0	0	0	90	Inflow, Natural
59,981	16,228	33,146	3,802	12,432	27,728	381,696	Outflow, Pumpback to Pyramid Lake
24,069	25,367	62,869	67,995	81,604	92,617	567,557	Outflow, Project Water Released to Castaic Lake
-2,499	5,965	-5,482	-1,673	6,518	2,225	1,850	Change in Storage
634	-149	-4,534	160	748	297	-6,005	Computed Losses (-), Gains (+)
							Castaic Lake Operation
24,069	25,367	62,869	67,995	81,604	92,617	567,557	Inflow, Project
0	0	0	0	6	14	672	Inflow, Natural
64,767	68,207	52,358	67,313	70,916	70,508	611,972	Delivered to Contracting Agencies
301	169	445	0	0	0	3,293	Outflow, Castaic Afterbay
-40,776	-42,794	14,518	-148	10,400	22,390	-41,665	Change in Storage
223	215	4,452	-830	-294	267	5,371	Computed Losses (-), Gains (+)
							Castaic Lagoon Operation
301	169	445	0	0	0	3,293	Inflow (Includes recreation inflow)
0	0	0	0	0	0	822	Outflow
351	447	334	327	277	240	2,870	Deliveries to Recreation
-50	-278	111	-327	-277	-240	-399	Change in Storage
0	0	0	0	0	0	0	Computed Losses (-), Gains (+)

MAP 4
WATER QUALITY MONITORING STATIONS

(as reported on pages 68 through 85 of this report)



1. Thermalito Afterbay at Feather River Outlet

2. Barker Slough Pumping Plant

3. California Aqueduct at Delta Pumping Plant

4. South Bay Aqueduct Terminal Reservoir

5. California Aqueduct at Entrance to O'Neill Forebay

6. California Aqueduct at Check 13

7. California Aqueduct Near Kettleman City

8. Coastal Branch at Check 5

9. California Aqueduct at Check 29

10. California Aqueduct at Tehachapi Afterbay

11. Pyramid Lake at Entrance to Angeles Tunnel

12. Castaic Lake at Outlet Works

13. California Aqueduct at Check 59

14. California Aqueduct at Inlet to Mojave Siphon

15. Silverwood Lake at Outlet to Mojave River

16. Silverwood Lake at Inlet to San Bernadino Tunnel

17. Devil Canyon Afterbay

18. Lake Perris at Inlet

WATER QUALITY

APPENDIX II

Water Quality*

TABLE 21: THERMALITO AFTERBAY AT FEATHER RIVER OUTLET
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUNE /1	JULY	AUG	SEP	OCT	NOV	DEC 1/	10 Month Average
Total Dissolved Solids	64	66	60	64	52		61	58	58	49	55		59
Total Hardness	46	43	36	39	36		39	30	34	36	32		37
Chlorides	1	1	1	1	1		1	1	1	1	1		1
Sulfates	4	3	2	3	2		3	2	3	3	2		3
Sodium	4	7	4	4	3		3	3	3	3	3		4
Percent Sodium	16	27	20	19	16		14	18	17	16	17		18
Electrical Conductivity	100	98	95	92	82		85	85	82	80	81		88
pH	7.7	7.8	7.6	7.9	7.8		7.7	7.7	7.7	7.6	7.4		7.7
Boron	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Fluoride													
Lead													
Selenium													
Hexavalent Chromium													
Arsenic													
Iron													
Manganese													
Magnesium	5	5	4	4	4		4	3	4	4	3		4
Copper													
Calcium	10	9	8	9	8		9	7	7	8	8		8
Zinc													
Phenol													
Color (units)													
Sampling Date	01/18	02/15	03/15	04/15	05/17			08/16	09/20	10/18	11/15		

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

1/ No Data Available For This Month

<X.X = none detected at stated detection level

Water Quality*

TABLE 22: NORTH BAY AQUEDUCT PUMPING PLANT HEADWORKS
(Inflow to North Bay Aqueduct)
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	221	236	362	293	255	188	154	148	185	186	182	178	216
Total Hardness	122	132	167	148	143	106	90	80	98	104	100	103	116
Chlorides	33	40	77	42	31	23	16	15	25	24	24	22	31
Sulfates	30	40	66	53	43	26	18	16	20	23	22	22	32
Sodium	34	37	66	49	39	28	21	19	26	27	27	36	34
Percent Sodium	38	38	47	42	38	37	34	35	37	37	37	44	39
Electrical Conductivity	376	426	626	499	434	320	253	236	311	340	312	300	369
pH	8	8	8	8	8	8	8	8	8	8	8	8	8
Boron	0	0	0	0	0	0	0	0	0	0	0	0	0
Fluoride													
Lead													
Selenium													
Hexavalent Chromium													
Arsenic													
Iron													
Manganese													
Magnesium	18	20	26	22	22	16	12	11	14	15	14	14	17
Copper													
Calcium	19	20	24	23	21	80	16	14	16	17	17	18	24
Zinc													
Phenol													
Color (units)													
Sampling Date	01/18	02/15	03/15	04/19	05/17	06/21	07/19	08/15	09/20	10/17	11/15	12/19	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

Water Quality*

TABLE 23: CALIFORNIA AQUEDUCT AT HARVEY O. BANKS PUMPING PLANT 1989

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	423	447	322	150	172	192	192	201	283	281	325	381	281
Total Hardness**	157	164	124	69	76	83	83	86	112	111	125	143	111
Chlorides**	143	153	97	21	30	39	39	43	80	79	99	124	79
Sulfates**	85	90	61	22	27	31	31	34	52	52	62	75	52
Sodium**	92	99	66	21	27	32	32	34	56	55	67	82	55
Percent Sodium**	56	57	54	40	43	46	46	47	52	52	54	55	50
Electrical Conductivity***	741	784	559	250	289	325	325	342	488	485	565	666	485
Electrical Conductivity	587	779	586	223	267	322	310	327	510	505	577	637	469
pH	7.7	7.9	7.8	7.8	7.8	7.9	8	7.8	8.2	7.6	7.7	7.8	7.9
Boron	0.2	0.2	0.2	<0.1	0.1	0.2	<0.1	<0.1	0.1	0.1	0.1	0.1	0.1
Fluoride	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	0
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Hexavalent Chromium		<0.005							<0.005				0
Arsenic	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Iron	0.056	0.278	0.041	0.019	0.056	0.008	0.049	0.006	0.022	0.1	0.053	0.042	0.061
Manganese	0.024	0.028	0.02	0.012	0.007	<0.005	<0.005	0.015	0.012	0.024	0.021	0.022	0.015
Magnesium	18	22	16	8	10	10	10	9	14	14	15	16	14
Copper	0.006	<0.005	<0.005	<0.005	0.01	<0.005	<0.005	<0.005	<0.005	0.014	0.009	<0.005	0.003
Calcium	23	22	21	13	16	17	17	13	17	18	19	21	18
Zinc	0.022	0.023	0.013	0.016	0.02	0.015	0.015	0.019	0.006	0.031	0.037	0.024	0.02
Phenol		0.001							<0.001				0.001
Color (units)	35	25	20	30	60	60	60	30	25	11	25	5	31
Sampling Date	01/17	02/15	03/15	04/19	05/16	06/20	07/18	08/15	09/19	10/19	11/14	12/19	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.

** Values correlated from continuous EC.

*** Continuous EC value.

<X.XXX = none detected at stated detection level

Water Quality*

TABLE 24: SOUTH BAY AQUEDUCT TERMINAL RESERVOIR
1989

Constituents	JAN	FEB	MAR	ARP	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	378	450	336	155	177	192	199	213	298	299	324	360	282.00
Total Hardness**	145	169	132	73	80	85	87	92	120	120	128	140	114.00
Chlorides**	116	148	98	19	29	35	38	44	81	82	93	109	74.00
Sulfates**	90	113	77	21	28	32	34	39	65	66	73	85	60.00
Sodium**	77	96	67	20	26	29	31	35	57	57	63	73	53.00
Percent Sodium**	54	55	52	37	41	43	44	45	51	51	52	53	48.00
Electrical Conductivity***	665	799	589	256	297	324	336	363	519	521	566	633	489.00
Electrical Conductivity	580	787	616	223	259	309	306	320	542	498	566	631	470.00
pH	7.9	8	7.8	7.9	7.9	7.8	8	7.8	8.2	7.9	7.8	7.9	7.90
Boron	0.2	2	0.2	<0.1	<0.1	0.1	<0.1	<0.1	0.2	0.1	0.2	0.1	0.30
Fluoride	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	0.00
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.00
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00
Hexavalent Chromium		<0.005							<0.005				0.00
Arsenic	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.00
Iron	0.298	0.07	0.018	0.028	0.111	0.147	0.014	0.014	0.011	0.019	0.235	0.062	0.09
Manganese	0.02	0.016	0.014	0.019	0.01	0.02	0.005	0.005	0.011	0.012	0.024	0.015	0.01
Magnesium	18	23	17	9	9	10	10	10	18	14	14	17	14.00
Copper	0.006	0.011	0.006	0.005	0.008	0.007	0.005	0.005	0.007	0.007	0.007	0.005	0.01
Calcium	22	23	20	14	14	16	16	16	26	18	17	22	19.00
Zinc	0.014	0.03	0.013	0.028	0.013	0.019	0.025	0.025	0.032	0.017	0.013	0.024	0.02
Phenol		0.001							<0.001				0.00
Color (units)	40	30	20	35	60	70	50	50	10	25	20	10	35.00
Sampling Date	01/17	02/14	03/14	04/18	05/16	06/20	07/18	08/15	09/19	10/17	11/14	12/19	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to miromhos; to obtain millsiemens divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.

** Values correlated from continuous EC.

*** Continuous EC value.

<X.XXX = none detected at stated detection level

Water Quality*

TABLE 25: CALIFORNIA AQUEDUCT ENTRANCE TO O'NEIL FOREBAY
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	383	464	333	197	165	175	165	197	265	278	342	361	277
Total Hardness**	151	180	134	86	74	78	74	85	110	114	137	144	114
Chlorides**	126	163	103	40	25	30	25	40	72	77	107	116	77
Sulfates**	88	112	74	34	25	27	24	34	54	57	76	82	57
Sodium**	82	104	69	33	24	27	24	32	51	54	71	76	54
Percent Sodium**	54	56	53	45	41	43	41	45	50	51	53	54	49
Electrical Conductivity***	674	823	583	333	274	292	273	332	458	481	599	633	480
Electrical Conductivity	578	803	611	220	257	287	283	316	525	509	573	627	466
pH	7.8	8	7.9	7.9	7.9	8.1	8.1	8	8.3	7.9	7.8	7.6	7.9
Boron	0.2	0.2	0.2	<0.1	<0.1	0.1	<0.1	<0.1	0.1	0.1	0.2	0.1	0.1
Fluoride	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	0
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Hexavalent Chromium		<0.005							<0.005				0
Arsenic	0.002	0.002	0.002	0.002	0.002	0.002	<0.001	<0.001	<0.001	0.002	0.002	0.002	0.002
Iron	0.27	0.033	0.043	0.022	0.127	0.07	0.034	0.054	0.078	0.103	0.074	0.07	0.082
Manganese	0.026	0.018	0.016	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.011	0.02	0.008
Magnesium	18	23	17	8	9	10	10	9	14	14	15	16	14
Copper	0.03	0.016	0.018	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006
Calcium	22	24	20	14	15	15	16	13	17	17	17	18	17
Zinc	0.035	0.017	0.019	0.02	0.008	0.019	0.012	0.01	0.009	0.008	0.013	0.008	0.015
Phenol		0.002							<0.001				0.001
Color (units)	35	25	20	30	60	40	35	20	30	25	20	20	30
Sampling Date	01/18	02/15	03/15	04/19	05/17	06/21	07/19	08/16	09/20	10/18	11/15	12/13	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.

** Values correlated from continuous EC.

*** Continuous EC value.

<X.XXX = none detected at stated detection level

Water Quality*

TABLE 26: CALIFORNIA AQUEDUCT AT CHECK 13
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUN	JUL 1/	AUG 2/	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	377	446	341	190	286	352	363	245	276	276	342	372	322
Total Hardness**	146	170	134	81	114	138	141	100	111	111	134	145	127
Chlorides**	113	142	98	34	74	103	107	57	71	70	98	111	90
Sulfates**	81	99	71	31	57	74	77	46	54	54	72	80	66
Sodium**	76	94	68	30	54	70	73	44	52	52	68	75	63
Percent Sodium**	53	55	53	45	51	53	53	49	50	50	53	53	51
Electrical Conductivity***	665	793	600	321	497	620	639	422	480	479	601	657	565
Electrical Conductivity	651	835	654	302	415	654	639	450	531	453	560	652	566
pH	7.8	8	7.8	7.7	8	8	8.2	7.9	8.1	7.9	7.7	7.7	7.9
Boron	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2
Fluoride	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.01	<0.1	0
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	0
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	0
Hexavalent Chromium		<0.005							<0.005				0
Arsenic	0.002	0.002	0.002	0.002	0.002	0.002	0.001		0.002	0.002	0.002	0.002	0.002
Iron	0.092	0.07	0.05	0.107	0.068	0.018	0.021		0.078	0.104	0.079	0.064	0.068
Manganese	0.019	0.024	0.009	0.006	<0.005	0.005	<0.005		<0.005	0.009	0.015	0.02	0.01
Magnesium	20	24	18	10	13	18	18	12	14	13	14	17	16
Copper	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	0.005		<0.005	<0.005	<0.005	<0.005	0.001
Calcium	25	28	24	16	18	24	28	18	18	17	18	22	21
Zinc	<0.005	0.007	0.005	<0.005	0.034	0.01	0.011		0.008	0.014	<0.005	0.006	0.009
Phenol		0							<0.001				0
Color (units)	35	25	5	30	25	10	15	20	30		20	20	20
Sampling Date	01/17	02/15	03/15	04/19	05/17	06/21	07/19	08/16	09/20	10/18	11/15	12/13	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to microhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.

** Values correlated from continuous EC.

*** Continuous EC value.

<X.XXX = none detected at stated detection level

/1 This month is all lab values

/2 Minor element data unavailable for this month

Water Quality*

TABLE 27: CALIFORNIA AQUEDUCT NEAR KETTLEMAN CITY
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUN	JUL 1/	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Hardness**	162	143	153	86	113	140	127	101	107	110	123	151	127
Chlorides**	124	104	115	42	72	100	86	59	65	68	82	112	86
Sulfates**	89	76	83	37	56	74	65	47	51	53	62	82	65
Sodium**	82	71	77	37	53	69	61	46	49	51	59	76	61
Percent Sodium**	53	52	52	48	51	52	51	50	50	50	51	52	51
Electrical Conductivity***	744	647	699	348	491	629	562	428	460	472	542	688	559
Electrical Conductivity	688	759	729	343	408	649	633	394	472	426	542	699	562
pH	7.9	7.8	7.9	7.8	8.1	8.1	8.4	7.8	7.9	7.9	7.6	7.8	8
Boron	0.3	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.1	0.2	0.2	0.2
Fluoride	<0.1	0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	0.2	<0.1	0.1	0.1	0.1
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Hexavalent Chromium		<0.005											0
Arsenic	0.002	0.002	0.002	0.002	0.002	0.002	<0.001	0.002	0.002	0.002	0.002	0.002	0.002
Iron	0.534	0.049	0.031	0.073	0.018	0.014	0.017	0.045	0.074	0.084	0.05	0.04	0.086
Manganese	0.009	0.008	<0.005	<0.005	<0.005	0.007	0.007	<0.005	<0.005	<0.005	<0.005	0.006	0.003
Magnesium	20	22	20	12	12	18	18	10	13	12	14	18	16
Copper	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	<0.005	<0.005	0.001
Calcium	27	28	25	18	18	24	27	15	18	17	19	24	22
Zinc	<0.005	<0.005	<0.005	<0.005	0.01	0.019	0.017	0.043	0.026	0.016	<0.005	0.006	0.011
Phenol		0							<0.001				0
Color (units)	25	20	5	30	25	10	10	20	20	20	15	10	18
Sampling Date	01/17	02/15	03/14	04/18	05/17	06/21	07/19	08/16	09/19	10/18	11/14	12/13	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, pe
noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.

** Values correlated from continuous EC.

*** Continuous EC value.

<X.XXX = none detected at stated detection level

1/ This month is all lab values

Water Quality*

TABLE 28: COASTAL BRANCH AT CHECK 5
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUN 1/	JUL 1/	AUG	SEP	OCT	NOV	DEC	9 Month Average
Total Dissolved Solids**	390	378	333	218	271	287	287	264	263	257	303	341	299
Total Hardness**	150	146	130	91	109	115	115	107	106	101	114	125	117
Chlorides**	113	109	91	47	67	73	73	65	64	61	79	94	78
Sulfates**	86	83	70	38	53	57	57	51	51	43	51	58	58
Sodium**	80	77	66	38	51	55	55	49	49	72	83	92	64
Percent Sodium**	54	54	53	48	51	51	51	50	50	61	61	62	54
Electrical Conductivity***	681	660	579	371	466	496	496	455	452	441	524	592	518
Electrical Conductivity	823	683	750	308		640	576	455	452	386	552	651	571
pH	8.1	8.2	8	7.5	8	8.2	8.1	8.1	7.7	7.6	8.3	7.9	8
Boron	0.2	0.2	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.20
Fluoride	0.2	0.2	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.20
Lead	0	0	0	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0	0	0	0	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium													
Arsenic	0	0	0	0	0	<0.01	<0.01	<0.01	<0.01	- - -	- - -	- - -	<0.01
Iron	0.03	0.04	0.04	0.03	0.06	<0.01	0.16	0.07	0.02	<0.01	<0.01	<0.01	0.04
Manganese	0.08	0	0.01	0.01	0.02	<0.01	0.01	0.01	0.01	0.01	- - -		0.02
Magnesium	23	19	20	10	17	21	16	13	15	13	7	18	16
Copper	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.04	0.25	0.04	0.01	0.02	0.03
Calcium	28	25	27	17	25	22	22	18	16	17	33	22	23
Zinc	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.04	0.01	0.04	<0.01	<0.01	0.02
Phenol	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Color (units)	7	7	7	7	7	7	7	7	7	7	7	7	7
Sampling Date	01/17	02/14	03/14	04/18	05/16	06/20	07/18	08/15	09/19	10-17	11-14	12-12	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.

** Values correlated from continuous EC.

*** Continuous EC value.

1/ This month is all lab values

Water Quality*

TABLE 29: GOVERNOR EDMUND G. BROWN CALIFORNIA AQUEDUCT AT CHECK 29 1989

Constituents	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	417	367	397	226	293	368	355	290	315	271	318	360	331
Total Hardness**	162	144	155	92	117	144	139	116	125	109	126	132	130
Chlorides**	124	105	116	49	76	105	100	74	84	67	85	102	91
Sulfates**	96	81	90	40	60	81	77	59	66	53	67	62	69
Sodium**	88	75	83	39	56	75	72	56	62	51	63	97	68
Percent Sodium**	54	53	54	48	51	53	53	51	52	51	52	61	53
Electrical Conductivity***	743	648	705	382	509	650	625	502	549	467	556	634	581
Electrical Conductivity	745	686	648	285	658	608	582	427	418	359	504	663	549
pH	7.7	7.8	7.8	7.6	8.2	8.2	8.3	8.2	7.8	7.7	7.9	7.9	7.9
Boron	0.2	0.2	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.2
Fluoride	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2
Lead	0	0	0	0	0	<0.01	0.01	<0.01	<0.1	<0.01	<0.01	<0.01	<0.01
Selenium	0	0	0	0	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium													
Arsenic	0	0	0	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	0.06	0.06	0.06	0.05	0.04	0.06	0.14	0.04	0.04	0.01	0.06	<0.01	0.06
Manganese	0.01	0.01	0.01	0.01	0	<0.01	<0.01	<0.01	0.01	0	0	0	<0.01
Magnesium	23	18	19	10	17	17	17	12	15	14	15	17	16
Copper	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Calcium	27	27	25	17	25	21	22	17	16	16	15	21	21
Zinc	0.02	0.02	0.01	0.01	0.02	0.03	0.18	0.03	0.02	0.01	0.02	0.02	0.03
Phenol	0	0.005											
Color (units)	20	15	10	25	15	7	10	10	8	9	7	- - -	12
Sampling Date	01/17	02/14	03/14	04/18	05/16	06/20	07/18	08/15	09/19	10/17	11/14	12-12	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.

** Values correlated from continuous EC.

*** Continuous EC value.

Water Quality*

TABLE 30: GOVERNOR EDMUND G. BROWN CALIFORNIA AT TEHACHAPI AFTERBAY
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	421	382	419	189	258	332	323	259	247	262	285	344	310
Total Hardness**	163	149	162	81	105	131	128	106	101	107	115	135	124
Chlorides**	129	113	128	36	63	93	90	64	59	65	74	98	84
Sulfates**	102	90	101	30	51	74	72	52	48	53	60	78	68
Sodium**	90	80	89	31	49	68	65	49	46	50	56	70	62
Percent Sodium**	55	54	55	46	50	53	53	50	50	51	51	53	52
Electrical Conductivity***	737	666	732	322	444	578	562	447	425	452	493	598	538
Electrical Conductivity	815	605	745	286	648	576	596	406	386	397	542	630	553
pH	7.6	7.8	7.6	6.9	8	8	8	7.8	7.6	7.5	7.9	7.7	7.8
Boron	0.2	0.2	0.2	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.3	0.2
Fluoride	0.2	0.2	1.1	0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.2
Lead	0	0	0	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0
Selenium	0	0	0	0	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Hexavalent Chromium													
Arsenic	0	0	0	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0
Iron	0	0.02	0.04	0.01	0.01	<0.01	<0.01	0.03	0.04	0.32	<0.01	<0.01	0.04
Manganese	0.1	0.05	0	0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.04	0	0	0.02
Magnesium	22	16	22	9	17	16	17	11	15	12	14	17	16
Copper	0.02	0	0	0.01	0	<0.01	<0.01	0.02	0.01	<0.01	0.02	0.01	0.01
Calcium	27	25	24	16	25	22	22	16	16	17	19	20	21
Zinc	0.02	0	0.01	0.02	0.01	<0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01
Phenol													
Color (units)	10	10	10	10	4	10	5	5	5	20	6	10	9
Sampling Date	01/18	02/15	03/15	04/19	05/17	06/21	07/19	08/16	09/20	10/18	11/15	12/13	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

Water Quality*

TABLE 31: PYRAMID LAKE AT ENTRANCE TO ANGELES TUNNEL
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	372	432	480	253	240	265	286	300	260	257	263	322	311
Total Hardness	152	147	152	106	98	94	118	124	103	126	105	114	120
Chlorides	142	138	133	68	58	62	85	90	76	80	79	98	92
Sulfates	59	61	63	41	38	39	45	45	37	42	35	35	45
Sodium	88	86	87	47	42	46	59	62	56	56	57	64	63
Percent Sodium	56	56	56	50	49	52	53	53	55	50	55	53	53
Electrical Conductivity	746	687	724	448	401	419	517	520	460	491	414	523	529
pH	7.9	7.8	7.9	7.7	8.2	8.2	7.8	9.0	7.5	7.7	8.0	8.1	8.2
Boron	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2
Fluoride	0.2	0.3	0.3	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00
Iron	0.00	0.00	0.02	0.02	0.00	0.00	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.01
Manganese	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	0.05	0.00		0.01
Magnesium	21	20	20	13	13	12	16	16	14	16	14	15	16
Copper	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	0.01	0.01	0.01	<0.01	0.01	0.00
Calcium	26	26	28	21	18	18	21	23	18	24	19	21	22
Zinc	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01		<0.01	0.01	0.00
Phenol													
Color (units)	5	7	5	10	8	5	5	5	8	5	5	3	6
Sampling Date	01/20	02/17	03/16	04/18	05/17	06/08	07/21	08/15	09/19	10/24	11/16	12/21	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

Water Quality*

TABLE 32: CASTAIC LAKE AT OUTLET WORKS

1989

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	351	409	440	385	378	389	396	424	439	288	333	305	378
Total Hardness	164	152	148	153	146	147	152	162	170	131	129	124	148
Chlorides	118	119	113	118	120	125	125	128	120	93	93	93	114
Sulfates	63	64	64	63	67	68	70	77	76	54	57	45	64
Sodium	75	76	78	78	81	84	84	87	83	65	65	64	77
Percent Sodium	50	53	54	53	55	57	55	54	52	52	53	53	53
Electrical Conductivity	672	646	606	670	681	696	694	722	642	541	558	534	639
pH	7.8	7.9	8.0	8.5	8.3	8.9	9.2	8.8	8.5	7.2	8.2	8.0	8.6
Boron	0.2	0.4	0.3	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.3
Fluoride	0.2	0.2	0.3	0.2	0.4	0.3	0.2	0.3	0.2	0.1	0.2	0.3	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00
Iron	0.00	0.00	0.01	0.00	0.00	0.00	<0.01	0.01	0.00	<0.01	<0.01	<0.01	0.00
Manganese	0.00	0.00	0.00	0.00	0.01	0.00	<0.01	<0.01	<0.01	0.00	0.00		0.00
Magnesium	23	18	19	19	21	21	19	20	19	16	16	15	19
Copper	0.00	0.00	0.01	0.00	0.00	0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01
Calcium	28	31	28	30	24	25	31	32	29	26	25	25	28
Zinc	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	<0.01	<0.01	<0.01	0.01	0.00
Phenol													
Color (units)	5	3	6	10	7	10	10	7	5	5	2	4	6
Sampling Date	01/17	02/16	03/15	04/17	05/17	06/21	07/17	08/14	09/18	10/23	11/13	12/20	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

Water Quality*

TABLE 33: GOVERNOR EDMUND G. BROWN CALIFORNIA AQUEDUCT AT CHECK 59
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	11 Month Average
Total Dissolved Solids**	447	396	318	209	254	322	321	256	228	234	254	NO DATA: STATION DISCONTINUED	294
Total Hardness**	160	144	120	86	100	121	121	101	92	94	100		112
Chlorides**	136	116	85	43	60	87	87	61	50	53	60		76
Sulfates**	109	93	69	34	48	70	70	49	40	42	48		61
Sodium**	96	83	63	36	47	65	64	48	41	42	47		57
Percent Sodium**	57	56	54	48	51	54	54	51	49	50	51		52
Electrical Conductivity***	808	710	561	354	439	570	567	443	389	402	439		517
Electrical Conductivity	861	656	796	301	627	524	565	417	391	400	515		550
pH	7.8	7.8	7.7	6.9	8.1	8.1	7.9	8.0	7.7	7.5	7.9		8
Boron	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2		0.19
Fluoride	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1		0.15
Lead	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		0.00
Selenium	0.000	0.000	0.000	0.000	0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		0.00
Iron	0.01	0.01	0.03	0.03	0.01	<0.01	<0.01	0.04	0.04	<0.01	<0.01		0.02
Manganese	0.00	0.01	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	0.00	0.01		0.00
Magnesium	23	18	22	10	16	15	17	12	12	13	15		16
Copper	0.02	0.00	0.00	0.00	0.01	0.01	0.01	0.01	<0.01	0.01	0.02		0.01
Calcium	28	26	26	16	24	21	20	17	16	16	19		21
Zinc	0.00	0.00	0.00	0.00	0.00	<0.01	0.01	0.01	0.01	<0.01	0.03		0.01
Phenol													
Color (units)	8	15	10	15	5	8	5	7	8	20	4		10
Sampling Date	01/18	02/15	03/15	04/19	05/17	06/21	07/19	08/16	09/20	10/18	11/15		

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.

** Values correlated from continuous EC.

*** Continuous EC value.

Water Quality*

TABLE 34: GOVERNOR EDMUND G. BROWN CALIFORNIA AQUEDUCT AT INLET TO MOJAVE SIPHON
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	11 Month Average
Total Dissolved Solids**	414	374	405	206	231	316	317	239	224	236	253	NO DATA; STATION DISCONTINUED	292
Total Hardness**	161	147	158	88	96	126	127	99	94	98	104		118
Chlorides**	124	108	120	43	53	86	86	56	50	55	61		77
Sulfates**	99	86	96	35	42	68	69	45	40	44	49		61
Sodium**	90	80	88	36	43	65	65	45	41	44	48		59
Percent Sodium**	55	54	55	47	49	53	53	50	49	49	50		51
Electrical Conductivity***	732	660	716	354	399	554	556	414	387	409	439		511
Electrical Conductivity	834	659	791	306	627	627	455	478	406	415	557		560
pH	7.8	8.4	7.8	7.2	8.2	8.3	7.9	8.1	7.8	7.6	8.0		7.9
Boron	0.2	0.3	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.2		0.16
Fluoride	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1		0.15
Lead	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01
Selenium	0.000	0.000	0.000	0.000	0.000	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001		<0.001
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01
Iron	0.00	0.01	0.03	0.02	0.00	<0.01	0.02	0.01	0.04	<0.01	<0.01		0.02
Manganese	0.01	0.00	0.01	0.02	0.00	<0.01	<0.01	<0.01	<0.01	0.00	0.01		0.01
Magnesium	24	19	22	10	17	17	14	14	12	12	14		16
Copper	0.02	0.00	0.00	0.00	0.00	<0.01	0.02	0.02	<0.02	0.02	<0.01		0.02
Calcium	27	29	25	16	24	23	18	18	16	17	20		21
Zinc	0.01	0.00	0.01	0.01	0.00	0.01	<0.01	0.02	0.01	<0.01	0.02		0.01
Phenol													
Color (units)	10	5	10	15	5	5	5	7	10	15	4		8.3
Sampling Date	01/18	02/15	03/15	04/19	05/17	06/21	07/19	08/16	09/20	10/18	11/15		

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.

** Values correlated from continuous EC.

*** Continuous EC value.

Water Quality*

TABLE 35: SILVERWOOD LAKE AT OUTLET TO MOJAVE RIVER
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	378	370	380	335	228	298	305	290	235	261	278	312	306
Total Hardness	146	152	138	121	95	116	118	114	94	103	105	108	118
Chlorides	151	145	136	108	61	90	97	95	72	84	84	93	101
Sulfates	56	55	59	50	33	44	46	40	28	33	33	31	42
Sodium	93	87	87	70	44	60	66	63	49	57	56	63	66
Percent Sodium	59	56	58	56	51	53	55	55	54	55	54	56	55
Electrical Conductivity	760	718	510	602	404	528	548	524	417	474	420	487	533
pH	7.7	7.8	7.6	7.8	7.6	8.1	8.0	8.1	7.8	7.6	7.9	7.8	7.9
Boron	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2
Fluoride	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00
Iron	0.00	0.00	0.02	0.01	0.00	0.00	<0.01	0.01	0.04	<0.01	<0.01	<0.01	0.01
Manganese	0.05	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	0.00	0.00		0.01
Magnesium	21	21	19	16	14	16	16	15	13	14	14	14	16
Copper	0.00	0.00	0.00	0.00	0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01	0.02	0.01
Calcium	146	26	24	22	15	20	21	21	16	18	19	20	31
Zinc	0.00	0.00	0.00	0.00	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.00
Phenol													
Color (units)	5	5	11	5	10	8	5	7	8	10	4	4	7
Sampling Date	01/19	02/15	03/14	04/17	05/16	06/20	07/19	08/15	09/19	10/17	11/14	12/19	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

Water Quality*

TABLE 36: SILVERWOOD LAKE AT INLET TO SAN BERNADINO TUNNEL
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	361	255	448	320	236	233	305	300	313	254	328	293	304
Total Hardness	148	134	136	125	94	114	118	116	100	107	103	112	117
Chlorides	149	134	133	102	62	84	97	98	81	86	84	97	101
Sulfates	53	51	58	49	34	43	47	41	35	32	28	32	42
Sodium	89	83	85	68	44	57	66	64	57	58	56	62	66
Percent Sodium	57	58	58	55	51	53	55	55	56	55	55	54	55
Electrical Conductivity	743	653	693	578	404	501	553	533	458	483	480	508	549
pH	7.7	7.7	7.8	7.8	7.6	8.1	8.0	8.2	7.8	7.7	7.9	7.9	7.9
Boron	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2
Fluoride	0.2	0.4	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00
Iron	0.00	0.01	0.01	0.01	0.00	0.00	<0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01
Manganese	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	0.00	0.00		0.00
Magnesium	22	18	18	17	14	15	16	15	14	15	19	15	17
Copper	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	0.01	<0.01	0.01	0.00
Calcium	23	24	25	22	19	21	21	22	17	18	10	20	20
Zinc	0.00	0.00	0.00	0.00	0.00	0.00	0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.00
Phenol													
Color (units)	5	5	12	5	8	8	5	7	7	5	4	6	6
Sampling Date	01/19	02/15	03/14	04/17	05/16	06/20	07/19	08/15	09/16	10/17	11/14	12/19	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

Water Quality*

TABLE 37: DEVIL CANYON AFTERBAY
1989

Constituents	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	11 Month Average
Total Dissolved Solids**	373	401	405	357	241	264	298	285	256	246	245	NO DATA; STATION DISCONTINUED	307
Total Hardness**	132	140	141	128	97	103	112	109	100	98	97		114
Chlorides**	110	121	122	103	57	66	80	75	63	59	59		83
Sulfates**	71	77	78	67	42	47	54	52	45	43	43		56
Sodium**	77	84	84	73	45	50	59	55	48	46	45		61
Percent Sodium**	56	57	57	55	50	52	53	53	51	51	51		53
Electrical Conductivity***	655	705	711	626	419	460	521	498	445	428	425		536
Electrical Conductivity	738	710	709	602	409	507	548	533	422	480	425		553
pH	7.4	7.7	7.7	7.1	7.7	8.1	8.0	8.1	7.7	7.5	7.9		7.72
Boron	0.2	0.4	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.1		0.17
Fluoride	0.2	0.2	0.2	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1		0.16
Lead	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01
Selenium	0.000	0.000	0.000	0.000	0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		0
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01
Iron	0.00	0.00	0.01	0.01	0.00	<0.01	0.02	<0.01	0.02	<0.01	<0.01		0.009
Manganese	0.00	0.01	0.00	0.02	0.03	<0.01	<0.01	<0.01	0.01	0.00	0.00		0.009
Magnesium	24	18	19	17	12	15	16	15	13	13	14		16
Copper	0.01	0.00	0.02	0.00	0.00	<0.01	0.01	0.03	<0.01	0.02	<0.01		0.011
Calcium	21	28	24	22	19	21	21	21	16	20	18		21
Zinc	0.00	0.00	0.00	0.00	0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01		0.006
Phenol													
Color (units)	3	6	5	10	7	7	5	7	10	10	5		7
Sampling Date	01/18	02/15	03/15	04/19	05/17	06/21	07/19	08/16	09/20	10/18	11/15		

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.

** Values correlated from continuous EC.

*** Continuous EC value.

Water Quality*

TABLE 38: LAKE PERRIS AT INLET

1989

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	301	299	330	302	293	289	312	327	311	289	314	293	305
Total Hardness	109	115	108	116	110	115	118	124	120	118	114	112	115
Chlorides	80	91	83	86	89	92	92	94	94	90	88	84	89
Sulfates	45	43	43	42	52	45	47	46	44	43	37	37	44
Sodium	57	61	61	61	64	64	68	68	68	65	64	62	64
Percent Sodium	54	54	56	54	56	55	56	55	56	55	56	55	55
Electrical Conductivity	517	512	452	520	530	538	548	554	558	531	439	499	517
pH	7.3	7.8	7.9	7.9	8.2	8.7	8.5	8.3	7.9	7.6	8.0	7.9	8.2
Boron	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2
Fluoride	0.8	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00
Iron	0.00	0.00	0.01	0.01	0.00	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01
Manganese	0.00	0.00	0.00	0.00	0.00	0.01	<0.01	<0.01	<0.01	0.00	0.00		0.00
Magnesium	15	14	16	16	15	17	17	18	17	17	15	15	16
Copper	0.00	0.00	0.00	0.00	0.01	0.00	0.01	<0.01	0.01	0.01	<0.01	0.01	0.01
Calcium	19	23	17	20	20	18	19	20	20	19	21	20	20
Zinc	0.00	0.00	0.00	0.00	0.00	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.00
Phenol													
Color (units)	3	2	3	5	4	5	5	5	5	5	5	5	4
Sampling Date	01/18	02/14	03/13	04/18	05/17	06/19	07/18	08/14	09/18	10/16	11/13	12/18	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

TABLE 39: WATER QUALITY
MINIMUM DETECTION CONCENTRATIONS FOR TESTED SUBSTANCES*

CARBAMATES	Reporting Limit m g/L
1-Naphtol	4.00
3-Hydroxycarbofuran	2.00
Aldicarb	2.00
Aldicarb Sulfone	2.00
Aldicarb Sulfoxide	2.00
Cabaryl	2.00
Cabofuran	2.00
Methiocarb	4.00
Methomyl	2.00
Oxamyl	2.00
CHLORINATED HYDROCARBONS	
Alachlor	0.05
Aldrin	0.01
Atrazine	0.02
BHC (alpha, beta, delts, gamma)	0.01
Captan	0.02
Chlordane	0.05
Chlorothalonil	0.01
Chlorpropham	0.02
Chlorpyrifos	0.01
DCPA	0.01
DDD, DDE, DDT	0.01
Dichloran	0.01
Dicofol	0.01
Dieldrin	0.01
Diuron	0.05
Endosulfan Sulfate	0.01
Endosulfan (I,II)	0.01
Endrin	0.01
Endrin Aldehyde	0.01
Heptachlor	0.01
Heptachlor Epoxide	0.01
Methoxychlor	0.01
PCB (various isomers)	0.10
PCNB	0.01
Simazine	0.02
Thiuobencarb	0.02
Toxaphene	0.20
HERBICIDES	
2,4, - D	0.10
2,4 - DB	0.10
2,4,5 - TP	0.10
2,4,5 - T	0.10
Dicamba	0.10
MCPA	0.10
MCPP	0.10
Pentachlorophenol (PCP)	0.10
MISC. PESTICIDES	
Acephate	0.10
Aminomethylphosphonic	100.00

MISC. PESTICIDES (CONT.)	Reporting limit m g/L
Benfluralin	0.01
Glyphosate	100.00
Propargite	1.00
Trifluralin	0.01
ORGANIC PHOSPHORUS PESTICIDES	
Azinphosmethyl	0.05
Carbophenothion (Trithion)	0.02
Chlorpyrifos	0.01
Demeton	0.02
Diazinon	0.01
Dimethoate	0.01
Disulfoton	0.01
Ethion	0.01
Malathion	0.01
Methidathion	0.02
Methyl Parathion	0.01
Mevinphos	0.01
Naled	0.02
Parathion	0.01
Phorate	0.01
Phosalone	0.02
Phosmet	0.02
Profenofos	0.01
s,s,s-Tributyl Phosphorotrithioate (DEF)	0.01
PURGEABLE ORGANICS	
1,1,1-Trichloroethane	0.50
1,1,2-Trichloroethane	0.50
1,1-Dichloroethane	0.50
1,1-Dichloroethylene	0.50
1,2-Dichloroethane	0.50
1,2-Dichlorobenzene	0.50
1,2-Dechloropropane	0.50
1,3-Dechlorobenzene	0.50
1,4-Dechlorobenzene	0.50
Benzene	0.50
Bromodichloromethane	0.50
Bromoform	0.50
Carbon tetrachloride	0.50
Chlorobenzene	0.50
Chloroform	0.50
cis-1,2-Dechloroethylene	0.50
Dibromochloromethane	0.50
Ethytibenzene	0.50
Tetrachloroethylene	0.50
Toluene	0.50
trans-1,2-Dichloroethylene	0.50
Trichloroethylene	0.50
Trichlorofluoromethane	0.50
Vynil chloride	0.50
Xylene (s) 1	0.50

*Listed are those pesticides that would be detected by lab scans currently used for pesticide analysis, and the minimum concentration at which these substances can be detected. Detected amounts from the quarterly sampling program are shown below:

PESTICIDES IN THE CALIFORNIA AQUEDUCT
1989

STATION	FEB	MAY	AUG	NOV
HARVEY O. BANKS DELTA PUMPING PLANT				
Chlorinated Hydrocarbons	None Detected		Sample not	None Detected
Atrizine		0.49	collected	
Simazine		0.34	this month.	
O'NEILL PUMPING PLANT DISCHARGE				
Chlorinated Hydrocarbons		None Detected		None Detected
Simazine	0.18			
NEAR KETTLEMAN CITY (CHECK 21)				
Chlorinated Hydrocarbons		None Detected		None Detected
Diazinon	0.13 A/			
TEHACHAPI AFTERBAY				
Chlorinated Hydrocarbons				
Simazine	0.11	None Detected		
2,4-D				0.2 B/