SANTA ANA RIVER WATERMASTER

FOR

ORANGE COUNTY WATER DISTRICT

VS. CITY OF CHINO, et al

CASE NO. 117628 - COUNTY OF ORANGE

EIGHTEENTH

ANNUAL REPORT

OF THE

SANTA ANA RIVER WATERMASTER

1987 - 1988

APRIL 30, 1989

SANTA ANA RIVER WATERMASTER

ORANGE COUNTY WATER DISTRICT VS. CITY OF CHINO ET AL
CASE NO. 117628-- COUNTY OF ORANGE

WATERMASTER
Harvey O. Banks
William J. Carroll
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William R. Mills, Jr.
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April 30, 1989

To: Clerk of Superior Court of Orange County and all Parties

Re: Watermaster Report for 1987-88

Gentlemen:

We have the honor of submitting herewith the Eighteenth Annual Report of the Santa Ana River Watermaster.

The principal findings of the Watermaster for the water year 1987-88 are as follows:

At Prado

1.	Base Flow at Prado	124,104	acre-feet
2.	Annual Weighted TDS of Base and Storm Flows	582	mg/L
3.	Annual Adjusted Base Flow	136,308	acre-feet
4.	Cumulative Adjusted Base Flow	1,558,445	acre-feet
5.	Cumulative Entitlement of OCWD	756,000	acre-feet
6.	Cumulative Credit	802,445	acre-feet
7.	One-Third of Cumulative Debit	0	acre-feet
8.	Minimum Required Base Flow in 1988-89	34,000	acre-feet

At Riverside Narrows

1.	Base Flow at Riverside Narrows	55.324	acre-feet
2.	Annual Weighted TDS of Base Flow	620	mg/L
3.	Annual Adjusted Base Flow	55.324	acre-feet
4.	Cumulative Adjusted Base Flow	610.174	acre-feet
5.	Cumulative Entitlement of CBMWD and WMWD	274.500	acre-feet
6.	Cumulative Credit	335.674	acre-feet
7.	One-Third of Cumulative Debit	0	acre-feet
8.	Minimum Required Base Flow in 1988-89	12.420	acre-feet

The above findings show that at the end of the 1987-88 water year, Chino Basin Municipal Water District and Western Municipal Water District have a cumulative credit of 802.548 acre-feet to their Base Flow obligation at Prado Dam. San Bernardino Valley Municipal Water District has a cumulative credit of 335.674 acre-feet to its Base Flow obligation at Riverside Narrows.

The Watermaster continued to exercise surveillance over the many projects within the watershed for their potential effect on Base Flow.

Sincerely yours,

SANTA ANA RIVER WATERMASTER

BY: Harvey O. Banks Donald L. Harriger

William J. Carroll William R. Mills, Jr.

Robert L. Reiter

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E R R A T A

PLEASE NOTE THE FOLLOWING CHANGES:

Letter of transmittal page 2, paragraph beginning "The above findings show..." second line should read as follows:

"Water District and Western Municipal Water District have a cumulative credit of 802,445 acre-..."

Page 6, TABLE 3, last line should read as follows:

"1987-88 13.78 170,279(9) 124,104(9) 582 136,308 802,445"

Page 20, last line should read as follows:

"...Flow for 1987-88 was 582 mg/L, as shown above."

Page 21, second paragraph, first line should reas as follows:

"The weighted average annual TDS of 582 mg/L is less than 700 mg/L. Therefore, the Base..."

Page 26, second paragraph, last line should read as follows:

"...inclusion of the Rubidoux wastewater is shown in the following table as 620 mg/L."

NOTE: Please be aware that during the printing process the commas did not print properly and often appear as periods. Therefore, any numbers with three digits after a period should be read as thousands (i.e. 145.344 should be read as 145,344).

5/22/89:cml

CHAPTER I

WATERMASTER ACTIVITIES

This is the Eighteenth Annual Report of the Santa Ana River Watermaster required by the Stipulated Judgment in the case of Orange County Water District vs. City of Chino, et al., entered by the court on April 17, 1969. This Stipulated Judgment became effective on October 1, 1970, and contains a declaration of rights of the entities in the Lower Area of the Santa Ana River Basin downstream of Prado Dam as against those in the Upper Area, and provides a physical solution to implement the provisions of the Judgment. The physical solution accomplishes, in general, a regional intrabasin allocation of the surface flow of the Santa Ana River System. All defendants and cross-defendants were dismissed except the four major public water districts within the Santa Ana River Basin, namely, the San Bernardino Valley Municipal Water District (SBVMWD), Western Municipal Water District (WMWD), Chino Basin Municipal Water District (CBMWD), and Orange County Water District (OCWD). The boundaries of these districts are shown on Plate 1. This arrangement leaves to each of the major hydrologic units in the watershed the determination and regulation of individual rights therein and the development and implementation of its own basin management plan. The History of Litigation and the Summary of Judgment are included as Appendices F and G in the Fifteenth Annual Report.

In order to administer the provisions of the Judgment, the court appointed a Watermaster composed of five persons. Since August 15, 1985, the Santa Ana River Watermaster Committee has consisted of Harvey O. Banks, William J. Carroll, William R. Mills, Jr., Donald L. Harriger, and Robert L. Reiter. In 1987-88 Mr. Banks continued to serve as chairman, and Mr. Mills continued to serve as secretary.

The time for submission of the annual report is seven months after the end of the water year. The items to be reported upon are listed in the letter of transmittal of this report.

Stream Flow and Water Quality Measurements

Stream flow measurements and water quality data required by the Watermaster are, for the most part, furnished by the U.S. Geological Survey (USGS). The financing of the cooperative monitoring program with the USGS is shared by the parties to the Judgment. These costs are set forth in Table 1.

The USGS measured and computed the mean daily discharge of the Santa Ana River at MWDSC Crossing and below Prado Dam. Runoff data have also been provided for several smaller streams tributary to Prado Reservoir: namely, Chino Creek at Schaefer Avenue, Cucamonga Creek near Mira Loma and Temescal Wash at Corona, and for the Santa Ana River at E Street in San Bernardino.

Precipitation during 1987-88 was below normal and totaled 13.78 inches at San Bernardino County Hospital, 76% of the 26 year base period average of 17.98 inches. In October and November, 5.98 inches were recorded. In December, January, February, and March a total of 5.15 inches were measured. In April a total of 2.46 inches were recorded. Only 0.19 inches were measured after April.

Significant amounts of storm runoff were recorded during October and the first week of November at both Riverside Narrows and Prado. Storm runoff continued intermittently from about December 4 through April 26 at Prado and through April 30 at Riverside Narrows.

The 1987-88 discharge record for the USGS gaging station, "Santa Ana River below Prado," is considered by the USGS to be a "good" record. Ten (10) direct discharge measurements, which ranged from about 107 to 960 cubic feet per second, were made during the year. Beginning October 1, 1987, to June 22, 1988, except for a 6 day period April 8-13, the discharge was regulated by Prado Reservoir with a maximum of 12,295 acre-feet in storage on January 18, 1988. The maximum average daily discharge after regulation by Prado Reservoir occurred on January 20, 1988, and amounted to 977 cubic feet per second. The mean annual discharge was approximately 243 cubic feet per second.

TABLE 1

COSTS TO THE PARTIES AND USGS FOR MEASUREMENTS WHICH PROVIDE DATA USED BY THE SANTA ANA RIVER WATERMASTER

October 1, 1987, to September 30, 1988

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT		
At Riverside Narrows (MWD Crossing)		
Water Quality Monitor/TDS Samples	$ 667	
Surface Water Gage	1,225	$ 1,892
WESTERN MUNICIPAL WATER DISTRICT		
Same as SBVMWD	$ 1,892	
Cucamonga Creek Discharge	1,837	
Chino Creek Discharge	1,225	$ 4,954
CHINO BASIN MUNICIPAL WATER DISTRICT		
Same as WMWD		$ 4,954
ORANGE COUNTY WATER DISTRICT		
At Prado Dam		
Water Quality Monitor/TDS Samples, Water Quality Sampling and Conductivity Programs	$ 5,555	
Chino Creek		
Surface Water Gage	1,225	$ 6,780
TOTAL FOR PARTIES		$ 18,580
UNITED STATES GEOLOGICAL SURVEY		$ 17,700
GRAND TOTAL		$ 36,280

The overall 1987-88 discharge record for the USGS gaging station, "Santa Ana River at MWD Crossing," is considered by the USGS to be a "poor" record at both low and high stages because of the shifting channel. The station was located at the MWDSC pipeline crossing for the entire year. The continuous downstream movement of sand deposits affected the stage discharge relationship for the station. Twenty (20) direct discharge measurements, which ranged from about 62 to 757 feet per second, were made during the year.

Complication and Analysis of Basic Data

The Watermaster has established procedures for compiling and analyzing the basic data necessary to carry out the provisions of the Judgment. The records maintained by the Watermaster have been listed in prior Annual Reports. Based on these data, determinations were made of the Base Flow, Storm Flow, Nontributary Flow, and relationships between electrical conductivity (EC) and total dissolved solids (TDS). These determinations are explained in detail in Chapters III and IV.

Administration Costs

In accordance with Paragraph 7(d) of the Judgment, the fees and expenses of each of the members of the Watermaster are borne by the district which nominated such member. All other Watermaster administrative costs and expenses are borne by the parties, with OCWD paying 40% of the cost and WMWD, SBVMWD, and CBMWD each paying 20% of the cost. The Judgment further provides that the Watermaster may from time to time, at its discretion, require advances of operating capital form the parties.

At its meeting on May 7, 1987, the Watermaster adopted a budget for the fiscal year 1987-88 in the amount of $16,000. Table 2 shows the items and amount included in said budgets together with actual expenses for the fiscal year 1987-88. At its meeting on May 26, 1988, the Watermaster adopted a budget for fiscal year 1988-89 in the amount of $16,000.

An audit prepared by Diehl, Evans and Company showing the details of income and expenses of the Santa Ana River Watermaster for the fiscal year 1987-88 is included herein as Appendix E.

TABLE 2

SANTA ANA RIVER WATERMASTER BUDGET AND EXPENSES

	July 1, 1987 to June 30, 1988 Budget	July 1, 1987 to June 30, 1988 Expenses	July 1, 1988 to June 30, 1989 Budget
Administration	$ 5.000.00	$ 3,178.00	$ 5.000.00
Support Engineering Services	8.000.00	7.762.00	8.000.00
Reproduction of Annual Report	3.000.00	1.754.00	3.000.00
Total	$16.0 00.00	$ 12.694.00	$16.000.00

Summary of Findings

A summary of findings by the Watermaster for the period 1970-71 through 1987-88 is presented in Table 3. The Base Flow obligations at both Riverside Narrows and Prado Dam provided for in the Judgment have been met and cumulative credits have been established.

TABLE 3
SUMMARY OF FINDINGS
AT PRADO

Water Year	Rainfall (in)(1)	Total Flow (ac-ft)(2)	Base Flow (ac-ft)	Weighted TDS (mg/L)(3)	Adjusted Base Flow (ac-ft)	Cumulative Credit (ac-ft)
1970-71	11.97	51.864	38.402	727	38.402	(3.598)
1971-72	9.62	51.743	40.416	707	40.416	(5.182)
1972-73	18.46	77.484	48.999	638	51.531	4.349
1973-74	12.72	63.620	43.106	633	45.513	7.862
1974-75	13.49	61.855	50.176	694	51.263	17.125
1975-76	15.86	59.209	45.627	635	48.098	23.223
1976-77	11.95	62.953	48.387	660	50.000	31.223
1977-78	30.47	252.837	58.501	383	73.955	63.178
1978-79	17.51	134.486	71.863	580	79.049	100.227
1979-80	30.93	527.760	82.509	351	106.505	164.732
1980-81	10.45	117.888(4)	74.875(5)	728	74.875(5)	205.652(6)
1981-82	18.34	143.702	81.548	584	89.431	253.083
1982-83	32.36	426.273(4)	111.692(5)	411	138.591(5)	353.036(6)
1983-84	10.81	178.395(4)	109.231(5)	627	115.876(5)	431.514(6)
1984-85	12.86	162.912	125.023(8)	617	133.670	523.184
1985-86	17.86	196.565	127.215(8)	567	141.315	622.499
1986-87	8.08	140.538	119.848	622	127.638	708.137
1987-88	13.78	170.279(9)	124.104(9)	581	136.411	802.548

TABLE 3
(Continued)

AT RIVERSIDE NARROWS

Water Year	Rainfall (in)(1)	Total Flow (ac-ft)(2)	Base Flow (ac-ft)	Weighted TDS (mg/L)(3)	Adjusted Base Flow (ac-ft)	Cumulative Credit (ac-ft)
1970-71	11.97	24,112	17,061	704	17,012	1,762
1971-72	9.62	22,253	16,157	712	16,017	2,529
1972-73	18.46	32,571	17,105	700	17,105	4,384
1973-74	12.72	24,494	16,203	700	16,203	5,337
1974-75	13.49	19,644	15,445	731	15,100	5,187
1975-76	15.86	26,540	17,263	723	16,977	6,914
1976-77	11.95	23,978	18,581	722	18,286	9,950
1977-78	30.47	181,760	22,360	726	21,941	16,641
1978-79	17.51	47,298	26,590	707	26,456	27,847
1979-80	30.93	254,077	25,549(7)	676	25,549	38,146
1980-81	10.45	34,278	19,764	715	19,550	42,446
1981-82	18.34	83,050	32,778	678	32,778	59,974
1982-83	32.36	279,987	57,128	610	57,128	101,852
1983-84	10.81	82,745	56,948	647	56,948	143,550
1984-85	12.86	78,771	69,772(8)	633	69,772	198,072
1985-86	17.86	99,258	68,220(8)	624	68,220	251,042
1986-87	8.08	77,752	59,808	649	59,808	295,600
1987-88	13.78	79,706	55,324	617	55,324	335,674

(1) Measured at San Bernardino County Hospital.

(2) Does not include Nontributary Flow.

(3) For Base and Storm Flow at Prado and Base Flow only at Riverside Narrows.

(4) Includes 16,090 acre-feet of water pumped from Lake Elsinore which passed Prado Dam in 1980-81; 7,720 acre-feet in 1982-83 and 12,550 acre-feet in 1983-84.

(5) Excludes water pumped from Lake Elsinore.

(6) Includes 8,045 acre-feet in the 1979-80, 3,362 acre-feet in 1982-83, and 4,602 acre-feet in 1983-84 of Lake Elsinore discharge.

(7) Includes Rubidoux Wastewater in 1979-80 and subsequent years.

(8) The values shown include ground water pumped from San Bernardino Basin and released to the river in accordance with Court Orders approving agreement and allowing temporary additional extractions of water from the San Bernardino Basin Area.

(9) Nontributary flow released to San Antonio Creek by MWDSC under the Ontario/MWDSC Exchange Program has been deducted.

Note: For the years 1973 through 1979-80, a correction has been made for different losses of State water than assumed in reports published for these years. The values changed are Base Flow, weighted TDS, and adjusted Base Flow. These changes, in turn, have changed the cumulative credit for these years. See Appendix C in the Twelfth Annual Report, 1981-82.

CHAPTER II
WATER SUPPLY CONDITIONS

The precipitation in the Santa Ana River Watershed during 1987-88. as represented by rainfall measured at San Bernardino County Hospital. was about 76% of normal in terms of the Base Period average. The Total Flow of the Santa Ana River below Prado Dam during the 1987-88 water year was about 176.300 acre-feet as compared to a total flow of 140.000 acre-feet which occurred in the previous year. The subnormal rainfall in the Santa Ana River Watershed during 1987-88 resulted in Base Flow amounts at both Prado and Riverside Narrows. 124.104 acre-feet and 55.324 acre-feet. respectively. or 103% and 93%. respectively. of 1986-87 Base Flows.

Chino Basin Ground Water Storage Program

This program was described and its implications with respect to Watermaster responsibilities and activities were described in the Sixteenth Annual Report. No water was stored underground in 1987-88 or previously. Metropolitan Water District of Southern California (MWDSC) is negotiating agreements with the concerned agencies. and is making the necessary environmental studies and preparing the required environmental documentation and environmental impact report.

Discharge of Ground Water from San Bernardino Basin Area To Santa Ana River

This program also was described in the Sixteenth Annual Report. No ground water was pumped from San Bernardino Basin to the Santa Ana River in 1987-88.

Discharge of State Water Project Water Above Prado Ontario/MWD Exchange Program

The Sixteenth Annual Report presents a description of this program and its implications with respect to the responsibilities and activities of the Watermaster. During 1987-88 MWDSC

delivered 5.106 acre-feet of Colorado River exchange water to the City of Ontario. State Water Project water was released to San Antonio Creek in the amount of 6.008 acre-feet.

The Watermaster has made some further field studies of the hydrologic and hydraulic conditions along Chino Creek as such conditions may affect quantity and quality of Base Flow at Prado due to the State Water Project dilution water released to San Antonio Creek from OC-59. The Watermaster developed a methodology and the procedures to determine such effects. For this report, a 4.1% loss and a transit period of 12 hours were determined.

MWDSC has agreed to reimburse the Watermaster for the increase in costs due to the Watermaster's involvement with the Program in determining the Base Flow effects.

Santa Ana Watershed Project Authority Projects Affecting Base Flow in the Santa Ana River

The activities of the Santa Ana Watershed Project Authority of interest to the Watermaster in carrying out its responsibilities were discussed in the Seventeenth Annual Report.

Precipitation During 1987-88

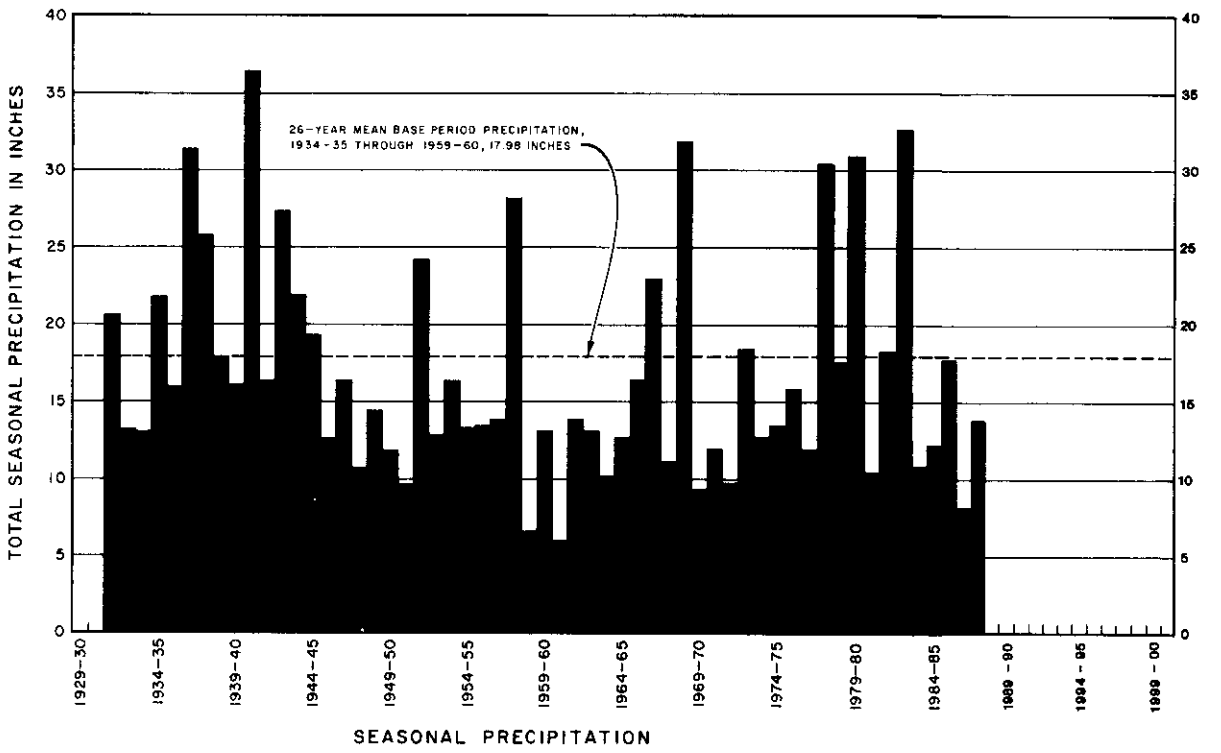
During the 1987-88 water year, the precipitation at the San Bernardino County Hospital amounted to 13.78 inches, which is 76% of the Base Period average. Most of the precipitation, 68%, occurred during the months of October through January. In April, 2.46 inches were recorded. The maximum monthly precipitation of 3.54 inches occurred during October.

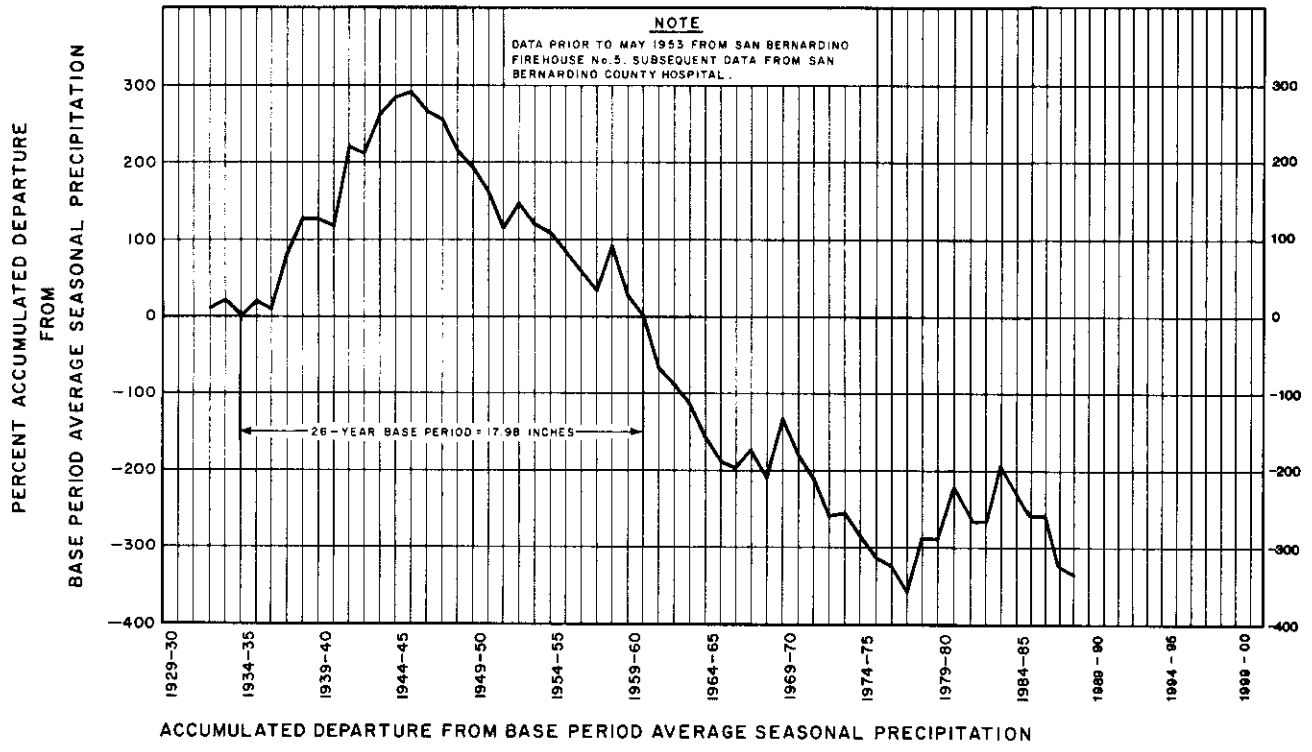
Figure 1 shows the seasonal precipitation form 1931-32 through 1987-88 and the accumulated departure from the 1934-35 through 1959-60 Base Period average.

Runoff During 1987-88

Below Prado

The total inflow at Prado for the 1987-88 water year was about 172.800 acre-feet, well above the Base Period (1934-35 through 1959-60) average of 78.780 acre-feet per year.





VARIATION IN PRECIPITATION AT SAN BERNARDINO

FIGURE 1

After 1943-44, the Base Flow at Prado Dam progressively decreased and reached a low in 1960-61 of 26,190 acre-feet. Since that year, the Base Flow has substantially increased. During the 18-year period (1970-71 through 1987-88) since the Judgment went into effect, the Base Flow, unadjusted for quality, has averaged 77,862 acre-feet per year. This compares to the 26-year Base Period average of 47,470 acre-feet and the Base Flow requirements under the Judgment of 42,000 acre-feet. The 1987-88 unadjusted Base Flow amounted to 124,104 acre-feet, an increase of 46,242 acre-feet over the 18-year average.

The calculated inflow to Prado Reservoir in 1987-88 was about 172,800 acre-feet exclusive of nontributary State Water Project water released to San Antonio Creek. During the month of December, inflow amounted to 21,882 acre-feet, or 13% of the seasonal total. The recorded maximum storage in Prado Reservoir occurred on January 18, 1988, when 12,295 acre-feet (about 3% of the reservoir capacity at spillway level) was in storage. The maximum release of 977 cfs from Prado Reservoir occurred January 20, 1988.

Figure 2 shows the Storm and Base Flow components of the Total Flow in the Santa Ana River below Prado Dam during the period 1934-35 through 1987-88.

At Riverside Narrows

The Total Flow of the Santa Ana River at Riverside Narrows for the 1987-88 water year was about 80,047 acre-feet.

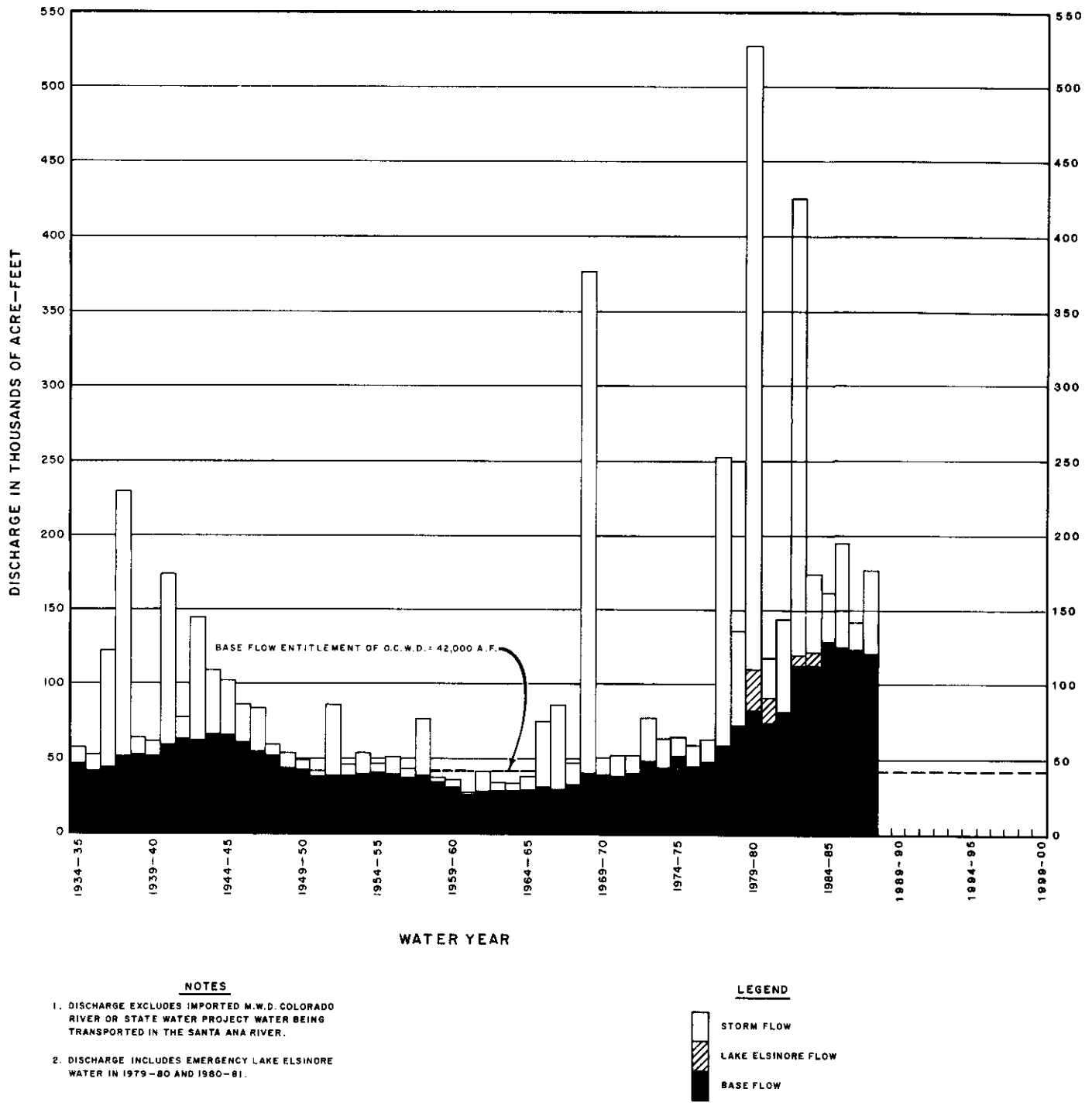
The unadjusted Base Flow at Riverside Narrows decreased from 27,120 acre-feet in 1943-44 to an all-time low of 13,450 acre-feet in 1965-66. Since that time, the Base Flow at Riverside Narrows has gradually increased, except in 1986-87 and 1987-88. During the 18-year period 1970-71 through 1987-88, the Base Flow has averaged 34,003 acre-feet per year. The 1987-88 unadjusted Base Flow amounted to 55,324 acre-feet, an increase of 21,321 acre-feet over the 18-year average.

Figure 3 shows the components of Total Flow in the Santa Ana River at Riverside Narrows for the period from 1934-35 through 1987-88.

Wastewater Effluent Discharges

A portion of the Base Flow at Prado is made up of treated wastewater effluent discharged from a number of wastewater treatment plants located above Prado Dam.

The quantities discharged by the major agencies are shown in Table No. 4. For the year 1987-88, about 123,000 acre-feet were discharged to the River above Prado Dam.



NOTES

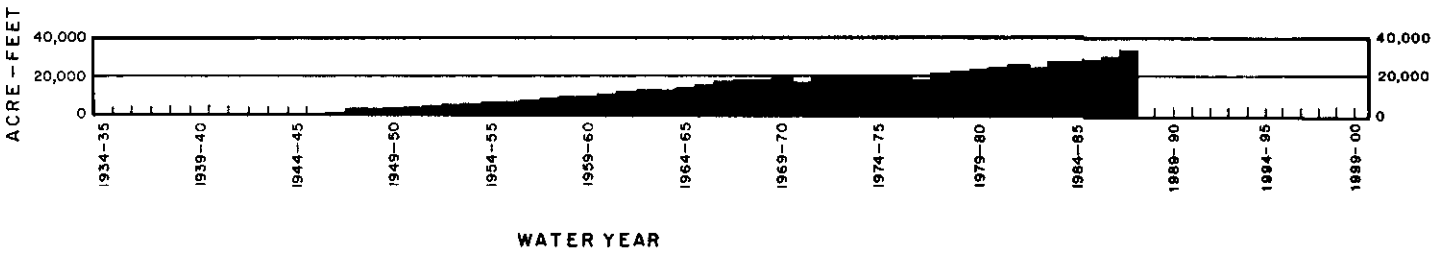
1. DISCHARGE EXCLUDES IMPORTED M.W.D. COLORADO RIVER OR STATE WATER PROJECT WATER BEING TRANSPORTED IN THE SANTA ANA RIVER.
2. DISCHARGE INCLUDES EMERGENCY LAKE ELSINORE WATER IN 1979-80 AND 1980-81.

LEGEND

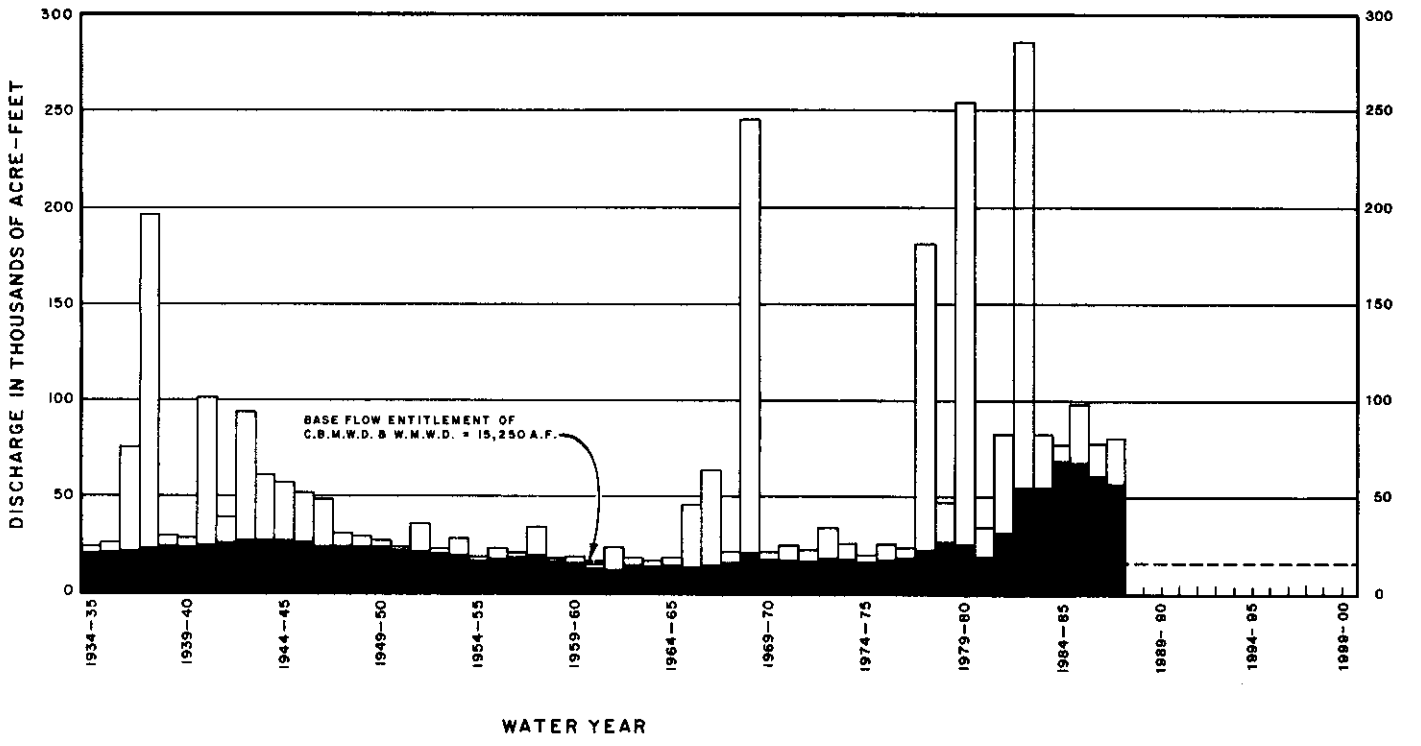
- STORM FLOW
- LAKE ELSINORE FLOW
- BASE FLOW

DISCHARGE OF SANTA ANA RIVER BELOW PRADO DAM

FIGURE 2



SEWAGE EFFLUENT FROM RIVERSIDE WATER QUALITY CONTROL PLANTS



NOTES

1. DISCHARGE EXCLUDES SEWAGE EFFLUENT FROM THE RIVERSIDE WATER QUALITY CONTROL PLANTS AND IMPORTED M.W.D. COLORADO RIVER OR STATE WATER PROJECT WATER BEING TRANSPORTED IN THE SANTA ANA RIVER.

2. DISCHARGE OF RUBIDOUX WASTEWATER PLANT INCLUDED IN BASE FLOW COMMENCING IN 1979-80.

LEGEND

STORM FLOW

BASE FLOW

DISCHARGE OF SANTA ANA RIVER AT RIVERSIDE NARROWS

FIGURE 3

TABLE 4

WASTEWATER EFFLUENT DISCHARGED
ABOVE PRADO BY MAJOR AGENCIES
(Acre-Feet)

Year	Red-lands	San Bern.	Colton	Rialto	River-side	Corona	CBMWD #1	CBMWD #2	Total
1970-71	2,650	17,860	2,520	2,270	18,620	3,190	0	0	47,110
1971-72	2,830	16,020	2,230	2,400	19,010	3,230	6,740	0	52,460
1972-73	2,810	18,670	2,530	2,260	19,060	3,340	10,380	0	59,050
1973-74	2,770	17,680	2,350	2,320	19,560	3,510	11,440	2,320	61,950
1974-75	2,540	16,750	1,980	2,320	19,340	4,020	14,960	2,280	64,190
1975-76	2,450	17,250	2,540	2,240	19,580	4,700	15,450	2,950	67,160
1976-77	3,170	17,650	3,260	2,330	18,770	5,010	14,640	3,380	68,210
1977-78	3,280	18,590	3,810	2,380	20,310	5,200	14,650	4,060	72,280
1978-79	3,740	19,040	3,850	3,050	21,070	5,390	15,040	5,070	76,250
1979-80	4,190	20,360	4,190	2,990	22,910	5,360	14,410	5,520	79,930
1980-81	4,410	20,550	3,930	3,370	24,180	5,590	17,270	5,260	84,560
1981-82	4,420	23,340	3,780	3,470	25,640	5,410	19,580	5,360	91,000
1982-83	4,530	24,160	3,600	3,620	25,020	5,860	20,790	4,290	91,870
1983-84	5,150	22,080	3,700	3,830	26,090	6,200	20,950	3,950	91,950
1984-85	4,990	23,270	3,830	4,070	27,750	6,250	25,160	4,280	99,600
1985-86	5,200	24,720	4,010	4,720	28,820	5,900	28,240	2,660	104,270
1986-87	5,780	26,810	4,170	5,350	30,340	6,170	27,160	5,000	110,780
1987-88	6,060	27,880	5,240	6,040	34,660	6,050	31,290	5,500	122,720

The amounts shown in Table 4 were determined from data provided by the agencies.

CHAPTER III

BASE FLOW AT PRADO

This chapter deals with determinations of: 1) the components of flow at Prado, which include Nontributary Flow, Storm Flow, and Base Flow; and 2) the adjusted Base Flow at Prado credited to CBMWD and WMWD.

Total Flow at Prado

The Total Flow of the Santa Ana River below Prado amounted to 176,292 acre-feet, measured at the USGS gaging station below Prado. This included 3,461 acre-feet that was in storage at the beginning of the year. No water was in storage at the end of the water year. The inflow into the reservoir, comprised 124,104 acre-feet of Base Flow and 42,714 acre-feet of Storm Flow. Nontributary Flow during 1987-88 due to the release of State Water Project water above Riverside Narrows during 1972-73 was 334 acre-feet. Nontributary flow due to State Water Project water releases to San Antonio Creek during the 1987-88 water year was 5,679 acre-feet. The components of flow of the Santa Ana River at Prado for each month in the 1987-88 water year are listed in Table 5, and are shown graphically on Plate 2.

Nontributary Flow

Since May 1973, OCWD has from time to time purchased State Water Project water for the replenishment of the groundwater basins in Orange County. The water has been released at two locations: Santa Ana River above Riverside Narrows (1972-73 only) and San Antonio Creek near Upland.

Releases Above Riverside Narrows

As fully discussed in Appendix F of the Fifth Annual Report, the Watermaster Committee determined a schedule of credits to OCWD for State Water Project water which was released above Riverside Narrows during 1972-73; for 1987-88 the credit is 334 acre-feet, assumed to be distributed uniformly throughout the year, as shown in Table 5. A portion of this water, because it percolated in the basin above the Narrows, did not reach the Narrows in 1972-73, and the schedule as developed in the Fifth Annual Report, is the best estimate of the amount that reaches Riverside Narrows each year.

TABLE 5
COMPONENTS OF FLOW AT PRADO DAM
FOR WATER YEAR 1987-88

(Acre-feet)

Month	USGS Measured Outflow	Storage Change (1)	Computed Inflow	Storm Flow	Nontributary Water Riverside Narrows (2)	Nontributary Water San Antonio Creek (3)	Base Flow
October	14.779	-583	14.196	5.913	28	0	8.255
November	16.741	-597	16.144	6.149	28	0	9.967
December	15.045	5.300	20.345	8.589	28	0	11.728
January	24.273	-2.391	21.882	9.765	28	0	12.089
February	18.060	-1.964	16.096	2.444	28	0	13.624
March	18.964	-2.763	16.201	3.360	28	0	12.813
April	14.052	4.000	18.051	6.495	28	725	10.804
May	14.198	-3.493	10.705	0	28	0	10.677
June	10.484	-971	9.513	0	28	447	9,038
July	10.675	0	10.675	0	28	2,149	8.498
August	9.402	0	9.402	0	27	875	8.500
September	9.620	0	9.620	0	27	1,483	8,110
Total	176.292	(3.461)	172.831	42.714	334	5.679	124,104

(1) The monthly change in storage is included in the monthly components of flow.

(2) That portion of State Water Project water released during 1972-73 upstream of Riverside Narrows. determined to have reached Prado in 1987-88.

(3) State Water Project water released into San Antonio Creek from OC-59 during 1987-88 and calculated to have reached Prado Dam in 1987-88 water year.

Releases to San Antonio Creek

During the water year 1987-88. 6.008 acre-feet of State Water Project water was released from the Rialto reach of the Foothill Feeder at OC-59 into San Antonio Creek near Upland. Losses

between OC-59 and Prado Dam were calculated per the procedures set forth in the Twelfth Annual Report of the Santa Ana River Watermaster (1981-82) Appendix C. The results of these calculations are shown in Table 2, Appendix A. Losses were estimated using these procedures to be about 4.1%. Conclusions of this analysis showed that about 5,679 acre-feet reached Prado Dam, 243 acre-feet were lost to evapotranspiration and about 86 acre-feet were still enroute at the end of the water year. A summary of the monthly totals for Nontributary water from OC-59 is shown on Table A-1, Appendix A.

During the 1987-88 water year, more than 100 acre-feet of water were stored behind Prado during the periods October 1 to April 4 and April 15 to June 16. During those periods, the water stored in Prado Reservoir varied up to a maximum of 12,295 acre-feet and the maximum mean daily flow released to the Santa Ana River was 977 cfs.

Storm Flow

Portions of storm flows are retained behind Prado Dam for regulation of downstream flows and for water conservation purposes. The U.S. Army Corps of Engineers (CORPS) owns and operates Prado Dam and operates according to a release schedule utilizing a debris pool elevation of 490 feet which impounds about 5,000 acre-feet. Storm flows captured within the debris pool are released following the storm to downstream groundwater recharge facilities. Monthly and annual quantities of storm flow are shown in Table 5.

The Orange County Water District and Corps completed their cooperative study on seasonal water conservation at Prado. The District funded study was conducted by the Corps and was completed in May 1988. The study evaluated the impacts of a seasonal water conservation program, beginning in April of each year on all existing uses within Prado reservoir at various elevations up to a maximum of 514 feet. The study concludes that a seasonal water conservation operating plan at Prado Dam would be consistent with sound flood control practices, and is viable and cost effective at all elevations up to 514 feet. However, the District must secure all necessary agreements and would be responsible for all implementation and operational costs. Two primary factors which must be resolved in the future are related to the existing oil production facilities and the least Bell's vireo, an endangered species.

During 1988, the cowbird trapping program conducted by CALTRANS in Prado Basin was concluded. The cowbird trapping program was intended to enhance the environment for the least Bell's vireo. The cowbird is a predator to the vireo. During the three year program, the numbers of least Bell's vireos dramatically increased and it is believed that the cowbird trapping program was primarily responsible.

During 1988, the Corps of Engineers continued their Santa Ana River Mainstream studies. A draft report was completed in August 1988. Congress continues to appropriate funds for further study and design of the project; however, construction starts have not been authorized.

Base Flow

The determination of Base Flow was affected by Nontributary Flow which had been released to San Antonio Creek and above Riverside Narrows. The general procedure used by the Watermaster to separate the 1987-88 flow components was the same as used for previous years and is fully described in the Fifth Annual Report, and the Twelfth Annual Report. The monthly and annual amounts are shown in Table 5.

Water Quality

The weighted average total dissolved solids (TDS) for the total flow passing Prado Dam, including Nontributary Flow released above Riverside Narrows and to San Antonio Creek, was found to be 584 mg/L. This determination was based on records from a continuous monitoring device, operated by the USGS, for electrical conductivity (EC) of the Santa Ana River below Prado, supplemented by grab samples for EC and TDS determination, and a statistical correlation of EC and TDS.

The EC of the outflow at Prado was recorded hourly on a punched tape by the USGS. The USGS collected a total of 22 grab samples and performed laboratory analyses for TDS. A correlation between TDS and EC was developed using the TDS data from the grab samples and the field EC recorded by the technician at the times when the samples were collected. Data used for the statistical analysis are listed in Table B-1, Appendix B. The statistical analysis yields the best fit equation shown as follows:

$$TDS = EC/[1.59 + (4.24 \times 10^{-5} \times EC)]$$

where: TDS = mg/L

EC = micromhos/cm

Application of the equation relating EC to TDS provided hourly TDS values. Using hourly data, flow weighted average daily values for TDS were computed and are listed in Table B-2, Appendix B.

The plot of TDS on Plate 3 shows the daily average TDS concentration of the Santa Ana River flow passing Prado Dam. The daily average TDS concentration was calculated from the hourly EC measurements and the correlation of EC and TDS. The daily TDS concentration could not be determined during the period when continuous EC data were not available, TDS was approximated by using best available data.

Water Quality Adjustment for Nontributary Flow

The weighted average annual TDS value of 584 mg/L, shown in Table B-3, Appendix B, represents the quality of Total Flow which includes Nontributary Flow from release of State Water Project water to San Antonio Creek and to Santa Ana River above Riverside Narrows. The Stipulated Judgment requires that Base Flow shall be subject to adjustment based on the TDS of Base Flow and Storm Flow only. Hence the following determination of Base Flow plus Storm Flow TDS has been made.

The flow weighted average TDS of State Water Project water arriving below Prado Dam from releases to San Antonio Creek in 1987-88 was 429 mg/L. This includes a 4.1% evapotranspiration loss and was determined using the procedures referenced in the Twelfth Annual Report, Appendix C. The calculation of weighted TDS of State Water Project water arriving at Prado Dam from releases at OC-59 is shown on Table A-3, Appendix A.

The amount of State Water Project dilution water required at Prado to mitigate the Ontario/MWDSC Exchange Program, as described in Chapter II of this report, was calculated to be 8.803 acre-feet. During this water year only 5679 acre-feet arrived at Prado from releases at OC-59. The discharge deficiency was, therefore, 3.124 acre-feet.

The flow weighted average TDS of State Water Project water released above Riverside Narrows during 1972-73 was 235 mg/L and was adjusted to 242 mg/L to reflect a 3% evapotranspiration loss of the water released.

		Annual Flow (Acre-feet)	Avg. TDS (mg/L)	Annual Flow x Average TDS (Acre-feet)(mg/L)
1.	Total Flow	176.292	584	102.954.528
2.	Nontributary Flow Riverside Narrows	334	242	80.828
3.	Ontario/MWDSC Exchange Program discharge deficiency	3.124	429	1.340.196
4.	Total Flow less Nontributary Flow plus discharge deficiency	179.082		104.213.896

Average TDS of Base and Storm Flows: 104.213.896 ÷ 179.082 = 582 mg/L

After adjusting for Nontributary Flows of State Water Project water from above Riverside Narrows and to San Antonio Creek, the weighted average annual TDS of Storm Flow and Base Flow for 1987-88 was 581 mg/L, as shown above.

Adjusted Base Flow at Prado

The stipulated Judgment provides that the amount of Base Flow at Prado received during any year shall be subjected to adjustment based on weighted average annual TDS of the Base Flow and Storm Flow at Prado as follows:

If the Weighted Average TDS in Base Flow and Storm Flow at Prado is:	Then the Adjusted Base Flow shall be determined by the formula:
Greater than 800 mg/L	$Q - \frac{35}{42.000}$ Q (TDS-800)
700 mg/L to 800 mg/L	Q
Less than 700 mg/L	$Q + \frac{35}{42.000}$ Q (700-TDS)

Where: Q = Base Flow actual received.

The weighted average annual TDS of 581 mg/L is less than 700 mg/L. Therefore, the Base Flow must be adjusted by the above equation for TDS less than 700 mg/L. Thus the Adjusted Base Flow is as follows:

$$(124.104 \text{ ac-ft}) + \frac{35}{42.000}(124.104 \text{ ac-ft})(700 - 582) = 136.308 \text{ ac-ft}$$

Entitlement and Credit or Debit

From pages 12 and 13 of the Stipulated Judgment, the following obligation of the CBMWD and WMWD is given: "CBMWD and WMWD shall be responsible for an average annual Adjusted Base Flow of 42,000 acre-feet at Prado. CBMWD and WMWD each year shall be responsible for not less than 37,000 acre-feet of Base Flow at Prado, plus one-third of any cumulative debit; provided, however, that for any year commencing on or after October 1, 1986, when there is not cumulative debit, or for any year prior to 1986 whenever the cumulative credit exceeds 30,000 acre-feet, said minimum shall be 34,000 acre-feet."

The Watermaster's findings concerning flow at Prado for 1987-88 required under the Stipulated Judgment are as follows:

1.	Total Flow at Prado	176.292	acre-feet
2.	Base Flow at Prado	124.104	acre-feet
3.	Annual Weighted TDS of Base and Storm Flows	582	mg/L
4.	Annual Adjusted Base Flow	136.308	acre-feet
5.	Cumulative Adjusted Base Flow	1.558.445	acre-feet
6.	Cumulative Entitlement of OCWD	756.000	acre-feet
7.	Cumulative Credit	802.445	acre-feet
8.	One-Third of Cumulative Debit	0	acre-feet
9.	Minimum Required Base Flow in 1988-89	34.000	acre-feet

CHAPTER IV

BASE FLOW AT RIVERSIDE NARROWS

This chapter deals with determination of 1) the components of flow at Riverside Narrows, which include Nontributary Flow, Storm Flow, and Base Flow; and 2) the adjusted Base Flow at Riverside Narrows credited to SBVMWD.

Total Flow at Riverside Narrows

The total flow of the Santa Ana River at Riverside Narrows amounted to 80,047 acre-feet, measured at the USGS gaging station near the MWD Upper Feeder Crossing. Separated into its components, Base Flow was 55,324 acre-feet, Storm Flow was 26,521 acre-feet, and Nontributary Flow due to a prior release of State Water Project water above Riverside Narrows was 341 acre-feet. Included in Base Flow are 2,139 acre-feet of wastewater from Rubidoux Community Services District which now bypasses the USGS gaging station. The components of flow of the Santa Ana River at Riverside Narrows for each month in the 1987-88 water year are listed in Table 6 and graphically shown on Plate 4.

Nontributary Flow

During the period May through September, 1973, 11,617 acre-feet of State Water Project water from the East Branch of the California Aqueduct were purchased by the Orange County Water District and released into the Santa Ana River in the vicinity of Colton.

The Watermaster's determination of the effect of these releases has been discussed in the Fifth Annual Report of the Watermaster. For the water year 1987-88 the amount of State Water Project water reaching Riverside Narrows has been agreed upon as 341 acre-feet.

Base Flow

Based on the hydrograph shown on Plate 4 and utilizing in general the procedures reflected in the Work Papers of the engineers (as referenced in Paragraph 2 of the Engineering Appendix of the Stipulated Judgment). a separation was made between Storm Flow and the sum of Base Flow and Nontributary Flow.

TABLE 6

COMPONENTS OF FLOW AT RIVERSIDE NARROWS

FOR WATER YEAR 1987-88
(acre-feet)

		Total Flow USGS Measurement	Storm Flow	Non-tributary Flow	Rubidoux Waste-water	Base Flow (1)
1987	October	11,948	7,545	29	198	4,572
	November	8,465	4,814	29	172	3,794
	December	7,611	3,152	29	173	4,603
1988	January	8,753	4,169	29	173	4,728
	February	4,669	795	29	173	4,018
	March	7,018	1,490	28	186	5,686
	April	9,253	4,439	28	175	4,961
	May	4,641	67	28	178	4,724
	June	4,019	0	28	172	4,163
	July	4,558	0	28	179	4,709
	August	4,479	0	28	181	4,632
	September	4,633	50	28	179	4,734
Total		80,047	26,521	341	2,139	55,324

(1) Base Flow includes Rubidoux wastewater discharged below Riverside Narrows.

Nontributary Flow was assumed to be equally distributed throughout the year (341 acre-feet divided by 12 months) and subtracted from the sum of the Base Flow and Nontributary Flow as shown on Table 6.

In April 1980, Rubidoux Community Services District made the first delivery of wastewater to the regional treatment plant at Riverside. Prior to that time, Rubidoux had discharged to the river upstream of the Riverside Narrows Gaging Station. Wastewater from Rubidoux during water year 1987-88, in the amount of 2,139 acre-feet as shown in Appendix D, has been added to the streamflow as measured at the gaging station.

Water Quality

The determination of quality of water at the Riverside Narrows Gaging Station was made using periodic grab samples taken and analyzed for TDS by the USGS, DWR and the City of Riverside. The results are summarized in Appendix C, Table C-1. Table C-2 shows the flow weighted quality of streamflow passing the gaging station which includes the Nontributary Flow.

The flow weighted quality of wastewater from Rubidoux is shown in Appendix D, Table D-1 as 717 mg/L. The Base Flow quality resulting from exclusion of the Nontributary Flow and inclusion of the Rubidoux wastewater is shown in the following table as 617 mg/L.

		Annual Flow (acre-feet)	Avg. TDS (mg/L)	Annual Flow x Avg. TDS (acre-feet x mg/L)
1.	Base Flow including Nontributary Flow	53,526	614	32,864,964
2.	Less Nontributary Flow	341	237	80,817
3.	Plus Rubidoux Wastewater	2,139	717	1,533,663
4.	Average TDS of Base Flow		34,317,810 ÷ 55,324 = 620	

Adjusted Base Flow at Riverside Narrows

The Stipulated Judgment provides that the amount of Base Flow at Riverside Narrows received during any year shall be subject to adjustment based on the weighted average annual TDS of the Base Flow as follows:

If the Weighted Average TDS in Base Flow at Riverside Narrow is:	Then the Adjusted Base Flow shall be determined by the formula:
Greater than 700 mg/L	$Q - \frac{11}{15.250} Q\ (TDS-700)$
600 mg/L to 700 mg/L	Q
Less than 600 mg/L	$Q + \frac{11}{15.250} Q\ (600-TDS)$

Where: Q = Base Flow actually received.

From the previous subsection, the weighted average annual TDS in the Base Flow at Riverside Narrows for the water year 1987-88 was 620 mg/L. Therefore, no adjustment is necessary, and the Adjusted Base Flow for 1987-88 is 55.324.

Entitlement and Credit or Debit

Paragraph 5(b) of the Judgment states that "SBVMWD shall be responsible for an average annual Adjusted Base Flow of 15,250 acre-feet at Riverside Narrows... SBVMWD each year shall be responsible at Riverside Narrows for not less than 13,420 acre-feet of Base Flow plus one-third of any cumulative debit, provided, however, that for any year commencing on or after October 1, 1986, when there is no cumulative debit, or for any year prior to 1986 whenever the cumulative credit exceeds 10,000 acre-feet, said minimum shall be 12,420 acre-feet."

The Watermaster's findings at Riverside Narrows for 1987-88 required under the judgment are as follows:

1.	Base Flow at Riverside Narrows	55.324	acre-feet
2.	Annual Weighted TDS of Base Flow	620	mg/L
3.	Annual Adjusted Base Flow	55.324	acre-feet
4.	Cumulative Adjusted Base Flow	610.174	acre-feet
5.	Cumulative Entitlement of CBMWD and WMWD	274.500	acre-feet
6.	Cumulative Credit	335.674	acre-feet
7.	One-Third of Cumulative Debit	0	acre-feet
8.	Minimum Required Base Flow in 1988-89	12.420	acre-feet

APPENDIX A

NONTRIBUTARY WATER RELEASED BY MWD TO SAN ANTONIO CREEK NEAR UPLAND

CONNECTION OC-59

1987-88

PREPARED BY

DONALD L. HARRIGER

TABLE A-1

NONTRIBUTARY WATER FROM OC-59
MONTHLY TOTALS
(Acre-Feet)

WATER YEAR 1987-88

Month	Released at OC-59	12 hr delay	Calculated flow at Prado (1)
1987			
October	0	0	0
November	0	0	0
December	0	0	0
1988			
January	0	0	0
February	0	0	0
March	0	0	0
April	756	756	725
May	0	0	0
June	512	466	447
July	2237	2241	2149
August	875	912	875
September	1628	1547	1483
TOTAL (2)	6008	5922	5679

Notes: (1) Calculated flow at Prado includes a 4.1% evapotranspiration loss calculated per the procedures referenced in the Twelfth Annual Watermaster Report, Appendix C.
(2) There is carryover of flow into W.Y. 88-89.

TABLE A-2

NONTRIBUTARY WATER FROM OC-59
APRIL 1988
(CFS-Days)

Day	Released at OC-59	12 hr. delay	Calculated flow at Prado
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	25	12	12
6	42	34	33
7	42	41	39
8	41	41	39
9	41	41	39
10	41	41	39
11	41	41	39
12	41	41	39
13	41	41	39
14	26	34	33
15	0	14	13
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	0	0	0
30	0	0	0
Total (CFS Days)	381	381	365
Total (AF)	756	756	725

TABLE A-2

NONTRIBUTARY WATER FROM OC-59
MAY 1988
(CFS-Days)

Day	Released at OC-59	12 hr. delay	Calculated flow at Prado
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	0	0	0
30	0	0	0
Total (CFS Days)	0	0	0
Total (AF)	0	0	0

TABLE A-2

NONTRIBUTARY WATER FROM OC-59
JUNE 1988
(CFS-Days)

Day	Released at OC-59	12 hr. delay	Calculated flow at Prado
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	18	9	9
24	32	25	24
25	32	32	31
26	32	32	31
27	32	32	31
28	32	32	31
29	38	34	33
30	42	39	37
Total (CFS Days)	258	235	225
Total (AF)	512	466	447

TABLE A-2

NONTRIBUTARY WATER FROM OC-59
JULY 1988
(CFS-Days)

Day	Released at OC-59	12 hr. delay	Calculated flow at Prado
1	42	42	40
2	42	42	40
3	42	42	40
4	42	42	40
5	42	42	40
6	41	42	40
7	41	41	39
8	41	41	39
9	41	41	39
10	41	41	39
11	41	41	39
12	41	41	39
13	41	41	39
14	41	41	39
15	41	41	39
16	41	41	39
17	41	41	39
18	41	41	39
19	41	41	39
20	41	41	39
21	31	36	35
22	0	16	15
23	0	0	0
24	0	0	0
25	26	13	12
26	41	34	33
27	41	41	39
28	41	41	39
29	41	41	39
30	41	41	39
31	41	41	39
Total (CFS Days)	1,128	1,130	1,083
Total (AF)	2,237	2,241	2,149

TABLE A-2

NONTRIBUTARY WATER FROM OC-59
AUGUST 1988
(CFS-Days)

Day	Released at OC-59	12 hr. delay	Calculated flow at Prado
1	28	33	32
2	0	14	13
3	0	0	0
4	23	11	11
5	42	32	31
6	42	42	40
7	42	42	40
8	42	42	40
9	42	42	40
10	42	42	40
11	41	42	40
12	41	41	39
13	41	41	39
14	15	28	27
15	0	8	8
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	0	0	0
30	0	0	0
31	0	0	0
Total (CFS Days)	441	460	441
Total (AF)	875	912	875

TABLE A-2

NONTRIBUTARY WATER FROM OC-59
SEPTEMBER 1988
(CFS-Days)

Day	Released at OC-59	12 hr. delay	Calculated flow at Prado
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	22	11	11
20	43	32	31
21	52	48	46
22	61	56	54
23	72	66	63
24	82	76	73
25	81	81	78
26	82	82	79
27	81	82	79
28	82	82	79
29	81	82	79
30	82	82	79
Total (CFS Days)	821	780	748
Total (AF)	1,628	1,547	1,483

TABLE A-3

CALCULATION OF WEIGHTED TDS FOR
STATE WATER PROJECT WATER ARRIVING AT
PRADO DAM FROM RELEASES AT OC-59

MONTH	TOTAL FLOW (cfs-day)	WEIGHTED AVERAGE TDS (mg/l) (1)	FLOW X TDS
APRIL	319 (2)	419	133794
JUNE	225	446	100363
JULY	1083	355	384789
AUGUST	441	435	191770
SEPTEMBER	748	532	397874
TOTAL	2816		1208589
WEIGHTED OC-59 QUALITY FOR YEAR		429	

Notes:
(1) Daily TDS values for State water calculated based on a mass balance using known flow and quality components. Calculations were derived from the procedures referenced in the Twelfth Annual Watermaster Report, Appendix C.

(2) Calculations for state water quality do not include OC-59 flows arriving at Prado on April 14 and 15, 1988 (33 and 13 cfs repectivily). Storm flow on these days invalidated water quality calculations.

APPENDIX B

WATER QUALITY-
SANTA ANA RIVER BELOW PRADO

1987-88

PREPARED BY

WILLIAM R. MILLS, JR.

METHOD OF ANALYZING WATER QUALITY DATA

Utilizing the USGS water quality records, the following analyses were performed by the Watermaster to determine the annual weighted TDS:

1. Mean daily flow weighted specific conductivity (EC) was calculated using the punched tape from the Prado water quality recorder, processed by a computer program designed by USGS. Input to the program included hourly EC data from the recorder tape, which was flow weighted using hourly discharge state data from the water stage recorder. However, due to recorder malfunction, hourly EC data was not available for the period April 19 to April 21, 1988.

2. Laboratory analyses of the 22 grab samples taken by the USGS below Prado Dam during the 1987-88 season were run to determine both EC and TDS. Data from the grab samples are given in Table B-1. Results of these analyses were used to prepare a correlation between EC recorded on punched tape of the USGS at the times when the grab samples were collected and the corresponding TDS. A detailed discussion of this statistical analysis is presented in the Fifth Annual Watermaster Report.

3. The equation from the curve fitting operation was then used to determine the mean daily TDS corresponding to the mean daily EC values for each day of the year except for the period when the recorder was not functioning.

4. The TDS for the period when EC data were not available was approximated using best available data. For the period April 19 to April 21, 1988, the interpolation was performed using calculated values of TDS determined before and after recorder malfunction.

5. The mean daily TDS values were then multiplied by the mean daily flow as shown in Table B-2. These products were then summed and divided by the total flow for the year to determine the weighted average TDS value for the water year. This value for TDS for the total flow including nontributary water was 584 mg/L of TDS for the 1987-88 water year. The weighted TDS calculation for the water year 1987-88 is shown in Table B-3.

TABLE B-1

USGS WATER QUALITY SAMPLES BELOW PRADO DAM
FOR WATER YEAR 1987-88

DATE	EC (micromhos/cm)	TDS (mg/l)	SOURCE
10/19	1100	686	USGS
11/03	776	478	USGS
11/18	846	526	USGS
12/03	1040	660	USGS
12/23	934	559	USGS
1/06	914	563	USGS
1/21	673	417	USGS
2/04	968	605	USGS
2/23	1050	629	USGS
3/04	945	594	USGS
3/23	1040	647	USGS
4/07	1040	625	USGS
5/05	918	560	USGS
5/11	953	567	USGS
6/06	1070	669	USGS
6/22	1070	662	USGS
7/01	971	593	USGS
7/28	961	585	USGS
8/09	965	601	USGS
8/16	1060	622	USGS
9/06	1050	640	USGS
9/08	1030	620	USGS

TABLE B-2

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

OCTOBER 1987

DAY		PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
OCT	1	53	1090	666	35307
	2	53	1100	672	35621
	3	53	1120	684	36250
	4	52	1150	702	36490
	5	52	1190	725	37721
	6	172	1150	702	120699
	7	265	1140	696	184392
	8	328	1080	660	216553
	9	348	994	609	211934
	10	342	995	610	208484
	11	336	1020	625	209837
	12	332	1020	625	207339
	13	329	1030	630	207426
	14	325	1020	625	202967
	15	319	1040	636	203021
	16	270	1060	648	175050
	17	245	1070	654	160298
	18	241	1090	666	160545
	19	236	1100	672	158616
	20	231	1110	678	156626
	21	225	1120	684	153892
	22	220	1130	690	151777
	23	240	1010	619	148453
	24	252	848	522	131427
	25	252	830	511	128697
	26	271	878	540	146221
	27	283	896	550	155754
	28	281	894	549	154316
	29	281	899	552	155158
	30	282	903	555	156387
	31	282	918	564	158923
TOTAL		7451			4606180
MONTHLY FLOW WEIGHTED TDS				618	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

NOVEMBER 1987

	DAY	PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
NOV	1	288	914	561	161614
	2	291	846	520	151416
	3	292	790	487	142087
	4	292	809	498	145432
	5	331	821	505	167249
	6	368	701	433	159265
	7	369	674	416	153656
	8	367	697	430	157943
	9	328	745	459	150690
	10	297	805	496	147206
	11	295	827	509	150125
	12	294	848	522	153331
	13	283	844	519	146913
	14	267	845	520	138768
	15	264	800	493	130054
	16	263	829	510	134157
	17	244	867	533	130041
	18	218	851	523	114088
	19	220	832	512	112620
	20	221	872	536	118447
	21	223	892	548	122196
	22	225	906	556	125182
	23	255	924	567	144623
	24	283	941	577	163384
	25	281	963	590	165928
	26	277	990	607	168034
	27	272	993	608	165488
	28	283	1020	625	176738
	29	283	1020	625	176738
	30	266	1030	630	167706
TOTAL		8440			4441119
MONTHLY FLOW WEIGHTED TDS				526	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

DECEMBER 1987

DAY		PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
DEC	1	282	1040	636	179473
	2	272	1040	636	173109
	3	247	1040	636	157198
	4	232	1040	636	147652
	5	235	1040	636	149561
	6	236	990	607	143162
	7	233	970	595	138559
	8	230	946	580	133474
	9	229	920	565	129329
	10	230	973	596	137187
	11	230	958	587	135125
	12	228	950	583	132859
	13	223	927	569	126875
	14	223	959	588	131146
	15	223	982	602	134211
	16	225	964	591	132995
	17	233	963	590	137584
	18	235	862	530	124538
	19	234	880	541	126539
	20	233	876	538	125438
	21	234	880	541	126539
	22	234	888	546	127662
	23	233	932	572	133263
	24	229	882	542	124110
	25	224	866	532	119247
	26	224	866	532	119247
	27	224	931	571	127981
	28	281	966	592	166431
	29	334	956	586	195826
	30	339	936	574	194700
	31	316	905	556	175621
TOTAL		7585			4406641
MONTHLY FLOW WEIGHTED TDS				581	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

JANUARY 1988

DAY		PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
JAN	1	298	895	550	163830
	2	298	882	542	161505
	3	300	892	548	164390
	4	300	905	556	166729
	5	301	903	555	166924
	6	304	906	556	169134
	7	307	889	546	167673
	8	310	882	542	168009
	9	312	886	544	169842
	10	314	911	559	175639
	11	316	948	582	183760
	12	318	935	574	182449
	13	319	965	592	188748
	14	322	972	596	191870
	15	323	960	589	190149
	16	323	976	598	193237
	17	332	964	591	196241
	18	652	984	603	393180
	19	973	814	501	487539
	20	977	731	451	440582
	21	961	719	444	426386
	22	935	743	458	428429
	23	334	785	484	161517
	24	227	849	522	118525
	25	220	902	554	121872
	26	219	888	546	119479
	27	220	884	543	119496
	28	277	853	525	145298
	29	317	834	513	162656
	30	316	841	517	163474
	31	313	892	548	171513
TOTAL		12238			6460075
MONTHLY FLOW WEIGHTED TDS				528	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

FEBRUARY 1988

DAY		PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
FEB	1	271	935	574	155483
	2	249	949	582	144947
	3	250	1030	630	157618
	4	251	943	579	145210
	5	271	880	541	146547
	6	282	902	554	156218
	7	284	916	562	159710
	8	321	940	577	185131
	9	330	956	586	193480
	10	330	963	590	194862
	11	332	988	605	201001
	12	336	997	611	205228
	13	339	977	599	203012
	14	339	967	593	200986
	15	340	995	610	207265
	16	339	992	608	206049
	17	337	1040	636	214477
	18	345	1020	625	215458
	19	346	1050	642	222264
	20	356	1030	630	224449
	21	353	1030	630	222557
	22	352	1040	636	224023
	23	352	1050	642	226119
	24	350	1060	648	226916
	25	350	1070	654	228997
	26	296	1070	654	193666
	27	266	1050	642	170874
	28	268	1040	636	170563
	29	270	1040	636	171836
TOTAL		9105			5574946
MONTHLY FLOW WEIGHTED TDS				612	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

MARCH 1988

DAY		PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
MAR	1	259	1030	630	163293
	2	310	1040	636	197293
	3	346	986	604	209064
	4	343	947	581	199256
	5	337	930	571	192341
	6	333	902	554	184470
	7	331	913	561	185545
	8	329	905	556	182846
	9	327	919	564	184479
	10	325	888	546	177309
	11	323	972	596	192466
	12	320	938	576	184171
	13	318	939	576	183210
	14	317	948	582	184341
	15	317	932	572	181306
	16	315	946	580	182801
	17	312	946	580	181060
	18	311	976	598	186058
	19	309	990	607	187445
	20	307	1020	625	191726
	21	307	1030	630	193555
	22	306	1030	630	192925
	23	306	1040	636	194747
	24	302	1040	636	192202
	25	299	1050	642	192072
	26	296	1040	636	188383
	27	289	1040	636	183928
	28	281	1040	636	178837
	29	271	1040	636	172472
	30	262	1050	642	168304
	31	253	1050	642	162523
TOTAL		9561			5750430
MONTHLY FLOW WEIGHTED TDS				601	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

APRIL 1988

DAY		PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
APR	1	244	1060	648	158193
	2	235	1100	672	157943
	3	228	1100	672	153239
	4	234	1100	672	157271
	5	258	1120	684	176463
	6	222	1060	648	143930
	7	233	1010	619	144123
	8	231	1010	619	142886
	9	219	1010	619	135463
	10	214	1010	619	132370
	11	209	1000	613	128031
	12	210	999	612	128518
	13	214	998	611	130838
	14	228	950	583	132859
	15	256	665	411	105203
	16	170	685	423	71925
	17	170	776	478	81286
	18	225	840	517	116262
	19	164	(2)	503	82418
	20	64	(2)	488	31256
	21	111	(2)	474	52636
	22	223	746	460	102586
	23	332	737	455	150922
	24	406	800	493	200008
	25	341	811	499	170248
	26	300	821	505	151585
	27	300	799	492	147608
	28	299	795	490	146395
	29	283	835	514	145381
	30	261	888	546	142393
TOTAL		7084			3920238
MONTHLY FLOW WEIGHTED TDS				553	

1. TDS = EC/(1.59+4.24E-5*EC)
2. EC recorder malfunction. TDS values approximated.

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

MAY 1988

DAY		PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
MAY	1	260	876	538	139974
	2	259	900	553	143166
	3	259	928	570	147513
	4	260	932	572	148705
	5	260	896	550	143095
	6	260	903	555	144187
	7	262	942	578	151417
	8	262	945	580	151888
	9	263	938	576	151366
	10	264	936	574	151625
	11	265	947	581	153944
	12	266	964	591	157229
	13	267	978	599	160054
	14	266	1000	613	162948
	15	265	1020	625	165496
	16	261	1020	625	162998
	17	258	1030	630	162662
	18	253	1030	630	159510
	19	250	1010	619	154638
	20	245	1010	619	151545
	21	201	1020	625	125527
	22	172	1020	625	107417
	23	170	1030	630	107181
	24	169	1030	630	106550
	25	158	1040	636	100556
	26	183	1030	630	115377
	27	182	1030	630	114746
	28	181	1030	630	114116
	29	180	1030	630	113485
	30	179	1040	636	113921
	31	178	1030	630	112224
TOTAL		7158			4295060
MONTHLY FLOW WEIGHTED TDS				600	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

JUNE 1988

DAY	PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
JUNE 1	169	1010	619	104535
2	173	996	610	105565
3	172	1010	619	106391
4	170	1030	630	107181
5	169	1040	636	107557
6	168	1050	642	107920
7	166	1020	625	103669
8	165	1010	619	102061
9	168	1030	630	105920
10	189	1040	636	120285
11	186	1050	642	119483
12	183	1060	648	118645
13	179	1050	642	114986
14	194	1060	648	125776
15	200	1060	648	129666
16	192	1080	660	126763
17	182	1080	660	120160
18	172	1080	660	113558
19	168	1070	654	109919
20	174	1070	654	113844
21	166	1080	660	109597
22	165	1070	654	107956
23	160	1080	660	105636
24	185	1060	648	119941
25	183	1020	625	114286
26	182	1010	619	112577
27	177	991	607	107477
28	173	979	600	103809
29	176	975	598	105188
30	180	968	593	106826
TOTAL	5286			3357178
MONTHLY FLOW WEIGHTED TDS			635	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

JULY 1988

DAY	PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
JULY 1	179	957	587	105055
2	182	934	573	104311
3	188	943	579	108763
4	188	944	579	108876
5	193	936	574	110847
6	187	939	576	107737
7	187	938	576	107625
8	185	940	577	106695
9	186	943	579	107606
10	190	947	581	110375
11	189	946	580	109681
12	188	942	578	108651
13	179	950	583	104306
14	175	964	591	103440
15	185	964	591	109351
16	185	964	591	109351
17	182	963	590	107469
18	180	953	585	105212
19	178	946	580	103297
20	181	940	577	104388
21	178	942	578	102871
22	155	958	587	91062
23	132	983	602	79522
24	128	993	608	77876
25	127	1000	613	77799
26	158	984	603	95280
27	162	973	596	96628
28	158	964	591	93392
29	163	948	582	94788
30	164	953	585	95860
31	170	961	589	100180
TOTAL	5382			3148294
MONTHLY FLOW WEIGHTED TDS			585	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

AUGUST 1988

DAY		PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
AUG	1	172	960	589	101256
	2	157	1010	619	97113
	3	146	1030	630	92049
	4	144	1040	636	91646
	5	170	978	599	101907
	6	177	959	588	104093
	7	184	954	585	107660
	8	184	951	583	107330
	9	187	950	583	108968
	10	185	955	586	108356
	11	188	968	593	111574
	12	183	974	597	109263
	13	179	978	599	107302
	14	181	983	602	109042
	15	143	1030	630	90158
	16	138	1040	636	87827
	17	139	1030	630	87636
	18	132	1040	636	84009
	19	139	1030	630	87636
	20	137	1030	630	86375
	21	136	1030	630	85744
	22	133	1040	636	84645
	23	133	1040	636	84645
	24	141	1040	636	89737
	25	137	1050	642	88006
	26	135	1070	654	88328
	27	135	1070	654	88328
	28	135	1070	654	88328
	29	134	1070	654	87673
	30	128	1080	660	84508
	31	128	1090	666	85269
TOTAL		4740			2936408
MONTHLY FLOW WEIGHTED TDS				619	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-2 (continued)

SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

SEPTEMBER 1988

DAY	PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos/cm)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
SEPT 1	136	1070	654	88982
2	133	1060	648	86228
3	137	1060	648	88821
4	129	1050	642	82867
5	114	1060	648	73910
6	116	1040	636	73826
7	120	1030	630	75657
8	135	1030	630	85114
9	132	1030	630	83223
10	131	1040	636	83372
11	134	1040	636	85282
12	139	1030	630	87636
13	138	1030	630	87005
14	137	1030	630	86375
15	123	1060	648	79745
16	136	1040	636	86554
17	149	1030	630	93941
18	145	1030	630	91419
19	149	1040	636	94828
20	183	1020	625	114286
21	172	1020	625	107417
22	209	994	609	127282
23	218	980	601	130941
24	228	974	597	136130
25	219	962	590	129186
26	213	958	587	125137
27	213	954	585	124628
28	221	950	583	128780
29	225	950	583	131111
30	216	955	586	126512
TOTAL	4850			2996196
MONTHLY FLOW WEIGHTED TDS			618	

1. TDS = EC/(1.59+4.24E-5*EC)

TABLE B-3

ANNUAL SUMMARY OF WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1987-88

MONTH	MONTHLY FLOW (cfs-day)	MONTHLY WEIGHTED TDS (mg/l)	MONTHLY FLOW TIMES TDS
OCTOBER	7451	618	4606180
NOVEMBER	8440	526	4441119
DECEMBER	7585	581	4406641
JANUARY	12238	528	6460075
FEBRUARY	9105	612	5574946
MARCH	9561	601	5750430
APRIL	7084	553	3920238
MAY	7158	600	4295060
JUNE	5286	635	3357178
JULY	5382	585	3148294
AUGUST	4740	619	2936408
SEPTEMBER	4850	618	2996196
TOTAL	88880		51892765
YEARLY WEIGHTED TDS		584	

APPENDIX C

WATER QUALITY
SANTA ANA RIVER AT RIVERSIDE NARROWS

1987-88

PREPARED BY

DONALD L. HARRIGER

TABLE C-1
WATER QUALITY ANALYSES
SANTA ANA RIVER AT RIVERSIDE NARROWS
WATER YEAR 1987-88

Date Sampled	EC Micromhos/cm	TDS mg/L	Source
1987			
10-07	940	577	USGS
10-08	960	616	C of R
10-12	809	532*	DWR
10-13	720	520*	C of R
10-19	920	572	USGS
10-22	920	605	C of R
10-27	990	642	C of R
11-05	394	287*	DWR
11-05	400	359*	C of R
11-05	336	221*	USGS
11-10	1030	667	C of R
11-19	980	629	C of R
11-23	928	587	USGS
11-25	930	656	C of R
12-03	900	619	C of R
12-04	928	602	USGS
12-08	910	619	C of R
12-03	922	665	DWR
12-17	560	254*	C of R
12-22	970	630	C of R
12-23	790	507*	USGS
12-31	920	628	C of R
1988			
01-05	980	627	C of R
01-07	937	593	USGS
01-12	926	633	DWR
01-14	980	616	C of R
01-19	940	586	C of R
01-26	988	600	USGS
01-28	840	648	C of R

* Storm flow, not used in determining monthly averages.

C of R	City of Riverside
USGS	United States Geological Survey
DWR	Department of Water Resources

Date Sampled	EC Micromhos/cm	TDS mg/L	Source
02-02	890	453*	C of R
02-08	956	657	DWR
02-08	965	600	USGS
02-09	1100	642	C of R
02-16	980	642	C of R
02-22	948	591	USGS
02-25	980	626	C of R
03-01	750	475*	C of R
03-07	914	633	DWR
03-09	950	594	USGS
03-10	1020	654	C of R
03-15	1020	491*	C of R
03-22	1000	650	C of R
03-24	973	619	USGS
03-29	1040	647	C of R
04-04	955	600	USGS
04-07	850	622	C of R
04-12	990	597	C of R
04-21	670	191*	C of R
04-26	900	575	C of R
05-05	968	611	USGS
05-05	980	616	C of R
05-10	960	586	C of R
05-19	980	610	C of R
05-24	940	591	C of R
06-02	980	612	C of R
06-06	938	590	USGS
06-07	980	633	C of R
06-09	926	631	DWR
06-16	970	619	C of R
06-21	970	619	C of R
06-22	938	596	USGS
07-01	933	587	USGS
07-05	990	627	C of R
07-14	940	616	C of R
07-19	920	613	C of R
07-26	970	632	C of R

* Storm flow, not used in determining monthly averages.

C of R	City of Riverside
USGS	United States Geological Survey
DWR	Department of Water Resources

Date Sampled	EC Micromhos/cm	TDS mg/L	Source
08-09	950	596	USGS
08-11	970	609	C of R
08-16	948	562	USGS
08-16	980	617	C of R
08-25	940	572	C of R
08-30	950	625	C of R
09-08	930	631	C of R
09-09	956	591	USGS
09-13	950	609	C of R
09-22	900	579	C of R
09-27	920	590	C of R

* Storm flow, not used in determining monthly averages.

C of R	City of Riverside
USGS	United States Geological Survey
DWR	Department of Water Resources

TABLE C - 2

FLOW WEIGHTED TDS OF BASE FLOW AT RIVERSIDE NARROWS

(Including Nontributary Flow)

Discharged Above the Narrows

Month	Acre-feet 1)	TDS 2) mg/L	Acre-Feet Times TDS
1987			
October	4,403	602	2.650.606
November	3.651	635	2.318.385
December	4.459	627	2.795.793
1988			
January	4.584	615	2.819.160
February	3.874	626	2.425.124
March	5.528	633	3.499.224
April	4.814	599	2.883.586
May	4.574	603	2.758.122
June	4.019	614	2.467.666
July	4.558	615	2.803.170
August	4.479	597	2.673.963
September	4.583	600	2.749,800
Total	53.526		32,844.599

Flow weighted TDS $\frac{32,844.599}{53.526}$ = 614 mg/L

1) Total Flow minus Storm Flow from Table 6
2) Estimated average TDS based on water quality data from Table C - 1.

APPENDIX D

QUANTITY AND QUALITY OF WASTEWATER FROM RUBIDOUX COMMUNITY SERVICES DISTRICT

1987-88

PREPARED BY

DONALD L. HARRIGER

TABLE D-1

QUANTITY AND QUALITY OF WASTEWATER FROM RUBIDOUX DISCHARGE BELOW THE RIVERSIDE NARROWS GAGING STATION

WATER YEAR 1987-88

Month	Acre-feet	TDS mg/L	Acre-feet Times TDS
1987			
October	198	710*	140,580
November	172	703	120,916
December	173	697*	120,581
1988			
January	173	690	119,370
February	173	698	120,754
March	186	676	125,736
April	175	733	128,275
May	178	735*	130,830
June	172	737	126,764
July	179	731	130,849
August	181	751	135,931
September	179	738	132,102
	2,139		1,532,688

$$\frac{1,532,716}{2,139} = 717 \text{ mg/L}$$

Average Flow Weighted Quality of Wastewater = 717 mg/L
* No data. average of preceeding and following month.

APPENDIX E

SANTA ANA RIVER WATERMASTER
FINANCIAL STATEMENTS WITH REPORT
ON
EXAMINATION BY CERTIFIED PUBLIC ACCOUNTANTS

1987-88

SANTA ANA RIVER WATERMASTER

FINANCIAL STATEMENTS

WITH REPORT ON EXAMINATION BY CERTIFIED PUBLIC ACCOUNTANTS

JUNE 30, 1988

DIEHL, EVANS & COMPANY
CERTIFIED PUBLIC ACCOUNTANTS

A PARTNERSHIP OF ACCOUNTANCY CORPORATIONS
ONE CIVIC PLAZA • SUITE 265
NEWPORT BEACH • CALIFORNIA 92660-5915
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ROBERT R. WINE, CPA
PHILIP H. HOLTKAMP, CPA
THOMAS M. PERLOWSKI, CPA

September 1, 1988

ACCOUNTANTS' REPORT

Santa Ana River Watermaster
Fountain Valley, California

We have examined the statement of assets and liabilities arising from cash transactions of the Santa Ana River Watermaster as of June 30, 1988 and the related statement of revenue collected, expenses paid and changes in fund balance for the year then ended. Our examination was made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

As described in Note 1, the Watermaster's policy is to prepare its financial statements on the basis of cash receipts and cash disbursements; consequently, certain revenue and the related assets are recognized when received rather than when earned and certain expenses are recognized when paid rather than when the obligation is incurred. Accordingly, the accompanying financial statements are not intended to present financial position and results of operations in conformity with generally accepted accounting principles for governmental units.

In our opinion, the aforementioned financial statements present fairly the assets and liabilities arising from cash transactions of the Santa Ana River Watermaster as of June 30, 1988, and the revenue collected and expenses paid for the year then ended, on the basis of accounting described in Note 1, which basis has been applied in a manner consistent with that of the preceding year.

Diehl, Evans and Company

OTHER OFFICES AT:
1910 NORTH BUSH ST.
SANTA ANA, CA 92706-2894
(714) 542-4453

2965 ROOSEVELT ST.
CARLSBAD, CA 92008-2389
(619) 729-2343

120 WEST WOODWARD AVE.
ESCONDIDO, CA 92025-9990
(619) 741-3141

SANTA ANA RIVER WATERMASTER

STATEMENT OF ASSETS AND LIABILITIES
ARISING FROM CASH TRANSACTIONS

June 30, 1988

ASSETS

Cash in checking account (Note 3)	$ 919
Cash in savings account (Note 3)	11,426
TOTAL ASSETS	$ 12,345

LIABILITIES AND FUND BALANCE

Liabilities	$ -
Fund balance	12,345
TOTAL LIABILITIES AND FUND BALANCE	$ 12,345

See accountants' report and notes to financial statements.

SANTA ANA RIVER WATERMASTER

STATEMENT OF REVENUE COLLECTED, EXPENSES
PAID AND CHANGES IN FUND BALANCE

For the year ended June 30, 1988

		Actual	Budget	Over (Under) Budget
REVENUE COLLECTED:				
Water district contributions (Note 2):				
Orange County Water District		$ 6,400	$ 6,400	$ -
Chino Basin Municipal Water District		3,200	3,200	-
San Bernardino Valley Municipal Water District		3,200	3,200	-
Western Municipal Water District		3,200	3,200	-
Interest from savings account		507	-	507
Reimbursement for Chino Creek Mitigation release		448	-	448
TOTAL REVENUE COLLECTED		16,955	16,000	955
EXPENSES PAID:				
Professional engineering services		7,762	8,000	(238)
Administrative expenses:				
Office and secretarial expense	$ 2,353			
Auditing services	825	3,178	5,000	(1,822)
Annual reports		1,754	3,000	(1,246)
TOTAL EXPENSES PAID		12,694	16,000	(3,306)
EXCESS OF REVENUE COLLECTED OVER EXPENSES PAID		4,261	$ -	$ 4,261
FUND BALANCE AT JULY 1, 1987		8,084		
FUND BALANCE AT JUNE 30, 1988		$ 12,345		

See accountants' report and notes to financial statements.

SANTA ANA RIVER WATERMASTER

NOTES TO FINANCIAL STATEMENTS

June 30, 1988

1. SIGNIFICANT ACCOUNTING POLICIES:

The Watermaster uses the cash receipts and cash disbursements method of accounting for all of its financial activity.

2. ORGANIZATION AND HISTORY:

The Santa Ana River Watermaster is composed of a committee of five representatives from four water districts. Two representatives serve from the Orange County Water District and one representative each serves from the Chino Basin Municipal Water District, Western Municipal Water District and San Bernardino Valley Municipal Water District. The committee was established on April 23, 1969 by order of the Superior Court of California in Orange County as part of a judgement resulting from a lawsuit by the Orange County Water District as plaintiff vs. City of Chino, et al, as defendants.

Costs and expenses incurred by the individual representatives are reimbursed directly from the water districts. Collective Watermaster costs and expenses are budgeted and paid for by the Watermaster after receiving contributions from the water districts. Water district contributions are made in the following ratios:

Orange County Water District	40%
Chino Basin Municipal Water District	20
Western Municipal Water District	20
San Bernardino Valley Municipal Water District	20
Total	100%

The Watermaster issues a report each year to satisfy its obligation to monitor and test water flows from the Upper Area to the Lower Area of the Santa Ana River.

3. CASH IN BANK:

The following disclosures are made in accordance with Statement No. 3 of the Governmental Accounting Standards Board (GASB 3):

Cash at June 30, 1988 consisted of the following:

	1988
Security Pacific National Bank:	
Demand account	$ 919
Savings account	11,426
Total Cash	$ 12,345

Cash is stated on a cost basis, which is the same as market.

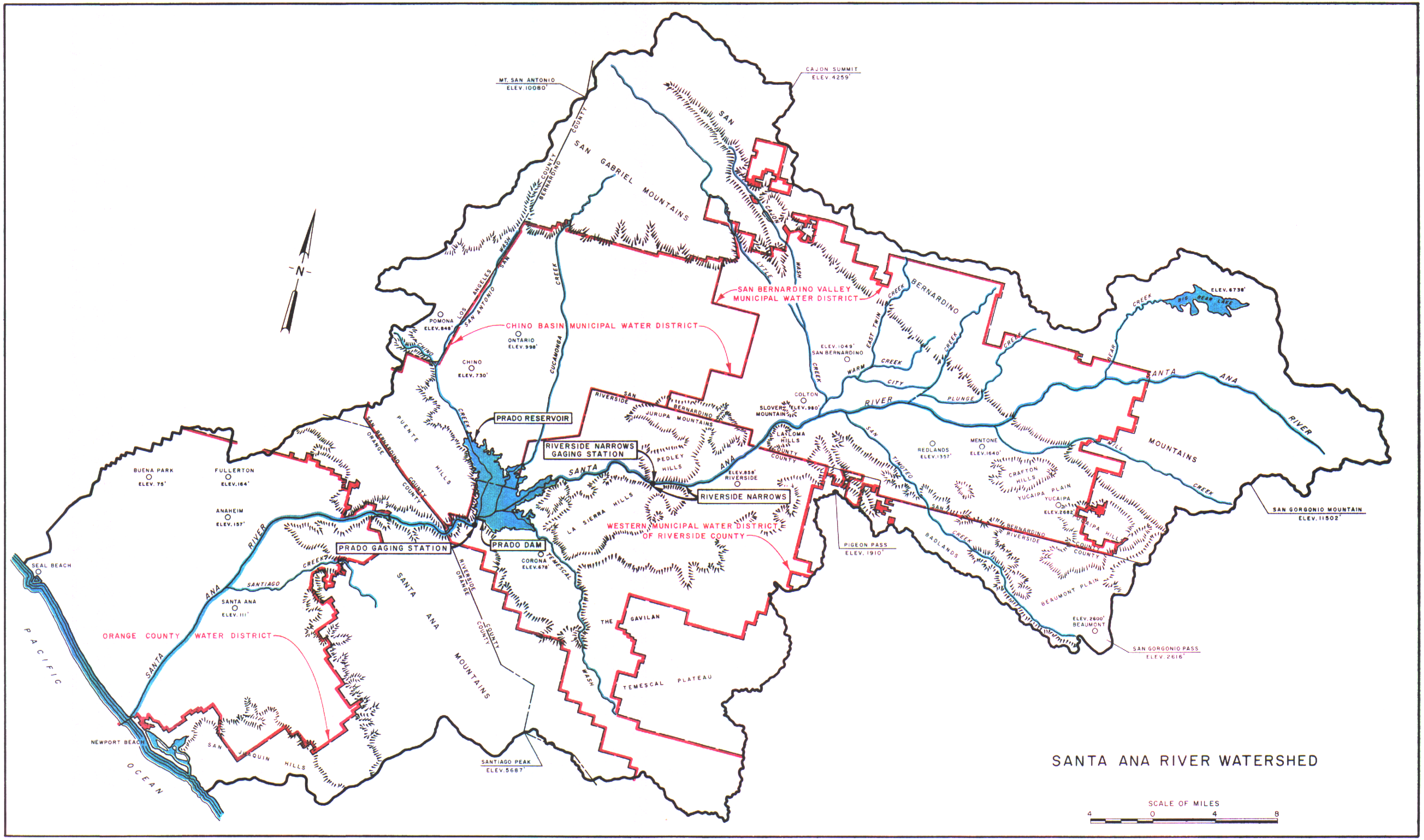
See accountants' report.

3. CASH IN BANK (CONTINUED):

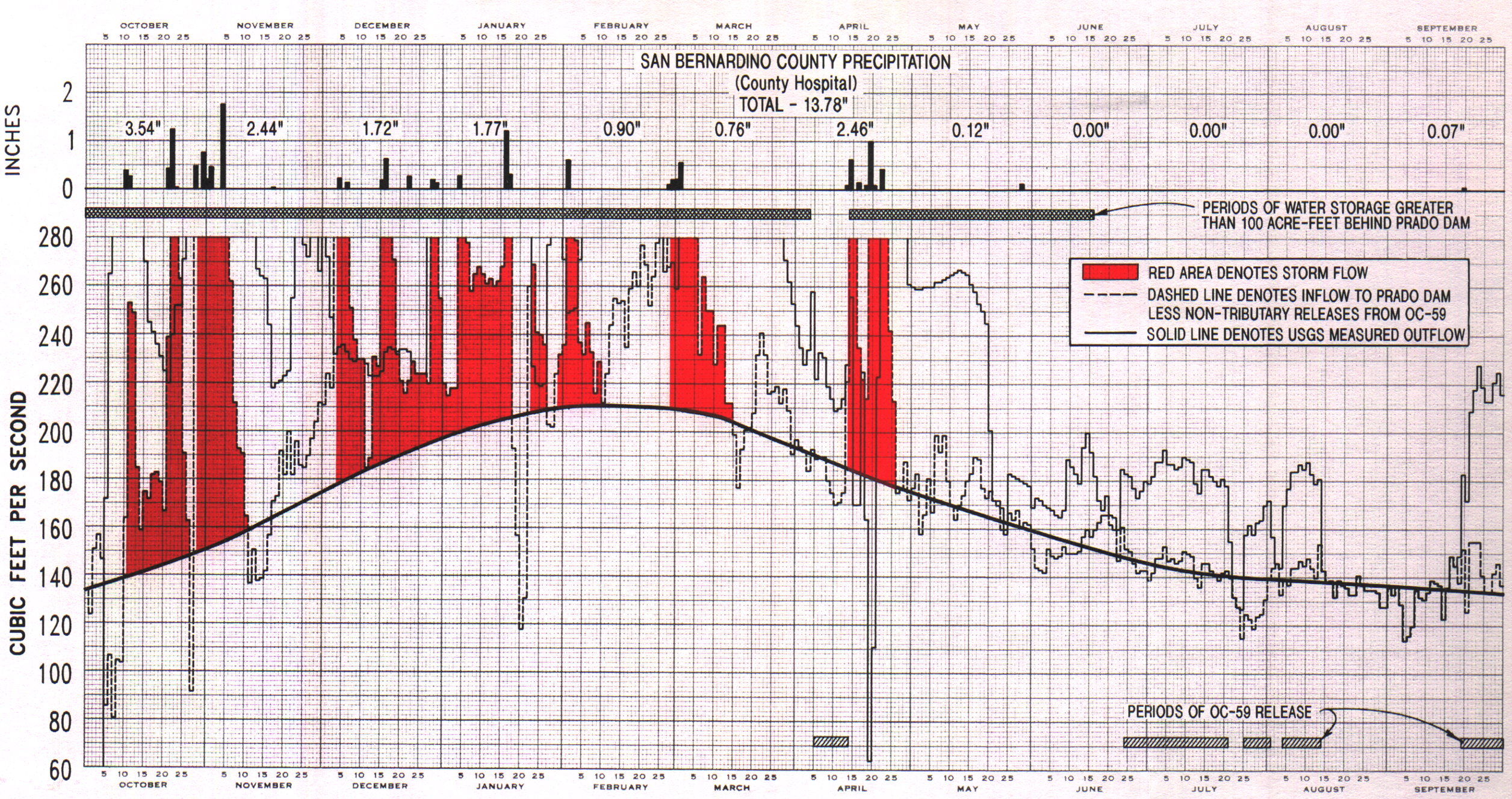
Collateral for Deposits

Under the provisions of the California Government Code, California banks and savings and loan associations are required to secure a District's deposits by pledging government securities as collateral. Also, deposits up to $100,000 are insured by the FDIC or FSLIC.

See accountants' report.

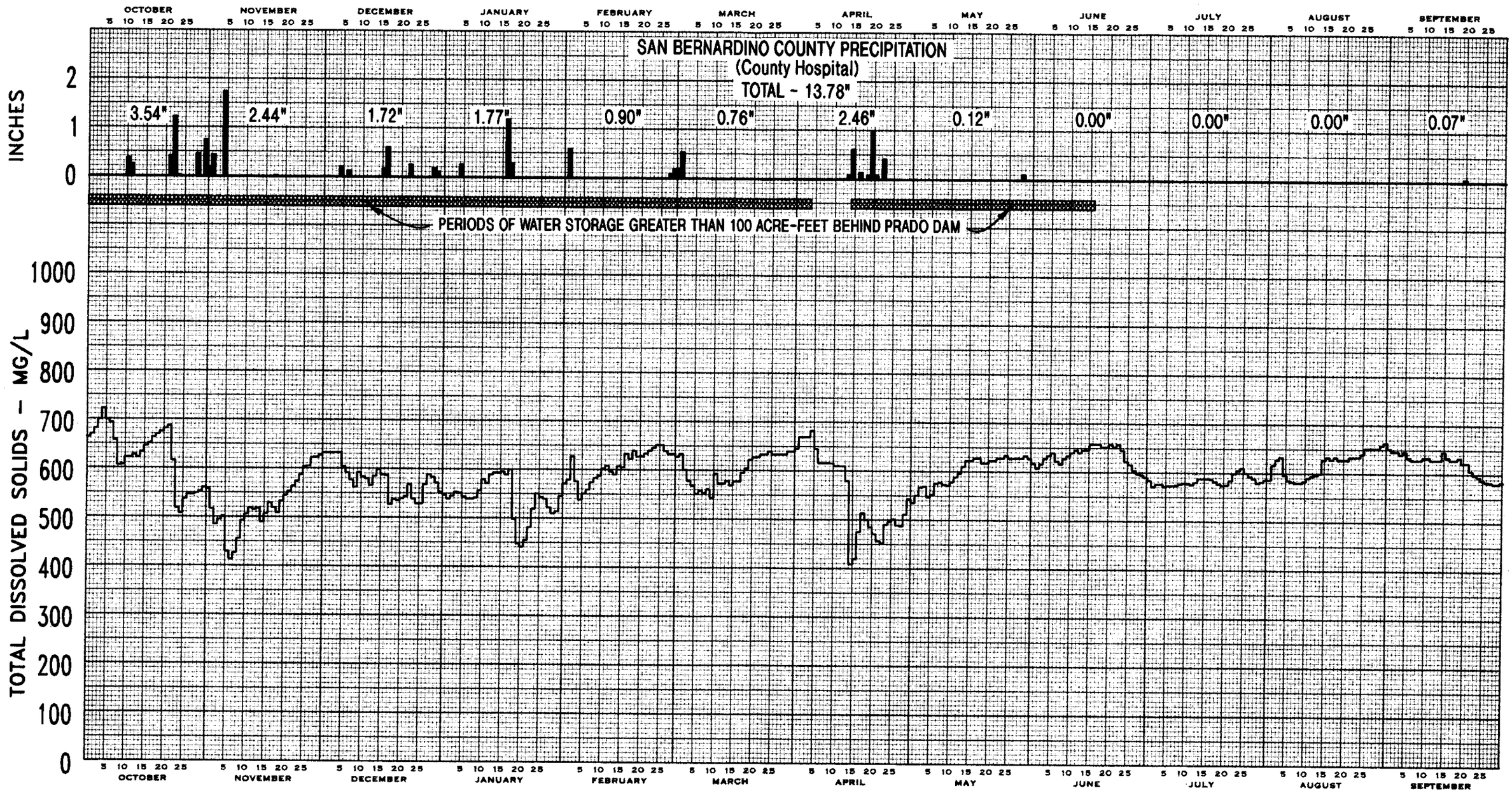


SANTA ANA RIVER WATERSHED
SCALE OF MILES
4 0 4 8
N
MT. SAN ANTONIO ELEV. 10080'
CAJON SUMMIT ELEV. 4259'
SAN GABRIEL MOUNTAINS
SAN BERNARDINO MOUNTAINS
SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
CHINO BASIN MUNICIPAL WATER DISTRICT
WESTERN MUNICIPAL WATER DISTRICT OF RIVERSIDE COUNTY
ORANGE COUNTY WATER DISTRICT
BIG BEAR LAKE
ELEV. 6738'
POMONA ELEV. 848'
ONTARIO ELEV. 998'
CHINO ELEV. 730'
SAN BERNARDINO ELEV. 1049'
COLTON ELEV. 980'
SLOVER MOUNTAIN
REDLANDS ELEV. 1357'
MENTONE ELEV. 1640'
CRAFTON HILLS
YUCAIPA PLAIN
YUCAIPA ELEV. 2682'
SAN GORGONIO MOUNTAIN ELEV. 11502'
SAN GORGONIO PASS ELEV. 2616'
BEAUMONT ELEV. 2600'
BEAUMONT PLAIN
BADLANDS
PIGEON PASS ELEV. 1910'
RIVERSIDE ELEV. 858'
LA LOMA HILLS
JURUPA MOUNTAINS
PEDLEY HILLS
LA SIERRA HILLS
PRADO RESERVOIR
RIVERSIDE NARROWS GAGING STATION
RIVERSIDE NARROWS
PRADO GAGING STATION
PRADO DAM
CORONA ELEV. 678'
PUENTE HILLS
SANTA ANA MOUNTAINS
SANTIAGO PEAK ELEV. 5687'
THE GAVILAN
TEMESCAL PLATEAU
TEMESCAL WASH
BUENA PARK ELEV. 75'
FULLERTON ELEV. 164'
ANAHEIM ELEV. 157'
SANTA ANA ELEV. 111'
SEAL BEACH
NEWPORT BEACH
SAN JOAQUIN HILLS
PACIFIC OCEAN
SANTA ANA RIVER
SANTIAGO CREEK
CHINO CREEK
CUCAMONGA CREEK
SAN ANTONIO WASH
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
ORANGE COUNTY
LYTLE CREEK
CAJON WASH
EAST TWIN CREEK
WARM CREEK
CITY CREEK
PLUNGE CREEK
MILL CREEK
BEAR CREEK
SAN TIMOTEO CREEK



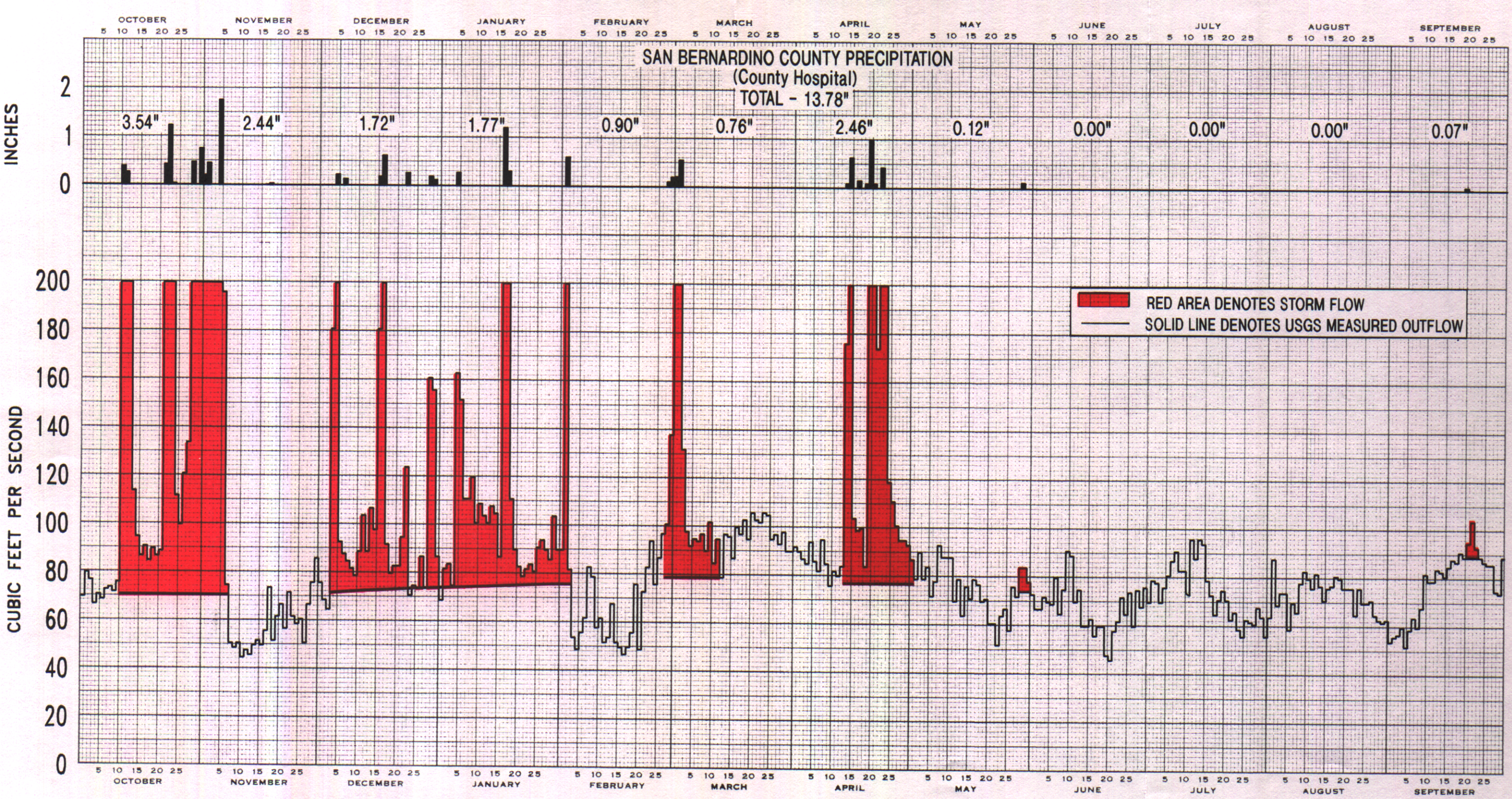
DISCHARGE OF SANTA ANA RIVER BELOW PRADO DAM & SAN BERNARDINO PRECIPITATION
WATER YEAR 1987-88

PLATE 2



DISSOLVED SOLIDS IN SANTA ANA RIVER BELOW PRADO DAM
WATER YEAR 1987-88

PLATE 3



DISCHARGE OF SANTA ANA RIVER AT RIVERSIDE NARROWS & SAN BERNARDINO PRECIPITATION
WATER YEAR 1987-88

PLATE 4