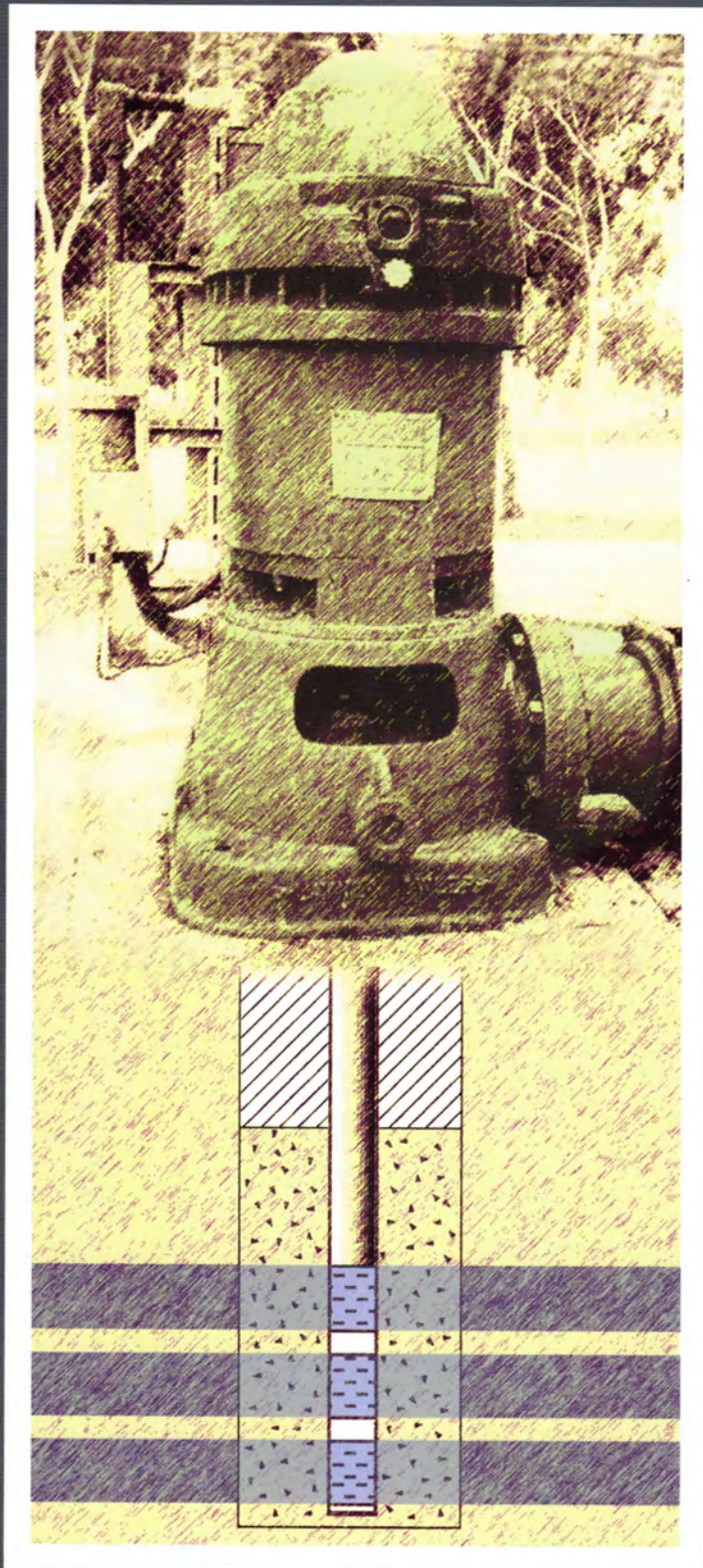


Orange County Water District



1997-98 Engineer's Report

On Groundwater
Conditions, Water
Supply and Basin
Utilization in the
Orange County
Water District

1997-98

ENGINEER'S REPORT ON

GROUNDWATER CONDITIONS,

WATER SUPPLY AND BASIN UTILIZATION

IN THE

ORANGE COUNTY WATER DISTRICT

FEBRUARY 1999

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ORANGE COUNTY WATER DISTRICT

February 10, 1999

Mr. William R. Mills Jr., P.E.
General Manager
Orange County Water District
Post Office Box 8300
Fountain Valley, CA 92728-8300

Dear Mr. Mills:

In accordance with Section 26 of the District Act, the 1997-98 Engineer's Report is hereby submitted.


Precipitation and runoff were above normal levels in the Santa Ana River watershed for the 1997-98 water year. The year's precipitation totaled 30.0 inches, 224% of normal. Santa Ana River flow past Prado Dam was 231% of the 30-year average, totaling 464,550 acre-feet for the water year, of which 219,541 acre-feet were captured by the District's Forebay facilities for groundwater recharge.

The year's total water usage within the District was 502,696 acre-feet, which includes 36,441 acre-feet of imported deliveries for groundwater replenishment and 15,096 acre-feet for use through the In-Lieu Program. Groundwater production within the basin totaled 313,805 acre-feet for the water year.

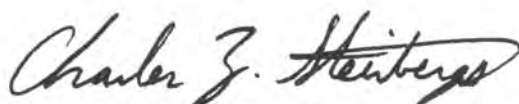
Accumulated basin overdraft within the District decreased from 234,685 acre-feet in June 1997 to 186,345 acre-feet in June 1998, a decrease of 48,340 acre-feet. The current accumulated basin overdraft is approximately 28% of the overdraft experienced in the 1950s.

Given the conditions of the groundwater basin, the portion of the 1999-2000 Replenishment Assessment allocated for District replenishment water purchases could equal the amount necessary to purchase 65,000 acre-feet.

Very truly yours,


Steven R. Conklin, P.E.
Associate General Manager




Charles Z. Steinbergs, P.E.
Senior Engineer



EXECUTIVE SUMMARY

Total water demand within the District was 466,225 acre-feet for the 1997-98 water year (beginning July 1, 1997 and ending June 30, 1998), a 10% decrease from the previous year's total demand of 515,414 acre-feet. Groundwater production for the water year totaled 313,805 acre-feet, a 5% decrease from the previous year's total of 331,406 acre-feet. For the water year, a total of 51,537 acre-feet was purchased for groundwater replenishment purposes, of which the major uses were 31,608 acre-feet for groundwater recharge at the District's Forebay facilities and 15,096 acre-feet for the In-Lieu Program.

For the 1997-98 water year, basin storage increased, and precipitation within the basin was above normal levels. As in previous years, District staff determined the change in basin storage by evaluating the change in measured groundwater levels from November 1997 to November 1998. As of November 1998, average groundwater levels in the basin had increased 1.9 feet from the prior year to 14.7 feet above sea level. For the water year, which ends June 30, it is estimated that the basin storage increased by 48,340 acre-feet. Precipitation within the basin was 224% of normal during the water year, totaling 30.0 inches.

Based on the groundwater basin conditions for the water year ending June 30, 1998, OCWD may purchase up to 65,000 acre-feet for groundwater basin replenishment during the ensuing water year, beginning July 1, 1999, pursuant to the District Act.

ACKNOWLEDGMENTS

A number of public and private agencies contributed data used in this report, including:

City of Anaheim
City of Buena Park
East Orange County Water District
City of Fountain Valley
City of Fullerton
City of Garden Grove
City of Huntington Beach
The Irvine Company
Irvine Ranch Water District
City of La Palma
Mesa Consolidated Water District
Metropolitan Water District of Southern California
Municipal Water District of Orange County
City of Newport Beach
City of Orange
Orange County Public Facilities & Resources Department
Orange County Sanitation District
City of Santa Ana
Santa Ana Watershed Project Authority
City of Seal Beach
Serrano Water District
Southern California Water Company
City of Tustin
United States Geological Survey
City of Westminster
Yorba Linda Water District

The cooperation received from all agencies is gratefully acknowledged.

The Basic Data Report is made a part of this report and is placed on file in the District office.

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GLOSSARY OF ACRONYMS

AF	acre-feet
BEA	Basin Equity Assessment
BPP	Basin Production Percentage
CBMWD	Central Basin Municipal Water District
CRA	Colorado River Aqueduct
GAP	Green Acres Project
IRWD	Irvine Ranch Water District
MCWD	Mesa Consolidated Water District
mg/l	milligrams per liter
MWD	Metropolitan Water District of Southern California
MWDOC	Municipal Water District of Orange County
OCS	Orange County Sanitation District
OCWD	Orange County Water District
RA	Replenishment Assessment
RTS	Readiness to Serve (MWD)
SAR	Santa Ana River
SARI	Santa Ana River Interceptor
SAWPA	Santa Ana Watershed Project Authority
SWP	State Water Project
TDS	total dissolved solids
WMWD	Western Municipal Water District
WF21	Water Factory 21

PART I: GROUNDWATER CONDITIONS

Section 25 of the District Act requires that OCWD order an annual investigation to report on the groundwater conditions within the District's boundaries. A summary of the groundwater conditions for the July 1, 1997 to June 30, 1998 water year are as follows:

GROUNDWATER CONDITIONS 1997-98 SUMMARY OF FINDINGS

1. Groundwater production totaled 313,805 acre-feet (AF) for the 1997-98 water year.
2. Groundwater stored in OCWD's basin increased by 48,340 acre-feet for the water year.
3. Accumulated overdraft on the last day of the 1997-98 water year was 186,345 acre-feet.¹
4. Annual overdraft for the 1997-98 water year was 5,350 acre-feet.
5. Average annual overdraft for the immediate past five water years (1993-94 to 1997-98) was 46,251 acre-feet.
6. Estimated annual overdraft for the 1998-99 water year is 50,000 acre-feet.
7. Estimated average annual overdraft for the immediate past four water years and the current year (1994-95 to 1998-99) is 41,004 acre-feet.
8. Estimated annual overdraft for the 1999-2000 water year is 75,000 acre-feet.
9. Under the provisions of Section 27 of the District Act, a portion or all of the 1999-2000 Replenishment Assessment (RA) could be equal to an amount necessary to purchase 65,000 acre-feet of replenishment water.²

¹ Engineer's Reports previous to 1992 have used November groundwater conditions to determine accumulated overdraft. This report's findings estimate accumulated overdraft as of the last day of June 1998. Prior to 1992, the monthly data was not available to make the adjustment to June basin conditions.

² The replenishment limit is determined by adding the five-year annual average overdraft (46,251) to one-tenth of the accumulated overdraft (i.e., 18,634), as described on page 7.

BASIN HYDROLOGY

Groundwater conditions in the Orange County groundwater basin are influenced by the natural hydrologic conditions of rainfall, groundwater seepage and stream flow. The basin is also influenced by groundwater extraction and injection through wells, use of imported waters for groundwater replenishment, and water conservation practices throughout OCWD.

The water year beginning July 1, 1997 yielded 30.0 inches of rainfall, 224% of the normal 13.4 inches. Stream flow in the Santa Ana River was above normal for the water year, totaling 464,550 acre-feet of natural flow through Prado Dam, a 263,022 acre-foot increase over the 30-year average of 201,528 acre-feet. The high stream flow amount at Prado Dam was primarily due to this year's above-average rainfall and the expanding upstream development resulting in increased treated wastewater discharges.

GROUNDWATER PRODUCTION

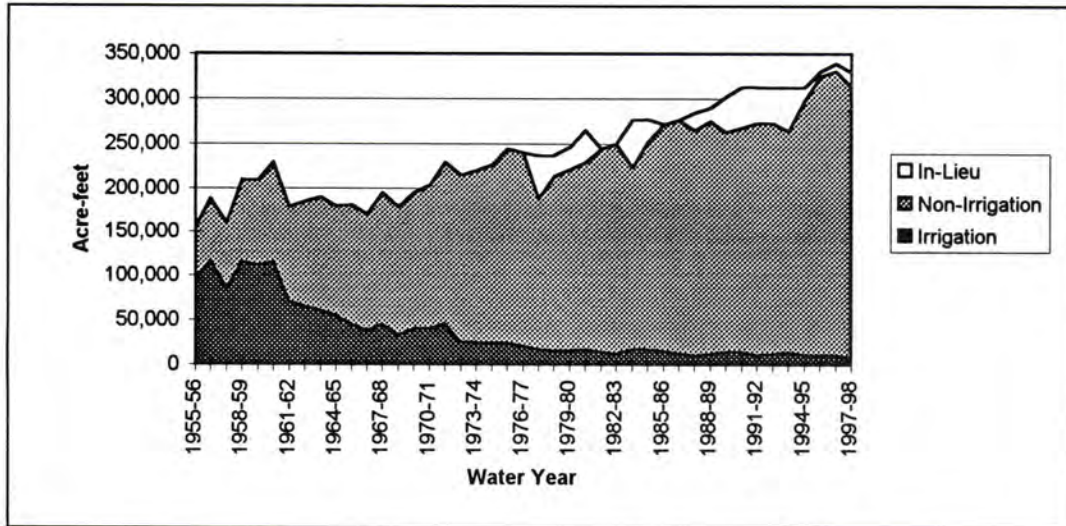
Groundwater production from wells within OCWD for the 1997-98 water year totaled 313,805 acre-feet: 306,975 acre-feet for non-irrigation uses and 6,830 acre-feet for irrigation uses. This year's groundwater production decreased 5% from the previous year's total of 331,406 acre-feet. The decrease was due primarily to the In-Lieu Program and reductions in groundwater usage for irrigation purposes.

OCWD's In-Lieu Program, which replaces quantities of groundwater with imported water to reduce groundwater pumping in coastal areas, was in effect this year with an amount totaling 15,096 acre-feet. The In-Lieu Program has served as an efficient groundwater replenishment method since the 1970s.

Groundwater production and In-Lieu quantities within OCWD for the period 1955-56 through 1997-98 are presented in Figure 1 and Table 1. Without the In-Lieu Program, groundwater production would have reached 328,901 acre-feet for the 1997-98 water year

1997-98 groundwater production quantities for non-irrigation purposes are listed in Appendix 2. Groundwater production quantities for irrigation purposes are listed in Appendix 3.

FIGURE 1. Groundwater Production



**TABLE 1. Historical Groundwater Production
Within Orange County Water District**

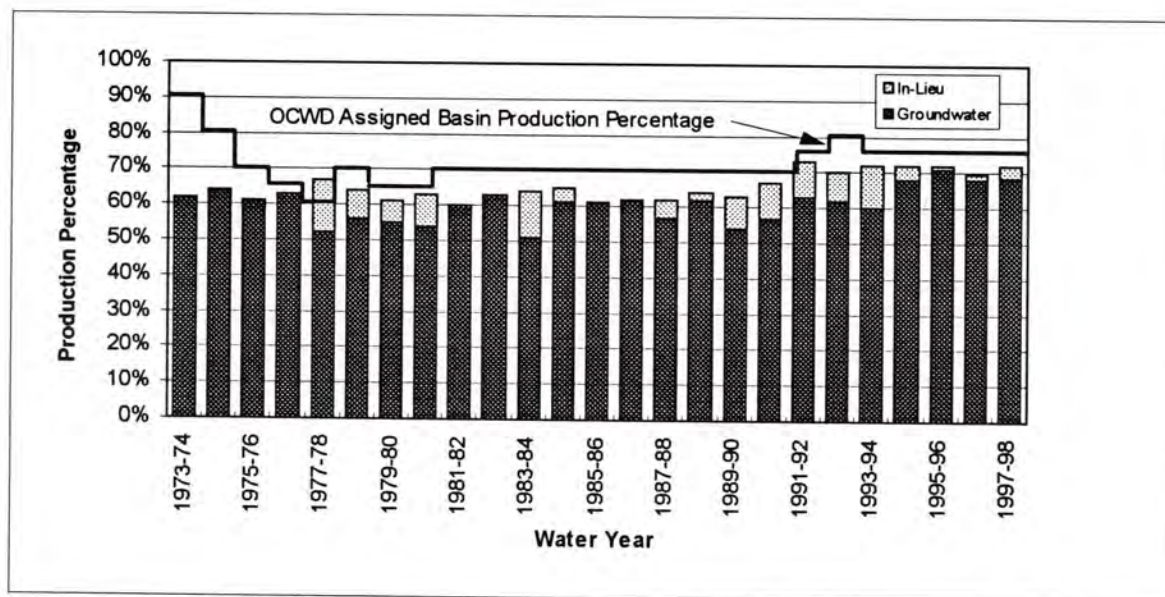
Water Year Jul 1-Jun 30	Groundwater Production (acre-feet)	In-Lieu Program (acre-feet)	Water Year Jul 1-Jun 30	Groundwater Production (acre-feet)	In-Lieu Program (acre-feet)
1955-56	154,677	-	1977-78	188,407	48,290
1956-57	186,032	-	1978-79	213,290	23,792
1957-58	160,258	-	1979-80	221,453	24,861
1958-59	208,571	-	1980-81	228,943	36,373
1959-60	207,448	-	1981-82	244,184	-
1960-61	226,025	-	1982-83	249,548	-
1961-62	177,172	-	1983-84	223,207	52,822
1962-63	186,093	-	1984-85	252,070	25,198
1963-64	188,603	-	1985-86	270,932	-
1964-65	179,798	-	1986-87	276,354	-
1965-66	182,172	-	1987-88	265,226	18,856
1966-67	169,375	-	1988-89	275,077	15,022
1967-68	193,656	-	1989-90	261,190	38,961
1968-69	178,798	-	1990-91	266,745	44,588
1969-70	194,379	-	1991-92	271,224	39,789
1970-71	203,923	-	1992-93	273,587	38,900
1971-72	229,048	-	1993-94	264,159	48,134
1972-73	214,983	-	1994-95	298,217	15,622
1973-74	218,863	-	1995-96	324,111	5,542
1974-75	225,597	-	1996-97	331,406	7,883
1975-76	245,456	-	1997-98	313,805	15,096
1976-77	243,511	-			

BASIN PRODUCTION PERCENTAGE

The Basin Production Percentage (BPP) is defined in the District Act as “the ratio that all water to be produced from groundwater supplies within the District bears to all water to be produced by persons and operators within the District from supplemental sources as well as from groundwater within the District.” The BPP applies only to water producers that utilize more than 25 acre-feet of groundwater per water year and have the ability to receive water from supplemental sources. Water producers that use 25 acre-feet or less from the groundwater basin are excluded from the production percentage limitation.

The BPP for the 1997-98 water year was established at 75% by the OCWD Board of Directors in April 1997. The actual 1997-98 Basin Production Percentage, including In-Lieu Program deliveries, was 72% for the District’s 22 major water agencies. The actual production percentage for each water agency is presented in Appendix 1. Historical assigned and actual Basin Production Percentages are presented in Figure 2.

FIGURE 2. Groundwater Basin Production Percentage



GROUNDWATER LEVELS

Groundwater levels in the Orange County groundwater basin are shown on Plate 1. Groundwater level data used to prepare this plate were collected during October and November 1998 from more than 300 production and monitoring wells screened within the principal aquifers (approximately 200 to 1,200 feet deep). The groundwater elevation plate shows pumping depressions ranging from 30 to 50 feet below sea level in the coastal and western areas of the basin. Also, the zero (0) mean sea level elevation contour line did not shift appreciably as compared to its alignment in the prior year.

Changes in groundwater levels from November 1997 through November 1998 are shown on Plate 2. As shown on this plate, water level changes in the coastal and central basin areas generally ranged from a 10-foot decrease to a 20-foot increase when compared to conditions in November 1997, while water levels in the vicinity of the District's Anaheim Forebay recharge facilities decreased approximately 10 feet due to maintenance activities in fall 1998, which shifted percolation to OCWD's Santiago Creek recharge facilities. Water levels in the Santiago Creek area rose by 10 to 50 feet over the previous year due to increased recharge activities in this area during summer and fall 1998. Water levels in the Irvine area increased between 10 and 40 feet when compared to their November 1997 levels.

Water level hydrographs for four monitoring wells located in different areas of the basin are shown on Plate 3. The hydrographs span the years between 1969 (the year the basin was considered full) and 1998.

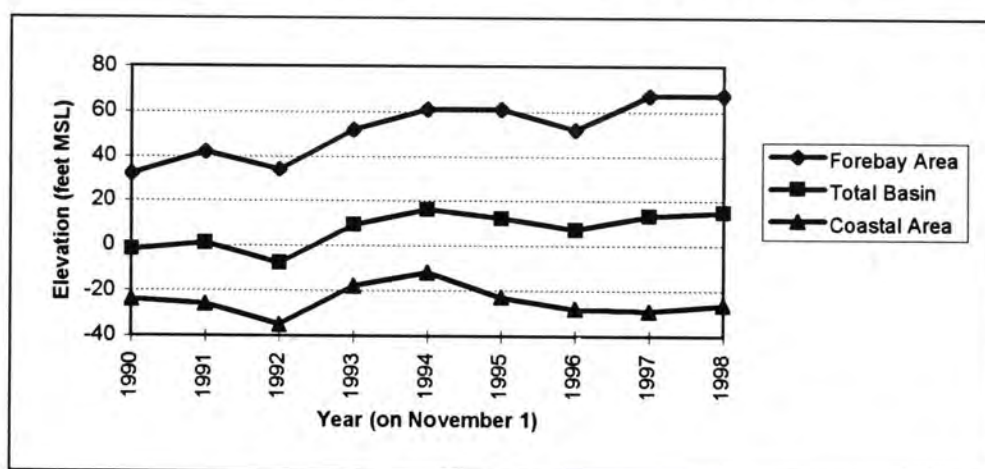
GROUNDWATER BASIN OVERDRAFT

Annual groundwater basin overdraft, as defined in the District Act, is the quantity by which production of groundwater supplies exceeds natural replenishment of groundwater supplies during a water year. This difference between extraction and replenishment can be estimated by determining the change in volume of groundwater in storage that would have occurred had supplemental water not been used for any groundwater recharge purpose, including seawater intrusion protection, water reclamation, and the In-Lieu Program.

For the 1997-98 water year, it is estimated that the volume of groundwater in storage increased by 48,340 acre-feet. In addition, 53,690 acre-feet was percolated or injected to replenish groundwater supplies with imported Colorado River water, State Project water, In-Lieu purchases, Water Factory 21 (excluding deep well water), Western MWD Transfer, Arlington Desalter and Alamitos Barrier water. Therefore, the annual overdraft for the 1997-98 water year is 5,350 acre-feet.

During the five years from July 1, 1993 to June 30, 1998, an annual average of 63,824 acre-feet of supplemental water and reclaimed water (including Alamitos Barrier and In-Lieu purchases; Colorado River, State Water Project, Bunker Hill Basin and Water Factory 21 water) was percolated or injected into the underground basin for replenishment or used directly in lieu of pumping groundwater. During a comparable five-year period, November 1, 1993 to November 1, 1998, average water levels in the District's Forebay (intake) area increased 15.3 feet and average water levels in the Pressure (coastal) area decreased 8.4 feet (see Figure 3), resulting in a net increase in basin storage of approximately 101,857 acre-feet, or an annual average increase of approximately 20,371 acre-feet. The average annual overdraft during these five years is estimated to be 46,251 acre-feet. Average seasonal rainfall in the OCWD service area during this five-year period was 17.4 inches, or 130% of the historical average of 13.4 inches.

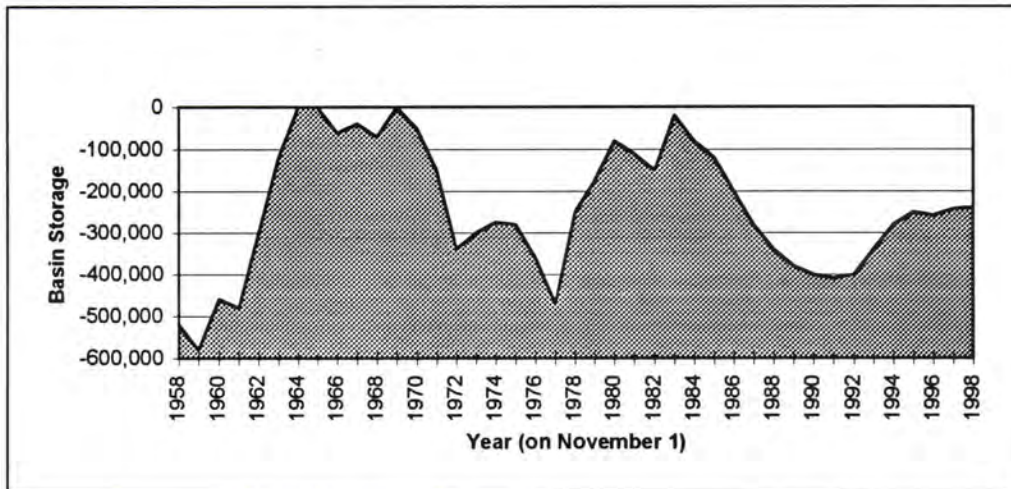
FIGURE 3. Average Piezometric Elevations



The accumulated overdraft, as defined in the District Act, is the quantity of water needed at OCWD's intake area in order to prevent landward movement of ocean water into the fresh groundwater body. Landward movement of ocean water can only be prevented if groundwater levels near the coast are several feet above sea level. Groundwater levels along the coast are related to the volume of water stored in the intake area, water pumped from the entire basin, and the pattern or location of pumping. Coastal groundwater levels are enhanced by seawater intrusion control projects.

For the purpose of estimating accumulated overdraft, groundwater levels, as measured on November 1, 1969, were assumed to represent full basin conditions, under which seawater intrusion would not occur. Using this 1969 reference year, the groundwater levels as of November 1, 1998 show an accumulated overdraft of approximately 238,143 acre-feet, as shown in Figure 4. For the 1997-98 water year, which ended June 30, it is estimated that the accumulated overdraft totaled 186,345 acre-feet.

FIGURE 4. Storage in Orange County's Groundwater Basin



Projected annual overdraft for the current water year (1998-99) is estimated to be 50,000 acre-feet. This estimate is based on the assumption that annual groundwater production for the current water year will total 350,000 acre-feet (including an estimated 13,000 acre-feet for the In-Lieu Program) and that natural replenishment will total 300,000 acre-feet.

Projected annual overdraft for the ensuing water year (1999-2000) is estimated to be 75,000 acre-feet. This estimate is based on the assumption that annual groundwater production for the ensuing water year will total 355,000 acre-feet and that natural replenishment will total 280,000 acre-feet.

On September 1, 1997, OCWD and MWD entered into a water supply management agreement which allows MWD to pre-deliver replenishment water to the groundwater basin (referred hereinafter as the Basin Water Supply Management Program). For the 1997-98 water year, MWD supplied 27,675 acre-feet of water under this agreement.

REPLENISHMENT RECOMMENDATION

The District Act allows the Board of Directors to determine a Replenishment Assessment that would provide the funds necessary to purchase sufficient water to replenish the average annual overdraft for the immediate past five years, plus an additional amount of water sufficient to mitigate the accumulated overdraft of not less than 10 years nor more than 20 years.

Based on the District's July to June water year, the five-year average annual overdraft is 46,251 acre-feet as of June 30, 1998, and one-tenth of the accumulated overdraft is 18,634 acre-feet. Therefore, in accordance with Section 27 of the District Act, the portion of the Replenishment Assessment levied in 1999-2000 for the purchase of replenishment water

could equal the amount necessary to purchase the sum of the above two quantities, which is equal to approximately 65,000 acre-feet of replenishment water.

Table 2 presents the 1999-2000 budget required to purchase 65,000 acre-feet of replenishment water. A Replenishment Assessment of \$27 per acre-foot for irrigation use and \$54 per acre-foot for non-irrigation use would correspond to this total. These assessments are based on the assumption that 11,000 acre-feet will be pumped for irrigation use and 339,000 acre-feet will be pumped for non-irrigation use, as shown in Table 5.

For the 1999-2000 water year, however, the District has budgeted for the direct purchase of only 39,000 acre-feet of replenishment water from Metropolitan Water District of Southern California (MWD). This would reflect the purchase of 2,000 acre-feet for basin replenishment at the Alamitos Barrier along the coastal zone, 6,000 acre-feet from the Arlington Desalter, and 31,000 acre-feet of imported water for percolation at OCWD's recharge facilities and for use in the In-Lieu Program. In addition to these purchases, 7,000 acre-feet from Water Factory 21 will be manufactured and injected along the Talbert Barrier. The combined total of 46,000 acre-feet of replenished water, which approximately equals the estimated 5-year average annual basin overdraft, will allow the District to maintain the current basin groundwater level.

**TABLE 2. 1999-2000 Replenishment Assessment Limit
for the Purchase of Replenishment Water**

Water Source	Acre-Feet	Cost (\$/AF)¹	Amount
Alamitos Barrier	2,000	\$458	\$ 916,000
Water Factory 21	7,000	\$458	\$ 3,206,000
Groundwater Replenishment	56,000	\$260	\$14,560,000
TOTAL	65,000		\$18,682,000

¹ Includes readiness-to-serve charge

RECOMMENDED BASIN PRODUCTION PERCENTAGE

For the 1999-2000 water year, a Basin Production Percentage of 75% is recommended. This recommendation is based on the projected availability of groundwater supplies in the basin and availability of supplemental water supplies.

To achieve water quality objectives in the groundwater basin, the OCWD Board of Directors may assign production requirements for the cities of Garden Grove and Orange during the 1999-2000 water year. Production requirements are exempt from the Basin Equity Assessment (BEA) when poor quality well water is produced and treated to domestic standards in amounts that exceed the BPP.

PART II: WATER SUPPLY AND BASIN UTILIZATION

Section 31.5 of the District Act requires an investigation and annual report setting forth the following information related to water supply and basin utilization within the OCWD service area, together with other information as OCWD may desire:

WATER SUPPLY AND BASIN UTILIZATION 1997-98 SUMMARY OF FINDINGS

1. Water production from supplemental sources was 179,041 acre-feet for the 1997-98 water year.
2. Water production from all other sources for the 1997-98 water year was 2,400 acre-feet.
3. Water served through the In-Lieu Program totaled 15,096 acre-feet for the 1997-98 water year.
4. Water demand within OCWD totaled 466,225 acre-feet for the 1997-98 water year.
5. Estimated 1998-99 demand for imported water is 144,000 acre-feet.
6. Water available for groundwater recharge is expected to exceed the recharge budget limit of 65,000 acre-feet in the 1999-2000 water year.

SUPPLEMENTAL WATER

Supplemental water is used by water agencies throughout OCWD to augment groundwater supply and to recharge the groundwater basin. Supplemental water, as defined in the District Act, is any water that originates from outside District boundaries, including the Santiago Creek watershed above Villa Park Dam. Sources of supplemental water include deliveries from the MWD and flows from Santiago Creek. MWD deliveries originate from either the Colorado River or the State Water Project. As a result, this water is sometimes referred to as “nonlocal water.” Water agencies utilizing supplemental water are listed in Appendix 1.

During the 1997-98 water year, use of supplemental water in the OCWD service area totaled 179,041 acre-feet: 127,504 acre-feet used directly by water agencies and 51,537 acre-feet used for groundwater replenishment. Water agency use included 116,595 acre-feet for municipal and industrial use and 10,909 acre-feet for agricultural purposes; groundwater replenishment included 15,096 acre-feet for the In-Lieu Program. Supplemental water usage for the 1997-98 water year is detailed in Table 3, with historical supplemental water usage shown in Figure 5. A breakdown of supplemental water purchases (i.e., quantities and applied water rates) by OCWD for the water years 1990-91 through 1997-98 is presented in Appendix 7.

Groundwater replenishment quantities include deliveries to OCWD’s Forebay recharge facilities; the Alamitos Barrier, a seawater intrusion barrier near Seal Beach; the In-Lieu Program; and water purchased from Western MWD and Arlington Desalter for groundwater recharge.

FIGURE 5. Historical Supplemental Water Usage

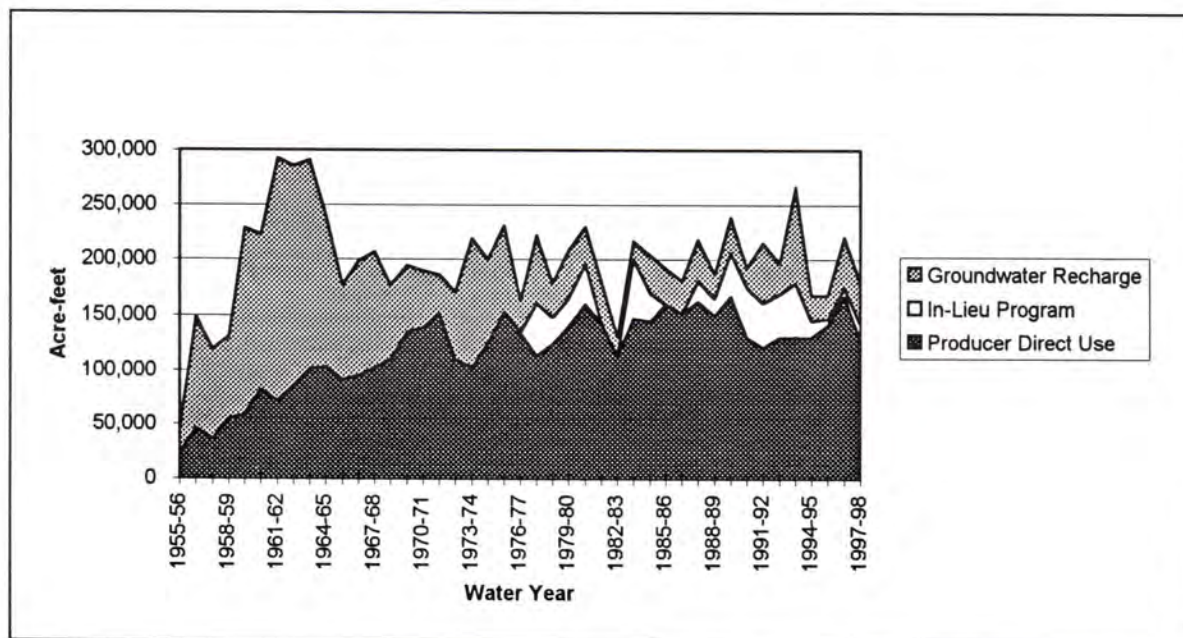


TABLE 3. 1997-98 Supplemental Water Usage

Direct Agency Use	Acre-feet
Agencies	125,104
Other Sources (Santiago Creek)	2,400
Subtotal	127,504
Groundwater Replenishment	
In-Lieu Program	15,096 ¹
Forebay Recharge	31,608 ¹
Arlington Desalter	2,517
Western MWD Transfer ²	702
Alamitos Barrier	1,614
Subtotal	51,537
TOTAL	179,041

¹ For the water year 1997-98, the entire quantity of In-Lieu Program water (15,096 acre-feet) plus 12,579 acre-feet of Forebay Recharge water, (27,675 acre-feet total), is designated as Basin Water Supply Management Program water under terms of the September 1, 1997 Water Supply Management Agreement between OCWD and MWD.

² Water pumped outside the groundwater basin for recharge through MWD's Demonstration Storage Program.

For the 1997-98 water year, the OCWD Board of Directors approved the continuation of the In-Lieu Program, previously sanctioned by MWD. The cost of the In-Lieu water to OCWD is the difference between the MWD Seasonal Storage rate and the cost to produce groundwater. OCWD pays this difference to participating agencies. In-Lieu water deliveries totaled 15,096 acre-feet for the 1997-98 water year, as shown in Table 4.

**TABLE 4. In-Lieu Program
1997-98 Water Deliveries**

Agency	Acre-feet
City of Huntington Beach	6,120
Mesa Consolidated Water District	5,468
City of Orange	1,797
City of Tustin	1,711
TOTAL	15,096¹

¹ For the water year 1997-98, the entire quantity of In-Lieu Program water (15,096 acre-feet) plus 12,579 acre-feet of Forebay Recharge water, (27,675 acre-feet total), is designated as Basin Water Supply Management Program water under terms of the September 1, 1997 Water Supply Management Agreement between OCWD and MWD.

During 1999-2000, availability of supplemental water is anticipated from three sources: Colorado River water imported by MWD, State Water Project water imported by MWD, and Santiago Creek. It is estimated that supplemental water available for groundwater replenishment during 1999-2000 will exceed 65,000 acre-feet, which is the budget limit for groundwater replenishment.

WASTEWATER RECLAMATION

Historically, only groundwater, supplemental water, and local surface water have been a source of water within OCWD. It is expected that wastewater reclamation will be a significant additional source in the near future. Wastewater is recycled at OCWD's Green Acres Project (GAP) and at the Irvine Ranch Water District (IRWD) for non-irrigation and industrial use. Recycled wastewater is also produced at OCWD's Water Factory 21 for use in the Talbert seawater intrusion barrier.

GAP and IRWD serve recycled wastewater to landscaped areas in Fountain Valley, Santa Ana, Huntington Beach, Costa Mesa, and the IRWD service area. For the 1997-98 water year, GAP and IRWD produced 9,820 acre-feet of recycled wastewater for irrigation and industrial purposes as detailed in Appendix 5.

Plans are underway to expand the use of recycled wastewater within the District. Service to Newport Beach is scheduled to commence in the 1998-99 water year. Planning is also underway to extend GAP water service to central Huntington Beach. At Water Factory 21, plans are being developed to improve Water Factory 21's seawater barrier with the addition of new injection wells. At a seawater intrusion barrier near Seal Beach, the Alamitos Barrier, plans are underway to construct additional injection wells and to improve the water supply system to include 50% recycled wastewater.

WATER DEMANDS

During the 1997-98 water year, water demands within OCWD's service area totaled 466,225 acre-feet, 10% less than the previous year's demand of 515,414 acre-feet. Total demand includes the use of groundwater, imported water, water from other sources (Santiago Creek) and reclaimed wastewater. Total demand excludes water used by OCWD for groundwater recharge.

1997-98 water demands and projected water demands for 1998-99 and 1999-2000 are shown in Table 5. 1998-99 (current year) water demands were determined by assessing recorded current year data and then projecting annual totals to the end of the current year. 1999-2000 (ensuing year) water demands are based on projections provided by the District's retail water producers. Long term projections are shown in Figure 6.

TABLE 5. Water Demands Within Orange County Water District

	Ground-water¹	Imported Water	Other Water	Recycled Water²	Total
1997-98					
Non-Irrigation	322,071	114,195	2,400	9820	448,486
Irrigation	6,830	10,909	0	0	17,739
Total	328,901	125,104	2,400	9,820	466,225
1998-99 (Current Year)³					
Non-Irrigation	339,000	134,000	4,000	10,000	487,000
Irrigation	11,000	10,000	0	0	21,000
Total	350,000	144,000	4,000	10,000	508,000
1999-2000 (Ensuing Year)³					
Non-Irrigation	344,000	138,000	4,000	10,000	496,000
Irrigation	11,000	10,000	0	0	21,000
Total	355,000	148,000	4,000	10,000	517,000

¹Includes In-Lieu water

²Includes OCWD's Green Acres Project (excluding OCSD usage) and IRWD's reclaimed water production

³Estimated

WATER QUALITY

Groundwater and supplemental water served by the major agencies within the OCWD service area was determined to have an average of 491 milligrams per liter (mg/l) of total dissolved solids (TDS). The average groundwater TDS concentration for the basin was 465 mg/l, ranging from a low of 231 mg/l in the coastal areas to greater than 600 mg/l in the inland areas near Anaheim, Fullerton and Yorba Linda.

Average concentrations of TDS, nitrates and hardness for groundwater and groundwater combined with supplemental water supplied by agencies within OCWD's service area during the 1997-98 water year are shown in Table 6. These concentrations were determined from groundwater and supplemental water analyses and from production reports submitted to and filed with OCWD by each agency.

TABLE 6. 1997-98 Water Quality Summary

City/Agency	Groundwater¹			Delivered Blend^{1,2}		
	TDS³	NO₃⁴	Hardness⁵	TDS³	NO₃⁴	Hardness⁵
Anaheim	624	3.9	331	608	3.0	315
Buena Park	319	0.6	161	388	0.5	191
East Orange County WD	621	6.9	343	614	6.2	335
Fountain Valley	357	0.5	185	415	0.4	208
Fullerton	597	3.3	316	590	2.7	307
Garden Grove	500	3.7	290	504	3.5	288
Huntington Beach	311	0.4	147	383	0.3	181
Irvine Ranch WD	231	0.2	73	373	0.2	156
La Palma	281	0.1	130	309	0.1	145
Mesa Consolidated WD	307	0.2	117	371	0.2	155
Newport Beach	482	1.7	229	516	1.0	245
Orange	492	2.5	275	511	1.9	273
Santa Ana	371	2.2	202	420	1.7	219
Seal Beach	244	0.0	74	285	0.1	99
Serrano Water District	590	2.0	353	583	1.6	332
Southern California WC	454	1.9	235	494	1.3	247
Tustin	709	9.2	349	682	7.6	334
Westminster	368	1.5	214	417	1.2	227
Yorba Linda WD	663	4.0	313	625	2.5	296
Average for OCWD Service Area	465	2.5	240	491	1.9	248

¹ Flow-weighted average water quality constituents for untreated groundwater in mg/l.

² Delivered Blend includes groundwater and imported MWD water (i.e., blend of Colorado River water and State Project water). Constituents in mg/l. Annual average water quality for MWD water:

TDS = 562 mg/l

NO₃ = 0.2 mg/l

Hardness = 267 mg/l

³ Secondary Drinking Water Standard for total dissolved solids (TDS):

500 mg/l (recommended limit)

1,000 mg/l (upper limit)

⁴ Primary Drinking Water Standard for nitrate (NO₃) is 10 mg/l (as N). (Note: standard is set in terms of nitrogen equivalents).

⁵ Hardness as CaCO₃:

0-75	mg/l = soft
75-150	mg/l = moderately hard
150-300	mg/l = hard
300-up	mg/l = very hard

NOTE: Primary Drinking Water Standards must be met. Secondary Drinking Water Standards relate to odor and aesthetics, and must be met to the extent practical.

WATER RESOURCES DATA

A summary of water resources data for the 1996-97 and 1997-98 water years within OCWD is shown in Appendix 6.

WATER CONSERVATION

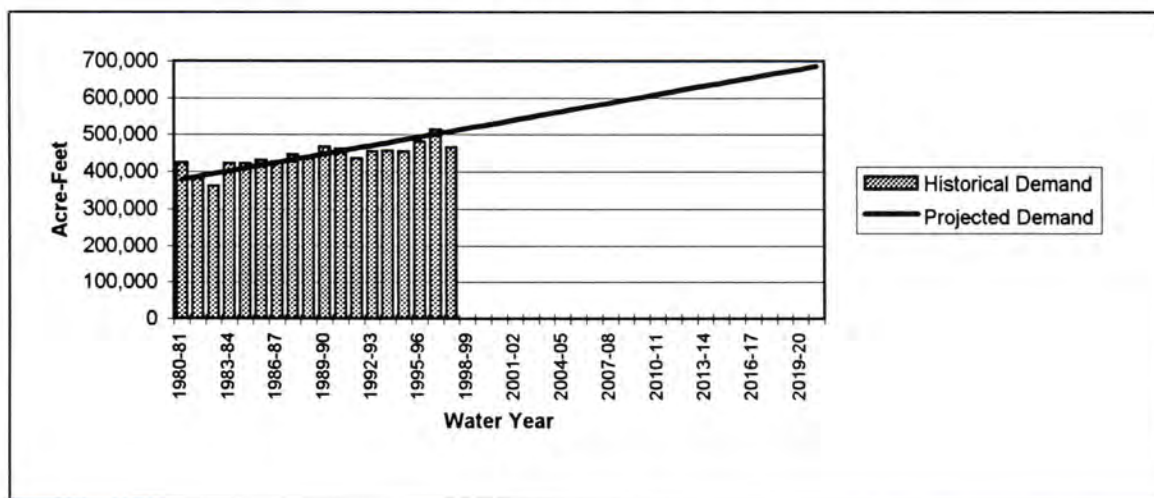
On September 20, 1995, OCWD approved an innovative program to encourage water conservation among groundwater producing agencies within the OCWD service area. The objective of the program is to encourage the installation of ultra low-flush toilets and low-flow showerheads by creating an incentive (i.e., opportunity to reduce the purchase of supplemental water) for participating agencies. For the water year 1997-98, nineteen agencies participated in the program and conserved 1,701 acre-feet of water. From the inception of the program through June 30, 1998, a total of 3,092 acre-feet of water have been conserved as a result of the program's implementation.

WATER DEMAND FORECAST

During the past year, OCWD has participated with MWDOD and retail groundwater producers to predict future demands in the OCWD service area. Each producer projected its total water demands to the year 2020. These projections include the effect of local water conservation measures. Figure 6 illustrates historical and projected water demands for the OCWD service area to the year 2020.

Population within OCWD's service area is expected to increase from just over 2 million currently to nearly 2.6 million by the year 2020. This growth in population is expected to increase water demands from 463,000 acre-feet per year to 686,000 acre-feet per year. With these future demands and assuming a BPP of 75%, groundwater production levels will increase from 315,000 acre-feet per year to 490,000 acre-feet per year during the next 22 years. To support these high levels of groundwater production, OCWD must continue to purchase imported supplies for groundwater recharge, capture Santa Ana River flows, and develop local reclaimed water supplies for replenishment purposes.

FIGURE 6. Water Demand Projections



PART III: WATER PRODUCTION COSTS

Section 31.5 of the District Act requires that the costs of producing groundwater and obtaining supplemental water be evaluated annually. The cost of producing groundwater and supplemental water varies for each producer, depending on many factors. Although these variations in cost are recognized, it is necessary for the purpose of this report to arrive at figures representing the average cost of producing groundwater and purchasing supplemental water for irrigation and non-irrigation use. A summary of water production costs are as follows:

WATER PRODUCTION COSTS 1997-98 SUMMARY OF FINDINGS

1. Groundwater production cost—including energy costs and the Replenishment Assessment—for non-irrigation use in the 1999-2000 water year is estimated to be \$150 per acre-foot.
2. Groundwater production cost—including energy costs and the Replenishment Assessment—for irrigation use in the 1999-2000 water year is estimated to be \$124 per acre-foot.
3. Estimated cost of MWD water (i.e., treated, non-interruptible) for non-irrigation use in the 1999-2000 water year is \$458 per acre-foot.
4. Estimated cost of MWD water (i.e., untreated, non-interruptible) for irrigation use in the 1999-2000 water year is \$376 per acre-foot.

GROUNDWATER PRODUCTION COSTS FOR NON-IRRIGATION USE

The groundwater production cost, including energy costs and the Replenishment Assessment for non-irrigation use for the 1999-2000 water year is estimated to total \$150 per acre-foot, as detailed in Table 7. Energy costs for the production of an acre-foot of groundwater for each of the major producers are shown in Appendix 1. A survey of the major water agencies was conducted to determine characteristics of a representative extraction facility and the associated production costs. The findings of the survey are presented in Appendix 4.

Significant components included in the cost of groundwater production for non-irrigation use are energy, operation and maintenance requirements. Based on responses to the October 1998 agency survey, energy costs range from \$22.53 per acre-foot to \$65.39 per acre-foot and operation and maintenance costs range from \$2.97 per acre-foot to \$171.02 per acre-foot. Elements that influence these costs include load factors and variations in groundwater levels. Recently drilled wells are generally deeper (1,100-foot depth for a typical well) than those drilled decades ago. The average load factor, which indicates the percent-of-use of an extraction facility, was 63% for the major water agencies within OCWD.

GROUNDWATER PRODUCTION COSTS FOR IRRIGATION USE

Groundwater production costs for irrigation use are determined for producers that have the ability to receive supplemental water and for producers that do not have the ability to receive supplemental water. Groundwater production costs for both types of producers are shown in Table 7. Costs shown are based on a representative irrigation facility; characteristics of such a facility are presented in Appendix 4.

Groundwater production costs for irrigation use during the 1999-2000 water year are expected to total \$226.02 per acre-foot for producers with a supplemental water connection. This total includes capital, operation and maintenance, energy, and OCWD's Replenishment Assessment. Groundwater production costs for this type of producer are based on an annual production of 415 acre-feet and an average load factor of 30%. 1999-2000 groundwater production costs remain lower than supplemental water costs for this type of producer.

1999-2000 groundwater production costs for irrigation use are expected to total \$313.95 per acre-foot for producers without a supplemental water connection. Groundwater production costs for this type of producer are based on an annual production of 187 acre-feet and an average load factor of 30%. Energy costs average \$74.16 per acre-foot for this type of producer, which reflects the need to double pump groundwater (pumping from the groundwater basin to a reservoir and then from the reservoir to delivery system pressure). 1999-2000 groundwater production costs for this type of producer exceed the 1999-2000 supplemental water cost of \$260 per acre-foot.

TABLE 7. 1999-2000 Groundwater Production Costs

Item	Non-irrigation		Irrigation with Supplemental connection		Irrigation without Supplemental connection	
	Annual \$	\$/AF ¹	Annual \$	\$/AF ²	Annual \$	\$/AF ³
Fixed Costs						
Capital Costs	74,830 ⁴	65.76	29,930 ⁴	72.12	29,930	160.05
Variable Costs						
Operation & Maintenance	60,007	52.73 ⁵	12,342	29.74	5,561	29.74
Energy	56,900	50.00 ⁵	30,776	74.16	13,868	74.16
Replenishment	113,800	100.00 ⁶	20,750	50.00 ⁶	9,350	50.00 ⁶
Assessment						
Total Variable Costs	230,697	202.73	63,868	153.90	28,779	153.90
Total Production Costs	305,527	268.49	93,798	226.02	58,709	313.95

¹ Based on an estimated 61% load factor, 1138 acre-feet/year, and an average lift of 280 feet.

² Based on an estimated 30% load factor, 415 acre-feet/year, and an average lift of 123 feet.

³ Based on an estimated 30% load factor, 187 acre-feet/year, and an average lift of 123 feet.

⁴ Based on current construction costs amortized over 30 years at 6% interest.

⁵ Based on survey of large system groundwater producers for energy and annual production.

⁶ Proposed for adoption in the 1999-2000 budget.

COST OF SUPPLEMENTAL WATER

Supplemental water is supplied to the OCWD service area by MWD. MWD delivers both treated and untreated water in either a non-interruptible supply or interruptible supply. As a result, there are four cost categories: treated, non-interruptible; treated, interruptible; untreated, non-interruptible; and untreated, interruptible. Treated water is used primarily for municipal and industrial purposes, while untreated water is used for irrigation and groundwater recharge purposes. Table 8 shows the estimated costs for each MWD category for the 1999-2000 water year. Figures 7 and 8 show historical supplemental water costs along with historical groundwater production costs. A comparison of estimated costs for groundwater versus supplemental water during the ensuing year (1999-2000) is shown in Table 9 and in Figures 7 and 8. Values used in Figure 7 are presented in tabular form in Appendix 8.

Components of supplemental water cost include: MWD's commodity charge, distribution facility costs, annual operation and maintenance costs. Additional costs include MWD's "Readiness-to-Serve" (RTS) charge and a water surcharge by the Municipal Water District of Orange County (MWDOC).

The amortized costs of distribution facilities and annual operation and maintenance costs were determined and found to vary widely between producers. The costs for some producers are minimal, while for other producers the costs are quite high. Because of these variables, no unit costs are given in this report; however, it should be kept in mind that this component may be substantial for some producers.

The RTS is a charge implemented by MWD that provides firm revenues to fund facilities for reliability and water quality improvements for existing users of the system. In 1999-2000 MWD will collect approximately \$80 million in RTS charges from member agencies. The member agencies will use approximately \$40 million in property tax standby charges that they currently collect to defray the majority of the RTS charge in 1999-2000. The remainder of the RTS charge will be spread among existing members based on usage at an approximate cost of \$22 per acre-foot. This charge is planned to increase in the future.

MWDOC distributes MWD supplemental water to many water producers within OCWD. The water surcharge by MWDOC applies only to producers who purchase supplemental water from MWDOC. Producers that purchase supplemental water directly from MWD avoid this cost. This surcharge, \$5 per acre-foot, provides general funding for MWDOC.

TABLE 8. 1999-2000 Supplemental Water Costs

	Treated (\$/acre-foot)	Untreated (\$/acre-foot)
Non-Interruptible (Full Service)		
Commodity Charge	431	349
Readiness-to-Serve	22	22
MWDOC Surcharge	5	5
Total	458	376
Interruptible (Seasonal Storage)		
Commodity Charge	266	233
Readiness-to-Serve	22	22
MWDOC Surcharge	5	5
Total	293	260

FIGURE 7. Adopted and Projected Water Rates for Non-Irrigation Use

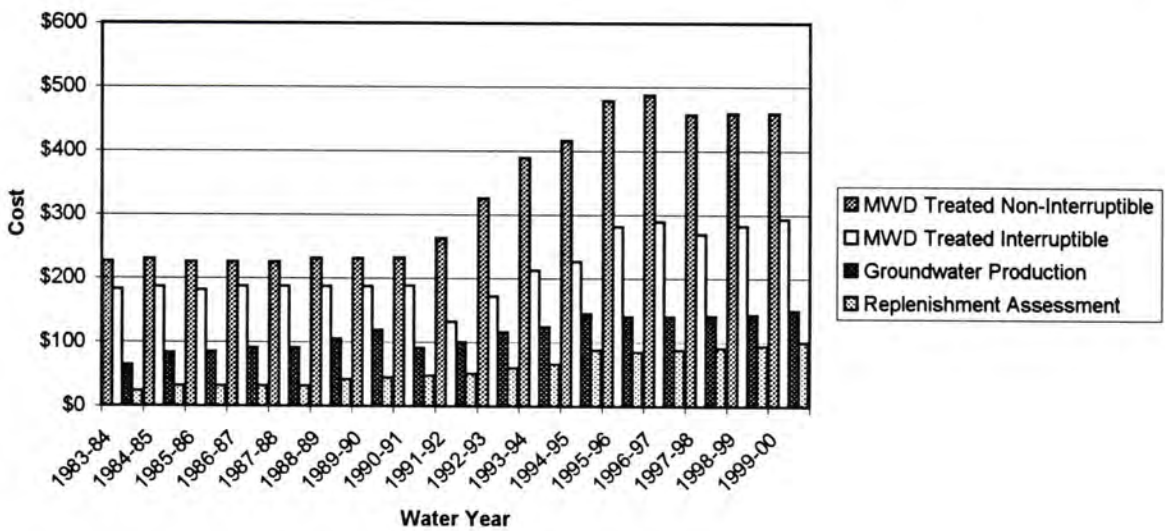


FIGURE 8. Adopted and Projected Water Rates for Irrigation Use

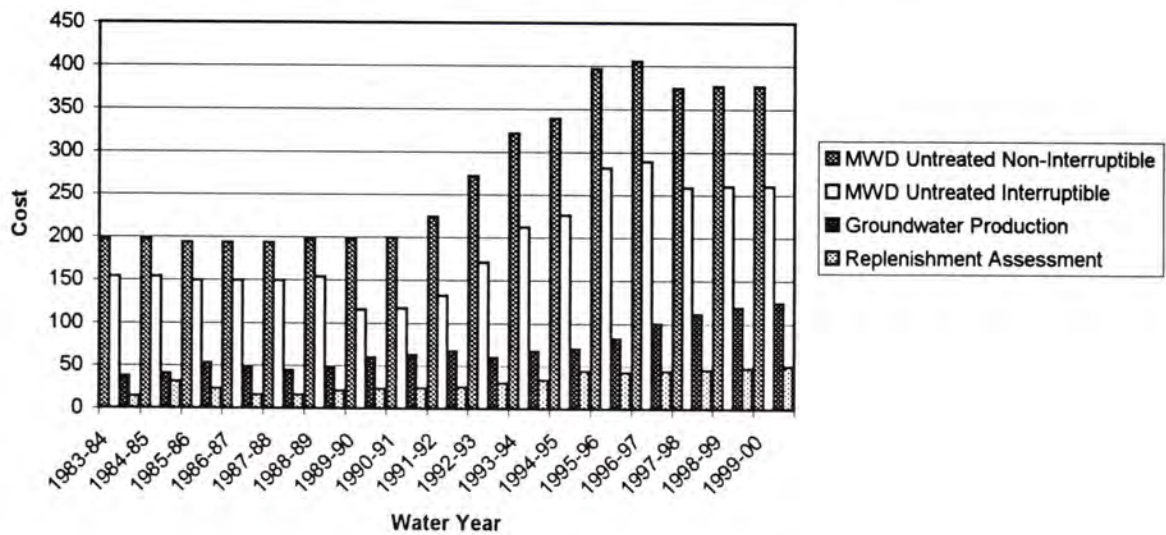
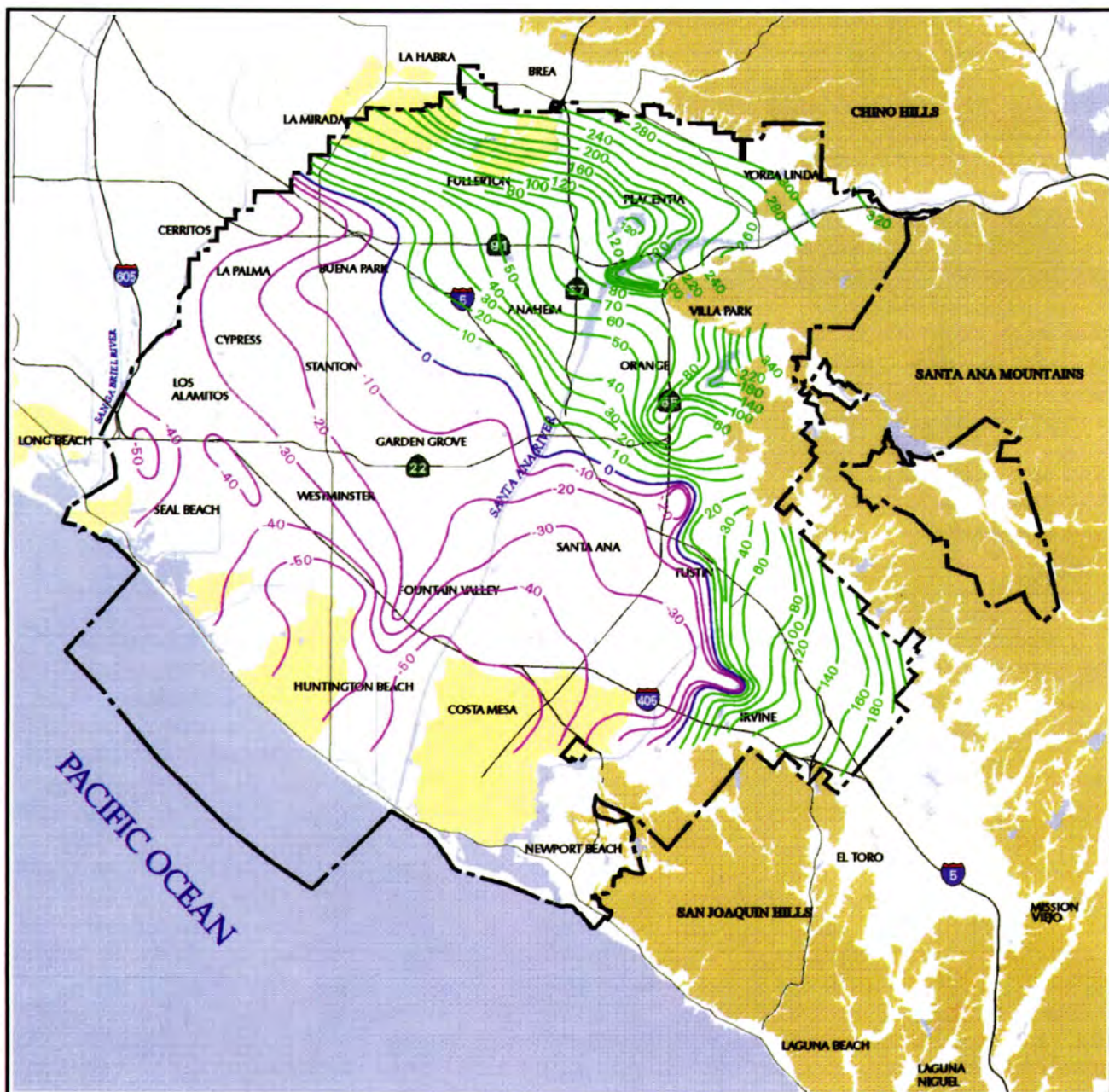


TABLE 9. 1999-2000 Water Production Costs Comparison

	Groundwater (\$/acre-foot)	Supplemental Water (\$/acre-foot)
Irrigation Use		
Fixed Cost	\$ 72.12	\$ 14.20
Variable Cost	153.90 ¹	376.00
Total	\$226.02	\$390.20
Non-Irrigation Use		
Fixed Cost	65.76	15.04
Variable Cost	202.73 ¹	458.00
Total	\$268.49	\$473.04

¹ Includes Replenishment Assessment of \$50/acre-foot and \$100/acre-foot for purchase of water for irrigation use and non-irrigation use, respectively.



- WATER
- MESAS
- IMPERMEABLE FORMATION
- OCWD BOUNDARY
- FREEWAYS/HIGHWAYS
- GROUNDWATER ELEVATION (FEET MSL)

GROUNDWATER CONTOUR MAP NOVEMBER 1998

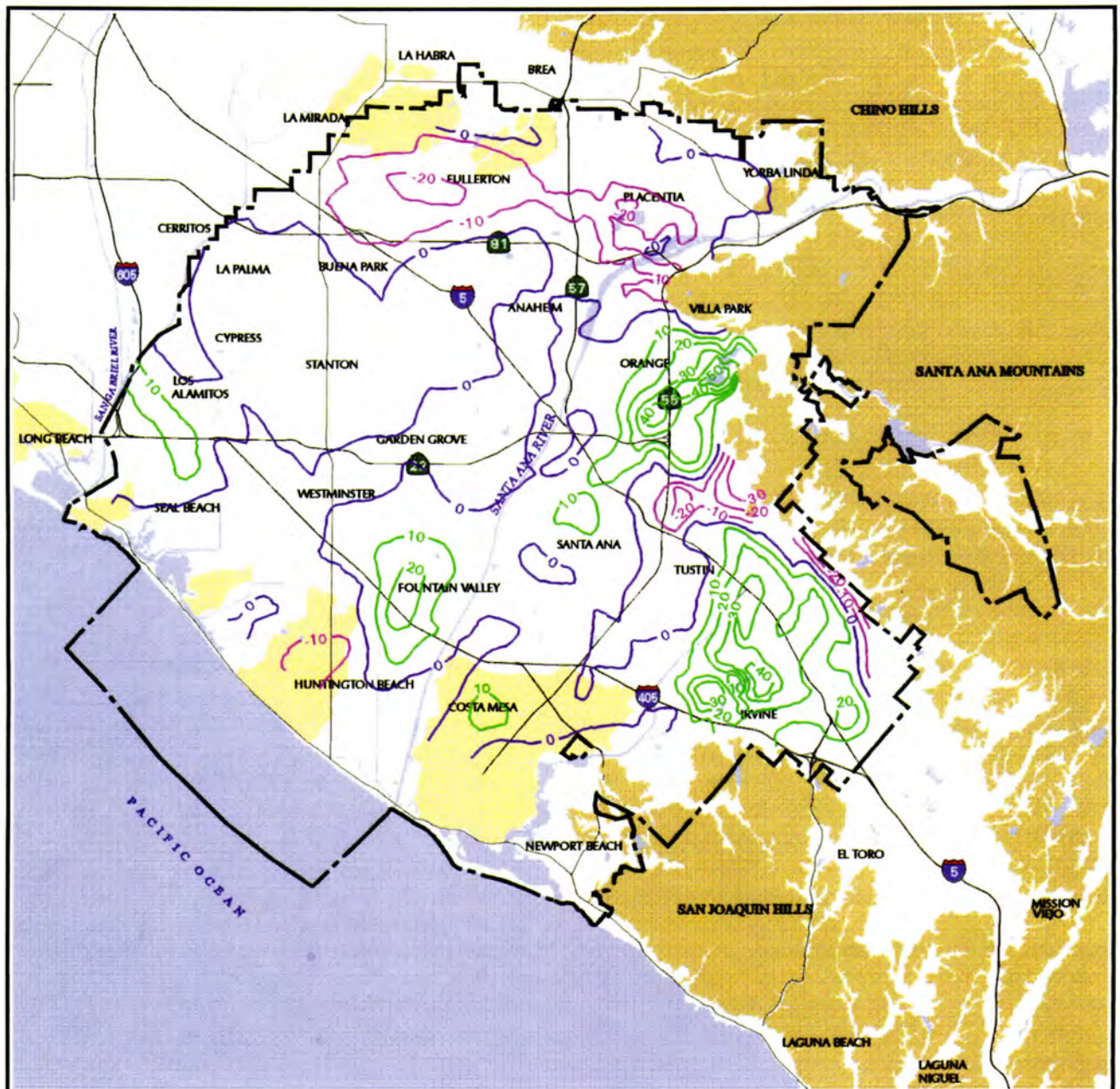


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PLATE 2



- WATER
- MESAS
- IMPERMEABLE FORMATION
- OCWD BOUNDARY
- FREEWAYS/HIGHWAYS
- GROUNDWATER ELEVATION CHANGE (FEET)

CHANGE IN WATER LEVEL NOV. 1997 TO NOV. 1998

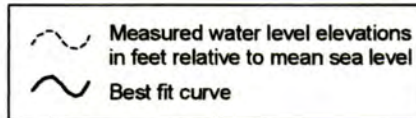


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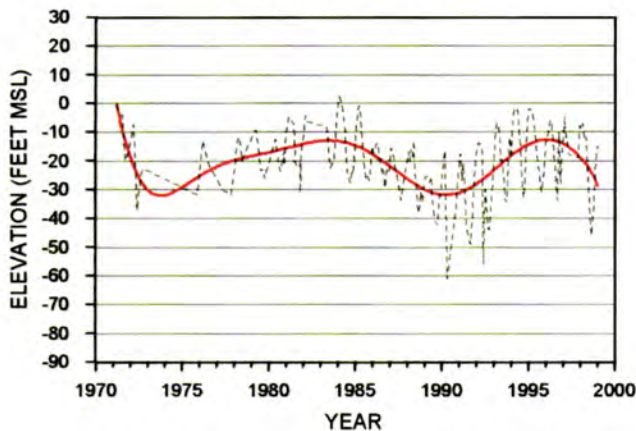


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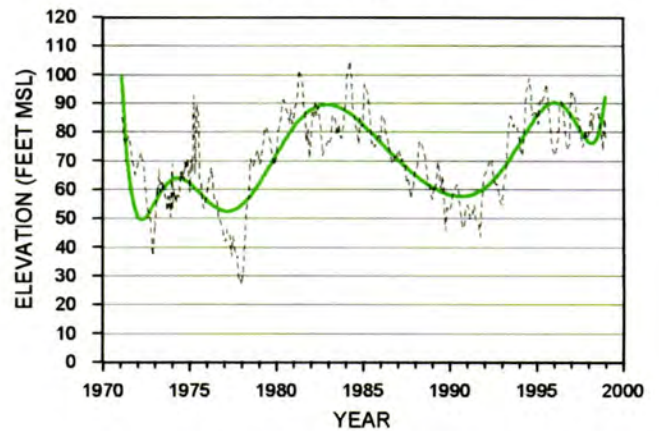
PLATE 3 MONITORING WELL HYDROGRAPHS TRENDS



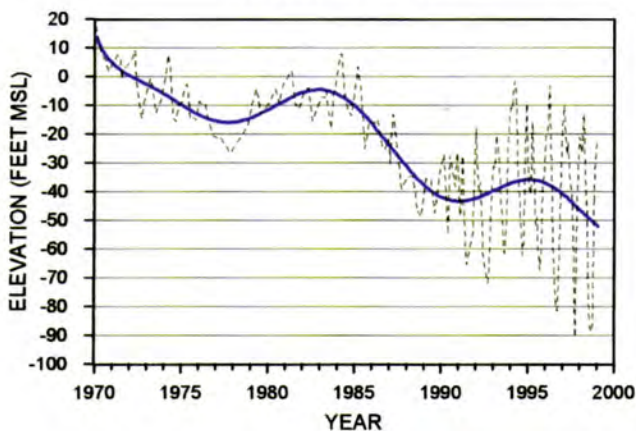
GG-16
04S/11W-33L01



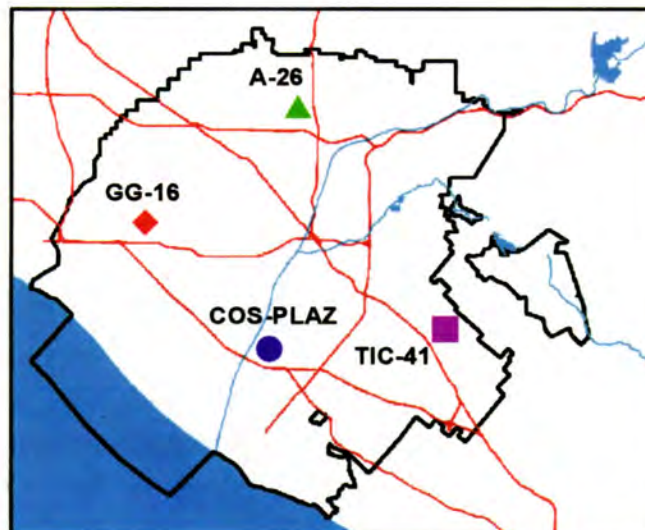
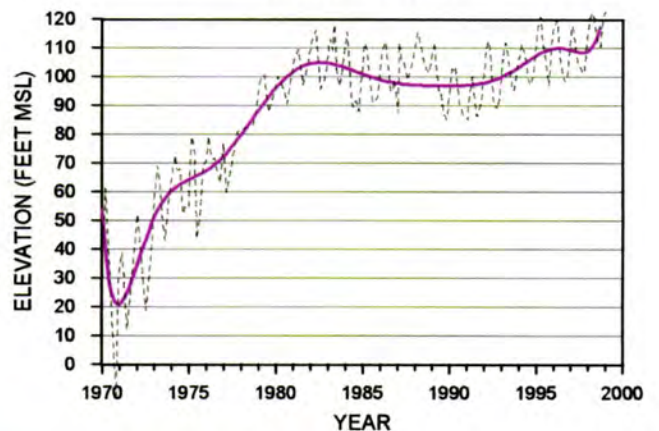
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04S/10W-01F01



COS-PLAZ
05S/10W-35K01



TIC-41
05S/09W-36B01



APPENDIX 1. Water Production Data 1997-98

Producer	Supplemental Water (AF)				Groundwater (AF)				Reclaimed Water (AF)			BPP (%)	Energy (\$/AF)	BEA ³ (\$/AF)
	Non-Irrigation ¹	Irrigation	Conservation Credit	Total	Non-Irrigation ¹	Irrigation	In-Lieu ²	Total	Non-Irrigation ¹	Irrigation	Total			
Anaheim, City of	17,566	-	267	17,833	52,846	-	-	52,846	-	-	-	74.8%	46	313
Buena Park, City of	4,533	-	35	4,568	11,447	-	-	11,447	-	-	-	71.5%	35	324
East Orange County Water District	106	-	3	109	846	-	-	846	-	-	-	88.6%	47	301
Environmental Management Agency	104	-	-	104	121	-	-	121	-	-	-	53.8%	50	315
Fountain Valley, City of	2,947	-	60	3,007	7,475	75	-	7,550	726	-	726	71.5%	42	324
Fullerton, City of	5,707	6	93	5,806	23,377	15	-	23,392	-	-	-	80.1%	57	299
Garden Grove, City of	2,014	-	194	2,208	27,424	-	-	27,424	-	-	-	92.5%	45	160 ⁵
Huntington Beach, City of	7,935	-	196	8,131	20,001	-	6,120	26,121	4	-	4	76.3%	22	340
Irvine Company, The	-	9,717	-	9,717	-	4,653	-	4,653	-	-	-	32.4%	72	202
Irvine Ranch Water District	15,071	1,120	92	16,283	21,113	90	-	21,203	8,176	-	8,176	56.6%	41	310
La Palma, City of	256	-	16	272	2,292	-	-	2,292	-	-	-	89.4%	47	324
Mesa Consolidated Water District	3,844	-	101	3,945	11,457	-	5,468	16,925	477	-	477	81.1%	55	- ⁵
Newport Beach, City of	7,580	-	17	7,597	10,076	-	-	10,076	-	-	-	57.0%	56	315
Orange, City of	7,474	42	114	7,630	20,350	137	1,797	22,284	-	-	-	74.5%	50	315
Orange Park Acres Mutual Water Co.	230	-	-	230	572	-	-	572	-	-	-	71.3%	50	315
Santa Ana, City of	12,031	-	137	12,168	34,788	-	-	34,788	437	-	437	74.1%	60	300
Seal Beach, City of	504	-	30	534	3,460	-	-	3,460	-	-	-	86.6%	77	311
Serrano Water District ⁴	1,389	-	5	1,394	1,644	-	-	1,644	-	-	-	54.1%	54	308
Southern California Water Company	10,813	-	176	10,989	18,513	-	-	18,513	-	-	-	62.8%	51	310
Tustin, City of	2,078	-	54	2,132	9,361	-	1,711	11,072	-	-	-	83.9%	63	- ⁵
Westminster, City of	3,557	-	76	3,633	10,512	-	-	10,512	-	-	-	74.3%	43	329
Yorba Linda Water District	5,505	24	35	5,564	8,944	90	-	9,034	-	-	-	61.9%	59	278
Agency Total	111,244	10,909	1,701	123,854	296,619	5,060	15,096	316,775	9,820	-	9,820	71.9%		
Other Producers	-	-	-	-	7,188	1,770	-	8,958	-	-	-	100.0%		315
Total	111,244	10,909	1,701	123,854	303,807	6,830	15,096	325,733	9,820	-	9,820	72.5%		

¹All water used for purposes other than commercial agriculture.

²Imported MWD water purchased for domestic use to offset groundwater pumping.

³Basin Equity Assessment (BEA) costs are based on MWD water costs.

⁴Santiago Creek diversion is defined as Supplemental Water in the District Act and accounted for in the Engineer's Report as "other sources."

⁵Partial or full BEA exemption due to producer's involvement in groundwater quality improvement projects.

**APPENDIX 2. 1997-98¹ Groundwater Production—
Non-Irrigation Use Production Over 25 Acre-feet**

PRODUCER	ACRE-FEET	PRODUCER	ACRE-FEET
Anaheim Cemetery	33.3	Mesa Consolidated Water District	11,457.1
Abbey Funeral Center	63.7	Mesa Verde Country Club	246.2
Anaheim, City of	52,845.8	Midway City Mutual Water Co.	161.4
Angelica Healthcare	370.1	Mile Square Golf Course	270.9
Appleman and Goldman	59.9	McKesson Water Products	48.7
Bit O Home LLC.	25.8	Navy Golf Course	387.6
Buena Park, City of	11,446.6	Newport Beach, City of	10,075.9
Blue Diamond/Livingston Graham	37.3	Newport Beach Golf Course	98.6
Catalina Street Pump Owners	37.7	Oasis Drinking Waters	58.0
Chapman, Irvin C.	342.3	Old Ranch Country Club	376.4
Community College District	27.1	Orange, City of	20,349.9
Diamond Park Mutual Water Co.	46.8	Orange County Water District	2,298.1
Diamond-Newport Ice Corp.	49.7	Orange Park Acres Mutual Water Co.	571.5
Donovan Golf Course Mgmt., Inc.	252.9	Page Avenue Mutual Water Company	49.3
East Orange County Water District	846.1	River View Golf	269.0
Eastside Water Association	29.6	Rockwell International	167.9
Environmental Management Agency	121.8	Santa Ana, City of	34,788.1
Fairhaven Memorial Park	96.6	Santa Ana Country Club	183.8
FJC U.S.A., Inc.	162.4	Seal Beach, City of	3,459.9
Forest Lawn Memorial Park	204.3	Serrano Water District	1,644.3
Fountain Valley, City of	7,475.3	Silverado Cont.	168.4
Fullerton, City of	23,377.4	South Midway City Water Co.	92.5
Garden Grove, City of	27,741.3	Southern California Water Co.	18,513.4
Good Shepherd Cemetery	33.6	Sparkletts Drinking Water Corp.	237.8
Harding Water	25.6	Transwestern Property Co.	34.2
Huntington Beach, City of	20,001.3	Tustin, City of	9,361.0
Hynes Estates, Inc.	75.5	Villa Capri Mobilehome Park	41.4
Irvine Ranch Water District	21,112.9	Walt Disney Production Maint. Div.	37.5
Knott's Berry Farm	260.4	Westminster Memorial Park	327.0
Kwikset Corporation	208.4	Westminster, City of	10,512.0
La Palma, City of	2,291.6	Woodbridge Village Homeowners Assoc.	151.5
Liberty Park Water Association	26.3	Yorba Linda Country Club (Calif. Golf)	292.2
Los Alamitos Race Course	288.9	Yorba Linda Water District	8,943.8
		Total	305,693.6

¹Water year begins July 1.

**APPENDIX 3. 1997-98¹ Groundwater Production—
Irrigation Use Production Over 25 Acre-feet**

PRODUCER	ACRE-FEET	PRODUCER	ACRE-FEET
Crimson Farms	103.5	Orange, City of	136.8
Etchandy, Gary	54.1	Osumi Farms, Inc.	540.0
Fairhaven Memorial Park	32.2	Pursche, Roy	85.2
Fountain Valley, City of	74.5	Ruiz, Stanley	55.1
Fujishige, Hiroshi	187.6	Sakioka Farms	89.9
Irvine Company, The	4,084.9	Seaview Ag, LLC	81.4
Irvine Ranch Water District	658.6	Shozi Brothers	64.5
Ito-Ozawa Farms	173.8	Village Nurseries	119.2
Kraemer 11 Partners	35.7	Yorba Linda Water District	90.4
		Total	6,667.4

¹Water year begins July 1.

APPENDIX 4. Typical Groundwater Extraction Facility Characteristics 1997-98

PARAMETER	NON-IRRIGATION	IRRIGATION
System Pressure	70 psi	22 psi
Load (Use) Factor	61 percent	30 percent
Efficiency	65 percent	65 percent
Design Flow Rate	2,000 gpm	1,000 gpm
Motor Horsepower	200 hp	60 hp
Type Motor	Electric	Electric
Well Casing Diameter	20 inches	12 inches
Depth of Well	1,100 feet	700 feet
Type of Pump	Vertical Turbine	Vertical Turbine
Depth of Bowls	300 feet	140 feet
Average Lift	280 feet	123 feet
System Discharge Pressure	161 feet	20-50 feet
Total Pumping Lift	441 feet	153 feet
Estimated Life	30 years	30 years
Annual Cost of Facilities ¹	\$74,830	\$29,930
Annual Cost of Land ¹	\$1,490	\$644

¹ Based on an interest rate of 6% amortized over a 30-year period.

APPENDIX 5. Reclaimed Water Production and Usage 1997-98

RETAIL AGENCY	SITE	ACRE-FEET
Green Acres Project		
OCSD	Plants 1 & 2 (plant maintenance)	5,414
City of Fountain Valley	Mile Square Park	419
	Mile Square Golf Course	59
	OCWD	11
	Fountain Valley Recreation Center	77
	Caltrans 405 medians	53
	Green Valley	29
	Baker Golf Course	78
Huntington Beach	Arevalos Park	4
MCWD	Mt. Olive	47
	Plaza Tower	23
	Civic Center Park	5
	Crystal Court	12
	Talbert Park	34
	Fairview Park	30
	Tewinkle Park	66
	Speede Lube	1
	Town Center	19
	Street medians	9
	Caltrans 405 medians	166
	Home Ranch	0
	Instant Storage	2
	Orange Coast College	63
	Centennial Soccer Field	19
City of Santa Ana	Bomo Koral Park	9
	McFadden School	20
	Adams Park	8
	Chroma Systems	368
	South Coast Village	13
Green Acres Project Total		7,058
Irvine Ranch Water District	Multiple Sites	8,176
Total Usage		9,820¹

¹ Total usage excludes use by OCSD.

APPENDIX 6. 1997-98 Water Resources Summary

	1997-98 Water Year (AF)	1996-97 Water Year (AF)	Change from last year to this year (AF)
SUMMARY OF BASIN CONDITIONS			
BASIN SUPPLIES			
Supplemental/Nonlocal Recharge Water	36,441	44,893	(8,452)
Natural Flows (SAR & Santiago Creek)	439,476	198,798	240,678
Incidental Recharge ¹	101,530	73,872	27,658
Talbert Barrier (w/Deep Wells)	3,859	3,085	774
TOTAL	581,306	320,648	260,658
BASIN LOSSES			
Groundwater Production (w/Deep Wells)	313,805	331,406	(17,601)
River Flow Lost to Ocean	259,749	28,180	231,569
TOTAL	573,554	359,586	213,968
BASIN STATUS			
Change in Storage - Surface Water and Groundwater ¹	56,867	(19,500)	76,367
Basin Operating Storage ² - Producing from Storage	513,655	465,315	48,340
Basin Operating Storage ² - Recharge Storage	186,345	234,685	(48,340)
OTHER KEY INFORMATION			
1. Imported Deliveries to Producers	137,250	166,924	(29,674)
2. Producers' Seasonal Storage Program:	33,090	26,559	6,531
Short-term In-Lieu (Put & Take)	17,994	18,676	(682)
Long-term In-Lieu (OCWD)	15,096	7,883	7,213
3. Basin Production Percentage (includes OCWD In-Lieu)	72%	69%	3%
4. Total Water Demand	466,225	515,414	(49,189)
5. Wellhead Treatment/Water Reclamation Projects:			
Arlington Desalter	2,517	6,176	(3,659)
Other OCWD Wellhead Treatment Projects	10,239	8,060	2,179
Green Acres Project (w/o Deep Wells)	6,643	6,508	135
Water Factory 21 (w/o Deep Wells)	2,153	1,814	339
6. Deep Well Water for WF21 & GAP	2,117	1,792	325
7. Baseflow of Santa Ana River ³	147,953	138,071	9,882
8. Effluent Discharge to SAR above Prado Dam	152,265	139,893	12,372
9. Riverside Canal Flows:			
Drought Emergency Exchange Program	0	0	0
MWD Demonstration Storage Program	702	3,089	(2,387)
10. Prado Wetlands Inflow	83,750	7,010	76,740
11. SARI Flow at Prado	8,916	10,389	(1,473)
12. Year-end Storage behind Prado Dam	16,176	0	16,176
13. Year-end Storage in Deep Basins	23,955	17,107	6,848
14. Total Artificial Recharge (Percolation + Barriers)	259,313	236,128	23,185
15. Rainfall (inches)	30.0	13.6	16.4
16. OCSD Discharge to Ocean ¹	285,224	270,598	14,626

¹ Estimated

² Based on water in storage above 1956 low basin level

³ Prado outflow minus decrease in Prado storage, Riverside Canal and Arlington Desalter

**APPENDIX 7. Non-Local Water Purchases by Orange County Water District
for Water Years 1990-91 through 1997-98**

	Arlington Desalter		Alamitos Barrier		Forebay Recharge		In-Lieu Program		Basin Water Supply Mgmt. Program		SAR Upstream (WMWD Transfer)		TOTAL	
Water Year	Purchased AF	Rate ¹ \$/AF	Purchased AF	Rate ² \$/AF	Purchased AF	Rate ³ \$/AF	Purchased AF	Rate ³ \$/AF	Purchased ⁴ AF	Rate \$/AF	Purchased AF	Rate ⁵ \$/AF	Purchased AF	Paid ⁴
1990-91	4,490.7	143.24	1,933.1	195.76	15,619.0	116.60	44,738.6	116.60	0.0	0.00	0.0	0.00	66,781.4	\$9,354,652
1991-92	3,325.7	168.54	1,623.0	268.87	51,691.9	132.00	39,788.7	132.00	0.0	0.00	0.0	0.00	96,429.3	\$13,320,832
1992-93	2,952.7	168.00	1,614.0	327.00	26,293.4	170.85	38,900.3	170.85	0.0	0.00	0.0	0.00	69,760.4	\$12,162,175
1993-94	5,158.9	208.00	1,432.6	392.00	78,521.3	212.00	48,133.9	212.00	0.0	0.00	2,093.8	138.00	135,340.5	\$28,774,477
1994-95	1,930.3	223.59	798.3	419.00	15,354.2	226.00	15,622.2	226.00	0.0	0.00	2,343.2	138.00	36,048.2	\$8,090,109
1995-96	2,770.6	229.00	1,691.6	440.00	15,278.7	233.35	5,542.4	233.35	0.0	0.00	888.2	138.00	26,171.5	\$6,359,947
1996-97	6,176.2	231.00	1,885.5	441.87	33,742.7	237.55	7,883.0	237.55	0.0	0.00	2,958.0	138.00	52,645.4	\$12,241,183
1997-98	2,516.9	233.00	1,613.8	445.00	19,029.4	237.75	0.0	237.75	27,674.9	238.00	701.8	138.00	51,536.8	\$9,417,940
Total	29,322.0		12,591.9		255,530.6		200,609.1		27,674.9		8,985.0		534,713.5	\$99,721,315

¹ Arlington Desalter rate is based on MWD untreated seasonal storage rate per project agreement between OCWD and SAWPA.

² Alamitos Barrier rate is based on MWD non-interruptible treated water rate and includes CBMWD charges.

³ Rate does not include MWD RTS and Connection Maintenance charges, but does include MWDOC surcharges.

⁴ Basin Water Supply Management Program (effective on 9/1/97) water charges have not been incurred by OCWD. Price of water to be set and charged at the time OCWD takes possession of deliveries. Total for 1997-98 includes the entirety of In-Lieu Program water (i.e., 15,096 acre-feet) plus 12,579 acre-feet of Forebay Recharge water.

APPENDIX 8. Values Used in Figure 7 for Water Rates for Non-Irrigation Use

Water Year	Replenishment Assessment	Groundwater Production Cost ¹	MWD Treated Interruptible Rate ^{2,3}	MWD Treated Non-Interruptible Rate ²
	\$/AF	\$/AF	\$/AF	\$/AF
1983-84	24	64	182	226
1984-85	32	83	186	230
1985-86	32	85	181	225
1986-87	32	91	187	225
1987-88	32	91	187	225
1988-89	42	105	187	231
1989-90	45	119	187	231
1990-91	48	91	188	232
1991-92	51	100	132	263
1992-93	60	116	171	325
1993-94	65.50	124	212	389
1994-95	88	145	226	416
1995-96	85	140	281	478
1996-97	88	140	289	487
1997-98	91	141	269	456
1998-99	94	143	282	458
1999-00	100	150	293	458

¹ Includes RA plus cost of energy to produce groundwater.

² Includes MWDOC surcharge and approximated MWD Readiness-to-Serve (RTS) charge (note: RTS charge commenced on July 1, 1996).

³ Reported as MWD "Interruptible Treated" through June 30, 1991 and "Treated Shift Seasonal Storage" commencing July 1, 1991.



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