# 2008 - 2009 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District

SINCE 1933

2008-2009 ENGINEER'S REPORT

ORANGE COUNTY WATER DISTRICT

# 2008-2009

# ENGINEER'S REPORT ON THE

# GROUNDWATER CONDITIONS,

# WATER SUPPLY AND BASIN UTILIZATION

# IN THE

# ORANGE COUNTY WATER DISTRICT

## FEBRUARY 2010

SINCE 1933

**ORANGE COUNTY WATER DISTRICT**

ORANGE COUNTY'S GROUNDWATER AUTHORITY



February 17, 2010

Mr. Michael R. Markus
General Manager
Orange County Water District
Post Office Box 8300
Fountain Valley, CA 92728-8300

Dear Mr. Markus:

In accordance with Section 26 of the District Act, the 2008-2009 Engineer's Report is hereby submitted.

Precipitation for the water year July 1, 2008 through June 30, 2009 within OCWD boundaries averaged 10.47 inches, which was 78% of the long-term average rainfall of 13.4 inches per year. Santa Ana River flow past Prado Dam for the water year totaled 168,160 acre-feet, which was 31 percent below the 30-year average flow. Flow past the District's spreading grounds (including any flow from Santiago Creek) that was lost to the Pacific Ocean totaled 13,460 acre-feet.

Total water demand within the District for the 2008-09 water year was 456,913 acre-feet (excludes water used for groundwater replenishment and barrier maintenance). Supplemental water used for the year for groundwater replenishment and barrier maintenance totaled 28,425 acre-feet (excludes In-Lieu Program water). Groundwater production within the basin for the water year totaled 324,147 acre-feet (includes In-Lieu Program water) which was 11.5% decrease from the prior year.

Accumulated basin overdraft increased from 306,000 acre-feet on June 30, 2008 to 347,000 acre-feet on June 30, 2009 using the three-layer approach and new baseline full condition for the basin. Under the provisions of Section 27 of the District Act, a portion of the 2009-10 Replenishment Assessment could be equal to an amount necessary to purchase up to 108,000 acre-feet of replenishment water.

Very truly yours,

David A. Youngblood, P.E.
Director of Engineering

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Senior Engineer

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# EXECUTIVE SUMMARY

Total water demand within Orange County Water District (OCWD) was 456,913 acre-feet (AF) for the 2008-09 water year (beginning July 1, 2008 and ending June 30, 2009). Groundwater production for the water year totaled 324,147 AF. For this water year, a total of 28,425 AF of supplemental water was used for the purpose of groundwater replenishment and barrier maintenance.

For the water year, which ended June 30, 2009, the "annual overdraft" (annual basin storage decrease without supplemental replenishment water) was 100,200 AF. The accumulated overdraft on June 30, 2009 was 347,000 AF. Precipitation within the basin was 78% of normal during the water year, totaling 10.47 inches.

Based on the groundwater basin conditions for the water year ending June 30, 2009, OCWD may purchase up to 108,000 AF of water for groundwater replenishment during the ensuing water year, beginning July 1, 2010, pursuant to the District Act.

# ACKNOWLEDGMENTS

A number of public and private entities 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
Golden State Water Company
City of Huntington Beach
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
County of Orange, Public Works Department
Orange County Sanitation District
San Bernardino Valley Municipal Water District
City of Santa Ana
Santa Ana Watershed Project Authority
City of Seal Beach
Serrano Water District
City of Tustin
United States Geological Survey
Western Municipal Water District
City of Westminster
Yorba Linda Water District

The cooperation received from all agencies is gratefully acknowledged.

This report is based on the 2008-09 Basic Data Report which is placed on file at the Fountain Valley office of OCWD.

# GLOSSARY OF ACRONYMS

| | |
|---|---|
| AF | Acre-feet |
| AWPF | Advanced Water Purification Facility |
| BEA | Basin Equity Assessment |
| BPP | Basin Production Percentage |
| CPTP | Coastal Pumping Transfer Program |
| CR | Capacity Reservation |
| CUP | Conjunctive Use Program |
| DRWF | Dyer Road Well Field |
| GAP | Green Acres Project |
| GWR System | Groundwater Replenishment System |
| IDP | Irvine Desalter Project |
| IRWD | Irvine Ranch Water District |
| MCWD | Mesa Consolidated Water District |
| MF | Microfiltration |
| mg/L | Milligrams per Liter |
| MGD | Million Gallons per Day |
| MWD | Metropolitan Water District of Southern California |
| MWDOC | Municipal Water District of Orange County |
| O&M | Operation and Maintenance |
| OCSD | Orange County Sanitation District |
| OCWD | Orange County Water District |
| RA | Replenishment Assessment |
| RO | Reverse Osmosis |
| RTS | Readiness-to-Serve |
| SAR | Santa Ana River |
| SBVMWD | San Bernardino Valley Municipal Water District |
| SWP | State Water Project |
| TDS | Total Dissolved Solids |
| UV | Ultraviolet |
| WMWD | Western Municipal Water District |
| WRD | Water Replenishment District of Southern California |
| WSM | Basin Water Supply Management Program |

# PART I: GROUNDWATER CONDITIONS

Section 25 of the OCWD 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 water year of July 1, 2008 to June 30, 2009 is as follows.

## GROUNDWATER CONDITIONS
## 2008-09 SUMMARY OF FINDINGS

1. Groundwater production (excluding Talbert Barrier) totaled 324,147 acre-feet (AF) for the 2008-09 water year.

2. Groundwater stored in the basin decreased by 41,000 AF for the 2008-09 water year.

3. Accumulated Overdraft[1] on June 30, 2009 water year was 347,000 AF.[2]

4. Annual Overdraft[3] was 100,200 for the 2008-09 water year.

5. Average Annual Overdraft[3] for the immediate past five water years (2004-05 through 2008-09) was 73,000 AF.

6. Projected Annual Overdraft[3] for the current 2009-10 water year is 93,000 AF.

7. Projected Annual Overdraft[3] for the ensuing 2010-11 water year is 74,000 AF.

8. Projected Accumulated Overdraft on June 30, 2010 is 366,000 AF assuming average hydrological conditions.

9. Under the provisions of Section 27 of the District Act, a portion of the 2010-11 Replenishment Assessment (RA) could be equal to an amount necessary to purchase up to 108,000 AF of replenishment water.[4]

*[1] Accumulated overdraft was calculated using the OCWD-adopted (February 2007) three-layer storage change methodology and associated new benchmark for full-basin condition. Water year 2005-06 was the first year this methodology was used. Refer to other portions within this section for additional explanation.*

*[2] Water from the Metropolitan Water District of Southern California (MWD) Long-Term Groundwater Storage Program was included as part of the total stored water in determining the basin's accumulated overdraft.*

*[3] "Annual overdraft" is defined in the District Act as "annual basin storage decrease without supplemental replenishment water."*

*[4] Determined by adding the five-year annual overdraft (73,000 AF) to one-tenth of the accumulated overdraft (347,000 AF), which results in the following:*
*73,000 AF + [(347,000 AF) x 0.10] =107,700 AF (or 108,000 AF when rounded).*

## BASIN HYDROLOGY

Groundwater conditions in the Orange County groundwater basin are influenced by the natural hydrologic conditions of rainfall, capture and recharge of Santa Ana River (SAR) and Santiago Creek stream flows, natural infiltration of surface water, and the transmissive capacity of the basin. The basin is also influenced by groundwater extraction and injection through wells, use of imported water for groundwater replenishment, wastewater reclamation and water conservation practices throughout OCWD.

The water year beginning July 1, 2008, yielded an average of 10.47 inches of rainfall within OCWD's boundaries, which is approximately 78% of the long-term annual average of 13.4 inches. The previous year (2007-08) had rainfall equaling 10.64 inches which was also lower than the long-term average rainfall. The average seasonal rainfall in the OCWD service area for the five-year period (from July 1, 2004 through June 30, 2009) was 12.7 inches. Below average rainfall in the watershed led to lower flows in the SAR reaching Orange County. Stream flow in the SAR measured downstream of Prado Dam for water year 2008-09 totaled 168,160 AF which was approximately 31 percent below the 30-year flow average of 244,110 AF.

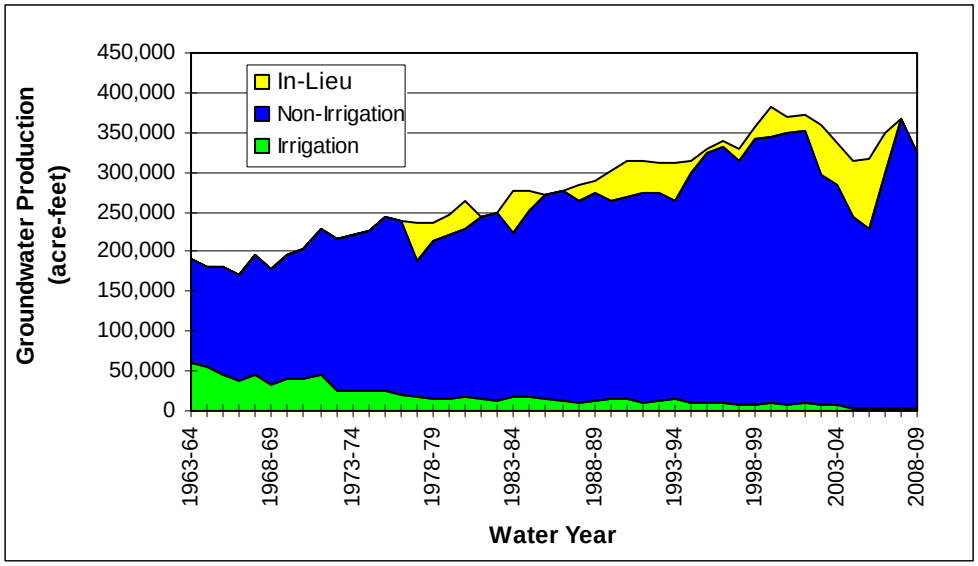
## GROUNDWATER PRODUCTION

Groundwater production from wells within OCWD for the 2008-09 water year totaled 324,147 AF: 321,631 AF for non-irrigation and 2,516 AF for irrigation uses. An additional amount of 23,344 AF of groundwater was extracted from the basin as part of MWD Long-Term Groundwater Storage Program and accounted for as supplemental water for the participating groundwater producers. The term "irrigation" used in the District Act and herein refers to irrigation for agricultural, horticultural or floricultural crops and for pasture grown for commercial purposes.

OCWD's In-Lieu Program replaces groundwater supplies with imported water to reduce groundwater pumping. The Program was in effect in 2008-09 but In-Lieu water was not available for purchase from MWD. Groundwater production and In-Lieu quantities within OCWD for the period 1961-62 through 2008-09 are presented in Figure 1 and Table 1. For the 2008-09 water year, total groundwater production remained unchanged at 324,147 AF since no In-Lieu Program water was available for purchase.

Groundwater production and In-Lieu Program quantities for 2008-09 for the major groundwater producers are presented in Appendix 1. The groundwater production for all producers exceeding 25 AF per year for non-irrigation and irrigation purposes are listed in Appendices 2 and 3, respectively.

## FIGURE 1. Groundwater Production




## TABLE 1. Historical Groundwater Production Within OCWD

| Water Year Jul 1-Jun 30 | Groundwater Production (AF) | In-Lieu Program (AF) | Water Year Jul 1-Jun 30 | Groundwater Production (AF) | In-Lieu Program (AF) |
|---|---|---|---|---|---|
| 1961-62 | 177,172 | - | 1985-86 | 270,932 | - |
| 1962-63 | 186,093 | - | 1986-87 | 276,354 | - |
| 1963-64 | 188,603 | - | 1987-88 | 265,226 | 18,856 |
| 1964-65 | 179,798 | - | 1988-89 | 275,077 | 15,022 |
| 1965-66 | 182,172 | - | 1989-90 | 261,190 | 38,961 |
| 1966-67 | 169,375 | - | 1990-91 | 266,745 | 44,588 |
| 1967-68 | 193,656 | - | 1991-92 | 271,224 | 39,789 |
| 1968-69 | 178,798 | - | 1992-93 | 273,587 | 38,900 |
| 1969-70 | 194,379 | - | 1993-94 | 264,159 | 48,134 |
| 1970-71 | 203,923 | - | 1994-95 | 298,217 | 15,622 |
| 1971-72 | 229,048 | - | 1995-96 | 324,111 | 5,542 |
| 1972-73 | 214,983 | - | 1996-97 | 331,406 | 7,883 |
| 1973-74 | 218,863 | - | 1997-98 | 313,805 | 15,096 |
| 1974-75 | 225,597 | - | 1998-99 | 342,823 | 13,352 |
| 1975-76 | 245,456 | - | 1999-00 | 345,362 | 38,007 |
| 1976-77 | 243,511 | - | 2000-01 | 350,385 | 18,640 |
| 1977-78 | 188,407 | 48,290 | 2001-02 | 352,113 | 19,473 |
| 1978-79 | 213,290 | 23,792 | 2002-03 | 297,191 | 61,463 |
| 1979-80 | 221,453 | 24,861 | 2003-04 | 284,621 | 52,168 |
| 1980-81 | 228,943 | 36,373 | 2004-05 | 244,370 | 69,617[1] |
| 1981-82 | 244,184 | - | 2005-06 | 228,159 | 89,216[1] |
| 1982-83 | 249,548 | - | 2006-07 | 299,118 | 50,740[1] |
| 1983-84 | 223,207 | 52,822 | 2007-08 | 366,185 | -[1] |
| 1984-85 | 252,070 | 25,198 | 2008-09 | 324,147 | -[1] |

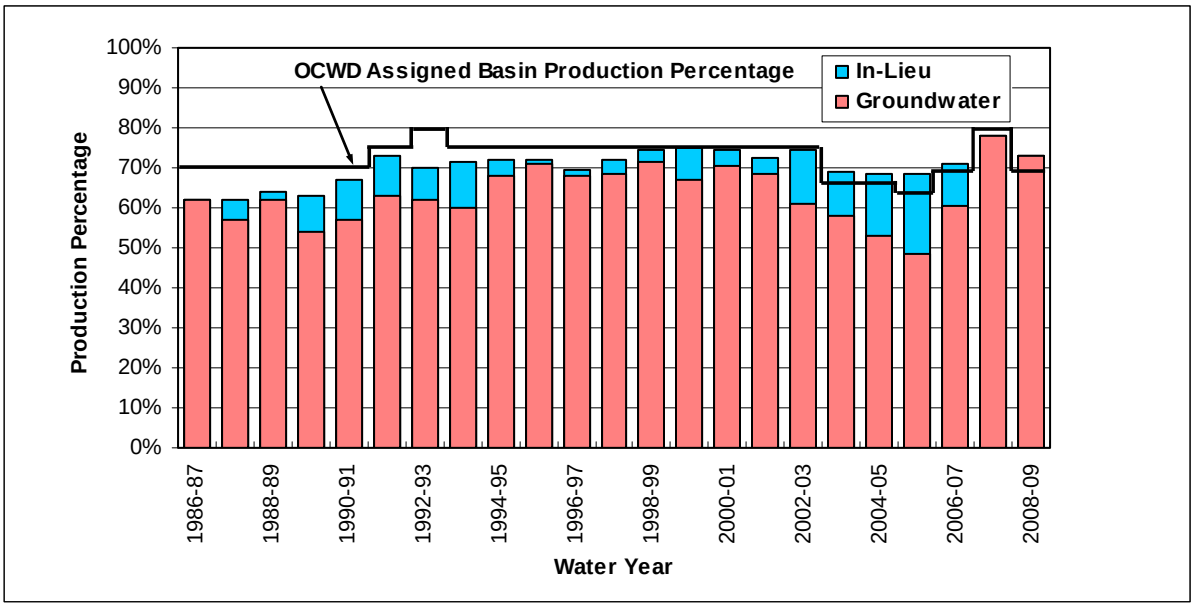
*[1]Basin losses under MWD CUP are not taken into account (for information on losses, see page 14 in this report).*

## 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 AF of groundwater per water year. Water producers that use 25 AF or less from the groundwater basin are excluded from the production percentage limitation.

The BPP for the 2008-09 water year was established at 69.0 percent by the OCWD Board of Directors. The overall BPP achieved within OCWD for non-irrigation use in the 2008-09 water year was equal to 72.5%. The BPP achieved by the District's major groundwater producers for non-irrigation use for this same time period and including water conservation credits, was 72.3 percent. The production percentage achieved by each major producer for non-irrigation use is presented in Appendix 1. Historical assigned and achieved BPPs are presented below in Figure 2.

### FIGURE 2. Groundwater BPP




## 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 late June and early July 2009 from approximately 400 production wells and monitoring wells screened within the principal aquifer system (approximately 300 to 1,200 feet deep) from which

over 90% of basin pumping occurs. The groundwater elevation plate shows pumping depressions generally ranging from 60 to 100 feet below sea level in the coastal area of the basin. A general indicator of changing basin levels is the location of the zero (0) mean sea level elevation contour line each year. The "zero contour line" remained generally unchanged except in Orange and Tustin areas where it moved less than one mile landward when compared to its alignment the prior year, indicating a generally mild decline in groundwater levels.

Plate 2 shows the change in water levels between June 2008 and June 2009 for the groundwater basin's principal aquifer system. Throughout much of the basin, groundwater levels in June 2009 were generally lower than those in June 2008.

Overall, groundwater levels dropped slightly (10 feet or less) in most areas of the basin from June 2008 to June 2009. However, in the managed recharge areas of the basin (i.e., Anaheim and Orange spreading grounds) and at the Talbert Barrier, groundwater levels rose slightly (10 feet or less). Groundwater levels also rose by as much as 10-30 feet in the immediate vicinity of Mesa Consolidated Water District (MCWD) and Irvine Ranch Water District (IRWD) Dyer Road Well Field production wells.

Besides local rainfall being only 78 percent of average for 2008-09, other factors that affected groundwater levels from June 2008 to June 2009 include: 1) total basin pumping was approximately 18,800 AF less than the prior year's historical high due to a reduced BPP and lower-than-anticipated water demands, 2) 18,100 AF of imported MWD direct replenishment water during May and June 2009; and 3) 54,200 AF of Groundwater Replenishment System (GWR System) recycled water for injection into the Talbert Barrier and recharge in Kraemer and Miller spreading grounds.

The additional water recharged in the Forebay spreading grounds at the end of the water year (imported MWD water purchased in May and June 2009) effectively raised water levels just prior to the end-of-June water level measurements that were used to calculate the storage change and accumulated overdraft. Along with the large amount of GWR System water recharged in the Forebay and at the Talbert Barrier, the additional water recharged at the end of this water year stabilized water levels in those areas and led to a somewhat smaller than expected annual storage decrease.

Below is a general description of the groundwater level trends from June 2008 to June 2009 within each of the three major aquifer systems.

**Shallow Aquifer System :**

Shallow aquifer water levels decreased by 10 feet or less throughout the majority of the groundwater basin. However, in the immediate vicinity of the OCWD Anaheim recharge facilities, Santiago Basin, and the Talbert Barrier, water levels rose approximately 5 to 10

feet. The increased water levels at the Talbert Barrier are the result of increased GWR System injection, whereas the increased water levels at the Anaheim recharge facilities are likely a result of both GWR System recharge and the aforementioned MWD imported water recharged during the last two months of the water year.

In the Pressure area of the groundwater basin, as well as in the Irvine Sub-basin, shallow aquifer water levels dropped only 0 to 5 feet. Relatively smaller or more gradual water level fluctuations in the Pressure area of the shallow aquifer system are typically due to the lack of pumping from this aquifer along with being further away from the Anaheim and Orange recharge area.

At the Talbert Barrier, water levels rose approximately 5 feet as compared to no change for the rest of the coastal area. Although the slight rising trend at the Talbert Barrier was encouraging, June 2009 groundwater elevations both at and seaward of the Talbert Barrier were still below protective elevations (below sea level).

**Principal Aquifer System :**

Principal aquifer water levels decreased by approximately 5 feet or less throughout much of the greater Forebay area of Anaheim, Fullerton, and Orange. However, in the immediate vicinity of the Anaheim and Orange Forebay spreading grounds, water levels rose slightly, with the largest increase of approximately 10 feet at Kraemer and Miller basins likely due to GWR System recharge.

Water levels also decreased by approximately 5 feet or less throughout most of the Irvine Sub-basin. However, in the immediate vicinity of the Irvine Desalter Project (IDP) wells along the Interstate 5 Freeway, water levels rose approximately 10 feet from June 2008 to June 2009. This localized increase in water levels was likely due to reduced pumping from the IDP wells.

The largest water level decline in the principal aquifer occurred in the Tustin area. June 2009 water levels in that area were approximately 15 feet lower than those in June 2008, primarily because City of Tustin groundwater production in May and June of 2009 was nearly 40 percent greater than for those same two months during 2008.

Water levels throughout the majority of the Pressure area of the basin, including the coastal area, generally had little to no change, rising 5 feet or less. Areas of exception include the IRWD Dyer Road Well Field and MCWD area, where water levels rose 10 to 30 feet due to IRWD implementing a more uniform year-round pumping distribution relative to the previous year since the MWD seasonal shift program has ended. Therefore, the summertime groundwater levels in this area are higher (and winter levels somewhat lower) than in previous years.

**Deep Aquifer System :**

Deep aquifer water levels generally declined by 10 feet or less throughout the majority of the groundwater basin from June 2008 to June 2009, except in the west Orange County areas of Seal Beach and Los Alamitos where water levels declined by 15 to 20 feet. This larger decline was likely due to pumping further to the west in Los Angeles County by the City of Long Beach which operates several wells that tap down into the deep aquifer. Water level declines in the City of Long Beach were as large as 20 to 40 feet in the deep aquifer.

Contrary to the deep aquifer water level decline throughout most of the basin, deep aquifer water levels near Kraemer and Miller basins rose approximately 5 feet and this trend is consistent with the shallow and principal aquifer trends in that area.

Water level hydrographs for four monitoring wells located in different areas of the groundwater basin are shown on Plate 3. The hydrographs are representative of the principal aquifer system and span the years between 1970 (shortly after the basin was considered approximately full) and 2009.

## COASTAL GROUNDWATER CONDITIONS

The coastal portion of the groundwater basin, essentially that area within five miles of the coast, is sensitive to lower groundwater levels due to seawater intrusion potential and seasonal effects on production well capacity due to lower groundwater levels. Coastal groundwater levels are affected by groundwater production, overall groundwater storage in the basin and, to a lesser extent, injection at the Talbert and Alamitos barriers. For the year ending June 30, 2009, groundwater production from the cities of Fountain Valley, Huntington Beach, Newport Beach, Seal Beach, Westminster, IRWD's Dyer Road Well Field, MCWD and OCWD totaled approximately 109,400 AF. This amount of groundwater production represents an 8% decrease in coastal production as compared to the prior water year which had a higher BPP.

Talbert Barrier injection totaled approximately 33,100 AF for water year 2008-09, representing a historical high and an increase of 125% (more than double) as compared to the prior water year. The significant increase in injection was due to the increased operation and optimization of the GWR System Advanced Water Purification Facility (AWPF) as well as the new injection wells that were constructed as part of the GWR System. For the first half of 2008-09 (from July 2008 through December 2008), a blend of both GWR System and imported potable water was injected into the Talbert Barrier in compliance with the regulatory demonstration period for injection with recycled water. For the second half of 2008-09 (from January 2009 through June 2009), 100% GWR System recycled water was injected into the Talbert Barrier. Injection into the Alamitos Barrier totaled approximately 2,100 AF for water year 2008-09, representing a 40% increase from

the prior water year. These injection totals include all sources of water (imported and recycled); however, for the Alamitos Barrier, the above total only represents OCWD's share which is less than half of the total injection based on the location of the barrier wells that lie within both Los Angeles and Orange counties. At the Alamitos Barrier, the increased injection was primarily due to the Leo J. Vander Lans Water Treatment Facility (located in Long Beach) as well as repairs to barrier facilities (wells and pipelines) completed the prior year.

Coastal groundwater levels during water year 2008-09 reached their lowest point in the late summer and early fall of 2008. Minimum levels in the principal aquifer for summer/fall 2008 were consistently about 10 feet higher than the minimum levels for summer/fall 2007 throughout the entire coastal area from Seal Beach to Costa Mesa. During the summer of 2008 (from June 2008 through October 2008), water levels remained unusually flat rather than the sharp decline experienced in most previous years.

In addition to the lack of decline in summer coastal water levels in the principal aquifer, water levels experienced a less than typical water level rise into the winter months of 2008-09. In fact, water level trends throughout the entire coastal area show that during water year 2008-09, the seasonal fluctuation from the summer-low to the winter-high water level condition was much less than in previous years. In IRWD's Dyer Road Well Field area, the seasonal fluctuation during 2008-09 was approximately 40 feet, as compared to 80 to 100 feet of seasonal fluctuation normally experienced in that area. In the Seal Beach area, the seasonal fluctuation in the principal aquifer during 2008-09 was only 10 feet, as compared to 40 to 60 feet in previous years.

The reduced seasonal fluctuation in groundwater levels is primarily due to the termination of the MWD seasonal shift program which provided financial incentives for groundwater producers to proportionally shift more of their annual pumping to the summer months, thereby reducing demand on the MWD system during those peak-demand summer months. IRWD and City of Long Beach (whose pumping influences water levels in west Orange County) were the last two large producers in the coastal area to end their participation in the seasonal shift program. During water year 2008-09, monthly groundwater production across the groundwater basin and in Long Beach generally followed the demand curve.

## ANNUAL 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 2008-09 water year, it is estimated that the volume of groundwater in storage decreased by 41,000 AF. Approximately 28,425 AF of water was supplied to the basin as follows: 1) directly from the percolation or injection of imported water from the Colorado River and State Water Project (SWP), and 2) use of recycled water to supplement imported water in the Talbert and Alamitos seawater intrusion barriers. The annual overdraft was 100,200 AF for the 2008-09 water year. For the five-year period from July 1, 2004 to June 30, 2009, an annual average of approximately 77,900 AF of supplemental water and recycled water was percolated or injected into the underground basin for replenishment or used directly in place of pumping groundwater (i.e, In-Lieu Program). The average annual overdraft during the same five-year period was approximately 73,000 AF.

## GROUNDWATER BASIN ACCUMULATED OVERDRAFT

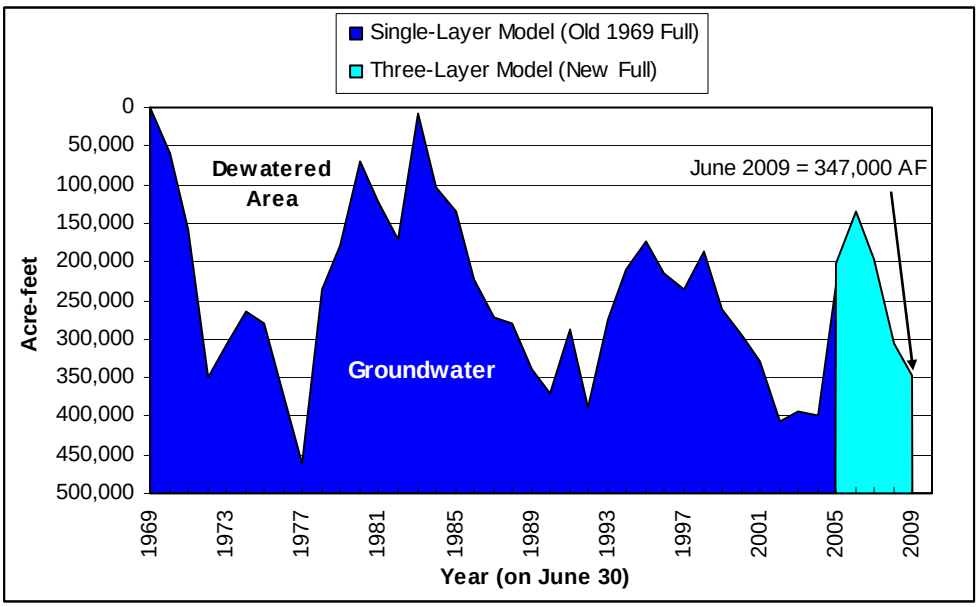
The accumulated overdraft, as defined in the District Act, is the quantity of water needed to be replaced at OCWD's intake area to prevent landward movement of ocean water into the fresh groundwater body. Landward movement of ocean water can be prevented if groundwater levels near the coast are several 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. However, the Talbert and Alamitos seawater intrusion control projects have been implemented to prevent landward movement of ocean water into the fresh groundwater body. Due to the operation of seawater intrusion barrier facilities, there is no longer a direct correlation between accumulated overdraft and controlling seawater intrusion. These facilities allow greater utilization of the basin's storage capacity. OCWD is also dedicated to maximizing its replenishment capabilities by actively negotiating with the U.S. Army Corps of Engineers to increase its water conservation program behind Prado Dam and creating a Long-Term Facilities Plan to evaluate cost-effective improvements to its groundwater recharge capabilities.

In February 2007, OCWD staff completed a report entitled "Evaluation of Orange County Groundwater Basin Storage and Operational Strategy." This report presented a new methodology that had been developed, tested, and documented for calculating accumulated overdraft and storage change based on a three aquifer layer approach. Furthermore, the report provided the basis for calculating accumulated overdraft using a new full-basin benchmark that was developed for each of the three aquifer layers, which in effect replaces the traditional single-layer full benchmark of 1969. Lastly, the report recommended a basin management operational strategy that provided general guidelines for annual basin refill or storage decrease based on the level of accumulated overdraft while using the BPP formula. The District endorsed and adopted the new storage change method on March 21, 2007.

The annual analysis of basin storage change and accumulated overdraft for water year 2008-09 has been completed. This effort represents the fourth year (water year 2005-06 was the first year) of implementing the new methodology for calculating the storage change in the basin based on water levels in the three primary aquifer layers, as well as a new full basin benchmark for calculating the accumulated overdraft. Based on the new methodology using the new "full" benchmark, an accumulated overdraft of 347,000 AF was calculated for the water year ending June 30, 2009. The accumulated overdraft for the prior water year ending June 30, 2008 was 306,000 AF (calculated using the new three-layer storage method). Therefore, the annual decrease of 41,000 AF (reported earlier herein this report) in stored groundwater was calculated as the difference between the June 2008 and June 2009 accumulated overdrafts.

Figure 3 shows the accumulated overdraft quantities for the years 1969 through 2009. It is noteworthy mentioning that all reported quantities up through June 2005 were based upon the traditional single-layer full benchmark of 1969 methodology. Starting in July 2005 and thereafter, the reported quantities were calculated based upon the new full condition three-layer methodology.

## FIGURE 3. Accumulated Basin Overdraft




Projected accumulated overdraft for the current water year (2009-10) ending on June 30 is estimated to be 366,000 AF assuming average hydrology. Projected annual overdraft for the current water year (2009-10) is estimated to be 93,000 AF. This quantity is based on the assumption that annual groundwater production for the current water year will be approximately 314,000 AF (including groundwater pumping within the BPP, In-Lieu Program water, groundwater pumped above the BPP from water quality improvement

projects and extraction of MWD's Long-Term Groundwater Storage Program water) and that natural replenishment (i.e., captured SAR base and storm flows, and natural incidental recharge) will be approximately 221,000 AF for the Santa Ana River basin under average conditions for precipitation.

Projected annual overdraft for the ensuing water year (2010-11) is estimated to be 74,000 AF. This estimate is based on the assumption that total annual groundwater production for the ensuing water year will be 295,000 AF—a figure that is based upon an assumed BPP of 62% and includes 22,000 AF of production from water quality improvement projects (discussed further in the subsequent section, "Recommended BPP"). MWD stored water (groundwater storage program described in next paragraph) is expected to be drawn down to zero prior to 2010-11 water year. However, this water is considered to be MWD supply and not groundwater production. Assuming average hydrological conditions for 2010-11, the natural replenishment is estimated to be approximately 221,000 AF.

On June 25, 2003, OCWD, the Municipal Water District of Orange County (MWDOC), MWD, and participating producers officially approved the funding agreement for the MWD Long-Term Groundwater Storage Program. This conjunctive use program (also informally referred to as "MWD CUP") provides for MWD to store up to 66,000 AF in the OCWD groundwater basin to be extracted (less basin losses) via pumping in place of receiving imported supplies during water shortage events. A compensation package from MWD was included in the agreement to build eight new groundwater production wells, improvements to the seawater intrusion barrier, construction of the Diemer Bypass Pipeline and an annual administrative fee. The preferred means to store water in the MWD storage account has been through the In-Lieu deliveries to participating groundwater producers. The annual quantities and cumulative totals of MWD water stored since the program's inception are shown in Appendix 6. It is important to note that the reported quantities do not take into account basin losses. The cumulative basin losses for the CUP through June 30, 2009 were calculated to be 3,039.7 AF and the annual losses are as follows: losses were ignored for various reasons in 2003-04; 154.0 AF in 2004-05; 714.5 AF in 2005-06; 1,083.1 AF in 2006-07; 731.4 AF in 2007-08 and 356.7 AF in 2008-09.

## REPLENISHMENT RECOMMENDATION

Section 27(b) of the District Act states the following:

"*The total of the replenishment assessment levied in any year shall not exceed an amount of money found to be necessary to purchase sufficient water to replenish the average annual overdraft for the immediate past five water years plus an additional amount of water sufficient to eliminate over a period of not less than 10 years nor more than 20 years, the accumulated overdraft, plus an amount of money to pay the costs of initiating, carrying on, and completing any of the powers, projects and purposes for which this district is organized.*"

Based upon Section 27(b), that portion of the RA that is used for water purchases for the ensuing water year 2010-11 is limited to the amount needed to purchase 108,000 AF (rounded), as calculated below:

Five-year (7/1/2004 through 6/30/2009) Average Annual Overdraft* = 73,000 AF
Accumulated Overdraft (End of Water Year 2008-09) = 347,000 AF
Assumed Time Period to Eliminate Accumulated Overdraft = 10 years
Potential Water Purchase Amount: 73,000 AF + (347,000 AF/10 years) = 107,700 AF (use 108,000 AF)

**Referred to as the Average Annual Overdraft in Section 27(b) of the District Act.*

Table 2 presents the proposed 2010-11 budget for water purchases, which shows the proposed quantity of purchased water (25,000 AF) being significantly less than the prescribed limit of 108,000 AF as allowed for under the provisions of Section 27(b) of the District Act.

## TABLE 2. 2010-11 Budget for Water Purchases

| Water Source | AF | Rate ($/AF)* | Total Cost ($) |
|---|---|---|---|
| Alamitos Barrier | 2,000 | $789.00 | $ 1,578,000 |
| Arlington Desalter | 1,000 | $410.00 | $ 410,000 |
| Recycled Water from IRWD Intertie | 2,000 | $ 89.27 | $ 178,540 |
| MWD Untreated Non-Interruptible Water | 11,000 | $528.00 | $ 5,808,000 |
| MWD In-Lieu Water | 0 | $595.00 | $ 0 |
| MWD Direct Replenishment Water | 9,000 | $403.00 | $ 3,627,000 |
| WMWD Replenishment Water | 0 | $150.00 | $ 0 |
| WATER PURCHASES SUBTOTAL | 25,000 | — | $11,601,540 |
| **Applicable Charges** | | | **Total Cost** |
| MWDOC Surcharge (8-year average) | — | — | $ 450,000 |
| MWD/MWDOC Capacity Charge | — | — | $ 570,000 |
| MWD/MWDOC RTS Charge | — | — | $ 360,000 |
| ADDITIONAL CHARGES SUBTOTAL | — | — | $ 1,380,000 |
| WATER COST | 25,000 | — | $12,981,540 |

*Rates include required MWDOC Capacity and Readiness to Serve charges where appropriate.

## RECOMMENDED BASIN PRODUCTION PERCENTAGE

In December 2002, OCWD approved a basin management approach for determining the BPP for future water years. The management approach is based upon the development of a base amount of groundwater production that the basin can annually sustain utilizing dependable water supplies OCWD expects to receive. In December 2007, a new methodology was adopted by OCWD for setting the BPP and a policy that calls for OCWD to provide an estimate of the BPP each January for the following fiscal year to assist the groundwater producers in the preparation of their annual budgets.

A BPP ranging from 57% to 62% is currently estimated for the ensuing water year 2010-11. Analysis of the groundwater basin's accumulated overdraft, the available supplies to the basin and the projected pumping demands indicate that this level of pumping can be sustained for 2010-11 without detriment to the basin.

A BPP of 62% corresponds to approximately 295,000 AF of groundwater production including 22,000 AF of groundwater production above the BPP to account for groundwater quality enhancement projects, as described below. As mentioned previously, MWD stored water from the MWD storage program is expected to be withdrawn to a zero balance prior to the beginning of 2010-11 water year.

In order to achieve water quality objectives in the groundwater basin, it is recommended for the ensuing water year 2010-11 that additional production of approximately 22,000 AF (above the BPP) be allowed for City of Tustin, MCWD and IRWD. These agencies need the additional pumping allowance in order to accommodate groundwater quality improvement projects. As in prior years, production above the BPP from these projects would be partially or fully exempt from the Basin Equity Assessment (BEA) as a result of the benefit provided to the basin by removing poor-quality groundwater and treating it for beneficial use.

In March 2010, staff will review with the OCWD Board of Director the basis and the assumptions made for the proposed BPP and receive any direction on the matter. In April 2010, staff will again apprise the OCWD Board of Directors on the status of the aforementioned conditions. If the estimates of basin supplies in the current or ensuing year are substantially different than those contained in the respective conditions, a revised BPP may then be recommended.

# 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
## 2008-09 SUMMARY OF FINDINGS

1. Water usage from all supplemental sources totaled 147,214 AF for the 2008-09 water year, and no In-Lieu water was available for purchase.

2. Water usage from recycled water produced from within OCWD including the GWR System totaled 68,177 AF for the 2008-09 water year.

3. Water demand within OCWD totaled 456,913 AF for the 2008-09 water year.

4. Estimated demand for groundwater for the ensuing 2010-11 water year is 295,000 AF.

5. Supplemental replenishment water at discounted rate will not be available through June 2010. For the ensuing 2010-11 water year, it is unlikely that discounted replenishment water of any type (Direct or In-Lieu) will be available.

## SUPPLEMENTAL WATER

Supplemental water is used by water agencies within OCWD's boundary to augment groundwater supplies in satisfying their user demands and by OCWD to recharge the groundwater basin. Supplemental water, as defined in Section 31.5 of the District Act, is any water that originates from outside the SAR watershed (comprised of an area of 2,081 square miles) with the exception of water that originates within the portion of the Santiago Creek watershed that lies upstream of Villa Park Dam which is counted as supplemental water. Please note that the Santiago Creek watershed lies entirely within the SAR watershed. Sources of supplemental water typically include imported deliveries from MWD and diversions from Irvine Lake / Santiago Reservoir (i.e., Santiago Creek) that are conveyed to users within OCWD boundaries. MWD deliveries originate from either the Colorado River or the SWP. In addition, supplemental water would also include deliveries from within the SAR watershed that involve "water exchanges" (i.e., releasing a quantity of water that originates from within the SAR watershed while importing an equal quantity of supplemental water to replace it). Western Municipal Water District (WMWD) in Riverside County has a water exchange program with OCWD.

Non-local waters are defined, for the purposes of this report, as waters purchased from agencies outside of OCWD boundary for use within OCWD. Non-local waters include supplemental water and also water deliveries purchased by OCWD where the water source is located within the SAR watershed. Water deliveries to OCWD from the Arlington Desalter in Riverside and the San Bernardino Valley Municipal Water District's (SBVMWD) High Groundwater Mitigation Project are considered non-local waters. Both projects involve pumping (and treatment in Arlington's case) and release of groundwater from the SAR upstream groundwater basins to OCWD via the SAR for groundwater replenishment at OCWD Forebay recharge facilities. For the purpose of being consistent with previous Engineer's Reports and to present information in a concise manner, non-local water deliveries that are purchased and used by OCWD for groundwater replenishment are included in the supplemental water totals in this report.

Recycled wastewater that is produced and used within OCWD is considered, for purposes of this report, as neither non-local water nor supplemental water (sometimes referred to as "neutral water"). Therefore, recycled water that originates from within OCWD is reported separately from supplemental water totals. However, recycled water used in the Alamitos Barrier is supplied by Water Replenishment District of Southern California (WRD) and originated from outside the SAR watershed, and, as such, is categorized as supplemental water.

Water agencies utilizing supplemental water are listed in Appendix 1. As summarized in Table 3, the use of supplemental water in the OCWD service area during 2008-09 water year totaled 147,214 AF of which 118,789 AF resulted from the direct use by water agencies and 28,425 AF (including any In-Lieu Program water which was zero for 2008-09) were used for

groundwater replenishment purposes. The supplemental water used by water agencies included 118,770 AF for municipal and industrial use and 19 AF for agricultural purposes. Historical supplemental water usage for the 2008-09 water year and earlier is illustrated in Figure 4. The GWR System delivered recycled water to both Talbert Barrier and Kraemer and Miller recharge basins throughout the 2008-09 water year. A breakdown of non-local water purchases by OCWD for 1990-91 through 2008-09 is presented in Appendix 6.

## TABLE 3. 2008-09 Supplemental Water Usage

| Direct Agency Use | AF |
|---|---|
| Imported Water | 116,487 |
| Santiago Creek Native Water | 2,302 |
| **Subtotal** | **118,789** |
| **Groundwater Replenishment (Purchased)** | |
| In-Lieu Program[1] | 0 |
| Forebay Recharge[2] | 18,100 |
| Alamitos Barrier[3] | 2,094 |
| Talbert Barrier | 4,140 |
| Western Municipal Water District | 3,663 |
| Arlington Desalter | 428 |
| **Subtotal** | **28,425** |
| **TOTAL** | **147,214** |

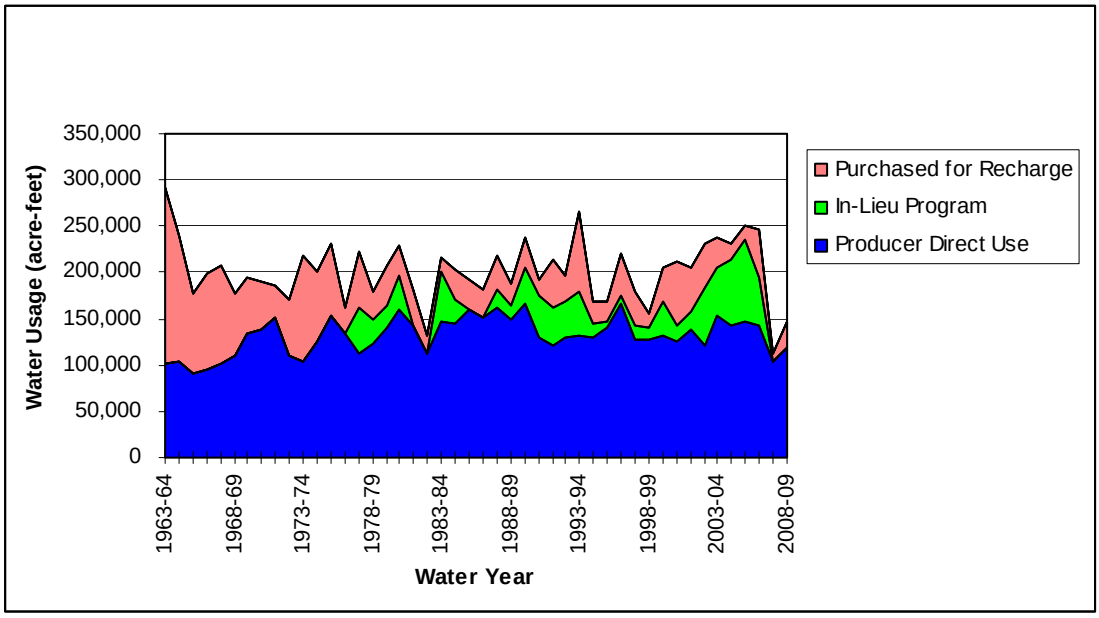
[1] *Any amount reported herein includes water received by OCWD's groundwater producers as In-Lieu water under MWD's groundwater storage program (i.e., CUP).*

[2] *Since replenishment water at discounted rate was not available, OCWD purchased full service rate untreated water for Forebay Recharge.*

[3] *Total combines imported and recycled water deliveries.*

For the 2008-09 water year, the OCWD Board of Directors budgeted funds to participate in the MWD In-Lieu Program. The cost of the In-Lieu Program water to OCWD is the difference between the cost for treated replenishment water (formerly called "Long-Term Seasonal Storage" water) and the cost to produce groundwater (i.e., RA plus the cost of energy to pump groundwater). OCWD pays this difference to the participating agencies. Similar to the 2007-08 water year, there was no In-Lieu Program water delivery for the 2008-09 water year as shown in Table 3.

## FIGURE 4. Historical Supplemental Water Usage




Recycled water use within OCWD is presented in Table 4 (excluding WRD-supplied recycled water to the Alamitos Barrier because this water is categorized as supplemental water and is already included in the total amount reported in Table 3). The major areas of recycled water use are: 1) groundwater replenishment (including Kraemer and Miller recharge basins and Talbert Barrier injection wells), and 2) supply water for irrigation and industrial users.

## TABLE 4. 2008-09 Recycled Water Usage

| **Groundwater Replenishment** | **Water Usage (AF)** |
|---|---|
| GWR System AWPF (for Talbert Barrier) | 28,952 |
| GWR System AWPF (for Recharge Basins) | 25,248 |
| **Subtotal** | **54,200** |
| **Irrigation and Industrial** | **Water Usage (AF)** |
| IRWD[1] | 11,441 |
| OCWD (Green Acres Project)[2] | 2,536 |
| **Subtotal** | **13,977** |
| **TOTAL** | **68,177** |

[1]*Recycled water used within the portion of OCWD that lies within IRWD's boundaries (excludes OCWD/IRWD intertie water deliveries to the Green Acres Project).*
[2]*Excludes deliveries to the Orange County Sanitation District and includes OCWD/IRWD intertie water deliveries to the Green Acres Project.*

## AVAILABILITY OF SUPPLEMENTAL REPLENISHMENT WATER

The availability of replenishment water from MWD has been significantly impacted by the drought and pumping restrictions on the Sacramento-San Joaquin Delta in order to protect the endangered Delta smelt, salmon and other migratory species. Under the federal Endangered Species Act, the United States National Marine Fisheries Service released a new biological opinion called the Salmon Opinion in June 2009. Since its release, the Salmon Opinion has been under the review of Department of Water Resources, MWD and many other affected agencies to determine its impact(s). The United States National Marine Fisheries Service estimated that the preliminary impact of the Salmon Opinion to cities and farms south of the Delta would likely be 5% to 7% in water reductions. However, analysis by the Department of Water Resources indicates that the Salmon Opinion will reduce water deliveries to the southern California region by as much as 10%. It is important to note that the water supply reductions caused by the Salmon Opinion are apart from those reductions associated with the Delta Smelt Opinion released by the United States Fish and Wildlife Services in December 2008. These pumping restrictions mean that the years in which MWD has excess imported supplies (thus, allowing MWD to provide replenishment water to local groundwater agencies) will be significantly reduced. MWD is estimating that it will have excess supplies approximately 2 out of 10 years.

MWD has projected that replenishment water will not be available through June 2010. The availability of replenishment water in ensuing water year 2010-11 is highly unlikely.

## WATER DEMANDS

During the 2008-09 water year, total water demands within OCWD's service area totaled 456,913 AF. Total demand includes the use of groundwater, MWD In-Lieu Program water, imported water, Santiago Creek native water and recycled water. Total demand excludes groundwater, supplemental water and recycled water used by OCWD for groundwater recharge and also excludes water credits given for water conservation efforts.

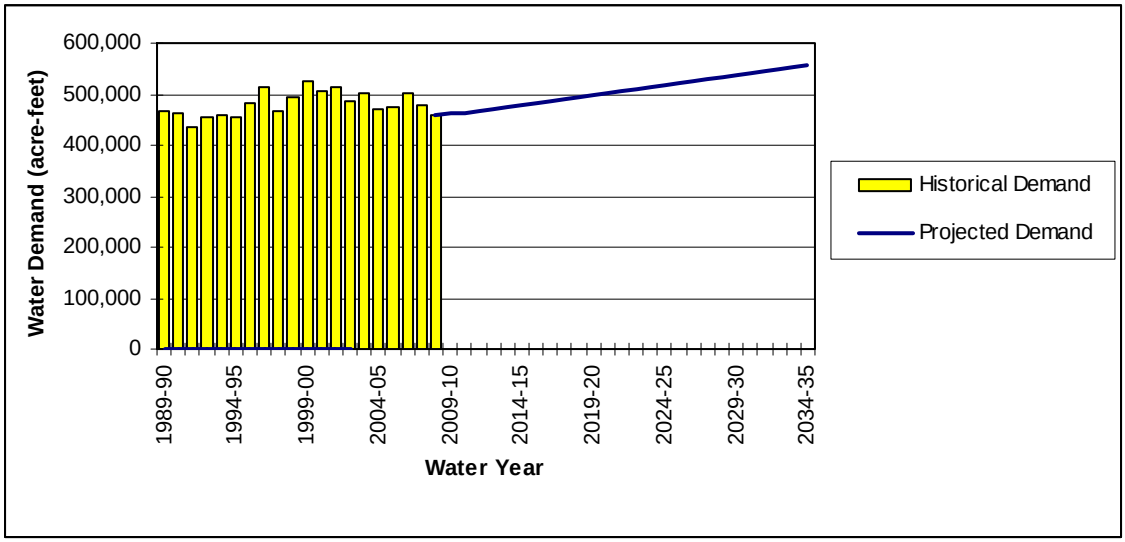
Water demands for 2008-09 and projected water demands for 2009-10 and 2010-11 are shown in Table 5. The water demands for the current year 2009-10 were determined by assessing the current year data that is available and projecting that data to develop annual totals for the current year. The water demands for the ensuing year 2010-11 are based on projections provided by the retail water agencies within OCWD's service area. Long-term water demand projections are illustrated in Figure 5.

## TABLE 5. Water Demands Within OCWD

| | Ground-water[1] | Imported Water[2,3] | Santiago Creek Native Water[3] | Recycled Water[4] | Total |
|---|---|---|---|---|---|
| **2008-09** | | | | | |
| Non-Irrigation | 321,631 | 116,468 | 2,302 | - | 440,401 |
| Irrigation | 2,516 | 19 | - | 13,977 | 16,512 |
| **Total** | **324,147** | **116,487** | **2,302** | **13,977** | **456,913** |
| **2009-10 (Current Year)[5]** | | | | | |
| Non-Irrigation | 296,000 | 145,500 | 3,000 | - | 444,500 |
| Irrigation | 2,000 | 500 | - | 13,000 | 15,500 |
| **Total** | **298,000** | **146,000** | **3,000** | **13,000** | **460,000** |
| **2010-11 (Ensuing Year)[5]** | | | | | |
| Non-Irrigation | 292,400 | 141,900 | 3,000 | - | 437,300 |
| Irrigation | 2,600 | 100 | - | 15,000 | 17,700 |
| **Total** | **295,000** | **142,000** | **3,000** | **15,000** | **455,000** |

[1] *Includes In-Lieu Program water if such Program water were available (none in 2008-09).*
[2] *Excludes water conservation credits and imported water used for groundwater replenishment.*
[3] *"Imported Water" and "Santiago Creek Native Water" are both counted as supplemental water.*
[4] *Excludes recycled water injected into the groundwater basin for seawater intrusion protection. Includes recycled water from IRWD and OCWD's Green Acres Project (excluding OCSD usage).*
[5] *Demands are estimated by OCWD assuming average hydrology.*

## FIGURE 5. Water Demand Projections



## WATER DEMAND FORECAST

OCWD participates with MWDOC and retail groundwater producers to predict future demands in the OCWD service area. Each groundwater producer projected its total water demands to the year 2035. These projections include the effect of local water conservation efforts. Figure 5 illustrates the historical and the projected water demands for OCWD service area to the year 2035.

Population within OCWD's service area is expected to increase from the current 2.38 million people to approximately 2.7 million people by the year 2035. This population growth is expected to increase water demands from the current 456,913 AF per year to 557,660 AF per year in 2035 as projected in the OCWD Long-Term Facilities Plan dated June 8, 2009. In an effort to support increasing water demands, OCWD will look to increase basin production by operating the existing GWR System, expanding the current AWPF production capacity, capturing more SAR storm flows, purchasing imported supplies for groundwater recharge whenever supplies are available, developing other local recycled water supplies for replenishment purposes, expanding recharge facilities and improving the In-Lieu Program (provided that In-Lieu water is available or whenever it becomes available).

## ADVANCED WASTEWATER RECLAMATION

Groundwater, supplemental water and local surface water have historically been the primary water sources within OCWD. In recent decades, wastewater reclamation has increasingly become a significant source of additional water. Purified recycled wastewater has been produced by OCWD for use as injection water in the Talbert Barrier and as percolation water in Kraemer and Miller recharge basins. OCWD and IRWD recycle wastewater at their respective treatment plants for irrigation and industrial uses.

OCWD and the Orange County Sanitation District (OCSD) signed a Joint Exercise of Powers Agreement in October 2002 to construct the $486.9 million GWR System. The GWR System was operational in January 2008. The advanced treatment processes utilized in the GWR System consist of microfiltration (MF) followed by reverse osmosis (RO) and ultraviolet (UV) light disinfection in combination with hydrogen peroxide. For 2008-09 water year, the GWR System treated and delivered 54,200 AF of wastewater that has been purified to drinking water standards for direct injection into the Talbert seawater intrusion barrier and percolation into the OCWD groundwater basin at Kraemer and Miller recharge basins.

For 2008-09, OCWD and IRWD recycled water deliveries for landscape irrigation and industrial uses in Fountain Valley, Costa Mesa, Huntington Beach, Newport Beach, Santa Ana and the IRWD service area totaled 13,977 AF.

WRD placed the 3-MGD Alamitos Barrier Recycled Water Project, known as the Leo J. Vander Lans Water Treatment Facility, into service in October 2005. This project supplies highly treated recycled water to the Alamitos Barrier. The Leo J. Vander Lans advanced wastewater treatment facility located in Long Beach utilizes the treatment processes of MF, RO and UV light disinfection. This project is intended to replace up to 50% of the imported water used to supply the Alamitos Barrier with recycled water. The project operated for eleven months in 2008-09 (from July 2008 through November 2008 and from January 2009 through June 2009). For 2008-09, the project supplied 472 AF of recycled water to the Alamitos Barrier, which represented 23% of the barrier's supply. Recycled water deliveries from the Leo J. Vander Lans plant to the Orange County portion of the Alamitos Barrier are classified as supplemental water because this recycled water originates from outside the SAR watershed.

## WATER QUALITY

OCWD maintains a comprehensive groundwater protection policy that includes water quality monitoring, removal of contaminants, regulatory agency support, toxic residuals removal and hazardous waste management. In addition, OCWD provides water quality information to regulatory agencies, other water agencies and the general public. In order to meet the current and future water quality testing requirements, a new OCWD Advanced Water Quality Assurance Laboratory at the Fountain Valley campus was completed in this water year. A photograph of OCWD Advanced Water Quality Assurance Laboratory is shown on the front cover of this report. The new laboratory will house approximately 30 chemists and laboratory technicians, 10 water quality monitoring personnel and all the analytical equipment that are needed to perform more than 350,000 analyses of approximately 18,000 water samples taken each water year. The new laboratory will also support the extensive water quality testing requirements for the GWR System.

When blended together by the major agencies within the OCWD service area, the blended groundwater (without treatment) and treated supplemental water for 2008-09 is determined to have a flow-weighted average of 490 milligrams per liter (mg/L) of total dissolved solids (TDS), which is an increase from 469 mg/L for average TDS reported for the prior year (2007-08). As a result of low BPP for 2008-09, major agencies utilized more treated supplemental water which contained higher TDS concentration; thus, increasing the flow-weighted average TDS. The average groundwater TDS concentration for the basin for 2008-09 is 443 mg/L (versus 456 mg/L reported for 2007-08), ranging from a low of 214 mg/L in the Seal Beach area to greater than 600 mg/L in certain inland areas.

Average concentrations of TDS, nitrates and hardness for groundwater and groundwater combined with supplemental water supplied by agencies within OCWD's service area

# TABLE 6. 2008-09 Water Quality Summary

| City/Agency | Groundwater[1,7] | | | Delivered Blend[1,2,7] | | |
|---|---|---|---|---|---|---|
| | TDS[3] | $NO_3$-N[4] | Hard-ness[5] | TDS[3] | $NO_3$-N[4] | Hard-ness[5] |
| Anaheim | 555 | 3.1 | 327 | 572 | 2.2 | 313 |
| Buena Park | 363 | 1.0 | 198 | 440 | 0.8 | 224 |
| East Orange County Water District | 574 | 3.7 | 346 | 589 | 2.3 | 320 |
| Fountain Valley | 397 | 1.1 | 247 | 464 | 0.9 | 258 |
| Fullerton | 586 | 3.3 | 305 | 594 | 2.4 | 297 |
| Garden Grove | 495 | 3.4 | 301 | 531 | 2.5 | 295 |
| Golden State Water Company | 441 | 2.2 | 244 | 504 | 1.5 | 258 |
| Huntington Beach | 316 | 0.3 | 167 | 408 | 0.3 | 202 |
| Irvine Ranch Water District[6] | 314* | 0.4* | 114* | 316* | 0.4* | 115* |
| La Palma | 266 | ND[8] | 142 | 370 | 0.1 | 184 |
| Mesa Consolidated Water District | 364 | 0.2 | 134 | 404 | 0.2 | 158 |
| Newport Beach | 416 | 1.2 | 234 | 482 | 0.9 | 250 |
| Orange | 482 | 2.4 | 292 | 518 | 1.8 | 289 |
| Santa Ana | 389 | 2.2 | 232 | 458 | 1.6 | 247 |
| Seal Beach | 214 | ND[8] | 81 | 340 | 0.1 | 144 |
| Serrano Water District | 642 | 1.6 | 356 | 660 | 1.1 | 351 |
| Tustin[6] | 569* | 6.5* | 286* | 584* | 4.3* | 284* |
| Westminster | 357 | 1.3 | 226 | 436 | 1.0 | 243 |
| Yorba Linda Water District | 617 | 2.9 | 326 | 616 | 2.1 | 312 |
| **Weighted Average[7]** | **443** | **2.0** | **240** | **490** | **1.5** | **252** |

[1] *All groundwater results (alone or blend) are for untreated groundwater (see note 6 below). Units are reported in mg/L.*

[2] *Delivered blend includes untreated groundwater and treated imported MWD water (i.e., blend of Colorado River water and State Project water as measured at the MWD Diemer Plant), except Serrano Water District, which blends with treated Santiago Reservoir water. Units are reported in mg/L. Annual average water qualities for MWD and Santiago Reservoir (Irvine Lake) for 2007-08 are as follows:*

| *MWD Water Quality* | | | *Santiago Reservoir Water Quality* | | |
|---|---|---|---|---|---|
| *TDS* | = | *612 mg/L* | *TDS* | = | *702 mg/L* |
| *$NO_3$-N* | = | *1.4 mg/L* | *$NO_3$-N* | = | *0.05 mg/L* |
| *Hardness (as $CaCO_3$)* | = | *281 mg/L* | *Hardness (as $CaCO_3$)* | = | *340 mg/L* |

[3] *Secondary Drinking Water Standards for TDS are as follows:*

*500 mg/L = recommended limit*
*1,000 mg/L = upper limit*

[4] *Primary Drinking Water Standard for nitrate $NO_3$-N (i.e., nitrate expressed as nitrogen) is 10 mg/L.*

[5] *Hardness is reported as mg/L of $CaCO_3$. General classifications of hard and soft water are within the following concentration ranges:*

| | | | | | |
|---|---|---|---|---|---|
| *0-75 mg/L* | = | *soft* | *150-300 mg/L* | = | *hard* |
| *75-150 mg/L* | = | *moderately hard* | *300-up mg/L* | = | *very hard* |

[6] *Agencies with active groundwater quality improvement projects that treat for one or more of the constituents listed in the table. The results shown herein for "groundwater" and "delivered blend" reflect results from untreated groundwater. Water quality constituents that are marked with an asterisk (*) are reduced prior to delivery to customers.*

[7] *All water quality results are flow-weighted averages based on groundwater and imported water delivered to each entity.*

[8] *ND = non-detect. Nitrate (as $NO_3$-N) analytical detection limit for OCWD Laboratory = 0.1 mg/L.*

during the 2008-09 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. The city of Tustin and IRWD have active groundwater treatment projects that help to reduce certain constituents reported in Table 6 in their groundwater supply prior to service to their customers (see note 6 for explanation).

## WATER RESOURCES DATA

A summary of water resources data within OCWD for the 2008-09 water year and the previous year (2007-08) is included in Appendix 5.

# PART III: WATER PRODUCTION COSTS FOR ENSUING YEAR (2010-11)

Section 31.5 of the District Act requires that costs of producing groundwater and obtaining supplemental water be evaluated annually. These costs vary for each groundwater producer and depend 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.

## ENSUING YEAR (2010-11) WATER PRODUCTION COSTS SUMMARY OF FINDINGS

1. Cost for producing water from the groundwater basin within OCWD including a replenishment assessment for 2010-11 is estimated to be $412 per acre-foot.

2. Cost of treated, non-interruptible supplemental water for 2010-11 is estimated to be $791 per acre-foot.

4. Cost for untreated, interruptible replenishment water for 2010-11 is estimated to be $410 per acre-foot.

5. Cost for In-Lieu Program water for 2010-11 is estimated to be $602 per acre-foot.

## GROUNDWATER PRODUCTION COSTS FOR NON-IRRIGATION USE

Cost for producing an acre-foot of groundwater in the ensuing 2010-11 water year has been estimated for a potable water well for a large groundwater producer (i.e., a city water department, water district) in OCWD's service area. Operations and maintenance (O&M) and energy costs were estimated using cost information provided by nineteen large groundwater producers from a survey conducted by OCWD in fall 2009. The capital cost component was derived using available actual project cost data for eight production wells constructed under the MWD Long-Term Groundwater Storage Program. Appendix 4 contains several of the key design characteristics for the MWD eight-well project. The OCWD RA used in the cost determination is the proposed RA for 2010-11.

The estimated cost for groundwater production for a large groundwater producing entity such as a city water department or a water district is presented in Table 7. The total cost to produce an acre-foot of groundwater within OCWD in the ensuing 2010-11 water year is estimated to be $412 per acre-foot. Based on responses to the aforementioned survey, the flow-weighted average (based upon the quantity of groundwater pumped) for energy cost equaled $61 per AF. O&M costs ranged from $21 to $178 per acre-foot with a median cost of approximately $50 per acre-foot. Elements that influence these costs include load factors and variations in groundwater levels. Recently drilled wells are generally deeper than those drilled decades ago. From the aforementioned survey, the average load factor which indicates the percent-of-use of an extraction facility equaled 56 percent.

### TABLE 7. Estimated 2010-11 Groundwater Production Costs

| Cost Item | Non-Irrigation Use | |
|---|---|---|
| | Annual Cost ($) | Cost per AF ($/AF) |
| Energy | 158,600[1] | 61[2] |
| Proposed RA | 647,400[1] | 249[3] |
| Total Production Costs | 806,000 | 310 |
| Capital | 135,200[4] | 52[4] |
| O&M | 130,000[1] | 50[2] |
| Total Other Costs | 265,200 | 102 |
| Total Cost to Producers | 1,071,200 | 412 |

[1] *Based upon an annual average production of 2,600 AF per production well.*
[2] *Based on survey of major agencies within OCWD's service area, non-irrigation groundwater users.*
[3] *Proposed RA for 2010-11.*
[4] *Based on the estimated average cost for design and construction of a production well (excluding land cost) under the MWD Long-Term Groundwater Storage Program (cost amortized over 30 years at 5 percent interest). Typical design parameters are listed in Appendix 4.*

## COST OF SUPPLEMENTAL WATER

Supplemental water is supplied to the OCWD service area by MWD. MWD delivers both treated and untreated water as either a non-interruptible supply or an interruptible supply. As a result, there are several categories of water available from MWD. The categories most applicable for purposes of this report are 1) uninterruptible (i.e., firm) treated water, which is referred to as "full service water," 2) interruptible treated water, which is referred to as "In-Lieu water," and 3) interruptible untreated water, which is referred to as "replenishment water." Treated water is used directly by various groundwater producers for municipal and industrial purposes, while untreated water is used by OCWD for groundwater replenishment. Table 8 shows the estimated costs for the three aforementioned MWD water categories for the ensuing 2010-11 water year. Figure 6 illustrates the historical supplemental water costs along with the historical groundwater production costs. A comparison of estimated costs for groundwater versus supplemental water (non-irrigation use) during the ensuing water year 2010-11 is summarized in Table 9 and also in Figure 6. Values used in Figure 6 are presented in tabular form in Appendix 7.

## TABLE 8. Estimated 2010-11 Supplemental Water Costs[1]

| Rate and Charge Components | Treated Water Rates ($/AF) | |
|---|---|---|
| **Firm Deliveries** | **Full Service Water** | |
| MWD Supply Rate (MWDOC Melded Rate) | 166.50 | |
| MWD System Access Rate | 185.50 | |
| MWD System Power Rate | 127.00 | |
| MWD Water Stewardship Rate | 42.00 | |
| MWD Treatment Surcharge | 217.00 | |
| MWD RTS and Capacity Charges[2] | 46.00 | |
| MWDOC Surcharge | 7.00 | |
| **Total** | **791.00** | |
| **Rate and Charge Components** | **Treated Water Rates ($/AF)** | **Untreated Water Rates ($/AF)** |
| **Interruptible Deliveries** | **In-Lieu Water** | **Replenishment Water** |
| MWD Replenishment Water Rate | 595.00 | 403.00 |
| MWDOC Surcharge | 7.00 | 7.00 |
| **Total** | **602.00** | **410.00** |

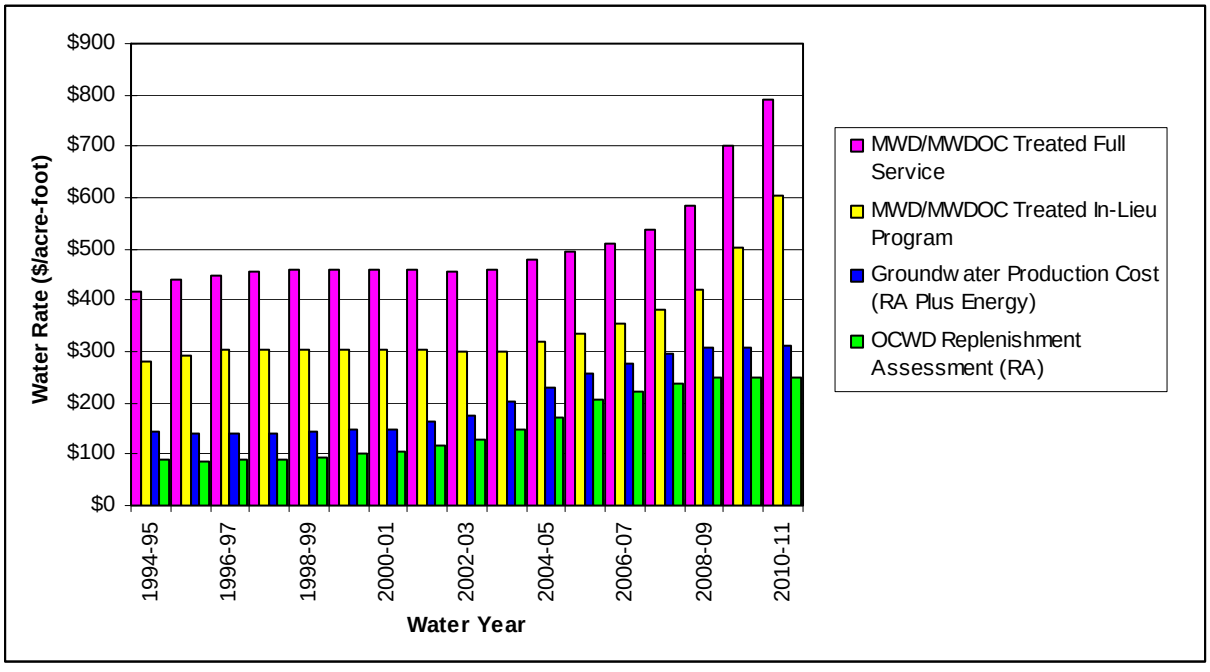
[1] *Rates are an average of calendar year 2010 and proposed calendar year 2011. Supplemental water costs for MWD member agencies (i.e., Anaheim, Fullerton and Santa Ana) are not reported herein due to the variability between the agencies on water supply allocations between MWD's Tier 1 and Tier 2.*

[2] *Readiness-to-Serve (RTS) and Capacity charges have been converted to an approximate cost per acre-foot, but are not normally reported in terms of unit cost.*

Cost components for supplemental treated and untreated water are listed in Table 8. Beyond the normally expected water supply and treatment and power charges, there are several other charges. The System Access charge is for costs associated with the conveyance and distribution system, including capital and O&M costs. The Water Stewardship charge is used to support MWD's financial commitment to conservation, water recycling, groundwater recovery and other water management programs approved by MWD. MWD uses the Capacity Charge to recover its cost for use of peaking capacity within its distribution system. The Readiness-to-Serve (RTS) charge is to recover MWD's cost associated with providing standby and peak conveyance capacity and system emergency storage capacity. As of January 1, 2003, the RTS charge was discontinued for "interruptible" deliveries and the Capacity Charge commenced for full service and agricultural program deliveries. The Capacity Charge does not apply to replenishment water.

MWDOC is a MWD member agency that distributes MWD supplemental water to many water agencies within the OCWD service area. The MWDOC surcharge applies to the MWD supplemental water purchased by these agencies and provides general funding for MWDOC. There are three MWD member agencies within the OCWD service area that purchase supplemental water directly from MWD for which the MWDOC surcharge does not apply, and they are the cities of Anaheim, Fullerton and Santa Ana.

**FIGURE 6[1]. Adopted and Projected Water Rates for Non-Irrigation Use**

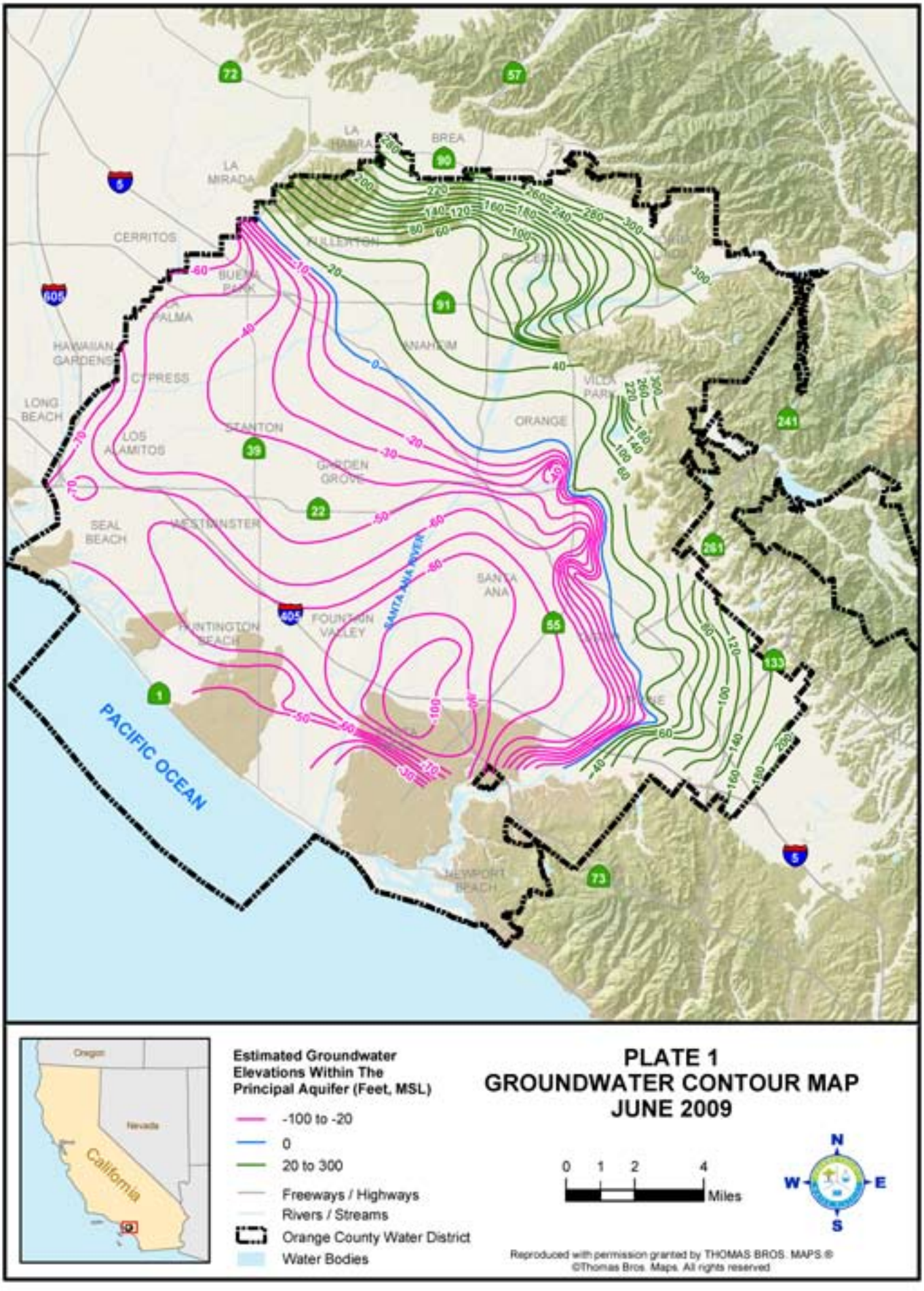


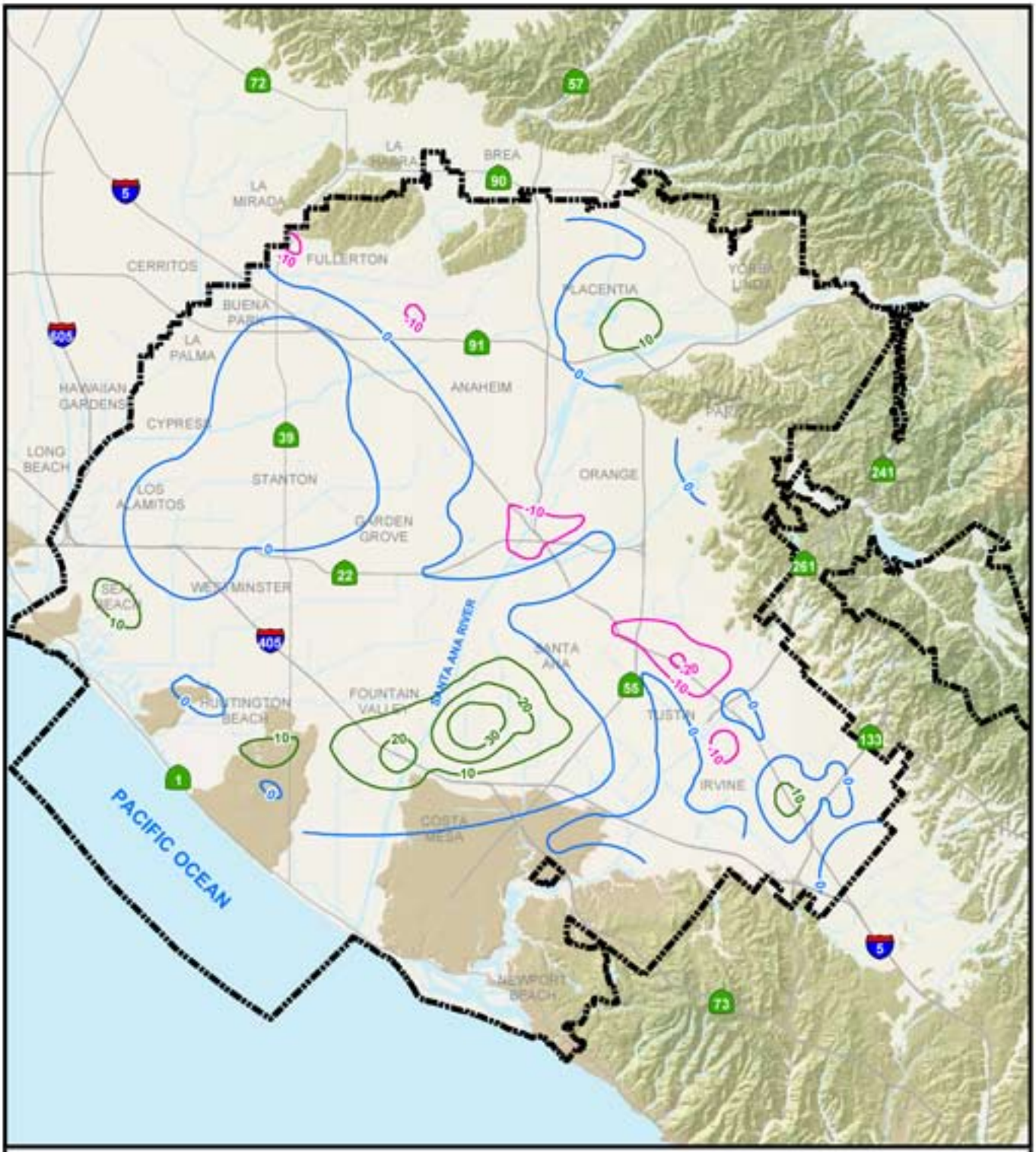

[1] *Refer to Appendix 7 for actual values used in Figure 6.*

## TABLE 9. Estimated 2010-11 Water Production Cost Comparison

| Non-Irrigation Use | Groundwater Cost ($/AF) | Supplemental Water Cost ($/AF) |
|---|---|---|
| Fixed Cost | 52[1] | 791[3] |
| Variable Cost | 360[2] | -[3] |
| **Total** | **412** | **791** |

[1] *Capital cost.*
[2] *Cost for energy, O&M plus proposed RA.*
[3] *Delineation of fixed and variable costs is not available.*


Oregon
Nevada
California
Estimated Groundwater Elevations Within The Principal Aquifer (Feet, MSL)
-100 to -20
0
20 to 300
Freeways / Highways
Rivers / Streams
Orange County Water District
Water Bodies
PLATE 1
GROUNDWATER CONTOUR MAP
JUNE 2009
0 1 2 4
Miles
N
W
E
S
Reproduced with permission granted by THOMAS BROS. MAPS.®
©Thomas Bros. Maps. All rights reserved
PACIFIC OCEAN
SANTA ANA RIVER
LA HABRA
BREA
LA MIRADA
CERRITOS
FULLERTON
BUENA PARK
LA PALMA
HAWAIIAN GARDENS
CYPRESS
ANAHEIM
LONG BEACH
LOS ALAMITOS
STANTON
ORANGE
VILLA PARK
GARDEN GROVE
SEAL BEACH
WESTMINSTER
SANTA ANA
HUNTINGTON BEACH
FOUNTAIN VALLEY
NEWPORT BEACH
72
57
90
5
405
91
39
22
241
261
55
133
1
73





**Estimated Groundwater Elevation Changes Within The Principal Aquifer (Feet)**

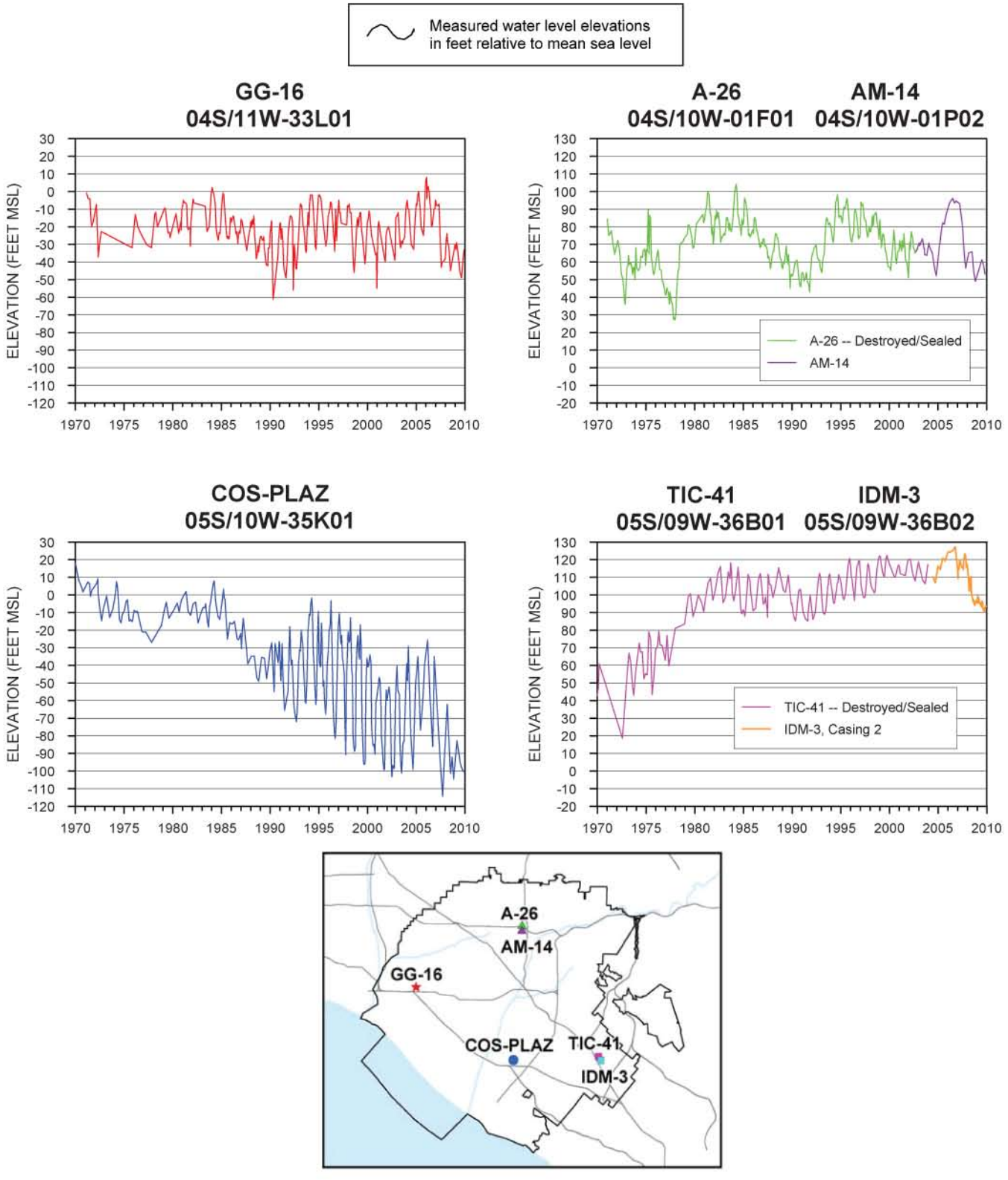
- -20 to -10
- 0
- 10 to 30
- Freeways / Highways
- Rivers / Streams
- Orange County Water District
- Water Bodies

# PLATE 2
# CHANGE IN WATER LEVEL BETWEEN JUNE 2008 AND JUNE 2009

0 1 2 4 Miles

N W E S

# PLATE 3
# KEY WELL GROUNDWATER ELEVATION TRENDS



# APPENDIX 1. Water Production Data 2008-09

| Groundwater Producer | Groundwater (AF) | | | | Supplemental Water (AF) | | | | (AF) | Actual BPP |
|---|---|---|---|---|---|---|---|---|---|---|
| | Non-Irrigation[1] | | Irrigation Pumping | Total | Non-Irrigation[1] | | Irrigation Deliveries | Total | Grand Total | Non-Irrigation[1] only |
| | Pumping | In-Lieu Program[2] | | | Deliveries | Conservation Credit[3] | | | | |
| Anaheim, City of[7] | 51,298.4 | - | - | 51,298.4 | 22,617.2 | 252.6 | - | 22,869.8 | 73,245.0 | 69.2% |
| Buena Park, City of[7] | 11,242.2 | - | - | 11,242.2 | 5,065.0 | 9.0 | - | 5,074.0 | 16,316.2 | 68.9% |
| East Orange County Water District | 759.4 | - | - | 759.4 | 516.1 | 6.4 | - | 522.5 | 1,281.9 | 59.2% |
| County of Orange | 95.8 | - | - | 95.8 | 118.7 | - | - | 118.7 | 214.5 | 44.7% |
| Fountain Valley, City of | 7,098.5 | - | - | 7,098.5 | 3,270.6 | 16.2 | - | 3,286.8 | 10,385.3 | 68.4% |
| Fullerton, City of | 21,040.5 | - | 8.0 | 21,048.5 | 9,474.0 | 15.9 | - | 9,489.9 | 30,541.5 | 68.9% |
| Garden Grove, City of[4,7] | 18,950.5 | - | - | 18,950.5 | 8,508.3 | 31.4 | - | 8,539.7 | 27,490.2 | 68.9% |
| Golden State Water Company[7] | 18,664.8 | - | - | 18,664.8 | 10,891.9 | 43.3 | - | 10,935.2 | 29,547.3 | 63.1% |
| Huntington Beach, City of | 21,856.7 | - | - | 21,856.7 | 9,773.4 | 43.4 | - | 9,816.8 | 31,673.5 | 69.0% |
| Irvine Ranch Water District[4,5] | 44,952.8 | - | 801.0 | 45,753.8 | 386.6 | 508.6 | - | 895.2 | 46,649.0 | 98.0% |
| La Palma, City of | 1,637.5 | - | - | 1,637.5 | 703.1 | 4.5 | - | 707.6 | 2,345.1 | 69.8% |
| Mesa Consolidated Water District[4] | 15,895.6 | - | - | 15,895.6 | 3,086.1 | 77.5 | - | 3,163.6 | 19,059.2 | 83.4% |
| Newport Beach, City of | 11,350.4 | - | - | 11,350.4 | 5,846.2 | 16.7 | - | 5,863.0 | 17,213.4 | 65.9% |
| Orange, City of [5] | 23,892.2 | - | 19.3 | 23,911.5 | 9,347.3 | 30.3 | 19.3 | 9,396.9 | 33,308.4 | 71.8% |
| Orange County Water District[6] | 1,418.4 | - | - | 1,418.4 | - | - | - | - | 1,418.4 | 100.0% |
| Santa Ana, City of[7] | 28,426.4 | - | - | 28,426.4 | 12,752.5 | 45.8 | - | 12,798.3 | 41,224.7 | 69.0% |
| Seal Beach, City of | 2,731.3 | - | - | 2,731.3 | 1,255.6 | 2.7 | - | 1,258.3 | 3,989.6 | 68.5% |
| Serrano Water District[5] | 2,241.5 | - | - | 2,241.5 | 1,019.8 | 2.5 | - | 1,022.3 | 3,263.8 | 68.7% |
| Tustin, City of[4] | 8,423.2 | - | - | 8,423.2 | 4,625.5 | 22.9 | - | 4,648.4 | 13,071.6 | 64.4% |
| Westminster, City of[7] | 9,057.5 | - | - | 9,057.5 | 4,052.9 | 34.4 | - | 4,087.3 | 13,144.8 | 68.9% |
| Yorba Linda Water District[7] | 12,031.2 | - | 110.9 | 12,142.1 | 5,459.2 | 27.7 | - | 5,486.9 | 17,629.0 | 68.7% |
| **Total (Major Groundwater Producers)** | 313,064.8 | 0.0 | 939.2 | 314,004.0 | 118,770.1 | 1,191.8 | 19.3 | 119,981.2 | 433,985.3 | 72.3% |
| Other Producers Production | 6,845.6 | - | 1,576.4 | 8,422.0 | - | - | - | - | 8,422.0 | - |
| Exempt Well Production | 1,720.8 | - | - | 1,720.8 | - | - | - | - | 1,720.8 | - |
| **Total Amount** | 321,631.2 | 0.0 | 2,515.6 | 324,146.8 | 118,770.1 | 1,191.8 | 19.3 | 119,981.2 | 444,128.1 | - |
| **Basin Production Percentage (includes non-irrigation deliveries, but excludes water conservation credits)** | | | | | | | | | | **72.5%** |

[1] *Water classed as being used for purposes other than commercial agriculture.*
[2] *Imported MWD water purchased for domestic use to offset groundwater pumping.*
[3] *Accounts for only those credits allowed for under the program initiated on September 20, 1995.*
[4] *Agencies that participate in a groundwater water quality improvement project.*
[5] *Agencies that can receive Santiago Creek native water above Villa Park Dam that are conveyed to users within OCWD. Such water, if delivered, is included within the classification of "Supplemental Water" as defined in the District Act.*
[6] *Groundwater quantity reported herein is that quantity used by OCWD for purposes other than seawater intrusion barrier maintenance.*
[7] *These agencies participated in the MWD Long-Term Groundwater Storage Program for which groundwater was extracted and accounted for as supplemental water.*

# APPENDIX 2. 2008-09[1] Groundwater Production — Non-Irrigation Use Production Over 25 Acre-Feet

| PRODUCER | AF | PRODUCER | AF |
|---|---|---|---|
| Alta Vista Country Club | 398.0 | Mesa Verde Country Club | 277.0 |
| Anaheim Cemetery | 56.0 | Midway City Mutual Water Co. | 138.9 |
| Anaheim, City of | 51,298.4 | Mile Square Golf Course | 140.7 |
| Angelica Textile Services – Plant 10 | 167.9 | Navy Golf Course | 659.8 |
| Buena Park, City of | 11,242.2 | Newport Beach Golf Course | 139.3 |
| Canyon RV Park | 107.6 | Newport Beach, City of | 11,350.4 |
| Catalina St. Pump Owners | 26.8 | Niagara Drinking Water | 77.9 |
| CCDA Waters, L.L.C. | 153.7 | Old Ranch Country Club | 603.6 |
| County of Orange | 95.8 | Orange, City of | 23,892.2 |
| Cypress GC LLC/Cypress Golf Club | 34.2 | Orange County Water District | 1,418.4 |
| Danone Waters of North America | 234.0 | Pacific Scientific Company | 38.3 |
| Diamond Park Mutual Water | 37.3 | Page Avenue Mutual Water Co. | 40.0 |
| Donovan Golf Course Management | 281.9 | River View Golf | 295.4 |
| Eastlake Village HOA | 89.4 | Santa Ana, City of | 28,426.4 |
| East Orange County Water District | 759.4 | Santa Ana Country Club | 271.4 |
| Eastside Water Association | 250.0 | Seal Beach, City of | 2,731.3 |
| Fairhaven Memorial Park | 211.3 | Serrano Water District | 2,241.5 |
| Forest Lawn Memorial Park | 215.6 | South Midway City Water Co. | 64.6 |
| Fountain Valley, City of | 7,098.5 | The Boeing Company | 58.5 |
| Fullerton, City of | 21,040.5 | The Good Shepherd Cemetery | 54.6 |
| Garden Grove, City of | 18,950.5 | The Lakes Master Association | 49.7 |
| Golden State Water Company | 18,664.8 | Tustin, City of | 8,423.2 |
| Huntington Beach, City of | 21,856.7 | Villa Capri Mobile Home Park | 52.0 |
| Hynes Estates, Inc. | 80.6 | Walt Disney Product Maintenance Division | 39.8 |
| Irvine Ranch Water District * | 44,952.8 | Westminster, City of | 9,057.5 |
| Knott's Berry Farm | 297.9 | Westminster Memorial Park | 425.9 |
| La Palma, City of | 1,637.5 | Yorba Linda Country Club | 323.4 |
| Los Alamitos Race Course | 179.9 | Yorba Linda Water District | 12,031.2 |
| Melrose Abbey Funeral Center | 33.5 | | |
| Mesa Consolidated Water District | 15,895.6 | **Total** | **319,671.3** |

[1]*Water year begins on July 1.*

** The reported groundwater production includes 743.6 af from a production well formerly owned by the Orange Park Acres Mutual Water Company which is now part of IRWD.*

# APPENDIX 3. 2008-09[1] Groundwater Production — Irrigation Use Production Over 25 Acre-Feet

| PRODUCER | AF | PRODUCER | AF |
|---|---|---|---|
| F S Nursery | 37.1 | Roy Pursche | 40.6 |
| Hiroshi Fujishige | 30.6 | Roy K. Sakioka and Sons | 34.4 |
| Irvine Ranch Water District | 801.0 | Village Nurseries | 162.3 |
| Ito-Ozawa Farms | 304.1 | Yorba Linda Water District | 110.9 |
| Orange County Produce | 939.7 | **Total** | **2,460.7** |

[1]*Water year begins on July 1.*

# APPENDIX 4. Typical Groundwater Extraction Facility Characteristics

| PARAMETER | CHARACTERISTICS |
|---|---|
| Water System Pressure | 62 psi |
| Load (Use) Factor | 63% |
| Design Flow Rate | 2,563 gpm |
| Annual Production | 2,600 AF |
| Bowl Efficiency (minimum) | 84% |
| Motor Horsepower | 325 hp |
| Type Motor | Electric |
| Well Casing Diameters | 16 – 20 inches |
| Type of Pump | Vertical Turbine |
| Depth of Well | 1,052 feet |
| Depth of Bowls | 278 feet |
| Total Dynamic Head | 325 feet |
| Estimated Life | 30 years |
| Annual Cost of Facilities[1] | $135,200 |

*[1] Based on an interest rate of 5 percent amortized over a 30-year period. Cost for land not included.*

# APPENDIX 5. 2008-09 Water Resources Summary

| | 2008-2009 Water Year (AF) | 2007-2008 Water Year (AF) | Change from last year to this year (AF) |
|---|---|---|---|
| **SUMMARY OF BASIN CONDITIONS** | | | |
| BASIN SUPPLIES | | | |
| Non-local Recharge Water (MWD, In-Lieu & other purchases) | 22,272 | 4,149 | 18,123 |
| MWD Program Stored Water | (23,344) | 0 | (23,344) |
| Natural Flows (SAR @ Imperial, local inflows & Santiago Creek) | 171,753 | 212,363 | (40,610) |
| GWR System AWPF Water to Forebay Recharge Basins | 25,248 | 7,719 | 17,529 |
| GWR System AWPF Water to Talbert Barrier | 28,952 | 10,072 | 18,880 |
| Imported Water to Talbert Barrier | 4,140 | 4,581 | (441) |
| Alamitos Barrier | 2,094 | 1,506 | 588 |
| Incidental Recharge | 69,352 | 46,826 | 22,526 |
| River Flow Lost to Ocean | (13,460) | (27,430) | 13,970 |
| Evaporation from Basin Surfaces | (2,594) | (2,924) | 330 |
| Change in Recharge Facilities Storage[1] | 2,252 | (1,319) | 3,571 |
| **TOTAL BASIN SUPPLY** | **282,162** | **258,182** | **(23,980)** |
| PRODUCTION AND IN-LIEU | | | |
| Groundwater Production | 347,491 | 366,185 | (18,694) |
| In-Lieu (OCWD Purchases) | 0 | 0 | 0 |
| MWD Storage Program Extractions | (23,344) | 0 | (23,344) |
| **TOTAL GROUNDWATER PRODUCTION AND IN-LIEU** | **324,147** | **366,185** | **(42,038)** |
| BASIN STATUS | | | |
| Change in Groundwater Storage | (41,000) | (108,000) | 67,000 |
| Accumulated Overdraft (AOD)[2] | 347,000 | 306,000 | 41,000 |
| AOD without MWD Storage Program water | 370,460 | 355,844 | 14,616 |
| Overdraft without MWD Storage | 370,460 | 355,844 | 14,616 |
| **OTHER KEY INFORMATION** | | | |
| 1. Imported Deliveries to Producers[3] | 103,490 | 107,767 | (4,277) |
| 2. Producers' Short-term Seasonal Shift Program | 0 | 5,618 | (5,618) |
| 3. Basin Production Percentage[4] | 71.8% | 77.3% | -5.5% |
| 4. Talbert Barrier Supplies: | | | |
| - AWPF (without deep wells)[5] | 28,952 | 10,072 | 18,880 |
| - OC-44 Water | 4,140 | 4,581 | (441) |
| 5. Green Acres Project (w/o Deep Wells) | 6,306 | 6,104 | 202 |
| 6. Arlington Desalter Purchases | 474 | 1,267 | (793) |
| 7. WMWD/EVMWD Exchange Water | 3,663 | 2,882 | 781 |
| 8. Base Flow of Santa Ana River | 109,846 | 121,902 | (12,056) |
| 9. Year-end Storage behind Prado Dam | 0 | 0 | 0 |
| 10. Year-end Storage in Deep Basins | 16,203 | 13,951 | 2,252 |
| 11. Total Artificial Recharge (percolation plus barriers w/ deep wells) | 236,216 | 211,359 | 24,857 |
| 12. Rainfall Measured at OCWD Field Headquarters (inches) | 10.77 | 9.91 | 0.86 |
| 13. Annual Mean Temperature at Santa Ana Fire Station (°F) | 66.9 | 66.6 | 0.3 |

[1] *A negative value for "Change in Recharge Facilities Storage" translates into a positive value (i.e., increase in basin supply) when performing a summation of "Total Basin Supply" (with the reverse also holding true).*
[2] *Based on maximum basin operating range of 500,000 acre-feet.*
[3] *Santiago Creek Native and In-Lieu water are included (excluded is imported water used for groundwater replenishment).* [4] *Excludes groundwater extracted for the MWD Storage Program.*
[5] *GWR System Advanced Water Purification Facility.*

# APPENDIX 6. Non-Local Water Purchased by OCWD for Water Years 1990-91 Through 2008-09

| | Water Exchange | | Talbert Barrier | | Forebay Recharge | | In-Lieu Program | | Basin Water | SAR Upstream GW Projects | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Western MWD | Alamitos Barrier | FV[1] OC32A | MCWD OC44B | Forebay Recharge | CUP[2] Recharge | CUP[2] In-Lieu | In-Lieu | Supply Mgmt. Program[3] | Arlington Desalter | San Bern. Valley MWD | |
| Water Year | Purch. a.f. | Purch. a.f. | Purch. a.f. | Purch. a.f. | Purch. a.f. | Purch. a.f. | Purch. a.f. | Purch. a.f. | Purch. a.f. | Purch. a.f. | Purch. a.f. | Purch. a.f. |
| 1990-91 | - | 1,933.1 | - | - | 15,619.0 | - | - | 44,738.6 | - | 4,490.7 | - | 66,781.4 |
| 1991-92 | - | 1,623.0 | - | - | 51,691.9 | - | - | 39,788.7 | - | 3,325.7 | - | 96,429.3 |
| 1992-93 | - | 1,614.0 | - | - | 26,293.4 | - | - | 38,900.3 | - | 2,952.7 | - | 69,760.4 |
| 1993-94 | 2,093.8 | 1,432.6 | - | - | 78,521.3 | - | - | 48,133.9 | - | 5,158.9 | - | 135,340.5 |
| 1994-95 | 2,343.2 | 798.3 | - | - | 15,354.2 | - | - | 15,622.2 | - | 1,930.3 | - | 36,048.2 |
| 1995-96 | 888.2 | 1,691.6 | - | - | 15,278.7 | - | - | 5,542.4 | - | 2,770.6 | - | 26,171.5 |
| 1996-97 | 2958.0 | 1,885.5 | - | - | 33,742.7 | - | - | 7,883.0 | - | 6,176.2 | - | 52,645.4 |
| 1997-98 | 701.8 | 1,613.8 | - | - | 19,029.4 | - | - | - | 27,674.9 | 2,516.9 | - | 51,536.8 |
| 1998-99 | 996.1 | 1,493.6 | - | - | 10,371.5 | - | - | - | 13,351.9 | 2,351.3 | - | 28,564.4 |
| 1999-00 | - | 1,873.6 | - | - | 28,478.1 | - | - | 24,726.0 | 13,280.8 | 4,994.6 | - | 73,353.1 |
| 2000-01 | - | 1,672.5 | 941.7 | - | 59,138.4 | - | - | 11,191.0 | 7,449.0 | 5,177.9 | 2,787.6 | 88,358.1 |
| 2001-02 | 2,990.3 | 2,282.2 | 2,673.0 | - | 30,092.6 | - | - | 19,472.4 | - | 5,819.8 | 4,296.4 | 67,626.7 |
| 2002-03 | 3,471.4 | 1,448.7 | 1,540.1 | - | 35,755.1 | - | - | 25,631.0 | 35,832.0 | 4,924.7 | - | 108,603.0 |
| 2003-04 | 3,605.0 | 1,938.3 | 1,703.3 | 3,380.6 | 14,832.0 | 2,462.7 | 2,479.6 | 49,688.8 | - | 4,087.3 | - | 84,177.6 |
| 2004-05 | - | 1,914.9 | 2,451.8 | 8,368.6 | 3,810.8 | - | 15,021.1 | 54,596.1 | - | 567.5 | - | 86,730.8 |
| 2005-06 | - | 833.0[4] | 1,079.9 | 5,431.1 | 7,256.7 | - | 15,452.9 | 73,763.1[5] | - | - | - | 103,816.7 |
| 2006-07 | 1,745.0 | 534.1[4] | 143.9 | 7,394.7 | 42,173.0 | - | 14,427.3 | 36,313.0 | - | 227.6 | - | 102,958.6 |
| 2007-08 | 2,882.4 | 1,505.7[4] | - | 4,581.4 | - | - | - | - | - | 1,266.6 | - | 10,236.1 |
| 2008-09 | 3,663.5 | 2,094.2[4] | - | 4,140.3 | 18,100.0 | - | - | - | - | 428.2 | - | 28,426.2 |
| Total | 28,338.7 | 30,182.7 | 10,533.7 | 33,296.7 | 505,538.8 | 2,462.7 | 47,380.9 | 495,990.5 | 97,588.6 | 59,167.5 | 7,084.0 | 1,317,564.8 |

[1] Includes only imported water (i.e., groundwater excluded from Fountain Valley deliveries to OCWD).

[2] "CUP" is the multi-agency conjunctive use program (known as the MWD Long-Term Groundwater Storage Program or MWD CUP). Basin losses are not taken into account.

[3] Known as Basin Water Supply Management Program (WSM) water. All water was received as In-Lieu except in WY1997-98 when 12,579 AF of the total WSM deliveries Were received as Forebay recharge water. WSM totals should be added to In-Lieu/Recharge totals reported herein. WSM program was terminated on December 31, 2003.

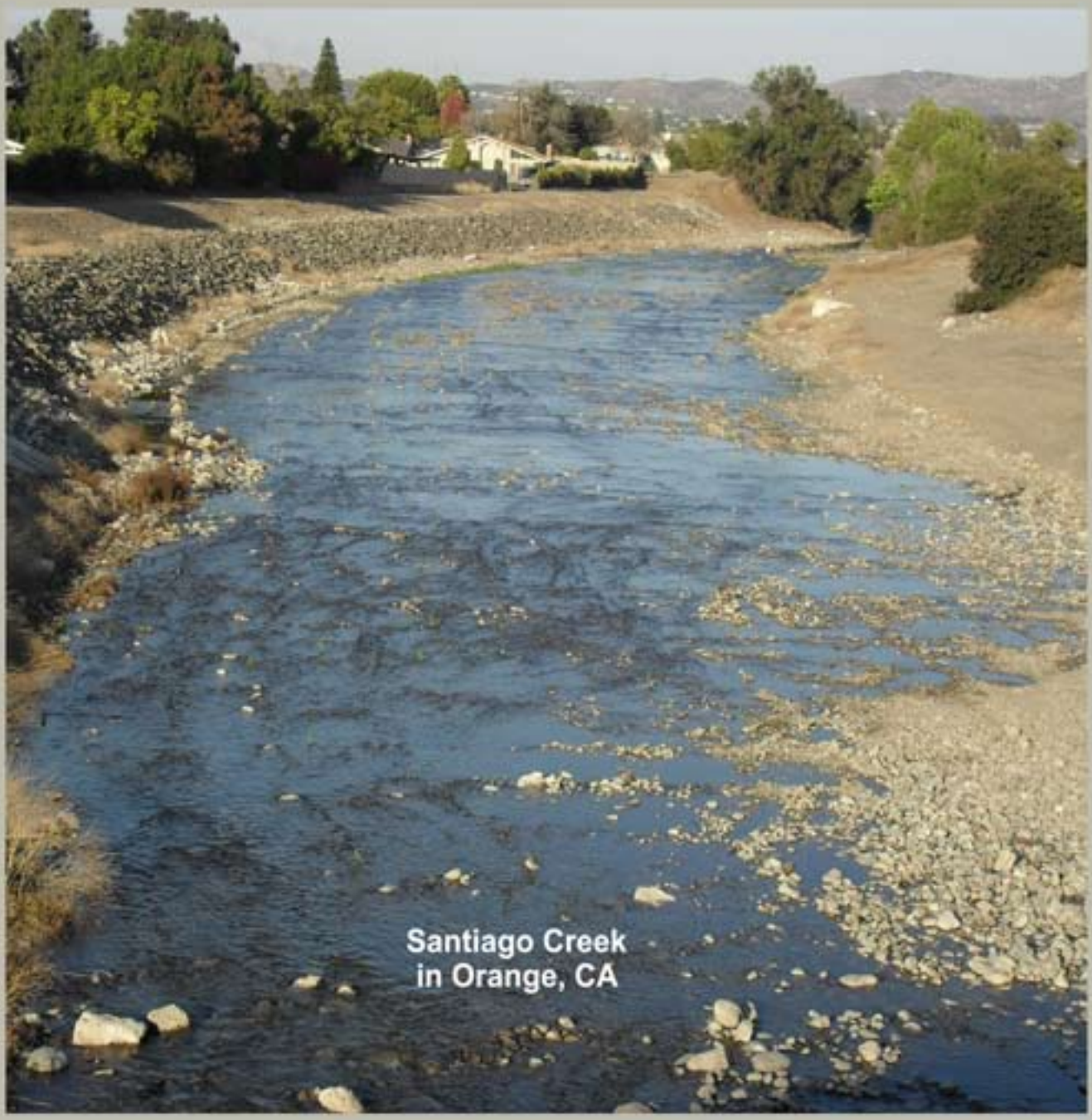
[4] Includes both MWD imported deliveries and supplemental recycled water deliveries.

[5] Includes 16,000 AF of 2005-06 MWD Supplemental Storage Program (i.e., "Super In-Lieu") water that was received as In-Lieu by the groundwater producers.

# APPENDIX 7. Values Used in Figure 6
# For Water Rates for Non-Irrigation Use

| Water Year | RA ($/AF) | Estimated Groundwater Production Cost[1,2] ($/AF) | MWD Treated Interruptible Rate (In-Lieu Program)[2,3] ($/AF) | MWD Treated Non-Interruptible Rate (Full Service)[2,3] ($/AF) |
|---|---|---|---|---|
| 1985-86 | 32 | 85 | 181 | 225 |
| 1986-87 | 32 | 91 | 187 | 231 |
| 1987-88 | 32 | 91 | 187 | 231 |
| 1988-89 | 42 | 105 | 187 | 231 |
| 1989-90 | 45 | 119 | 136 | 231 |
| 1990-91 | 48 | 91 | 137 | 232 |
| 1991-92 | 51 | 100 | 156 | 263 |
| 1992-93 | 60 | 116 | 206 | 325 |
| 1993-94 | 67.5 | 124 | 257 | 389 |
| 1994-95 | 88 | 145 | 279 | 416 |
| 1995-96 | 85 | 140 | 294 | 440 |
| 1996-97 | 88 | 140 | 303 | 448 |
| 1997-98 | 91 | 141 | 303 | 455 |
| 1998-99 | 94 | 143 | 303 | 458 |
| 1999-00 | 100 | 150 | 303 | 459 |
| 2000-01 | 107 | 150 | 303 | 459 |
| 2001-02 | 117 | 162 | 303 | 459 |
| 2002-03 | 127 | 176 | 299 | 455 |
| 2003-04 | 149 | 203 | 301 | 460 |
| 2004-05 | 172 | 229 | 318 | 479 |
| 2005-06 | 205 | 258 | 337 | 494 |
| 2006-07 | 223 | 278 | 354 | 510 |
| 2007-08 | 237 | 296 | 382 | 538 |
| 2008-09 | 249 | 307 | 420 | 586 |
| 2009-10 | 249 | 308 | 501 | 703 |
| 2010-11 | 249[3] | 310 | 602[4] | 791[4] |

[1] *Includes RA plus energy cost to produce groundwater.*
[2] *Rate is rounded.*
[3] *Rate is proposed.*
[4] *Rate is estimated.*

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