



**City of Newport Beach**

**Final**

# **2010 Urban Water Management Plan**

**June 2011**



**MALCOLM  
PIRNIE**

**ARCADIS**

*The Water Division of ARCADIS*



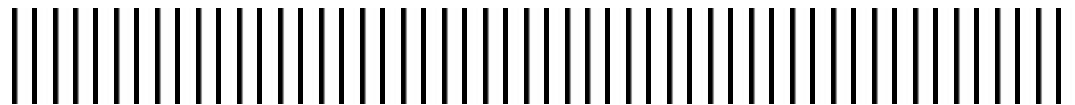
## City of Newport Beach

3300 Newport Blvd. • Newport Beach, CA 92663

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# 2010 Urban Water Management Plan

June 2011



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- H. Copy of Plan Adoption

## Acronyms Used in the Report

|              |                                                     |
|--------------|-----------------------------------------------------|
| 20x2020      | 20% water use reduction in GPCD by year 2020        |
| Act          | Urban Water Management Planning Act                 |
| AF           | acre-feet                                           |
| AFY          | acre-feet per year                                  |
| Basin        | Orange County Groundwater Basin                     |
| BDCP         | Bay Delta Conservation Plan                         |
| BEA          | Basin Equity Assessment                             |
| BMP          | Best Management Practice                            |
| BPP          | Basin Production Percentage                         |
| CDR          | Center for Demographic Research                     |
| cfs          | cubic feet per second                               |
| CII          | Commercial/Industrial/Institutional                 |
| CIMIS        | California Irrigation Management Information System |
| City         | City of Newport Beach                               |
| CRA          | Colorado River Aqueduct                             |
| CUP          | Conjunctive Use Program                             |
| CUWCC        | California Urban Water Conservation Council         |
| DMM          | Demand Management Measure                           |
| DWR          | Department of Water Resources                       |
| EOCF #2      | East Orange County Feeder #2                        |
| ETo          | Evapotranspiration                                  |
| FY           | Fiscal Year                                         |
| FYE          | Fiscal Year Ending                                  |
| GAP          | Green Acres Project                                 |
| GPCD         | gallons per capita per day                          |
| gpm          | gallons per minute                                  |
| GWRS         | Groundwater Replenishment System                    |
| HECW         | High Efficiency Clothes Washer                      |
| HET          | high efficiency toilet                              |
| HOA          | Homeowners Association                              |
| IRP          | Integrated Water Resources Plan                     |
| IWA          | International Water Association                     |
| LOI          | Letter of Intent                                    |
| MCL          | Maximum Contaminant Level                           |
| Metropolitan | Metropolitan Water District of Southern California  |
| MF           | Microfiltration                                     |
| MG           | million gallons                                     |
| MGD          | million gallons per day                             |
| MOU          | Memorandum of Understanding                         |

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|           |                                                            |
|-----------|------------------------------------------------------------|
| MWDOC     | Municipal Water District of Orange County                  |
| NBMC      | Newport Beach Municipal Code                               |
| NDMA      | N-nitrosodimethylamine                                     |
| NOAA      | National Oceanic and Atmospheric Administration            |
| OCSD      | Orange County Sanitation District                          |
| OCWD      | Orange County Water District                               |
| Poseidon  | Poseidon Resources LLC                                     |
| PPCP      | Pharmaceuticals and Personal Care Product                  |
| PSA       | Public Service Announcements                               |
| QSA       | Quantification Settlement Agreement                        |
| RA        | Replenishment Assessment                                   |
| RHNA      | Regional Housing Needs Assessment                          |
| RO        | Reverse Osmosis                                            |
| RUWMP     | Regional Urban Water Management Plan                       |
| RWQCB     | Regional Water Quality Control Board                       |
| SBx7-7    | Senate Bill 7 as part of the Seventh Extraordinary Session |
| SCAB      | South Coast Air Basin                                      |
| SCAG      | Southern California Association of Governments             |
| SDCWA     | San Diego County Water Authority                           |
| SOI       | Sphere of Influence                                        |
| SWP       | State Water Project                                        |
| TDS       | Total Dissolved Solids                                     |
| ULFT      | ultra-low-flush toilet                                     |
| UWMP      | Urban Water Management Plan                                |
| WEROC     | Water Emergency Response Organization of Orange County     |
| WOCWBF #2 | West Orange County Water Board Feeder #2                   |
| WSAP      | Water Supply Allocation Plan                               |
| WSCP      | Water Shortage Contingency Plan                            |
| WSDM      | Water Surplus and Drought Management Plan                  |

# Executive Summary

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This report serves as the 2010 update of the City of Newport Beach's (City) Urban Water Management Plan (UWMP). The UWMP has been prepared consistent with the requirements under Water Code Sections 10610 through 10656 of the Urban Water Management Planning Act (Act), which were added by Statute 1983, Chapter 1009, and became effective on January 1, 1984. The Act requires "every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually" to prepare, adopt, and file an UWMP with the California Department of Water Resources (DWR) every five years. 2010 UWMP updates are due to DWR by August 1, 2011.

Since its passage in 1983, several amendments have been added to the Act. The most recent changes affecting the 2010 UWMP include Senate Bill 7 as part of the Seventh Extraordinary Session (SBx7-7) and SB 1087. Water Conservation Act of 2009 or SBx7-7 enacted in 2009 is the water conservation component of the Delta package. It stemmed from the Governor's goal to achieve a 20% statewide reduction in per capita water use by 2020 (20x2020). SBx7-7 requires each urban retail water supplier to develop urban water use targets to help meet the 20% goal by 2020 and an interim 10% goal by 2015.

## Service Area and Facilities

The City provides water to a population of approximately 67,000 throughout its 35.77 square mile service area. The City receives its water from two main sources, the Lower Santa Ana River Groundwater basin, which is managed by the Orange County Water District (OCWD) and imported water from the Municipal Water District of Orange County (MWDOC). Groundwater is pumped from 4 active wells located throughout the City, and imported water is treated at the Diemer Filtration Plant and is delivered to the City through six imported water connections.

## Water Demand

Currently, the total water demand for retail customers served by the City is approximately 16,640 acre-feet annually consisting of 10,052 acre-feet of local groundwater and 432 acre-feet of recycled water. In the last five years, the City's water demand has decreased by about 5 percent while population has increased by 1.5 percent. This illustrates the City's proactive efforts in promoting water use efficiency. With its diligence in the promotion of water conservation as well as financial incentives to customers to retrofit their homes and businesses with water efficient devices and appliances, the City is

projecting a flattening demand trend in the next 25 years despite a projected 11 percent population growth.

With MWDOC's assistance, the City has selected to comply with **Option 1** of the SBx7-7 compliance options. The City is a member of the Orange County 20x2020 Regional Alliance formed by MWDOC. This regional alliance consists of 29 retail agencies in Orange County. Under Compliance Option 1, the City's 2015 interim water use target is 228.1 GPCD and the 2020 final water use target is **202.8 GPCD**.

### **Water Sources and Supply Reliability**

The City's main source of water supply is groundwater from the Lower Santa Ana River Groundwater Basin and imported water from Metropolitan through MWDOC. Recycled water was recently added to the City's water supply portfolio. Today, the City relies on 60% groundwater, 37% imported, and 3% recycled water. It is projected that by 2035, the water supply mix will remain roughly the same. The sources of imported water supplies include the Colorado River and the State Water Project (SWP). Metropolitan's 2010 Integrated Water Resources Plan (IRP) update describes the core water resource strategy that will be used to meet full-service demands (non-interruptible agricultural and replenishment supplies) at the retail level under all foreseeable hydrologic conditions from 2015 through 2035.

It is required that every urban water supplier assess the reliability to provide water service to its customers under normal, dry, and multiple dry water years. Metropolitan's 2010 RUWMP finds that Metropolitan is able to meet full service demands of its member agencies with existing supplies from 2015 through 2035 during normal years, single dry year, and multiple dry years. The City is therefore capable of meeting the water demands of its customers in normal, single dry, and multiple dry years between 2015 and 2035, as illustrated in Table 3-12, Table 3-13, and Table 3-14, respectively.

### **Future Water Supply Projects**

Potential recycled water users are locations where recycled water could replace potable water use. These potential users are typically landscape or agricultural irrigation systems, or possibly water users. However, due to the limited access to the project mains and some financial impact on end users, it is not feasible to distribute all of the potential recycled water, and the City does not predict that there will be many other end users in the near future.

In Orange County, there are three proposed ocean desalination projects that could serve MWDOC, including one specifically that may benefit the City. On January 20, 2010, the City signed a non-binding LOI for 7.1 MGD (8,000 AFY) of Huntington Beach Seawater Desalination Project supplies.

# 1. Introduction

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## 1.1. Urban Water Management Plan Requirements

Water Code Sections 10610 through 10656 of the Urban Water Management Planning Act (Act) requires "every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually" to prepare, adopt, and file an UWMP with the California Department of Water Resources (DWR) every five years. 2010 UWMP updates are due to DWR by August 1, 2011.

This UWMP provides DWR with information on the present and future water resources and demands and provide an assessment of the City's water resource needs. Specifically, this document will provide water supply planning for a 25-year planning period in 5-year increments. The plan will identify water supplies for existing and future demands, quantify water demands during normal year, single-dry year, and multiple-dry years, and identify supply reliability under the three hydrologic conditions. The City's 2010 UWMP update revises the 2005 UWMP. This document has been prepared in compliance with the requirements of the Act as amended in 2009, and includes the following analysis:

- Water Service Area and Facilities
- Water Sources and Supplies
- Water Use by Customer Type
- Demand Management Measures
- Water Supply Reliability
- Planned Water Supply Projects and Programs
- Water Shortage Contingency Plan
- Recycled Water

Since its passage in 1983, several amendments have been added to the Act. The most recent changes affecting the 2010 UWMP include Senate Bill 7 as part of the Seventh Extraordinary Session (SBx7-7) and SB 1087. Water Conservation Act of 2009 or SBx7-7, enacted in 2009, is the water conservation component of the historic Delta package. It stemmed from the Governor's goal to achieve a 20% statewide reduction in per capita water use by 2020 (20x2020). SBx7-7 requires each urban retail water supplier to develop urban water use targets to help meet the 20% goal by 2020 and an interim 10% goal by 2015. Each urban retail water supplier must include in its 2010 UWMPs the following information from its target-setting process:

- Baseline daily per capita water use
- 2020 Urban water use target
- 2015 Interim water use target
- Compliance method being used along with calculation method and support data

Wholesale water suppliers are required to include an assessment of present and proposed future measures, programs, and policies that would help achieve the 20 by 2020 goal.

The other recent amendment made to the UWMP Act to be included in the 2010 UWMP is set forth by SB 1087, Water and Sewer Service Priority for Housing Affordable to Low-Income Households. SB 1087 requires water and sewer providers to grant priority for service allocations to proposed developments that include low income housing. SB 1087 also requires UWMPs to include projected water use for single- and multi-family housing needed for low-income households.

The sections in this Plan correspond to the outline of the Act, specifically Article 2, Contents of Plans, Sections 10631, 10632, and 10633. The sequence used for the required information, however, differs slightly in order to present information in a manner reflecting the unique characteristics of the City's water utility. The UWMP Checklist has been completed, which identifies the location of Act requirements in this Plan and is included as Appendix A.



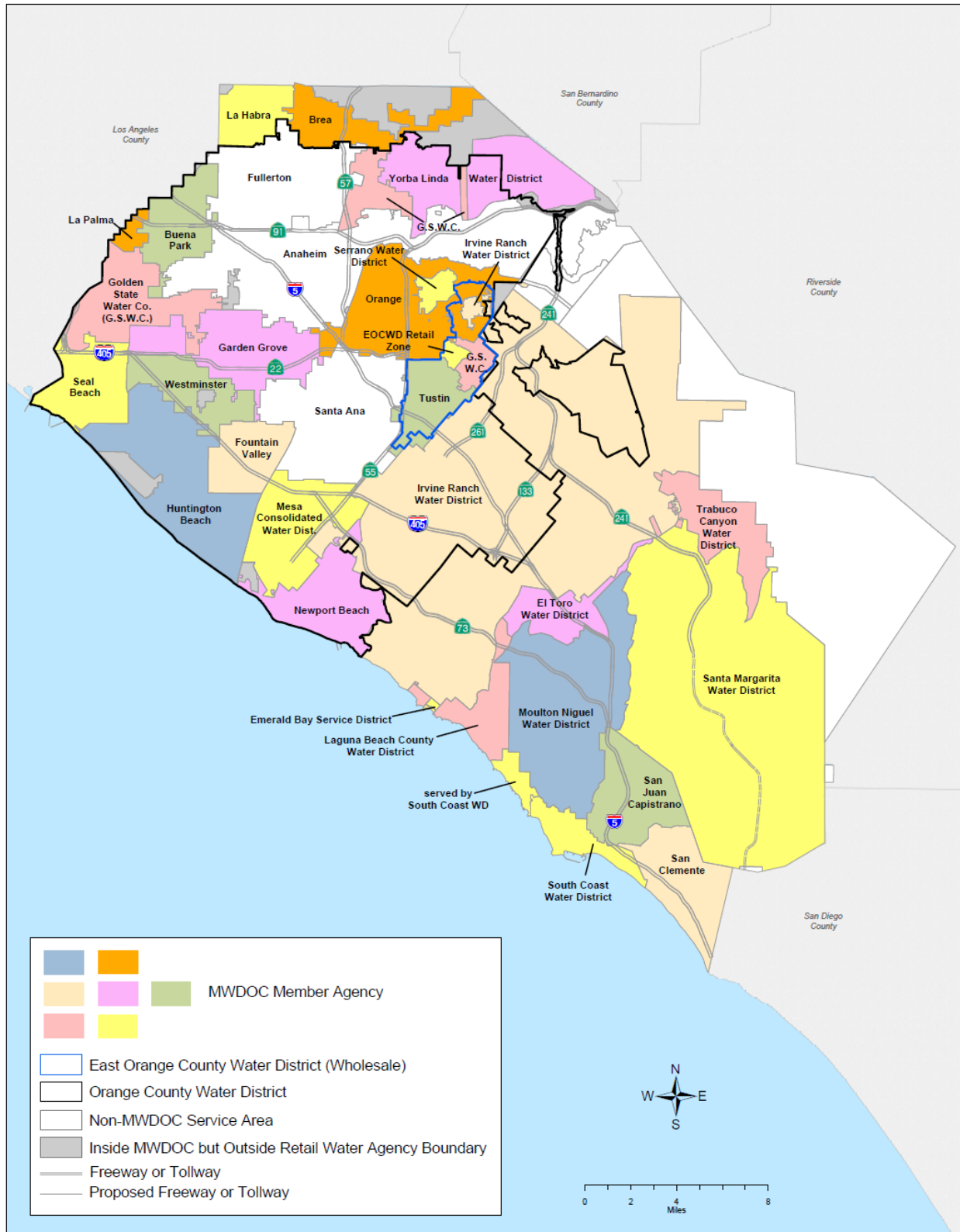


Figure 1-1: Regional Location of Urban Water Supplier

## **1.2. Agency Overview**

The City is located in Orange County, California. It serves a population of approximately 67,000 within a 35.77 square mile through 26,300 service connections. The City supplies groundwater, imported water, and recycled water to its customers. Groundwater is produced from local groundwater wells managed by OCWD and imported water is purchased from MWDOC, the regional wholesale water supplier of Orange County who in turn purchases imported water from northern California and the Colorado River through Metropolitan. The City purchases recycled water from OCWD. Today, the total water demand for the City is approximately 17,000 acre-feet annually consisting of 16,500 acre-feet of potable water and 450 acre-feet of recycled water. Due to its active efforts in promoting water conservation and water use efficiency to residents, the City is projecting a flattening demand trend in the next 25 years despite a projected 11 percent population growth.

The City Council operates under a Council-Manager format of government. Its seven City Council Members are elected by district, but voted on by the population as a whole. The current City Council members are:

- Michael F. Henn, Mayor
- Steven Rosansky
- Rush N. Hill, II
- Leslie Daigle
- Edward D. Selich
- Nancy Gardner, Mayor Pro Tem
- Keith D. Curry

The City receives its water from two main sources, the Lower Santa Ana River Groundwater basin, which is managed by the Orange County Water District (OCWD) and imported water from the Municipal Water District of Orange County (MWDOC). MWDOC is Orange County's wholesale supplier and is a member agency of the Metropolitan Water District of Southern California (Metropolitan).

## **1.3. Service Area and Facilities**

### **1.3.1. Newport Beach's Service Area**

Located along the Orange County coast of Southern California, the City is bounded to the west by the Pacific Ocean. To the north, south, and east, the City is surrounded by the cities of Huntington Beach, Laguna Beach, Irvine and Costa Mesa.

The water service area is entirely within the City's boundaries, and covers approximately 35.77 square miles. A map of the City's service area is shown in Figure 1-2. The City serves a population of approximately 67,000 through 26,300 service connections. The

City supplies groundwater, imported water, and recycled water to its residential and commercial customers. The City does not supply water to any agency customers.

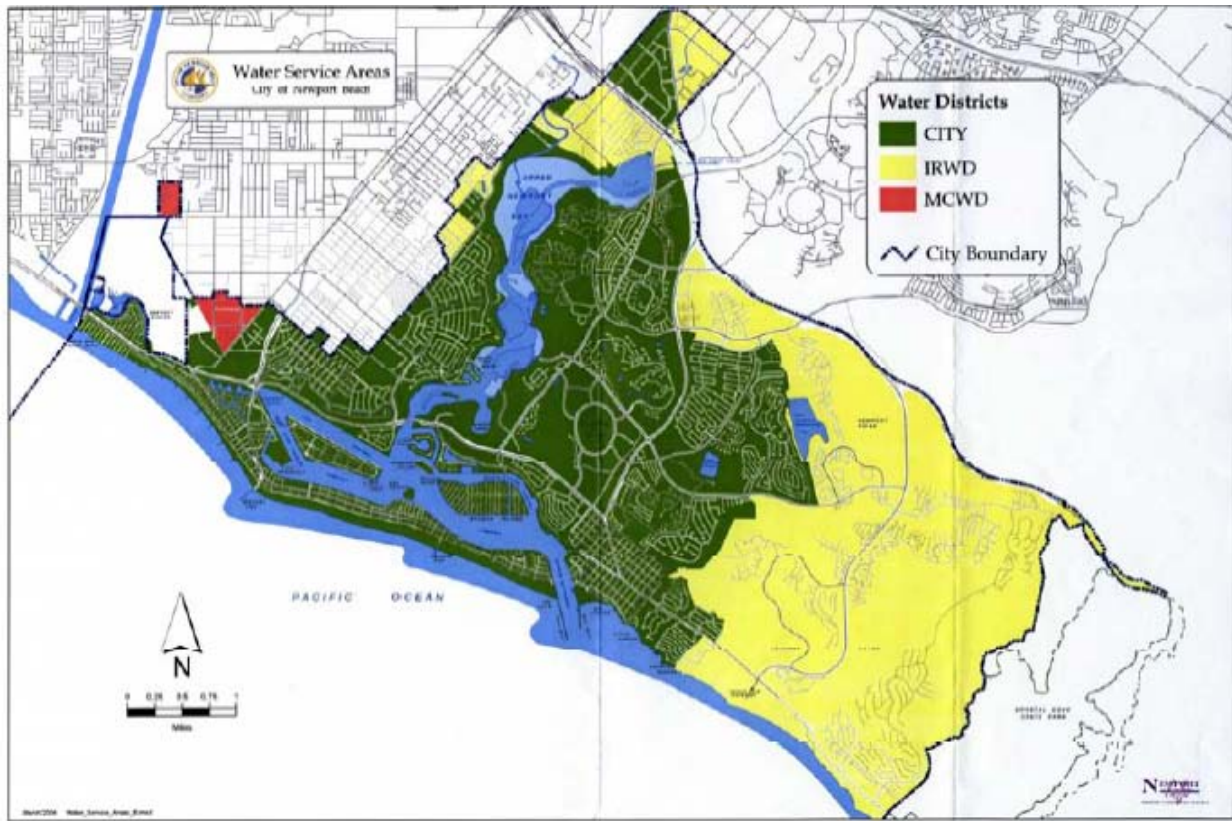


Figure 1-2: City of Newport Beach's Service Area

### 1.3.2. Newport Beach's Water Facilities

#### Imported Water Supply Facilities

MWDOC provides imported water to the City. MWDOC receives its water from Metropolitan. Most of Metropolitan's imported water supply is provided through the State Water Project (SWP) and Colorado River Aqueduct (CRA) and is treated at the Diemer and Weymouth plants. A large groundwater supply is also available, as described in Section 3.3. The use of this supply is regulated by the Basin Pumping Percentage (BPP) as set by the Orange County Water District (OCWD).

All of the water supplied by the City is sold to its retail customers (residential and commercial). The City maintains its own retail distribution system. The City delivers potable water through its water system which consists of approximately 284 miles of pipelines ranging in size from 4-inch to 30-inch with various pipe materials. The City has an extensive distribution system, which includes five pressure zones and six connections

along the Orange County Feeder and the East Orange County Feeder No. 2. The total available capacity is 104 cfs. The City has five pump stations which deliver water to the upper zones, and backup generation facilities ensure that the City can still deliver water to all zones during a rolling blackout.

### **Groundwater Facilities**

In addition to surface water, the City receives a large percentage of its supply from groundwater. Groundwater is pumped from four wells within the City of Fountain Valley and travels through over 6 miles of the 30-inch Groundwater Transmission Main in Fountain Valley, Huntington Beach, and Costa Mesa. In addition, a pump station, a treatment facility, and a 3-MG reservoir assist in the transmission and treatment effort. The City meets up to 62 percent of its demand through groundwater, under regulations of OCWD's BPP.

### **Recycled Water Facilities**

Through an agreement with the OCWD, the City purchases between 300 and 800 acre-feet per year (AFY) of recycled water for some large irrigation users. The City has no capability of treating water to produce reclaimed water, but OCWD has an elaborate system. The City began serving recycled water in 1999. OCWD provides water through the Green Acres Project, which has the capability to delivery up to 1,000 AFY. The City has investigated future sites or locations for reclaimed water, but there are limitations to the availability of reclaimed connections. The City is looking into the possibility of inter-district reclaimed water transfers to provide reclaimed water to some associations and recreation facilities.

### **Water Transmission System**

Water is delivered to the City's customers from the Groundwater Transmission Main, and from diversions off of the Orange County Feeder and the East Orange County Feeder No. 2. The transmission system consists of pipelines, booster pump stations, and storage tanks. The current capacity of the City's potable water supply is 104 cfs.

## 2. Water Demand

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### 2.1. Overview

Currently, the total water demand for retail customers served by the City is approximately 16,640 acre-feet annually consisting of 10,052 acre-feet of local groundwater and 432 acre-feet of recycled water. In the last five years, the City's water demand has decreased by about 5 percent while population has increased by 1.5 percent. This illustrates the City's proactive efforts in promoting water use efficiency. With its diligence in the promotion of water conservation as well as financial incentives to customers to retrofit their homes and businesses with water efficient devices and appliances, the City is projecting a flattening demand trend in the next 25 years despite a projected 11 percent population growth.

The passage of SBx7-7 will increase efforts to reduce the use of potable supplies in the future. This new law requires all of California's retail urban water suppliers serving more than 3,000 AFY or 3,000 service connections to achieve a 20 percent reduction in demands (from a historical baseline) by 2020. Due to great water conservation efforts in the past decade, the City is on its way to meeting this requirement on its own. Moreover, the City has elected to join the Orange County 20x2020 Regional Alliance. The City together with 28 other retail agencies in Orange County are committed to reduce the region's water demand by 2020 through the leadership of MWDOC, the region's wholesale provider.

This section will explore in detail the City's current water demands by customer type and the factors which influence those demands as well as providing a perspective of its expected future water demands for the next 25 years. In addition, to satisfy SBx7-7 requirements, this section will provide details of the City's SBx7-7 compliance method selection, baseline water use calculation, and its 2015 and 2020 water use targets.

### 2.2. Factors Affecting Demand

Water consumption is influenced by many factors from climate characteristics of that hydrologic region, to demographics, land use characteristics, and economics. The key factors affecting water demand in the City's service area are discussed below.

#### 2.2.1. Climate Characteristics

The City is located in Southern California's coastal plain where the climate is characteristically Mediterranean, with mild year-round temperatures, sunny days, and cool evenings. The average summer and winter temperatures are 75°F and 65°F,

respectively, and the average annual rainfall is just under 12 inches (Table 2-1). The average Evapotranspiration (ET<sub>o</sub>) is almost 50 inches per year which is four times the annual average rainfall. This translates to a high demand for landscape irrigation for homes, commercial properties, parks, and golf courses. Moreover, a region with low rainfall like Southern California is also more prone to droughts.

**Table 2-1: Climate Characteristics**

|               | <b>Standard<br/>Monthly Average<br/>ET<sub>o</sub> (inches) [1]</b> | <b>Annual Rainfall<br/>(inches) [2]</b> | <b>Average<br/>Temperature<br/>(°F) [3]</b> |
|---------------|---------------------------------------------------------------------|-----------------------------------------|---------------------------------------------|
| Jan           | 2.18                                                                | 2.60                                    | 55.9                                        |
| Feb           | 2.49                                                                | 2.54                                    | 56.7                                        |
| Mar           | 3.67                                                                | 2.25                                    | 57.4                                        |
| Apr           | 4.71                                                                | 0.70                                    | 59.5                                        |
| May           | 5.18                                                                | 0.18                                    | 61.7                                        |
| Jun           | 5.87                                                                | 0.08                                    | 64.3                                        |
| Jul           | 6.29                                                                | 0.02                                    | 67.3                                        |
| Aug           | 6.17                                                                | 0.09                                    | 68.7                                        |
| Sep           | 4.57                                                                | 0.30                                    | 68.1                                        |
| Oct           | 3.66                                                                | 0.28                                    | 65.1                                        |
| Nov           | 2.59                                                                | 1.02                                    | 60.0                                        |
| Dec           | 2.25                                                                | 1.59                                    | 56.1                                        |
| <b>Annual</b> | <b>49.63</b>                                                        | <b>11.65</b>                            | <b>61.7</b>                                 |

[1] CIMIS Station #75, Irvine, California from October 1987 to Present

[2] NOAA, Newport Beach Harbor, California 1971 to 2000, Mean Precipitation Total

[3] NOAA, Newport Beach Harbor, California 1971 to 2000, Mean Temperature

The source of the City's imported water supplies, the State Water Project and Colorado River Project, is influenced by weather conditions in Northern California and along the Colorado River. Both regions have recently been suffering from multi-year drought conditions and record low rainfalls which directly impact demands and supplies to Southern California.

### 2.2.2. Demographics

The City serves a population of 67,030. The population within the City's service area is expected to increase by 11 percent in the next 25 years, or 0.44 percent annually. Table 2-2 shows the population projections for the next 25 years based on the California State University at Fullerton, Center for Demographic Research (CDR) projections. Due to proactive water conservation efforts, future water demands are expected to increase at a much lower rate compared to the population growth.

**Table 2-2: Population – Current and Projected**

|                             | 2010   | 2015   | 2020   | 2025   | 2030   | 2035   |
|-----------------------------|--------|--------|--------|--------|--------|--------|
| Service Area Population [1] | 67,030 | 68,478 | 69,926 | 71,375 | 72,823 | 74,271 |

[1] Center for Demographic Research, California State University, Fullerton 2010

Other demographic factors that also play a role in influencing demands include recreation and tourism which is an important industry in the City. Tourism affects seasonal demands with higher demands in the summer especially at beach facilities as well as hotels and restaurants.

Over 50 percent of the City’s residents are employed in professional, managerial, and administrative occupations. The median age of City residents is 40 years, and the median household income is estimated at about \$110,500 per year<sup>1</sup>. The average household is 2.8 persons per dwelling unit.

### **2.2.3. Land Use**

Land use within the City’s service area is characterized as mostly suburban, and the City is almost built-out.

The City may consider the approval of a 401-acre Newport Banning Ranch development project located within the City’s Coastal Zone. The development will comprise of approximately 252 acres of open space and development of up to 1,375 residential dwelling units, 75,000 square feet of commercial area, a 75 room resort inn, and approximately 52 acres of parks. Approximately 40 acres of the project site are located within the City limits and approximately 361 acres are located outside the city limits but within the City’s Sphere of Influence (SOI). An annexation and a boundary adjustment will be coordinated through the Local Agency Formation Commission to extend the City limits to include portion of the project site currently within the SOI and to extend the City’s water service area to provide water to the entire project site. The estimated total average annual water demand from this development is 613.5 acre-feet<sup>2</sup>. Implementation of this project would be subject to compliance with the water conservation requirements of Newport Beach Municipal Code (NBMC). NBMC requires water efficiency design standards be incorporated into the landscape and irrigation plans as well as other indoor conservation measures including use of low water usage appliances and waterless urinals in public men’s restrooms.

<sup>1</sup> 2007 American community Survey

<sup>2</sup> Newport Banning Ranch Water Supply Assessment, City of Newport Beach (October 12, 2010)

## **2.3. Water Use by Customer Type**

The knowledge of an agency's water consumption by type of use or by customer class is key to developing that agency's water use profile which identifies when, where, how, and how much water is used, and by whom within the agency's service area. A comprehensive water use profile is critical to the assessment of impacts of prior conservation efforts as well as to the development of future conservation programs.

This section provides an overview of the City's water consumption by customer type in 2005 and 2010, as well as projections for 2015 to 2035. The customer classes are categorized as follows: single-family residential, multi-family residential, commercial/industrial/institutional (CII), dedicated landscape, and agriculture. Other water uses including sales to other agencies and non-revenue water are also discussed in this section.

### **2.3.1. Overview**

The City has maintained approximately 26,361 customer connections to its potable water distribution system since 2005. The City is expected to maintain the same numbers of connections through to at least 2015. After that the City is projecting a 5 percent increase by the year 2020 remaining through to 2035. All connections in the City's service area are metered.

Approximately 60 percent of the City's water demand is residential. Commercial/industrial and dedicated landscape sectors each consume approximately 20 percent of the City potable water supply. A small portion of the City's demand is from government/institutional establishments such as municipal buildings and hospitals. The City does not provide any sales to agriculture, nor other agencies, saline water intrusion barriers, groundwater recharge, or conjunctive use. A 4 percent increase in water demand between 2010 and 2035 is anticipated for the City's service area while population is projected to increase by 11 percent over the same period.

Tables 2-3 and 2-4 provide a summary of past, current, and projected water use by customer class and the number of water service customers by sector in five-year increments from 2005 through to 2035.



**Table 2-3: Past, Current and Projected Service Accounts by Water Use Sector**

| Fiscal<br>Year<br>Ending | Number of Accounts by Water Use Sector |                  |                           |               |           |                   |
|--------------------------|----------------------------------------|------------------|---------------------------|---------------|-----------|-------------------|
|                          | Single<br>Family                       | Multi-<br>Family | Commercial<br>/Industrial | Institutional | Landscape | Total<br>Accounts |
| <b>2005</b>              | 18,595                                 | 4,065            | 1,273                     | 571           | 983       | <b>25,487</b>     |
| <b>2010</b>              | 19,230                                 | 4,198            | 1,319                     | 596           | 1,018     | <b>26,361</b>     |
| <b>2015</b>              | 19,653                                 | 4,292            | 1,348                     | 609           | 1,041     | <b>26,943</b>     |
| <b>2020</b>              | 20,068                                 | 4,382            | 1,377                     | 622           | 1,063     | <b>27,512</b>     |
| <b>2025</b>              | 20,486                                 | 4,473            | 1,405                     | 635           | 1,085     | <b>28,084</b>     |
| <b>2030</b>              | 20,900                                 | 4,564            | 1,434                     | 648           | 1,107     | <b>28,653</b>     |
| <b>2035</b>              | 21,316                                 | 4,655            | 1,462                     | 661           | 1,129     | <b>29,223</b>     |

**Table 2-4: Past, Current and Projected Water Demand by Water Use Sector**

| Fiscal<br>Year<br>Ending | Water Demand by Water Use Sectors (AFY) |                  |                           |               |           |                 |
|--------------------------|-----------------------------------------|------------------|---------------------------|---------------|-----------|-----------------|
|                          | Single<br>Family                        | Multi-<br>Family | Commercial<br>/Industrial | Institutional | Landscape | Total<br>Demand |
| <b>2005</b>              | 7,482                                   | 2,597            | 3,300                     | 734           | 3,719     | <b>17,831</b>   |
| <b>2010</b>              | 7,297                                   | 2,308            | 2,960                     | 370           | 3,710     | <b>16,645</b>   |
| <b>2015</b>              | 7,258                                   | 2,300            | 2,947                     | 378           | 4,140     | <b>17,023</b>   |
| <b>2020</b>              | 7,411                                   | 2,348            | 3,009                     | 386           | 4,268     | <b>17,422</b>   |
| <b>2025</b>              | 7,565                                   | 2,397            | 3,072                     | 394           | 4,346     | <b>17,774</b>   |
| <b>2030</b>              | 7,718                                   | 2,446            | 3,134                     | 402           | 4,424     | <b>18,124</b>   |
| <b>2035</b>              | 7,872                                   | 2,494            | 3,196                     | 410           | 4,502     | <b>18,474</b>   |

### 2.3.2. Residential

Residential water use accounts for the majority of the City's water demands. The single family residential sector accounts for approximately 44 percent and multi-family residential accounts for 14 percent of the total water demand. The remaining demands are for the non-residential sector and system losses. Water consumption by the residential sector is projected to remain at about 58 percent through the 25-year planning horizon.

### 2.3.3. Non-Residential

The City has a mix of commercial uses (markets, restaurants, etc.), public entities (such as schools, fire stations and government offices), office complexes, light industrial, warehouses and facilities serving the public. In 2010 non-residential demand was approximately 42 percent of the overall demand and is expected to remain so through 2035. Commercial, industrial, and institutional (CII) uses (excluding large landscape) represent a combined 20 percent of the City's total demand. Demands from large

landscapes such as parks and golf courses are expected to remain at around 22 percent of the City's total water demands for the next 25 years.

### 2.3.4. Other Water Uses

#### 2.3.4.1. Sales to Other Agencies

While the City does sell water outside of its service area, the City does not sell water to other agencies.

#### 2.3.4.2. Non-Revenue Water

Non-revenue water is defined by the International Water Association (IWA) as the difference between distribution systems input volume (i.e. production) and billed authorized consumption. Non-revenue water consists of three components: unbilled authorized consumption (e.g. hydrant flushing, fire fighting, and blow-off water from well start-ups), real losses (e.g. leakage in mains and service lines), and apparent losses (unauthorized consumption and metering inaccuracies).

The City's non-revenue water accounts for about 6 percent of the City's total demand (Table 2-5).

**Table 2-5: Additional Water Uses and Losses (AFY)**

| Water Use                     | Fiscal Year Ending |            |              |              |              |              |              |
|-------------------------------|--------------------|------------|--------------|--------------|--------------|--------------|--------------|
|                               | 2005               | 2010       | 2015         | 2020         | 2025         | 2030         | 2035         |
| Saline Barriers               |                    |            |              |              |              |              |              |
| Groundwater Recharge          |                    |            |              |              |              |              |              |
| Conjunctive Use               |                    |            |              |              |              |              |              |
| Raw Water                     |                    |            |              |              |              |              |              |
| Recycled Water                |                    |            |              |              |              |              |              |
| Unaccounted-for System Losses | 925                | 990        | 1,078        | 1,082        | 1,085        | 1,099        | 1,108        |
| <b>Total</b>                  | <b>925</b>         | <b>990</b> | <b>1,078</b> | <b>1,082</b> | <b>1,085</b> | <b>1,099</b> | <b>1,108</b> |

## 2.4. SBx7-7 Requirements

### 2.4.1. Overview

SBx7-7, which became effective on February 3, 2010, is the water conservation component to the Delta legislative package. It seeks to implement Governor Schwarzenegger's 2008 water use reduction goals to achieve a 20% statewide reduction in urban per capita water use by December 31, 2020. As discussed above, the bill requires each urban retail water supplier to develop urban water use targets to help meet the 20% goal by 2020 and an interim 10% goal by 2015. The bill establishes methods for urban retail water suppliers to determine targets to help achieve water reduction targets. The

retail water supplier must select one of the four compliance options. The retail agency may choose to comply to SBx7-7 as an individual or as a region in collaboration with other water suppliers. Under the regional compliance option, the retail water supplier still has to report the water use target for its individual service area. The bill also includes reporting requirements in the 2010, 2015, and 2020 UWMPs. An agency that does not comply with SBx7-7 requirement will not be eligible for water related grant, or loan, from the state on and after July 16, 2016. However, if an agency that is not in compliance documents a plan and obtains funding approval to come into compliance then could become eligible for grants or loans.

#### **2.4.2. SBx7-7 Compliance Options**

DWR has established four compliance options for urban retail water suppliers to choose from. Each supplier is required to adopt one of the four options to comply with SBx7-7 requirements. The four options include:

- *Option 1* requires a simple 20% reduction from the baseline by 2020 and 10 percent by 2015.
- *Option 2* employs a budget-based approach by requiring an agency to achieve a performance standard based on three metrics
  - o Residential indoor water use of 55 GPCD
  - o Landscape water use commiserate with Model Landscape Ordinance
  - o 10 percent reduction in baseline CII water use
- *Option 3* is to achieve 95% of the applicable state hydrologic region target as set forth in the State's 20x2020 Water Conservation Plan.
- *Option 4* requires the subtraction of Total Savings from the Base GPCD:
  - o Total Savings includes indoor residential savings, meter savings, CII savings, and landscape and water loss savings.

#### **Newport Beach's Compliance Option Selection**

With MWDOC's assistance in the calculation of the City's base daily per capita use and water use targets, the City has selected to comply with **Option 1**.

While each retail agency is required to choose a compliance option in 2010, DWR allows for the agency to change its compliance option in 2015. This will allow the City to determine its water use targets for Compliance Option 2 and 4 as it anticipates more data to be available for targets calculation in the future.

#### **2.4.3. Regional Alliance**

Retail agencies can choose to meet the SBx7-7 targets on its own or several retail agencies may form a regional alliance and meet the water use targets as a region. The

benefit for an agency that joins a regional alliance is that it has multiple means of meeting compliance.

The City is a member of the Orange County 20x2020 Regional Alliance formed by MWDOC. This regional alliance consists of 29 retail agencies in Orange County as described in MWDOC's 2010 RUWMP. The Regional Alliance Weighted 2015 target is 174 GPCD and 2020 target is 157 GPCD.

#### **2.4.4. Baseline Water Use**

The first step to calculating an agency's water use targets is to determine its base daily per capita water use (baseline water use). This baseline water use is essentially the agency's gross water use divided by its service area population, reported in gallons per capita per day (GPCD). The baseline water use is calculated as a continuous 10-year average during a period which ends no earlier than December 31, 2004 and no later than December 31, 2010. Agencies that recycled water made up 10 percent or more of 2008 retail water delivery can use up to a 15-year average for the calculation.

Recycled water use represents less than 10% of the City's retail delivery in 2008; therefore, a 10-year instead of a 15-year rolling average was calculated. The City's baseline water use is **253.5 GPCD** which was obtained from the 10-year period July 1, 1995 to June 30, 2005.

Tables 2-6 and 2-7 provide the base period ranges used to calculate the baseline water use for the City as well as the service area population and annual water use data which the base daily per capita water use was derived. Data provided in Table 2-6 was used to calculate the continuous 10-year average baseline GPCD. Moreover, regardless of the compliance method adopted by the City, it will need to meet the minimum water use target of 5% reduction from a five-year baseline as calculated in Table 2-7. Because the City is an OCWD agency, the City's gross water use includes deductions for indirect potable recycled water use from the Groundwater Replenishment System (GWRS) and Water Factory 21 managed by OCWD. The calculations for the gross water use are described in MWDOC's 2010 RUWMP.

**Table 2-6: Base Daily per Capita Water Use – 10-year range**

| Highest Available Baseline [1] |  | Beginning    | Ending        |
|--------------------------------|--|--------------|---------------|
| 10 Year Avg                    |  | July 1, 1995 | June 30, 2005 |

| Fiscal Year Ending               | Service Area Population | Gross Water Use (gallons per day) | Daily Per Capita Water Use |
|----------------------------------|-------------------------|-----------------------------------|----------------------------|
| 1996                             | 60,709                  | 15,967,145                        | 263                        |
| 1997                             | 61,277                  | 16,814,358                        | 274                        |
| 1998                             | 61,896                  | 15,921,266                        | 257                        |
| 1999                             | 62,514                  | 16,976,611                        | 272                        |
| 2000                             | 64,923                  | 16,865,461                        | 260                        |
| 2001                             | 66,033                  | 16,197,012                        | 245                        |
| 2002                             | 66,495                  | 16,062,298                        | 242                        |
| 2003                             | 66,734                  | 16,083,658                        | 241                        |
| 2004                             | 65,500                  | 15,985,387                        | 244                        |
| 2005                             | 65,993                  | 15,630,375                        | 237                        |
| Base Daily Per Capita Water Use: |                         |                                   | 253.5                      |

[1] The most recent year in base period must end no earlier than December 31, 2004, and no later than December 31, 2010. The base period cannot exceed 10 years unless at least 10 percent of 2008 retail deliveries were met with recycled water.

**Table 2-7: Base Daily per Capita Water Use – 5-year range**

| Highest Available Baseline [2] |  | Beginning    | Ending        |
|--------------------------------|--|--------------|---------------|
| 5 Year Avg                     |  | July 1, 2003 | June 30, 2008 |

| Fiscal Year Ending               | Service Area Population | Gross Water Use (gallons per day) | Daily Per Capita Water Use |
|----------------------------------|-------------------------|-----------------------------------|----------------------------|
| 2004                             | 65,500                  | 15,985,387                        | 244                        |
| 2005                             | 65,993                  | 15,630,375                        | 237                        |
| 2006                             | 65,962                  | 15,616,451                        | 237                        |
| 2007                             | 66,067                  | 16,677,329                        | 252                        |
| 2008                             | 66,451                  | 16,038,474                        | 241                        |
| Base Daily Per Capita Water Use: |                         |                                   | 242.3                      |

[2] The base period must end no earlier than December 31, 2007, and no later than December 31, 2010.

#### 2.4.5. SBx7-7 Water Use Targets

Under Compliance Option 1, the simple 20 percent reduction from the baseline, the City's 2015 interim water use target is 228.1 GPCD and the 2020 final water use target is **202.8 GPCD** as summarized in Table 2-8.

**Table 2-8: Preferred Compliance Option and Water Use Targets**

|                                 | Baseline | 2015 Target | 2020 Target |
|---------------------------------|----------|-------------|-------------|
| Option 1 - Simple 20% Reduction | 253.5    | 228.1       | 202.8       |

#### **2.4.6. Water Use Reduction Plan**

The City is a member agency of MWDOC and a member of the Orange County 20x2020 Regional Alliance comprising 29 retail urban water suppliers in Orange County. The Orange County 20x2020 Regional Alliance was created to allow local water suppliers to meet their 20% by 2020 reduction targets under SBx7-7 on a regional basis through the successful implementation of region-wide programs.

The Orange County 20x2020 Regional Alliance will achieve its water use reduction by building on the existing collaboration between Metropolitan, MWDOC and the local agencies in Orange County. MWDOC as a regional wholesale water provider implements many of the urban water conservation Best Management Practices (BMPs) on behalf its member agencies. MWDOC's conservation measures are detailed in MWDOC's RUWMP Section 4, and Metropolitan's conservation measures detailed in Metropolitan's 2010 RUWMP Section 3.4.

Additionally, Metropolitan in collaboration with MWDOC and other Metropolitan member agencies is in the process of developing a Long Term Conservation Plan,<sup>3</sup> which seeks an aggressive water use efficiency target in order to achieve a 20% reduction in per capita water use by 2020 for the entire Metropolitan service area.

#### **Metropolitan Long Term Conservation Plan**

Metropolitan's Long Term Conservation Plan will build on Metropolitan's traditional programs of incentives, education and broad outreach while developing a new vision of water use efficiency by altering the public's perspective on water through market transformation. The overarching goals of the Long Term Conservation Plan are as follows:

- Achieve the 2010 IRP conservation target – The target for new water savings through conservation is a regional per capita use of 159 gallons per day in 2015 and 141 gallons per day in 2020.
- Pursue innovation that will advance water conservation
- Transform the public's value of water within this region – A higher value on water within this region can lead to a conservation ethic that results in permanent

<sup>3</sup> Metropolitan Water District of Southern California Long Term Conservation Plan Working Draft Version 6 (November 30, 2010)

change in water use behavior, earlier adoption of new water saving technologies, and transition towards climate-appropriate landscapes.

Achieving these goals requires the use of integrated strategies that leverage the opportunities within this region. It requires regional collaboration and sustained support for a comprehensive, multi-year program. It requires a commitment to pursue behavioral changes and innovation in technologies that evolve the market for water efficient devices and services. It requires strategic, focused implementation approaches that build from broad-based traditional programs. It requires that research be conducted to provide the basis for decisions. Lastly, it requires the support of local leaders to communicate a new value standard for water within this region. Metropolitan and its member agencies will implement the five strategies through a traditional program, a market acceleration program, and legislation and regulation. The five strategies include:

- **Use catalysts for market transformation.** Metropolitan and member agencies will pursue market transformation to affect the market and consumer choices for water efficient devices and services.
- **Encourage action through outreach and education.** Metropolitan and member agencies will provide outreach, educational workshops, and training classes through a range of media and formats which are essential to changing public perceptions of the value of water.
- **Develop regional technical capability.** Metropolitan and member agencies will conduct research, facilitate information sharing, and/or provide technical assistance to member agencies and retail agencies to develop technical capabilities within the region for water budgeting, advanced metering infrastructure, ordinances, retail rate structures, and other conservation measures.
- **Build strategic alliances.** Metropolitan and member agencies will form strategic alliances with partners to leverage resources, opportunities and existing momentum that support market transformation.
- **Advance water efficiency standards.** Metropolitan and member agencies will work to advance water efficiency codes and standards to increase efficiency and reduce water waste.

Successful market transformation requires the integrated use of all five strategies. It is implemented through three complementary programs: traditional and market acceleration programs, and legislation and regulation. When used together, these approaches can be catalytic and transform markets.

**Traditional Program:** A traditional program of incentives, outreach, education, and training will be used to provide a foundation of water savings, establish baseline conditions, provide market data, and help determine devices and services that are primed

for market acceleration. Implementation may include regional incentive programs, pilot programs, regional outreach, and research for a variety of devices and services.

**Market Acceleration Program:** A portion of Metropolitan’s resources will be used for market acceleration of devices and services that have potential for market change. Metropolitan will use a strategic focus for a specified time period to affect the market for a particular device or service. Tactics may include strategic outreach to manufacturers, retailers, contractors, and consumers; enhanced incentives; and collaboration on implementation.

**Legislation and Regulation:** Are important tools and often the primary means for ensuring future water savings from devices and services. Regulation, ordinances and codes establish conditions that will ensure a minimum level of water efficiency for a particular device or service in the future. Markets are dynamic, and the influences on manufactures, retailers, and consumers are constantly changing. Progress made on changing consumer preferences a market share of efficient products is protected through legislation and regulations requiring a minimum efficiency standard. This benefits both water agencies and manufactures who invest in bringing water-efficiency technologies to the market. Legislation and regulation are also effective exit strategies to discontinue traditional incentive programs so that resources can be redirected to new technologies and approaches.

Implementation of the combined programs, Traditional - Market Acceleration – Legislation and Regulation, will be closely coordinated between Metropolitan, member agencies and sub-agencies to maximize synergies. An adaptive management approach will be employed using research, implementation and evaluation to guide decisions on program activities and intensity.

## **Periodic Review**

A periodic review of conservation actions to measure progress towards the water savings goals will be an integral component of the effort. The review will include work that is completed or in progress. It will consider factors that have affected the results as well as the opportunities to improve cost effectiveness and water savings.

## **2.5. Demand Projections**

### **2.5.1. 25-Year Projections**

One of the main objectives of this UWMP is to provide an insight into the City’s future water demand outlook. Currently, the City’s total water demand is 16,645 acre-feet comprising of 60% local groundwater, 37% imported water, and 3% recycled water. As illustrated in Table 2-9, the City’s water demand is expected to increase by 11% in the next 25 years to 18,474 acre-feet by 2035.



**Table 2-9: Current and Projected Water Demands (AFY)**

| Water Supply Sources                             | Fiscal Year Ending |               |               |               |               |               |
|--------------------------------------------------|--------------------|---------------|---------------|---------------|---------------|---------------|
|                                                  | 2010               | 2015          | 2020          | 2025          | 2030          | 2035-opt      |
| MWDOC (Imported Treated Full Service (non-int.)) | 6,161              | 6,298         | 6,430         | 6,564         | 6,697         | 6,830         |
| BPP Groundwater                                  | 10,052             | 10,275        | 10,492        | 10,710        | 10,927        | 11,144        |
| Recycled Water                                   | 432                | 450           | 500           | 500           | 500           | 500           |
| <b>Total</b>                                     | <b>16,645</b>      | <b>17,023</b> | <b>17,422</b> | <b>17,774</b> | <b>18,124</b> | <b>18,474</b> |

The City's 25-year demand projections for imported water shown in Table 2-10 are based on the projections provided by the City to MWDOC. As the regional wholesale supplier of Orange County, MWDOC works in collaboration with each of its member agencies as well as with Metropolitan, its wholesaler, to develop demand projections for imported water.

**Table 2-10: Newport Beach's Demand Projections Provided to Wholesale Suppliers (AFY)**

| Wholesaler | Fiscal Year Ending |       |       |       |          |
|------------|--------------------|-------|-------|-------|----------|
|            | 2015               | 2020  | 2025  | 2030  | 2035-opt |
| MWDOC      | 6,298              | 6,430 | 6,564 | 6,697 | 6,830    |

### 2.5.2. Low Income Household Projections

One significant change to the UWMP Act since 2005 is the requirement for retail water suppliers to include water use projections for single-family and multifamily residential housing needed for lower income and affordable households. This requirement is to assist the retail suppliers in complying with the requirement under Section 65589.7 of the Government Code that suppliers grant a priority for the provision of service to housing units affordable to lower income households. A lower income household is defined as a household earning 80% of the County of Orange's median income or less.

In order to identify the planned lower income housing projects within its service area, DWR<sup>4</sup> recommends that retail suppliers may rely on Regional Housing Needs Assessment (RHNA) or Regional Housing Needs Plan information developed by the local council of governments, the California Department of Housing and Community Development.

<sup>4</sup> California Department of Water Resources, Guidebook to Assist Urban Water Suppliers to Prepare a 2010 UWMP, Final (March 2011)

The RHNA is an assessment process performed periodically as part of Housing Element and General Plan updates at the local level. Regional Council of Governments in California are required by the State Housing Element Law enacted in 1980 to determine the existing and projected regional housing needs for persons at all income levels. The RHNA quantifies the need for housing by income group within each jurisdiction during specific planning periods. The RHNA is used in land use planning, to prioritize local resource allocation and to help decide how to address existing and future housing needs. The RHNA consists of two measurements: 1) existing need for housing, and 2) future need for housing.

The current RHNA planning period is January 1, 2006 to June 30, 2014 completed by the Southern California Association of Governments (SCAG) in 2007. The next RHNA which will cover the planning period of January 1, 2011 to September 30, 2021 is not expected to be completed until fall of 2012; therefore, the 2007 RHNA will be used for the purpose of this 2010 UWMP.

Based on the 2007 Final Regional Housing Need Allocation Plan<sup>5</sup>, the projected housing need for low and very low income households (hereafter referred to as low-income) in the City of Newport Beach are 18.0% and 22.0%, respectively or 40.0% combined.

Therefore, from inference, it is estimated that approximately 40.0% of the projected water demands within the City's service area will be for housing needed for low income households. Table 2-11 provides a breakdown of the projected water needs for low income single family and multifamily units. The projected water demands shown here represent 40.0% of the projected water demand by customer type for single-family and multifamily categories provided in Table 2-4 above. For example, the total single family residential demand is projected to be 7,258 AFY in 2015 and 7,872 AFY in 2035. The projected water demands for housing needed for single family low income households are 2,903 and 3,149 AFY for 2015 and 2035, respectively.

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<sup>5</sup> Southern California Association Governments, Final Regional Housing Need Allocation Plan for Jurisdictions within the Six County SCAG Region (July 2007)

**Table 2-11: Projected Water Demands for Housing Needed for Low Income Households (AFY)**

| Water Use Sector                                            | Fiscal Year Ending  |                     |                     |                     |                     |
|-------------------------------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|                                                             | 2015                | 2020                | 2025                | 2030                | 2035-opt            |
| Total Retail Demand                                         | 17,023              | 17,422              | 17,774              | 18,124              | 18,474              |
| Total Residential Demand                                    | 9,558               | 9,759               | 9,962               | 10,164              | 10,366              |
| <b><i>Total Low Income Households Demand</i></b>            | <b><i>3,823</i></b> | <b><i>3,904</i></b> | <b><i>3,985</i></b> | <b><i>4,066</i></b> | <b><i>4,146</i></b> |
| SF Residential Demand - Total                               | 7,258               | 7,411               | 7,565               | 7,718               | 7,872               |
| <b><i>SF Residential Demand - Low Income Households</i></b> | <b><i>2,903</i></b> | <b><i>2,964</i></b> | <b><i>3,026</i></b> | <b><i>3,087</i></b> | <b><i>3,149</i></b> |
| MF Residential Demand - Total                               | 2,300               | 2,348               | 2,397               | 2,446               | 2,494               |
| <b><i>MF Residential Demand - Low Income Households</i></b> | <b><i>920</i></b>   | <b><i>939</i></b>   | <b><i>959</i></b>   | <b><i>978</i></b>   | <b><i>998</i></b>   |

## 3. Water Sources and Supply Reliability

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### 3.1. Overview

The City's main source of water supply is groundwater from the Lower Santa Ana River Groundwater Basin and imported water from Metropolitan through MWDOC. Recycled water was recently added to the City's water supply portfolio. Today, the City relies on 60% groundwater, 37% imported, and 3% recycled water. It is projected that by 2035, the water supply mix will remain roughly the same.

The City works together with three primary agencies – Metropolitan, MWDOC, and OCWD to insure a safe and high quality water supply, which will continue to serve the community in periods of drought and shortage. The sources of imported water supplies include the Colorado River and the State Water Project (SWP). Metropolitan's 2010 Integrated Water Resources Plan (IRP) update describes the core water resource strategy that will be used to meet full-service demands (non-interruptible agricultural and replenishment supplies) at the retail level under all foreseeable hydrologic conditions from 2015 through 2035. The imported water supply numbers shown here represent only the amount of supplies projected to meet demands and not the full supply capacity.

Local groundwater pumped from the City's wells is managed by OCWD. The Lower Santa Ana River Groundwater Basin is not adjudicated. In any given year, the amount of water which each City is allowed to pump out of the basin is based on the basin production percentage (BPP) established by OCWD. The OCWD sets the percentage of groundwater that an agency can pump based on their total potable water demand. The BPP fluctuates year by year but it is set uniformly for all Producers. Historically, BPP has ranged between approximately 60% to 80% depending on groundwater conditions, availability of recharge water supplies, and basin management objectives. For 2010/11, the BPP was set at 62 percent.<sup>6</sup> As illustrated in Figure 3-1, the BPP is assumed to remain at the conservative 62% level for the next 25 years. The remaining demand is projected to be met through imported water from Metropolitan/MWDOC and through a small portion of recycled water.

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<sup>6</sup> The BPP was changed by OCWD in late April 2010 and effective July 2010 to 62 percent.

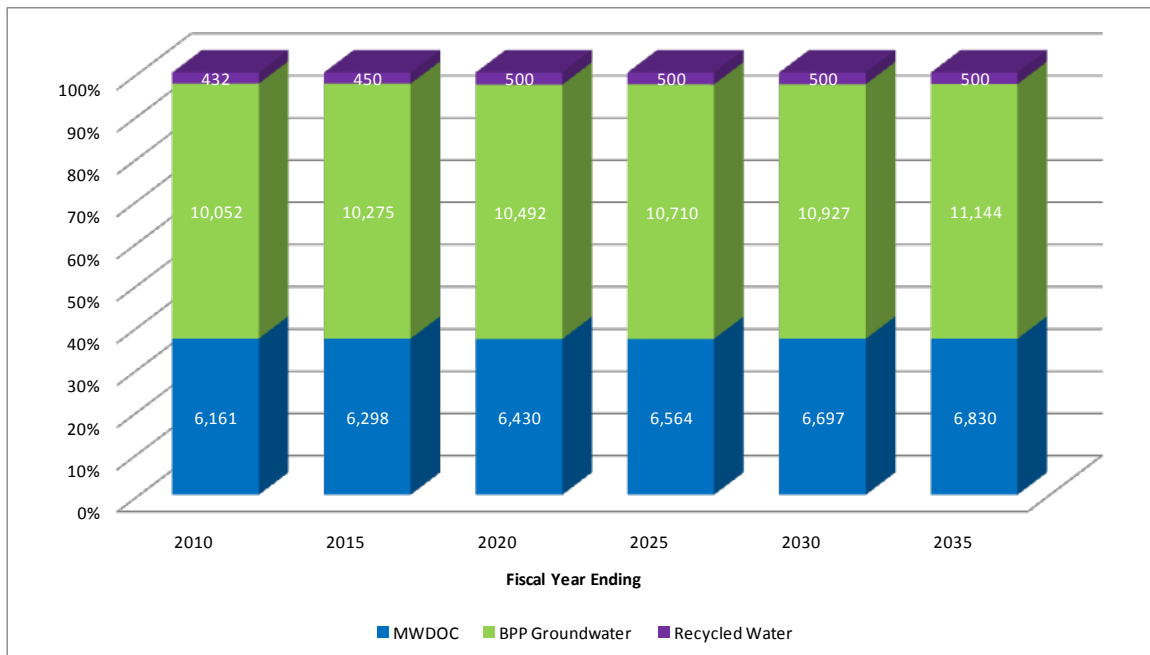


**Figure 3-1: Current and Projected Water Supplies (AFY)**

The following sections provide a detailed discussion of the City’s three main water sources as well as projections to the City’s future water supply portfolio for the next 25 years. Moreover, this compares projected supply and demand under various hydrological conditions to determine the City’s supply reliability for the 25 year planning horizon. This section satisfies the requirements of § 10631 (b) and (c), and 10635 of the Water Code.

### 3.2. Imported Water

The City currently relies on 6,161 AFY of imported water wholesaled by Metropolitan through MWDOW to supplement local groundwater. Imported water represents approximately 37% of the City’s total water supply. Metropolitan’s principal sources of water originate from two sources - the Colorado River via the Colorado Aqueduct and the Lake Oroville watershed in Northern California through the State Water Project (SWP). This water is treated at the Robert B. Diemer Filtration Plant located north of Yorba Linda. Typically, the Diemer Filtration Plant receives a blend of Colorado River water from Lake Mathews through the Metropolitan Lower Feeder and SWP water through the Yorba Linda Feeder. The AGENCY currently maintains six connections to the Metropolitan system along the Orange County Feeder and the East Orange County Feeder No. 2. The total available capacity is 104 cfs.

### **3.2.1. Metropolitan's 2010 Regional Urban Water Management Plan**

Metropolitan's 2010 Regional Urban Water Management Plan (RUWMP) reports on its water reliability and identifies projected supplies to meet the long-term demand within its service area. It presents Metropolitan's supply capacities from 2015 through 2035 under the three hydrologic conditions specified in the Act: single dry-year, multiple dry-years, and average year.

#### **Colorado River Supplies**

Colorado River Aqueduct supplies include supplies that would result from existing and committed programs and from implementation of the Quantification Settlement Agreement (QSA) and related agreements to transfer water from agricultural agencies to urban uses. Colorado River transactions are potentially available to supply additional water up to the CRA capacity of 1.25 MAF on an as-needed basis.

#### **State Water Project Supplies**

Metropolitan's State Water Project (SWP) supplies have been impacted in recent years by restrictions on SWP operations in accordance with the biological opinions of the U.S. Fish and Wildlife Service and National Marine Fishery Service issued on December 15, 2008 and June 4, 2009, respectively. In dry, below-normal conditions, Metropolitan has increased the supplies received from the California Aqueduct by developing flexible Central Valley/SWP storage and transfer programs. The goal of the storage/transfer programs is to develop additional dry-year supplies that can be conveyed through the available Banks pumping capacity to maximize deliveries through the California Aqueduct during dry hydrologic conditions and regulatory restrictions.

In June 2007, Metropolitan's Board approved a Delta Action Plan that provides a framework for staff to pursue actions with other agencies and stakeholders to build a sustainable Delta and reduce conflicts between water supply conveyance and the environment. The Delta action plan aims to prioritize immediate short-term actions to stabilize the Delta while an ultimate solution is selected, and mid-term steps to maintain the Bay-Delta while the long-term solution is implemented.

State and federal resource agencies and various environmental and water user entities are currently engaged in the development of the Bay Delta Conservation Plan (BDCP), which is aimed at addressing the basic elements that include the Delta ecosystem restoration, water supply conveyance, and flood control protection and storage development. In evaluating the supply capabilities for the 2010 RUWMP, Metropolitan assumed a new Delta conveyance is fully operational by 2022 that would return supply reliability similar to 2005 condition, prior to supply restrictions imposed due to the Biological Opinions.

## **Storage**

Storage is a major component of Metropolitan’s dry year resource management strategy. Metropolitan’s likelihood of having adequate supply capability to meet projected demands, without implementing its Water Supply Allocation Plan (WSAP), is dependent on its storage resources. In developing the supply capabilities for the 2010 RUWMP, Metropolitan assumed a simulated median storage level going into each of five-year increments based on the balances of supplies and demands.

## **Supply Reliability**

Metropolitan evaluated supply reliability by projecting supply and demand conditions for the single- and multi-year drought cases based on conditions affecting the SWP (Metropolitan’s largest and most variable supply). For this supply source, the single driest-year was 1977 and the three-year dry period was 1990-1992. Metropolitan’s analyses are illustrated in Tables 3-1, 3-2, and 3-3 which correspond to Metropolitan’s 2010 RUWMP’s Tables 2-11, 2-9 and 2-10, respectively. These tables show that the region can provide reliable water supplies not only under normal conditions but also under both the single driest year and the multiple dry year hydrologies.

**Table 3-1: Metropolitan Average Year Projected Supply Capability and Demands for 2015 to 2035**

| <p style="text-align: center;"><b>Average Year</b><br/> <b>Supply Capability<sup>1</sup> and Projected Demands</b><br/> <b>Average of 1922-2004 Hydrologies</b><br/>                     (acre-feet per year)</p> |                  |                  |                  |                  |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|
| Forecast Year                                                                                                                                                                                                     | 2015             | 2020             | 2025             | 2030             | 2035             |
| <b>Current Programs</b>                                                                                                                                                                                           |                  |                  |                  |                  |                  |
| In-Region Storage and Programs                                                                                                                                                                                    | 685,000          | 931,000          | 1,076,000        | 964,000          | 830,000          |
| California Aqueduct <sup>2</sup>                                                                                                                                                                                  | 1,550,000        | 1,629,000        | 1,763,000        | 1,733,000        | 1,734,000        |
| Colorado River Aqueduct                                                                                                                                                                                           |                  |                  |                  |                  |                  |
| Colorado River Aqueduct Supply <sup>3</sup>                                                                                                                                                                       | 1,507,000        | 1,529,000        | 1,472,000        | 1,432,000        | 1,429,000        |
| Aqueduct Capacity Limit <sup>4</sup>                                                                                                                                                                              | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        |
| Colorado River Aqueduct Capability                                                                                                                                                                                | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        |
| <b>Capability of Current Programs</b>                                                                                                                                                                             | <b>3,485,000</b> | <b>3,810,000</b> | <b>4,089,000</b> | <b>3,947,000</b> | <b>3,814,000</b> |
| <b>Demands</b>                                                                                                                                                                                                    |                  |                  |                  |                  |                  |
| Firm Demands of Metropolitan                                                                                                                                                                                      | 1,826,000        | 1,660,000        | 1,705,000        | 1,769,000        | 1,826,000        |
| IID-SDCWA Transfers and Canal Linings                                                                                                                                                                             | 180,000          | 273,000          | 280,000          | 280,000          | 280,000          |
| <b>Total Demands on Metropolitan<sup>5</sup></b>                                                                                                                                                                  | <b>2,006,000</b> | <b>1,933,000</b> | <b>1,985,000</b> | <b>2,049,000</b> | <b>2,106,000</b> |
| <b>Surplus</b>                                                                                                                                                                                                    | <b>1,479,000</b> | <b>1,877,000</b> | <b>2,104,000</b> | <b>1,898,000</b> | <b>1,708,000</b> |
| <b>Programs Under Development</b>                                                                                                                                                                                 |                  |                  |                  |                  |                  |
| In-Region Storage and Programs                                                                                                                                                                                    | 206,000          | 306,000          | 336,000          | 336,000          | 336,000          |
| California Aqueduct                                                                                                                                                                                               | 382,000          | 383,000          | 715,000          | 715,000          | 715,000          |
| Colorado River Aqueduct                                                                                                                                                                                           |                  |                  |                  |                  |                  |
| Colorado River Aqueduct Supply <sup>3</sup>                                                                                                                                                                       | 187,000          | 187,000          | 187,000          | 182,000          | 182,000          |
| Aqueduct Capacity Limit <sup>4</sup>                                                                                                                                                                              | 0                | 0                | 0                | 0                | 0                |
| Colorado River Aqueduct Capability                                                                                                                                                                                | 0                | 0                | 0                | 0                | 0                |
| <b>Capability of Proposed Programs</b>                                                                                                                                                                            | <b>588,000</b>   | <b>689,000</b>   | <b>1,051,000</b> | <b>1,051,000</b> | <b>1,051,000</b> |
| <b>Potential Surplus</b>                                                                                                                                                                                          | <b>2,067,000</b> | <b>2,566,000</b> | <b>3,155,000</b> | <b>2,949,000</b> | <b>2,759,000</b> |

<sup>1</sup> Represents Supply Capability for resource programs under listed year type.

<sup>2</sup> California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.

<sup>3</sup> Colorado River Aqueduct includes water management programs, IID-SDCWA transfers and canal linings conveyed by the aqueduct.

<sup>4</sup> Maximum CRA deliveries limited to 1.25 MAF including IID-SDCWA transfers and canal linings.

<sup>5</sup> Firm demands are adjusted to include IID-SDCWA transfers and canal linings. These supplies are calculated as local supply, but need to be shown for the purposes of CRA capacity limit calculations without double counting.



**Table 3-2: Metropolitan Single-Dry Year Projected Supply Capability and Demands for 2015 to 2035**

| <p style="text-align: center;"><b>Single Dry-Year<br/>Supply Capability<sup>1</sup> and Projected Demands<br/>Repeat of 1977 Hydrology<br/>(acre-feet per year)</b></p> |                  |                  |                  |                  |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|
| <b>Forecast Year</b>                                                                                                                                                    | <b>2015</b>      | <b>2020</b>      | <b>2025</b>      | <b>2030</b>      | <b>2035</b>      |
| <b>Current Programs</b>                                                                                                                                                 |                  |                  |                  |                  |                  |
| In-Region Storage and Programs                                                                                                                                          | 685,000          | 931,000          | 1,076,000        | 964,000          | 830,000          |
| California Aqueduct <sup>2</sup>                                                                                                                                        | 522,000          | 601,000          | 651,000          | 609,000          | 610,000          |
| Colorado River Aqueduct                                                                                                                                                 |                  |                  |                  |                  |                  |
| Colorado River Aqueduct Supply <sup>3</sup>                                                                                                                             | 1,416,000        | 1,824,000        | 1,669,000        | 1,419,000        | 1,419,000        |
| Aqueduct Capacity Limit <sup>4</sup>                                                                                                                                    | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        |
| Colorado River Aqueduct Capability                                                                                                                                      | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        |
| <b>Capability of Current Programs</b>                                                                                                                                   | <b>2,457,000</b> | <b>2,782,000</b> | <b>2,977,000</b> | <b>2,823,000</b> | <b>2,690,000</b> |
| <b>Demands</b>                                                                                                                                                          |                  |                  |                  |                  |                  |
| Firm Demands of Metropolitan                                                                                                                                            | 1,991,000        | 1,889,000        | 1,921,000        | 1,974,000        | 2,039,000        |
| IID-SDCWA Transfers and Canal Linings                                                                                                                                   | 180,000          | 273,000          | 280,000          | 280,000          | 280,000          |
| <b>Total Demands on Metropolitan<sup>5</sup></b>                                                                                                                        | <b>2,171,000</b> | <b>2,162,000</b> | <b>2,201,000</b> | <b>2,254,000</b> | <b>2,319,000</b> |
| <b>Surplus</b>                                                                                                                                                          | <b>286,000</b>   | <b>620,000</b>   | <b>776,000</b>   | <b>569,000</b>   | <b>371,000</b>   |
| <b>Programs Under Development</b>                                                                                                                                       |                  |                  |                  |                  |                  |
| In-Region Storage and Programs                                                                                                                                          | 206,000          | 306,000          | 336,000          | 336,000          | 336,000          |
| California Aqueduct                                                                                                                                                     | 556,000          | 556,000          | 700,000          | 700,000          | 700,000          |
| Colorado River Aqueduct                                                                                                                                                 |                  |                  |                  |                  |                  |
| Colorado River Aqueduct Supply <sup>3</sup>                                                                                                                             | 187,000          | 187,000          | 187,000          | 182,000          | 182,000          |
| Aqueduct Capacity Limit <sup>4</sup>                                                                                                                                    | 0                | 0                | 0                | 0                | 0                |
| Colorado River Aqueduct Capability                                                                                                                                      | 0                | 0                | 0                | 0                | 0                |
| <b>Capability of Proposed Programs</b>                                                                                                                                  | <b>762,000</b>   | <b>862,000</b>   | <b>1,036,000</b> | <b>1,036,000</b> | <b>1,036,000</b> |
| <b>Potential Surplus</b>                                                                                                                                                | <b>1,048,000</b> | <b>1,482,000</b> | <b>1,812,000</b> | <b>1,605,000</b> | <b>1,407,000</b> |

<sup>1</sup> Represents Supply Capability for resource programs under listed year type.

<sup>2</sup> California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.

<sup>3</sup> Colorado River Aqueduct includes water management programs, IID-SDCWA transfers and canal linings conveyed by the aqueduct.

<sup>4</sup> Maximum CRA deliveries limited to 1.25 MAF including IID-SDCWA transfers and canal linings.

<sup>5</sup> Firm demands are adjusted to include IID-SDCWA transfers and canal linings. These supplies are calculated as local supply, but need to be shown for the purposes of CRA capacity limit calculations without double counting.

**Table 3-3: Metropolitan Multiple-Dry Year Projected Supply Capability and Demands for 2015 to 2035**

**Multiple Dry-Year  
Supply Capability<sup>1</sup> and Projected Demands  
Repeat of 1990-1992 Hydrology  
(acre-feet per year)**

| Forecast Year                                    | 2015             | 2020             | 2025             | 2030             | 2035             |
|--------------------------------------------------|------------------|------------------|------------------|------------------|------------------|
| <b>Current Programs</b>                          |                  |                  |                  |                  |                  |
| In-Region Storage and Programs                   | 246,000          | 373,000          | 435,000          | 398,000          | 353,000          |
| California Aqueduct <sup>2</sup>                 | 752,000          | 794,000          | 835,000          | 811,000          | 812,000          |
| Colorado River Aqueduct                          |                  |                  |                  |                  |                  |
| Colorado River Aqueduct Supply <sup>3</sup>      | 1,318,000        | 1,600,000        | 1,417,000        | 1,416,000        | 1,416,000        |
| Aqueduct Capacity Limit <sup>4</sup>             | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        |
| Colorado River Aqueduct Capability               | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        | 1,250,000        |
| <b>Capability of Current Programs</b>            | <b>2,248,000</b> | <b>2,417,000</b> | <b>2,520,000</b> | <b>2,459,000</b> | <b>2,415,000</b> |
| <b>Demands</b>                                   |                  |                  |                  |                  |                  |
| Firm Demands of Metropolitan                     | 2,056,000        | 1,947,000        | 2,003,000        | 2,059,000        | 2,119,000        |
| IID-SDCWA Transfers and Canal Linings            | 180,000          | 241,000          | 280,000          | 280,000          | 280,000          |
| <b>Total Demands on Metropolitan<sup>5</sup></b> | <b>2,236,000</b> | <b>2,188,000</b> | <b>2,283,000</b> | <b>2,339,000</b> | <b>2,399,000</b> |
| <b>Surplus</b>                                   | <b>12,000</b>    | <b>229,000</b>   | <b>237,000</b>   | <b>120,000</b>   | <b>16,000</b>    |
| <b>Programs Under Development</b>                |                  |                  |                  |                  |                  |
| In-Region Storage and Programs                   | 162,000          | 280,000          | 314,000          | 336,000          | 336,000          |
| California Aqueduct                              | 242,000          | 273,000          | 419,000          | 419,000          | 419,000          |
| Colorado River Aqueduct                          |                  |                  |                  |                  |                  |
| Colorado River Aqueduct Supply <sup>3</sup>      | 187,000          | 187,000          | 187,000          | 182,000          | 182,000          |
| Aqueduct Capacity Limit <sup>4</sup>             | 0                | 0                | 0                | 0                | 0                |
| Colorado River Aqueduct Capability               | 0                | 0                | 0                | 0                | 0                |
| <b>Capability of Proposed Programs</b>           | <b>404,000</b>   | <b>553,000</b>   | <b>733,000</b>   | <b>755,000</b>   | <b>755,000</b>   |
| <b>Potential Surplus</b>                         | <b>416,000</b>   | <b>782,000</b>   | <b>970,000</b>   | <b>875,000</b>   | <b>771,000</b>   |

<sup>1</sup> Represents Supply Capability for resource programs under listed year type.

<sup>2</sup> California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.

<sup>3</sup> Colorado River Aqueduct includes water management programs, IID-SDCWA transfers and canal linings conveyed by the aqueduct.

<sup>4</sup> Maximum CRA deliveries limited to 1.25 MAF including IID-SDCWA transfers and canal linings.

<sup>5</sup> Firm demands are adjusted to include IID-SDCWA transfers and canal linings. These supplies are calculated as local supply, but need to be shown for the purposes of CRA capacity limit calculations without double counting.

### 3.2.2. Newport Beach's Imported Water Supply Projections

Based on Metropolitan's supply projections that it will be able to meet full service demands under all three hydrologic scenarios, MWDOC, Orange county's wholesale supplier projects that it would also be able to meet the demands of its retail agencies under these conditions.

California Water Code section 10631 (k) requires the wholesale agency to provide information to the urban retail water supplier for inclusion in its UWMP that identifies and quantifies the existing and planned sources of water available from the wholesale agency. Table 3-4 indicates the wholesaler's water availability projections by source for the next 25 years as provided to the City by MWDOC. The water supply projections shown in Table 3-4 represent the amount of supplies projected to meet demands. They do not represent the full supply capacity.

**Table 3-4: Wholesaler Identified & Quantified Existing and Planned Sources of Water (AFY)**

| Wholesaler Sources | Fiscal Year Ending |       |       |       |          |
|--------------------|--------------------|-------|-------|-------|----------|
|                    | 2015               | 2020  | 2025  | 2030  | 2035-opt |
| MWDOC              | 6,298              | 6,430 | 6,564 | 6,697 | 6,830    |

### 3.3. Groundwater

Local groundwater has been the cheapest and most reliable source of supply for the City. The City relies on approximately 10,000 acre-feet of groundwater from the Lower Santa Ana River Groundwater Basin (Orange County Basin) each year. This local source of supply meets approximately 60% of the City's total annual demand.

In the effort to maximize local resources, Metropolitan has partnered with OCWD and MWDOC and its member agencies who are groundwater producers in various programs to encourage the development of local resources. Metropolitan's Groundwater Replenishment Program is a program where a groundwater producer may purchase imported water from Metropolitan at a reduced rate when "surplus" water is available in lieu of extracting groundwater. This program indirectly replenishes the basin by avoiding pumping.

This section provides description of the Lower Santa Ana River Groundwater Basin and the management measures taken by OCWD the basin manager to optimize local supply and minimize overdraft. Moreover, this section provides information on historical groundwater production as well as a 25-year projection of the City's groundwater supply.

### 3.3.1. Lower Santa Ana River Groundwater Basin

The Lower Santa Ana Groundwater Basin, also known as the Orange County Groundwater Basin (Basin) underlies the north half of Orange County beneath broad lowlands. The Basin covers an area of approximately 350 square miles, bordered by the Coyote and Chino Hills to the north, the Santa Ana Mountains to the northeast, the Pacific Ocean to the southwest, and terminates at the Orange County line to the northwest, where its aquifer systems continue into the Central Basin of Los Angeles County. The aquifers comprising this Basin extend over 2,000 feet deep and form a complex series of interconnected sand and gravel deposits.

The Orange County Water District (OCWD) was formed in 1933 by a special legislative act of the State of California Legislature to protect and manage the County's vast, natural, underground water supply with the best available technology and to defend its water rights to the Orange County Groundwater Basin. This legislation is found in the State of California Statutes, Water – Uncodified Acts, Act 5683, as amended.<sup>7</sup> The Basin is managed by OCWD under the Act, which functions as a statutorily-imposed physical solution. Section 77 of the Act states that, *'nothing in this act contained shall be so construed as to affect or impair the vested right of any person, association or corporation to the use of water.'*<sup>8</sup>

The Basin is managed by OCWD for the benefit of municipal, agricultural and private groundwater producers. The Basin meets approximately 60 to 70 percent of the water supply demand within the boundaries of OCWD. There are 19 major producers including cities, water districts, and private water companies, extracting water from the Basin serving a population of approximately 2.55 million.<sup>9</sup>

Groundwater levels are managed within a safe basin operating range to protect the long-term sustainability of the basin and to protect against land subsidence. In 2007, OCWD established a new methodology for calculating accumulated overdraft and establishing new full-basin benchmarks.<sup>10</sup> Based on OCWD's 2009 Groundwater Management Plan, the optimal accumulated overdraft is between 100,000 and 434,000 AF. At the top of the range, OCWD will be able to provide at least three years of drought supply. An accumulated overdraft condition minimizes the localized high groundwater levels and increases ability to recharge storm events from the Santa Ana River. At an accumulated overdraft of 200,000 AF, the Basin is considered 99.7 percent full. OCWD estimates that

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<sup>8</sup> Orange County Water District Act, Section 77.

<sup>9</sup> MWDOC and Center for Demographics Research (2008)

<sup>10</sup> The Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy, published in February 2007,

the Basin can safely be operated on a short-term emergency basis with a maximum accumulated overdraft of approximately 500,000 AF.

In an effort to eliminate long-term overdraft conditions, OCWD developed a comprehensive computer-based groundwater flow model to study and better understand the Basin's reaction to pumping and recharge. OCWD manages the Basin by establishing on an annual basis the appropriate level of groundwater production known as the Basin Production Percentage (BPP) as described below.

### 3.3.2. Basin Production Percentage

No pumping right exists for the Orange County Basin. Total pumping from the basin is managed through a process that uses financial incentives to encourage groundwater producers to pump an aggregate amount of water that is sustainable without harming the Basin. The framework for the financial incentives is based on establishing the BPP which is the percentage of each Producer's total water supply that comes from groundwater pumped from the basin. Groundwater production at or below the BPP is assessed the Replenishment Assessment (RA). While there is no legal limit as to how much an agency could pump from the Basin, there is a financial disincentive to pumping above the BPP. Pumping above the BPP is also assessed a Basin Equity Assessment (BEA), which is calculated so that the cost of groundwater production is equal to MWDOC's melded rate.

The BPP is set uniformly for all Producers by OCWD on an annual basis. The BPP for the 2008-2009 water year (July 1, 2008 to June 30, 2009) was established at 69.0. The overall BPP achieved within OCWD for non-irrigation use in the 2008-09 water year was equal to 72.5 percent. The BPP has recently been set at 62 percent for the 2010-2011 water year. For the purpose of this UWMP, the BPP is assumed to be 62 percent for the entire 25-year planning horizon (Table 3-5).

**Table 3-5: Current Basin Production Percentage**

| Basin Name                      | Basin Production Percentage |
|---------------------------------|-----------------------------|
| Orange County Groundwater Basin | 62%                         |
| <b>Total</b>                    | <b>62%</b>                  |

The BPP is set based on groundwater conditions, availability of imported water supplies, and Basin management objectives. The BPP is also a major factor in determining the cost of groundwater production from the Basin for that year. When Metropolitan has an abundance of water, they may choose to activate their Groundwater Replenishment Program also known as In-Lieu Program, where imported water is purchased in-lieu of pumping groundwater.

In some cases, OCWD encourages the pumping of groundwater that does not meet drinking water standards in order to protect water quality. This is achieved by using a financial incentive called the BEA Exemption. A BEA Exemption is used to encourage pumping of groundwater that does not meet drinking water standards in order to clean up and contain the spread of poor quality water. OCWD uses a partial or total exemption of the BEA to compensate a qualified participating agency or Producer for the costs of treating poor-quality groundwater. When OCWD authorizes a BEA exemption for a project, it is obligated to provide the replenishment water for the production above the BPP and forgoes the BEA revenue that OCWD would otherwise receive from the producer.

### **3.3.3. Recharge Facilities**

Recharging water into the basin through natural and artificial means is essential to support pumping from the basin. Active recharge of groundwater began in 1949, in response to increasing drawdown of the basin and consequently the threat of seawater intrusion. In 1949, OCWD began purchasing imported Colorado River water from Metropolitan, which was delivered to Orange County via the Santa Ana River upstream of Prado Dam. The Basin's primary source of recharge is flow from the Santa Ana River. OCWD diverts river flows into recharge basins located in and adjacent to the Santa Ana River and its main Orange County tributary, Santiago Creek. Other sources of recharge water include natural infiltration and recycled water. Today OCWD owns and operates a network of recharge facilities that cover 1,067 acres. The recharge capacity has exceeded 10,000 AFY with the addition of the La Jolla Recharge Basin which came online in 2008. The La Jolla Recharge Basin is a 6-acre recharge basin.

One of OCWD's primary efforts has been the control of seawater intrusion into the Basin, especially via the Talbert and Alamitos seawater intrusion barriers. OCWD began addressing the Alamitos Gap intrusion by entering a partnership in 1965 with the Los Angeles County Flood Control District to operate injection wells in the Alamitos Gap. Operation of the injection wells forms a hydraulic barrier to seawater intrusion. To address seawater intrusion in the Talbert Gap, OCWD constructed Water Factory 21, a plant that treated secondary-treated water from the Orange County Sanitation District (OCSd) to produce purified water for injection. Water Factory 21 operated for approximately 30 years until it was taken off line in 2004. It was replaced by an advanced water treatment system, the Groundwater Replenishment System (GWRS).

The GWRS is a cooperative project between OCWD and OCSd that began operating in 2008. Secondary-treated wastewater from OCSd undergoes treatment consisting of microfiltration, reverse osmosis, and advanced oxidation with ultraviolet light and hydrogen peroxide. It is the largest water purification project of its kind, Phase 1 of the GWRS began operating in 2008 with a capacity of purifying 72,000 AFY of water. The GWRS provides recharge water for the Talbert Injection Barrier as well as to recharge

basins in the City of Anaheim. The Expanded Talbert Injection Barrier included 8 new injection wells which operation began in 2008. The GWRS increased reliable, local water supplies available for barrier injection from 5 MGD to 30 MGD.

#### **3.3.4. Metropolitan Groundwater Replenishment Program**

OCWD, MWDOC, and Metropolitan have developed a successful and efficient groundwater replenishment program to increase storage in the Orange County Groundwater Basin. The Groundwater Replenishment Program allows Metropolitan to sell groundwater replenishment water to OCWD and make direct deliveries to agency distribution systems in lieu of producing water from the groundwater basin when surplus water is available. This program indirectly replenishes the basin by avoiding pumping. In the in-lieu program, OCWD requests an agency to halt pumping from specified wells. The agency then takes replacement water through its import connections, which is purchased by OCWD from Metropolitan (through MWDOC). OCWD purchases the water at a reduced rate, and then bills the agency for the amount it would have had to pay for energy and the Replenishment Assessment (RA) if it had produced the water from its wells. The deferred local production results in water being left in local storage for future use. In 2008 and 2009, OCWD did not utilize replenishment water because such water was not available to purchase from Metropolitan.

#### **3.3.5. Metropolitan Conjunctive Use Program**

Since 2004, OCWD, MWDOC, and participating producers have participated in Metropolitan's Conjunctive Use Program (known as the Metropolitan Long-Term Groundwater Storage Program). This program allows for the storage of Metropolitan water in the Orange County groundwater basin. The existing Metropolitan storage program provides for Metropolitan to store 66,000 AF of water in the basin in exchange for Metropolitan's contribution to improvements in basin management facilities. These improvements include eight new groundwater production wells, improvements to the seawater intrusion barrier, construction of the Diemer Bypass Pipeline. This water can be withdrawn over a three-year time period. . The preferred means to store water in the Metropolitan storage account has been through the in-lieu deliveries to participating groundwater producers.

#### **3.3.6. Historical Groundwater Production**

Since its founding, OCWD has grown in size from 162,676 to 229,000 acres. Groundwater pumping from the basin has grown from approximately 150,000 AFY in the

mid-1950s to over 300,000 AFY. During the water year July 2008 to June 2009, total basin production for all agencies was approximately 324,147 acre-feet (AF).<sup>11</sup>

The City obtains groundwater pumped from four wells owned and operated by the City and managed by OCWD. The City's wells are located in the City of Fountain Valley, approximately five miles north of the City. The only constraints affecting groundwater supply to the City are the pumping capacity of the wells and pumping limitations (BPP) established by OCWD to maintain the groundwater basin.

Table 3-6 shows the City's recent groundwater production from the Basin in the past five years from 2005 to 2009. During certain seasons of 2005, 2006, and 2007, OCWD has operated the In-lieu Program with Metropolitan by purchasing water from Metropolitan to meet demands of member agencies rather than pumping water from the groundwater basin. In 2008 and 2009, OCWD did not utilize in-lieu water because such water was not available to purchase from Metropolitan.<sup>12</sup>

**Table 3-6: Amount of Groundwater Pumped in the Past 5 Years (AFY)**

| Basin Name(s)                  | Fiscal Year Ending |            |            |            |            |
|--------------------------------|--------------------|------------|------------|------------|------------|
|                                | 2005               | 2006       | 2007       | 2008       | 2009       |
| BPP GW                         | 4,984              | 3,546      | 3,605      | 14,338     | 11,309     |
| Plus In-Lieu taken for OCWD    | 6,652              | 7,682      | 8,553      | -          | -          |
| Subtotal OCWD Basin GW         | 11,636             | 11,228     | 12,158     | 14,338     | 11,309     |
| <b>% of Total Water Supply</b> | <b>65%</b>         | <b>63%</b> | <b>64%</b> | <b>78%</b> | <b>65%</b> |

### 3.3.7. Projections of Groundwater Production

The mission of the OCWD is to provide local water retailers with a reliable, adequate, high quality water supply at the lowest reasonable cost in an environmentally responsible manner. Efforts have been made to develop and secure new supplies. Also in December 2008, OCWD secured the rights to divert and use up to 362,000 AFY of Santa Ana River water through a decision of the State Water Resources Control Board. Description to other recent OCWD projects can be found in OCWD's 2009 GWMP.

Based on the annual MWDOC survey completed by each Producer in the spring of 2008, the estimated demand for groundwater in the OCWD boundary will increase from 519,000 AFY in 2015 to 558,000 AFY in 2035 representing a 7.5 percent increase over a 20 year period. OCWD's estimated total annual groundwater production for the water

<sup>11</sup> 2008-2009 Engineer's Report on Groundwater conditions, Water Supply and Basin Utilization in the Orange County Water District, February 2010

<sup>12</sup> 2008-2009 Engineer's Report on Groundwater conditions, Water Supply and Basin Utilization in the Orange County Water District, February 2010



year 2010-2011 is 295,000 AF based on a BPP of 62 percent and includes 22,000 AF of production from water quality improvement projects.

Table 3-7 shows the amount of groundwater projected to be pumped from the Basin in the next 25 years. The BPP is assumed to remain at 62 percent for the entire planning horizon.

**Table 3-7: Amount of Groundwater Projected to be Pumped (AFY)**

| Basin Name(s)           | Fiscal Year Ending |        |        |        |        |          |
|-------------------------|--------------------|--------|--------|--------|--------|----------|
|                         | 2010               | 2015   | 2020   | 2025   | 2030   | 2035-opt |
| BPP GW                  | 10,052             | 10,275 | 10,492 | 10,710 | 10,927 | 11,144   |
| % of Total Water Supply | 62%                | 62%    | 62%    | 62%    | 62%    | 62%      |

### 3.4. Recycled Water

The City participates in a reclaimed/recycled water program and uses the water supplies available to water greenbelts, parkways, golf courses, and other landscape areas that may otherwise use valuable potable water for irrigation. This reclaimed/recycled water is wholesaled by OCWD through its Green Acres Project (GAP). In 2009/10, usage of recycled water within the City's Water Utility service area was about 400 acre feet. Recycled water usage meets approximately 3% of the City's water demand. The City's recycled water program is more fully described in Section 6.

### 3.5. Supply Reliability

#### 3.5.1. Overview

It is required that every urban water supplier assess the reliability to provide water service to its customers under normal, dry, and multiple dry water years. The City depends on a combination of imported and local supplies to meet its water demands and has taken numerous steps to insure it has adequate supplies. Development of groundwater, recycled water system, and desalination opportunities augments the reliability of the imported water system. There are various factors that may impact reliability of supplies such as legal, environmental, water quality and climatic which are discussed below. The water supplies are projected to meet full-service demands; Metropolitan's 2010 RUWMP finds that Metropolitan is able to meet with existing supplies, full-service demands of its member agencies starting 2015 through 2035 during normal years, single dry year, and multiple dry years.

Metropolitan's 2010 Integrated Water Resources Plan (IRP) update describes the core water resource strategy that will be used to meet full-service demands at the retail level under all foreseeable hydrologic conditions from 2015 through 2035. The foundation of

Metropolitan’s resource strategy for achieving regional water supply reliability has been to develop and implement water resources programs and activities through its IRP preferred resource mix. This preferred resource mix includes conservation, local resources such as water recycling and groundwater recovery, Colorado River supplies and transfers, SWP supplies and transfers, in-region surface reservoir storage, in-region groundwater storage, out-of-region banking, treatment, conveyance and infrastructure improvements. MWDOC is reliant on Metropolitan for all of its imported water. With the addition of planned supplies under development, Metropolitan’s 2010 RUWMP finds that Metropolitan will be able to meet full-service demands from 2015 through 2035, even under a repeat of the worst drought. Table 3-8 shows the reliability of the wholesaler’s supply for single dry year and multiple dry year scenarios.

**Table 3-8: Wholesaler Supply Reliability - % of Normal AFY**

| Wholesaler Sources | Single Dry | Multiple Dry Water Years |        |        |
|--------------------|------------|--------------------------|--------|--------|
|                    |            | Year 1                   | Year 2 | Year 3 |
| MWDOC              | 100%       | 100%                     | 100%   | 100%   |

In addition to meeting full-service demands from 2015 through 2035, Metropolitan projects reserve and replenishment supplies to refill system storage. MWDOC’s 2010 RUWMP states that it will meet full-service demands to its customers from 2015 through 2035. Table 3-9 shows the basis of water year data used to predict drought supply availability.

**Table 3-9: Basis of Water Year Data**

| Water Year Type          | Base Year         | Base Year | Base Year |
|--------------------------|-------------------|-----------|-----------|
| Normal Water Year        | Average 1922-2004 |           |           |
| Single-Dry Water Year    | 1977              |           |           |
| Multiple-Dry Water Years | 1990              | 1991      | 1992      |

### 3.5.2. Factors Impacting Reliability

The Act requires a description of the reliability of the water supply and vulnerability to seasonal or climatic shortage. The City relies on import supplies provided by Metropolitan through MWDOC. The following are some of the factors identified by Metropolitan that may have an impact on the reliability of Metropolitan supplies.

**Environment** – Endangered species protection needs in the Sacramento-San Joaquin River Delta have resulted in operational constraints to the SWP system. The Bay-Delta’s declining ecosystem caused by agricultural runoff, operation of water pumps and other factors has led to historical restrictions in SWP supply deliveries. SWP delivery

restrictions due to the biological opinions resulted in the loss of about one-third of the available SWP supplies in 2008.

**Legal** – Listings of additional species under the Endangered Species Act and new regulatory requirements could impact SWP operations by requiring additional export reductions, releases of additional water from storage or other operational changes impacting water supply operations. Additionally, the Quantification Settlement Agreement has been challenged in courts and may have impacts on the Imperial Irrigation District and San Diego County Water Authority transfer. If there are negative impacts, San Diego could become more dependent on the Metropolitan supplies.

**Water Quality** –Water imported from the Colorado River Aqueduct (CRA) contains high level of salts. The operational constraint is that this water needs to be blended with SWP supplies to meet the target salinity of 500 mg/L of total dissolved solids (TDS). Another water quality concern is related to quagga mussel. Controlling the spread and impacts of quagga mussels within the Colorado River Aqueduct require extensive maintenance and results in reduced operational flexibility.

**Climate Change** – Changing climate patterns are expected to shift precipitation patterns and affect water supply. Unpredictable weather patterns will make water supply planning even more challenging. The areas of concern for California include the reduction in Sierra Nevada snowpack, increased intensity and frequency of extreme weather events, and rising sea levels causing increased risk of levee failure.

Legal, environmental, and water quality issues may have impacts on Metropolitan supplies. It is felt however climatic factors would have more of an impact than the others. Climatic conditions have been projected based on historical patterns; however severe pattern changes may occur in the future. Table 3-10 shows the factors resulting in inconsistency of supply.

**Table 3-10: Factors Resulting in Inconsistency of Supply**

| Name of Supply      | Legal | Environmental | Water Quality | Climatic |
|---------------------|-------|---------------|---------------|----------|
| State Water Project | X     | X             |               |          |
| Colorado River      |       |               | X             | X        |

These and other factors are addressed in greater detail in Metropolitan’s 2010 RUWMP.

### 3.5.2.1. Water Quality

**Imported Water** - Metropolitan is responsible for providing water of a high quality throughout its service area. The water that Metropolitan delivers is tested both for

currently regulated contaminants and for additional contaminants of concern as over 300,000 water quality tests are conducted each year to regulate the safety of its waters. Metropolitan's supplies originate primarily from the Colorado River Aqueduct (CRA) and from the State Water Project (SWP). A blend of these two sources, proportional to each year's availability of the source, is then delivered throughout Metropolitan's service area.

Metropolitan's primary sources face individual water quality issues of concern. The CRA water source contains a higher level of total dissolved solids (TDS) and a lower level of organic material while the SWP contains a lower TDS level while its level of organic materials is much higher, lending to the formation of disinfection byproducts. To remediate the CRA's high level of salinity and the SWP's high level of organic materials, Metropolitan has been blending CRA water with SWP supplies as well as implementing updated treatment processes to decrease the disinfection byproducts. In addition, Metropolitan has been engaged in efforts to protect its Colorado River supplies from threats of uranium, perchlorate, and chromium VI while also investigating the potential water quality impact of emerging contaminants, N-nitrosodimethylamine (NDMA) and pharmaceuticals and personal care products (PPCPs). Metropolitan has assured its ability to overcome the above mentioned water quality concerns through its protection of source waters, implementation of renovated treatment processes, and blending of its two sources. While unforeseeable water quality issues could alter reliability, Metropolitan's current strategies ensure the deliverability of high quality water.

**Groundwater** - The Orange County Water District (OCWD) is responsible for managing the Orange County Groundwater Basin. To maintain groundwater quality, OCWD conducts an extensive monitoring program that serves to manage the basin's groundwater production, control groundwater contamination, and comply with all necessary laws and regulations.<sup>13</sup> A network of nearly 700 wells provides OCWD a source for samples, which are tested for a variety of purposes. The District collects 600 to 1,700 samples each month to monitor the quality of the basin's water. These samples are collected and tested according to approved federal and state procedures as well as industry-recognized quality assurance and control protocols.

OCWD recognizes the importance of maintaining the basin's high water quality. OCWD's 2009 Groundwater Management Plan Update includes a section labeled, "Water Quality Management," which discusses the water quality concerns as well as management programs that OCWD is currently involved with.

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<sup>13</sup> The information in this section is referenced from the Groundwater Management Plan 2009 Update "Groundwater Monitoring" section (pages 3-1 through 3-20) and "Water Quality Management" section (pages 5-1 through 5-30).

Table 3-11 shows the amount in acre-feet per year that water quality would have on supply.

**Table 3-11: Water Quality – Current and Projected Water Supply Impacts (AFY)**

| Water Source | Fiscal Year Ending |      |      |      |      |          |
|--------------|--------------------|------|------|------|------|----------|
|              | 2010               | 2015 | 2020 | 2025 | 2030 | 2035-opt |
| Imported     | 0                  | 0    | 0    | 0    | 0    | 0        |
| Local        | 0                  | 0    | 0    | 0    | 0    | 0        |

### 3.5.3. Normal-Year Reliability Comparison

The City has entitlements and/or written contracts to receive imported water from Metropolitan via the regional distribution system. Although pipeline capacity rights do not guarantee the availability of water, per se, they do guarantee the ability to convey water when it is available to the Metropolitan distribution system. All imported water supplies assumed in this section are available to the City from existing water transmission facilities. Table 3-12 shows supply and demand under normal year conditions. Water supplies are projected to be available from Metropolitan; however, it is not included here since projected supplies meet projected demands.

**Table 3-12: Projected Normal Water Supply and Demand (AFY)**

|                     | Fiscal Year Ending |               |               |               |               |
|---------------------|--------------------|---------------|---------------|---------------|---------------|
|                     | 2015               | 2020          | 2025          | 2030          | 2035          |
| <b>Total Demand</b> | <b>17,023</b>      | <b>17,422</b> | <b>17,774</b> | <b>18,124</b> | <b>18,474</b> |
| BPP GW              | 10,275             | 10,492        | 10,710        | 10,927        | 11,144        |
| Recycled Water      | 450                | 500           | 500           | 500           | 500           |
| Imported            | 6,298              | 6,430         | 6,564         | 6,697         | 6,830         |
| <b>Total Supply</b> | <b>17,023</b>      | <b>17,422</b> | <b>17,774</b> | <b>18,124</b> | <b>18,474</b> |

### 3.5.4. Single Dry-year Reliability Comparison

The City has documented that it is 100% reliable for single dry year demands from 2015 through 2035 with a demand increase of 4.6% using FY 2006-07 as the single dry year. Table 3-13 compiles supply and demand projections for a single dry water year. The available imported supply is greater than shown; however, it is not included because all demands are met.

**Table 3-13: Projected Single-Dry Year Water Supply and Demand (AFY)**

|                     | Fiscal Year Ending |               |               |               |               |
|---------------------|--------------------|---------------|---------------|---------------|---------------|
|                     | 2015               | 2020          | 2025          | 2030          | 2035          |
| <b>Total Demand</b> | <b>17,806</b>      | <b>18,223</b> | <b>18,592</b> | <b>18,958</b> | <b>19,324</b> |
| BPP GW              | 11,040             | 11,299        | 11,527        | 11,754        | 11,981        |
| Recycled Water      | 450                | 500           | 500           | 500           | 500           |
| Imported            | 6,316              | 6,425         | 6,565         | 6,704         | 6,843         |
| <b>Total Supply</b> | <b>17,806</b>      | <b>18,223</b> | <b>18,592</b> | <b>18,958</b> | <b>19,324</b> |

### 3.5.5. Multiple Dry-Year Reliability Comparison

The City is capable of providing their customers all their demands with significant reserves in multiple dry years from 2015 through 2035 with a demand increase of 4.6% using FY 2006-07 as the multiple dry years. This is true even if the demand projections were to be increased by a large margin. Table 3-14 shows supply and demand projections under multiple dry year conditions.

**Table 3-14: Projected Multiple Dry Year Period Supply and Demand (AFY)**

|                           |                     | Fiscal Year Ending |               |               |               |               |
|---------------------------|---------------------|--------------------|---------------|---------------|---------------|---------------|
|                           |                     | 2015               | 2020          | 2025          | 2030          | 2035          |
| <b>First Year Supply</b>  | <b>Total Demand</b> | <b>17,806</b>      | <b>18,223</b> | <b>18,592</b> | <b>18,958</b> | <b>19,324</b> |
|                           | BPP GW              | 11,040             | 11,299        | 11,527        | 11,754        | 11,981        |
|                           | Recycled Water      | 450                | 500           | 500           | 500           | 500           |
|                           | Imported            | 6,316              | 6,425         | 6,565         | 6,704         | 6,843         |
|                           | <b>Total Supply</b> | <b>17,806</b>      | <b>18,223</b> | <b>18,592</b> | <b>18,958</b> | <b>19,324</b> |
| <b>Second Year Supply</b> | <b>Total Demand</b> | <b>17,806</b>      | <b>18,223</b> | <b>18,592</b> | <b>18,958</b> | <b>19,324</b> |
|                           | BPP GW              | 11,040             | 11,299        | 11,527        | 11,754        | 11,981        |
|                           | Recycled Water      | 450                | 500           | 500           | 500           | 500           |
|                           | Imported            | 6,316              | 6,425         | 6,565         | 6,704         | 6,843         |
|                           | <b>Total Supply</b> | <b>17,806</b>      | <b>18,223</b> | <b>18,592</b> | <b>18,958</b> | <b>19,324</b> |
| <b>Third Year Supply</b>  | <b>Total Demand</b> | <b>17,806</b>      | <b>18,223</b> | <b>18,592</b> | <b>18,958</b> | <b>19,324</b> |
|                           | BPP GW              | 11,040             | 11,299        | 11,527        | 11,754        | 11,981        |
|                           | Recycled Water      | 450                | 500           | 500           | 500           | 500           |
|                           | Imported            | 6,316              | 6,425         | 6,565         | 6,704         | 6,843         |
|                           | <b>Total Supply</b> | <b>17,806</b>      | <b>18,223</b> | <b>18,592</b> | <b>18,958</b> | <b>19,324</b> |

## 4. Demand Management Measures

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### 4.1. Overview

Water conservation, often called demand-side management, can be defined as practices, techniques, and technologies that improve the efficiency of water use. Such practices are referred to as demand management measures (DMM). Increased efficiency expands the use of the water resource, freeing up water supplies for other uses, such as population growth, new industry, and environmental conservation.

The increasing efforts in water conservation are spurred by a number of factors: growing competition for limited supplies, increasing costs and difficulties in developing new supplies, optimization of existing facilities, delay of capital investments in capacity expansion, and growing public support for the conservation of limited natural resources and adequate water supplies to preserve environmental integrity.

The City recognizes the importance of water conservation and has made water use efficiency an integral part of water use planning. The City has been a signatory to the California Urban Water Conservation Council's (CUWCC) Best Management Practices (BMPs) Memorandum of Understanding (MOU) since August 2005. The City completed and submitted its first BMP Activity Report in fiscal year 2006 showing implementation status of each BMP. This section of the UWMP describes the DMMs currently being implemented or scheduled for implementation by the City to satisfy the requirements of § 10631 (f) & (j).

Demand Management Measures as defined by the Act corresponds to the CUWCC's BMPs. The Act allows the urban water supplier who is signatory to the CUWCC MOU to submit to DWR copies of its annual reports and other relevant documents to assist DWR in determining whether the urban water supplier is implementing or scheduling the implementation of water demand management activities.

### 4.2. Water Use Efficiency Programs

As Signatory to the Urban MOU, the City has committed to use good-faith efforts to implement the 14 cost-effective BMPs. The City has implemented and is actively participating in many water conservation activities. A Water Conservation Ordinance was adopted by the City Council in 2009 in the City's municipal code as Chapter 14.16 Water Conservation and Supply Level Regulations.

Moreover, as a member agency of MWDOC, the City actively participates in various Metropolitan residential and CII rebate programs, as well as school and public education and outreach programs, and other programs administered by MWDOC. MWDOC implements many of the urban water conservation BMPs on behalf of its member agencies. MWDOC's 2010 RUWMP should be referred to for a detailed discussion of each regional BMP program. The City works cooperatively with MWDOC for technical and financial support needed to facilitate meeting the terms of the MOU. MWDOC's current Water Use Efficiency Program, detailed in their 2010 RUWMP, implemented on behalf of its member agencies following three basic focuses:

1. Regional Program Development – MWDOC develops, obtains funding for, and implements regional BMP programs on behalf of all retail water agencies in Orange County.
2. Local Program Assistance - MWDOC assists retail agencies to develop and implement local programs within their individual service areas.
3. Research and Evaluation – MWDOC conducts research programs which allow an agency to measure the water savings benefits of a specific program and then compare those benefits to the costs of implementing the program in order to evaluate the economic feasibility of the program.

Table 4-1 provides an overview of City's DMM program status.

**Table 4-1: Urban Supplier's Demand Management Measures Overview**

| Demand Management Measure (DMM)                   | DMM Status |         |        |
|---------------------------------------------------|------------|---------|--------|
|                                                   | Past       | Current | Future |
| Residential Water Surveys                         |            | X       |        |
| Residential Plumbing Retrofits                    |            | X       |        |
| System Water Audits, Leak Detection and Repair    |            | X       |        |
| Metering with Commodity Rates                     |            | X       |        |
| Large Landscape Conservation Programs             |            | X       |        |
| High-Efficiency Washing Machine Rebates           |            | X       |        |
| Public Information Programs                       |            | X       |        |
| School Education Programs                         |            | X       |        |
| Commercial, Industrial and Institutional Programs |            | X       |        |
| Wholesale Agency Assistance                       |            | N/A     |        |
| Conservation Pricing                              |            | X       |        |
| Conservation Coordinator                          |            | X       |        |
| Water Waste Prohibition                           |            | X       |        |
| Residential ULFT Replacement Programs             | X          |         |        |



#### **4.2.1. DMM 1: Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers**

***Residential Survey Program*** - As part of this DMM, an agency targets single- and multi-family homes and sends out a qualified surveyor who checks water using devices within the house and evaluates landscapes and irrigation systems. MWDOC had a formal program that ended in FY 2001/02. Currently, the City has a program to monitor high water users through the billing system. City staff goes out to the high use customer's home to evaluate their indoor use and identify problems and fixes (e.g. leaky toilets).

The City also participates in regional landscape programs aimed at helping residential and small commercial customers to be more water efficient through MWDOC. A thorough site inspection that includes a landscape survey is conducted as part of the Smart Timer and Rotating Nozzle Rebate Programs. Details of these residential landscape water use efficiency programs are provided below.

***Smart Timer Rebate Program*** - The Smart Timer Rebate Program started in FY 2004/05. Under this regional program, residential and small commercial properties are eligible for a rebate when they purchase and install a weather-based irrigation controller which has the potential to save 41 gallons per day per residence and reduce runoff and pollution by 49%. Once residents are enrolled in the rebate program, a detailed residential outdoor water survey is conducted to inspect the irrigation system, distribution uniformity, and irrigated area. Water savings from the program can be estimated from information obtained from the water surveys pre- and post-installation of the Smart Timer. The City is eligible to receive 1,192 valves over the life of the program. As of FY 2010-11, 278 rebates have been given out to residential customers and 249 rebates to small commercial customers which translate to a water savings of approximately 636 acre-feet. The City will continue to provide on-site meetings, literature and incentives related to this program. As part of the MWDOC Grant for the SmartTimers a site audit and inspection is required and provided by contract through MWDOC.

In FY 2007/08 the City with the assistance of a Cal Fed grant installed 640 weather-based irrigation controllers with pre and post installation inspections. This program found that the first 100 homes retrofit with smart controllers saved 458,000 gallons in the first comparison billing period. One homeowners association (HOA), who first retrofit with smart controllers and then retrofit for irrigation system uniformity, saved 1.3 million gallons in the first comparison billing period.

Moreover, the City is in the process of contracting for a professional/consultant that can assist the City in developing a residential and commercial site auditing program. Presently the City pays a contractor for audits as needed. Once the City has developed a program it is the desire of the City to hire a full or part-time professional staff person to

do audits for residential and commercial properties as well as site measurements for public properties.

***Rotating Nozzle Rebate Program*** – This rebate program started in 2007 and is offered to both residential and commercial customers. Through this program, site owners will purchase and install rotary nozzles in existing irrigation systems. Following the submittal of a rebate application, water bill, and original purchase receipt, MWDOC will direct a third party installation verification contractor to perform installation verifications on up to 100% of the sites that installed devices. As of FY 2010-11, the total rotating nozzle program participation includes 179 residential and 5,520 small commercial customers representing 51 acre-feet of savings, collectively, since the beginning of the program.

***Synthetic Turf Rebate Program*** – Through this program, residential and small commercial customers of participating retail water agencies are eligible to receive rebate money for qualifying synthetic turf projects. To date 9,428 sq. ft. of synthetic turf have been installed on residential properties translating to a savings of 4.3 acre-feet since the beginning of the program.

***California Friendly Landscape Training (Residential)*** - The California Friendly Landscape Training provides education to residential homeowners and professional landscape contractors on a variety of landscape water efficiency practices they can employ. These classes are hosted by Metropolitan and/or the retail agencies to encourage participation across the county. The residential training program consists of either a half-day Mini Class or individual, topic-specific, four-hour classes.

#### **4.2.2. DMM 2: Residential Plumbing Retrofit**

Between 1994 and 2009, the City, in conjunction with MWDOC, distributed a total of 7,219 ultra low flush toilets (ULFT) to single-family and multi-family homes. In addition, through Metropolitan's mass showerhead distribution, the City installed 4,453 low-flow showerheads between 1991 and 1998, and over 75 percent of the City's single- and multi-family homes constructed prior to 1992 are fitted with low-flow showerheads. MWDOC estimated that today low flow showerhead saturation is at nearly 100% for single-family homes and at 94% for multi-family homes. Both the low-flow shower head program and ULFT rebate program have sunset. The City has met the requirement for this DMM.

#### **4.2.3. DMM 3: System Water Audits, Leak Detection and Repair**

The City records daily production and demand data and reads all meters on a bi-monthly basis. All metered sales and other verifiable uses such as backwash, flushwater, and operation and maintenance, are recorded. The unaccounted water loss varies year to year but is approximately five percent of the total water in the system. The City is meeting the requirement for this DMM.

The City has not developed a formal methodology to estimate the water savings attributable to this DMM. There are, however, real water savings as a result of the proactive pre-screening leak detections and repair program which maintains an acceptable non-revenue water

#### **4.2.4. DMM 4: Metering with Commodity Rates**

All of the City's water connections are metered and billed based on commodity rates. In multi-family dwellings with one property owner, a master-meter can be used. However, for multi-family dwellings with more than one owner, separate water meters must be installed.

#### **4.2.5. DMM 5: Large Landscape Conservation Programs and Incentives**

The City adopted a new Landscape Ordinance in 2010 in accordance with AB 1881 (Appendix E). The new provisions amend Chapter 14.17 of Title 14 of the Newport Beach Municipal Code Regulations pertaining to water-efficient landscaping regulations. The purpose of the City's Water Efficient Landscape Ordinance and related Design Standards document is to establish an alternative model acceptable under AB 1881 as being at least as effective as the State Model Water Efficient Landscape Ordinance.

The City supports large landscape conservation through MWDOC's regional programs, many of which target both residential and commercial customers as described under DMM 1. Programs which specifically assist large landscape customers are summarized below. The City encourages commercial properties such as golf courses and HOAs to take advantage of these programs.

***MWDOC Landscape Performance Certification Program*** - MWDOC has a program titled "Landscape Performance Certification Program", which provides a water-based budget for dedicated meters. This program involves developing water budgets based off of agency-provided consumption data, site-provided area measurement, local weather data, and contact information for the site owner, the responsible landscape company, and a property manager. On a monthly basis, the site's water budget is developed by water meter and provided back to the three involved entities in an e-mail report card format. Also included is a website where all involved can view their site for budget numbers, which illustrate whether a meter is over, under, or exactly at their budget. Included is a calculation based on individual water rates showing dollars lost. This program does not include a formal landscape survey component. Financial incentives are offered to improve landscape water use efficiency, and regional funding is available from Metropolitan.

The City has participated in the Landscape Performance Certification Program since its initiation in FY 2004-05. The number of participated landscape meters has increased from 32 in FY 2004-05 to 171 in FY 2010-11. Through the SmarTimer Grant the City is

requiring all Commercial applicants to participate in this program as a condition of funding by the City.

***California Friendly Landscape Training (Professional)*** – The California Friendly Landscape Training provides education to residential homeowners and professional landscape contractors on a variety of landscape water efficiency practices they can employ. These classes are hosted by MWDOC and/or the member agencies to encourage participation across the county. The Professional Training Program course consists of four consecutive classes in landscape water management, each building upon principles presented in the preceding class. Each participant receives a bound handbook containing educational materials for each class. These classes are offered throughout the year and taught in both English and Spanish languages.

#### **4.2.6. DMM 6: High-Efficiency Washing Machine Rebate Programs**

Orange County residents are eligible to receive an \$85 rebate when they purchase of a new High Efficiency Clothes Washer (HECW). This program began in 2001 and is sponsored by MWDOC, Metropolitan, and local retail water agencies. Rebates are available on a first-come, first-served basis, while funds last. Participants must be willing to allow an inspection of the installed machine for verification of program compliance. Machines must have a water factor of 4.0 or less. Depending on use, these machines can save 10,000 gallons of water per year. Participants are encouraged to contact their local gas and/or electric utility as additional rebates may be available.

Over the past 9 years, 1,918 residences have installed HECWs through this program representing a water savings of approximately 240 acre-feet. The City continues to provide information to residences about these rebate programs.

#### **4.2.7. DMM 7: Public Information Programs**

The City has an active program to promote and educate its customers about water conservation and other water-related topics. The City participates annually in the Children's Water Education Festival sponsored by OCWD, The Disneyland Resort and various cities and agencies throughout Orange County. Moreover, when requested, the Water Conservation Coordinator goes into the classrooms, interest groups, and homeowner associations to discuss various aspects of conservation. The City has also updated its website to include conservation related materials and information.

#### **City of Newport Beach's Local Public Information Programs**

The City has taken the lead to educating its residents on the importance of using water wisely and caring for their watershed. The City currently provides customers with various tools, programs and incentives that are promoted through outreach marketing campaigns

to reach as diverse an audience as possible. The City's Water Conservation Marketing Campaigns comprises of many programs as described below.

**July: Smart Irrigation Month** – June 2008, City Council adopted a resolution declaring July as “Smart Irrigation Month” to promote a reminder for residents to repair faulty irrigation systems and install ETo controllers using Metropolitan’s region-wide TV, radio and print advertising campaign.

**WaterSmartNewport.org** – This website is the City’s water conservation campaign with the goal to create a recognizable brand specific to the City.

**Interest Group and Public Events** – The City uses public events and relationships with nonprofit groups to promote public awareness. City staff presents at clubs and HOA such Kiwanis and Rotary and participate in environmental related events alongside interest groups and nonprofits.

**Media Outreach: Public Service Announcements (PSAs), NBTv and Magazine Print Articles** – The City reaches a broad age demographic through TV and magazine articles. In 2010, PSAs are featured on NBTv, City website, cable TV, pre-movie display in all City movie theaters, and through other media outlets.

### **MWDOC’s Regional Public Information Programs**

MWDOC currently offers a wide range of public information programs in Orange County in collaboration with its member agencies including the City of Newport Beach. Current regional public information programs within the MWDOC’s service area are summarized below.

**Water Facility Inspection Trip Program** - The inspection trip program is sponsored by MWDOC and Metropolitan. Each year, Orange County elected officials, residents, business owners, and community leaders are invited to attend educational inspection trips to tour key water facilities throughout the state of California. The goal is to educate members of our community about planning, procurement and management of southern California’s water supply and the issues surrounding delivery and management of this vital resource.

**O.C. Water Hero Program** - The goal of this program is to engage children in water use efficiency activities while facilitating discussion with friends and family members about how to save water. Any Orange County child can become a Water Hero by pledging to save 20 gallons of water per day. In exchange for their pledge, they receive a free Water Hero kit, which includes a variety of fun, water-saving items like a 5-minute shower timer and “fix-it” ticket pad for busting water wasters. To become a Superhero, a student must get their parents to also pledge to save 20 gallons of water per day. To date, more

than 13,000 children in Orange County have become Water Heroes and more than 4,000 have become Superheroes.

***eCurrents*** - This monthly electronic newsletter is designed to keep MWDOC's 28 member agencies, residents and businesses, stakeholder groups, opinion leaders, and others apprised of MWDOC news, programs, events, and activities. The publication also serves to keep readers informed about regional, state, and federal issues affecting water supply, water management, water quality, and water policy and regulation.

***Water Advisory Committee of Orange County (WACO)*** - WACO was formed in 1983 to facilitate the introduction, discussion, and debate of current and emerging water issues among Orange County policymakers and water professionals. The committee's membership has evolved to include elected officials and management staff from Orange County cities and water districts, engineers, attorneys, consultants, and other industry professionals. Monthly meetings are open to the public and are typically held on the first Friday of each month at 7:30 a.m.

#### **4.2.8. DMM 8: School Education Programs**

Since 1975, MWDOC has offered water education programs to Orange County public and private schools for all grade levels from kindergarten through high school. The City participates in this program, and during FY 2009/10, MWDOC and the City's Water Conservation coordinator made 6 presentations to 1,687 students.

#### **MWDOC's Regional School Education Programs**

***Water Education School Program*** - One of the most successful and well-recognized water education curriculums in Southern California is MWDOC's Water Education School Program. For more than 30 years, School Program mascot "Ricki the Rambunctious Raindrop" has been educating students in grades K-5 about the water cycle, the importance and value of water, and the personal responsibility we all have as environmental stewards.

The School Program features assembly-style presentations that are grade-specific and performed on-site at the schools. The program curriculum is aligned with the science content standards established by the State of California. Since its inception in 1973, nearly three million Orange County students have been educated through the School Program.

In 2004, MWDOC formed an exciting partnership with Discovery Science Center that has allowed both organizations to reach more Orange County students each year and provide them with even greater educational experiences in the areas of water and science. Discovery Science Center currently serves as the School Program administrator, handling

all of the program marketing, bookings, and program implementation. During the 2010-11 school year, more than 70,000 Orange County students will be educated through the program.

***Water Education Poster & Slogan Contest*** - Each year, MWDOC holds a Water Education Poster and Slogan Contest to increase water awareness. To participate, children in grades K-6 develop posters and slogans that reflect a water awareness message. The goal is to get children thinking about how they can use water wisely and to facilitate discussion about water between children and their friend, parents, and teachers. Each year, more than 1,500 poster and slogan entries are received through the contest.

During a special judging event, approximately 16 posters and 10 slogans are selected as the winners. All of the winners – and their parents, teachers, and principals – are invited to attend a special awards ceremony with Ricki Raindrop at Discovery Science Center. At the awards ceremony, the winners are presented with their framed artwork as well as a custom t-shirt featuring their poster or slogan, a trophy, a certificate, and other fun water-saving prizes.

***Orange County Children's Water Education Festival*** - The largest water education festival of its kind is the annual Children's Water Education Festival (Festival). The Festival is presented by OCWD, the National Water Research Institute, Disneyland Resort, and MWDOC. Each year, more than 5,000 students participate in the Festival over the course of this two-day event. The Festival is currently held at the Richard Nixon Library and Birthplace in Yorba Linda, California.

The Festival presents a unique opportunity to educate students in grades four through six about local water issues and help them understand how they can protect our water resources and the environment. Students attend the Festival with their teacher and classmates, visiting a variety of booths focused on different water-related topics throughout the day. Participating organizations (presenters) engage the students through interactive educational presentations that are aligned with the science content standards established by the State of California.

#### **4.2.9. DMM 9: Conservation Programs for Commercial, Industrial and Institutional Accounts**

***Save Water Save a Buck*** - This program began in 2002 and offers rebates to assist commercial, industrial, and institutional customers in replacing high-flow plumbing fixtures with low-flow fixtures. Facilities where low-flow devices are installed must be located in Orange County.

Rebates are available only on those devices listed in Table 4-2 below and must replace higher water use devices. Installation of devices is the responsibility of each participant. Participants may purchase and install as many of the water saving devices as is applicable to their site.

**Table 4-2: Retrofit Devices and Rebate Amounts Available Under Save Water Save a Buck Program**

| <b>Retrofit Device</b>                | <b>Rebate Amount</b>  |
|---------------------------------------|-----------------------|
| High Efficiency Toilet                | \$50                  |
| Ultra-Low-Water or Zero Water Urinal  | \$200                 |
| Connectionless Food Steamers          | \$485 per compartment |
| Air-Cooled Ice Machines (Tier III)    | \$300                 |
| Cooling Tower Conductivity Controller | \$625                 |
| pH / Conductivity Controller          | \$1,750               |
| Dry Vacuum Pumps                      | \$125 per HP          |
| Water Pressurized Broom               | \$110                 |

As of FY 2010/11 the City's commercial, industrial, and institutional customers have installed a total 1,231 water-saving fixtures since the program inception in FY 2001/02. This represents a water savings of 540 acre-feet. The City will continue to educate this account category to meet the DMM requirements. The City is also working with the Orange County Sanitation District to target CII customers in the City who could benefit from the reduction or recycling are large water using devices that Metropolitan will help fund to upgrade.

**Water Smart Hotel Program** - In 2008 and 2009, MWDOC received grants from the CA Department of Water Resources and the US Bureau of Reclamation (USBR) to conduct the Water Smart Hotel Program, a program designed to provide Orange County hotels and motels with commercial and landscape water saving surveys, incentives for retrofits and customer follow-up and support. The goal of the program is to implement water use efficiency changes in hotels to achieve an anticipated water savings of 7,078 acre feet over 10 years.

The Program is offered to hotels in MWDOC's service area as identified by retail water agencies. It is anticipated that detailed survey of the indoor and outdoor water using aspects of up to 105 participating hotels will be performed. Participating hotels will receive survey reports that recommend indoor and outdoor retrofits, upgrades, and other



changes that should, based on the survey, result in significant water savings. Quantities of each device and associated fixture and installation costs, water savings and payback information (based on rebate amount Incentives offered through the Save Water Save A Buck Rebate Program will be augmented using DWR and USBR Water Use Efficiency grant funds to bridge the gap between existing incentives and the actual costs of Hotel Water Survey recommendations. To date, over 24 surveys have been performed county-wide, and over 9,500 water-saving devices have been installed through the program. These devices are saving 351 acre feet per year or 3,510 acre feet over the ten year device life.

**Industrial Process Water Use Reduction Program** - The IPWURP provides engineering surveys to identify water saving process improvements in the Orange County industrial customer base. Additionally, it provides Engineering Assistance and Financial incentives to help implement the recommendations from those surveys. This is done with funding from DWR, USBR, Metropolitan and MWDOC.

Focused on industrial process water only, the program targets, but is not limited to, the highest water use customers in the following sectors Textile, Metals, Electronics, Laundries, Food Processing, and Pharmaceuticals. The program offers two levels of surveys:

- A preliminary Focused Survey to ascertain the magnitude of water savings possible.
- A Comprehensive Survey which is a more detailed study of the customer's process and includes customized retrofit recommendations, estimated costs, savings in water and sewer discharge, and a simple ROI

Incentives are calculated via a "Pay for Performance" model based on water savings (monitored for 1 year). Qualified participants will receive the lesser of:

- \$4.37 per 1,000 gallons of water saved, or
- Fifty (50) percent of the total amount of retrofit cost

The incentives are paid in two payments:

- The first payment after verification of equipment installation and startup
- The second payment after a one-year monitoring period to measure water savings

Types of projects have included treating and reusing water in manufacturing process or for cooling towers and new wash equipment with upgraded washers, nozzles and automated control systems. This is a regional program that is available to the City.

To date the program has identified a water savings potential of 450 million gallons per year within Orange County. The program water savings goal is 80 million gallons per year or 245 acre feet per year. The City of Newport Beach does not have a large industrial business sector. Currently, two of its industrial water users are part of this program.

#### **4.2.10. DMM 10: Wholesale Agency Programs**

This BMP pertains to wholesale agency programs which are not applicable to the City, a retail agency. The City is a member agency of MWDOC, the region's wholesaler that is responsible for the implementation and reporting requirements of this DMM.

#### **4.2.11. DMM 11: Conservation Pricing**

The City currently has uniform commodity pricing for all water sectors plus a combined fixed charge based on meter size. The current commodity charges for single family, multi-family, and CII customers are \$2.46 per HCF for water and \$0.35 per HCF for sewer. The monthly fixed charges are based on the customer meter size as shown in Table 4-3. The City is currently investigating the various tiered rate pricing schemes so it can report to the Council on the efficiency and staffing requirements to convert the current billing system to one that includes tiered pricing.

**Table 4-3 City of Newport Beach Monthly Combined Fix Charges**

| <b>Meter Size</b> | <b>Fixed Charges</b> |
|-------------------|----------------------|
| 5/8"              | \$13.09              |
| 1"                | \$21.82              |
| 1 ½"              | \$43.64              |
| 2"                | \$69.82              |
| 3"                | \$130.91             |
| 4"                | \$218.18             |
| 6"                | \$436.37             |
| 8"                | \$689.19             |

#### **4.2.12. DMM 12: Water Conservation Coordinator**

The City has a designated a water conservation coordinator since November 2007. The current water conservation coordinator is Mr. Shane Burckle. His responsibilities include the following tasks:

- Manage, oversee and coordinate the City's water conservation program; implement specific projects to improve water conservation and water quality, and

- assist in the City's compliance with all storm water quality (National Pollutant Discharge Elimination System (NPDES)) requirements.
- Perform professional level duties in the City's residential, commercial and large landscape water conservation programs; develop programs to promote water conservation, conduct field audits and provide consultation on residential and landscape water conservation methods;
  - Establish an effective City-wide water conservation program; develop applicable procedures, standards and guidelines;
  - Respond to customer inquiries or complaints; make site visits, gather and analyze data, and make written reports to site owners and managers with recommendations for improving water use, irrigation efficiency and runoff reduction; contact property owners and other members of the public to explain code requirements and to answer questions related to code compliance;
  - Advise and assist the Water Division within the Municipal Operations Department regarding rate structures and water conservation initiatives;
  - Develop and chair water a conservation committee to ensure the City is effectively managing water conservation efforts across departments and citywide;
  - Assist with the City's NPDES requirements and provide support in meeting reporting requirements; attend NPDES meetings as requested by the Division Manager;
  - Develop and submit applications for grant funding related to water conservation and water quality; administer and maintain grant contract requirements;
  - Manage a variety of projects related water conservation, water quality protection, and watershed management;
  - Assist, train, and advise Code and Water Quality Enforcement staff and other City personnel in the enforcement of water conservation and water quality rules, regulations, and ordinances;
  - Conduct field inspections and surveys to determine compliance with NPDES requirements;
  - Serve as liaison and educator to the community, including residents, visitors, and businesses; attend meetings and collaborate with stakeholders; provide public information and outreach on water conservation initiatives; develop public education materials on water conservation and water quality issues; conduct public presentations and classroom visits;
  - Provide technical expertise and advice on water conservation and water quality practices to managerial staff, the public, and other interested parties;
  - Issue Notices of Violation, Administrative Citations and letters to property owners/tenants and businesses whose properties are not in compliance with current water conservation and water quality regulations;
  - Conduct follow-up investigations and develop correspondence.

#### **4.2.13. DMM 13: Water Waste Prohibition**

Most recently, the City Council has approved NBMC 14.16 Water Conservation and Supply Level Regulations which establishes permanent water conservation requirements intended to alter behavior related to water use efficiency for non-shortage conditions and further establishes four levels of water supply shortage response actions to be implemented during times of declared water shortage. Details of this water ordinance are provided in Section 5 of this UWMP.

#### **4.2.14. DMM 14: Residential Ultra-Low-Flush Toilet Replacement Programs**

Over the past 19 years, MWDOC has continuously implemented a regional ULF Toilet Rebate and/or Distribution Program targeting single- and multi-family homes in Orange County. Since the end of distribution program in 2004, MWDOC's program has focused solely on providing rebate incentives for retrofitting non-efficient devices with either ULFTs or High Efficiency Toilets (HETS) – toilets using 1.28 gallons per flush or less. The ULFT portion of this program concluded in June 2009, and over 360,000 ULFTs were replaced in single family and multi-family homes, with an overall program to date savings of approximately 138,457 acre feet of water. The HET rebate program, which concluded in 2010, has incentivized over 26,000 devices, with an overall program to date savings of approximately 3,419.

The City has participated in this program from the beginning. To date 7,219 ULFTs and 254 HETs have been installed representing a combined water savings of 2,719 acre-feet. The City meets the coverage requirements for this DMM.

## 5. Water Supplies Contingency Plan

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Recent water supply challenges throughout the American Southwest and the State of California have resulted in the development of a number of policy actions that water agencies would implement in the event of a water shortage. In southern California, the development of such policies has occurred at both the wholesale and retail level. This section describes how new and existing policies that Metropolitan, MWDOC and the City have in place to respond to water supply shortages, including a catastrophic interruption and up to a 50 percent reduction in water supply.

### 5.1. Shortage Actions

#### Metropolitan

As an importer of water from multiple sources, including both the Colorado River and Sierra Nevada, a number of water supply challenges have impacted the reliability of Metropolitan's imported supplies. In response to these challenges, Metropolitan has implemented existing policies as well as developed new ones.

The first action that Metropolitan implements in the event of a water shortage is the suspension and/or reduction of its interruptible supplies, which are supplies sold at a discount in return for the buyers agreeing to be the first to be cutback in the event of a shortage. Metropolitan currently has two interruptible programs for agricultural users and groundwater replenishment, under which supplies were either suspended or reduced in 2007.

In addition, in preparation for the possibility of being unable to meet "firm demands" (non-interruptible supplies) of its member agencies, in February 2008, the Metropolitan's Board of Directors (Board) adopted the Water Supply Allocation Plan (WSAP), which was subsequently updated in June 2009.

Metropolitan's plan includes the specific formula for calculating member agency supply allocations and the key implementation elements needed for administering an allocation. Metropolitan's WSAP is the foundation for the urban water shortage contingency analysis required under Water Code Section 10632 and is part of Metropolitan's 2010 RUWMP.

Metropolitan's WSAP was developed in consideration of the principles and guidelines described in Metropolitan's 1999 Water Surplus and Drought Management Plan (WSDM), with the objective of creating an equitable needs-based allocation. The plan's

formula seeks to balance the impacts of a shortage at the retail level while maintaining equity on the wholesale level for shortages of Metropolitan supplies of up to 50 percent. The formula takes into account: impact on retail customers and the economy; growth and population; changes in supply conditions; investments in local resources; demand hardening aspects of non-potable recycled water use; implementation of conservation savings program; participation in Metropolitan's interruptible programs; and investments in facilities.

The formula is calculated in three steps: based period calculations, allocation year calculations, and supply allocation calculations. The first two steps involve standard computations, while the third section contains specific methodology developed for the WSAP.

**Step 1: Base Period Calculations** – The first step in calculating a water supply allocation is to estimate water supply and demand using a historical based period with established water supply and delivery data. The base period for each of the different categories of demand and supply is calculated using data from the three most recent non-shortage years, 2004-2006.

**Step 2: Allocation Year Calculations** – The next step in calculating the water supply allocation is estimating water needs in the allocation year. This is done by adjusting the base period estimates of retail demand for population or economic growth and changes in local supplies.

**Step 3: Supply Allocation Calculations** – The final step is calculating the water supply allocation for each member agency based on the allocation year water needs identified in Step 2. Each element and its application in the allocation formula are discussed in detail in Metropolitan's WSAP.

In order to implement the WSAP, the Metropolitan Board makes a determination on the level of the regional shortage, based on specific criteria, in April each year. If it is determined allocations are necessary, they go into effect in July for that year and remain for a 12-month period, although the schedule is at the discretion of Metropolitan's Board.

Metropolitan's 2010 RUWMP forecasts that Metropolitan will be able to meet projected firm demands throughout the forecast period from 2015 to 2035. However, these projections do not mean that Metropolitan would not implement its WSAP during this period.

## MWDOC

To prepare for the potential allocation of imported water supplies from Metropolitan, MWDOC worked collaboratively with its 28 member agencies to develop its own Water

Supply Allocation Plan (MWDOC WSAP), adopted January 2009, to allocate imported water supplies at the retail level. The MWDOC WSAP lays out the essential components of how MWDOC will determine and implement each member agency's allocation during a time of shortage.

The MWDOC WSAP uses a similar method and approach, when reasonable, as that of the Metropolitan's WSAP. However, MWDOC's plan remains flexible to use an alternative approach when Metropolitan's method produces a significant unintended result for the member agencies. The MWDOC WSAP model follows five (5) basic steps to determine a retail agency's imported supply allocation.

**Step 1: Determine Baseline Information** – The first step in calculating a water supply allocation is to estimate water supply and demand using a historical based period with established water supply and delivery data. The base period for each of the different categories of demand and supply is calculated using data from the last three non-shortage years – calendar years, 2004, 2005, and 2006.

**Step 2: Establish Allocation Year Information** – In this step, the model adjusts for each member agency's water need in the allocation year. This is done by adjusting the base period estimates for increased retail water demand based on growth and changes in local supplies.

**Step 3: Calculate Initial Minimum Allocation Based on Metropolitan's Declared Shortage Level** – This step sets the initial water supply allocation for each member agency. After a regional shortage level is established, MWDOC will calculate the initial allocation as a percentage of adjusted Base Period Imported water needs within the model for each member agency.

**Step 4: Apply Allocation Adjustments and Credits in the Areas of Retail Impacts, Conservation, and the Interim Agriculture Water Program** – In this step, the model assigns additional water to address disparate impacts at the retail level caused by an across-the-board cut of imported supplies. It also applies a conservation credit given to those agencies that have achieved additional water savings at the retail level as a result of successful implementation of water conservation devices, programs and rate structures.

**Step 5: Sum Total Allocations and Determine Retail Reliability** – This is the final step in calculating a retail agency's total allocation for imported supplies. The model sums an agency's total imported allocation with all of the adjustments and credits and then calculates each agency's retail reliability compared to its Allocation Year Retail Demand.

The MWDOC WSAP includes additional measures for plan implementation, including the following:

- **Appeal Process** – An appeals process to provide member agencies the opportunity to request a change to their allocation based on new or corrected information. MWDOC anticipates that under most circumstances, a member agency’s appeal will be the basis for an appeal to Metropolitan by MWDOC.
- **Melded Penalty Rate Structure** – At the end of the allocation year, MWDOC would only charge a penalty to each member agency that exceeded their allocation if MWDOC exceeds its total allocation and is required to pay a penalty to Metropolitan. Metropolitan enforces allocations to member agencies through a tiered penalty rate structure: penalty rates to a member agency that exceeds its total annual allocation at the end of the twelve-month allocation period, according to a specified rate structure. MWDOC’s penalty would be assessed according to the member agency’s prorated share (acre-feet over usage) of MWDOC penalty amount with Metropolitan. Penalty funds collected by Metropolitan will be invested in water conservation and local resource development.
- **Tracking and Reporting Water Usage** – MWDOC will provide each member agency with water use monthly reports that will compare each member agency’s current cumulative retail usage to their allocation baseline. MWDOC will also provide quarterly reports on its cumulative retail usage versus its allocation baseline.
- **Timeline and Option to Revisit the Plan** – The allocation period will cover 12 consecutive months and the Regional Shortage Level will be set for the entire allocation period. MWDOC only anticipates calling for allocation when Metropolitan declares a shortage; and no later than 30 days from Metropolitan’s declaration will MWDOC announce allocation to its member agencies.

Due to the complexity of calculating allocations and the potential for unforeseen circumstances that may occur during an allocation year, after one year of implementation, MWDOC staff and member agencies have the opportunity to make recommendations to the MWDOC Board that will improve the method, calculation, and approach of the MWDOC WSAP.

### **City of Newport Beach**

In 1992, the City adopted its Water Shortage Contingency Plan (WSCP) in response to California Assembly Bill Number 11. The WSCP is intended to conservatively manage the City’s water resources to provide water to its customers on an equitable and business-sound basis, in the event of a curtailment of deliveries of up to 50 percent.

The City adopted Water Conservation and Supply Level Regulations Ordinance No. 2010-16 on September 14, 2010, which establishes a comprehensive staged water conservation program that will encourage reduced water consumption within the City through conservation, enable effective water supply planning, assure reasonable and



beneficial use of water, prevent waste of water, and maximize the efficient use of water within the City. Along with permanent water conservation requirements, the City's Water Conservation and Supply Level Regulations consists of the following four stages found in Table 5-1 to respond to a reduction in potable water available to the City for distribution to its customers with permanent conservation requirements in effect at all times unless a mandatory conservation stage has been implemented by the City.

**Table 5-1: Water Supply Shortage Stages and Conditions – Rationing Stages**

| Stage No.                                   | Water Supply Conditions                                                                                                                                                                                                                                                     | % Shortage                            |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Level 1 Mandatory Conservation Requirements | The City Council determines that a water supply shortage or threatened shortage exists, due to drought or other water supply conditions, and it is necessary to impose the mandatory conservation requirements applicable to the particular level of water supply shortage. | To be determined by the City Council. |
| Level 2 Mandatory Conservation Requirements |                                                                                                                                                                                                                                                                             |                                       |
| Level 3 Mandatory Conservation Requirements |                                                                                                                                                                                                                                                                             |                                       |
| Level 4 Mandatory Conservation Requirements |                                                                                                                                                                                                                                                                             |                                       |

## 5.2. Three-Year Minimum Water Supply

As a matter of practice, Metropolitan does not provide annual estimates of the minimum supplies available to its member agencies. As such, Metropolitan member agencies must develop their own estimates for the purposes of meeting the requirements of the Act.

Section 135 of the Metropolitan Water District Act declares that a member agency has the right to invoke its "preferential right" to water, which grants each member agency a preferential right to purchase a percentage of Metropolitan's available supplies based on specified, cumulative financial contributions to Metropolitan. Each year, Metropolitan calculates and distributes each member agency's percentage of preferential rights. However, since Metropolitan's creation in 1927, no member agency has ever invoked these rights as a means of acquiring limited supplies from Metropolitan.

As an alternative to preferential rights, Metropolitan adopted the Water Shortage Allocation Plan (WSAP) in February 2008. Under the WSAP, member agencies are allowed to purchase a specified level of supplies without the imposition of penalty rates. The WSAP uses a combination of estimated total retail demands and historical local supply production within the member agency service area to estimate the firm demands on Metropolitan from each member agency in a given year. Based on a number of

factors, including storage and supply conditions, Metropolitan then determines whether it has the ability to meet these firm demands or will need to allocate its limited supplies among its member agencies. Thus, implicit in Metropolitan's decision not to implement an allocation of its supplies is that at a minimum Metropolitan will be able to meet the firm demands identified for each of the member agencies.

In order to estimate the minimum available supplies from Metropolitan for the period 2011-2013, an analysis was performed to assess the likelihood that Metropolitan would re-implement mandatory water use restrictions in the event of a 1990-92 hydrologic conditions over this period. Specific water management actions during times of water shortage are governed by Metropolitan's Water Shortage and Drought Management Plan (WSDM Plan). Adopted by the Metropolitan Board in 1999, the WSDM Plan provides a general framework for potential storage actions during shortages, but recognizes that storage withdrawals are not isolated actions but part of a set of resource management actions along with water transfers and conservation. As such, there is no specific criterion for which water management actions are to be taken at specific levels of storage. The implementation of mandatory restrictions is solely at the discretion of the Metropolitan Board and there are no set criteria that require the Board to implement restrictions. Given these conditions, the analysis relies upon a review of recent water operations and transactions that Metropolitan has implemented during recent drought.

The first step in the analysis was a review of projected SWP allocations to Metropolitan, based on historical hydrologies. As with the recent drought, potential impacts to SWP supplies from further drought and the recently implemented biological opinions are anticipated to be the biggest challenges facing Metropolitan in the coming three years.

A review of projected SWP allocations from the DWR's State Water Project Delivery Reliability Report 2009 (2009 SWP Reliability Report) was made to estimate a range of conservative supply assumptions regarding the availability of SWP supplies. The 2009 SWP Reliability Report provides estimates of the current (2009) and future (2029) SWP delivery reliability and incorporates regulatory requirements for SWP and CVP operations in accordance with USFWS and NMFS biological opinions. Estimates of future reliability also reflect potential impacts of climate change and sea level rise.

The analysis assumes a maximum SWP allocation available to Metropolitan of 2,011,500 AF and a Metropolitan storage level of 1,700,000 AF at 2010 year-end. The analysis also assumes a stable water supply from the Colorado River in the amount of 1,150,000 AF through 2015. Although the Colorado River watershed has also experienced drought in recent years, Metropolitan has implemented a number of supply programs that should ensure that supplies from this source are relatively steady for the next three years. Based on estimated "firm" demands on Metropolitan of 2.12 MAF, the annual surplus or deficit was calculated for each year of the three-year period.

A review of recent Metropolitan water management actions under shortage conditions was then undertaken to estimate the level of storage withdrawals and water transfers that Metropolitan may exercise under the 1990-92 hydrologic conditions were identified. For this analysis, it was assumed that, if Metropolitan storage levels were greater than 2 MAF at the beginning of any year, Metropolitan would be willing to take up to 600 TAF out of storage in that year. Where Metropolitan storage supplies were between 1.2 MAF and 2 MAF at the beginning of the year, it was assumed that Metropolitan would be willing to take up to 400 TAF in that year. At storage levels below 1.2 MAF, it was assumed that Metropolitan would take up to 200 TAF in a given year.

It was also assumed that Metropolitan would be willing to purchase up to 300 TAF of water transfer in any given year. For years where demands still exceeded supplies after accounting for storage withdrawals, transfer purchases were estimated and compared against the 300 TAF limit.

**Table 5-2: Metropolitan Shortage Conditions**

| Study Year | Actual Year | SWP Allocation (%) | SWP (AF) | CRA (AF)  | Total (AF) | Demand (AF) | Surplus/ Shortage (AF) | Storage at YE (AF) | Transfers (AF) |
|------------|-------------|--------------------|----------|-----------|------------|-------------|------------------------|--------------------|----------------|
| 2011       | 1990        | 30%                | 603,450  | 1,108,000 | 1,711,450  | 2,124,000   | (400,000)              | 1,300,000          | (12,550)       |
| 2012       | 1991        | 27%                | 542,820  | 1,108,000 | 1,650,820  | 2,123,000   | (200,000)              | 1,100,000          | (272,180)      |
| 2013       | 1992        | 26%                | 522,990  | 1,108,000 | 1,630,990  | 2,123,000   | (200,000)              | 900,000            | (292,010)      |

Based on the analysis above, Metropolitan would be able to meet firm demands under the driest three-year hydrologic scenario using the recent water management actions described above without re-implementing mandatory water use restrictions on its member agencies. Given the assumed absence of mandatory restrictions, the estimated minimum imported water supplies available to MWDOC from Metropolitan is assumed to be equal to Metropolitan's estimate of demand for firm supplies for MWDOC, which Metropolitan uses when considering whether to impose mandatory restrictions. Thus, the estimate of the minimum imported supplies available to MWDOC is 261,577 AF<sup>14</sup>.

MWDOC also has also adopted a shortage allocation plan and accompanying allocation model that estimates firm demands on MWDOC. Assuming MWDOC would not be imposing mandatory restrictions if Metropolitan is not, the estimate of firms demands in MWDOC's latest allocation model has been used to estimate the minimum imported supplies available to each of MWDOC's customer agencies for 2011-13. Thus, the estimate of the minimum imported supplies available to the City is 7,891 AF<sup>15</sup>.

<sup>14</sup> Metropolitan 2010/11 Water Shortage Allocation Plan model (March 2011)

<sup>15</sup> MWDOC Water Shortage Allocation model (August 2010)

As captured in its 2010 RUWMP, Metropolitan believes that the water supply and demand management actions it is undertaking will increase its reliability throughout the 25-year period addressed in its plan. Thus for purposes of this estimate, it is assumed that Metropolitan and MWDOC will be able to maintain the identified supply amounts throughout the three-year period.

Metropolitan projects reliability for full service demands through the year 2035. Additionally, through a variety of groundwater reliability programs conducted by OCWD and participated in by the City, local supplies are projected to be maintained at demand levels. Based on the MWDOC Water Supply Allocation Plan, the City is expected to fully meet demands for the next three years assuming Metropolitan and MWDOC are not in shortage, a Basin Production Percentage of 62% for Local Supplies and zero allocations are imposed for Imported Supplies. The Three Year Estimated Minimum Water Supply is listed in Table 5-3.

**Table 5-3: Three-Year Estimated Minimum Water Supply (AFY)**

| Source          | Year 1    | Year 2    | Year 3    |
|-----------------|-----------|-----------|-----------|
|                 | 2010/2011 | 2011/2012 | 2012/2013 |
| Local Supplies  | 10,267    | 10,267    | 10,267    |
| Imported Supply | 7,891     | 7,891     | 7,891     |
| Total           | 18,158    | 18,158    | 18,158    |

### 5.3. Catastrophic Supply Interruption

Given the great distances that imported supplies travel to reach Orange County, the region is vulnerable to interruptions along hundreds of miles aqueducts, pipelines and other facilities associated with delivering the supplies to the region. Additionally, this water is distributed to customers through an intricate network of pipes and water mains that are susceptible to damage from earthquakes and other disasters.

#### Metropolitan

Metropolitan has comprehensive plans for stages of actions it would undertake to address a catastrophic interruption in water supplies through its WSDM and WSAP Plans. Metropolitan also developed an Emergency Storage Requirement to mitigate against potential interruption in water supplies resulting from catastrophic occurrences within the southern California region, including seismic events along the San Andreas Fault. In addition, Metropolitan is working with the State to implement a comprehensive improvement plan to address catastrophic occurrences that could occur outside of the Southern California region, such as a maximum probable seismic event in the Delta that would cause levee failure and disruption of SWP deliveries. For greater detail on

Metropolitan's planned responses to catastrophic interruption, please refer to Metropolitan's RUWMP.

### **Water Emergency Response Organization of Orange County**

In 1983, the Orange County water community identified a need to develop a plan on how agencies would respond effectively to disasters impacting the regional water distribution system. The collective efforts of these agencies resulted in the formation of the Water Emergency Response Organization of Orange County (WEROC) to coordinate emergency response on behalf of all Orange County water and wastewater agencies, develop an emergency plan to respond to disasters, and conduct disaster training exercises for the Orange County water community. WEROC was established with the creation of an indemnification agreement between its member agencies to protect each other against civil liabilities and to facilitate the exchange of resources. WEROC is unique in its ability to provide a single point of contact for representation of all water and wastewater utilities in Orange County during a disaster. This representation is to the county, state, and federal disaster coordination agencies. Within the Orange County Operational Area, WEROC is the recognized contact for emergency response for the water community.

### **City of Newport Beach**

The City developed its Emergency Preparedness Plan in 1998 to meet emergencies within its service area and has updated the plan as necessary. The plan provides information on City operations, assigns responsibilities, and establishes general policies and procedures associated with operations during natural disasters, technological incidents, and nuclear defense emergencies.

Table 5-4 summarizes various possible catastrophes and a summary of the actions that would be taken in response.

**Table 5-4: Preparation Actions for Catastrophe**

| Possible Catastrophe  | Preparation Actions                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Regional Power Outage | Request information from SCE to determine how long outage will be. Pump Stations will automatically utilize back-up power through an auto-transfer switch. Utilize Metropolitan connections and emergency supply in Big Canyon Reservoir. Notify customers, media, state and local authorities if service is disrupted or significant demand management is necessary. |
| Earthquake            | The City would activate its EOC and each Department                                                                                                                                                                                                                                                                                                                   |

| Possible Catastrophe  | Preparation Actions                                                                                                                                                                                                                                                                                                                       |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | would activate their respective DOC's. All City departments are assigned specific functions as described in the Functional Responsibility Matrix. Each department will respond to, manage, and request mutual aid resources/personnel to respond to their assigned responsibilities. Issue boil alert of "do not drink" orders as needed. |
| Diemer Plant Shutdown | Request information from Metropolitan on length of shutdown. If insignificant, utilize emergency water storage or pump groundwater from wells to supply demand for all customers. Also, potentially implement water use prohibitions, depending on length and severity.                                                                   |
| Supply Contamination  | Notify Newport Beach Police Department and Department of Health Services. Attempt to isolate affected areas, in known, preventing spreading to other areas. Issue a "do not drink" or boil order as necessary. Provide alternate water supply to areas affected. Activation of EOC would depend on severity.                              |
| Flooding              | Request information from other City departments on the severity and location of the flooding, to determine the potential damage to facilities. Activation of DOC and potentially EOC, based on severity. Utilize portable pumps and generators at locations most affected.                                                                |
| Tsunami               | Emergency evacuation. Subsequently, possible activation of DOC and EOC based on severity. Have not fully addressed this event.                                                                                                                                                                                                            |

## 5.4. Prohibitions, Penalties and Consumption Reduction Methods

### Prohibitions

The Water Conservation and Supply Level Regulations Ordinance No. 2010-16 lists water conservation requirements which shall take effect upon implementation by the City Council. These prohibitions shall promote the efficient use of water, reduce or eliminate water waste, complement the City's Water Quality regulations and urban runoff reduction efforts, and enable implementation of the City's Water Shortage Contingency Measures. Prohibitions include, but are not limited to, restrictions on outdoor watering, washing of

vehicles, food preparation establishments, repairing of leaks and other malfunctions, swimming pools, decorative water features, construction activities, and water service provisions which can be found in Table 5-5.

**Table 5-5: Mandatory Prohibitions**

| Examples of Prohibitions                                                                                                                                                                                                                                                                                                                                                                                                                        | Stage When Prohibition Becomes Mandatory |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| The use of potable water to irrigate any lawn and/or ornamental landscape area using a landscape irrigation system or watering device that is not continuously attended is prohibited unless such irrigation is limited to no more than fifteen (15) minutes per day per station. Systems that lawfully use recycled water or use very low flow drip type irrigation systems, weather based controllers, or stream rotor sprinklers are exempt. | Year Round                               |
| Watering of any vegetated area in a manner that causes excessive water flow or runoff onto an adjoining sidewalk, street, driveway, alley, gutter, or ditch is prohibited.                                                                                                                                                                                                                                                                      | Year Round                               |
| Washing down sidewalks, walkways, drive ways, parking areas, or other paved surfaces is prohibited except as required to alleviate safety or sanitary hazards by use of a handheld container or hose equipped with an automatic shutoff device.                                                                                                                                                                                                 | Year Round                               |
| Leaks, breaks, and malfunctions in the water user's plumbing or distribution system must be repaired within seven (7) days notice by the City, unless other arrangements have been made with the City.                                                                                                                                                                                                                                          | Year Round                               |
| The use of potable water for landscape irrigation during a rainfall event is prohibited.                                                                                                                                                                                                                                                                                                                                                        | Year Round                               |
| By July 1, 2012, all landscape irrigation systems connected to dedicated landscape meters shall include rain sensors that automatically shut off such systems during periods of rain or include evapotranspiration systems that schedule irrigation based on climatic conditions.                                                                                                                                                               | Year Round                               |
| Water fountains and other decorative water features must use a re-circulating water system                                                                                                                                                                                                                                                                                                                                                      | Year Round                               |
| The use of water to clean a vehicle is prohibited except by use of a handheld container, hose equipped with an automatic shut off device, or at a commercial car washing facility.                                                                                                                                                                                                                                                              | Year Round                               |
| All new commercial conveyor car wash systems in commercial car washing facilities shall be                                                                                                                                                                                                                                                                                                                                                      | Year Round                               |

| Examples of Prohibitions                                                                                                                                                                                                                                                                                                                                                                       | Stage When Prohibition Becomes Mandatory |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| operational re-circulating water systems.                                                                                                                                                                                                                                                                                                                                                      |                                          |
| By January 1, 2013, all commercial conveyor car wash systems in commercial car washing facilities shall be operational re-circulating water systems, or the customer must have secured an exemption from this requirement.                                                                                                                                                                     | Year Round                               |
| No public place where food is sold, served, or offered for sale shall serve drinking water to customers unless requested.                                                                                                                                                                                                                                                                      | Year Round                               |
| Commercial lodging establishments must provide customers the option of not having towels and linen laundered daily.                                                                                                                                                                                                                                                                            | Year Round                               |
| No installation of a single pass cooling system.                                                                                                                                                                                                                                                                                                                                               | Year Round                               |
| All new washing machines installed in commercial and/or coin-operated laundries shall be ENERGY STAR® and CEE Tier III qualified. By January 1, 2014, all washing machines installed in commercial and/or coin-operated laundries shall be ENERGY STAR® and CEE Tier III qualified.                                                                                                            | Year Round                               |
| No customer shall use water from any fire hydrant for any purpose other than fire suppression or emergency aid without first: (1) requesting and posting the appropriate fees at the City, and (2) obtaining a hydrant meter to record all water consumption for a specified project.                                                                                                          | Year Round                               |
| No person shall use potable water for soil compaction or dust control in a construction site where there is an appropriate source of non-potable water approved by the Department of Public Health. No person shall operate a hose within a construction site that is not equipped with an automatic shutoff device, provided such devices are available for the size and type of hose in use. | Year Round                               |
| New or remodeled commercial kitchens shall be equipped with water conserving kitchen spray valves and best-available water-conserving technology.                                                                                                                                                                                                                                              | Year Round                               |
| Defrosting of food with running water is prohibited.                                                                                                                                                                                                                                                                                                                                           | Year Round                               |
| Scoop sinks shall be set at minimum water flow at all times and shut off during non-working hours.                                                                                                                                                                                                                                                                                             | Year Round                               |
| Hoses used for commercial kitchen areas must be equipped with an automatic shut off device.                                                                                                                                                                                                                                                                                                    | Year Round                               |



| Examples of Prohibitions                                                                                                                                                                                                                                                                                                                                                                                                                    | Stage When Prohibition Becomes Mandatory |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Watering or irrigation of vegetated areas is limited to four (4) days per week from April – October and two (2) days per week from November – March except by use of a hand held device, hose equipped with an automatic shutoff device, low flow irrigation systems, irrigation of food crops, for the express purpose of adjusting or repairing an irrigation system, or with approved recycled water.                                    | Level 1                                  |
| No customer shall use more water during any billing period than the percentage of the base amount established in the resolution declaring the Level One water supply shortage, whose percentage shall be in the range from one hundred (100) percent and ninety (90) percent of the base amount.                                                                                                                                            | Level 1                                  |
| Leaks, breaks, and malfunctions in the water user's plumbing or distribution system must be repaired within three (3) days notice by the City, unless other arrangements have been made with the City.                                                                                                                                                                                                                                      | Level 1                                  |
| Filling or refilling ornamental lakes and ponds more than once a week is prohibited. Ornamental lakes and ponds that sustain aquatic life of significant value and were actively managed prior to the storage declaration are exempt.                                                                                                                                                                                                       | Level 1                                  |
| The use of potable water to fill or refill by more than one foot a residential swimming pool or outdoor spa more than once a week is prohibited.                                                                                                                                                                                                                                                                                            | Level 1                                  |
| Watering or irrigation of vegetated areas is limited to the hours between 5 pm and 9:00 am three (3) days per week from April – October and one (1) day per week from November – March except by use of a hand held device, hose equipped with an automatic shutoff device, low flow irrigation systems, irrigation of food crops, for the express purpose of adjusting or repairing an irrigation system, or with approved recycled water. | Level 2                                  |
| No customer shall use more water during any billing period than the percentage of the base amount established in the resolution declaring the Level Two water supply shortage, which percentage shall be in the range from ninety (90) percent to seventy-five (75) percent of the base amount.                                                                                                                                             | Level 2                                  |
| Leaks, breaks, and malfunctions in the water user's                                                                                                                                                                                                                                                                                                                                                                                         | Level 2                                  |

| Examples of Prohibitions                                                                                                                                                                                                                                                                                                                                                                                                                  | Stage When Prohibition Becomes Mandatory |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| plumbing or distribution system must be repaired within two (2) days notice by the City, unless other arrangements have been made with the City.                                                                                                                                                                                                                                                                                          |                                          |
| Filling or refilling ornamental lakes and ponds more than once every other week is prohibited. Ornamental lakes and ponds that sustain aquatic life of significant value and were actively managed prior to the storage declaration are exempt.                                                                                                                                                                                           | Level 2                                  |
| The use of potable water to fill or refill by more than one foot a residential swimming pool or outdoor spa more than once a week is prohibited.                                                                                                                                                                                                                                                                                          | Level 2                                  |
| Watering or irrigation of vegetated areas is limited to the hours between 5 pm and 9:00 am two (2) days per week from April – October and one (1) day per week from November – March except by use of a hand held device, hose equipped with an automatic shutoff device, low flow irrigation systems, irrigation of food crops, for the express purpose of adjusting or repairing an irrigation system, or with approved recycled water. | Level 3                                  |
| No customer shall use more water during any billing period than the percentage of the base amount established in the resolution declaring the Level Three water shortage, whose percentage shall be in the range from seventy-five (75) percent and sixty (60) percent of the base amount.                                                                                                                                                | Level 3                                  |
| Leaks, breaks, and malfunctions in the water user's plumbing or distribution system must be repaired within one (1) day notice by the City, unless other arrangements have been made with the City.                                                                                                                                                                                                                                       | Level 3                                  |
| Filling or refilling ornamental lakes and ponds is prohibited. Ornamental lakes and ponds that sustain aquatic life of significant value and were actively managed prior to the storage declaration are exempt.                                                                                                                                                                                                                           | Level 3                                  |
| The use of potable water to fill or refill a residential swimming pool or outdoor spa is prohibited.                                                                                                                                                                                                                                                                                                                                      | Level 3                                  |
| Irrigation of any vegetated area with potable water is prohibited except by use of a hand held container or hose equipped with an automatic shut off device. Maintenance of landscape to the extent necessary for fire and/or erosion protection is exempt. Maintenance of plant materials identified to be rare or essential to the well being of rare                                                                                   | Level 4                                  |

| Examples of Prohibitions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Stage When Prohibition Becomes Mandatory |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| <p>animals is exempt. Maintenance of landscape within active public parks and playing fields, day care centers, school grounds, cemeteries, and golf course greens is exempt provided that such irrigation does not exceed two times per week. Public work projects and actively irrigated environmental projects are exempt. Food crops, provided that such irrigation does not exceed two times per week, are exempt.</p>                                                                                                                   |                                          |
| <p>No new potable water service, meters, or will-serve letters will be provided except under one or more of the following:</p> <ul style="list-style-type: none"> <li>a. Projects necessary to protect public health, safety, and/or well being.</li> <li>b. Projects with a valid unexpired building permit.</li> <li>c. Projects with applicants who can provide substantial evidence of an enforceable commitment that water demands will be offset prior to the provision of new water meters to the satisfaction of the City.</li> </ul> | <p>Level 4</p>                           |
| <p>No customer shall use more water during any billing period than the percentage of the base amount established in the resolution declaring the Level Four water shortage, which percentage shall be less than sixty (60) percent of the base amount.</p>                                                                                                                                                                                                                                                                                    | <p>Level 4</p>                           |

## Consumption Reduction Methods

Reductions in water consumption by the City during water shortages will reduce MWDOC's overall demands on Metropolitan. Under the ordinance, the City has the authority of allocating available supplies as deemed necessary under the water conservation phases. Consumption Reduction Methods are listed in Table 5-6.

**Table 5-6: Consumption Reduction Methods**

| Consumption Reduction Methods    | Stage When Method Takes Effect | Projected Reduction (%)               |
|----------------------------------|--------------------------------|---------------------------------------|
| Year Round Conservation Measures |                                | To be determined by the City Council. |
| Level 1 Conservation Measures    | 1                              |                                       |
| Level 2 Conservation Measures    | 2                              |                                       |
| Level 3 Conservation Measures    | 3                              |                                       |
| Level 4 Conservation Measures    | 4                              |                                       |

### Penalties for Excessive Use

Any customer who violates provisions of the Water Conservation and Supply Level Regulations by either excess use of water or by specific violation of one or more of the applicable water use restrictions for a particular mandatory conservation stage may be cited by the City and may be subject to written notices, surcharges, fines, flow restrictions, service disconnection, and/or service termination which are detailed in Table 5-7.

**Table 5-7: Penalties and Charges**

| Penalties or Charges                  | Stage When Penalty Takes Effect              |
|---------------------------------------|----------------------------------------------|
| Written Notice                        | First Violation                              |
| Installation of Water Flow Restrictor | Second and Subsequent Violations             |
| Termination of Service                | Willful violations of mandatory restrictions |

## 5.5. Impacts to Revenue

The actions described above to address a range of water shortage conditions have the potential to impact the City's revenues and expenditures. To assess these impacts, the City calculated the revenue impacts resulting from a 10%, 20% and 50% reduction in sales as compared to a base year that was based on an estimate of normal year baseline. Other factors incorporated into the analysis included water losses, pricing structure and avoided costs. The results of this analysis are shown below in Table 5-8.

**Table 5-8: Revenue Impacts Analysis**

| <b>Demand</b>                          | <b>Baseline</b> | <b>10%</b>           | <b>20%</b>           | <b>50%</b>           |
|----------------------------------------|-----------------|----------------------|----------------------|----------------------|
| Water Sales (HCF)                      | 6,514,518       | 5,863,066            | 5,211,614            | 3,257,259            |
| <b>Revenue</b>                         |                 |                      |                      |                      |
| Tier 1 Revenue                         | \$16,025,714    | \$14,423,143         | \$12,820,571         | \$11,218,000         |
| Fixed Monthly/Bimonthly Charge Revenue | \$4,884,770     | \$4,884,770          | \$4,884,770          | \$4,884,770          |
| Total Rate Revenue                     | \$20,910,484    | \$19,307,913         | \$17,705,341         | \$12,897,627         |
| <b>Revenue Lost</b>                    |                 | <b>(\$1,602,571)</b> | <b>(\$3,205,143)</b> | <b>(\$8,012,857)</b> |
| <b>Variable Costs</b>                  |                 |                      |                      |                      |
| Water Produced/Purchased(\$)           | \$8,017,810     | \$7,216,029          | \$6,414,248          | \$4,008,905          |
| <b>Avoided Costs</b>                   |                 | <b>\$801,781</b>     | <b>\$1,603,562</b>   | <b>\$4,008,905</b>   |
| <b>Net Revenue Change</b>              |                 | <b>(\$800,790)</b>   | <b>(\$1,601,581)</b> | <b>(\$4,003,952)</b> |

Anticipated shortfalls in projected revenue due to water supply shortages would need to be covered through increased water rates and/or an advance from funds set aside by the City. The existing rate structure could be adjusted to recapture a portion of the lost revenue, which would affect all water users within the City's service area. The City has a Water Rate Stabilization Fund to be used in times of drought and emergencies to offset the loss of revenue. The City could also advance funds from its General Fund for the loss of essential revenue.

## 5.6. Reduction Measuring Mechanism

In order to quantify actual reductions in water use, several measuring mechanisms must be utilized. Water Use Monitoring Mechanisms ranging from water meter auditing, daily production monitoring, distribution records, and monitoring employees are listed in Table 5-9.

**Table 5-9: Water Use Monitoring Mechanisms**

| <b>Mechanisms for Determining Actual Reductions</b> | <b>Type of Data Expected</b>                                                                                                                                                                                                                              |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Water meter auditing                                | Actual reduction of water used for meters over one-inch                                                                                                                                                                                                   |
| Monitor daily production/distribution records       | Daily production and distribution records would be monitored. The data is recorded by zone, which would enable City staff to determine which zone was using more water than expected. Customers would be alerted to actual water use (increase/decrease). |
| Monitoring Employee                                 | City Code Enforcement Staff employee would monitor all unnecessary domestic irrigation use and serve on the “dawn” patrol to verify that residences and irrigation customers are not over-watering in the early hours of the day.                         |

## 6. Recycled Water

### 6.1. Agency Coordination

Recycled water is defined as domestic wastewater purified through primary, secondary and tertiary treatment. Recycled water is acceptable for most non-potable water purposes such as irrigation, commercial, and industrial processes. The City maintains an agreement with OCWD to supply Green Acres Project (GAP) water to customers where available. The addition of this supplemental water will reduce the demand on the City's water supply, thereby providing additional reserves for firefighting capacity, preserving potable water for drinking, and ensuring landscape irrigation during period of drought. Use of recycled water is expected to continue an upward trend in the City; throughout the County of Orange and all throughout the state of California.

The City continues to support regional efforts to increase the use of recycled water. Because the City produces a majority of its water supply from the Basin, the City benefits from the actions of OCWD using recycled water to protect the Basin through seawater intrusion barriers and groundwater recharge basins. The City, therefore, indirectly benefits from this regional use of recycled water.

**Table 6-1: Participating Agencies**

| Participating Agencies | Participated  |
|------------------------|---------------|
| Water Agencies         | Newport Beach |
| Wastewater Agencies    | OCSD          |
| Groundwater Agencies   | OCWD          |

### 6.2. Wastewater Description and Disposal

Within its service area, the City is responsible for wastewater collection and conveyance to the Orange County Sanitation District (OCSD) sewer treatment plant, located in Huntington Beach. OCSD also treats wastewater from several other municipalities. OCSD discharges treated water into the ocean through a 120-inch diameter ocean outfall pipe that extends five miles offshore to the discharge point. A standby 78-inch diameter outfall pipeline stretches one mile from shore. The treatment levels meet all current State and Federal requirements. OCSD also sends up to 10 mgd of treated wastewater every day to the Orange County Water District for further processing for landscape irrigation and for injection into the groundwater seawater intrusion barrier.

Within the City's service area, discharge of treated wastewater is regulated by the Regional Water Quality Control Board (RWQCB). In general, the majority of the wastewater generated and treated during the summer months is used for alternative beneficial uses such as wetland habitat and restoration and irrigation for golf courses. The use of the recycled water helps supply part of the water demand during the peak summer months.

Table 6-2 summarizes the past, current, and projected wastewater volumes collected and treated, and the quantity of wastewater treated to recycled water standards for treatment plants within OCSD's service area. Table 6-3 summarizes the disposal method, and treatment level of discharge volumes.

**Table 6-2: Wastewater Collection and Treatment (AFY)**

| Type of Wastewater                             | Fiscal Year Ending |         |         |         |         |         |          |
|------------------------------------------------|--------------------|---------|---------|---------|---------|---------|----------|
|                                                | 2005               | 2010    | 2015    | 2020    | 2025    | 2030    | 2035-opt |
| Wastewater Collected & Treated in Service Area | 273,017            | 232,348 | 302,400 | 312,704 | 321,104 | 329,392 | 333,536  |
| Volume that Meets Recycled Water Standards     | 12,156             | 75,000  | 105,000 | 105,000 | 105,000 | 105,000 | 105,000  |

**Table 6-3: Disposal of Wastewater (Non-Recycled) (AFY)**

| Method of Disposal | Treatment Level | Fiscal Year Ending |         |         |         |         |          |
|--------------------|-----------------|--------------------|---------|---------|---------|---------|----------|
|                    |                 | 2010               | 2015    | 2020    | 2025    | 2030    | 2035-opt |
| Ocean Outfall      | Secondary       | 157,348            | 197,400 | 207,704 | 216,104 | 224,392 | 228,536  |

### 6.3. Current Recycled Water Uses

The City has approximately 10 miles of recycled water distribution pipeline, which currently supplies eight recycled use sites.

Recycled water is supplied to the City from the Orange County Water District (OCWD) from Fountain Valley as part of OCWD's Green Acres Project. OCWD produces approximately 7.5 MGD of tertiary treated, disinfected recycled water. Some of the sites served by recycled water include the Newport Beach County Club, the Big Canyon Country Club, median strips, and a City owned park. In FY 2009-10, approximately 400 AF of recycled water was used in the City's service area for landscape irrigation, about 3% of the City's annual water demand.



Table 6-4 below illustrates the current uses for recycled water in the City. The usage is limited to landscape irrigation with a tertiary treatment level.

**Table 6-4: Current Recycled Water Uses (AFY)**

| User Type            | Treatment Level | Fiscal Year Ending |
|----------------------|-----------------|--------------------|
|                      |                 | 2010               |
| Agriculture          |                 |                    |
| Landscape            | Tertiary        | 432                |
| Wildlife Habitat     |                 |                    |
| Wetlands             |                 |                    |
| Industrial           |                 |                    |
| Groundwater Recharge |                 |                    |
| <b>Total</b>         |                 | <b>432</b>         |

## 6.4. Potential Recycled Water Uses

Potential recycled water users are locations where recycled water could replace potable water use. These potential users are typically landscape or agricultural irrigation systems, or possibly water users. However, due to the limited access to the project mains and some financial impact on end users, it is not feasible to distribute all of the potential recycled water, and the City does not predict that there will be many other end users in the near future.

Tables 6-5 and 6-6 represent projected recycled water use within the City's service area through 2035. Recycled water use will remain constant through the 25-year period, with landscape irrigation as its sole use.

**Table 6-5: Projected Future Use of Recycled Water in Service Area (AFY)**

| User Type                       | Fiscal Year Ending |      |      |      |      |          |
|---------------------------------|--------------------|------|------|------|------|----------|
|                                 | 2010               | 2015 | 2020 | 2025 | 2030 | 2035-opt |
| Projected Use of Recycled Water | 432                | 450  | 500  | 500  | 500  | 500      |

**Table 6-6: Projected Recycled Water Uses (AFY)**

| User Type            | Treatment Level | Fiscal Year Ending |            |            |            |            |
|----------------------|-----------------|--------------------|------------|------------|------------|------------|
|                      |                 | 2015               | 2020       | 2025       | 2030       | 2035-opt   |
| Agriculture          |                 |                    |            |            |            |            |
| Landscape            | Tertiary        | 450                | 500        | 500        | 500        | 500        |
| Wildlife Habitat     |                 |                    |            |            |            |            |
| Wetlands             |                 |                    |            |            |            |            |
| Industrial           |                 |                    |            |            |            |            |
| Groundwater Recharge |                 |                    |            |            |            |            |
| <b>Total</b>         |                 | <b>450</b>         | <b>500</b> | <b>500</b> | <b>500</b> | <b>500</b> |

Table 6-7 compares the recycled water use projections from the City's 2005 UWMP with actual 2010 recycled water use.

**Table 6-7: Recycled Water Uses – 2005 Projections compared with 2010 Actual (AFY)**

| User Type            | 2005 Projection for 2010 | 2010 Actual Use |
|----------------------|--------------------------|-----------------|
| Agriculture          |                          |                 |
| Landscape            | 444                      | 432             |
| Wildlife Habitat     |                          |                 |
| Wetlands             |                          |                 |
| Industrial           |                          |                 |
| Groundwater Recharge |                          |                 |
| <b>Total</b>         | <b>444</b>               | <b>432</b>      |

#### **6.4.1. Direct Non-Potable Reuse**

The City currently uses recycled water from OCWD's Green Acres Project for direct non-potable reuse such as landscape irrigation.

#### **6.4.2. Indirect Potable Reuse**

The City benefits indirectly from the replenishment of the Orange County groundwater basin using GWRS water that meets state and federal drinking water standards for potable reuse.

## **6.5. Optimization Plan**

To promote the use of recycled water, the City provides financial incentives by offering a 20 percent discount off potable water rates. The current rate for recycled users is \$1.66 per unit (one unit equals 748 gallons).

In Orange County, the majority of recycled water is used for irrigating golf courses, parks, schools, business and communal landscaping. However, future recycled water use can increase by requiring dual piping in new developments, retrofitting existing landscaped areas and constructing recycled water pumping stations and transmission mains to reach areas far from the treatment plants. Gains in implementing some of these projects have been made throughout the county; however, the additional costs, large energy requirements, and facilities make such projects very expensive to pursue.

The City will conduct future cost/benefit analyses for recycled water projects, and seek creative solutions and a balance to recycled water use, in coordination with MWDOC, OCWD, Metropolitan and other cooperative agencies. These include solutions for funding, regulatory requirements, institutional arrangements and public acceptance.

## **7. Future Water Supply Projects and Programs**

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### **7.1. Water Management Tools**

Resource optimization such as desalination to minimize the needs for imported water is led by the regional agencies in collaboration with local agencies.

With the eventual replacement of older wells with new more efficient wells, increasing the capacity of existing booster stations, and continued efforts in reducing water waste, the City can meet projected demands with existing facilities and distribution system.

### **7.2. Transfer or Exchange Opportunities**

MWDOC will continue to help its member agencies in developing Transfer or Exchange opportunities and ensuring their success. In fulfilling this role, MWDOC will look to help its member agencies navigate the operational and administrative issues of wheeling water through the Metropolitan water distribution system.

The City relies on the efforts of Metropolitan as well as MWDOC to pursue transfer or exchange opportunities. At this time, the City is not currently involved in any transfer or exchange opportunities.

### **7.3. Planned Water Supply Projects and Programs**

At this time, the City does not have any planned water supply projects or programs.

### **7.4. Desalination Opportunities**

Desalination is viewed as a way to develop a local, reliable source of water that assists agencies reduce their demand on imported water, reduce groundwater overdraft, and in some cases make unusable groundwater available for municipal uses. Currently, there are no identified projects within the City for desalination of seawater or impaired groundwater. However, from a regional perspective, desalination projects within the region indirectly benefit the City.

In Orange County, there are three proposed ocean desalination projects that could serve MWDOC, including one specifically that may benefit the City. These are the Huntington Beach Seawater Desalination Project, the South Orange Coastal Desalination Project, and the Camp Pendleton Seawater Desalination Project.

**Table 7-1: Opportunities for Desalinated Water**

| Sources of Water     | Check if Yes |
|----------------------|--------------|
| Ocean Water          | X            |
| Brackish Ocean Water | X            |
| Brackish Groundwater |              |

#### 7.4.1. Groundwater

There are currently no brackish groundwater opportunities within the City's service area.

#### 7.4.2. Ocean Water

***Huntington Beach Seawater Desalination Project*** – Poseidon Resources LLC (Poseidon), a private company, has proposed development of the Huntington Beach Seawater Desalination Project to be located adjacent to the AES Generation Power Plant in the City of Huntington Beach along Pacific Coast Highway and Newland Street. The proposed project would produce up to 50 MGD (56,000 AFY) of drinking water and will distribute water to coastal and south Orange County to provide approximately 8% of Orange County's water supply needs. The project supplies would be distributed to participating agencies through a combination of (1) direct deliveries through facilities including the East Orange County Feeder #2 (EOCF #2), the City of Huntington Beach's distribution system, and the West Orange County Water Board Feeder #2 (WOCWBF #2), and (2) water supply exchanges with agencies with no direct connection to facilities associated with the Project.

Poseidon had received non-binding Letters of Intent (LOI) from the Municipal Water District of Orange County and 17 retail water agencies to purchase a total of approximately 72 MGD (88,000 AFY) of Project supplies. On January 20, 2010, the City signed a non-binding LOI for 7.1 MGD (8,000 AFY) of Project supplies.

The Project has received specific approvals from the Huntington Beach City Council, including the Coastal Development Permit, Tentative Parcel Map, Subsequent Environmental Impact Report and Conditional Use Permit, which collectively provided for the long-term operation of the desalination facility.

In addition to final agreements with the participating agencies, the Project still needs approvals from the State Lands Commission and the California Coastal Commission before Poseidon can commence construction of the desalination facility in Huntington Beach. A public hearing on the Project before the State Lands Commission is expected as early as this October. If project receives all required permits by 2011, it could be producing drinking water for Orange County by as soon as 2013.

***South Orange Coastal Desalination Project*** – MWDOC is proposing a desalination project in joint with Laguna Beach County Water District, Moulton Niguel Water District, City of San Clemente, City of San Juan Capistrano, South Coast Water District, and Metropolitan. The project is to be located adjacent to the San Juan Creek in Dana Point just east of the transition road from PCH to the I-5. The project will provide 15 MGD (16,000 AFY) of drinking water and will provide up to 30% of its potable water supply to the participating agencies.

Phase 1 consists of drilling 4 test borings and installing monitoring wells. Phase 2 consists of drilling, constructing and pumping a test slant well. Phase 3 consists of constructing a Pilot Test Facility to collect and assess water quality. Phases 1 and 2 have been completed and Phase 3 commenced in June 2010 and will last 18 months.

If pumping results are favorable after testing, a full-scale project description and EIR will be developed. If EIR is adopted and necessary permits are approved, project could be operational by 2016.

***Camp Pendleton Seawater Desalination Project*** – San Diego County Water Authority (SDCWA) is proposing a desalination project in joint with Metropolitan to be located at Camp Pendleton Marine Corps Base adjacent to the Santa Margarita River. The initial project would be a 50 or 100 MGD plant with expansions in 50 MGD increments up to a max of 150 MGD making this the largest proposed desalination plant in the US.

The project is currently in the study feasibility stage and is conducting geological surveys to study the effect on ocean life and examining routes to bring desalination to SDCWA's delivery system. MWDOC and south Orange County agencies are maintaining a potential interest in the project, but at this time is only doing some limited fact finding and monitoring of the project.

## 8. UWMP Adoption Process

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### 8.1. Overview

Recognizing that close coordination among other relevant public agencies is the key to the success of its UWMP, the City worked closely with other entities such as MWDOC to develop and update this planning document. The City also encouraged public involvement through the holding of a public hearing to learn and ask questions about their water supply.

This section provides the information required in Article 3 of the Water Code related to adoption and implementation of the UWMP. Table 8-1 summarizes external coordination and outreach activities carried out by the City and their corresponding dates. The UWMP checklist to confirm compliance with the Water Code is provided in Appendix A.

**Table 8-1: External Coordination and Outreach**

| <b>External Coordination and Outreach</b>                                                                                                          | <b>Date</b>                 | <b>Reference</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------|
| Encouraged public involvement (Public Hearing)                                                                                                     | May 28, 2011 & June 4, 2011 | Appendix G       |
| Notified city or county within supplier's service area that water supplier is preparing an updated UWMP (at least 60 days prior to public hearing) | March 22, 2011              | Appendix F       |
| Held public hearing                                                                                                                                | June 14, 2011               | Appendix G       |
| Adopted UWMP                                                                                                                                       | June 14, 2011               | Appendix H       |
| Submitted UWMP to DWR (no later than 30 days after adoption)                                                                                       | July 14, 2011               |                  |
| Submitted UWMP to the California State Library and city or county within the supplier's service area (no later than 30 days after adoption)        | July 14, 2011               |                  |
| Made UWMP available for public review (no later than 30 days after filing with DWR)                                                                | August 13, 2011             |                  |

This UWMP was adopted by the City Council on June 14, 2011. A copy of the adopted resolution is provided in Appendix H.

A change from the 2004 legislative session to the 2009 legislative session required the City to notify any city or county within its service area at least 60 days prior to the public

hearing. The City sent a Letter of Notification to the County of Orange on March 22, 2011 that it is in the process of preparing an updated UWMP (Appendix F).

## 8.2. Public Participation

The City encouraged community and public interest involvement in the plan update through public hearings and inspection of the draft document. Public hearing notifications were published in local newspapers. A copy of the published Notice of Public Hearing is included in Appendix G. The hearing provided an opportunity for all residents and employees in the service area to learn and ask questions about their water supply in addition to the City's plans for providing a reliable, safe, high-quality water supply. Copies of the draft plan were made available for public inspection at the City Clerk's and Utilities Department offices.

## 8.3. Agency Coordination

All of the City's water supply planning relates to the policies, rules, and regulations of its regional and local water providers. The City is dependent on imported water from Metropolitan through MWDOC, its regional wholesaler. The City is also dependent on groundwater from OCWD, the agency which manages the Santa Ana River Groundwater Basin as well as provides recycled water in partnership with the Orange County Sanitation District (OCSD). As such, the City involved these water providers in the development of its 2010 UWMP at various levels of contribution as summarized in Table 8-2.

**Table 8-2: Coordination with Appropriate Agencies**

|                  | Participated in Plan Development | Commented on Draft | Attended Public Meetings | Contacted for Assistance | Sent Copy of Draft Plan | Sent Notice of Intention to Adopt | Not Involved/No Information |
|------------------|----------------------------------|--------------------|--------------------------|--------------------------|-------------------------|-----------------------------------|-----------------------------|
| MWDOC            | X                                |                    |                          | X                        |                         |                                   |                             |
| Metropolitan     | X                                |                    |                          |                          |                         |                                   |                             |
| OCWD             | X                                |                    |                          |                          |                         |                                   |                             |
| County of Orange |                                  |                    |                          |                          |                         | X                                 |                             |

As a member agency of MWDOC, MWDOC provided assistance to the City's 2010 UWMP development by providing much of the data and analysis such as, population projections from the California State University at Fullerton, Center of Demographic



Research (CDR) and SBx7-7 modeling. MWDOC provided information that quantifies water availability to meet their projected demands for the next 25 years, in five-year increments. Based on the projections of retail demand and local supplies completed by the City, and the imported supply availability described in Metropolitan's 2010 RUWMP, MWDOC prepared an informational package with data specific to the City, that incorporated additional calculations for the required planning efforts. The City's UWMP was developed in collaboration with MWDOC's 2010 RUWMP to ensure consistency between the two documents as well as Metropolitan's 2010 RUWMP and 2010 Integrated Water Resources Plan.

As a groundwater producer who relies on supplies from the OCWD-managed Orange County Groundwater Basin, the City coordinated the preparation of this 2010 UWMP with OCWD. OCWD provided projections of the amount of groundwater, the City is allowed to extract in the 25-year planning horizon. In addition, information from OCWD's 2009 Groundwater Management Plan and 2008-2009 Engineer's Report were incorporated in this document where relevant.

## **8.4. UWMP Submittal**

### **8.4.1. Review of Implementation of 2005 UWMP**

As required by California Water Code, the City summarizes the implementation of the Water Conservation and Water Recycling Programs to date, and compares the implementation to those as planned in its 2005 UWMP.

#### **Comparison of 2005 Planned Water Conservation Programs with 2010 Actual Programs**

As a signatory to the MOU regarding urban water use efficiency, the City's commitment to implement BMP-based water use efficiency program continues today. For the City's specific achievements in the area of conservation, please see Section 4 of this Plan.

#### **Comparison of 2005 Projected Recycled Water Use with 2010 Actual Use**

Current recycled water projections for the City in 2010 are about 3% less than previously forecasted for 2010 in the 2005 UWMP, as illustrated in Table 6-7.

### **8.4.2. Filing of 2010 UWMP**

The City Council reviewed the Final Draft Plan on June 14, 2011. The seven-member City Council approved the 2010 UWMP on June 14, 2011. See Appendix H for the resolution approving the Plan.

By July 14, 2011, the City's Adopted 2010 UWMP was filed with DWR, California State Library, County of Orange, and cities within its service area.

## Appendices

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- A. Urban Water Management Plan Checklist
- B. Orange County Water District Groundwater Management Plan 2009 Update
- C. Calculation of Dry Year Demands
- D. CUWCC BMP Retail Coverage Report 2009-2010
- E. Chapter 14.16 Water Conservation and Supply Level Regulations, Chapter 14.17 Water-Efficient Landscaping Regulations, Chapter 14.36 Water Quality
- F. 60 Day Notification Letters
- G. Public Hearing Notice
- H. Copy of Plan Adoption

## Appendix A

### Urban Water Management Plan Checklist

### Urban Water Management Plan checklist, organized by subject

| No.                     | UWMP requirement <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Calif. Water<br>Code reference | Additional clarification | UWMP location |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|--------------------------|---------------|
| <b>PLAN PREPARATION</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                |                          |               |
| 4                       | Coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable.                                                                                                                                                                                                                                                              | 10620(d)(2)                    |                          | Section 8.3   |
| 6                       | Notify, at least 60 days prior to the public hearing on the plan required by Section 10642, any city or county within which the supplier provides water that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. Any city or county receiving the notice may be consulted and provide comments.                                                                                                                                               | 10621(b)                       |                          | Appendix F    |
| 7                       | Provide supporting documentation that the UWMP or any amendments to, or changes in, have been adopted as described in Section 10640 et seq.                                                                                                                                                                                                                                                                                                                                                      | 10621(c)                       |                          | Section 8.4   |
| 54                      | Provide supporting documentation that the urban water management plan has been or will be provided to any city or county within which it provides water, no later than 60 days after the submission of this urban water management plan.                                                                                                                                                                                                                                                         | 10635(b)                       |                          | Section 8.4   |
| 55                      | Provide supporting documentation that the water supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan.                                                                                                                                                                                                                                                         | 10642                          |                          | Section 8.2   |
| 56                      | Provide supporting documentation that the urban water supplier made the plan available for public inspection and held a public hearing about the plan. For public agencies, the hearing notice is to be provided pursuant to Section 6066 of the Government Code. The water supplier is to provide the time and place of the hearing to any city or county within which the supplier provides water. Privately-owned water suppliers shall provide an equivalent notice within its service area. | 10642                          |                          | Appendix G    |
| 57                      | Provide supporting documentation that the plan has been adopted as prepared or modified.                                                                                                                                                                                                                                                                                                                                                                                                         | 10642                          |                          | Appendix H    |
| 58                      | Provide supporting documentation as to how the water supplier plans to implement its plan.                                                                                                                                                                                                                                                                                                                                                                                                       | 10643                          |                          | Section 8.4   |

| No.                       | UWMP requirement a                                                                                                                                                                                                                                                                                                                            | Calif. Water<br>Code reference | Additional clarification                                                                                                                    | UWMP location                  |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| 59                        | Provide supporting documentation that, in addition to submittal to DWR, the urban water supplier has submitted this UWMP to the California State Library and any city or county within which the supplier provides water supplies a copy of its plan no later than 30 days after adoption. This also includes amendments or changes.          | 10644(a)                       |                                                                                                                                             | Section 8.4                    |
| 60                        | Provide supporting documentation that, not later than 30 days after filing a copy of its plan with the department, the urban water supplier has or will make the plan available for public review during normal business hours                                                                                                                | 10645                          |                                                                                                                                             | Section 8.4                    |
| <b>SYSTEM DESCRIPTION</b> |                                                                                                                                                                                                                                                                                                                                               |                                |                                                                                                                                             |                                |
| 8                         | Describe the water supplier service area.                                                                                                                                                                                                                                                                                                     | 10631(a)                       |                                                                                                                                             | Section 1.3.1                  |
| 9                         | Describe the climate and other demographic factors of the service area of the supplier                                                                                                                                                                                                                                                        | 10631(a)                       |                                                                                                                                             | Section 2.2.1                  |
| 10                        | Indicate the current population of the service area                                                                                                                                                                                                                                                                                           | 10631(a)                       | Provide the most recent population data possible. Use the method described in "Baseline Daily Per Capita Water Use." See Section M          | Section 2.2.2                  |
| 11                        | Provide population projections for 2015, 2020, 2025, and 2030, based on data from State, regional, or local service area population projections.                                                                                                                                                                                              | 10631(a)                       | 2035 and 2040 can also be provided to support consistency with Water Supply Assessments and Written Verification of Water Supply documents. | Section 2.2.2                  |
| 12                        | Describe other demographic factors affecting the supplier's water management planning.                                                                                                                                                                                                                                                        | 10631(a)                       |                                                                                                                                             | Section 2.2.3                  |
| <b>SYSTEM DEMANDS</b>     |                                                                                                                                                                                                                                                                                                                                               |                                |                                                                                                                                             |                                |
| 1                         | Provide baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data.                                                                                                | 10608.20(e)                    |                                                                                                                                             | Section 2.4.4<br>Section 2.4.5 |
| 2                         | Wholesalers: Include an assessment of present and proposed future measures, programs, and policies to help achieve the water use reductions. Retailers: Conduct at least one public hearing that includes general discussion of the urban retail water supplier's implementation plan for complying with the Water Conservation Bill of 2009. | 10608.36<br>10608.26(a)        | Retailers and wholesalers have slightly different requirements                                                                              | Appendix G<br>Section 2.4.6    |

| No.                    | UWMP requirement <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                      | Calif. Water Code reference | Additional clarification                                                                                                                                   | UWMP location  |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 3                      | Report progress in meeting urban water use targets using the standardized form.                                                                                                                                                                                                                                                                                                    | 10608.40                    |                                                                                                                                                            | Not applicable |
| 25                     | Quantify past, current, and projected water use, identifying the uses among water use sectors, for the following: (A) single-family residential, (B) multifamily, (C) commercial, (D) industrial, (E) institutional and governmental, (F) landscape, (G) sales to other agencies, (H) saline water intrusion barriers, groundwater recharge, conjunctive use, and (I) agriculture. | 10631(e)(1)                 | Consider 'past' to be 2005, present to be 2010, and projected to be 2015, 2020, 2025, and 2030. Provide numbers for each category for each of these years. | Section 2.3    |
| 33                     | Provide documentation that either the retail agency provided the wholesale agency with water use projections for at least 20 years, if the UWMP agency is a retail agency, OR, if a wholesale agency, it provided its urban retail customers with future planned and existing water source available to it from the wholesale agency during the required water-year types          | 10631(k)                    | Average year, single dry year, multiple dry years for 2015, 2020, 2025, and 2030.                                                                          | Section 2.5    |
| 34                     | Include projected water use for single-family and multifamily residential housing needed for lower income households, as identified in the housing element of any city, county, or city and county in the service area of the supplier.                                                                                                                                            | 10631.1(a)                  |                                                                                                                                                            | Section 2.5.2  |
| <b>SYSTEM SUPPLIES</b> |                                                                                                                                                                                                                                                                                                                                                                                    |                             |                                                                                                                                                            |                |
| 13                     | Identify and quantify the existing and planned sources of water available for 2015, 2020, 2025, and 2030.                                                                                                                                                                                                                                                                          | 10631(b)                    | The 'existing' water sources should be for the same year as the "current population" in line 10. 2035 and 2040 can also be provided.                       | Section 3.1    |
| 14                     | Indicate whether groundwater is an existing or planned source of water available to the supplier. If yes, then complete 15 through 21 of the UWMP Checklist. If no, then indicate "not applicable" in lines 15 through 21 under the UWMP location column.                                                                                                                          | 10631(b)                    | Source classifications are: surface water, groundwater, recycled water, storm water, desalinated sea water, desalinated brackish groundwater, and other.   | Section 3.3    |
| 15                     | Indicate whether a groundwater management plan been adopted by the water supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization.                                                                                                                                                                         | 10631(b)(1)                 |                                                                                                                                                            | Appendix B     |
| 16                     | Describe the groundwater basin.                                                                                                                                                                                                                                                                                                                                                    | 10631(b)(2)                 |                                                                                                                                                            | Section 3.3    |
| 17                     | Indicate whether the groundwater basin is adjudicated? Include a copy of the court order or decree.                                                                                                                                                                                                                                                                                | 10631(b)(2)                 |                                                                                                                                                            | Not applicable |

| No. | UWMP requirement <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Calif. Water Code reference | Additional clarification                            | UWMP location  |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------|----------------|
| 18  | Describe the amount of groundwater the urban water supplier has the legal right to pump under the order or decree. If the basin is not adjudicated, indicate "not applicable" in the UWMP location column.                                                                                                                                                                                                                                                                                                                                                                           | 10631(b)(2)                 |                                                     | Not applicable |
| 19  | For groundwater basins that are not adjudicated, provide information as to whether DWR has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition. If the basin is adjudicated, indicate "not applicable" in the UWMP location column. | 10631(b)(2)                 |                                                     | Section 3.3    |
| 20  | Provide a detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years                                                                                                                                                                                                                                                                                                                                                                                                                       | 10631(b)(3)                 |                                                     | Section 3.3.6  |
| 21  | Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped.                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 10631(b)(4)                 | Provide projections for 2015, 2020, 2025, and 2030. | Section 3.3.7  |
| 24  | Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 10631(d)                    |                                                     | Section 7.2    |
| 30  | Include a detailed description of all water supply projects and programs that may be undertaken by the water supplier to address water supply reliability in average, single-dry, and multiple-dry years, excluding demand management programs addressed in (f)(1). Include specific projects, describe water supply impacts, and provide a timeline for each project.                                                                                                                                                                                                               | 10631(h)                    |                                                     | Section 7.3    |
| 31  | Describe desalinated water project opportunities for long-term supply, including, but not limited to, ocean water, brackish water, and groundwater.                                                                                                                                                                                                                                                                                                                                                                                                                                  | 10631(i)                    |                                                     | Section 7.4    |
| 44  | Provide information on recycled water and its potential for use as a water source in the service area of the urban water supplier. Coordinate with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area.                                                                                                                                                                                                                                                                                                                      | 10633                       |                                                     | Section 6.1    |
| 45  | Describe the wastewater collection and treatment systems in the supplier's service area, including a quantification of the amount of wastewater collected and treated and the methods of wastewater disposal.                                                                                                                                                                                                                                                                                                                                                                        | 10633(a)                    |                                                     | Section 6.2    |

| No.                                                                             | UWMP requirement <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                  | Calif. Water Code reference | Additional clarification | UWMP location |
|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------|---------------|
| 46                                                                              | Describe the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.                                                                                                                                                                                                          | 10633(b)                    |                          | Section 6.2   |
| 47                                                                              | Describe the recycled water currently being used in the supplier's service area, including, but not limited to, the type, place, and quantity of use.                                                                                                                                                                                                                          | 10633(c)                    |                          | Section 6.3   |
| 48                                                                              | Describe and quantify the potential uses of recycled water, including, but not limited to, agricultural irrigation, landscape irrigation, wildlife habitat enhancement, wetlands, industrial reuse, groundwater recharge, indirect potable reuse, and other appropriate uses, and a determination with regard to the technical and economic feasibility of serving those uses. | 10633(d)                    |                          | Section 6.4   |
| 49                                                                              | The projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected.                                                                                                                                                                | 10633(e)                    |                          | Section 6.4   |
| 50                                                                              | Describe the actions, including financial incentives, which may be taken to encourage the use of recycled water, and the projected results of these actions in terms of acre-feet of recycled water used per year.                                                                                                                                                             | 10633(f)                    |                          | Section 6.5   |
| 51                                                                              | Provide a plan for optimizing the use of recycled water in the supplier's service area, including actions to facilitate the installation of dual distribution systems, to promote recirculating uses, to facilitate the increased use of treated wastewater that meets recycled water standards, and to overcome any obstacles to achieving that increased use.                | 10633(g)                    |                          | Section 6.5   |
| WATER SHORTAGE RELIABILITY AND WATER SHORTAGE CONTINGENCY PLANNING <sup>b</sup> |                                                                                                                                                                                                                                                                                                                                                                                |                             |                          |               |
| 5                                                                               | Describe water management tools and options to maximize resources and minimize the need to import water from other regions.                                                                                                                                                                                                                                                    | 10620(f)                    |                          | Section 3     |
| 22                                                                              | Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage and provide data for (A) an average water year, (B) a single dry water year, and (C) multiple dry water years.                                                                                                                                                                 | 10631(c)(1)                 |                          | Section 3.5.1 |
| 23                                                                              | For any water source that may not be available at a consistent level of use - given specific legal, environmental, water quality, or climatic factors - describe plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable.                                                                           | 10631(c)(2)                 |                          | Section 3.5.2 |
| 35                                                                              | Provide an urban water shortage contingency analysis that specifies stages of action, including up to a 50-percent water supply reduction, and an outline of specific water supply conditions at each stage                                                                                                                                                                    | 10632(a)                    |                          | Section 5.2   |



| No. | UWMP requirement <sup>a</sup>                                                                                                                                                                                                                                                                                                                                               | Calif. Water<br>Code reference | Additional clarification                    | UWMP location   |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------------------|-----------------|
| 36  | Provide an estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency's water supply.                                                                                                                                                                                         | 10632(b)                       |                                             | Section 5.3     |
| 37  | Identify actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.                                                                                                                                 | 10632(c)                       |                                             | Section 5.4     |
| 38  | Identify additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street cleaning.                                                                                                                                                                           | 10632(d)                       |                                             | Section 5.5     |
| 39  | Specify consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are appropriate for its area, and have the ability to achieve a water use reduction consistent with up to a 50 percent reduction in water supply. | 10632(e)                       |                                             | Section 5.5     |
| 40  | Indicated penalties or charges for excessive use, where applicable.                                                                                                                                                                                                                                                                                                         | 10632(f)                       |                                             | Section 5.5     |
| 41  | Provide an analysis of the impacts of each of the actions and conditions described in subdivisions (a) to (f), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of reserves and rate adjustments.                                                                          | 10632(g)                       |                                             | Section 5.6     |
| 42  | Provide a draft water shortage contingency resolution or ordinance.                                                                                                                                                                                                                                                                                                         | 10632(h)                       |                                             | Appendix D      |
| 43  | Indicate a mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis.                                                                                                                                                                                                                                              | 10632(i)                       |                                             | Section 5.7     |
| 52  | Provide information, to the extent practicable, relating to the quality of existing sources of water available to the supplier over the same five-year increments, and the manner in which water quality affects water management strategies and supply reliability                                                                                                         | 10634                          | Four years 2010, 2015, 2020, 2025, and 2030 | Section 3.5.2.1 |

| No.                               | UWMP requirement <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Calif. Water<br>Code reference | Additional clarification                                                                                        | UWMP location                                   |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| 53                                | Assess the water supply reliability during normal, dry, and multiple dry water years by comparing the total water supply sources available to the water supplier with the total projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and multiple dry water years. Base the assessment on the information compiled under Section 10631, including available data from state, regional, or local agency population projections within the service area of the urban water supplier. | 10635(a)                       |                                                                                                                 | Section 3.5.3<br>Section 3.5.4<br>Section 3.5.5 |
| <b>DEMAND MANAGEMENT MEASURES</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                |                                                                                                                 |                                                 |
| 26                                | Describe how each water demand management measures is being implemented or scheduled for implementation. Use the list provided.                                                                                                                                                                                                                                                                                                                                                                                                                      | 10631(f)(1)                    | Discuss each DMM, even if it is not currently or planned for implementation. Provide any appropriate schedules. | Section 4                                       |
| 27                                | Describe the methods the supplier uses to evaluate the effectiveness of DMMs implemented or described in the UWMP.                                                                                                                                                                                                                                                                                                                                                                                                                                   | 10631(f)(3)                    |                                                                                                                 | Section 4                                       |
| 28                                | Provide an estimate, if available, of existing conservation savings on water use within the supplier's service area, and the effect of the savings on the ability to further reduce demand.                                                                                                                                                                                                                                                                                                                                                          | 10631(f)(4)                    |                                                                                                                 | Section 4                                       |
| 29                                | Evaluate each water demand management measure that is not currently being implemented or scheduled for implementation. The evaluation should include economic and non-economic factors, cost-benefit analysis, available funding, and the water suppliers' legal authority to implement the work.                                                                                                                                                                                                                                                    | 10631(g)                       | See 10631(g) for additional wording.                                                                            | Not applicable                                  |
| 32                                | Include the annual reports submitted to meet the Section 6.2 requirements, if a member of the CUWCC and signer of the December 10, 2008 MOU.                                                                                                                                                                                                                                                                                                                                                                                                         | 10631(j)                       | Signers of the MOU that submit the annual reports are deemed compliant with Items 28 and 29.                    | Not applicable                                  |

a The UWMP Requirement descriptions are general summaries of what is provided in the legislation. Urban water suppliers should review the exact legislative wording prior to submitting its UWMP.

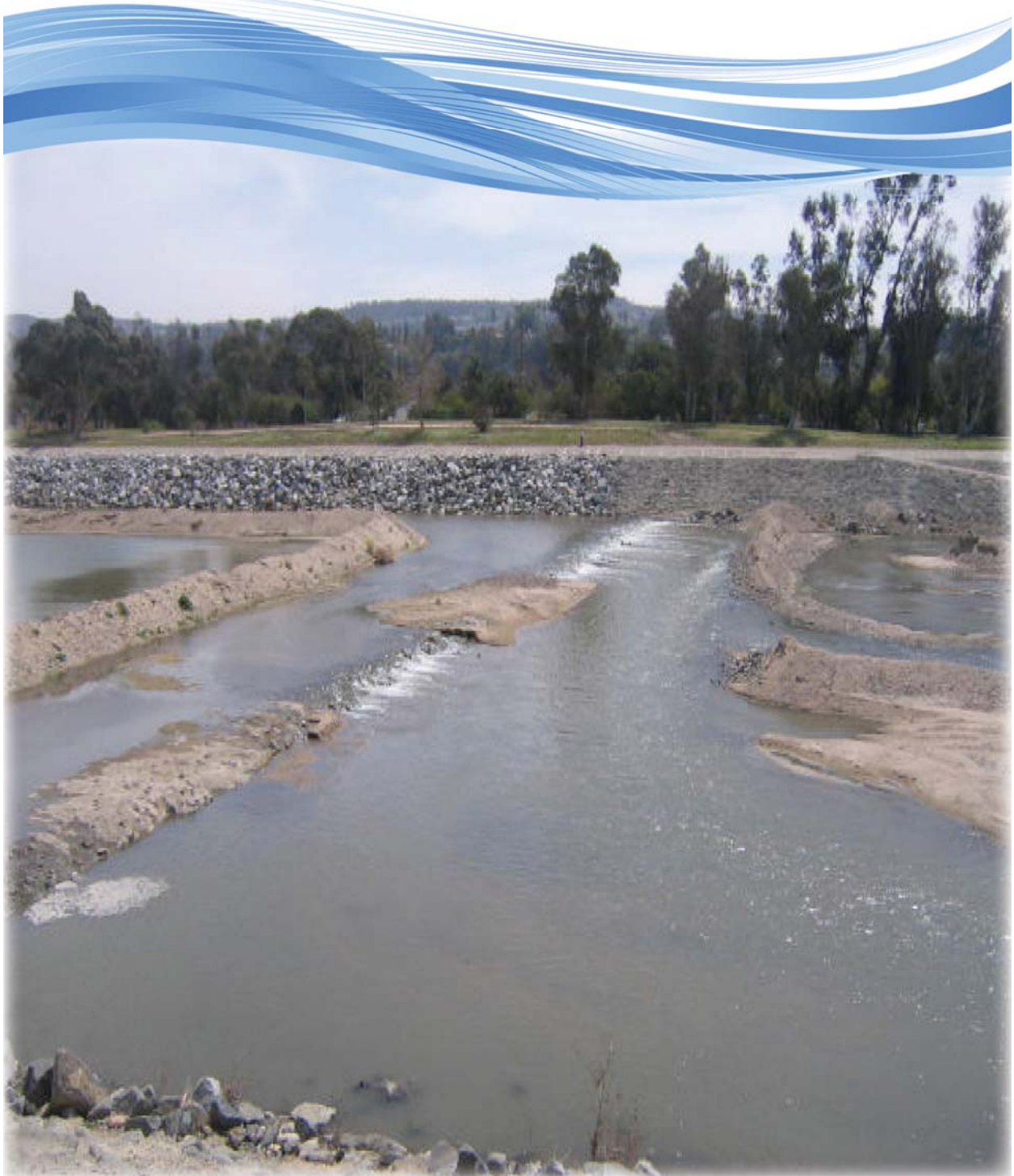
b The Subject classification is provided for clarification only. It is aligned with the organization presented in Part I of this guidebook. A water supplier is free to address the UWMP Requirement anywhere with its UWMP, but is urged to provide clarification to DWR to facilitate review

## Appendix B

### Orange County Water District Groundwater Management Plan 2009 Update

# 2009 UPDATE

## Groundwater Management Plan Orange County Water District







ORANGE COUNTY WATER DISTRICT

GROUNDWATER MANAGEMENT PLAN  
2009 UPDATE

Greg Woodside, PG CHg  
Marsha Westropp, Senior Watershed Planner

July 9, 2009



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FEBRUARY 2007

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## EXECUTIVE SUMMARY

The Orange County Water District (OCWD) is a special district formed in 1933 by an act of the California Legislature. The District manages the groundwater basin that underlies north and central Orange County. Water produced from the basin is the primary water supply for approximately 2.5 million residents living within the District boundaries.

### ES-1 Introduction

The mission of the OCWD is to provide local water retailers with a reliable, adequate, high quality water supply at the lowest reasonable cost in an environmentally responsible manner. The District implements a comprehensive program to manage the groundwater basin to assure a safe and sustainable supply. The *Groundwater Management Plan 2009 Update* documents the objectives, operations, and programs aimed at accomplishing the District's mission.

The Orange County groundwater basin meets approximately 60 to 70 percent of the water supply demand within the boundaries of the District as shown in Figures ES-1 and ES-2. Nineteen major producers, including cities, water districts, and private water companies, pump water from the basin and retail it to the public. There are also approximately 200 small wells that pump water from the basin, primarily for irrigation purposes.

#### *OCWD History*

Since its founding, the District has grown in size from 162,676 to 229,000 acres. Along with this growth in area has come a rapid growth in population. Facing the challenge of increasing demand for water has fostered a history of innovation and creativity that has enabled OCWD to increase available groundwater supplies while protecting the long-term sustainability of the basin. Groundwater pumping from the basin has grown from approximately 150,000 acre-feet per year (afy) in the mid-1950s to over 300,000 afy, as shown in Figure ES-3.

#### *History of Active Groundwater Recharge*

To accommodate increasing demand for water supplies, OCWD started actively recharging the groundwater basin over fifty years ago. In 1949, the District began purchasing imported Colorado River water from the Metropolitan Water District of Southern California (Metropolitan), which was delivered to Orange County via the Santa Ana River upstream of Prado Dam. In 1953, OCWD began making improvements in the Santa Ana River bed and constructing off-channel recharge basins to increase recharge capacity. The District currently operates 1,067 acres of recharge facilities adjacent to the Santa Ana River and its main Orange County tributary, Santiago Creek.



## *Control of Seawater Intrusion and Construction of the Groundwater Replenishment System*

One of the District's primary efforts has been the control of seawater intrusion into the groundwater basin, especially in two areas: the Alamitos Gap and the Talbert Gap. OCWD began addressing the Alamitos Gap intrusion by entering a partnership in 1965 with the Los Angeles County Flood Control District to operate injection wells in the Alamitos Gap. Operation of the injection wells forms a hydraulic barrier to seawater intrusion.

**FIGURE ES- 1**  
**ORANGE COUNTY WATER DISTRICT BOUNDARY**



To address seawater intrusion in the Talbert Gap, OCWD constructed Water Factory 21, a plant that treated secondary-treated water from the Orange County Sanitation District (OCSD) to produce purified water for injection. Water Factory 21 operated for approximately 30 years until it was taken off line in 2004. It was replaced by an advanced water treatment system, the Groundwater Replenishment (GWR) System. The GWR System, the largest water purification project of its kind, began operating in 2008 to provide water for the Talbert Injection Barrier as well as to supply water to recharge basins in the City of Anaheim.

**FIGURE ES- 2**  
**ORANGE COUNTY GROUNDWATER BASIN**

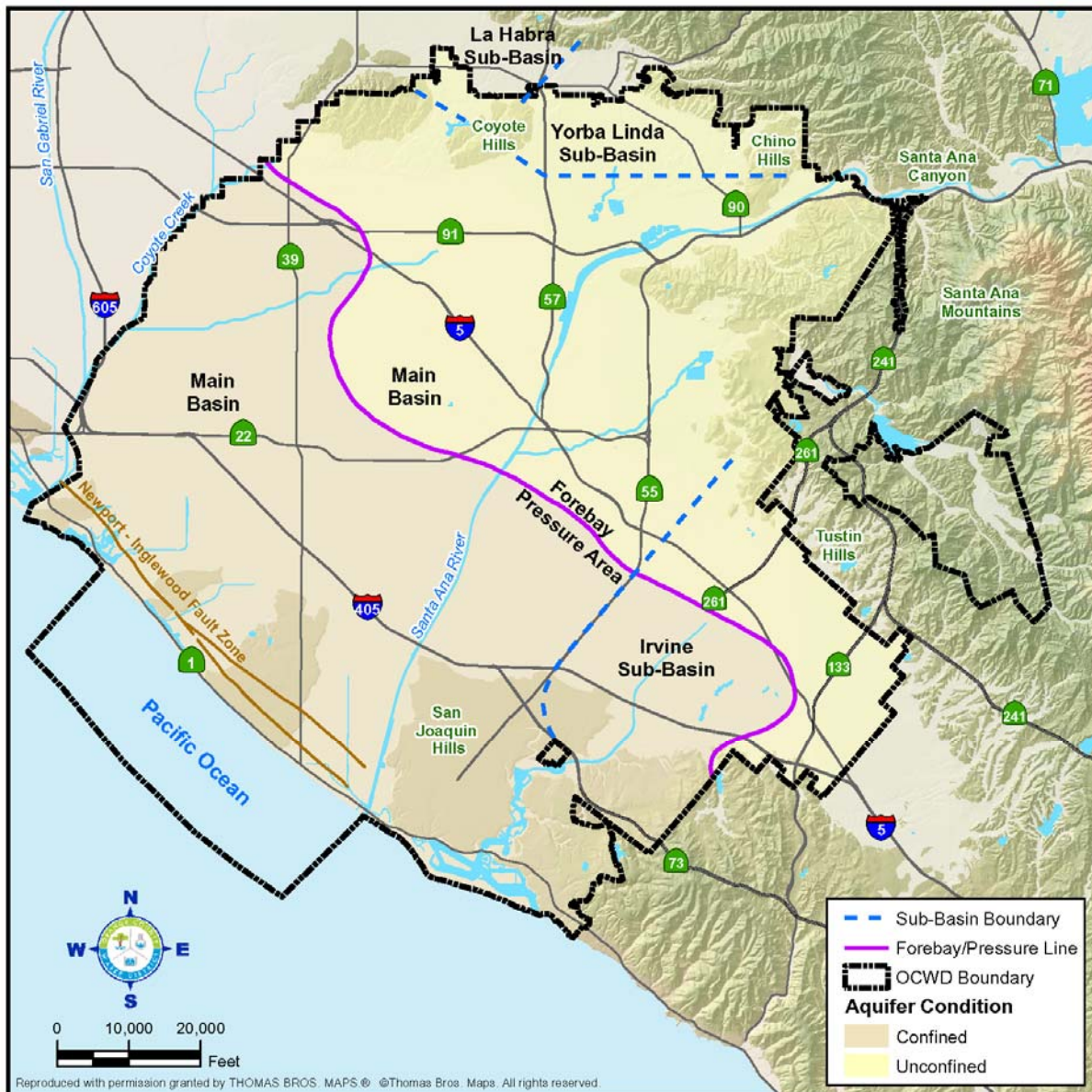
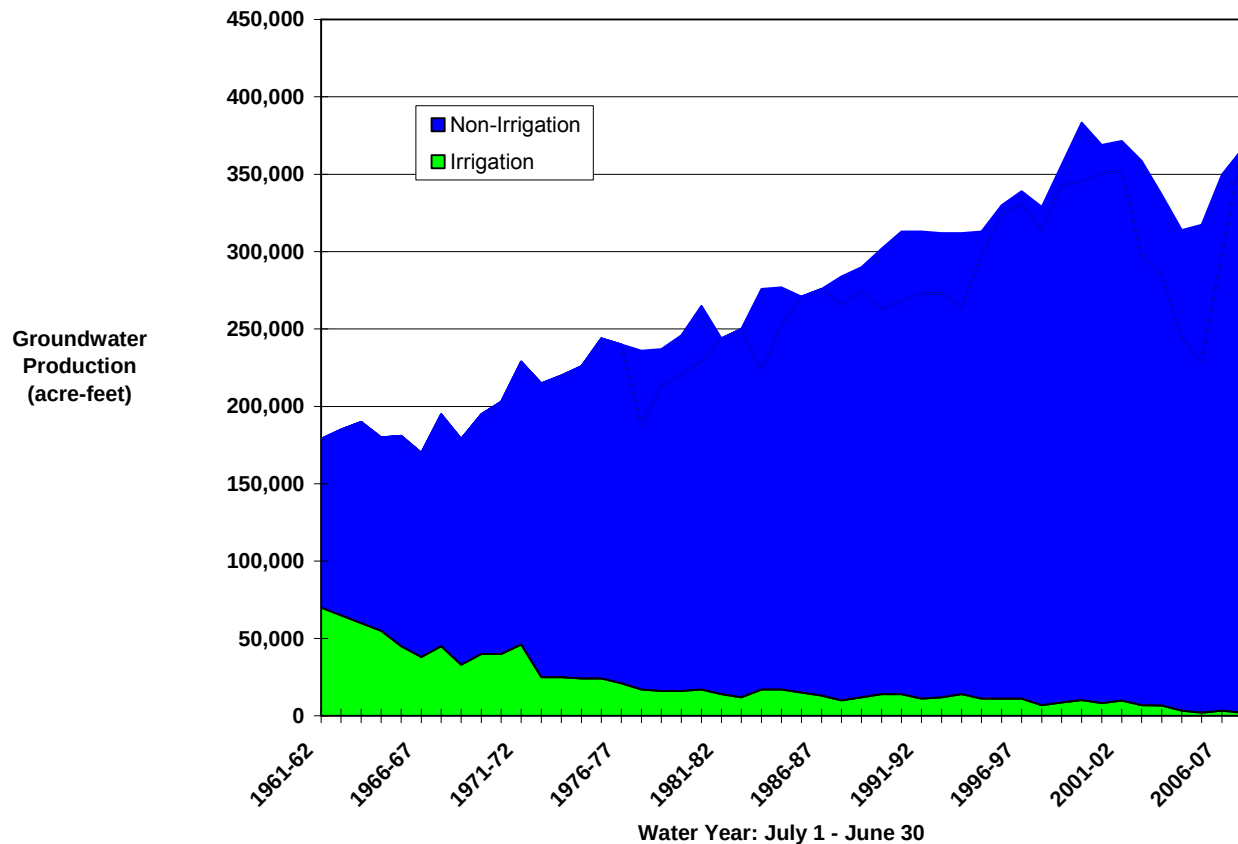


**FIGURE ES- 3**  
**GROUNDWATER PRODUCTION**



### *Preparation of the Groundwater Management Plan*

The District's previous update to the *Groundwater Management Plan* was prepared in 2004. The five Key Performance Indicators established in the 2004 plan were accomplished, as shown in Table ES-1. In addition, over eighteen major projects completed between 2004 and 2008 have improved District operations, increased groundwater recharge capacity, and improved water quality.

The *Groundwater Management Plan 2009 Update* provides information on District operations, lists projects completed since publication of the 2004 report, and discusses plans for future projects and operations. The updated plan was prepared and adopted in accordance with procedures stipulated by A.B. 3030 and Section 10750 et seq. of the California Water Code.

### *Goals and Objectives*

The District's goals are to (1) protect and enhance groundwater quality, (2) to protect and increase the sustainable yield of the basin in a cost-effective manner and (3) to increase the efficiency of OCWD's operations. Section 1.8 contains a complete list of management objectives aimed at accomplishing these goals.



**TABLE ES- 1**  
**KEY PERFORMANCE INDICATORS**

| 2004 Groundwater Management Plan<br>Key Performance Indicators                                                                                   | 2008 Status                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cease landward migration of 250 mg/L chloride contour by 2006                                                                                    | GWR System began operation in 2008.                                                                                                                                                                       |
|                                                                                                                                                  | Reliable, local water supplies available for barrier injection increased from 5 mgd to 30 mgd.                                                                                                            |
|                                                                                                                                                  | Reversal of landward migration at Talbert Barrier observed in 2008.                                                                                                                                       |
| Increase Prado water conservation pool elevation by four feet by 2005                                                                            | Memorandum of Agreement with the Army Corps of Engineers was executed in 2006 allowing a four-foot increase in the maximum winter pool elevation.                                                         |
| Increase recharge capacity by 10,000 afy                                                                                                         | Increase in recharge capacity of greater than 10,000 afy occurred with (1) the La Jolla Recharge Basin coming on line in 2008 and (2) operation of Basin Cleaning Vehicles.                               |
| All water recharged into the basin through District facilities meets or is better than Department of Public Health MCLs and Notification Levels. | No exceedances of MCLs or Notification Levels in recharge water as documented in <i>Santa Ana River Water Quality Monitoring Reports</i> (OCWD 2005, 2006, 2007, and 2008) and GWR System permit reports. |
| Reduce basin overdraft by 20,000 afy                                                                                                             | Basin's accumulated overdraft was reduced by 202,000 af between June 2004 and June 2007. (OCWD <i>Engineer's Report</i> , 2008)                                                                           |

## ES-2 Basin Hydrogeology

The Orange County groundwater basin covers an area of approximately 350 square miles underlying the north half of Orange County beneath broad lowlands known as the Tustin and Downey plains. The aquifers comprising the basin extend over 2,000 feet deep and form a complex series of interconnected sand and gravel deposits. In the inland area, generally northeast of Interstate 5, the clay and silt deposits become thinner and more discontinuous, allowing larger quantities of groundwater to flow between shallow and deeper aquifers.

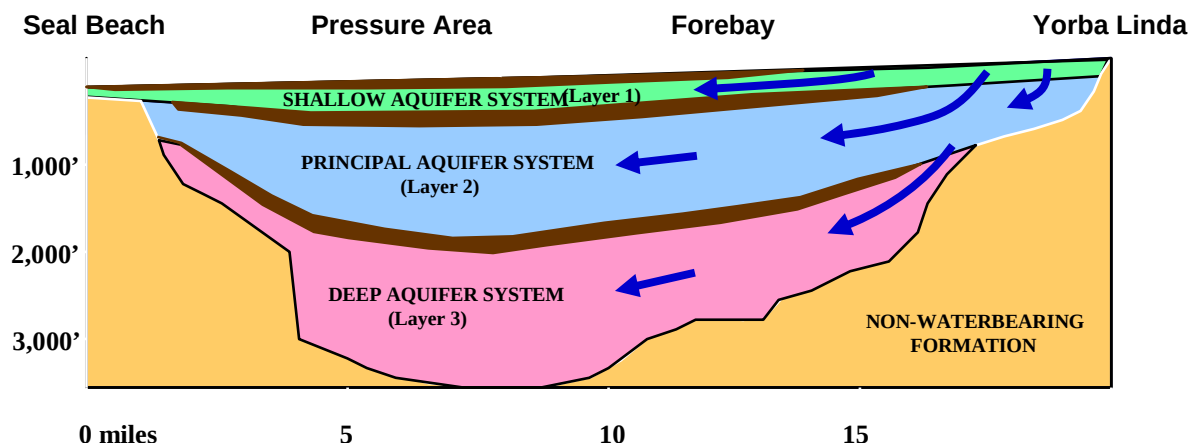
### *Forebay and Pressure Areas*

The basin is divided into two primary hydrologic divisions; the Forebay and Pressure areas (see Figure ES-2). The boundary between the two areas generally delineates the areas where surface water or shallow groundwater can or cannot move downward to the first producible aquifer in significant quantities from a water supply perspective. Most of the groundwater recharge occurs in the Forebay.

OCWD conducts an extensive groundwater monitoring network to collect data to depths of up to 2,000 feet in the basin. Data from these monitoring wells were used to delineate

the depth of the “principal” aquifer system, within which most of the groundwater production occurs. Figure ES-4 schematically depicts the basin’s three aquifer systems, with groundwater flowing from Yorba Linda to the coast.

**FIGURE ES- 4  
GROUNDWATER BASIN CROSS-SECTION**



Shallower aquifers exist above the principal aquifer system. Production from this system, principally for industrial and agricultural uses, is typically about five percent of total basin production. Deeper aquifers exist below the principal aquifer system, but these zones have been found to contain colored water or are too deep to economically construct production wells; few wells penetrate this system.

A vast amount of water is stored within the basin, although only a fraction of this amount can be removed without causing physical damage such as seawater intrusion or the potential for land subsidence.

### *Water Budget*

OCWD developed a hydrologic budget in order to construct a Basin Model and to evaluate basin production capacity and recharge requirements. The hydrologic budget quantifies the amount of basin recharge, groundwater production, and subsurface flows along the coast and across the Orange/Los Angeles County line.

### *Calculation of Groundwater Elevation, Storage, and Accumulated Overdraft*

Annual changes in the amount of groundwater stored in the basin are estimated using groundwater elevation measurements and aquifer storage coefficients for the three primary aquifer systems in the basin. This three-layer method involves measuring the water levels throughout the basin at the end of each water year at nearly every production and monitoring well in the basin. Water level measurements are contoured and digitized into the Geographic Information System. Storage change volumes for each of the three aquifer levels are determined and then totaled to provide a net annual storage change for the basin.

The District estimates that the basin can be operated on a short-term basis with a maximum accumulated overdraft (storage reduction from full condition) of approximately 500,000 acre-feet (af) without causing irreversible seawater intrusion and land subsidence. In 2007, OCWD developed a new methodology to calculate accumulated overdraft and storage change. The need for this change was driven by the record-setting wet year of 2004-05, which resulted in the basin approaching a near-full condition. Analysis showed that the traditional method of cumulatively adding the annual storage change each year contained considerable uncertainty. The updated approach is based on a determination of the amount of groundwater in storage in each of the three major aquifer systems.

### *Elevation Trends and Groundwater Model*

Groundwater level profiles generally following the Santa Ana River in Orange County are prepared to evaluate changes in the basin due to groundwater pumping and OCWD recharge operations. Groundwater levels are managed within a safe basin operating range to protect the long-term sustainability of the basin and to protect against land subsidence.

The District has developed a comprehensive computer-based groundwater flow model. Development of the model substantially improved the overall understanding of processes and conditions in the basin. The model also allows analysis of how the basin reacts to various theoretical pumping and recharge conditions. The model's ability to simulate known and projected future conditions will evolve and improve as new data become available and updated simulations are completed.

## **ES-3 Groundwater Monitoring**

For its size, the Orange County groundwater basin is one of the world's most extensively monitored. The comprehensive monitoring program tracks dynamic basin conditions including groundwater production, storage, elevations, and water quality.

OCWD's monitoring program has helped improve groundwater management throughout the basin by:

- Establishing on an annual basis the appropriate level of groundwater production.
- Determining the extent of seawater intrusion and subsequently building improvements to seawater barriers to prevent and reverse such intrusion.
- Discovering areas of groundwater contamination to protect public health and beneficial use of groundwater, and to begin remediation efforts at an early stage.
- Assuring that the groundwater basin is managed in accordance with relevant laws and regulations.

### *Collection and Management of Monitoring Data*

Large-capacity well owners report monthly groundwater production for each of their wells. OCWD operates its own groundwater monitoring network with a diverse cross-section of well types and broad range of well depths and screened intervals. The type





In 2008, nearly 14,000 groundwater samples were collected and analyzed in order to comply with state and federal regulations and to enable OCWD to monitor the water quality of the basin. The number of water quality samples continues to increase in response to new regulatory requirements and to gain a better understanding of the basin. OCWD's laboratory is state-certified to perform bacteriological, inorganic, and organic analyses. State-certified contractor laboratories analyze radiological samples.

OCWD's water quality monitoring program includes:

- Testing groundwater samples for more than 100 regulated and unregulated chemicals at a specified monitoring frequency established by the U.S. Environmental Protection Agency (EPA) and the California Department of Public Health (CDPH) regulations.
- Monitoring and preventing the encroachment of seawater into fresh groundwater zones along coastal Orange County.
- Assessing Santa Ana River water quality. Since the quality of the surface water that is used to recharge the groundwater basin affects groundwater quality, a routine monitoring program is maintained to continually assess ambient river water quality. Water samples are collected each month from the river. The District also monitors the quality of imported replenishment water and tests selected monitoring wells to assess the water quality in areas where GWR System water is being injected and recharged.

### *Data Management and Publication*

Data collected in OCWD's monitoring program are stored in the District's electronic database, the Water Resources Management System (WRMS). WRMS contains comprehensive well information, as well as information on subsurface geology, groundwater modeling, and water quality. Data are used in calibrating the basin model, evaluating the causes of seasonal groundwater fluctuations, and estimating changes in basin storage throughout the year.

Regular District publications include the annual release of the Engineer's Report on Groundwater Conditions, Water Supply and Basin Utilization; the Santa Ana River Water Quality Monitoring Report; and the Groundwater Replenishment System Operations Annual Report.

## **ES-4 Recharge Water Supply Management**

OCWD operates recharge facilities to maximize groundwater recharge. Recharging water into the basin through natural and artificial means is essential to support pumping from the basin. The basin's primary source of water for groundwater recharge is flow from the Santa Ana River. OCWD diverts river flows into recharge basins located in and adjacent to the Santa Ana River and its main Orange County tributary, Santiago Creek. Other sources of recharge water include natural infiltration, recycled water, and imported water.



### *History of Recharge Operations*

Active recharge of groundwater began in 1949, in response to increasing drawdown of the basin and, consequently, the serious threat of seawater intrusion. In 1953, OCWD began to make improvements in the Santa Ana River bed and areas adjacent to the river to increase recharge capacity. Today the District owns and operates a network of recharge facilities that cover 1,067 acres, as shown in Figure ES-6. The District has an ongoing program to assess enhancements in the existing recharge facilities, evaluate new recharge methods, and analyze potential new recharge facilities.

### *OCWD Recharge Facilities*

Surface water from the Santa Ana River flows into Orange County through the Prado Dam. The District is able to recharge essentially all non-storm flow in the Santa Ana River that enters Orange County through Prado Dam. The dam was built and is operated by the Army Corps of Engineers (ACOE) for flood control purposes. Agreements between the ACOE and OCWD enable the dam to be operated for water conservation purposes, such that the District is able to capture a portion of the storm flows for groundwater recharge.

Water released at Prado Dam naturally flows downstream into Orange County and percolates through the river's 300-400 foot-wide unlined channel bottom. Active management of recharge begins at the intersection of the river and Imperial Highway in the City of Anaheim. It is in the six-mile reach of the river below Imperial Highway and areas adjacent to the river where many of the recharge basins are located. The recharge facilities are grouped into four major components: the Main River System, the Off-River System, the Deep Basin System, and the Burris Basin/Santiago System.

The Main River System consists of approximately 290 acres of the Santa Ana River Channel. One of the District's main control facilities, the Imperial Inflatable Dam and Bypass structure diverts Santa Ana River water flows from the Main River System into the Off-River System. The Off-River System is a shallow, sandy bottom, 100- to 200-foot wide channel that runs parallel to the Main River System; a levee separates these two systems.

Water can be diverted from the Off-River System into the Deep Basin System. These recharge basins range in depth from ten to sixty feet. Flows are regulated between these basins to maximize recharge.

Water in the Santa Ana River can also be diverted at the Five Coves Inflatable Dam into the Burris Basin/Santiago System. This system includes 373 acres of shallow and deep recharge basins. The Santiago Pipeline allows water to be diverted from Burris Basin into the Santiago Basins.

The Santiago Basins recharge water diverted from Burris Basin as well as flows from Santiago Creek. The creek is a tributary of the Santa Ana River that extends from the Santa Ana Mountains through the City of Orange to its confluence with the Santa Ana River in the City of Santa Ana.

**FIGURE ES- 6**  
**OCWD RECHARGE FACILITIES IN ANAHEIM AND ORANGE**



### *Sources of Recharge Water Supplies*

In addition to Santa Ana River and Santiago Creek, other sources of recharge water include natural recharge, imported water, and water purified by OCWD's GWR System. The GWR System (Figure ES-7) is a cooperative project with the OCSD that began operating in 2008. Secondary-treated wastewater from OCSD undergoes treatment consisting of microfiltration, reverse osmosis, and advanced oxidation with ultraviolet light and hydrogen peroxide. The water purified through the GWR System is injected into the groundwater basin near the coast to maintain a barrier preventing seawater intrusion and provides an additional supply of water for recharge operations.

**FIGURE ES-7**  
**GROUNDWATER REPLENISHMENT SYSTEM**



### **ES-5     Groundwater Quality Management**

OCWD conducts an extensive program aimed at protecting the quality of the water in the basin. These efforts include groundwater monitoring, participating in and supporting regulatory programs, remediation projects, working with groundwater producers, and providing technical assistance.

#### *Groundwater Protection Policy*

The District adopted a Groundwater Protection Policy in May 1987, in recognition of the serious threat posed by groundwater contamination. This policy is described in Section 5 of the Plan.

### *Salinity and Nitrate Management*

Managing salinity, the amount of dissolved minerals in water, and nitrates are significant water quality challenges in southern California. Elevated levels of nitrates pose a risk to human health. High concentrations of salts can contaminate groundwater supplies, constrain implementation of water recycling projects, and cause other negative economic impacts such as the need for increased water treatment by residential, industrial and commercial users.

Sources of salinity in water used to recharge the groundwater basin include Santa Ana River water, imported water, shallow groundwater within Orange County, seawater migrating into the basin, precipitation, and legacy contamination from historical agricultural operations. Water treatment plants, also referred to as desalters, have been built in Riverside and San Bernardino Counties to reduce salinity levels in water supplies. Within Orange County, desalters in Tustin and Irvine are reducing salinity levels in the groundwater basin. The GWR System provides a dependable supply of low salinity water that is expected to reduce the basin salt imbalance by approximately 47,000 tons/year.

Nitrates are one of the most common and widespread contaminants in groundwater supplies. Elevated levels of nitrates in soil and water supplies originate from fertilizer use, animal feedlots and wastewater disposal systems. OCWD conducts an extensive program to protect the basin from nitrate contamination, including operating 450 acres of wetlands in the Prado Basin (Figure ES-8) to naturally remove nitrate before the water enters the District's recharge facilities.

**FIGURE ES-8  
PRADO WETLANDS**





Ninety-eight percent of the drinking water wells pumping from the Orange County groundwater basin meet the nitrate drinking water standard. The two percent that do not meet the nitrate standard are treated to reduce nitrate levels prior to being served to customers.

The Irvine and Tustin desalters are in operation to remove salts and nitrate from groundwater. The Irvine Desalter also addresses contamination from organic compounds.

### *Synthetic Organic Contaminants*

Ninety-five percent of the basin's groundwater that is used for drinking water is pumped from the main aquifer. Water from this aquifer continues to be of high quality. OCWD routinely monitors potential contamination and is working to remediate some localized contamination in the shallow aquifer.

One contaminant of concern is methyl tertiary butyl ether (MTBE), a chemical previously added to gasoline. The District analyzes groundwater for MTBE and other fuel-related contaminants. The District is implementing remediation efforts to address contamination from volatile organic compounds (VOCs). Two particular projects are the North Basin Groundwater Protection Project and the South Basin Groundwater Protection Project. The North Basin Groundwater Protection Project is being constructed in Anaheim and Fullerton to remove and contain groundwater contaminated with VOCs. The South Basin Groundwater Protection Project is being designed to address VOC and perchlorate contamination in the area of southeast Santa Ana/South Tustin and the western portion of Irvine.

## **ES-6 Integrated Management of Production and Recharge**

OCWD is internationally known for its unique, proactive, supply-side management approach. This is a major factor that has enabled the District to develop one of the most advanced and progressive groundwater management systems in the world. Growth in demand for water supplies has challenged the District to augment recharge water supplies, effectively manage demands on the basin, and balance the amount of total recharge and total pumping to protect the basin.

### *Cooperative Efforts to Protect Water Supplies and Water Quality*

OCWD participates in cooperative efforts with local, state, and federal regulatory agencies and stakeholders within the District boundaries and in the Santa Ana River Watershed. For example, the ACOE works cooperatively with OCWD to store water behind Prado Dam and to release flows at rates that allow for the maximum capture of water for recharge operations. Other cooperative efforts include natural resource conservation efforts in the Prado Basin and participating in working groups and task forces with stakeholders throughout the watershed.

### *Water Supplies*

OCWD provides access to basin supplies at a uniform cost to all entities without regard to the length of time they have been producing from the basin. The District's programs include operating the groundwater recharge basins, increasing supplies of recycled

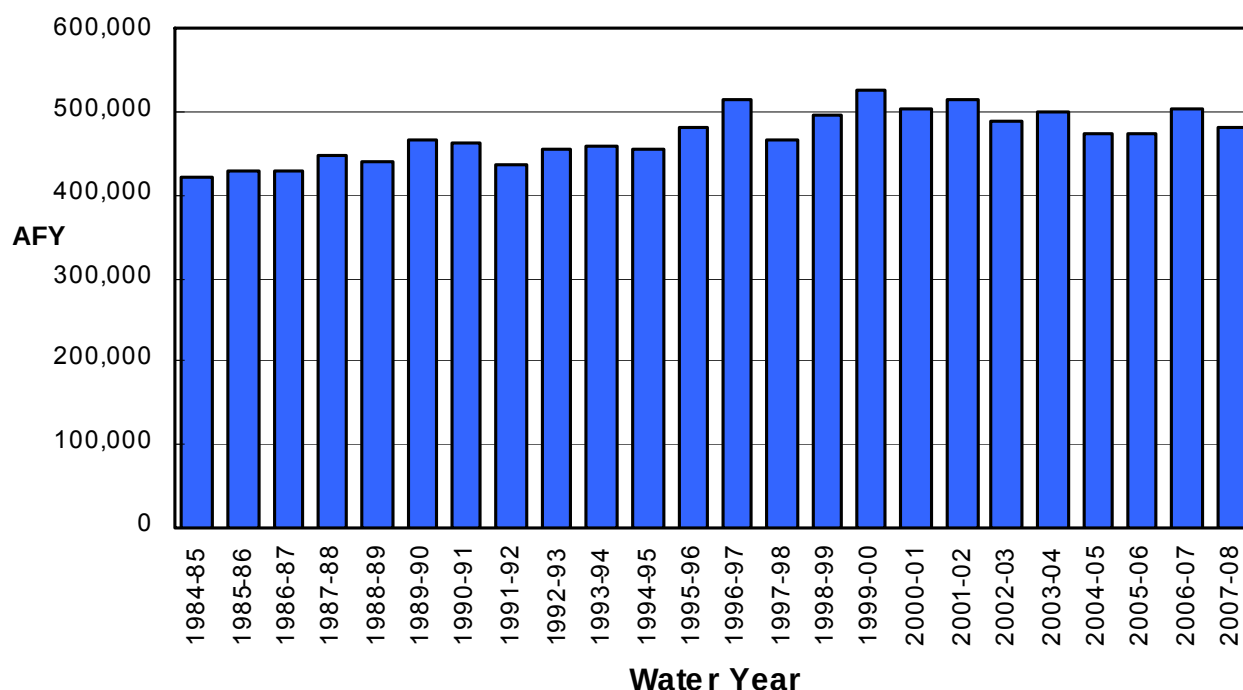
water available for groundwater recharge, producing recycled water for irrigation and other non-potable uses, participating in water conservation efforts, and working with the Municipal Water District of Orange County (MWDOC) in developing and conducting other supply augmentation projects and strategies.

### *Water Demand*

Numerous factors influence water demands such as population growth, economic conditions, conservation programs, and hydrologic conditions. Estimates of future demands are therefore subject to some uncertainty and are updated on a regular basis.

Total water demand within the District's boundary for water year 2007-08 (July 1-June 30) was 480,000 af. Total demand is met with a combination of groundwater, imported potable water, local surface water, and recycled water used for irrigation and industrial purposes. Figure ES-9 shows historical total District water demands from 1984 to the present. Estimating water demands is necessary for the planning of future water supply project and programs.

**FIGURE ES-9  
HISTORICAL TOTAL DISTRICT WATER DEMANDS**



### *Basin Operating Range*

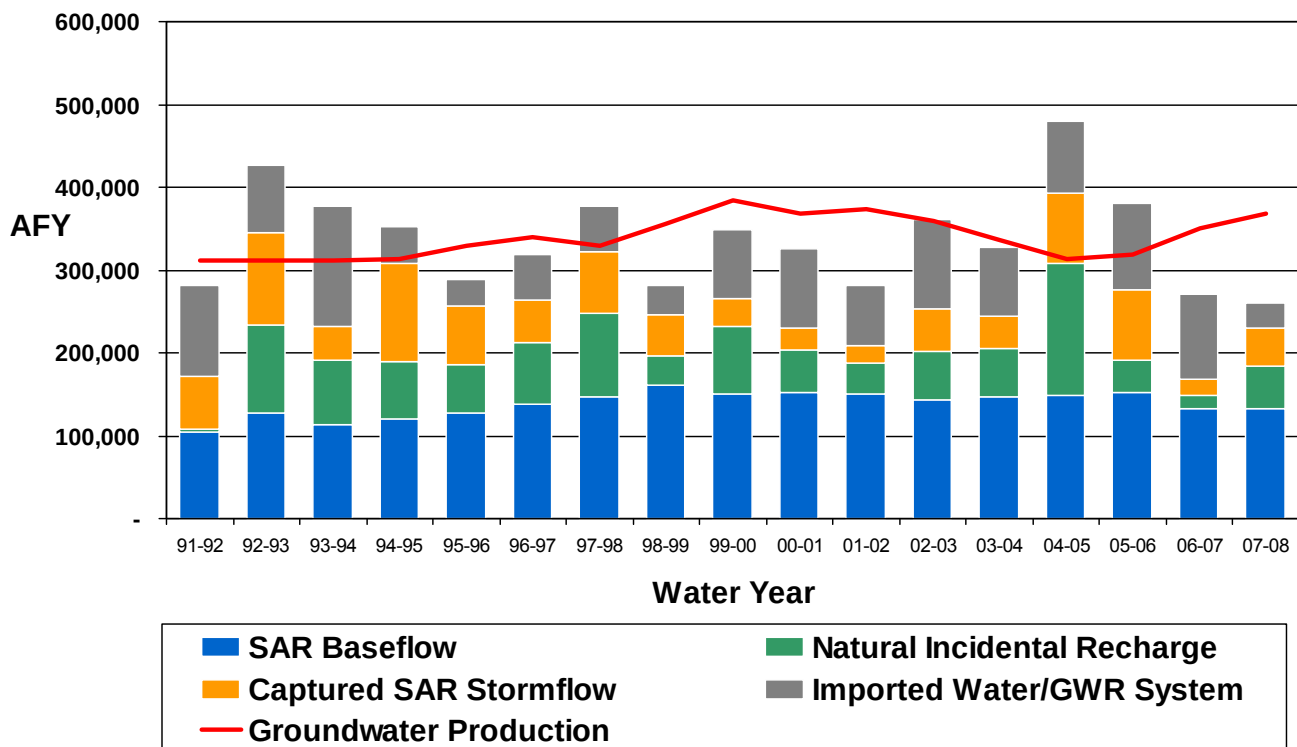
Total pumping from the basin is managed through a process that uses financial incentives to encourage groundwater producers to pump an aggregate amount of water that is sustainable without harming the basin. The process that determines a sustainable level of pumping considers the basin's safe operating range and the amount of recharge water available to the District. The basin operating range refers to the upper and lower levels of groundwater storage in the basin that can be reached without

causing negative impacts. Each year the District estimates the level of storage for the following year.

### *Integrated Management of Recharge and Production*

Over the long term, the basin must be maintained in an approximate balance to ensure the long term viability of the water supply. In one particular year, water withdrawals may exceed water recharged as long as over the course of a number of years this is balanced by years where water recharged exceeds withdrawals. Levels of basin production and water recharged since water year 1991-92 are shown in Figure ES-10. The primary mechanism used by OCWD to manage pumping is the Basin Production Percentage (BPP). The BPP is the percentage of each Producer's total water supply that comes from groundwater pumped from the basin. The BPP is set uniformly for all Producers. Groundwater production at or below the BPP is assessed the Replenishment Assessment. Pumping above the BPP is also assessed a Basin Equity Assessment, which is calculated so that the cost of groundwater production is higher than purchasing imported potable water. This serves to discourage production above the BPP.

**FIGURE ES-10**  
**BASIN PRODUCTION AND RECHARGE SOURCES**



### *Drought Management*

During a drought, flexibility to maintain pumping from the basin becomes increasingly important. To the extent that the basin has water in storage that can be pumped out during a drought, the basin provides a valuable water supply asset during drought conditions. For the basin to serve as a safe, reliable supply, sufficient groundwater must be stored before a drought occurs and the basin needs to be refilled after a period of storage reduction occurs.

### **ES-7 Financial Management**

The District has an excellent revenue base and a strong “AA+” financial rating. The District also has the ability to issue additional long-term debt, if necessary, to develop projects to increase the basin’s yield and protect water quality. The annual operating budget for fiscal year 2008-09 was approximately \$116.3 million.

OCWD maintains reserve funds to ensure financial integrity and to purchase supplemental water when it becomes available for groundwater recharge. The District’s primary sources of revenue include the Replenishment Assessment, Basin Equity Assessment, property taxes, and other miscellaneous revenues such as rental fees on District property.

The District’s programs to protect and increase the basin’s sustainable yield in a cost-effective manner continue to evolve due to changes in the availability of recharge water supplies. Below average rainfall over the past four years in the Santa Ana River Watershed as well as other factors has reduced the availability of Santa Ana River water. The availability of imported water supplies for groundwater recharge has also changed significantly in the last few years. The occurrence of wet and dry periods, the future availability and cost of imported water supplies for recharge, and changing water management practices of agencies in the watershed will continue to affect the District’s management of the basin.



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# 1 INTRODUCTION

The Orange County Water District (OCWD) manages the Orange County Groundwater Basin (the basin) in coastal Southern California. This section provides background information on the District and sets the framework for the Groundwater Management Plan 2009 Update (Plan). The subsections below:

- Discuss the District's formation, mission, and operating authorities.
- Trace changing conditions in the basin that are important to development of the Plan.
- Describe the public participation component of the Plan.
- Discuss the Plan's compliance with the California Water Code.
- Present basin management objectives that guide the District's management of the basin.
- Explain the District's public education programs.

## 1.1 History of OCWD

The OCWD was formed by a special act of the California Legislature in 1933 to manage the groundwater basin that underlies north and central Orange County. District boundaries are shown in Figure 1-1. OCWD is not a water retailer and does not serve water to the public; rather, the District manages the groundwater basin.

**Figure 1-1**  
**Orange County Water District Boundary**



Nineteen major producers, including cities, water districts, and private water companies, pump water from the basin and retail it to the public. There are also approximately 200 small wells that pump water from the basin, primarily for irrigation purposes. OCWD protects and manages the quantity and quality of the groundwater resource that meets approximately 60 to 70 percent of the water supply demand for a population of over 2.5 million.

Since its founding, the District has grown in area from 162,676 to 229,000 acres and has experienced an increase in population from approximately

120,000 to 2.5 million people. Facing the challenge of increasing demand for water has fostered a history of innovation and creativity that has enabled OCWD to increase available groundwater supplies while protecting the long-term sustainability of the basin.

The District's powers, as defined in its enabling legislation by the State of California (Water Code App §40-1, *et seq.*, or the 'OCWD Act'), include the following:

*Within or outside the District to construct, purchase, lease or otherwise acquire, and to operate and maintain necessary waterworks... to replenish the undergroundwater basin within the district, or to augment and protect the quality of the common water supplies of the district, ... (portions of Section 2.5 of OCWD Act)*

*For the common benefit of the district and for the purpose of managing the groundwater basin and managing, replenishing, regulating, and protecting the groundwater supplies within the district to exercise the following powers:*

*Provide for the conjunctive use of groundwater and surface water resources within the district area.*

*Store water in undergroundwater basins or reservoirs within or outside of the district. Regulate and control the storage of water and the use of groundwater basin storage space in the groundwater basin.*

*Purchase and import water into the district.*

*Transport, reclaim, purify, treat, inject, extract, or otherwise manage and control water for the beneficial use of persons or property within the district and to improve and protect the quality of the groundwater supplies within the district. (Portions of Section 2.6 of OCWD Act)*

*To provide for the protection and enhancement of the environment within and outside the district in connection with the water activities of the district. (Section 2.7 of OCWD Act)*

These powers illustrate the range of activities the District is involved with in managing the groundwater basin.

The Orange County Groundwater Basin was used by early settlers to supplement Santa Ana River surface water. Adequate, dependable water supplies were always a challenge for the residents of this semi-arid land. By 1900, conflicts over water supplies were escalating. The county's economic growth into an agricultural center was only one source of the problem. The other source was upstream: Santa Ana River flows were decreasing due to increased water use in the basins upstream of Orange County. San

Bernardino, Riverside, and Orange Counties were dependent on the same water source – the Santa Ana River in the Santa Ana River Watershed (shown in Figure 1-2).

**FIGURE 1-2**  
**SANTA ANA RIVER WATERSHED**





In the early 1900s, reduced river flows and lowering of the Orange County groundwater table heightened conflicts between water users. Lower basin users initiated legal and other efforts to secure rights to water supplies. In 1932, The Irvine Company filed suit against upper basin users to protect its rights to river flows. Around the same time, the Orange County Farm Bureau formed the Santa Ana Basin Water Rights Protective Association to consider options to secure adequate supplies. This group developed a series of proposals, one of which led to legislation that created the OCWD.

The Orange County Water District Act was passed by the state legislature on June 4, 1933. The new District promptly joined The Irvine Company's lawsuit and was party to the 1942 settlement of that suit. The agreement limited the amount of river water that could be used for recharge in the upper basin to ensure that Orange County would have a share of Santa Ana River water.

Creation of the District and settlement of the lawsuit did not immediately solve the water supply problems in Orange County. Throughout the 1930s to early 1950s, groundwater pumping continued to exceed the rate of water recharged into the basin, a condition referred to as "overdraft." OCWD began looking for additional water supplies.

Efforts to bring more water into southern California were already underway. The Metropolitan Water District of Southern California (Metropolitan), created in 1927, built an aqueduct to transport and sell Colorado River water. Between 1949 and 1953, OCWD purchased 28,000 acre feet per year (afy) of Metropolitan water for groundwater recharge. However, these additional supplies were not enough to satisfy growing demand; by 1954, groundwater levels fell an average of fifteen feet below sea level. Now, the principal limitation faced by OCWD was the lack of an adequate, dependable funding base for purchasing the large amounts of recharge water needed to refill the overdrafted basin.

OCWD's only funding source at that time was local *ad valorem* taxes. Using property taxes to buy imported water was becoming controversial. Property owners in most of the District belonged to Metropolitan so their property taxes were funding imported water purchases. But water users pumping from the basin who were not Metropolitan members were benefiting from the imported supply without paying for it. In addition, some tax-paying property owners were not using the water that they were being charged for.

A twelve-person Orange County Water Basin Conservation Committee (the Committee of Twelve) was formed in 1952 to develop a solution to the funding problem. This process is described by author William Blomquist in his book "Dividing the Waters" (Blomquist, 1992).

*"The area's water management problems were discussed at a joint meeting in 1952 of the Water Problems Committee of the Orange County Farm Bureau, the Water Committee of the Associated Chambers of Commerce, and the Board of Directors of the Orange County Water District. The twelve-man Orange County Water Basin Conservation Committee (the Committee of 12) was formed to study the issues further and develop recommendations. The Committee of 12 maintained the area's basic commitment to increasing supply rather than restricting*

*demand. They considered and rejected centralized control over water consumption and distribution by an agency empowered to enforce conservation, or adjudication and limitation of water rights using the court-reference procedure. They supported instead a proposal to fund replenishment by taxing pumping. This approach held the promise of raising the necessary funds, relating producers' taxation to their benefits received, and relieving non-producers from paying for replenishment except to the extent that they purchased water from producers. Furthermore, at least theoretically, a tax on pumping would build in conservation incentives without mandating conservation.*

*OCWD was not authorized to tax pumping, so the Orange County Water District Act would have to be amended. The Committee of 12 assembled a package of amendments that amounted to a substantial redesign of the district. To be fair, a pump tax would have to be implemented basin-wide, so the Committee proposed enlarging the district's territory to include Anaheim, Fullerton, and Santa Ana, plus areas owned by the Anaheim Union Water Company and the Santa Ana Valley Irrigation Company near the canyon. A pump tax would make it necessary to measure and record water production from the thousands of wells within the district, so an amendment was proposed requiring every producer therein to register wells with OCWD and to record and submit production data to the District twice per year. The Committee also proposed that an annual District Engineer's Report on basin conditions and groundwater production be submitted to the District and water users, to allow them to monitor the effects of the replenishment program and to provide a shared picture on a regular basis of basin conditions, including the extent of seawater intrusion and the level of the water table."*

Passage of these proposed amendments in 1954 was one of the most significant modifications to the original District Act. These major revisions gave OCWD the authority to assess a charge to pump groundwater, known as a Replenishment Assessment (RA). The OCWD Board of Directors voted to institute the first RA on June 9, 1954. The District now had adequate funds to purchase the amount of imported water needed for groundwater recharge, to monitor water quality and basin conditions, maintain and improve spreading facilities and pay for administrative costs.

One pressing problem arising from overdrafting the basin was seawater intrusion. In 1956, the groundwater level dropped to its lowest historical point, as much as 40 feet below sea level, and seawater intruded 3 ½ miles inland. Although imported water was helping refill the basin, the challenge of seawater intrusion remained. This was a problem primarily in two areas: the Alamitos Gap at the mouth of the San Gabriel River at the Orange County/Los Angeles County border and the Talbert Gap in Fountain Valley. In 1965, the District began a joint program that continues to the present with the Los Angeles County Flood Control District to inject fresh water in the Alamitos Gap to prevent saltwater intrusion.

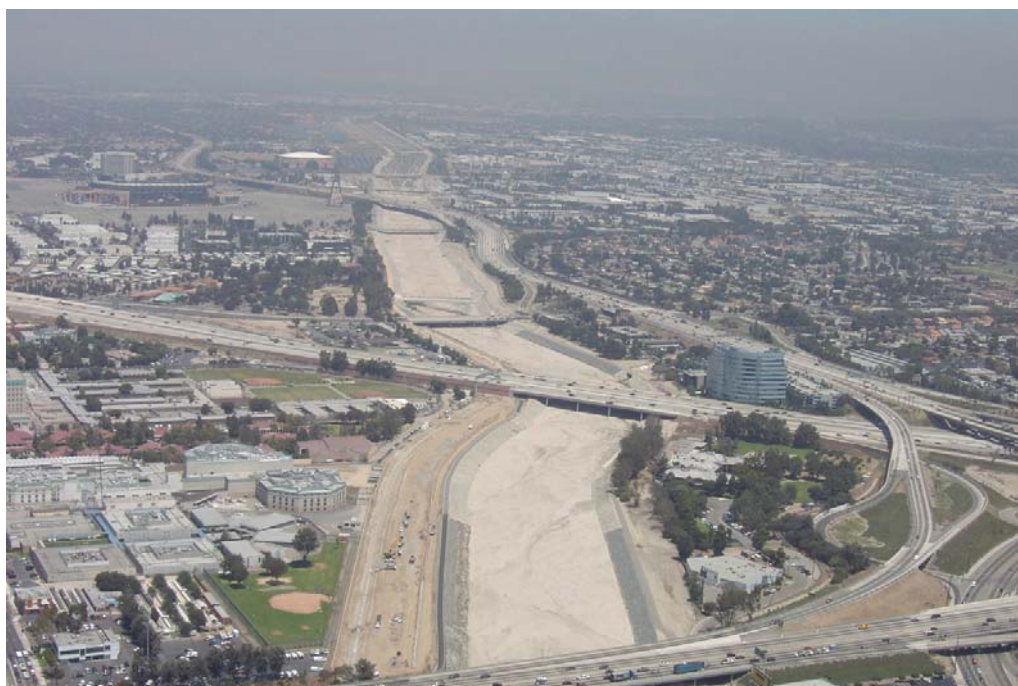
The Talbert Gap was a greater challenge as it needed nearly six times the amount of water. After much research and planning, the District built Water Factory 21 (WF-21), a

water treatment plant that treated secondary-treated water from the Orange County Sanitation District (OCSD) to produce purified water for injection into the Talbert Gap. For over 20 years, a blend of WF-21 water and imported water was used to successfully manage seawater intrusion at the Talbert Gap.

WF-21, with a capacity that varied through time from four to fifteen million gallons per day (mgd), operated until 2004 when it was shut down to allow for construction of the Groundwater Replenishment (GWR) System. In operation since 2008, the GWR System is capable of producing up to 72 mgd of water for use in Talbert Barrier operations and for groundwater recharge.

OCWD's recharge operations have played a central role in expanding water supplies. Efforts to increase the capture of Santa Ana River baseflows and stormflows and to recharge imported water date back to 1949. Currently, OCWD operates approximately 1,067 acres of riverbed and off-stream infiltration basins in the cities of Anaheim and Orange. Figure 1-3 is a view of the Santa Ana River looking upstream. Freeway 22 crosses the river in the foreground, Freeway 5 in the middle of the photograph, and Freeway 57 in the background.

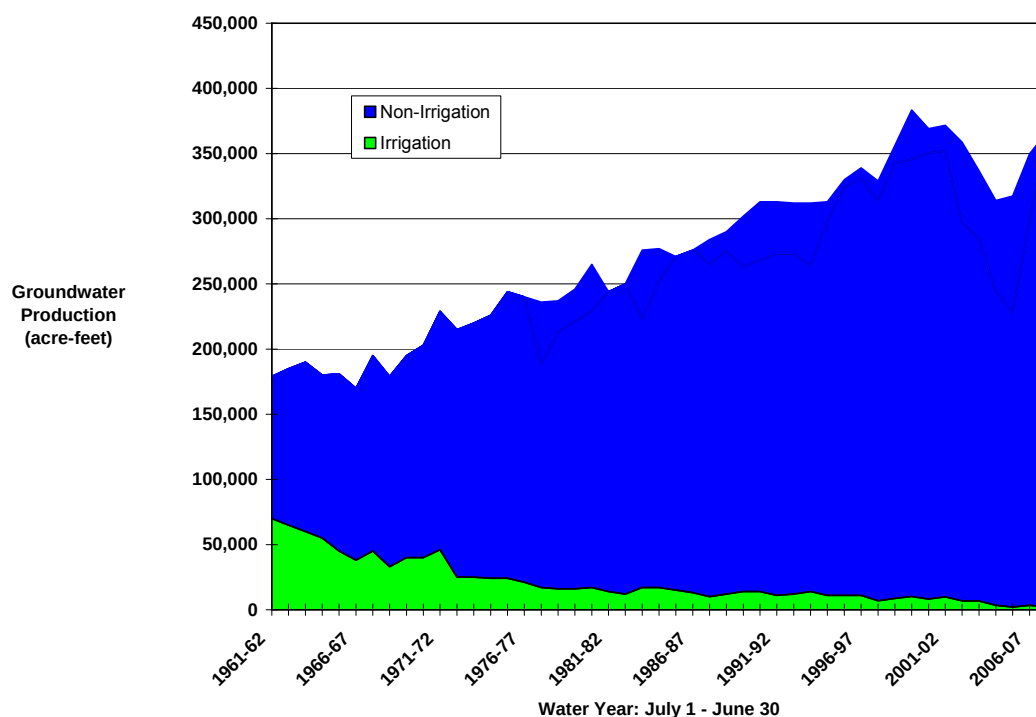
**FIGURE 1-3**  
**SANTA ANA RIVER LOOKING UPSTREAM IN ANAHEIM AND ORANGE**



OCWD has achieved world-renowned status for its innovative approach to groundwater recharge, water quality protection, and groundwater resource management. The District has employed groundwater management techniques to increase the annual yield from the basin as shown in Figure 1-4. Annual production increased from approximately 150,000 afy in the mid-1950s to approximately 350,000 afy in water year 2007-08.

OCWD has managed the basin in order to provide a reliable supply of relatively low-cost water and to accommodate rapid population growth while at the same time avoiding the costly and time-consuming adjudication of water rights experienced in nearly every other major groundwater basin in Southern California.

**FIGURE 1-4  
GROUNDWATER PRODUCTION 1961-2008**



Note: Non-irrigation includes In-lieu recharge. (See explanation of In-lieu recharge water in Section 4.2.4.3)

## 1.2 Groundwater Producers

The local agencies that produce the majority of the groundwater from the basin are shown in Figure 1-5. As part of its plan to involve other affected agencies and work cooperatively where service areas or boundaries overlie the basin, the District meets monthly with nineteen local, major water producers to discuss and evaluate important basin management issues. This group is referred to as the groundwater producers (Producers). Generally each year a chairman is elected to represent the group. This monthly meeting provides a forum for the Producers to provide their input to the District on important issues such as:

- Setting the Basin Production Percentage (BPP) each year;
- Reviewing the merits of proposed capital improvement projects;
- Purchasing imported replenishment water to recharge the groundwater basin;
- Reviewing water quality data and regulations;



- Maintaining and monitoring basin water quality; and
- Budgeting and considering other important policy decisions.

The District as the groundwater basin manager and the Producers as the local retailers cooperate to serve the 2.5 million residents within the OCWD service territory. The Producers and OCWD served as the Advisory Committee for the preparation of this *Groundwater Management Plan*.

FIGURE 1-5  
RETAIL WATER AGENCIES WITHIN OCWD



### ***1.3 Public Education Programs***

Proactive community outreach and public education are central to the operation of the OCWD. Each year, staff members give more than 120 presentations to community leaders and citizens, conduct more than 70 tours of OCWD facilities, and take an active part in community events. In addition to presentations and tours, OCWD administers multiple education programs as described below.

Since its inception in 1996, the Children's Water Education Festival has been the largest of its kind in the nation, hosting more than 6,000 children each year. This two-day outdoor event teaches children about water resources, recycling, pollution prevention, wetland preservation, and other environmental topics through interactive and hands-on activities.

In 2007, the O.C. Water Hero program was initiated to make water conservation fun while helping children and parents develop effective water-use efficiency habits that will last a lifetime. The program challenges both children and their parents to commit to saving 20 gallons of water a day.

O.C. Water 101 is a free water education class that is offered to the public. This one-day session focuses on the global water crisis, how water affects health, California's unique water situation, future challenges for water supplies in Orange County, and how water agencies are helping to conserve available water resources. Discussions include high-tech solutions to help alleviate water shortages today and in the future, as well as providing individuals with the resources and information necessary to save water.

The Hotel/Motel Water Conservation Program began in 1999 to assist hotels and motels in Orange County. At no cost, hotels and motels can order laminated towel rack hangers, bed cards, or combination cards that ask guests to consider reusing their towels and bed linens during their stay. The cards, which gently encourage guests to be environmentally aware, help hotels and motels save money and water.

In 2008, the District, in conjunction with the Municipal Water District of Orange County (MWDOC) and the Orange County Business Council, hosted the O.C. Water Summit, which brought over 400 key policy makers, community leaders and business professionals together to discuss the state's water challenges and possible regional solutions.

The District was recognized as a Groundwater Guardian member in 1996, thereafter forming the OCWD Groundwater Guardian Team. This program is designed to empower local citizens and communities to take voluntary steps toward protecting groundwater resources. The OCWD Groundwater Guardian Team attends and supports community events that are related to this cause.

Through its programs and outreach efforts OCWD informs and educates the public about Orange County's water supply, as well as overall water issues. OCWD strives to draw the communities' attention to the state's water needs and teaches them effective ways to minimize water consumption. The community is encouraged to make life-long commitments to conserving water and respecting it as a precious resource.

## 1.4 Preparation of the Orange County Water District Groundwater Management Plan

OCWD prepared the first *Groundwater Management Plan* in 1989 and updated the plan in 1990, 1994, and 2004.

The 2009 update of the Plan includes new information about projects completed by the District in the past five years and the updated approach to calculating basin storage changes. The Plan identifies OCWD's goals and basin management objectives in protecting and managing the Orange County groundwater basin. The Plan also describes factors for the District's Board to consider in making decisions regarding how much pumping the basin can sustain.

Specific projects that may be developed as a result of recommendations in the Plan would be separately reviewed and approved by the District's Board of Directors and processed for environmental review prior to project implementation. The Plan does not commit the District to a particular program or level of basin production, but describes the factors to consider and key issues as the Board makes basin management decisions on a regular basis each year. Potential projects that are conceptually described in the Plan are described in greater detail in the District's *Long-Term Facilities Plan* (OCWD, 2009).

## 1.5 OCWD Accomplishments, 2004-2008

In the *OCWD 2004 Groundwater Management Plan*, the District established quantifiable objectives, identified as Key Performance Indicators. Those Key Performance Indicators are listed in Table 1-1 along with a summary of actions taken and projects completed to accomplish them.

TABLE 1-1  
KEY PERFORMANCE INDICATORS

| 2004 Groundwater Management Plan Key Performance Indicators           | 2008 Status                                                                                                                                                                 |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cease landward migration of 250 mg/L chloride contour by 2006         | GWR System began operation in 2008.                                                                                                                                         |
|                                                                       | Reliable, local water supplies available for barrier injection increased from 5 mgd to 30 mgd.                                                                              |
|                                                                       | Reversal of landward migration at Talbert Barrier observed in 2008.                                                                                                         |
| Increase Prado water conservation pool elevation by four feet by 2005 | Memorandum of Agreement with the Army Corps of Engineers was executed in 2006 allowing a 5,000 af increase in the maximum winter pool elevation.                            |
| Increase recharge capacity by 10,000 afy                              | Increase in recharge capacity of greater than 10,000 afy occurred with (1) the La Jolla Recharge Basin coming on line in 2008 and (2) operation of Basin Cleaning Vehicles. |

| 2004 Groundwater Management Plan Key Performance Indicators                                                                                     | 2008 Status                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| All water recharged into the basin through District facilities meets or is better than Department of Public Health MCLs and Notification Levels | No exceedances of MCLs or Notification Levels in recharge water as documented in <i>Santa Ana River Water Quality Monitoring Reports</i> (OCWD 2005, 2006, 2007, 2008) and GWR System permit reports. |
| Reduce basin overdraft by 20,000 afy                                                                                                            | Basin's accumulated overdraft was reduced by 202,000 af between June 2004 and June 2007. (OCWD Engineer's Report, 2008)                                                                               |

Major accomplishments since adoption of the 2004 Plan include:

- Phase 1 of the GWR System began operating in 2008 with a capacity of purifying 72 afy of water for the Talbert Barrier and groundwater recharge.
- The Irvine Desalter Project, a cooperative project between OCWD and Irvine Ranch Water District (IRWD), began operating in 2007 to remediate groundwater contamination and provide 8,000 afy of additional water supplies.
- The *Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy*, published in February 2007, established a new methodology for calculating accumulated overdraft and establishing new full-basin benchmarks (see Appendix D).
- Development of a groundwater model.
- Beginning the construction of the North Basin Groundwater Protection Project.
- Securing the rights to divert and use up to 362,000 afy of Santa Ana River water through a decision of the State Water Resources Control Board in December 2008.

A comprehensive list of projects completed between 2004 and 2009 and the location in the Plan of the project description is shown in Table 1-2.

**Table 1-2  
Summary of Completed Projects 2004-2009**

| Project                                   | Description                                                                                                                                                                            | Location in GWMP | Construction Completed | Operation Began |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------|-----------------|
| Groundwater Replenishment System          | Purifies up to 72,000 afy of secondary-treated water from OCSD to create a new water supply for seawater intrusion barrier and groundwater recharge                                    | Section 4.2.3.1  | 2007                   | 2008            |
| Prado Basin Water Conservation Project    | Increases winter-time storage level at Prado Dam by 5,000 af                                                                                                                           | Section 4.1.1    | N/A                    | 2006            |
| Talbert Barrier Expansion                 | Expanded Talbert Seawater Intrusion Barrier by constructing 8 new injection wells (4 with 1 casing each and 4 with 3 casings each)                                                     | Section 6.3.3    | 2007                   | 2008            |
| Irvine Desalter Project                   | Constructed extraction and treatment system to pump and treat up to 8,000 afy contaminated groundwater                                                                                 | Section 5.8.4    | 2007                   | 2007            |
| La Jolla Recharge Basin                   | New 6-acre recharge basin increases recharge capacity up to 9,000 afy                                                                                                                  | Section 4.4.1    | 2008                   | 2008            |
| Olive Basin Intake Structure Improvements | Construction of new intake structure and transfer pipe decreases sediment fouling of recharge basin                                                                                    | Section 4.4.1    | 2006                   | 2007            |
| Basin Cleaning Vehicles                   | Construction of four basin cleaning vehicles removes sediment from recharge basins                                                                                                     | Section 4.1      | 2004                   | 2004            |
| Santiago Creek Recharge Enhancement       | Grading of Santiago Creek bed improves recharge rate by an estimated 3,600 afy                                                                                                         | Section 4.4.1    | 2008                   | 2008            |
| Conjunctive Use "8 Well Project"          | Construction of 8 new extraction wells as part of Conjunctive Use Project with MWD to allow storage and withdrawal of imported water in the groundwater basin for use in drought years | Section 6.3.3    | 2007                   | N/A             |



| <b>Project</b>                                                  | <b>Description</b>                                                                                                     | <b>Location in GWMP</b> | <b>Construction Completed</b> | <b>Operation Began</b> |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------------|------------------------|
| Mini-Anaheim Recharge Basin Modifications                       | Modifications to increase recharge basin performance                                                                   | Section 4.4.1           | 2005                          | 2005                   |
| Kraemer-Miller Pipeline Improvements                            | New pipelines to provide enhanced supply of recharge water to recharge basins                                          | Section 4.4.1           | 2007                          | 2007                   |
| Santiago Creek Monitoring Wells                                 | Three new monitoring wells constructed to assess hydrogeologic conditions along Santiago Creek                         | Section 4.2.2           | 2009                          | 2009                   |
| Monitoring Wells for GWR System                                 | Construction of three new monitoring wells for GWR System compliance monitoring                                        | Section 3.7.3           | 2004                          | 2005                   |
| Monitoring Wells for North Basin Groundwater Protection Project | Construction of new monitoring wells to assess occurrence of groundwater contamination                                 | Section 5.8.1           | 2008                          | 2008                   |
| Extraction Wells for North Basin Groundwater Protection Project | Four new extraction wells constructed to remove contaminated groundwater                                               | Section 5.8.1           | 2009                          | Estimated in 2010      |
| Lincoln & Burris Exploratory Wells                              | Construction of ten monitoring wells to characterize the ability of sediments adjacent to the basin to percolate water | Section 4.4.1           | 2006                          | 2007                   |
| Prado Wetlands Reconstruction                                   | Flood damage repairs restore wetlands function                                                                         | Section 5.3.3           | 2008                          | 2008                   |
| Warner Basin Dam                                                | Construction of a dam to replace need for building temporary earthen berms for each basin cleaning.                    | Section 4.4.1           | 2007                          | 2007                   |

## **1.6 Public Outreach**

The California Water Code describes the process for development and adoption of a groundwater management plan that includes a public participation component. To adopt this plan, publicly-noticed meetings held as part of the District's regularly-scheduled board meetings and information were posted on the OCWD website. Appendix A contains copies of the public notices.

In addition to the publicly-noticed public participation opportunities and postings on the web site, the District held workshops with the Producers. The Producers include cities, special districts, and investor-owned utilities that produce more than 90 percent of the water pumped from the basin. The content of the Plan was developed with input and review from the Producers through holding workshops and providing the Producers with draft versions of the Plan prior to its finalization. This group and OCWD served as the advisory committee of stakeholders guiding the development and implementation of the plan and providing a forum for resolving controversial issues.

As part of its overall outreach program, the District informs and engages the public in groundwater discussions through an active speaker's bureau, media releases, and the water education class "Orange County Water 101".

## **1.7 Compliance with California Water Code**

Criteria regarding adoption of a groundwater management plan are included in Section 10750 et seq. of the California Water Code, also referred to as A.B. 3030. A complete list of required and recommended components of groundwater management plans and the location of those components in the Plan can be found in Appendix B. This plan is developed to meet the requirements of the California Water Code.

## **1.8 Groundwater Management Goals and Basin Management Objectives**

OCWD's goals in managing the Orange County groundwater basin are as follows:

- To protect and enhance the groundwater quality of the Orange County groundwater basin,
- To protect and increase the sustainable yield of the basin in a cost-effective manner, and
- To increase the efficiency of OCWD's operations.

Basin management objectives that accomplish all three of the above mentioned goals include:

- Updating the *Groundwater Management Plan* periodically,
- Updating the *Long-Term Facilities Plan* periodically, and
- Continuing annual publication of the *Santa Ana River Water Quality Report*; the *Engineer's Report on the Groundwater Conditions, Water Supply and Basin*

*Utilization; the Santa Ana River Watermaster Report; and the Groundwater Replenishment System Operations Annual Report.*

More specific basin management objectives set to accomplish one of the above mentioned goals are summarized below and described in detail in this report.

### **1.8.1 PROTECT AND ENHANCE GROUNDWATER QUALITY**

Basin management objectives established by OCWD to protect and enhance groundwater quality include:

- Conducting groundwater quality monitoring programs throughout the basin.
- Monitoring and managing recharge water supplies so that water recharged through District facilities meets or is better than primary drinking water levels and notification levels.
- Monitoring the quality of Santa Ana River water on a routine basis at Imperial Highway and in the upper watershed.
- Implementing the District's Groundwater Quality Protection Policy.
- Constructing and managing water quality treatment projects.
- Operating seawater intrusion barriers to prevent landward migration of seawater into the groundwater basin.
- Supporting natural resource programs in the Santa Ana River Watershed to improve water quality.
- Participating in cooperative efforts with regulators and stakeholders within the Santa Ana River Watershed.

### **1.8.2 PROTECT AND INCREASE THE BASIN'S SUSTAINABLE YIELD IN A COST EFFECTIVE MANNER**

Basin management objectives established by OCWD to protect and increase the basin's sustainable yield include:

- Monitoring groundwater levels, recharge rates, and production rates.
- Operating the groundwater basin in accordance with the *Groundwater Basin Storage and Operational Strategy*.
- Managing recharge operations to maximize recharge of the groundwater basin.
- Researching and implementing new strategies and programs to increase recharge capacity.
- Promoting incidental recharge to the extent feasible without negatively impacting groundwater quality.



- Planning for and conducting programs that maximize the capacity of the basin to respond to and recover from droughts.
- Supporting natural resource programs in the Santa Ana River watershed.

### **1.8.3 Increase Operational Efficiency**

Basin management objectives established by OCWD to increase operational efficiency include:

- Managing the District's finances to provide long-term fiscal stability and to maintain financial resources to implement District programs.
- Operating District programs in a cost-effective and efficient manner.
- Managing natural resource programs in the Santa Ana River watershed in an efficient manner.
- Implementing efficient environmental management programs to reduce greenhouse gas emissions, such as use of solar power where feasible.

District programs that are conducted to meet the state goals and basin management objectives and to contribute to a more reliable supply for long-term beneficial uses of groundwater are described in the following sections, a summary of which can be found in Appendix C.

## 2 BASIN HYDROGEOLOGY

The groundwater basin covers approximately 350 square miles in north-central Orange County and is composed of layers of sediment with variable thickness and hydraulic properties. Because of the basin's size and complexity, understanding basin hydrogeology is critical to successful water management. This section:

- Describes the hydrogeologic characteristics of the basin, including aquifer systems, basin boundaries, and physiographic features.
- Describes the major components of inflows and outflows that compromise the basin water budget.
- Presents groundwater storage and elevation trends and issues related to land subsidence.
- Explains the updated methodology for calculating accumulated overdraft and groundwater storage change implemented in 2007.
- Traces the history, development, and operation of the District's Basin Model.

### 2.1 DESCRIPTION OF BASIN HYDROGEOLOGY

The Orange County Groundwater Basin is located in the area designated by the California Department of Water Resources (DWR) as Basin 8-1, the "Coastal Plain of Orange County Groundwater Basin" in Bulletin 118 (DWR, 2003).

Figure 2-1 displays the OCWD boundaries in relation to the boundaries of Basin 8-1. The groundwater basin underlies the north half of Orange County beneath broad lowlands known as the Tustin and Downey plains. The basin covers an area of approximately 350 square miles, bordered by the Coyote and Chino Hills to the north, the Santa Ana Mountains to the northeast, and the Pacific Ocean to the southwest. The basin boundary extends to the Orange County-Los Angeles line to the northwest, where groundwater flow is unrestricted across the county line into the Central Basin of Los Angeles County (see Figure 2-2). The Newport-Inglewood fault zone forms the southwestern boundary of all but the shallow aquifer in the basin.

Basin aquifers are over 2,000 feet deep and form a complex series of interconnected sand and gravel deposits (DWR, 1967). In coastal and central portions of the basin, these deposits are extensively separated by lower-permeability clay and silt deposits, known as aquitards. In the inland area, generally northeast of Interstate 5, the clay and silt deposits become thinner and more discontinuous, allowing larger quantities of groundwater to flow more easily between shallow and deeper aquifers. Figure 2-3 presents a geologic cross section through the basin along the Santa Ana River.

Shallower aquifers exist above the principal aquifer system, the most prolific being known as the Talbert aquifer. Production from this shallow aquifer system is typically about five percent of total basin production. The majority of water from the shallow

aquifer is pumped by small systems for industrial and agricultural use although the cities of Garden Grove, Anaheim, and Tustin have a few large system wells that pump from the shallow aquifer for municipal use.

Deeper aquifers exist below the principal aquifer system. Few wells penetrate into this region because of the high cost of drilling deep wells and because the aquifers contain colored water in some areas. The treatment and use of colored water is discussed in detail in Section 5.4.

**FIGURE 2-1**  
**DWR Bulletin 118 Groundwater Basins**





### 2.1.1 FOREBAY AND PRESSURE AREAS

The Department of Water Resources, formerly the Division of Water Resources (DWR, 1934), divided the basin into two primary hydrologic divisions, the Forebay and Pressure areas, as shown in Figure 2-2. The Forebay/Pressure area boundary generally delineates the areas where surface water or shallow groundwater can or cannot move downward to the first producible aquifer in quantities significant from a water-supply perspective. From a water-quality perspective, the amount of vertical flow to deeper aquifers from surface water or shallow groundwater may be significant in terms of impacts of past agricultural or industrial land uses (e.g., fertilizer application and leaky underground storage tanks).

FIGURE 2-2  
ORANGE COUNTY GROUNDWATER BASIN

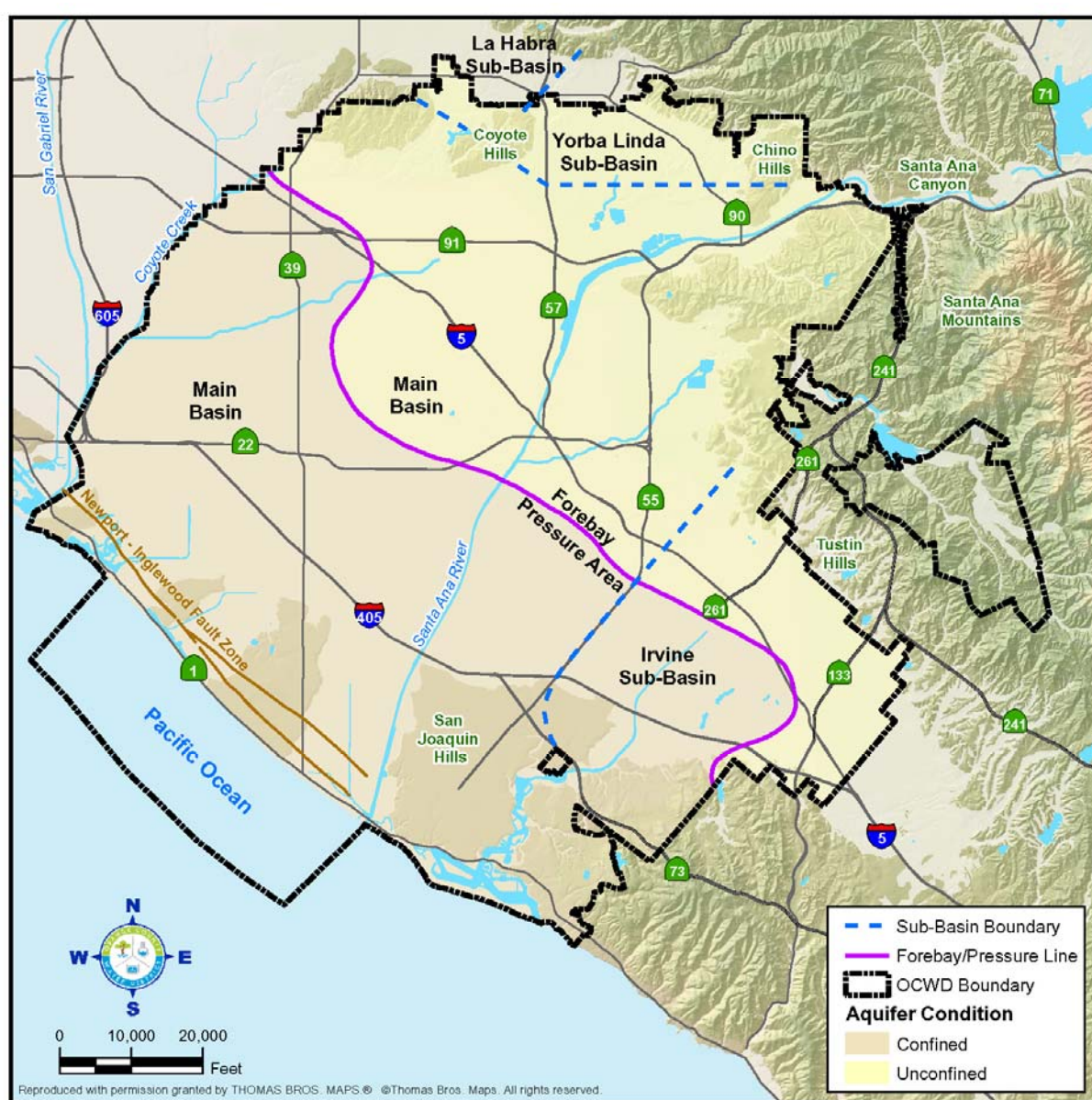
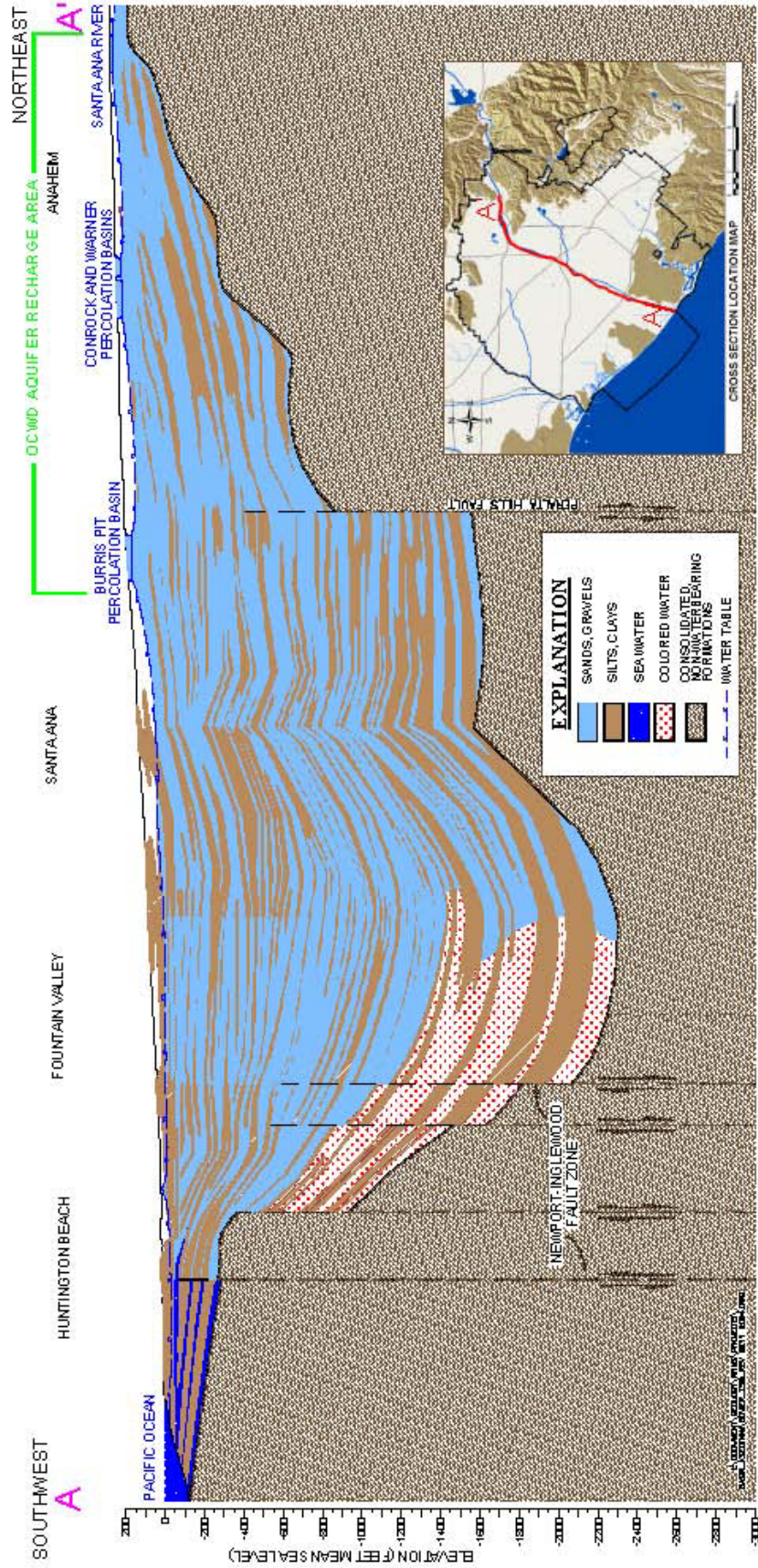




FIGURE 2-3  
GEOLOGIC CROSS-SECTION THROUGH ORANGE COUNTY GROUNDWATER BASIN



The Forebay refers to the area of intake or recharge where most of the groundwater recharge occurs. Highly-permeable sands and gravels with few and discontinuous clay and silt deposits allow direct percolation of Santa Ana River and other surface water. The Forebay area encompasses most of the cities of Anaheim, Fullerton, and Villa Park and portions of the cities of Orange and Yorba Linda.

The Pressure Area, in a general sense, is defined as the area of the basin where large quantities of surface water and near-surface groundwater is impeded from percolating into the major producible aquifers by clay and silt layers at shallow depths (upper 50 feet). The principal and deeper aquifers in this area are under “confined” conditions (under hydrostatic pressure); the water levels of wells penetrating these aquifers exhibit large seasonal variations. Most of the central and coastal portions of the basin fall within the Pressure Area.

### **2.1.2 GROUNDWATER SUBBASINS, MESAS AND GAPS**

The Irvine subbasin, bounded by the Santa Ana Mountains and the San Joaquin Hills, forms the southern-most portion of the basin. The Costa Mesa Freeway (State Route 55) and Newport Boulevard form the subbasin’s approximate western boundary with the main basin. Here the aquifers are thinner and contain more clay and silt deposits than aquifers in the main portion of the basin. The Irvine Ranch Water District (IRWD) is the primary groundwater producer.

The aquifer base in the Irvine subbasin ranges from approximately 1,000 feet deep beneath the former Marine Corps Air Station (MCAS) Tustin to less than 200 feet deep at the eastern boundary of the former MCAS El Toro. East of former MCAS El Toro, the aquifer further thins and transitions into lower-permeability sandstones and other semi-consolidated sediments, which have minor water storage and transmission capacity. Groundwater historically flowed out of the Irvine subbasin westerly into the main basin since the amount of natural recharge in the area, predominantly from the Santa Ana Mountains, was typically greater than the amount of pumping (Singer, 1973; Banks, 1984). With the operation of the Irvine Desalter Project commencing in 2007, groundwater production in the Irvine subbasin may exceed the natural replenishment from the adjacent hills and mountains, in which case groundwater would be drawn into the Irvine subbasin from the Main Basin.

The Yorba Linda subbasin is located north of the Anaheim Forebay recharge area, within the cities of Yorba Linda and Placentia. Due to low transmissivity and high total dissolved solids (TDS) concentrations (Mills, 1987) there is little groundwater pumped from this subbasin. Groundwater from the Yorba Linda subbasin flows southward into the Main basin since the limited groundwater production is less than the natural replenishment from the adjacent Chino Hills.

The La Habra Basin is located north of the Main Basin within the cities of La Habra and Brea. It comprises a shallow alluvial depression between the Coyote Hills and the Puente Hills. Similar to the Yorba Linda subbasin, little groundwater production occurs in the La Habra Basin due to low transmissivity and poor water quality (high TDS). Hydrogeologic studies have indicated that 2,200 to 5,500 afy of groundwater flows out of the La Habra Basin in two areas: (1) southerly into the Main Basin along the Brea

Creek drainage between the East and West Coyote Hills and (2) westerly into the Central basin in Los Angeles County (James M. Montgomery, 1977; Ramsey, 1980; OCWD, 1994).

Four relatively flat elevated areas, known as mesas, occur along the coastal boundary of the basin. The mesas were formed by ground surface uplift along the Newport Inglewood Fault Zone. Ancient meandering of the Santa Ana River carved notches through the uplifted area and left behind sand- and gravel-filled deposits beneath the lowland areas between the mesas, known as gaps (Poland et al., 1956). Groundwater in the shallow aquifers within the gaps is susceptible to seawater intrusion. The Talbert and Alamitos seawater intrusion barriers were constructed to address this problem. Locations of mesas and details of seawater barrier operations are discussed in Section 3.6.

## **2.2 DETERMINATION OF TOTAL BASIN VOLUME**

A vast amount of fresh water is stored within the basin, although only a fraction of this water can be removed practically using pumping wells and without causing physical damage such as seawater intrusion or the potential for land subsidence (Alley, 2006). Nonetheless, it is important to note the total volume of groundwater that is within the active flow system, i.e., within the influence of pumping and recharge operations.

OCWD used its geographic information system and the aquifer system boundaries described in detail in Section 2.8 to calculate the total volume of each of the three major aquifer systems as well as the intervening aquitards. The total volume was calculated by multiplying the area and thickness of each hydrogeologic unit. Because groundwater fills the pore spaces that represent typically between 20 and 30 percent of the total volume, the total volume was multiplied by this porosity percentage to arrive at a total groundwater volume. Assuming the basin is completely full, based on District estimates, the total amount of fresh groundwater stored in the basin is approximately 66 million acre-feet (maf), as shown in Table 2-1.

**TABLE 2-1**  
**ESTIMATED BASIN GROUNDWATER STORAGE BY HYDROGEOLOGIC UNIT**  
(Volumes in Acre-feet)

| Hydrogeologic Unit       | Pressure Area     | Forebay           | Total             |
|--------------------------|-------------------|-------------------|-------------------|
| Shallow Aquifer System   | 3,800,000         | 1,200,000         | 5,000,000         |
| Aquitard                 | 900,000           | 200,000           | 1,100,000         |
| Principal Aquifer System | 24,300,000        | 8,600,000         | 32,900,000        |
| Aquitard                 | 1,600,000         | 300,000           | 1,900,000         |
| Deep Aquifer System      | 18,800,000        | 6,300,000         | 25,100,000        |
| <b>Total</b>             | <b>49,400,000</b> | <b>16,600,000</b> | <b>66,000,000</b> |

- Notes: 1. Volumes calculated using the 3-layer basin model surfaces with ArcInfo Workstation GRID.  
 2. A porosity of 0.25 was assumed for aquifer systems.  
 3. A porosity of 0.30 was assumed for aquitards.



For comparison, DWR (1967) estimated that about 38 maf of fresh water is stored in the groundwater basin when full. DWR used a factor known as the specific yield to calculate this volume. The specific yield (typically between 10 and 20 percent) is the amount of water that can be drained by gravity from a certain volume of aquifer and reflects the soil's ability to retain and hold a significant volume of water due to capillary effects. Thus, DWR's *drainable* groundwater volume, although technically correct, is roughly half of OCWD's estimate of *total* groundwater volume in the basin.

## 2.3 WATER BUDGET

OCWD staff developed a hydrologic budget (inflows and outflows) for the purpose of constructing the Basin Model and for evaluating basin production capacity and recharge requirements. The key components of the budget include measured and unmeasured (estimated) recharge, groundwater production, and subsurface flows along the coast and across the Orange/Los Angeles County line. Because the basin is not operated on an annual safe-yield basis, the net change in storage in any given year may be positive or negative; however, over the period of several years, the basin must be maintained in an approximate balance.

Table 2-2 presents the components of a balanced basin water budget (no annual change in storage) and does not represent data for any given year. The annual budget presented is based on the following assumptions: (1) average precipitation, (2) accumulated overdraft of 400,000 af, (3) recharge of 235,000 af at the Forebay recharge facilities, and (4) adjusted groundwater production so that total basin inflows and outflows are equal. The 235,000 af of Forebay recharge consists of 148,000 af of Santa Ana River baseflow, 50,000 af of Santa Ana River stormflow, and 37,000 af of GWR System water. The major components of the water budget are described in the following sections.

### 2.3.1 MEASURED RECHARGE

Measured recharge consists of all water artificially recharged at OCWD's Forebay percolation facilities and water injected at the Talbert Barrier and on the Orange County side of the Alamitos Barrier. Santa Ana River stormflows and baseflows serve as the primary source of recharge in the Forebay.

OCWD's Talbert Barrier is a series of injection wells that span the 2.5-mile wide Talbert Gap, between the Newport and Huntington Beach mesas. A blend of imported and purified water is injected into multiple aquifers that are used for municipal supply. Over 95 percent of the injected water flows inland and becomes part of the basin's replenishment supply.

The Alamitos Barrier is a series of wells injecting a blend of imported and purified water into multiple aquifer zones that span the Alamitos Gap at the Los Angeles/Orange County line. Essentially all of the injected water flows inland, replenishing groundwater basins in the two counties. From inspection of groundwater contour maps, it appears that roughly one-third of the Alamitos Barrier injection water remains within or flows into Orange County.



TABLE 2-2  
REPRESENTATIVE ANNUAL BASIN WATER BUDGET

| FLOW COMPONENT                                                   | Acre-feet      |
|------------------------------------------------------------------|----------------|
| <b>INFLOW</b>                                                    |                |
| <b>Measured Recharge</b>                                         |                |
| 1. Forebay recharge facilities                                   | 235,000        |
| 2. Talbert Barrier injection                                     | 35,000         |
| 3. Alamitos Barrier injection, Orange County portion only        | 2,500          |
| <b>Subtotal:</b>                                                 | <b>272,500</b> |
| <b>Estimated Unmeasured Recharge (average precipitation)</b>     |                |
| 1. Inflow from La Habra basin                                    | 3,000          |
| 2. Recharge from foothills into Irvine subbasin                  | 14,000         |
| 3. Areal recharge from rainfall/irrigation into Main basin       | 17,500         |
| 4. Recharge from foothills into Yorba Linda subbasin             | 6,000          |
| 5. Subsurface inflow at Imperial Highway beneath Santa Ana River | 4,000          |
| 6. Santa Ana River recharge, Imperial Highway to Rubber Dam      | 4,000          |
| 7. Subsurface inflow from Santiago Canyon                        | 10,000         |
| 8. Recharge along Peralta Hills                                  | 4,000          |
| 9. Recharge along Tustin Hills                                   | 6,000          |
| 10. Seawater inflow through coastal gaps                         | 500            |
| <b>Subtotal:</b>                                                 | <b>69,000</b>  |
| <b>TOTAL INFLOW:</b>                                             | <b>341,500</b> |
| <b>OUTFLOW</b>                                                   |                |
| 1. Groundwater Production                                        | 333,500        |
| 2. Subsurface Outflow                                            | 8,000          |
| <b>TOTAL OUTFLOW:</b>                                            | <b>341,500</b> |
| <b>CHANGE IN STORAGE:</b>                                        | <b>0</b>       |

### 2.3.2 UNMEASURED RECHARGE

Unmeasured recharge also referred to as “incidental recharge” accounts for a significant amount of the basin’s producible yield. This includes recharge from precipitation at the basin margin along the Chino, Coyote, and San Joaquin Hills and the Santa Ana Mountains; Santa Ana River recharge between Imperial Highway and the OCWD rubber diversion dam; irrigation return flows; urban runoff; and underflow beneath the Santa Ana River and Santiago Creek. This latter refers to groundwater that enters the basin at the mouth of Santa Ana Canyon, the Santiago Creek drainage below Villa Park Dam, and seawater inflow through the gaps.

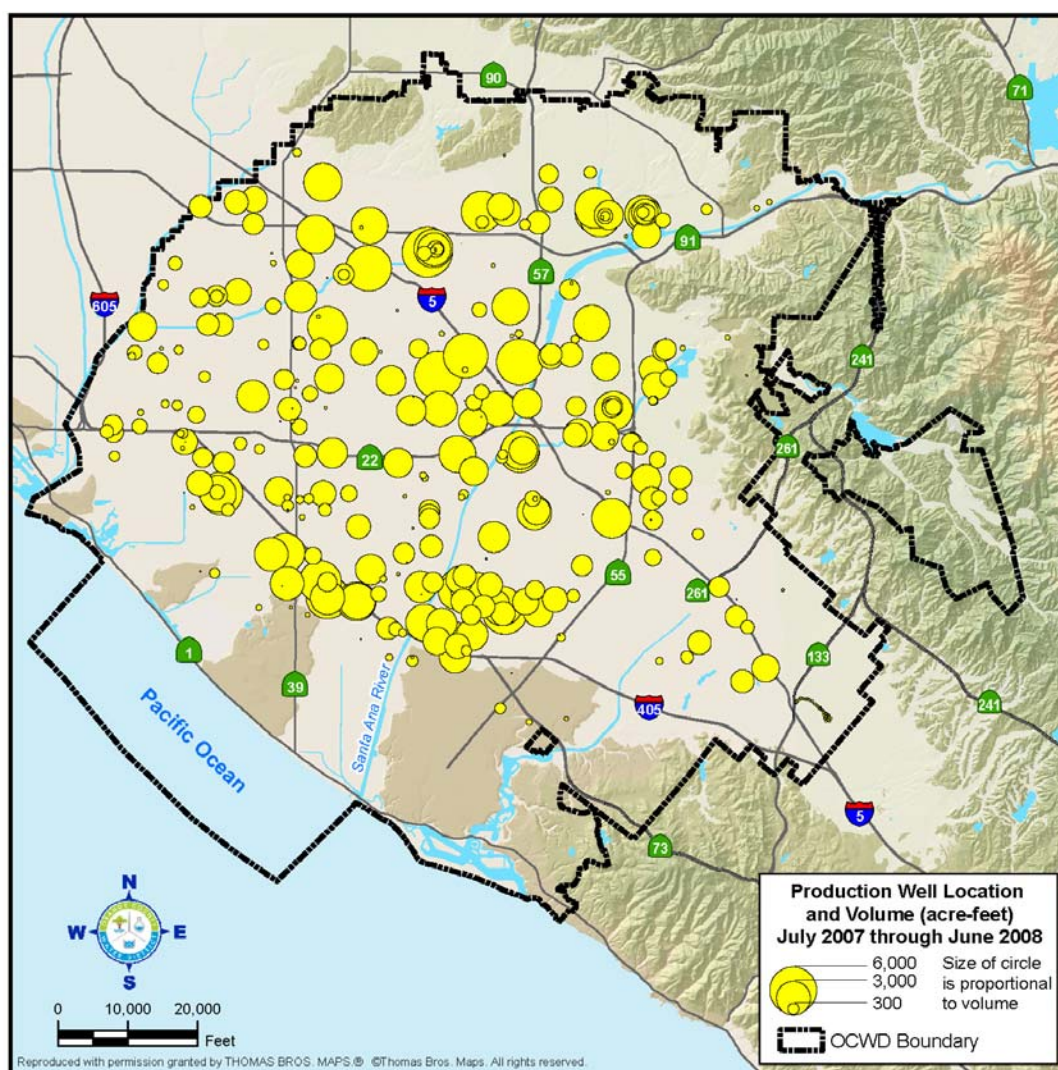
Unmeasured recharge is estimated at an average of 60,000 afy. This number is derived from estimating annual changes in groundwater storage by comparing groundwater elevation changes, after subtracting losses to Los Angeles County. Net incidental recharge is used to refer to the amount of incidental recharge after accounting for groundwater losses, such as outflow to Los Angeles County. This average unmeasured recharge was substantiated during calibration of the Basin Model and is also consistent

with the estimate of 58,000 afy reported by Hardt and Cordes (1971) as part of a U.S. Geological Survey (USGS) modeling study of the basin. Because unmeasured recharge is one of the least understood components of the basin's water budget, the error margin of staff's estimate for any given year is probably in the range of 10,000 to 20,000 af. Since the unmeasured recharge is well distributed throughout the basin, the physical significance (e.g., water level drawdown or mounding in any given area) of over- or underestimating the total recharge volume within this error margin is considered to be minor.

### 2.3.3 GROUNDWATER PRODUCTION

Groundwater production from the basin, as shown in Figure 2-4, occurs from approximately 450 active wells within the District, approximately 200 of which produce less than 25 afy.

FIGURE 2-4  
DISTRIBUTION OF GROUNDWATER PRODUCTION



Groundwater production from approximately 200 large-capacity or large-system wells operated by the 21 largest water retail agencies accounted for an estimated 97 percent of the total production in 2006-07. Large-capacity wells are all metered, as required by the District Act, and monthly individual well production has been documented since 1988. Prior to 1988, per-well production data were recorded semi-annually.

Groundwater production is distributed uniformly throughout the majority of the basin with the exceptions of the Yorba Linda subbasin, the immediate coastal areas, and the foothill margins of the basin, where little to no production occurs. Increases in coastal production would lead to increased stress on the Talbert and Alamitos barriers, requiring additional barrier capacity. Inasmuch as it is technically and economically feasible, future increases in coastal groundwater demand should be addressed by wells constructed inland in areas of lower well density and higher aquifer transmissivity.

The distribution of existing wells and the siting of future wells depend on many different factors, including logistics, property boundaries, hydrogeology, and regulatory guidelines. Logistical considerations include property availability, city and other political boundaries, and proximity to other water facilities. Proximity to existing water transmission pipelines can be extremely important, given the cost of new reaches of pipeline. Hydrogeologic considerations for siting a well may include: thickness of permeable aquifer units, groundwater quality, drawdown interference from nearby wells, seasonal water level fluctuations, and potential impacts to the basin such as seawater intrusion.

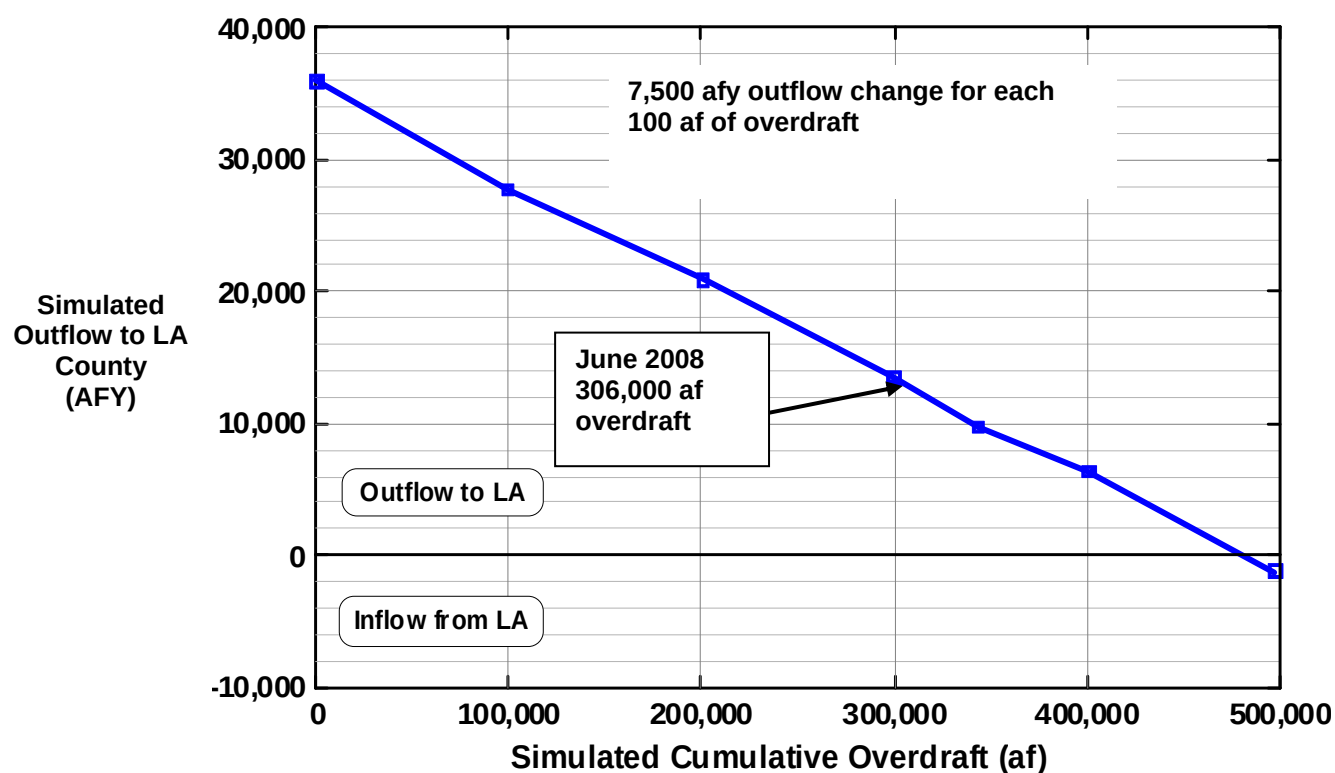
#### **2.3.4 SUBSURFACE OUTFLOW**

Groundwater outflow from the basin across the Los Angeles/Orange County line has been estimated to range from approximately 1,000 to 14,000 afy based on groundwater elevation gradients and aquifer transmissivity (DWR, 1967; McGillicuddy, 1989). The Water Replenishment District has also indicated underflow from Orange County to Los Angeles County within the aforementioned range. Underflow varies annually and seasonally depending upon hydrologic conditions on either side of the county line.

Modeling by OCWD indicated that, assuming groundwater elevations in the Central Basin remain constant; underflow to Los Angeles County increases approximately 7,500 afy for every 100,000 af of increased groundwater in storage in Orange County (see Figure 2-5).

With the exception of unknown amounts of semi-perched (near-surface) groundwater being intercepted and drained by submerged sewer trunk lines and unlined flood control channels along coastal portions of the basin, no other significant basin outflows are known to occur.

**FIGURE 2-5**  
**RELATIONSHIP BETWEEN BASIN STORAGE AND ESTIMATED OUTFLOW**



## 2.4 GROUNDWATER ELEVATION AND STORAGE CALCULATION

OCWD estimates annual changes in the amount of groundwater stored in the basin using groundwater elevation measurements and aquifer storage coefficients for the three primary aquifer systems in the basin. This three-layer method involves measuring the water levels at the end of each water year at nearly every production and monitoring well in the basin. Water level measurements are contoured, as shown in Figure 2-6, and then digitized into the Geographic Information System (GIS). The GIS is then used to subtract the previous year's water level maps from the current water year, resulting in a water level change contour map for each of the three aquifer layers. Figure 2-7 shows the water level change for the principal aquifer (layer 2). For each of the three aquifer layers, the GIS is then used to multiply these water level changes by a grid of aquifer storage coefficients from OCWD's calibrated basin groundwater model. This results in a storage change volume for each of the three aquifer layers, which are totaled to provide a net annual storage change for the basin.

A more detailed description of the three-layer methodology is presented in OCWD's *Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy* (February 2007).



FIGURE 2-6  
JUNE 2008 WATER LEVELS

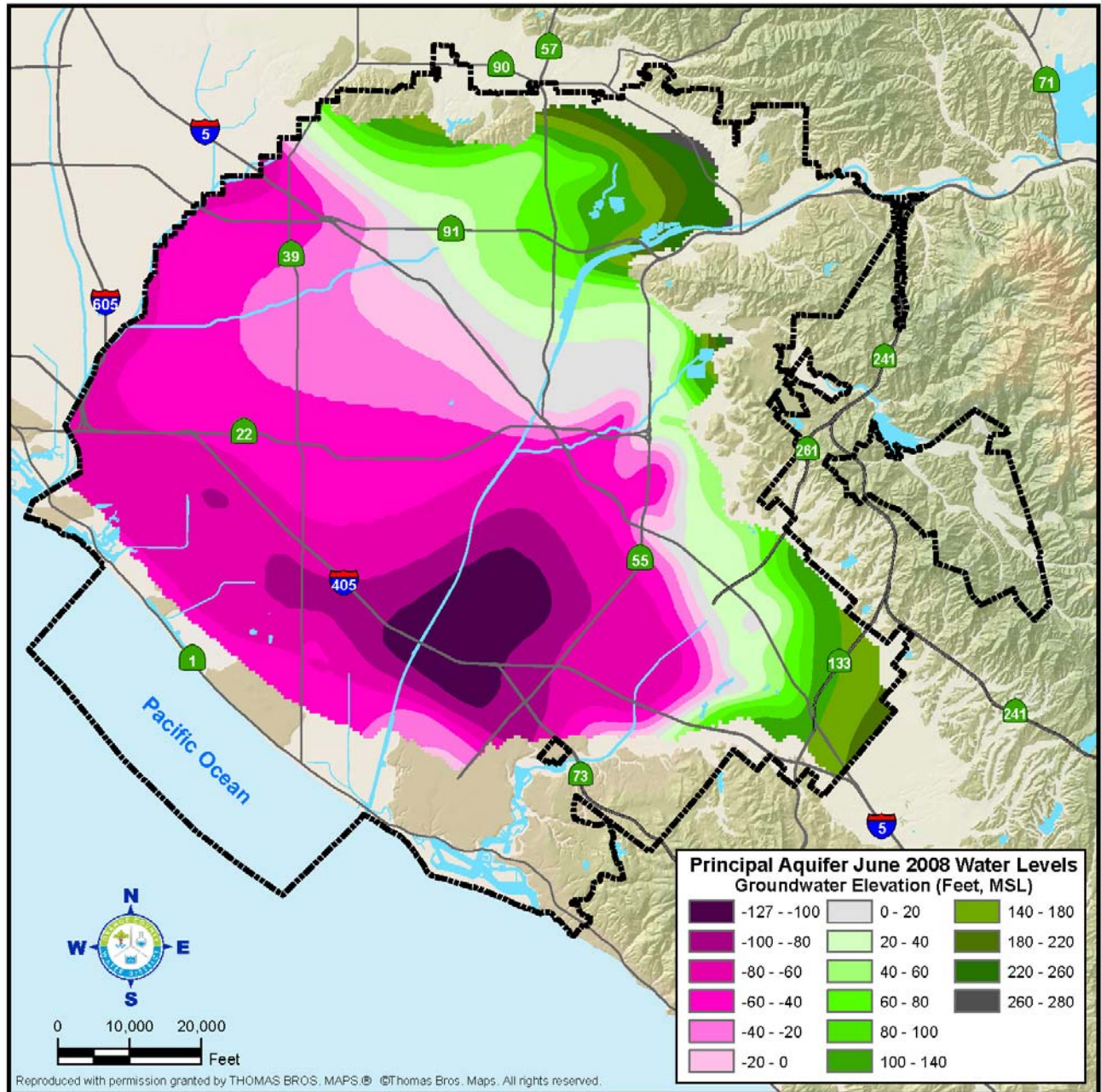
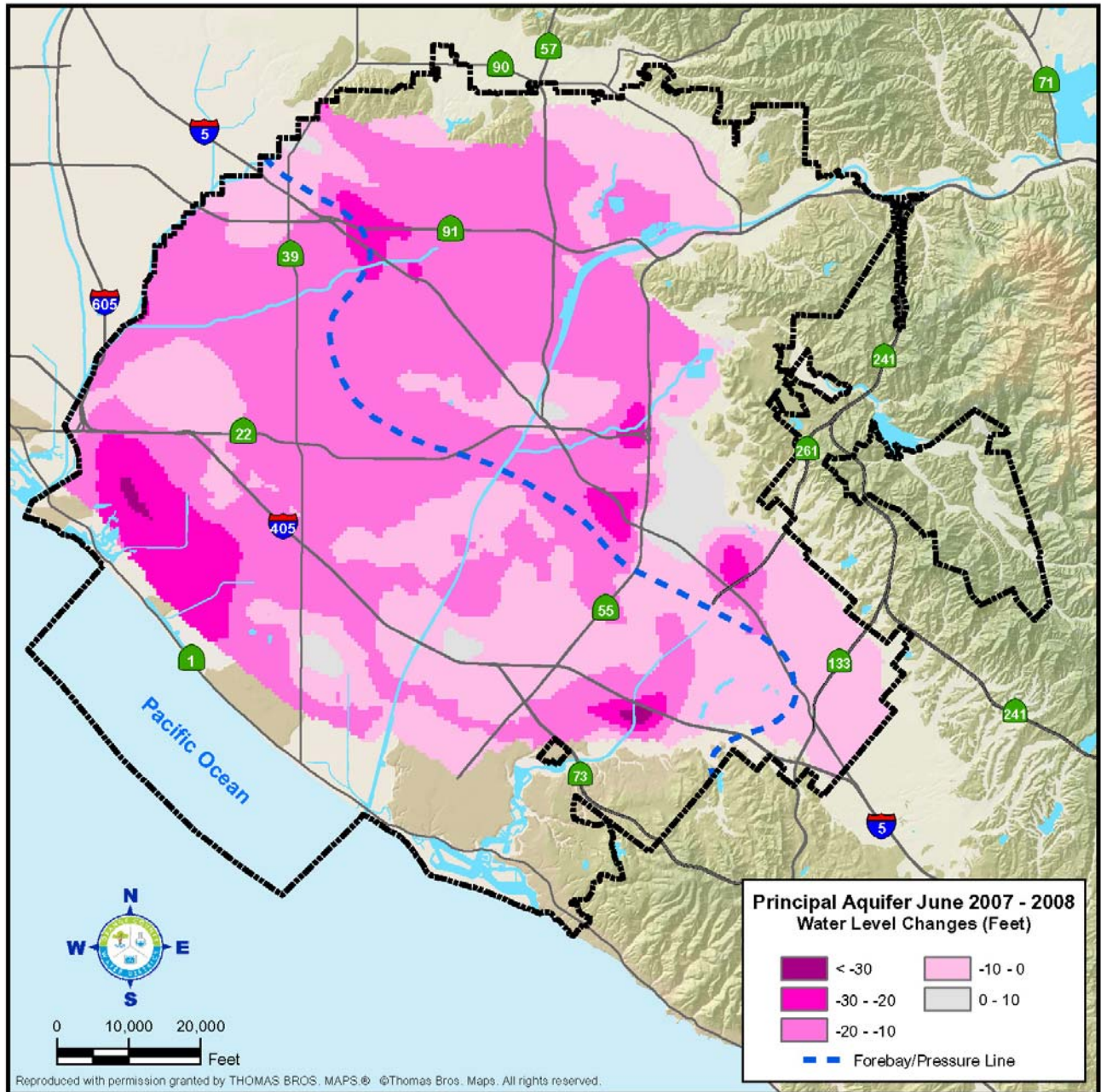


FIGURE 2-7  
WATER LEVEL CHANGES



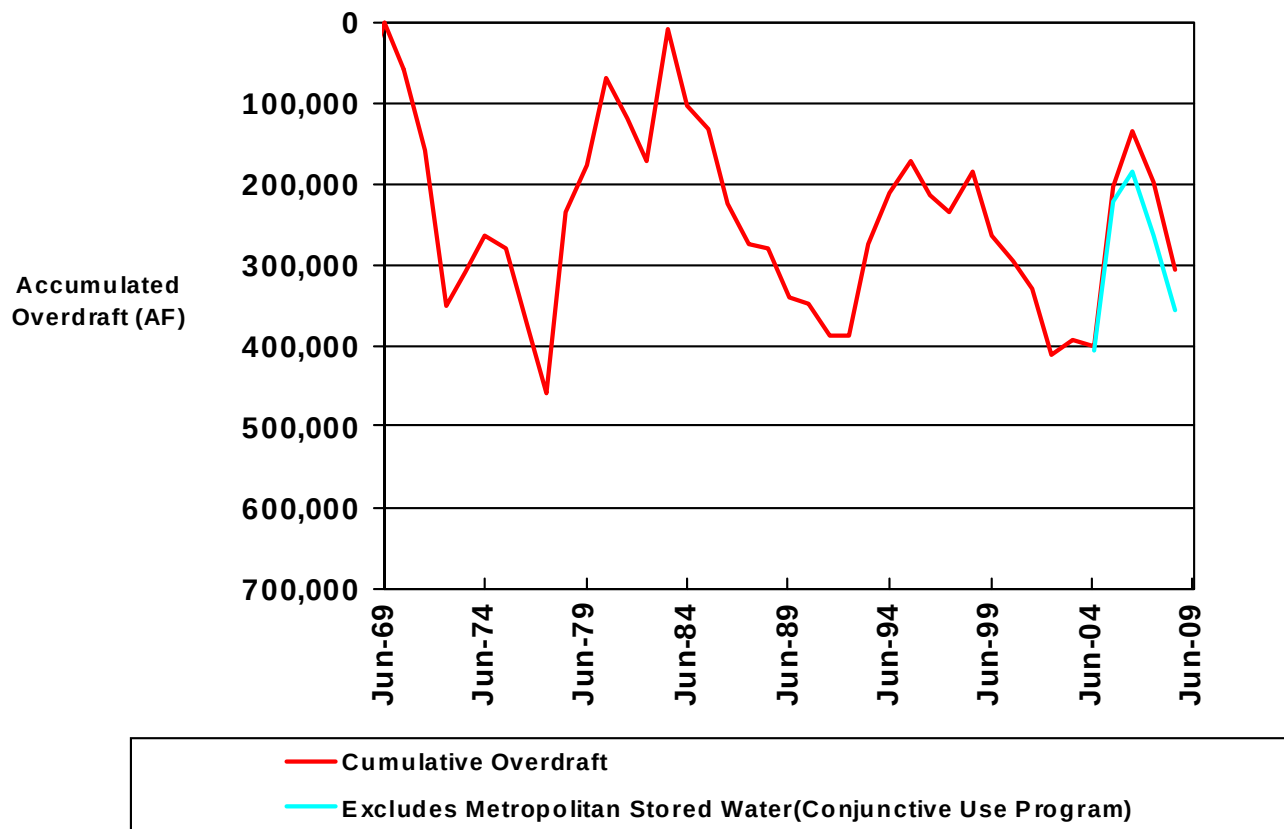


## 2.5 ACCUMULATED OVERDRAFT CALCULATION

OCWD estimates that the basin can be operated on a short-term basis with a maximum accumulated overdraft (storage reduction from full condition) of approximately 500,000 af without causing irreversible seawater intrusion and land subsidence.

The estimated maximum historical accumulated basin overdraft of 500,000 to 700,000 af occurred in 1956-57 (DWR, 1967; OCWD, 2003). Until 2007, water level elevations in November 1969 were used as the baseline to represent near-full conditions. The net decrease in storage from 1969 conditions represented the accumulated overdraft. Since 2004, OCWD has participated in Metropolitan's Conjunctive Use Program. This program allows for the storage of Metropolitan water in the Orange County groundwater basin. Figure 2-8 illustrates the basin accumulated overdraft since 1962. The accumulated overdraft including the Metropolitan Conjunctive Use water is shown in red. The blue line indicates the basin accumulated overdraft calculated without Metropolitan's stored water.

FIGURE 2-8  
ACCUMULATED BASIN OVERDRAFT



### 2.5.1 DEVELOPMENT OF NEW METHODOLOGY

The traditional full-basin benchmark of 1969 was revised in 2007. A new methodology was developed to calculate accumulated overdraft and storage change. The need for this new methodology was driven by the record-setting wet year of 2004-05, in which an unprecedented storage increase of 170,000 af was estimated by OCWD staff.

During that year, water levels throughout the basin rose approximately 30 feet overall, approaching a near-full condition. Analysis showed that groundwater in storage in November 2005 was only 40,000 af less than the full basin 1969 benchmark. However, the traditional method of cumulatively adding the annual storage change each year to the previous year's accumulated overdraft produced an accumulated overdraft of approximately 190,000 acre-feet for November 2005. The discrepancy of 150,000 af in the two different calculations indicated that the current condition could not be properly rectified back to the 1969 benchmark. This brought to light three important discoveries:

- The traditional storage change calculation contained considerable uncertainty that when cumulatively added over tens of years, led to a large discrepancy in the accumulated overdraft relative to 1969.
- Water level conditions in 1969 no longer represent a full basin, particularly because of changes in pumping and recharge conditions.
- A more accurate storage change calculation should be based on water level changes and storage coefficients for each of the three major aquifer systems.

In February 2007, the District adopted an updated approach to defining the full basin condition and calculating storage changes. This updated approach includes:

- A new full-basin groundwater level based on the following prescribed conditions:
  - o Observed historical high water levels
  - o Present-day pumping and recharge conditions
  - o Protective of seawater intrusion
  - o Minimal potential for mounding at or near recharge basins
- Calculation of the amount of groundwater in storage in each of the three major aquifer systems.

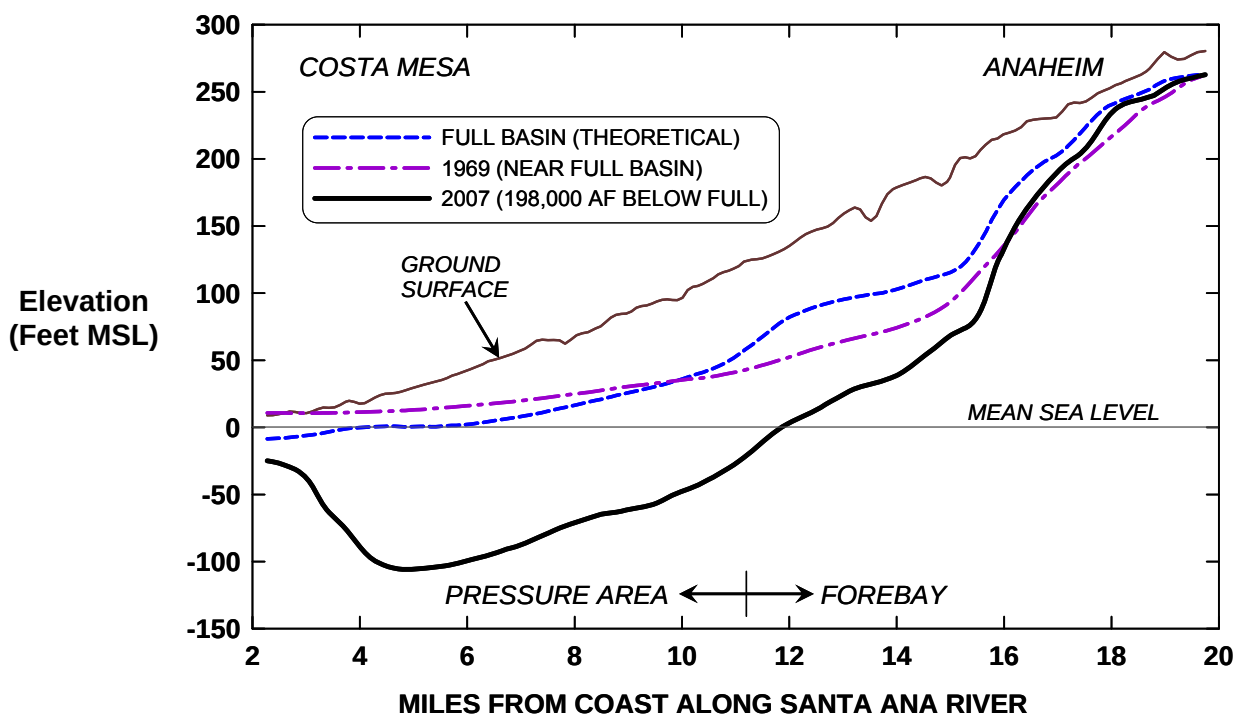
A more detailed description of this new methodology is presented in OCWD's *Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy* (February 2007), which is included as Appendix D.

## 2.6 ELEVATION TRENDS

Groundwater elevation profiles for the principal aquifer, generally following the Santa Ana River from Costa Mesa to the Anaheim Forebay area, are shown in Figure 2-9. The groundwater elevation profiles represent the newly-calculated full basin condition, 1969 conditions (formerly considered full), and 2007 conditions. A comparison of these profiles shows that groundwater elevations in the Forebay recharge area are relatively close while elevations in 2007 are significantly lower in the central and coastal portions of the basin than the full or 1969 conditions.



**FIGURE 2-9**  
**PRINCIPAL AQUIFER HISTORICAL GROUNDWATER ELEVATION PROFILES**



The lowering of coastal area groundwater levels relative to groundwater levels further inland in the Forebay translates into a steeper hydraulic gradient, which drives greater flow from the Forebay to the coastal areas. However, the lowering of coastal water levels also increases seawater intrusion potential.

Figure 2-10 presents average groundwater elevations for the principal aquifer in the Forebay, coastal areas, and the total basin on November 1 of each year, when groundwater levels are somewhat intermediate between the late summer low and late winter high. Average values were calculated using a 1,000-foot square grid and the groundwater elevation contour map prepared each year. Groundwater elevations were estimated at each grid point using the groundwater elevation contours, and the average values were calculated for each of the three areas.

A comparison of the groundwater level trends in Figure 2-10 to the changes in accumulated overdraft in Figure 2-8 provides insights into the basin's response during filling and emptying cycles. From November 2003 to November 2005, the basin's accumulated overdraft reduced 220,000 af due to the near-record high precipitation in water year 2004-05. During this period of refill, average groundwater levels in the coastal area increased approximately 20 feet, while groundwater levels in the Forebay increased approximately 40 feet. Between November 2005 and November 2007, basin accumulated overdraft increased approximately 100,000 af as groundwater withdrawals exceeded recharge due to several factors, including near-record low precipitation. Average groundwater levels during this period fell by 40 feet in the Forebay and coastal areas.

**FIGURE 2-10**  
**AVERAGE PRINCIPAL AQUIFER GROUNDWATER ELEVATIONS**  
**FOR THE FOREBAY, TOTAL BASIN, AND COASTAL AREA**

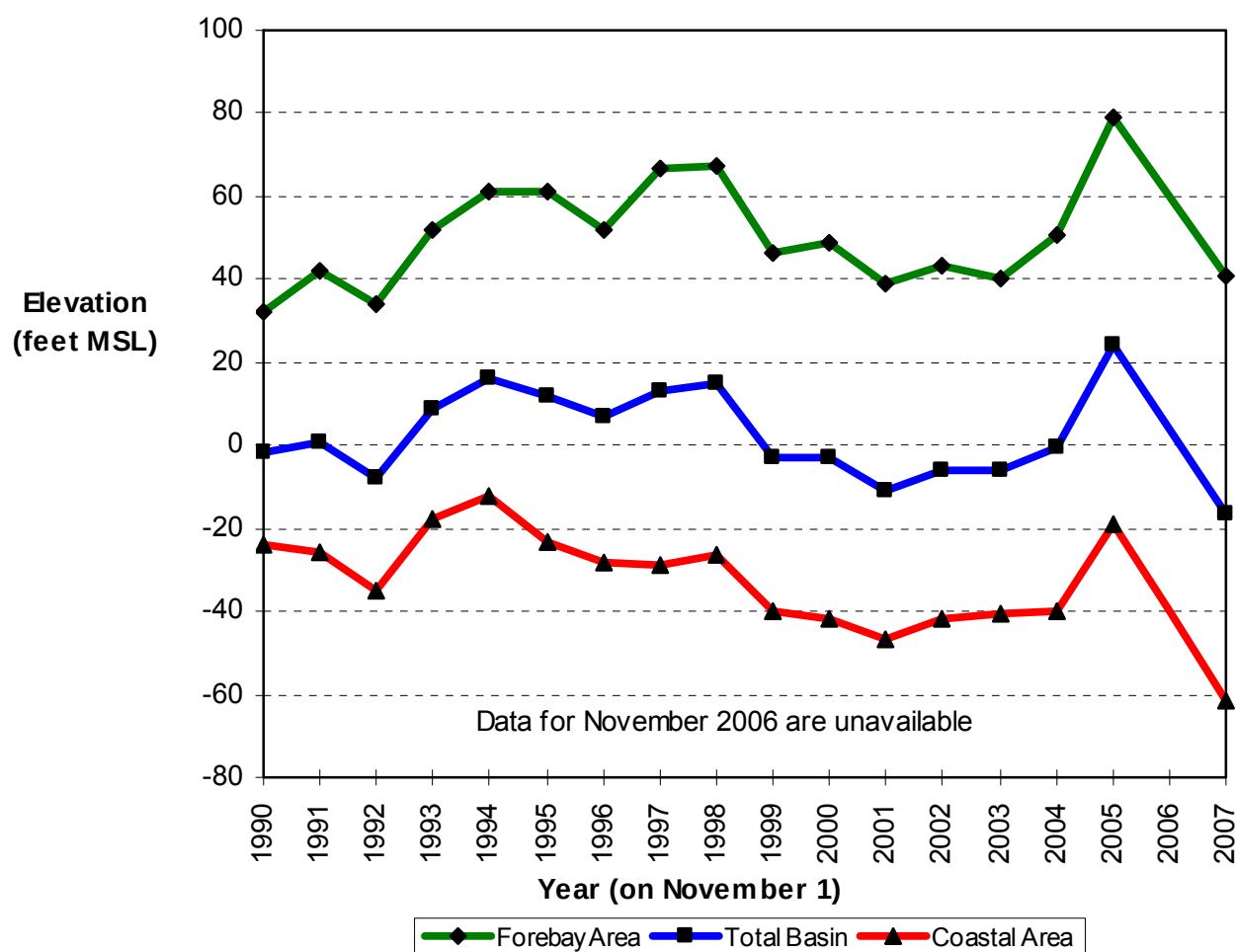


Figure 2-11 shows the locations of four wells, A-27, SA-21, SAR-1, and OCWD-CTG1, with long-term groundwater level data. Figure 2-12 presents water level hydrographs and locations of wells A-27 and SA-21, representing historical conditions in the Forebay and Pressure area, respectively. The hydrograph data for well A-27 near Anaheim Lake date back to 1932 and indicate that the historic low water level in this area occurred in 1951-52. The subsequent replenishment of Colorado River water essentially refilled the basin by 1965. Water levels in this well reached an historic high in 1994 and have generally remained high as recharge has been nearly continuous at Anaheim Lake since the late 1950s.

The hydrograph for well SA-21 indicates that water levels in this area have decreased since 1970. In addition, the magnitude of the seasonal water level fluctuations has approximately doubled from pre-1990 to the present. The increased water level fluctuations are due to a combination seasonal water demand-driven pumping and participation in the Metropolitan Short-Term Seasonal Storage Program by local

Producers (Boyle Engineering and OCWD, 1997), which encouraged increased pumping from the groundwater basin during summer months when Metropolitan was experiencing high demand for imported water. Although this program did not increase the amount of pumping from the basin on an annual basis, it did result in greater water level declines during the summer.

**FIGURE 2-11**  
**LOCATION OF LONG-TERM GROUNDWATER ELEVATION HYDROGRAPH**

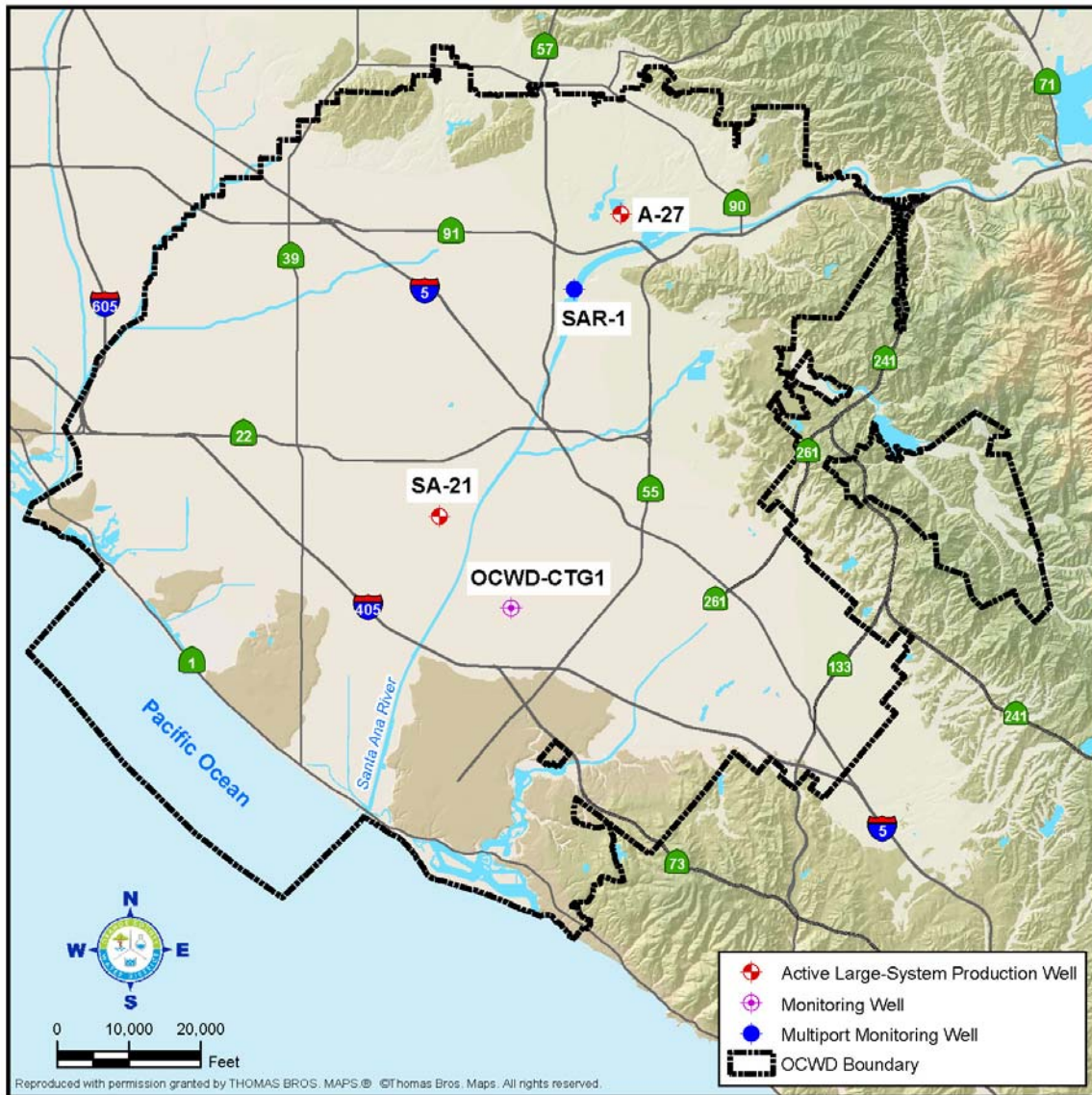


**FIGURE 2-12**  
**WATER LEVEL HYDROGRAPHS OF WELLS A-27 AND SA-21**

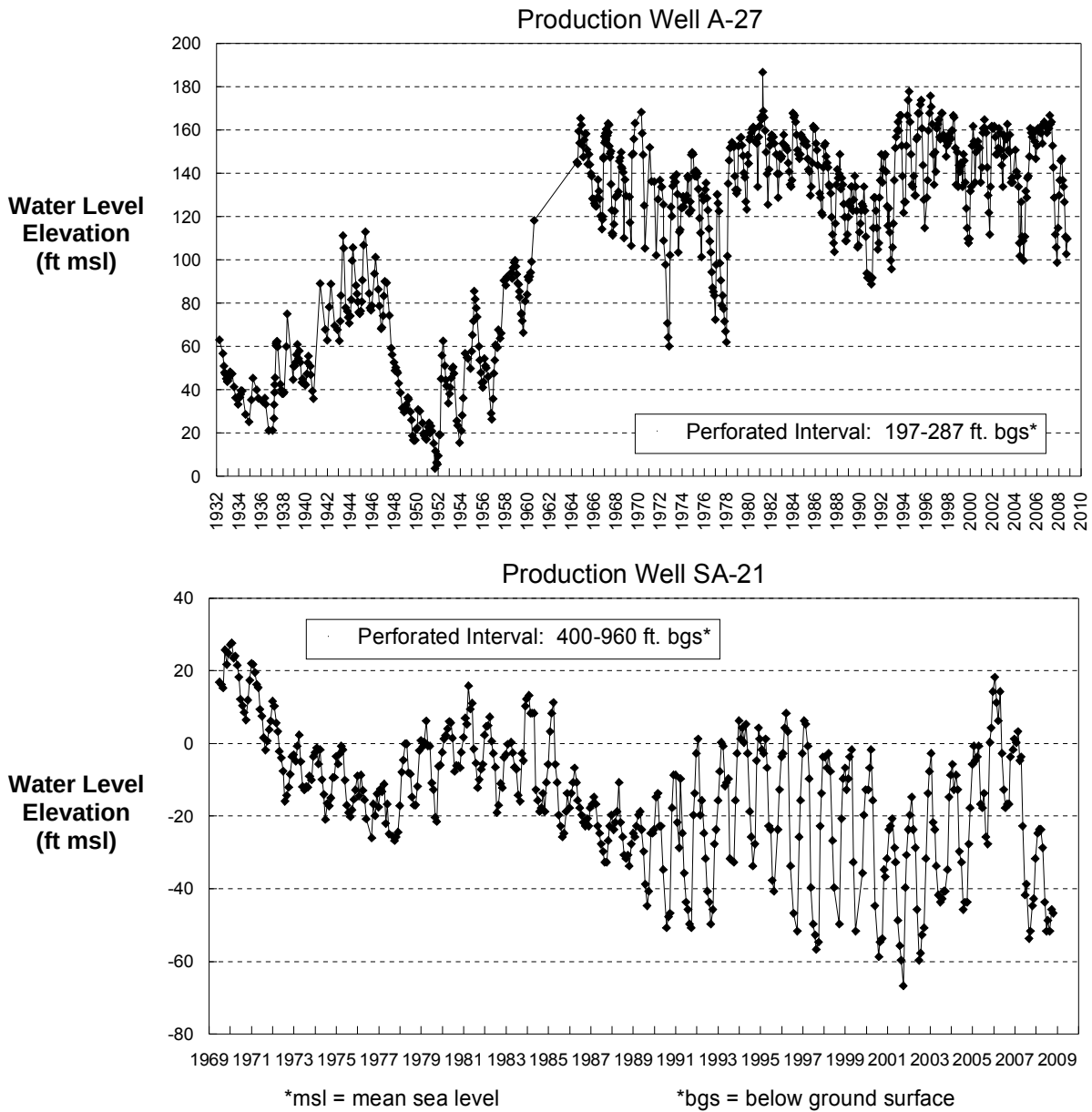
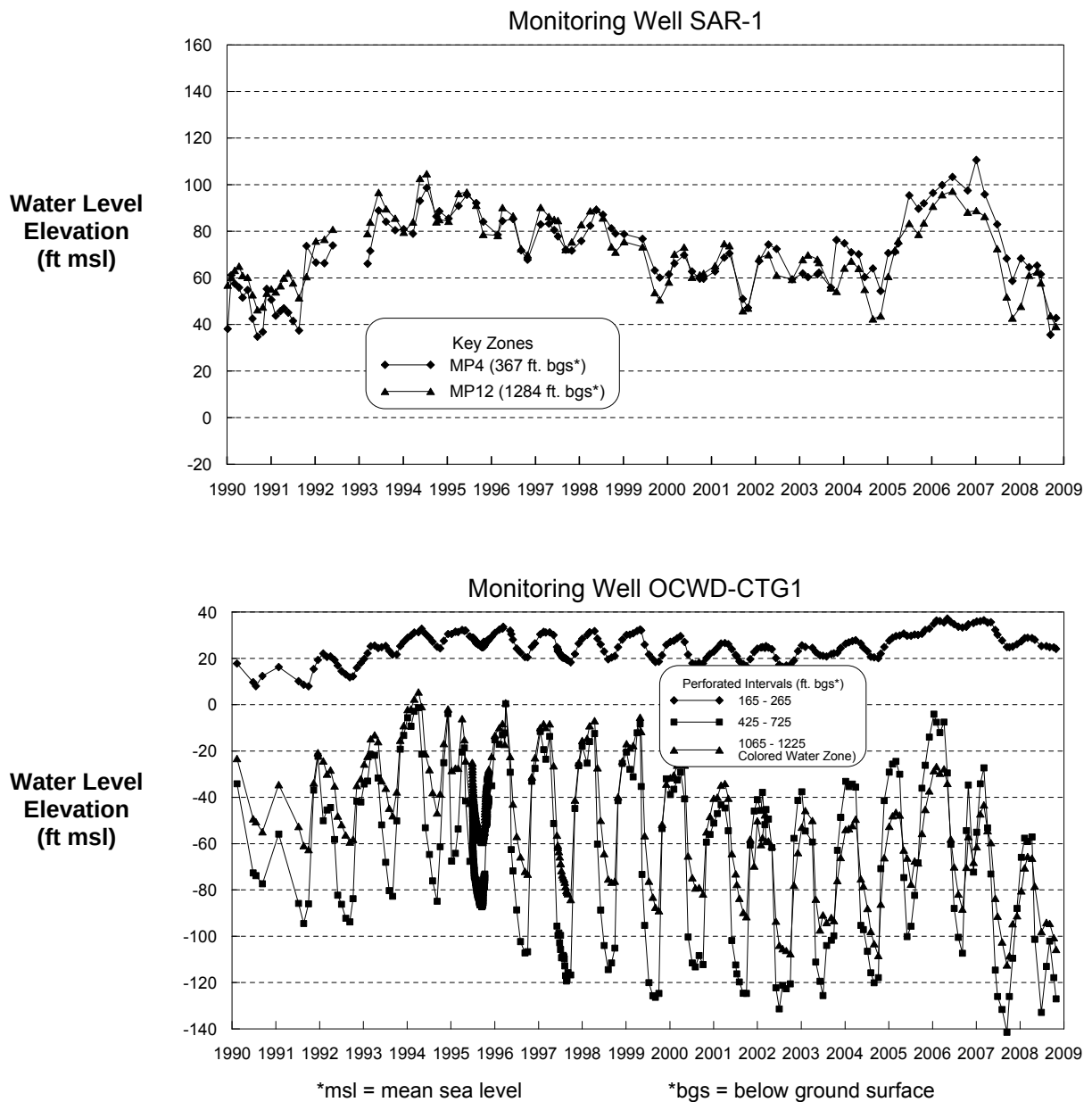


Figure 2-13 presents water level hydrographs and locations of two OCWD multi-depth monitoring wells, SAR-1 and OCWD-CTG1, showing the relationship between water level elevations in aquifer zones at different depths. The hydrograph of well SAR-1 in the Forebay exhibits a similarity in water levels between shallow and deep aquifers, which indicates the high degree of hydraulic interconnection between aquifers characteristic of much of the Forebay.

**FIGURE 2-13**  
**WATER LEVEL HYDROGRAPHS OF WELLS SAR-1 AND OCWD-CTG1**



The hydrograph of well OCWD-CTG1 is typical of the Pressure Area in that a large water level distinction is observed between shallow and deep aquifers, indicating the effects of a clay/silt layer that restricts vertical groundwater flow. Water levels in the deepest aquifer zone at well OCWD-CTG1 have higher elevations than overlying aquifers, in part, because few wells directly produce water from these zones, primarily due to their associated colored water.

## 2.7 LAND SUBSIDENCE

Subsidence of the ground surface has been associated with groundwater withdrawal in many regions of the world. In the case of thick sedimentary groundwater basins comprised of alternating “confined” or “pressure” aquifers (permeable sands and gravels) and aquitards (less permeable silts and clays), the extraction of groundwater reduces the fluid pressure of the saturated pore spaces within the buried sediments. The pressure reduction in the deeper sediments allows the weight of the overlying sediments to compact the deeper sediments, particularly the clays and silts. If groundwater withdrawals cause water level drawdowns to be sustained for several years or more, the incremental amount of sediment compaction can eventually manifest itself in a measurable lowering of the land surface (USGS, 1999).

OCWD commissioned a study by the DWR (1980) to evaluate the potential for land subsidence in the basin. Because the study was limited in scope, its findings were deemed preliminary pending further investigation. Nevertheless, the study cited survey data from the Orange County Surveyor that indicated that the land surface in the city of Santa Ana declined a maximum of 0.84 inch/year from 1956 to 1961. Surveys during the period 1970 to 1976 indicated maximum land surface declines of 0.24 inch/year in Santa Ana. Key findings of the study included the following:

- Subsidence in the City of Santa Ana is apparently related to the removal of groundwater. However, it is not possible to directly correlate observed subsidence and historic water-level declines.
- Subsidence in the vicinity of the City of Huntington Beach can be attributed to the removal of oil.
- Most of the compaction takes place in the fine-grained sediments.
- Water squeezed out of the compacted fine-grained sediments, known as “water of compaction,” results in a permanent loss of storage in fine-grained sediments.

Land surface changes (rising and lowering) of similar magnitude to those noted by DWR were reported by Bawden (Bawden et al, 2001) while reviewing satellite radar images for a seismic assessment of Southern California. Bawden reported seasonal land surface changes of up to 4.3 inches (total seasonal amplitude from high to low) in the Los Angeles-Orange County area and a net decline of approximately 0.5 inch/year near Santa Ana over the period 1993 to 1999, which coincides with a period of net withdrawal of groundwater from the basin. Despite the indications of land subsidence to some degree in portions of Orange County, there has been no indication that the suggested land surface changes have caused, or are likely to cause, any structural damage in the area. By maintaining groundwater levels and basin storage within its



historical operating range, the potential for problematic land subsidence is reduced. Conversely, land subsidence could become a problem if the basin was overdrafted beyond the historical operating range.

Groundwater withdrawals are regulated within the basin operating range, which is explained in detail in Section 6.5. In the event that land subsidence becomes a problem in a localized area, OCWD will work with local officials to investigate and remediate the problem.

## **2.8 GROUNDWATER MODEL DESCRIPTION**

In general, a groundwater flow model contains two major components: the mathematical model and the conceptual model. The mathematical model is the computer program used to solve the complex system of equations that govern the flow of groundwater. The conceptual model is the hydrogeologic framework of the area being modeled, obtained by gathering, analyzing, interpreting, and finally integrating all the geologic and hydrologic data for a given area into a conceptual understanding of how the flow system looks and behaves.

For a properly-constructed model, the mathematical model needs to be appropriate for the level of detail inherent in the conceptual model. For a mathematical model solved by numerical methods, the modeled area must be divided into a mesh of grid cells – the smaller the grid cells, generally the more accurate the computations – assuming the hydrogeology can be reasonably-defined at the grid cell level of detail. Based on all the input data, the model calculates a water level elevation and fluxes for each and every grid cell of the modeled area at a given point in time.

OCWD's basin model encompasses the entire basin and extends approximately three miles into the Central Basin in Los Angeles County to provide for more accurate model results than if the model boundary stopped at the county line (see Figure 2-14). As noted previously in this chapter, the county line is not a hydrogeologic boundary, i.e., groundwater freely flows through aquifers that have been correlated across the county line.

Coverage of the modeled area is accomplished with grid cells having horizontal dimensions of 500 feet by 500 feet (approximately 5.7 acres) and vertical dimensions ranging from approximately 50 to 1,800 feet, depending on the thickness of each model layer at that grid cell location. Basin aquifers and aquitards were grouped into three composite model layers thought sufficient to describe the three distinguishable flow systems referred to as the shallow, principal, and deep aquifer systems. The three model layers comprise a network of over 90,000 grid cells.

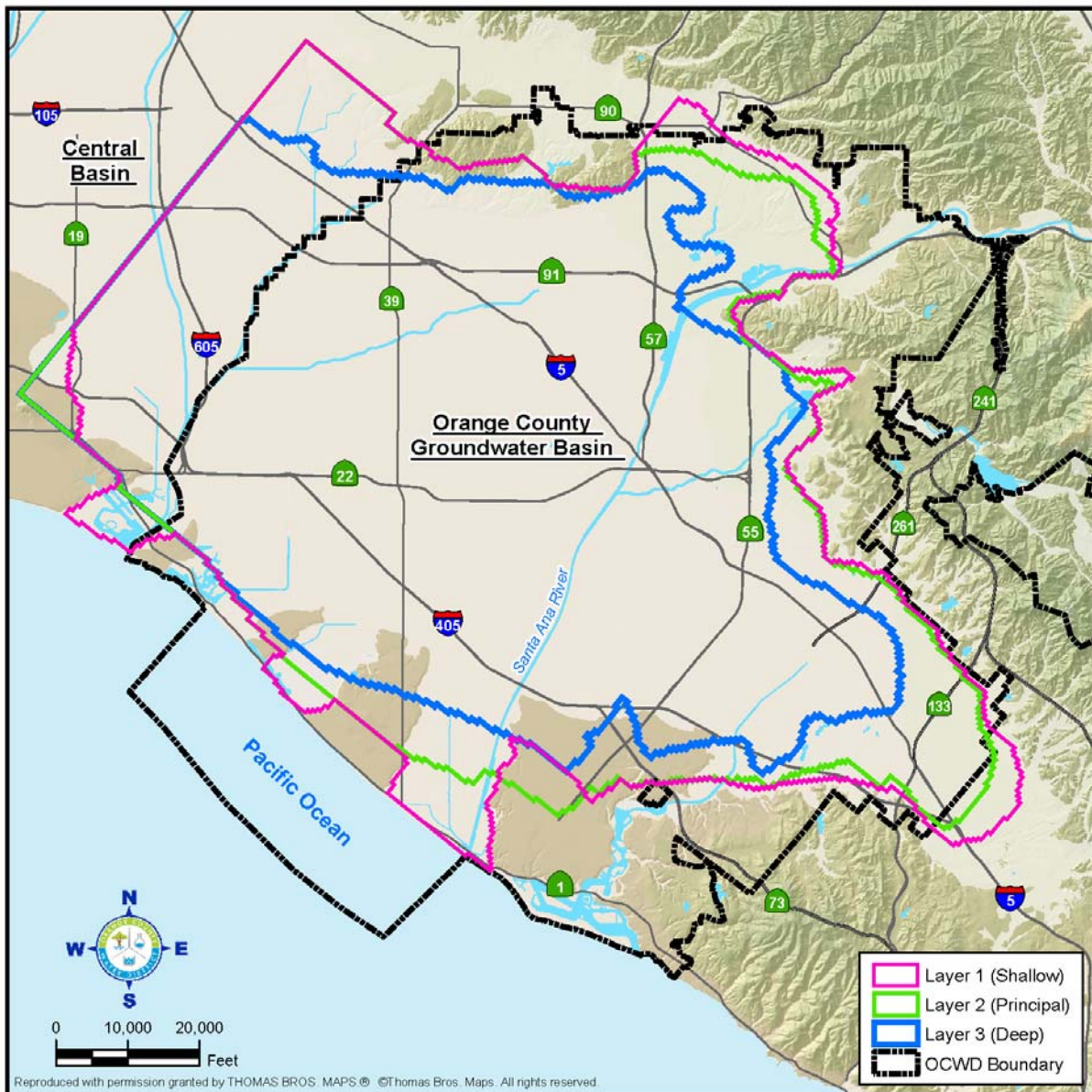
The widely-accepted computer program, "MODFLOW," developed by the USGS, was used as the base modeling code for the mathematical model (McDonald and Harbaugh, 1988). Analogous to an off-the-shelf spreadsheet program needing data to be functional, MODFLOW requires vast amounts of input data to define the hydrogeologic conditions in the conceptual model. The types of information that must be input in digital format (data files) for each grid cell in each model layer include the following:

- Aquifer top and bottom elevations



- Aquifer lateral boundary conditions (ocean, faults, mountains)
- Aquifer hydraulic conductivity and storage coefficient/specific yield
- Initial groundwater surface elevation
- Natural and artificial recharge rates (runoff, precipitation, percolation, injection)
- Groundwater production rates for approximately 200 large system and 200 small system wells

FIGURE 2-14  
BASIN MODEL EXTENT

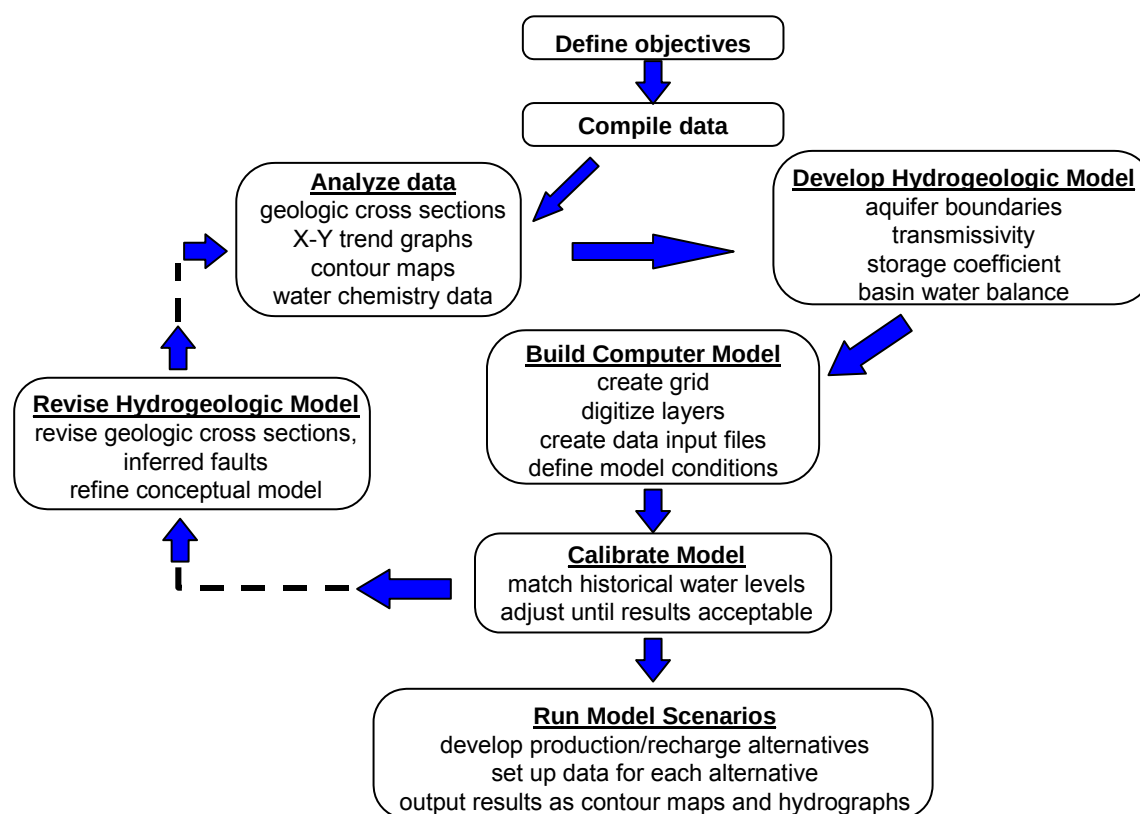


These data originate from hand-drawn contour maps, spreadsheets, and the Water Resources Management System (WRMS) historical database. Because MODFLOW requires the input data files in a specific format, staff developed a customized database and GIS program to automate data compilation and formatting functions. These data pre-processing tasks form one of the key activities in the model development process.

Before a groundwater model can be reliably used as a predictive tool for simulating future conditions, the model must be calibrated to reach an acceptable match between simulated and actual observed conditions. The basin model was first calibrated to steady-state conditions to numerically stabilize the simulations, to make rough adjustments to the water budget terms, and to generally match regional groundwater flow patterns. Also, the steady-state calibration helped to determine the sensitivity of simulated groundwater levels to changes in incidental recharge and aquifer parameters such as hydraulic conductivity. Steady-state calibration of the basin model is documented in more detail in the *OCWD Master Plan Report* (OCWD, 1999).

Typical transient model output consists of water level elevations at each grid cell that can be plotted as a contour map for one point in time or as a time-series graph at a single location. Post-processing of model results into usable graphics is performed using a combination of semi-automated GIS and database program applications. Figure 2-15 presents a simplified schematic of the modeling process.

**FIGURE 2-15**  
**MODEL DEVELOPMENT FLOWCHART**



Model construction, calibration, and operation were built upon 12 years of effort by OCWD staff to collect, compile, digitize, and interpret hundreds of borehole geologic and geophysical logs, water level hydrographs, and water quality analyses. The process was composed of ten main tasks comprising over 120 subtasks. The major tasks are summarized below:

1. Finalize conceptual hydrogeologic model layers and program GIS/database applications to create properly formatted MODFLOW input data files. Over 40 geologic cross sections were used to form the basis of the vertical and lateral aquifer boundaries.
2. Define model layer boundaries. The top and bottom elevations of the three aquifer system layers and intervening aquitards were hand-contoured, digitized, and overlain on the model grid to populate the model input arrays with a top and bottom elevation for each layer at every grid cell location. Model layer thickness values were then calculated by using the GIS.
3. Develop model layer hydraulic conductivity (K) grids. Estimates of K for each layer were based on (in order of importance): available aquifer test data, well specific capacity data, and lithologic data. In the absence of reliable aquifer test or specific capacity data for areas in Layers 1 and 3, lithology-based K estimates were calculated by assigning literature values of K to each lithology type (e.g., sand, gravel, clay) within a model layer and then calculating an effective K value for the entire layer at that well location. Layer 2 had the most available aquifer test and specific capacity data. Therefore, a Layer 2 transmissivity contour map was prepared and digitized, and the GIS was then used to calculate a K surface by dividing the transmissivity grid by the aquifer thickness grid. Initial values of K were adjusted during model calibration to achieve a better match of model results with known groundwater elevations.
4. Develop layer production factors for active production wells simulated in the model. Many production wells had long screened intervals that spanned at least two of the three model layers. Therefore, groundwater production for each of these wells had to be divided among each layer screened by use of layer production factors. These factors were calculated using both the relative length of screen within each model layer and the hydraulic conductivity of each layer. Well production was then multiplied by the layer factors for each individual well. For example, if a well had a screened interval equally divided across Layers 1 and 2, but the hydraulic conductivity of Layer 1 was twice that of Layer 2, then the calculated Layer 1 and 2 production factors for that well would have been one-third and two-thirds, respectively, such that when multiplied by the total production for this well, the production assigned to Layer 1 would have been twice that of Layer 2. For the current three-layer model, approximately 25 percent of the production wells in the model were screened across more than one model layer. In this context, further vertical refinement of the model (more model layers) may better represent

the aquifer architecture in certain areas but may also increase the uncertainty and potential error involved in the amount of production assigned to each model layer.

5. Develop basin model water budget input parameters, including groundwater production, artificial recharge, and unmeasured recharge. Groundwater production and artificial recharge volumes were applied to grid cells in which production wells or recharge facilities were located. The most uncertain component of the water budget – unmeasured or incidental recharge – was applied to the model as an average monthly volume based on estimates calculated annually for the OCWD *Engineer's Report*. Unmeasured recharge was distributed to cells throughout the model, but was mostly applied to cells along margins of the basin at the base of the hills and mountains. The underflow component of the incidental recharge represents the amount of groundwater flowing into and out of the model along open boundaries. Prescribed groundwater elevations were assigned to open boundaries along the northwest model boundary in Los Angeles County; the ocean at the Alamitos, Bolsa, and Talbert Gaps; the mouth of the Santa Ana Canyon; and the mouth of Santiago Creek Canyon. Groundwater elevations for the boundaries other than the ocean boundaries were based on historical groundwater elevation data from nearby wells. The model automatically calculated the dynamic flow across these open boundaries as part of the overall water budget.
6. Develop model layer storage coefficients. Storage coefficient values for portions of model layers representing confined aquifer conditions were prepared based on available aquifer test data and were adjusted within reasonable limits based on calibration results.
7. Develop vertical leakance parameters between model layers. Vertical groundwater flow between aquifer systems in the basin is generally not directly measured, yet it is one of the critically-important factors in the model's ability to represent actual basin hydraulic processes. Using geologic cross-sections and depth-specific water level and water quality data from the OCWD multi-depth monitoring well network, staff identified areas where vertical groundwater flow between the modeled aquifer systems is either likely to occur or be significantly impeded, depending on the relative abundance and continuity of lower-permeability aquitards between model layers. During model calibration, the initial parameter estimates for vertical leakance were adjusted to achieve closer matches to known vertical groundwater gradients.
8. Develop groundwater contour maps for each model layer to be used for starting conditions and for visual comparison of water level patterns during calibration. Staff used observed water level data from multi-depth and other wells to prepare contour maps of each layer for November 1990 as a starting point for the calibration period. Care was taken to use wells screened within the appropriate vertical interval representing each model



layer. The hand-drawn contour maps were then digitized and used as model input to represent starting conditions.

9. Perform transient calibration runs. The nine-year period of November 1990 to November 1999 was selected for transient calibration, as it represented the period corresponding to the most detailed set of groundwater elevation, production, and recharge data. The transient calibration process and results are described in Section 2.8.1.
10. Perform various basin production and recharge scenarios using the calibrated model. Criteria for pumping and recharge, including facility locations and quantities, were developed for each scenario and input for each model run.

### 2.8.1 MODEL CALIBRATION

Calibration of the transient basin model involved a series of simulations of the period 1990 to 1999, using monthly flow and water level data. The time period selected for calibration represents a period during which basic data required for monthly transient calibration were essentially complete (compared to pre-1990 historical records). The calibration period spans at least one “wet/dry” rainfall cycle. Monthly water level data from almost 250 target locations were used to determine if the simulated water levels adequately matched observed water levels. As shown in Figure 2-16, the calibration target points were densely distributed throughout the basin and also covered all three model layers.

After each model run, a hydrograph of observed versus simulated water levels was created and reviewed for each calibration target point. In addition, a groundwater elevation contour map for each layer was also generated from the simulated data. The simulated groundwater contours for all three layers were compared to interpreted contours of observed data (November 1997) to assess closeness of fit and to qualitatively evaluate whether the simulated gradients and overall flow patterns were consistent with the conceptual hydrogeologic model. November 1997 was chosen for the observed versus simulated contour map comparison since these hand-drawn contour maps had already been created for the prior steady state calibration step. Although November 1997 observed data were contoured for all three layers, the contour maps for Layers 1 and 3 were somewhat more generalized than for Layer 2 due to a lower density of data points (wells) in these two layers.

Depending on the results of each calibration run, model input parameters were adjusted, including hydraulic conductivity, storage coefficient, boundary conditions, and recharge distribution. Time-varying head boundaries along the Orange/Los Angeles County line were found to be extremely useful in obtaining a close fit with observed historical water levels in the northwestern portion of the model. Fifty calibration runs were required to reach an acceptable level of calibration in which model-generated water levels were within reasonable limits of observed water level elevations during the calibration period. Figures 2-17 through 2-19 show examples of hydrographs of observed versus simulated water levels for three wells used as calibration targets.

FIGURE 2-16  
BASIN MODEL CALIBRATION WELLS

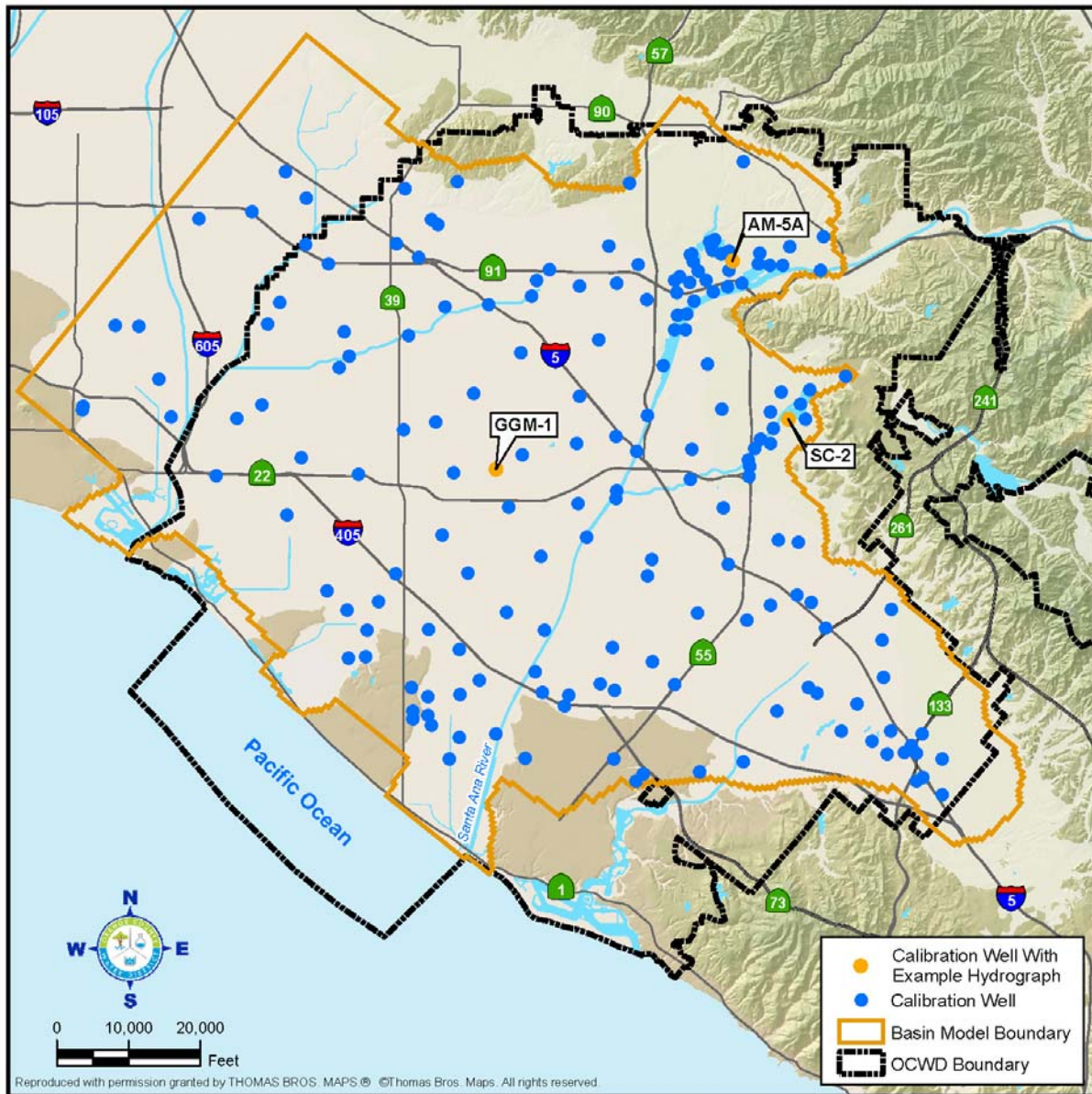


**Figure 2-17**  
**CALIBRATION HYDROGRAPH FOR MONITORING WELL AM-5A**  
**(Model Layer 1 -- Anaheim Forebay)**

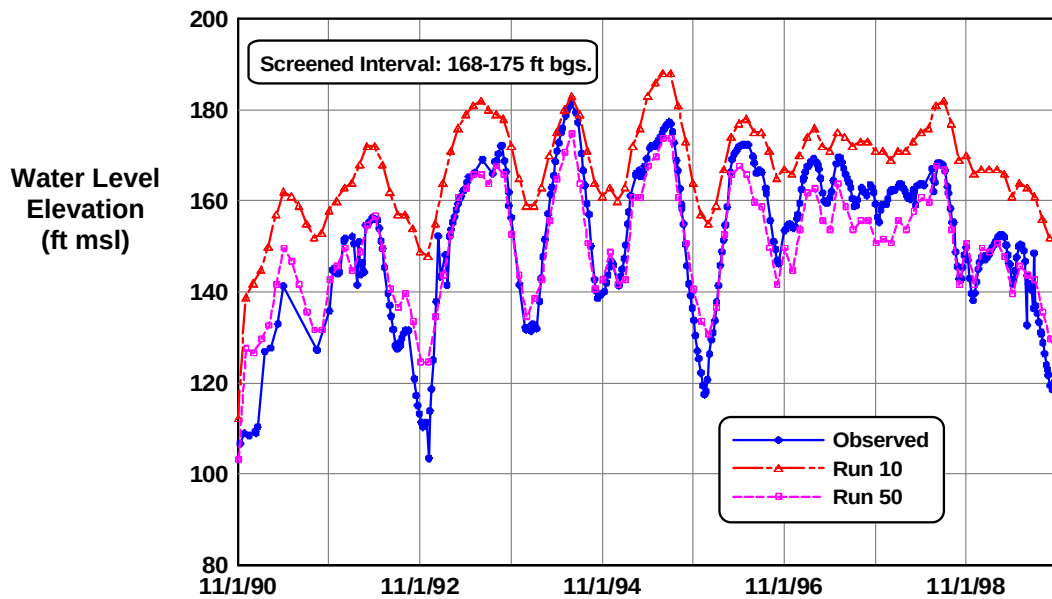


**FIGURE 2-18**  
**CALIBRATION HYDROGRAPH FOR MONITORING WELL SC-2**  
**(Model Layer 2 -- Santiago Pit Area)**

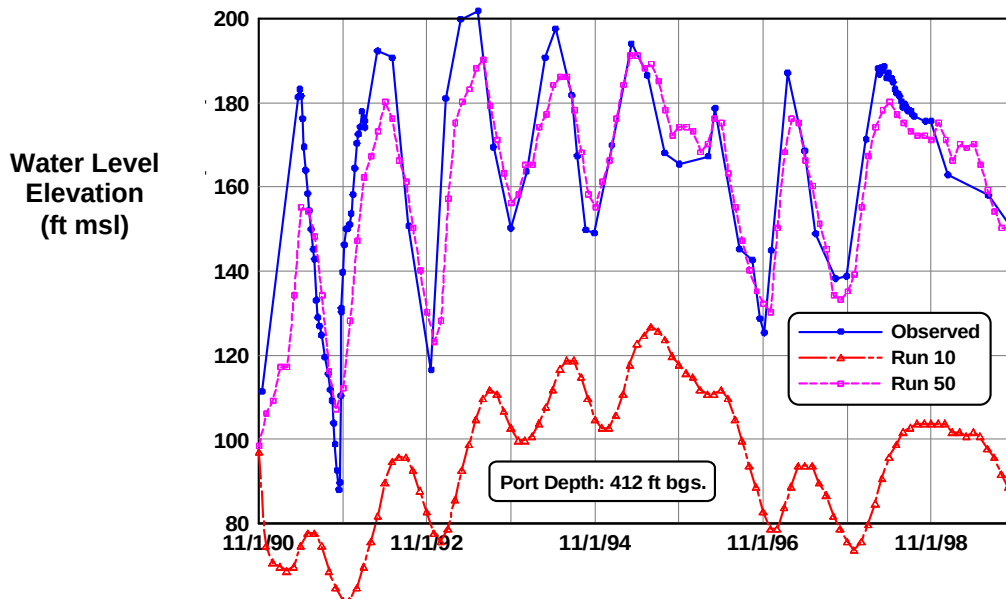
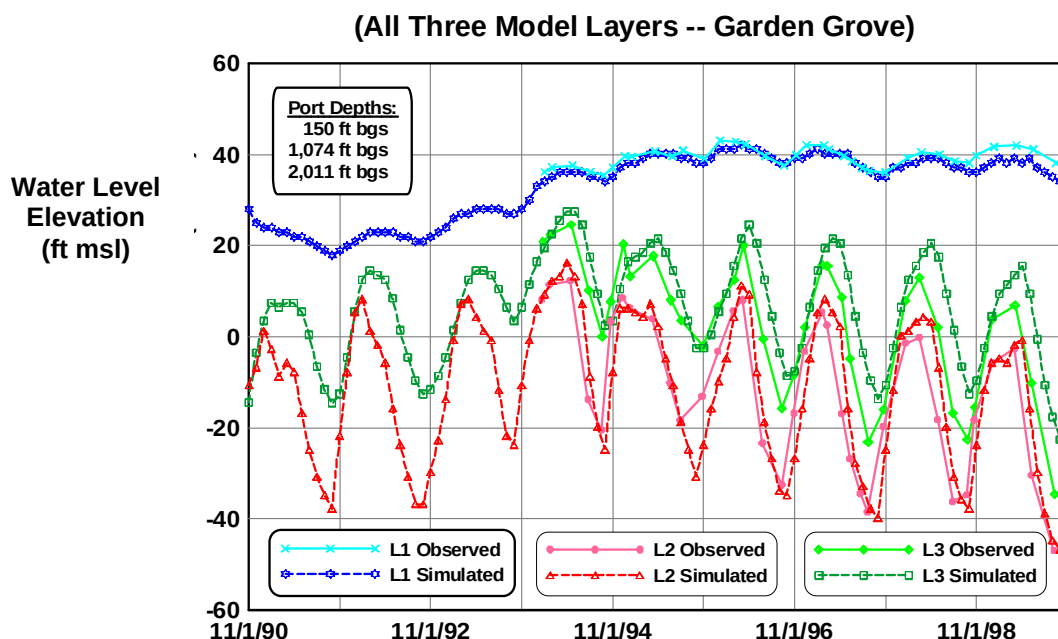




**FIGURE 2-19**  
**CALIBRATION HYDROGRAPH FOR MONITORING WELL GGM-1**



Noteworthy findings of the model calibration process are summarized below:

- The model was most sensitive to adjustments to hydraulic conductivity and recharge distribution. In other words, minor variations in these input parameters caused significant changes in the model water level output.
- The model was less sensitive to changes in storage coefficient, requiring order-of-magnitude changes in this parameter to cause significant changes in simulated water levels, primarily affecting the amplitude of seasonal water level variations.
- The vast amount of observed historical water level data made it readily evident when the model was closely matching observed conditions.
- Incidental (unmeasured) recharge averaging approximately 70,000 afy during the 1990-1999 period appeared to be reasonable, as the model was fairly sensitive to variations in this recharge amount.
- Groundwater outflow to Los Angeles County was estimated to range between 5,000 and 12,000 afy between 1990 and 1999, most of this occurring in Layers 1 and 3.
- Groundwater flow at the Talbert Gap was inland during the entire model calibration period, indicating moderate seawater intrusion conditions. Model-derived seawater inflow ranged from 500 to 2,700 afy in the Talbert Gap and is consistent with chloride concentration trends during the calibration period that indicated inland movement of saline groundwater in these areas.
- Model-derived groundwater inflow from the ocean at Bolsa Gap was only 100-200 afy due to the Newport-Inglewood Fault zone, which offsets the Bolsa

- aquifer and significantly restricts the inland migration of saline water across the fault.
- Model adjustments (mainly hydraulic conductivity and recharge) in the Santiago Pits area in Orange significantly affected simulated water levels in the coastal areas.
  - Model reductions to the hydraulic conductivity of Layer 2 (Principal aquifer system) along the Peralta Hills Fault in Anaheim/Orange had the desired effect of steepening the gradient and restricting groundwater flow across the fault into the Orange area. These simulation results were consistent with observed hydrogeologic data indicating that the Peralta Hills Fault acts as a partial groundwater barrier.
  - Potential unmapped faults immediately downgradient from the Santiago Pits appear to restrict groundwater flow in the Principal aquifer system, as evidenced by observed steep gradients in that area, which were reproduced by the model. As with the Peralta Hills Fault, an approximate order-of-magnitude reduction in hydraulic conductivity along these suspected faults achieved the desired effect of reproducing observed water levels with the model.

## 2.8.2 MODEL ADVISORY PANEL

The model development and calibration process was regularly presented to and reviewed by a Model Advisory Panel. This technical panel consisted of four groundwater modeling experts who were familiar with the basin and highly qualified to provide insight and guidance during the model construction and calibration process. Twelve panel meetings were held between 1999 and 2002. The panel was tasked with providing written independent assessments of the strengths, weaknesses, and overall validity and usefulness of the model in evaluating various basin management alternatives. Two memoranda were prepared: one at the completion of the steady-state model calibration and steady-state scenarios (Harley et al., 1999) and one at the completion of the transient model calibration and initial transient basin operational scenarios (Harley et al., 2001). Key conclusions and findings of the panel regarding the transient model are summarized below.

- Transient modeling has substantially improved the overall understanding of processes and conditions that determine how and why the basin reacts to pumping and recharge. This improved understanding, coupled with the model's ability to simulate existing and possible future facilities and alternative operations, significantly improves the District's potential ability to enhance and actively manage basin water resources.
- Modeling has helped verify major elements of the basin conceptual model and has been instrumental in clarifying:
  - o Variations in the annual water balance
  - o Hydrostratigraphy of the basin
  - o Horizontal flow between basin subareas

- o The potential degree of interconnection and magnitude of vertical flow between major aquifers
- o The potential hydraulic significance of the Peralta Hills Fault in the Anaheim Forebay
- o Variations in aquifer hydraulic properties
- o The relative significance of engineered versus natural recharge and groundwater outflow within the basin
- o Numerous other issues and conditions.
- The ability of the model to simulate known and projected future conditions will evolve and improve as new data become available and updated calibration runs are completed.
- Parameters used to set up the model appear to be within limits justified by known, estimated, and assumed subsurface conditions based upon available historic data.
- Initial transient calibration completed using a nine-year calibration period (1990-1999) is considered adequate to confirm the initial validity of the model for use in evaluating a variety of potential future projects and conditions.
- Areas of the basin that could benefit from future exploration, testing, monitoring, analysis and/or additional model calibration were identified.
- The model is not considered appropriate for assessing detailed local impacts related to new recharge facilities or well fields. These impacts should be assessed using more detailed local submodels and by conducting detailed field studies.
- The model does not, nor is it intended to, address water supply availability, cost, water quality, or land subsidence.

Recommendations of the panel included suggestions that thorough documentation be prepared on model configuration and calibration and that the model calibration period be extended as new data become available.

### 2.8.3 TALBERT GAP MODEL

Between 1999 and 2000, OCWD contracted with Camp Dresser & McKee Inc. to develop a detailed groundwater flow model of the Talbert Gap and surrounding area for the purpose of evaluating and estimating the amount and location of fresh water injection wells needed to control seawater intrusion under current and projected future basin conditions. The Talbert Gap modeling effort was undertaken as part of the design scope of work for Phase 1 of the GWR System, which included expansion of the existing Talbert Barrier. The configuration and initial calibration of the Talbert Gap Model and further model refinement and calibration were documented by Camp Dresser & McKee Inc. (2000, 2003).

Consistent with the Basin Model Advisory Panel's findings, OCWD determined that a more detailed model of the Talbert Gap was necessary to evaluate the local water level changes associated with various potential injection barrier alignments and flow rates. The Talbert model comprises an area of 85 square miles, 13 Layers (seven aquifers

and six aquitards), and 509,000 grid cells (250 feet x 250 feet horizontal dimensions). Figures 2-20 and 2-21 show the model area and layering schematic, respectively.

**FIGURE 2-20**  
**TALBERT GAP MODEL AND BASIN MODEL BOUNDARIES**

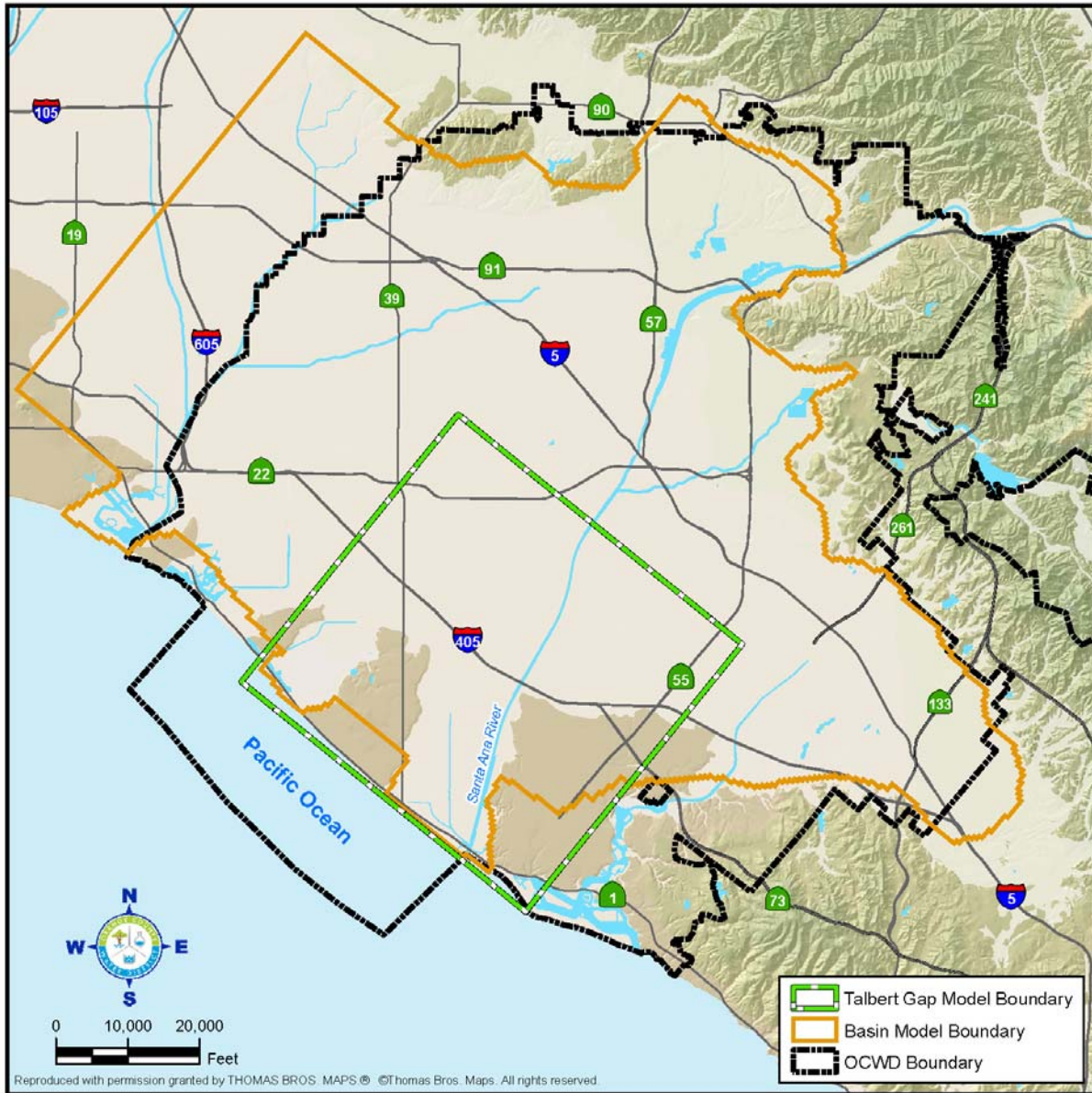
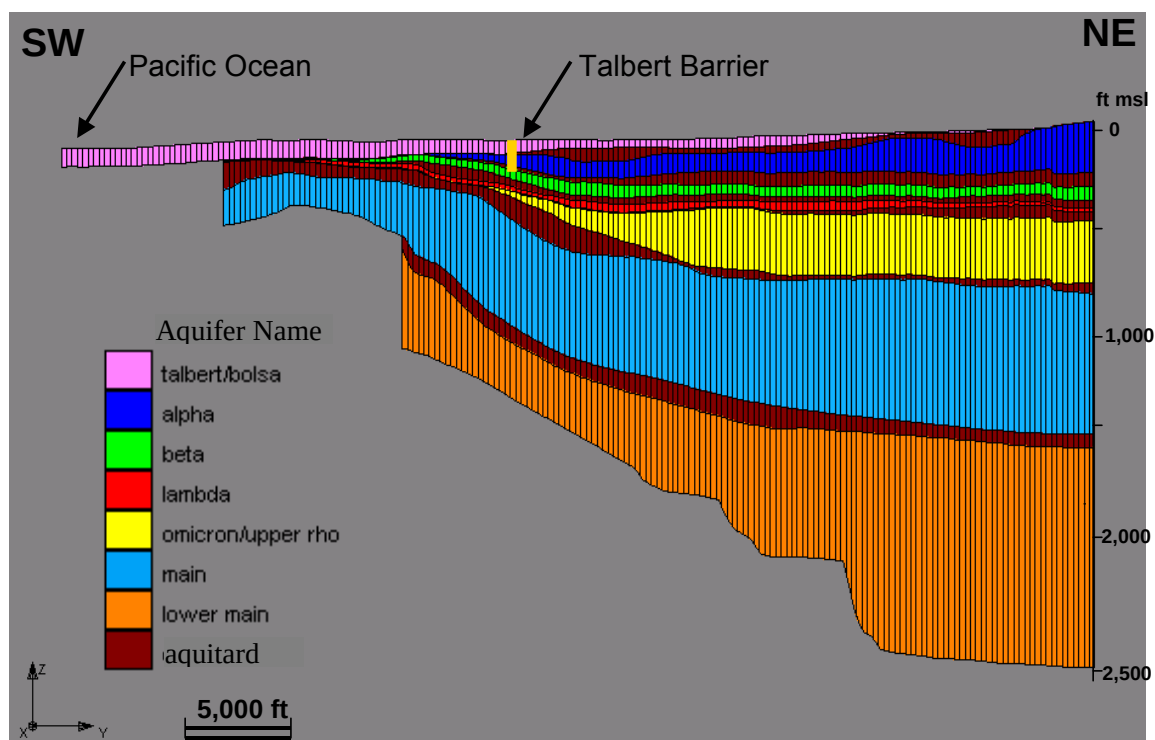


FIGURE 2-21  
TALBERT GAP MODEL AQUIFER LAYERING SCHEMATIC



Key findings of the Talbert Gap model are summarized below.

- Depending on the amount of basin production, particularly near the Talbert Barrier, 30 mgd (approximately 34,000 afy) of injection will substantially raise water levels, yet may not be sufficient to fully prevent seawater intrusion in the Talbert Gap. Additional injection wells beyond those planned for Phase 1 of the GWR System may be required.
- Under projected 2020 conditions, the future Talbert Barrier may require an annual average injection rate of up to 45 mgd based on the results of existing analyses. This estimated future injection requirement will be further evaluated as additional data are collected.
- The Talbert model inland boundaries do not coincide with hydrologic or geologic features, e.g., recharge area, faults. Therefore, simulated water levels are highly influenced by the time-varying water levels specified along the boundaries. For future Talbert model predictive runs, the basin model should be used to generate water levels that can then be specified along the inland Talbert model boundaries.
- The Talbert model was less sensitive to adjustment hydraulic conductivity and storage coefficient than the basin model, primarily because of the stronger influence of the specified-head boundaries in the Talbert model.



### 3 GROUNDWATER MONITORING

OCWD conducts a comprehensive monitoring program of the groundwater basin and surface water supplies in the watershed to properly manage water supplies and to safeguard the basin's water quality. This section describes OCWD's basin monitoring programs, including the following:

- Groundwater monitoring locations;
- Water sample collection and analysis procedures;
- Monitoring of production rates, groundwater elevation, groundwater quality, and recharge water quality; and
- Seawater intrusion monitoring and prevention.

#### 3.1 Introduction

For its size, the Orange County groundwater basin is one of the world's most extensively monitored. The District's comprehensive monitoring program tracks dynamic basin conditions including groundwater production, storage, elevations, and water quality.

OCWD's monitoring program has helped improve groundwater management throughout the basin by:

- Establishing on an annual basis the safe and sustainable level of groundwater production.
- Determining the extent of seawater intrusion and subsequently building improvements to seawater barriers to prevent and reverse such intrusion.
- Discovering areas of groundwater contamination to protect public health and beneficial use of groundwater, and to begin remediation efforts at an early stage.
- Assuring that the groundwater basin is managed in full compliance with all relevant laws and regulations.

#### 3.2 Collection and Management of Monitoring Data

Data are collected through a vast network of production and monitoring wells at frequencies necessary for short- and long-term trend analyses. The wells are located throughout the basin to enable not only analysis of the basin as a whole but also to focus on local or sub-regional investigations. Multi-depth monitoring wells provide depth-specific water level and quality data allowing analysis of the basin's multiple-aquifer configuration.

The network of nearly 700 municipal drinking water, private domestic, industrial, irrigation, and monitoring wells is used to collect data for a variety of purposes. A list of

each OCWD monitoring well with well type, cased depth, and top and bottom perforation is shown in Appendix E. Figure 3-1 shows the locations of over 200 production wells that extract groundwater for municipal use. Monthly individual well production rates for large-capacity wells have been collected since 1988. Monitoring wells, shown in Figure 3-2, are operated by OCWD to supplement the water quality data collected at production wells and to fill data gaps.

FIGURE 3-1  
PRODUCTION WELL LOCATIONS

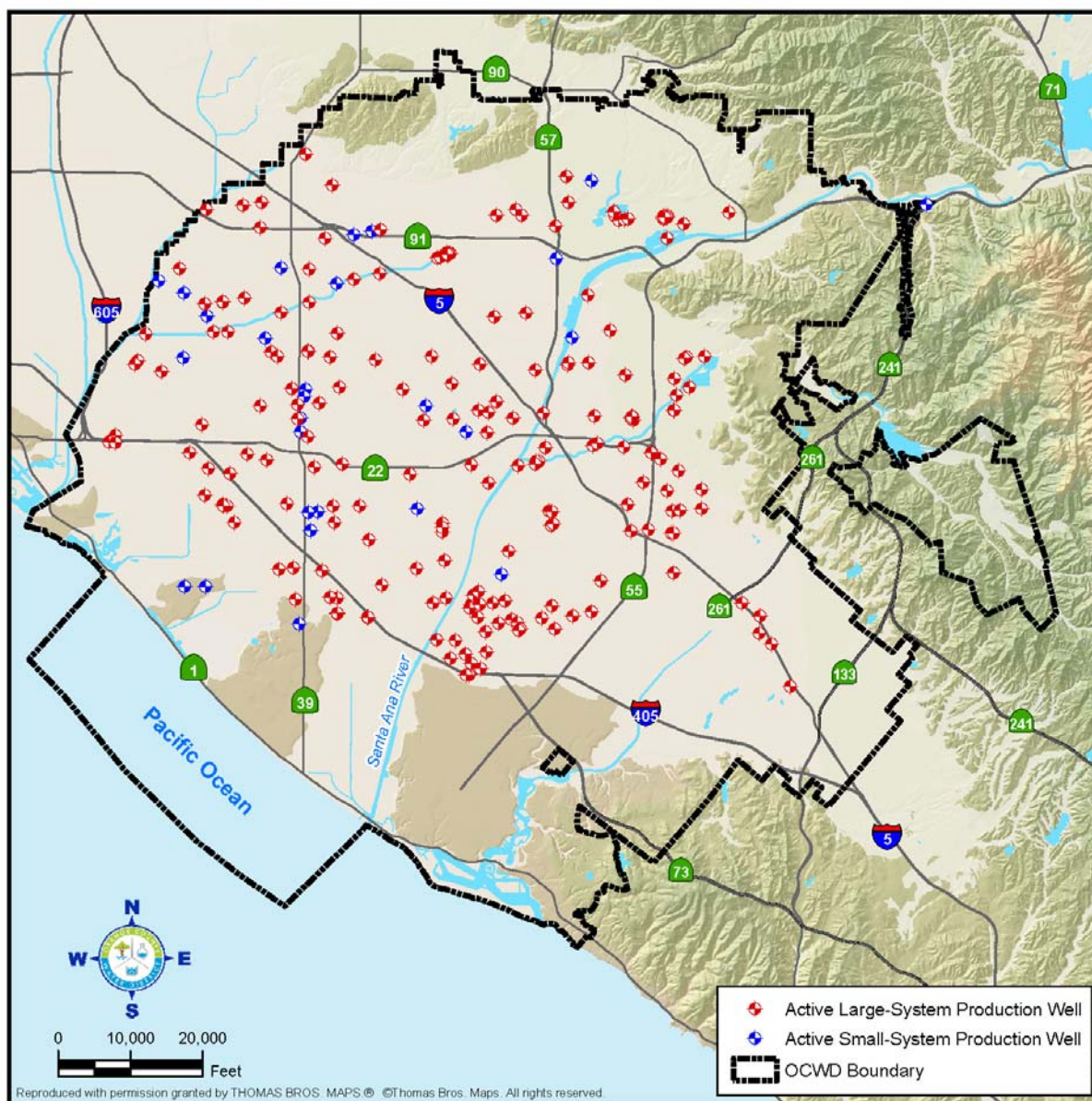
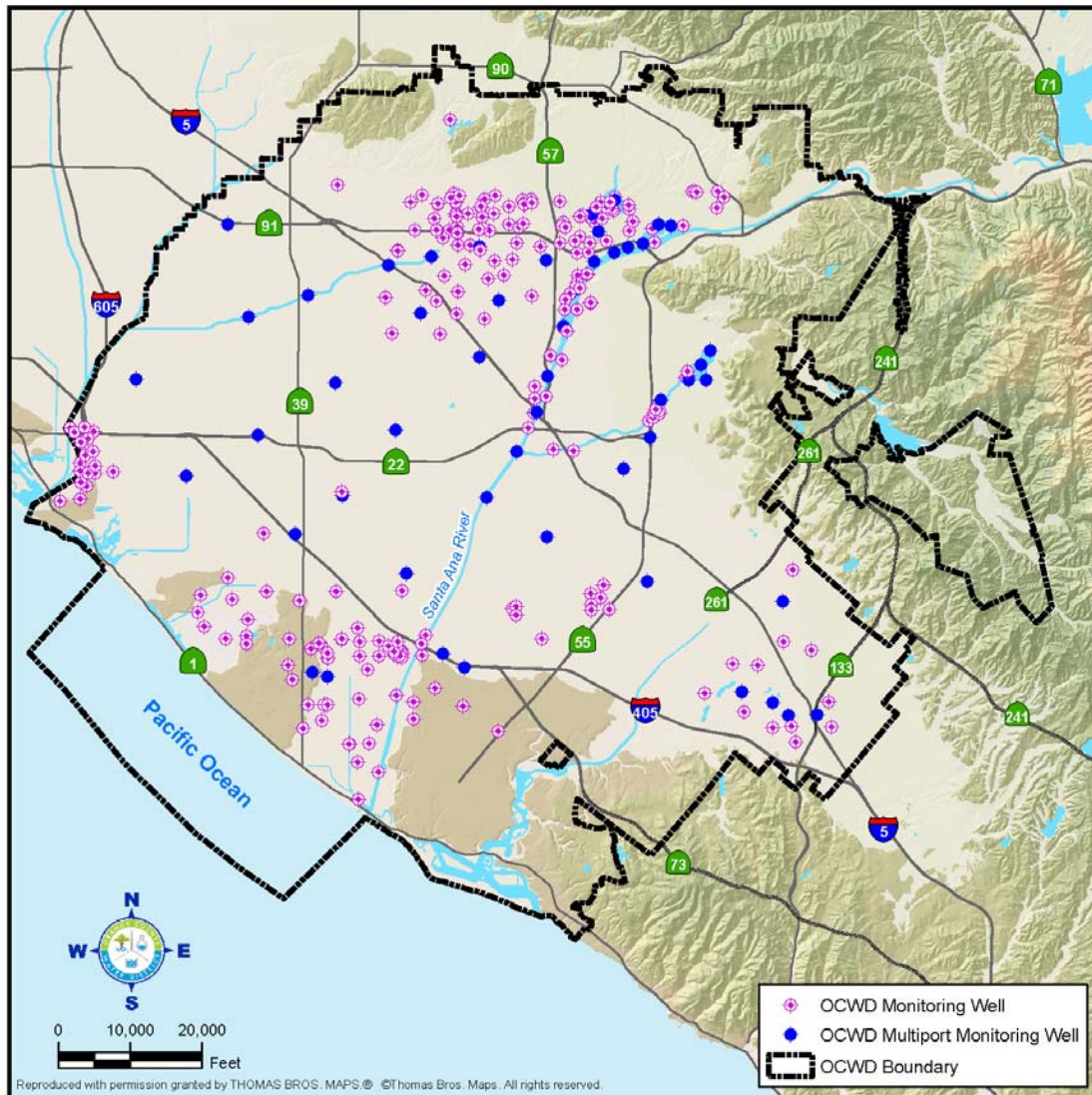




**FIGURE 3-2**  
**OCWD MONITORING WELL LOCATIONS**



Note: Monitoring wells constructed and/or owned by other entities besides OCWD are not shown.

Data collected in OCWD's monitoring program are stored in the District's electronic database, the Water Resources Management System (WRMS). WRMS contains comprehensive well information, current and historical data, as well as information on sub-surface geology, groundwater modeling, and water quality. This database provides for subsequent retrieval and analysis of data or preparation of data reports and data submittals to other agencies.

### 3.3 Water Sample Collection and Analysis

OCWD's laboratory is state-certified to perform bacteriological, inorganic, and organic analyses (see Figure 3-3). The District utilizes state-certified contractor laboratories to analyze asbestos, dioxin, and radiological samples. Analytical methods approved by the California Department of Public Health (CDPH) or U.S. Environmental Protection Agency (EPA) are used for analyzing water quality samples for the drinking water compliance program. As new chemicals are regulated, the OCWD laboratory develops the analytical capability and becomes certified in the approved method to process compliance samples. The amount of samples taken is dynamic, ranging from 600 to 1,700 samples in any given month.

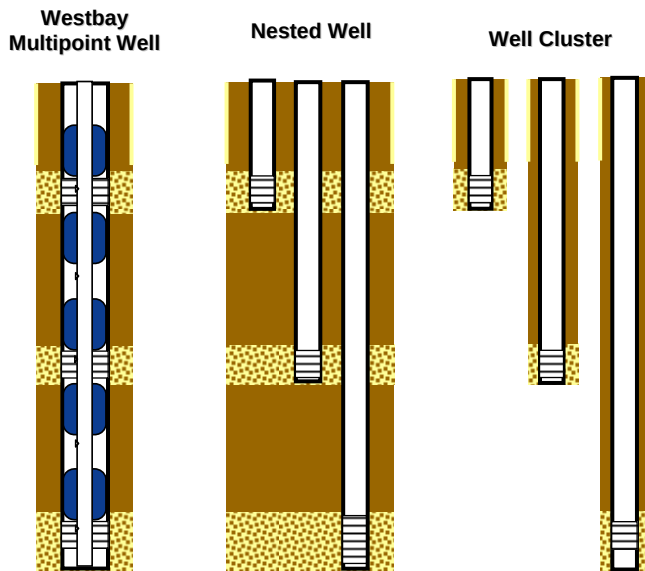
Water quality samples are collected in the field in accordance with approved federal and state procedures and industry-recognized quality assurance and control protocols to ensure that sampled water is representative of ambient groundwater (or surface water) conditions.

Water samples are collected in method-specific containers, stored in coolers at approximately 4°C, and delivered to state-certified laboratories, researchers, or contract laboratories for analysis. The majority of samples are delivered to the laboratory on the day of sample collection. When samples must be shipped, they are sent overnight for next-day delivery. Site conditions, field measurements of selected water quality parameters (temperature, pH, electrical conductivity, and dissolved oxygen), and other relevant sample observations are recorded in field notebooks at each sampling location, and a chain-of-custody form is completed for each sample collected per site. Sampling occurs in a variety of terrains and occasionally in inclement weather and outside normal business hours.

**FIGURE 3-3**  
**OCWD'S STATE CERTIFIED NEW LABORATORY**



**FIGURE 3-4**  
**THREE COMMON MONITORING WELL DESIGNS**

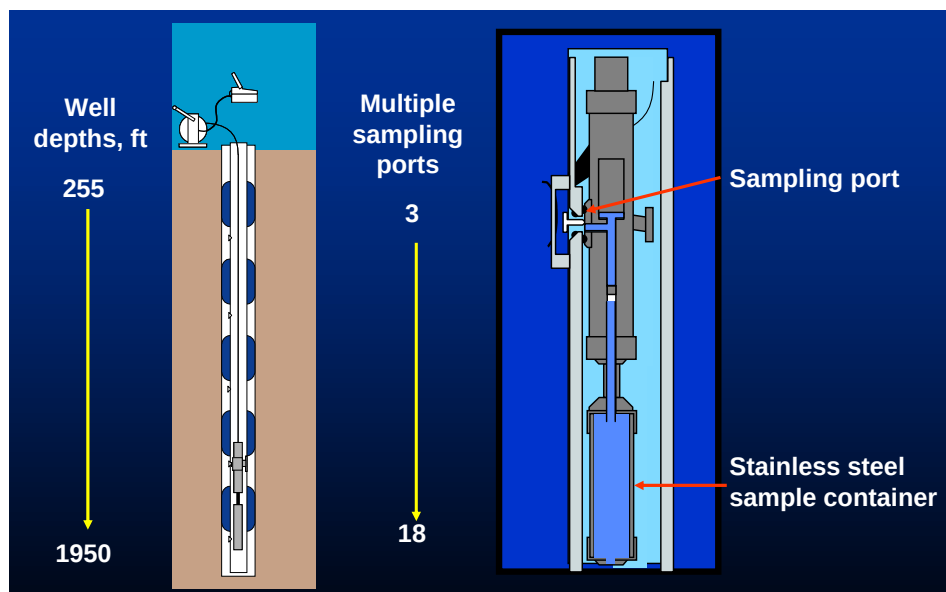


Production wells that provide water for drinking water, irrigation/agriculture, and industrial uses generally have well screens located in the permeable, water-bearing zones that may tap multiple aquifers. Therefore, water quality samples collected from these wells may represent water from one or more aquifers; some permeable zones may provide greater contribution than others to the overall water sample. In contrast, monitoring wells are designed and constructed with well screens placed at a specific depth and length to provide water quality at desired zones within an aquifer.

Figure 3-4 illustrates the three monitoring well designs used for basinwide water quality monitoring activities: multi-point, nested, and cluster.

The multi-point well is a Westbay well design that contains a single casing with sampling ports located at specific depths in the underlying aquifers (Figure 3-5). Individual sampling points are hydraulically separated by packers. A computer-assisted sampling probe is used to collect a water sample at the desired depth. The sampling port has direct hydraulic connection between the port and the aquifer, allowing groundwater to flow into a detachable stainless steel sample container. OCWD has more than 50 multi-point wells ranging from a few hundred feet to over 2,000 feet in depth.

**FIGURE 3-5**  
**MULTIPOINT WELL DESIGN DETAIL**





A nested well design consists of a single borehole with individual monitoring wells screened at specific depths and completed in the borehole. A cluster is represented by individual monitoring wells completed with single casings at targeted depths within close proximity of each other. A “single point” monitoring well is one individual monitoring well that typically is screened over about 10 to 30 feet of sediments. The primary difference between the multi-point wells and the nested, cluster or single-point monitoring wells is the method of sample collection. Westbay multi-point wells do not require purging of groundwater prior to sample collection. In contrast, single point monitoring wells use a submersible pump to purge groundwater from the well and the surrounding formation until “ambient” or steady state conditions are obtained as determined by steady, continuous field measurements of pH, electrical conductivity, and temperature.

Between forty to nearly 2,000 gallons of groundwater may be purged from a monitoring well prior to sample collection. Generally, a truck equipped with one or more submersible pumps and a portable generator is used to purge and sample groundwater from single-point monitoring wells. Portable submersible pump and reel systems provide additional flexibility to increase the efficiency of sampling monitoring wells without dedicated pumps. One truck is outfitted with a dual system of submersible pumps and environmental hoses installed separately on hydraulic booms to sample two wells simultaneously (see Figure 3-6).

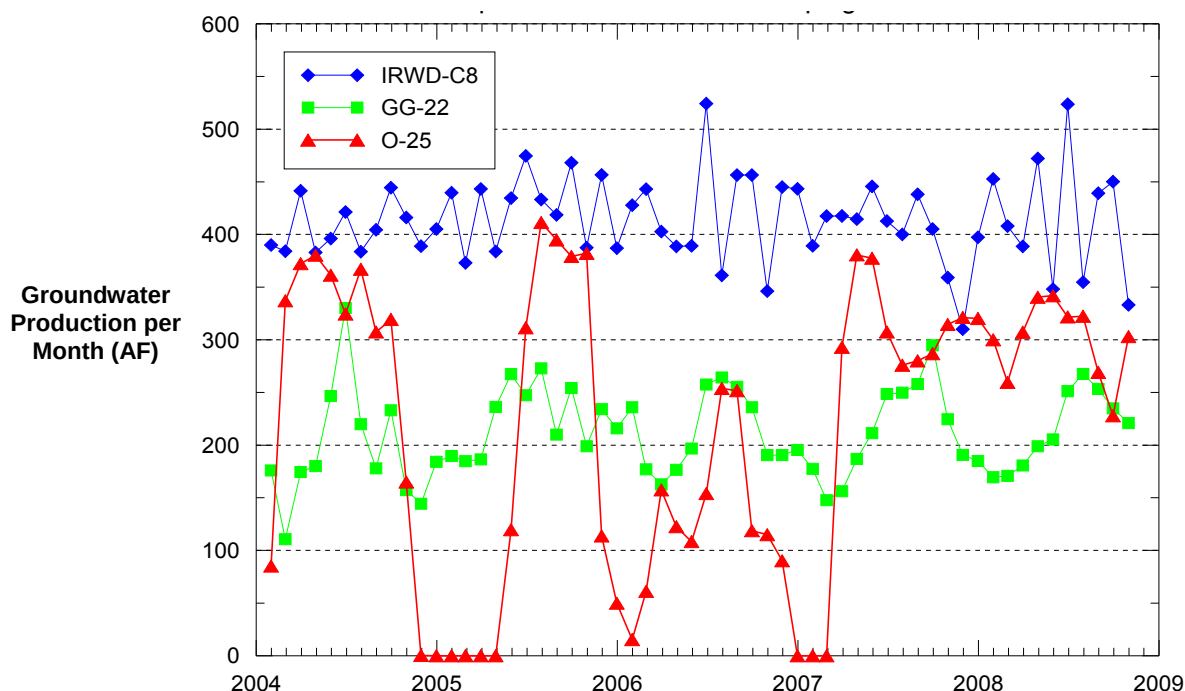
**FIGURE 3-6**  
**DUAL BOOM WATER QUALITY SAMPLING VEHICLE**



### 3.4 Production and Groundwater Elevation Monitoring

Approximately 200 large-capacity municipal supply wells account for 97 percent of production. Large-capacity well owners, who are required by the District Act to report to OCWD every six months, voluntarily report monthly groundwater production for each of their wells. The production volumes are verified by OCWD field staff. Data are used to assess the Replenishment Assessment, quantify total basin pumping, calibrate the basin model described in Section 2.8, and to evaluate seasonal groundwater level fluctuations. As an example, Figure 3-7 illustrates seasonal groundwater production trends in three municipal wells.

**FIGURE 3-7**  
**EXAMPLES OF SEASONAL WELL PUMPING PATTERNS**



Groundwater elevation (or level) data are measured at least semi-annually at nearly every production and monitoring well. Over 1,000 individual measurement points are monitored for water levels on a monthly or bi-monthly basis to evaluate short-term effects of pumping or recharge operations. More frequent water level measurements are collected at selected monitoring wells in the vicinity of OCWD's recharge facilities, seawater barriers, and areas of special investigation where drawdown, water quality impacts, or contamination are of concern. The number of municipal wells that are monitored varies from year to year depending on well maintenance, abandonment, new well construction, and related factors.

### 3.5 Water Quality Monitoring

In 2008, nearly 14,000 groundwater samples were collected and analyzed to comply with state and federal regulations and to enable OCWD to monitor the water quality of the basin. OCWD conducts the EPA/CDPH compliance sampling and reporting for Producers wells. The number of water quality samples varies each year in response to regulatory requirements and to gain a better understanding of the basin, as shown in Figure 3-8. A summary of the well types, the number of wells, and the number of sample points is presented in Table 3-1.

**FIGURE 3-8**  
**GROUNDWATER AND SURFACE SITE SAMPLES COLLECTED BY OCWD**

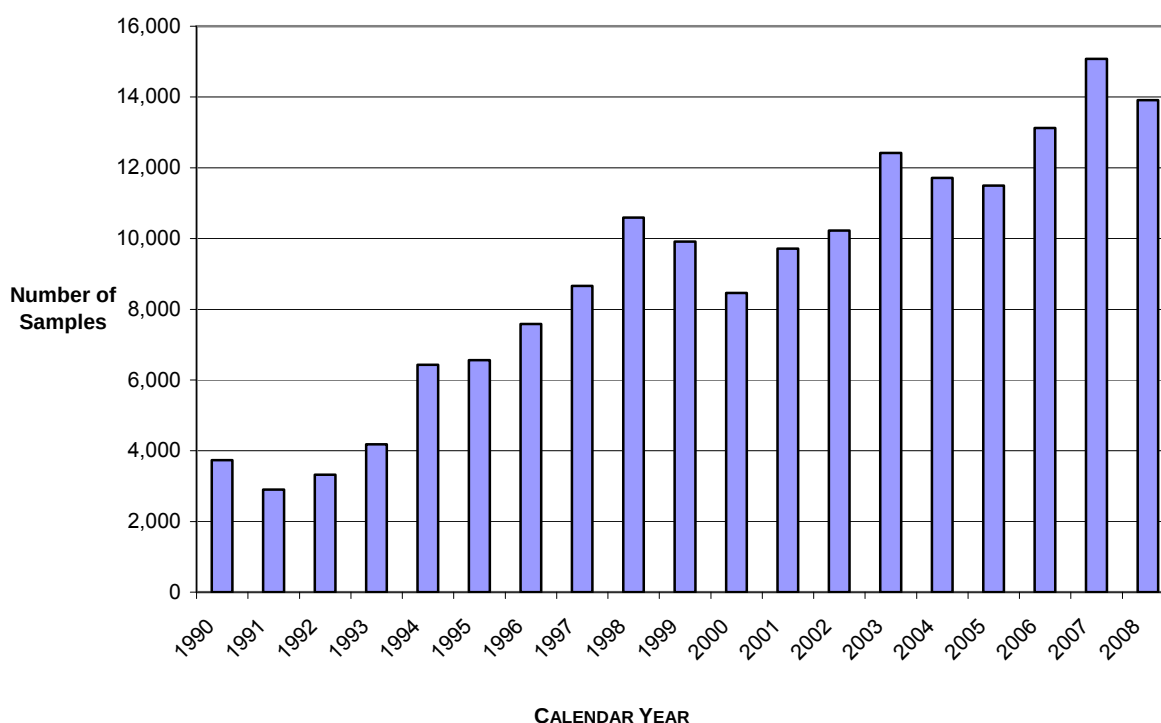


**TABLE 3-1**  
**DISTRIBUTION OF WELLS IN BASINWIDE MONITORING PROGRAM**

| Well Type                                             | No. of Wells | No. of Individual Sample Points |
|-------------------------------------------------------|--------------|---------------------------------|
| Drinking Water Wells                                  | 228          | 228                             |
| Industrial And Irrigation wells                       | 123          | 123                             |
| OCWD Monitoring Wells (excluding seawater monitoring) | 254          | 728                             |
| OCWD Seawater Intrusion Monitoring Wells              | 93           | 244                             |
| <b>Total</b>                                          | <b>698</b>   | <b>1323</b>                     |

Samples collected throughout the basin are used to monitor the impacts of basin extraction, determine the effectiveness of the seawater intrusion barriers, assess the impacts of historic and current land uses, and serve as a sentinel or early warning of emerging contaminants of concern. The District's comprehensive water quality monitoring programs fall roughly into three categories: (1) compliance with permits and drinking water regulations, (2) OCWD Board approved projects for research and other purposes, and (3) basin management.

### **3.5.1 DRINKING WATER REGULATIONS**

The Federal Safe Drinking Water Act (SDWA) directs the EPA to set health-based standards (maximum contaminant levels or MCLs) for drinking water to protect public health against both naturally-occurring and man-made contaminants. EPA administers the SDWA at the federal level and establishes MCLs for bacteriological, inorganic, organic, and radiological constituents (U.S. Code Title 42, and Code of Federal Regulations Title 40). California administers and enforces the federal program and has adopted its own SDWA, which may contain more stringent state requirements (California Health and Safety Code, Section 116350 and related sections). The regulations implementing the California SDWA are referred to as the Title 22 Drinking Water Standards.

Since the 1970s, the number of chemicals regulated in groundwater sources has increased more than four-fold. OCWD monitors more than 100 regulated and unregulated chemicals at a specified monitoring frequency established by regulation as shown in Table 3-2.

Typically, about one-third of the drinking water wells are sampled every year for general minerals, metals, and secondary MCL constituents (color, odor, TDS, sodium, chloride, alkalinity, etc.). VOCs and nitrate are sampled annually at every well. Quarterly monitoring is required if VOCs are detected or if nitrate concentrations exceed 50 percent of the MCL. In addition, OCWD monitors wells routinely for selected chemicals on the unregulated lists, chemicals with Notification Levels, or new chemicals of concern.

Analyses for synthetic organic chemicals (SOCs) including tests for herbicides, pesticides, plasticizers, and other semi-volatile organics require use of twelve or more analytical methods. Newly-constructed wells are monitored for SOCs for four consecutive quarters to provide seasonal data for CDPH to assess the long-term monitoring frequency in their vulnerability assessment.

In addition to the regulated chemicals, both EPA and the CDPH require monitoring for unregulated chemicals. Unregulated chemicals do not have an established drinking water standard, but are new priority chemicals of concern. Monitoring provides information regarding their occurrence and levels detected in drinking water supply wells as the first assessment step to determine if the establishment of a standard (MCL) is necessary. Wells must be sampled twice within twelve months to comply with the unregulated chemical monitoring rules.



**TABLE 3-2  
MONITORING OF REGULATED AND UNREGULATED CHEMICALS**

| DPH Title 22 Drinking Water Monitoring Frequency -- Regulated Chemicals |                                                                                                                                                                                                                                     |                                                                                                                                     | Comments                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chemical Class                                                          | Frequency                                                                                                                                                                                                                           | Monitoring Notes                                                                                                                    |                                                                                                                                                                                                                                      |
| Inorganic - General Minerals                                            | Once every 3 years                                                                                                                                                                                                                  |                                                                                                                                     |                                                                                                                                                                                                                                      |
| Inorganic - Trace Metals                                                | Once every 3 years                                                                                                                                                                                                                  |                                                                                                                                     |                                                                                                                                                                                                                                      |
| Nitrate and nitrite                                                     | Annually                                                                                                                                                                                                                            | New wells sampled quarterly for 1st year                                                                                            |                                                                                                                                                                                                                                      |
| Detected $\geq$ 50% MCL                                                 | Quarterly                                                                                                                                                                                                                           |                                                                                                                                     |                                                                                                                                                                                                                                      |
| Perchlorate                                                             |                                                                                                                                                                                                                                     | New wells sampled quarterly for 1st year                                                                                            |                                                                                                                                                                                                                                      |
| Detected $\geq$ DLR                                                     | Quarterly                                                                                                                                                                                                                           | Detection limit = 4 ppb                                                                                                             |                                                                                                                                                                                                                                      |
| Non-detect at < DLR                                                     | Once every 3 years                                                                                                                                                                                                                  |                                                                                                                                     | OCWD will monitor at least annually                                                                                                                                                                                                  |
| Volatile organic chemicals (VOC)                                        | Annually                                                                                                                                                                                                                            | New wells sampled quarterly for 1st year                                                                                            |                                                                                                                                                                                                                                      |
| Detected VOC                                                            | Quarterly                                                                                                                                                                                                                           |                                                                                                                                     |                                                                                                                                                                                                                                      |
| Synthetic organic chemicals (SOC)                                       |                                                                                                                                                                                                                                     | New wells sampled quarterly for 1st year; if non-detect, susceptibility waiver for 3 years                                          |                                                                                                                                                                                                                                      |
| Atrazine and simazine                                                   | Once every 3 years                                                                                                                                                                                                                  |                                                                                                                                     |                                                                                                                                                                                                                                      |
| Radiological                                                            |                                                                                                                                                                                                                                     | New wells sampled quarterly for 1st year (initial screening) to determine reduced monitoring frequency for each radionuclide        |                                                                                                                                                                                                                                      |
| Detected at $> 1/2$ MCL $\leq$ MCL                                      | Once every 3 years                                                                                                                                                                                                                  | Per radionuclide                                                                                                                    | Reduced monitoring after initial year                                                                                                                                                                                                |
| Detected at $\leq 1/2$ MCL                                              | Once every 6 years                                                                                                                                                                                                                  | Per radionuclide                                                                                                                    | Reduced monitoring after initial year                                                                                                                                                                                                |
| Non-detect at < DLR                                                     | Once every 9 years                                                                                                                                                                                                                  | Per radionuclide                                                                                                                    | Reduced monitoring after initial year                                                                                                                                                                                                |
| <b>EPA and DPH Unregulated Chemicals</b>                                |                                                                                                                                                                                                                                     |                                                                                                                                     |                                                                                                                                                                                                                                      |
| DHS : 4-Inorganic and 5-organic chemicals                               |                                                                                                                                                                                                                                     |                                                                                                                                     | DHS UCMR - required testing for all new wells                                                                                                                                                                                        |
| EPA UCMR1 - List 1: 1-Inorganic and 10-organic chemicals                | <u>Two required samples:</u><br>(1) Vulnerable period: May-Jun-Jul-Aug-Sep<br>(2) 5 to 7 months before or after the sample collected in the vulnerable period. No further testing after completing the two required sampling events | Monitoring completed for existing wells in 2001- 2003; new wells tested during 1st year                                             | EPA UCMR1 - no longer required by EPA; sampling period was 2001-2003; received waiver April '08 from DPH of non vulnerable so no further testing required. New wells were being tested since 2001 to Apr. 08 (waiver granted by DPH) |
| EPA UCMR1 - List 2: 13-Organic chemicals                                |                                                                                                                                                                                                                                     |                                                                                                                                     |                                                                                                                                                                                                                                      |
| EPA UCMR2 - List 1: 10 organic chemicals                                |                                                                                                                                                                                                                                     | All water utilities serving >10,000 people. Monitoring period: 2008- 2010                                                           | Current EPA program: Jan 2008 - Dec. 2010                                                                                                                                                                                            |
| EPA UCMR2 - List 2: 15 organic chemicals                                |                                                                                                                                                                                                                                     | All water utilities serving population >100,000 and EPA selected systems serving <100,000 population. Monitoring period: 2008- 2010 |                                                                                                                                                                                                                                      |

### 3.5.2 MONITORING FOR CONTAMINANTS IN THE BASIN

OCWD has taken a proactive role in monitoring the basin for VOCs for over twenty years. This extensive monitoring program that tests agricultural, industrial, private, and domestic wells, led to the discovery of the El Toro MCAS solvent plume, discussed in Section 5.5. In response to the detection of VOCs in Anaheim and Fullerton over 100 monitoring wells, many in cluster well configuration were drilled to provide a broad range of monitoring points to define the areal extent of VOC contamination.

Monitoring wells are sampled as frequently as quarterly in areas of localized high concentrations of solvents and annually at other locations. Other chemicals are added to the monitoring program when concern arises. In the case of the North Basin

Groundwater Protection Project, described in Section 5.8, OCWD monitors for VOCs, 1,4-dioxane, and other constituents.

Monitoring gaps for regulated and unregulated chemicals occur in areas within Irvine where drinking water wells were not operating on a regular basis. OCWD's fills the data gaps with the non-potable well monitoring program. Monitoring wells and accessible agricultural wells are sampled for volatile organics, general minerals, and selected chemicals of concern to provide water quality information in this area of the basin.

### **3.6 Seawater Intrusion Monitoring and Prevention**

Monitoring and preventing the encroachment of seawater into fresh groundwater zones along coastal Orange County is a major basin management issue. Seawater encroachment also represents a key factor in determining the basin operating range in terms of the maximum accumulated overdraft. Besides seawater intrusion, other identified sources of coastal groundwater salinity include connate water (water trapped in the pore spaces of sediments at the time of deposition) and brines disposed of at the ground surface during past oil production (Poland et al., 1956; DWR, 1961; DWR, 1968; J.M. Montgomery, 1974). The primary avenues for seawater intrusion into the basin are permeable sediments underlying topographic lowlands or "gaps" between the erosional remnants or "mesas" of the Newport-Inglewood Uplift, as shown in Figure 3-9. The susceptible locations are the Talbert, Bolsa, Sunset, and Alamitos Gaps.

Seawater intrusion through the Alamitos and Talbert Gaps is controlled via the operation of seawater barriers consisting of injection wells. The Alamitos Barrier has been operated since 1965 under a joint funding agreement between OCWD and Los Angeles County Department of Public Works (LACDPW) and a joint management committee consisting of OCWD, LACDPW, and other local stakeholders including the Water Replenishment District, City of Long Beach, and Golden State Water Company. OCWD has operated the Talbert Seawater Barrier since 1975. Flow and pressure readings are used to maximize total injection without over pressurizing the wells.

A coastal seawater monitoring program assesses the effectiveness of the Alamitos and Talbert Barriers and tracks salinity levels in the Bolsa and Sunset Gaps. Over 425 monitoring and production wells are sampled semi-annually to assess water quality conditions during periods of lowest production (winter) and peak demands (summer). Monthly water levels are measured in many of the coastal wells to evaluate seasonal effects of pumping and the operation of the injection barrier. A small subset of coastal wells is equipped with pressure transducers and data loggers for twice daily measurement and recording of water level conditions.

Key groundwater monitoring parameters used to determine the effectiveness of the barriers include water level elevations, chloride, TDS, electrical conductivity, and bromide. Groundwater elevation contours for the aquifers most susceptible to seawater intrusion are prepared to evaluate the freshwater mound developed by the barrier injection wells and to determine if it is sufficient to prevent the inland movement of saline water. The Talbert Gap chloride concentration contours shown in Figure 3-10 illustrate both the historical inland progression of groundwater salinity and its recent

reversal due to injecting large volumes of water and basin management practices employed in the last four years.

FIGURE 3-9  
SEAWATER BARRIER LOCATIONS

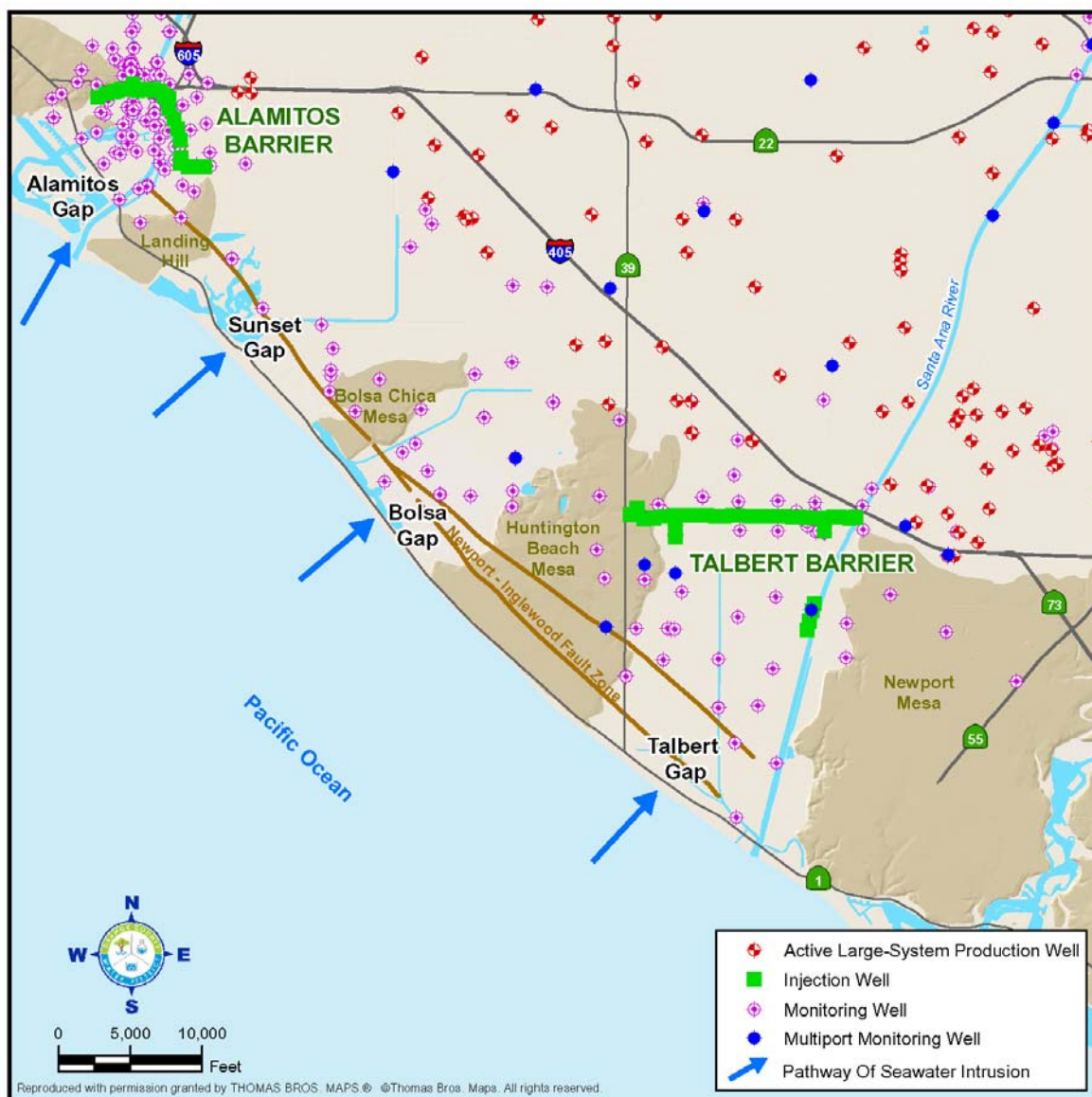
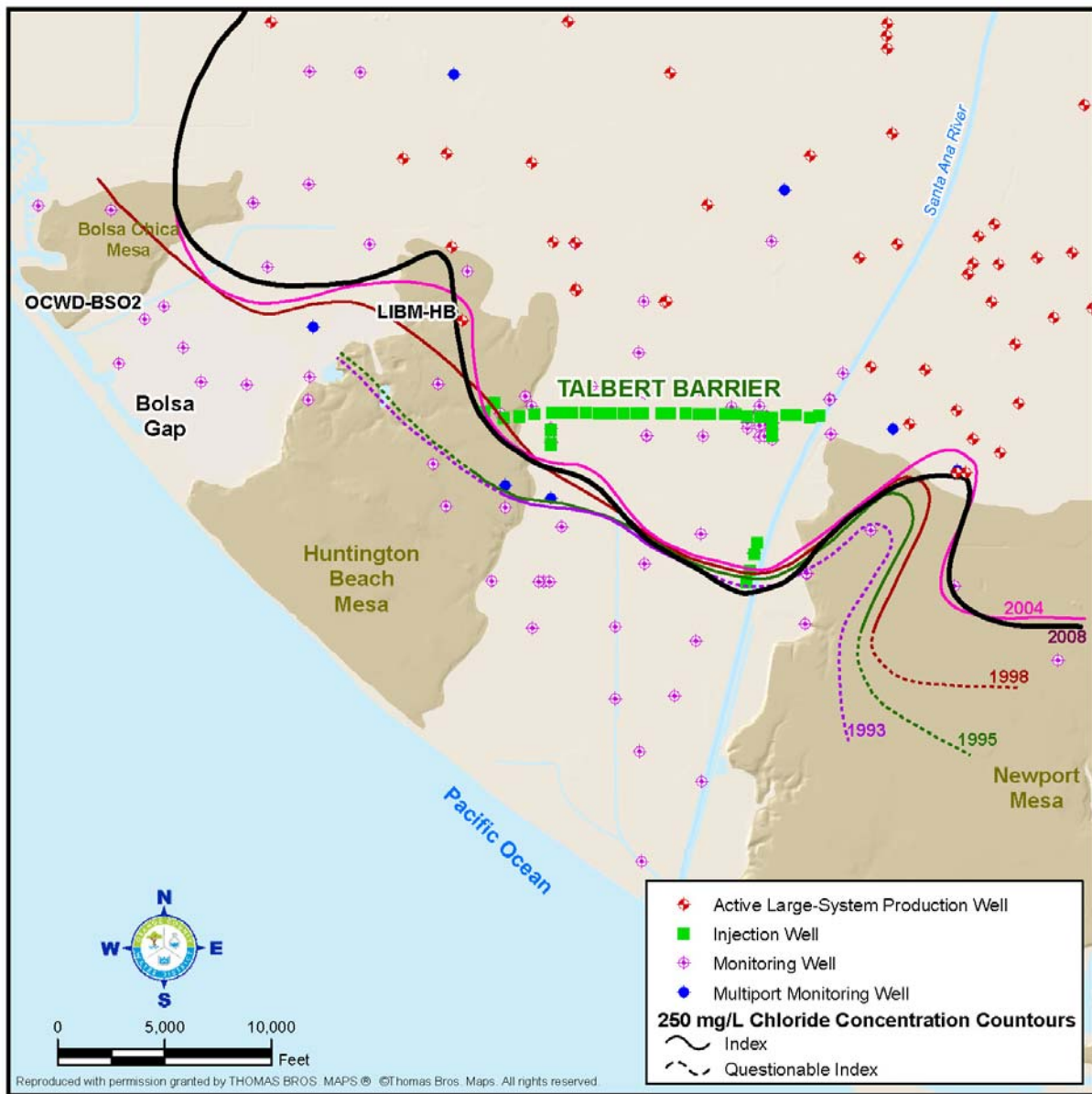
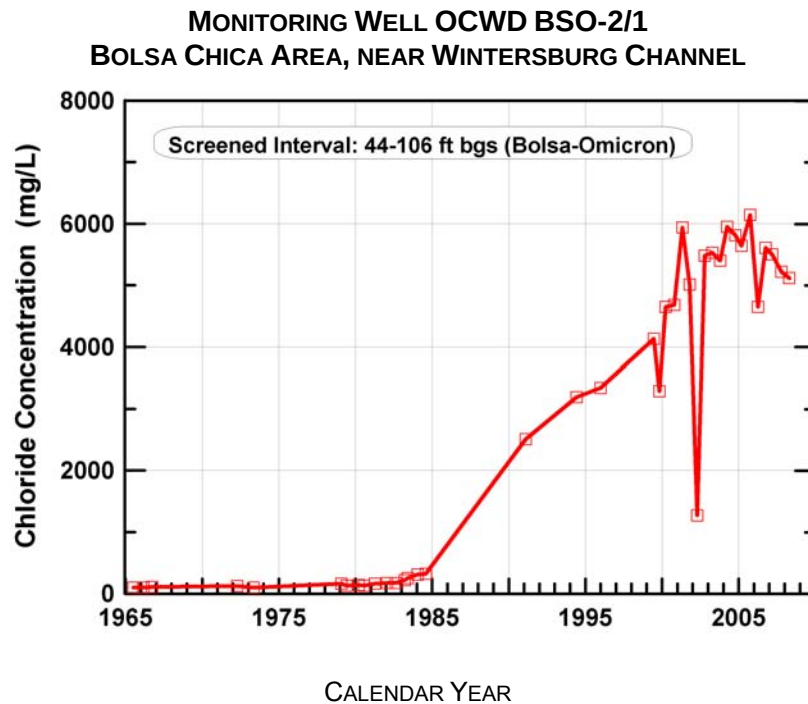
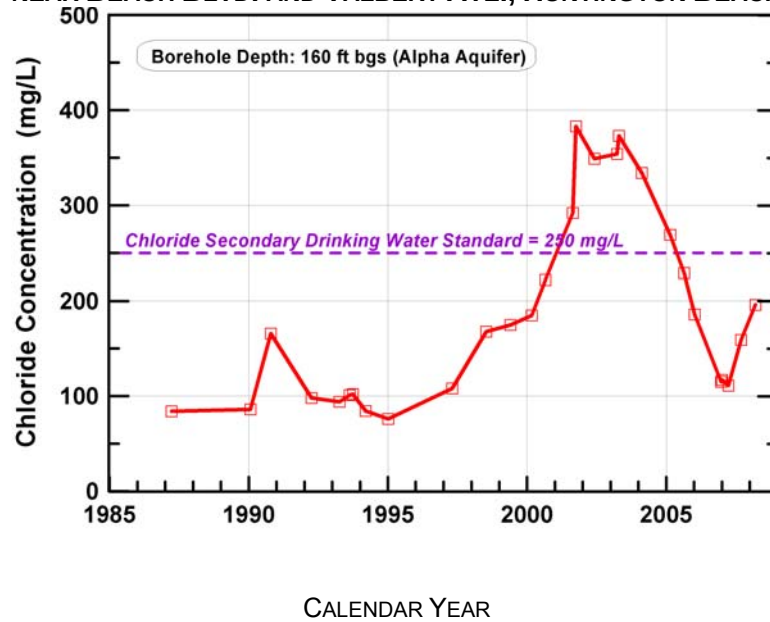


**FIGURE 3-10**  
**LANDWARD MOVEMENT OF 250 MG/L CHLORIDE CONCENTRATION CONTOUR**



In addition to contour maps, OCWD staff prepares and reviews chloride concentration trends at individual wells to identify and evaluate intrusion in specific aquifer zones. Chloride concentration trend charts for two of those wells are shown in Figure 3-11 with their locations shown in Figure 3-10.

**FIGURE 3-11**  
**EXAMPLE CHLORIDE CONCENTRATION TREND CHARTS**  
**DOMESTIC WELL LIBM-HB**  
**NEAR BEACH BLVD. AND TALBERT AVE., HUNTINGTON BEACH**





### 3.7 Monitoring Quality of Recharge Water

OCWD conducts an extensive program to monitor the quality of the water recharged into the groundwater basin. This includes monitoring of the Santa Ana River surface water and other recharge water supplies.

#### 3.7.1 SANTA ANA RIVER WATER QUALITY

Since the quality of the surface water that is used for recharge may affect groundwater quality, a routine monitoring program is maintained to continually assess ambient river water quality conditions. Characterizing the quality of the Santa Ana River and its impact on the basin is necessary to verify the sustainability of continued use of river water for recharge and to safeguard a high-quality drinking water supply for Orange County.

On-going monthly surface water monitoring of the Santa Ana River is conducted at Imperial Highway near the diversion of the river to the off-river recharge basins and at a site below Prado Dam. Sampling frequencies for selected river sites and recharge basins are shown in Table 3-3.

**TABLE 3-3**  
**SURFACE WATER QUALITY SAMPLING FREQUENCY WITHIN ORANGE COUNTY**

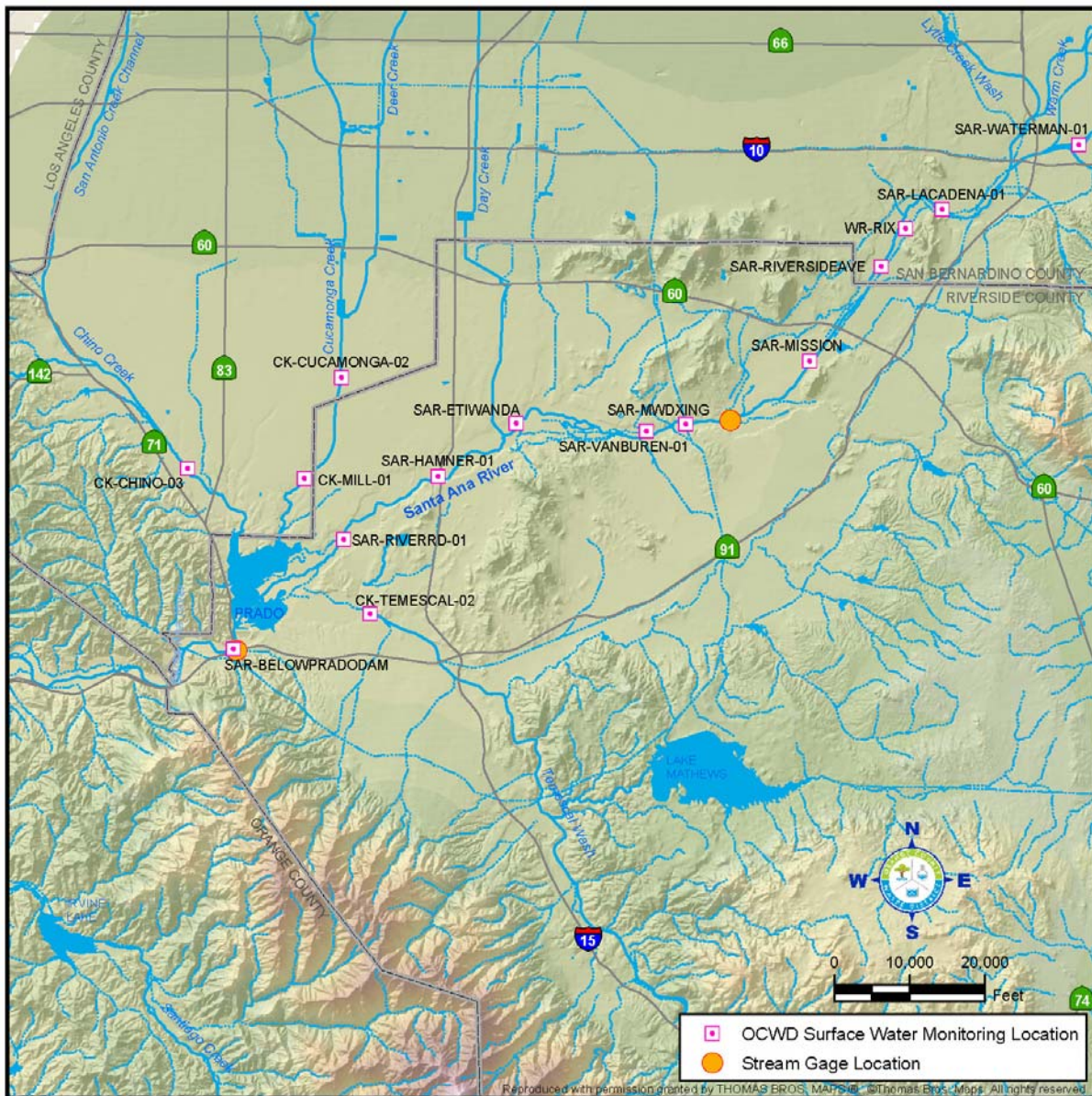
| Category                              | SAR Below Dam | SAR Imperial Hwy | Anaheim Lake | Kraemer/ Miller Basin |
|---------------------------------------|---------------|------------------|--------------|-----------------------|
| General Minerals                      | M             | M                | M            | Q                     |
| Nutrients                             | M             | M                | M            | Q                     |
| Metals                                | Q             | Q                | Q            | Q                     |
| Microbial                             | M             | M                | M            | M                     |
| Volatile organic compounds (VOC)      | M             | M                | M            | Q                     |
| Semi-volatile organic compounds (SOC) | Q             | Q                | Q            | Q                     |
| Total organic halides (TOX)           | M             | M                | M            |                       |
| Radioactivity                         | Q             | Q                | Q            | Q                     |
| Perchlorate                           | M             | M                | M            | Q                     |
| Chlorate                              | M             | M                | M            | Q                     |
| Iodine                                |               | Q                | Q            |                       |
| NDMA Formation Potential (NDMA-FP)    |               | Q                | Q            |                       |

M = monthly, Q = quarterly

Note: NDMA-FP and iodine are focused testing initiated in late 2007 and will continue through 2009. Data will be reviewed to determine if monitoring should continue or incorporated into the long-term monitoring program.

General minerals, nutrients, and selected other constituents are monitored monthly, and radioactivity constituents, metals, volatile organics, and semi-volatile organics (e.g., pesticides and herbicides) are monitored quarterly. Several points on the river and key tributaries to the river above Prado Dam, as shown in Figure 3-12 are also monitored annually for general minerals and nutrients.

**FIGURE 3-12**  
**OCWD SURFACE WATER MONITORING LOCATIONS ABOVE PRADO DAM**





### 3.7.1.1 Santa Ana River Water Quality and Health Study

In 2004, OCWD completed the Santa Ana River Water Quality and Health (SARWQH) study (OCWD, 2004). This voluntary study was conducted from 1994 to 2004 at a cost of \$10 million. The study was initiated due to OCWD's concerns about the high percentage of treated wastewater discharges into the non-storm flows of the Santa Ana River.

The goal of the SARWQH Study was to apply advanced water quality characterization methods to assess the quality of Santa Ana River water and the groundwater after Santa Ana River water is used to recharge the groundwater basin. The multi-disciplinary study design included an examination of hydrogeology, microbiology, inorganic and organic water chemistry, toxicology and public health. The organic water chemistry component included an analysis of trace (low concentration) constituents and dissolved organic compound (DOC) characterization. Analyses and research in the SARWQH Study were conducted by scientists, researchers, and water quality experts from numerous organizations, including Stanford University, Lawrence Livermore National Laboratory, USGS, Oregon State University, and Metropolitan Water District.

The results of this extensive study confirmed that current recharge practices using Santa Ana River water are protective of public health. Findings from the SARWQH Study provided information necessary for the planning and permitting of other OCWD projects, such as the GWR System. Results are also helping to shape the CDPH proposed regulations for groundwater recharge.

At the request of OCWD, the National Water Research Institute (NWRI) conducted an independent review of the results from the SARWQH Study. NWRI assembled a group of experts in the fields of hydrogeology, water chemistry, microbiology, and the other requisite fields to form the Scientific Advisory Panel. This Panel met annually during the study to review the results and provide recommendations on future work. The panel also prepared a final report (NWRI, 2004) that concluded:

"Based on the scientific data collected during the SARWQH Study, the Panel found that:

- The SAR met all water-quality standards and guidelines that have been published for inorganic and organic contaminants in drinking water.
- No chemicals of wastewater origin were identified at concentrations that are of public health concern in the SAR, in water in the infiltration basins, or in nearby groundwaters.

The constituents that were considered included non-regulated chemicals (e.g., pharmaceutically active chemicals) and contaminants of concern that arose during the course of the SARWQH study (e.g., n-Nitrosodimethylamine [NDMA]).

The unprecedented classification of the major components of DOC and the transformations that occur within these chemical classes as water moves downstream and into the aquifer provided significant new evidence to support the conclusion that the product water is suitable for potable

consumption and is also becoming comparable to other sources of drinking water, such as the Colorado River, in its organic profile.”

### 3.7.2 REPLENISHMENT WATER FROM METROPOLITAN

When the District purchases replenishment water from Metropolitan and it is delivered at Anaheim Lake, the water is blended with Santa Ana River water. OCWD samples this blended water for general minerals, nutrients, and other selected constituents. The District may also sample for radioactive constituents, metals, volatile organics, and semi-volatile organics (e.g., pesticides and herbicides).

### 3.7.3 GROUNDWATER REPLENISHMENT SYSTEM

Recharge water produced by the GWR System is extensively monitored daily, weekly, and quarterly for general minerals, metals, organics, and microbiological constituents as shown in Table 3-4. Focused research-type testing has been conducted on organic contaminants and selected microbial species (i.e., protozoa, coliphage, etc.)

TABLE 3-4  
GROUNDWATER REPLENISHMENT SYSTEM PRODUCT WATER QUALITY MONITORING

| Category                                                                               | Testing Frequency |
|----------------------------------------------------------------------------------------|-------------------|
| General Minerals                                                                       | M                 |
| Nitrogen Species (NO <sub>3</sub> , NO <sub>2</sub> , NH <sub>3</sub> , Org-N) and TDS | W                 |
| Metals                                                                                 | Q                 |
| Inorganic chemicals                                                                    | Q                 |
| Microbial                                                                              | D                 |
| Total Organic Carbon (TOC)                                                             | D                 |
| Non-volatile synthetic organic compounds (SOCs)                                        | Q                 |
| Disinfection Byproducts                                                                | Q                 |
| Radioactivity                                                                          | Q                 |

D = Daily, W = twice weekly, M = monthly, Q = quarterly,

After the GWR System water is recharged, the water is monitored in the groundwater basin. The District uses an array of monitoring wells in the Talbert Gap and in Anaheim to monitor the water quality. As part of the construction of the GWR System, three new monitoring wells were constructed to complement the District’s existing monitoring wells network.

### 3.7.4 INTEGRATED GROUNDWATER AND SURFACE WATER MONITORING

As part of its recharge water quality monitoring program, the District monitors groundwater quality at selected monitoring wells downgradient of the recharge facilities where the subsurface rate of travel of recharge water is known. These wells provide an indication of groundwater quality as recharge water flows away from the recharge

basins. Recharge water samples are collected in coordination with these targeted groundwater samples so that the changes in water quality with time after recharge can be assessed. This allows for evaluations of water quality for parameters such as nitrate as the water is infiltrated and subsequently flows in the subsurface.

This integration of groundwater and surface water monitoring was established based on recharge water tracer studies conducted with water recharge at Anaheim Lake, Kraemer Basin, and the Santa Ana River (Clark et. al, 2004).

### **3.8 Publication of Data**

In addition to collecting and managing data in the District's WRMS as described previously in this section, OCWD analyzes and reports data in a number of regular publications as shown in Table 3-5 below.

**TABLE 3-5  
DATA COLLECTION AND REPORTING**

| <b>Report</b>                                                                                                           | <b>Frequency of Publication</b> | <b>Contents</b>                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District | Annual                          | Basin hydrology, groundwater conditions, total groundwater production, groundwater levels, coastal groundwater conditions, calculation of basin accumulated overdraft, supplemental water purchases; required by the District Act |
| Santa Ana River Water Quality Monitoring Report                                                                         | Annual                          | Surface water quality data for the Santa Ana River                                                                                                                                                                                |
| Groundwater Replenishment System and Talbert Barrier Report                                                             | Annual                          | Data related to the operation of the Groundwater Replenishment System and the Talbert Seawater Intrusion Barrier; required by RWQCB permit                                                                                        |
| Santa Ana River Watermaster Report                                                                                      | Annual                          | Amounts of Santa Ana River flows at Prado Dam and Riverside Narrows; required by 1969 stipulated judgment                                                                                                                         |
| Managed Aquifer Recharge                                                                                                | Annual beginning 2009           | Total amount of managed recharge, recharge data for each recharge basin, sources of and quantities of recharge water supplies                                                                                                     |

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## 4 RECHARGE WATER SUPPLY MANAGEMENT

OCWD manages the District's recharge facilities to maximize groundwater recharge. Efficiently operating existing groundwater recharge basins and facilities and expanding recharge operations where feasible are major District objectives. This section:

- Describes the operations of the OCWD recharge facilities;
- Explains seawater intrusion barrier operations; and
- Discusses the sources of recharge water supplies.

### 4.1 Recharge Operations

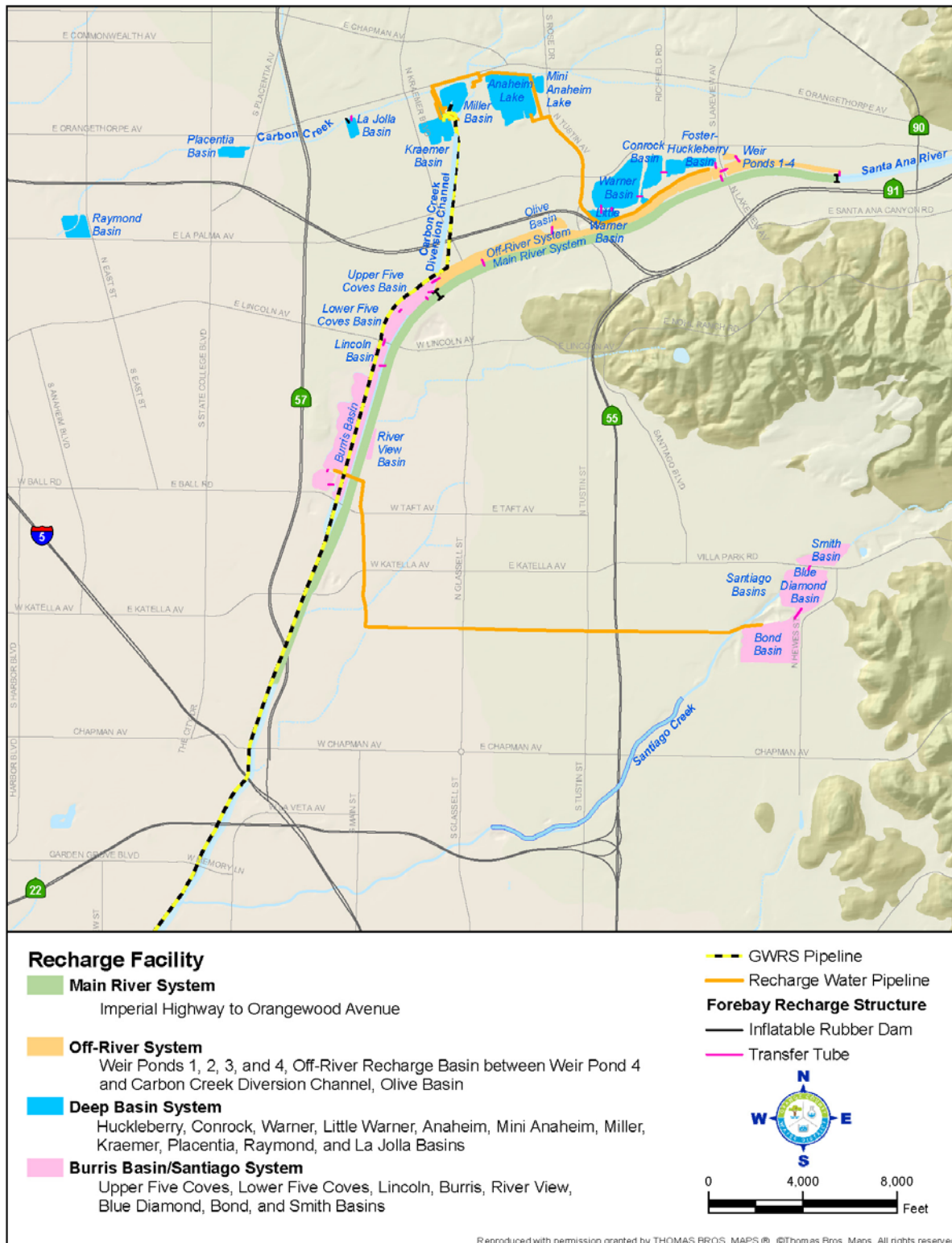
Recharging water into the basin, through natural and artificial means, is essential to support pumping from the basin. Although the amount of recharge and total pumping may not be the same each year, over the long-term the amount of recharge needs to be similar to total pumping. The basin's primary source of water for groundwater recharge is flow from the Santa Ana River. The Santa Ana River is the largest coastal stream in southern California with a length of 80 miles and a drainage area of 2,470 square miles (Blomquist, 1988). OCWD diverts river flows into recharge basins located in and adjacent to the Santa Ana River and its main Orange County tributary, Santiago Creek. Other sources of recharge water supplies include natural recharge, recycled water, and imported water.

OCWD currently operates 1,067 acres of recharge facilities located in and adjacent to the Santa Ana River and Santiago Creek. OCWD recharge facilities are shown in Figure 4-1. Active or managed recharge of groundwater began in 1949, in response to increasing drawdown of the basin and, consequently, the serious threat of seawater intrusion contaminating groundwater. The first imported water used to recharge the basin was Colorado River water purchased from Metropolitan.

In 1953, OCWD began making improvements in the Santa Ana River bed and areas adjacent to the river to increase recharge capacity. These improvements included modifying river channels and construction of off-channel recharge basins. Expansion of the recharge system has continued to the present time to the point where nearly all Santa Ana River non-stormflows are captured for recharge into the groundwater basin. Sources of recharge water have expanded to include water from Santiago Creek and purified water from the GWR System.

The recharge system consists of a series of recharge basins, also called percolation or spreading basins, whose sidewalls and bottoms allow for percolation into the underlying aquifer. The rate at which water enters from the surface into the ground is the percolation rate (or recharge or infiltration rate). The percolation rate and how it changes through time is the main factor in determining the effectiveness of the recharge facilities.

FIGURE 4-1  
OCWD RECHARGE FACILITIES IN ANAHEIM AND ORANGE





Higher percolation rates allow a greater quantity of water to infiltrate into the groundwater basin. Percolation rates tend to decrease with time as the percolation basins develop a thin clogging layer on the basin bottom. The clogging layer develops from fine grain sediment deposition and from biological growth. Percolation rates are restored by mechanical removal of the clogging layer from the basins. Mechanical removal methods that are employed utilize heavy equipment such as dozers, scrapers, and other equipment. Additionally, basin cleaning vehicles are employed in selected basins. These basin cleaning vehicles operate while the basin is in operation.

### 4.1.1 Prado Basin

The majority of water recharging the basin is Santa Ana River water that enters Orange County after flowing through the Prado Dam. The dam, shown in Figure 4-2, was built by the U.S. Army Corps of Engineers (ACOE) in 1941 “for flood control and other purposes.”

**FIGURE 4-2  
PRADO DAM AND OCWD PRADO WETLANDS**

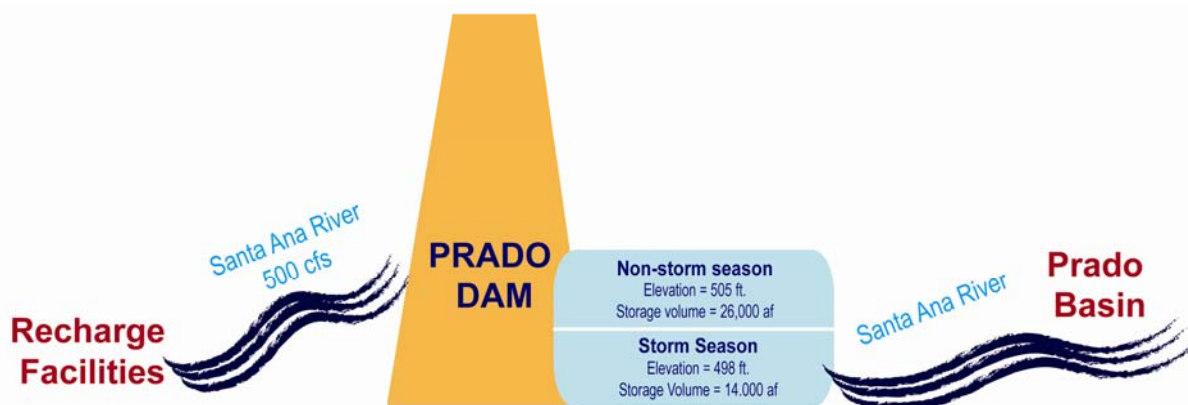




In the 1960s the ACOE began working with OCWD to conserve base and stormflows behind the dam in order to enable OCWD to divert flows into recharge facilities. In 1994, the ACOE adopted new dam operating procedures to increase water conservation (ACOE, 1994). During non-storm periods, the ACOE now releases water stored behind Prado Dam at rates compatible with OCWD's recharge capacity as long as the stored water does not compromise the use of the dam for flood control purposes.

Although the District's recharge system has the capacity to capture all Santa Ana River baseflows released through the Prado Dam, stormflows occasionally exceed the diversion capacity. OCWD continuously works with the ACOE to manage flow rates in order to maximize the recharge of stormflows. A new Memorandum of Agreement between OCWD and the ACOE, executed in 2006, authorized a four-foot increase in the maximum winter pool elevation. Water now can be stored temporarily behind Prado Dam up to an elevation of 498 feet mean sea level during the flood season, and up to an elevation of 505 feet during the non-flood season, as shown in Figure 4.3.

**FIGURE 4-3**  
**MAXIMUM CONSERVATION STORAGE ELEVATIONS ALLOWED BEHIND PRADO DAM**



#### 4.1.2 Recharge Facilities in Anaheim and Orange

The District operates 30 recharge facilities in the Cities of Anaheim and Orange and unincorporated areas of Orange County. These facilities, listed in Table 4-1, have a combined total storage volume of approximately 26,000 af. For descriptive purposes, they are grouped into four major components: the Main River System, the Off-River System, the Deep Basin System, and the Burris Basin/Santiago System.

**TABLE 4-1  
AREA AND STORAGE CAPACITIES OF RECHARGE FACILITIES**

| <b>Facility</b>                                       | <b>Wetted Area<br/>(acres)</b> | <b>Max. Storage Capacity (1)<br/>(af)</b> |
|-------------------------------------------------------|--------------------------------|-------------------------------------------|
| Anaheim Lake                                          | 72                             | 2,260                                     |
| Burris Basin                                          | 120                            | 2,670                                     |
| Conrock Basin                                         | 25                             | 1,070                                     |
| Five Coves Basin: Lower                               | 16                             | 182                                       |
| Five Coves Basin: Upper                               | 15                             | 164                                       |
| Foster-Huckleberry Basin                              | 21                             | 630                                       |
| Kraemer Basin                                         | 31                             | 1,170                                     |
| La Jolla Basin                                        | 6.5                            | 26                                        |
| Lincoln Basin                                         | 10                             | 60                                        |
| Little Warner Basin                                   | 11                             | 225                                       |
| Miller Basin (2)                                      | 25                             | 300                                       |
| Mini-Anaheim Lake                                     | 5                              | 13                                        |
| Off-River Channel: Olive Basin-Carbon Creek Diversion | 42                             | N/A                                       |
| Off-River Channel: Weir Pond 4-Olive Basin            | 47                             | N/A                                       |
| Olive Basin                                           | 5.8                            | 122                                       |
| Placentia Basin (2)                                   | 9                              | 350                                       |
| Raymond Basin (2)                                     | 19                             | 370                                       |
| River View Basin                                      | 3.6                            | 11                                        |
| Santa Ana River: Ball Road - Orangewood Ave.          | 59                             | N/A                                       |
| Santa Ana River: Five Coves Dam-Ball Road             | 74                             | N/A                                       |
| Santa Ana River: Imperial Hwy -Five Coves Dam         | 158                            | N/A                                       |
| Santiago Basins: Bond Basin                           | 86                             | 8,380                                     |
| Santiago Basins: Blue Diamond Basin                   | 79                             | 5,020                                     |
| Santiago Basins: Smith Basin                          | 22                             | 320                                       |
| Santiago Creek: Santiago Basins -Hart Park (3)        | 2.6                            | N/A                                       |
| Warner Basin                                          | 70                             | 2,620                                     |
| Weir Pond 1                                           | 6                              | 28                                        |
| Weir Pond 2                                           | 9                              | 42                                        |
| Weir Pond 3                                           | 14                             | 160                                       |
| Weir Pond 4                                           | 4                              | 22                                        |
| <b>Totals</b>                                         | <b>1,067</b>                   | <b>26,215</b>                             |

Notes:

1. Maximum (Max.) storage capacity is typically not achieved for most facilities due to need to reserve buffer space for system flow and level fluctuations.
2. Owned by Orange County Flood Control District (OCFCD). Max. storage capacity shown is maximum flood control storage.
3. Various owners, including OCFCD, City of Orange, and Metropolitan.

#### 4.1.2.1 Main River System

Water released at the Prado Dam naturally flows downstream and percolates through the river's 300-400 foot wide unlined channel bottom that consists of sandy, permeable sediment. The Main River System consists of approximately 291 acres along a six-mile reach of the Santa Ana River Channel, just west of Imperial Highway to Orangewood Avenue. Downstream of Orangewood Avenue shallow, low-permeability clay layers reduce the ability to recharge river water.

The upstream portion of the Main River System begins at the Imperial Inflatable Dam. The Imperial Inflatable Dam and Bypass Structure is one of the District's key control structures. It allows the District to divert Santa Ana River water from the Main River System into the Off-River System.

The Imperial Inflatable Dam, installed in 1993, is seven feet in diameter and 300 feet long, as shown in Figure 4-4. It is constructed of rubberized fabric that is inflated with air. When the stormflow rate exceeds approximately 1,500 cubic feet per second (cfs), the dam is deflated and only minimal water can be diverted for recharge. During some flow conditions, from 1,000-2,000 cfs, the dam is partially inflated, allowing some diversion for recharge and the remainder of the water to flow over the dam.

**FIGURE 4-4**  
**INFLATABLE DAM ON THE SANTA ANA RIVER**



The pooled water behind the inflated dam flows through the bypass structure on the north side of the river. The bypass structure includes a series of steel gates leading to conduits that divert up to 550 cfs of water into the Off-River System. Water passes through trash racks to keep debris out and then flows into Weir Pond 1.

OCWD maximizes recharge in the Main River System by bulldozing a series of sand levees in the river, as shown in Figure 4-5. These levees allow greater percolation by increasing the residence time of water in the

permeable section of the river and by spreading the water across the width of the river to maximize the wetted surface area. Typically, water flows at a velocity sufficient to prevent the accumulation of fine sediment and biological growth. The riverbed is also cleaned naturally, when winter and spring stormflows wash out the levees and scour the bottom. When necessary, heavy equipment is used to move sediments in order to restore the high percolation rate. Sand levees remain intact until flows exceed approximately 350 cfs, at which time they erode and water flows from bank to bank in the riverbed. Although percolation is believed to remain high during these high flow conditions, rates are difficult to measure.

**FIGURE 4-5**  
**SAND LEVEES IN THE SANTA ANA RIVER**



The Santa Ana River bed percolation rate has been declining by approximately one percent per year for the last 20 years due to the coarsening of the river bed that is a common problem in river beds downstream of dams. This occurs because sand that would naturally flow down the river is trapped behind Prado Dam. The reduction in the amount of sand in the river bed causes sediments to become less conducive to percolation, particularly in the area closest to Imperial Highway.

#### **4.1.2.2 Off-River System**

The Imperial Inflatable Dam and Bypass Structure diverts Santa Ana River water flows from the Main River System into the Off-River System. This system includes four ponds called 'Weir Ponds' and a channel called the 'Off-River recharge basin'. Weir Ponds 1, 2, 3, and 4 are used to remove sediment from the Santa Ana River water diverted at the Imperial Inflatable Dam. The Weir Ponds have a surface storage of approximately 200 acre-feet. At the most downstream Weir Pond, Weir Pond 4, water can flow into the Off-River Recharge Basin, the Huckleberry Basin, or the Warner Bypass Pipeline. The Off-River Recharge Basin consists of a shallow, sandy bottom, 200-foot wide channel that runs parallel to the Main River System for approximately 2.3 miles from the Imperial Inflatable Dam down to the Carbon Creek Diversion Channel. The Off-River Recharge Basin is separated from the Main River System by a levee. Water in the Off-River Recharge Basin can be diverted into Olive Basin, which is located near Tustin Avenue.

#### **4.1.2.3 Deep Basin System**

The Deep Basin System consists of the Warner Basin Sub-system (Foster-Huckleberry, Conrock, Warner, and Little Warner Basins), along with Anaheim Lake, Mini Anaheim, and Miller, Kraemer, La Jolla, Placentia, and Raymond Basins. Up to 400 cfs of water can be diverted into Foster-Huckleberry and then into Conrock and Warner Basins. These recharge basins range in depth from 10 to 60 feet. Portions of their side-walls and bottoms are composed of natural, sandy, permeable materials that allow water to percolate into the aquifer. Percolation rates vary depending on the size and depths of the basins; rates slow significantly as fine-grained sediment particles accumulate on the basin bottoms. Most of the basins in this system can be drained and cleaned with equipment, shown in Figure 4-6, to remove this clogging layer, thereby restoring percolation rates and increasing recharge efficiency.

**FIGURE 4-6**  
**CLEANING OF RECHARGE BASINS**



When the Warner Basin Sub-system is full, flows into the system are reduced to approximately 250 cfs. This maximizes percolation and allows the remainder of the water to be piped to the other downstream basins (Anaheim Lake, Mini Anaheim Lake, Miller, Kraemer, La Jolla, Placentia, and Raymond). Placentia and Raymond basins are owned by Orange County Public Works and can only be used during the non-flood season. Water is conveyed to these two basins using the Carbon Creek Channel.

The Five Coves Inflatable Dam is located on the Santa Ana River approximately three miles downstream of the Imperial Inflatable Dam. It was installed by OCWD in 1994 to divert flows into Five Coves, Lincoln, and Burris Basins. The dam is essentially the same size and construction as Imperial Inflatable Dam. Excess flows above 100 cfs and less than 500 cfs can be diverted at the dam; during storm events, flows over 500 cfs are lost to the ocean beyond this dam.

#### **4.1.2.4 Burris Basin/Santiago System**

The Burris Basin/Santiago System consists of 354 acres of shallow and deep recharge basins. The system begins at the confluence of the Santa Ana River and the Carbon Canyon Diversion Channel and ends at the Santiago Basins in Orange. It consists of Upper Five Coves, Lower Five Coves, Lincoln, Burris (shown in Figure 4-7) and River View Basins, the Santiago Basins (Blue Diamond Basin, Bond Basin, and Smith Basin), and Santiago Creek five miles east of the river.

The Five Coves Inflatable Rubber Dam diverts up to 500 cfs of flow from the Santa Ana River into Upper Five Coves Basin. This water can then flow sequentially into Lower



Five Coves Basin, Lincoln Basin, and Burris Basin. From there, the Burris Basin Pump Station can pump up to 230 cfs of water through the 66-inch diameter Santiago Pipeline to the Santiago Basins and Santiago Creek. Once Burris and the Santiago Basins are full, the flow must be reduced to match the Santiago Basins' percolation rate of approximately 125 cfs.

**FIGURE 4-7  
BURRIS BASIN**



Santiago Creek, a tributary to the Santa Ana River, shown in Figure 4-8, is the primary drainage for the northwest portion of the Santa Ana Mountains. The creek extends from the mountains, through the City of Orange to its confluence with the Santa Ana River in the City of Santa Ana. Two dams along the river impound flows. Santiago Dam, which creates Irvine Lake, is owned by the Irvine Ranch and Serrano Water Districts. Villa Park Dam is

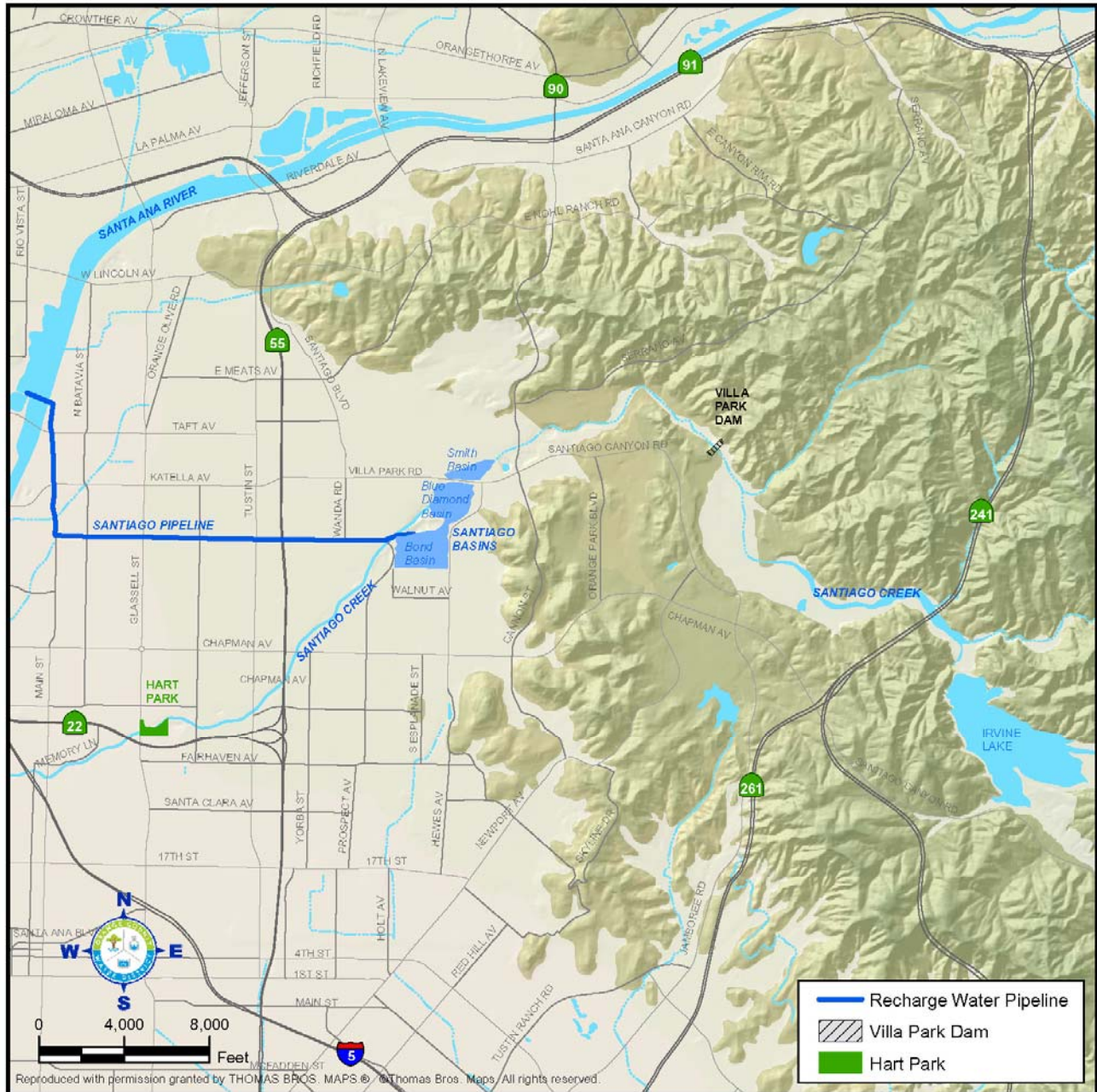
primarily a flood control dam owned and operated by the Orange County Flood Control District.

OCWD's Santiago Basins are located downstream of Villa Park Dam. Here Santiago Creek flows are supplemented by water diverted from the Santa Ana River through the Santiago Pipeline. These former gravel pits recharge up to approximately 125 cfs when full. When the Santiago Basins are full, overflow from the basins flows down the sandy and rocky Santiago Creek bed. Natural percolation through the creek bottom into the groundwater basin occurs until water reaches Hart Park in the City of Orange.

The Santiago Basin Pump Station, completed in 2003, provides greater flexibility in managing recharge operations. Pumps placed in the bottom of Bond Basin move water out of the Santiago Basin into Santiago Creek or back down into the Santiago Pipeline where water can be discharged to the River View Basin or back to Burris Basin. River View Basin is located on the east side of the Santa Ana River adjacent to Burris Basin. Pumping water to and from the Santiago Basins increases the quantity of groundwater recharge and creates capacity in the Santiago Basins for storage of water from winter storms.



FIGURE 4-8  
SANTIAGO CREEK STORAGE AND RECHARGE AREAS



## 4.2 Sources of Recharge Water

Water supplies used to recharge the groundwater basin are listed in Table 4-2.

**TABLE 4-2**  
**SOURCES OF RECHARGE WATER SUPPLIES**

| Water Supply                          |                                                    | Source of Recharge Water Supply                                                                          | Recharge location                                                         |
|---------------------------------------|----------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Santa Ana River                       | Baseflow                                           | Perennial flows from the upper watershed in Santa Ana River; predominately treated wastewater discharges | OCWD recharge basins and the Santa Ana River                              |
|                                       | Stormflow                                          | Precipitation from upper watershed flowing in Santa Ana River through Prado Dam                          | OCWD recharge basins and the Santa Ana River                              |
| Santiago Creek                        |                                                    | Santiago Creek                                                                                           | OCWD recharge basins; natural percolation in Santiago Creek               |
| Natural Recharge                      |                                                    | Precipitation and flows from Orange County foothills                                                     | Throughout the basin                                                      |
| Purified Water                        | Groundwater Replenishment System                   | GWR System treatment facility                                                                            | Injected into Talbert Barrier; Kraemer and Miller basins                  |
|                                       | Water Replenishment District of Southern CA        | Water purified at the Leo J. Vander Lans Treatment Facility                                              | Injected into Alamitos Barrier                                            |
| Imported Water and Supplemental Water | Metropolitan Water (untreated)                     | State Water Project and Colorado River Water                                                             | Various recharge basins                                                   |
|                                       | Metropolitan Water (treated)                       | State Water Project and Colorado River Water through the Diemer Water Treatment Plant                    | Injected into Talbert and Alamitos Barriers                               |
|                                       | Arlington Desalter                                 | Purified water from Arlington Desalter released to Santa Ana River above Prado Dam                       | OCWD recharge basins                                                      |
|                                       | San Bernardino Valley Municipal Water District     | Surplus groundwater released into the Santa Ana River in San Bernardino                                  | OCWD recharge basins                                                      |
|                                       | Western Municipal Water                            | Surplus groundwater released into the Santa Ana River in Riverside                                       | Released into the Santa Ana River above Prado Dam to OCWD recharge basins |
| In Lieu Replenishment Water           | Metropolitan Water District of Southern California | Treated imported water used to replace pumping of groundwater, when available                            | Water is delivered directly to Producers                                  |

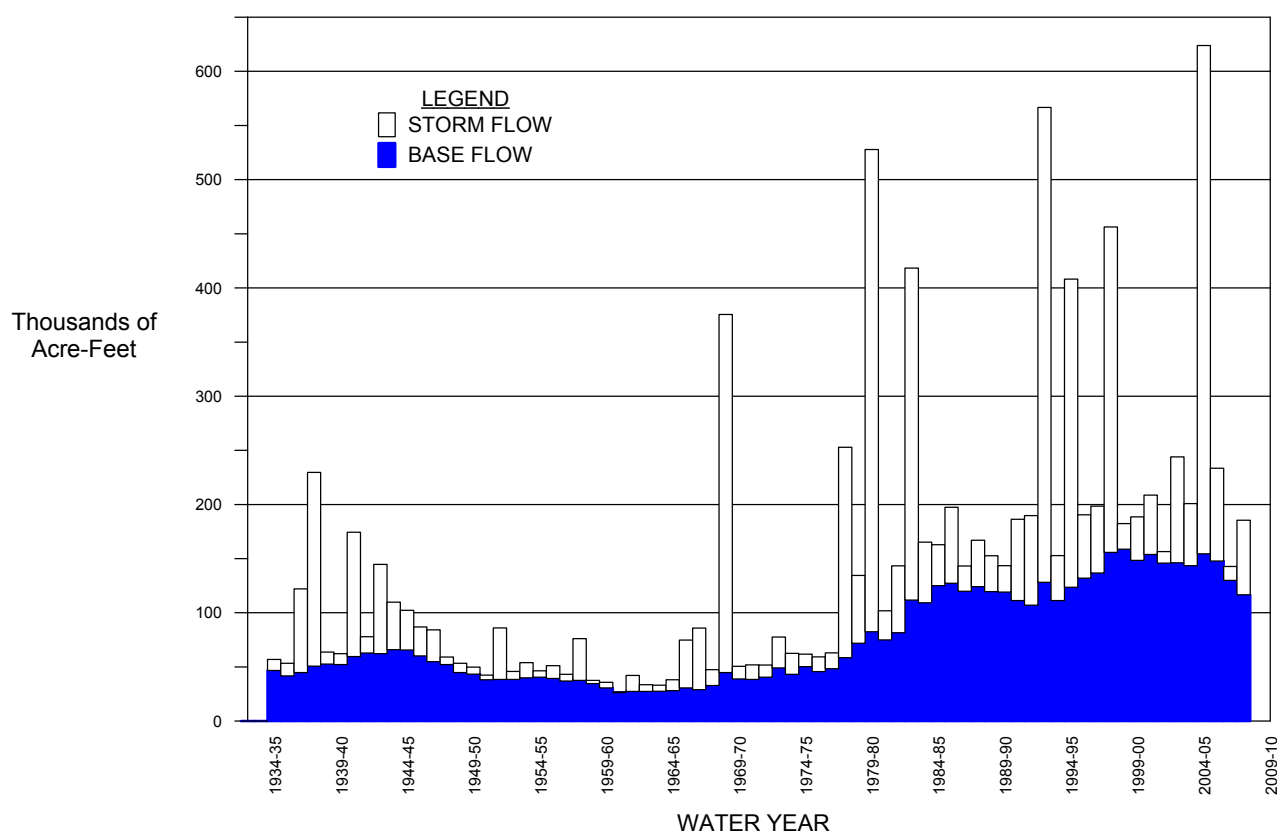
### 4.2.1 Santa Ana River

The primary source of water to recharge the basin is Santa Ana River flows. A large amount of the baseflow water, especially in the summer months, is composed of tertiary-treated wastewater discharges from wastewater treatment facilities upstream of Prado Dam.

OCWD has legal rights to a minimum of 42,000 afy of Santa Ana River baseflow. The minimum amount of Santa Ana River baseflow was established in a legal agreement entered into by OCWD and upstream water agencies in 1969. This agreement is commonly referred to as the '1969 Judgment.'

From the 1970s to the mid-1990s, the rate of Santa Ana River baseflow increased from approximately 50,000 afy to 150,000 afy. This is attributed primarily to population increases in the area above Prado Dam, which resulted in additional treated wastewater discharges from upstream communities. Figure 4-9 illustrates historic baseflow in the Santa Ana River at Prado Dam for the period from water year 1934-35 to 2006-07.

**FIGURE 4-9**  
**SANTA ANA RIVER FLOWS AT PRADO DAM**



Source: Santa Ana River Watermaster 2009

In December 2008, the State Water Resources Control Board (SWRCB) approved the issuance of a permit to OCWD to appropriate 362,000 afy from the Santa Ana River. The SWRCB also agreed to hold an additional 143,000 afy in abeyance for OCWD for possible future projects. This provides an opportunity for OCWD to pursue long-term projects and complete environmental analysis and planning of those projects by 2023. Provided that this is completed by 2023, OCWD can seek the additional rights without the need to restart the water rights application process.

The volume of water recharged into the basin from Santa Ana River stormflows changes yearly due to variations in the amount of precipitation and the timing of precipitation and stormflow. Although stormflows average approximately thirty-three percent of the total Santa Ana River flows, only approximately half of that amount is recharged at OCWD's spreading facilities. This is primarily because the magnitude of stormflow releases from Prado Dam often greatly exceeds the District's diversion and recharge capacity. While the estimated maximum percolation capacity of the recharge basins is 500 cfs, the rate of Santa Ana River stormflow can reach up to 3,000 cfs or more, roughly six times the recharge capacity. The volume of water lost to the ocean can reach 5,000 af/day or more. Although it is common to have some loss to the ocean every year, during wet years losses can be great; in water year 1997-98, the District lost approximately 270,000 af of Santa Ana River stormflows to the ocean.

Figure 4-10 shows the precipitation at San Bernardino, indicating the variation of precipitation from year to year.

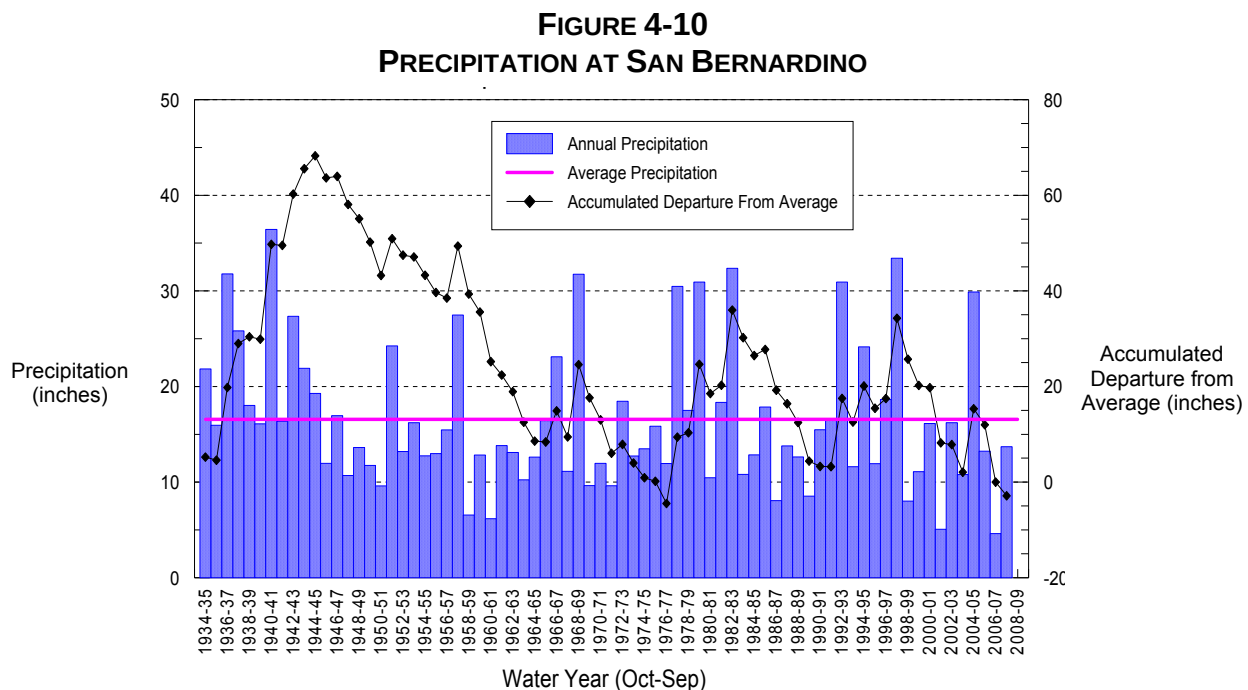
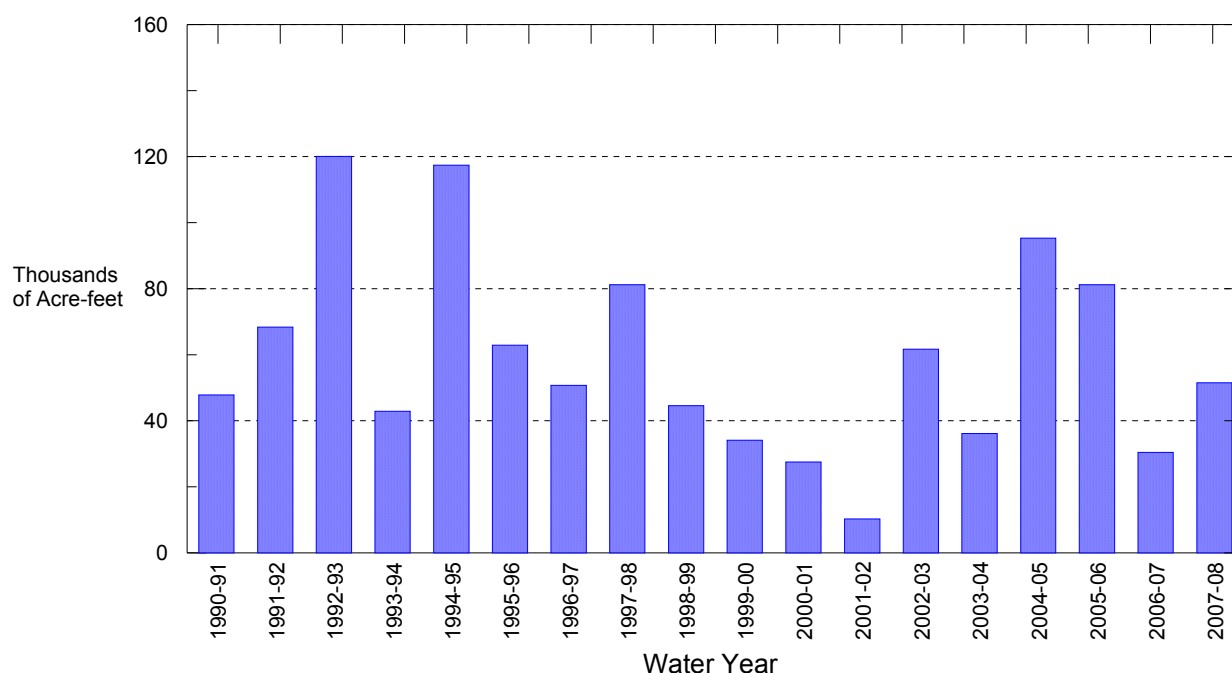


Figure 4-11 shows the amount of Santa Ana River stormflow recharged by the District for the past eighteen years. Based on the data in this figure, an average of 50,000 afy of stormflow has been captured and recharged. Precipitation in the form of snow accumulating in the upper watershed's mountains usually allows for greater recharge as snow melting over time provides a steady baseflow for recharge. Maximizing the capacity to store stormwater at Prado Dam for groundwater recharge also aids OCWD's efforts to maintain good water quality. Stormwater usually has lower total dissolved solids and nitrate concentrations than Santa Ana River baseflow, so blending stormwater with other sources of recharge water improves water quality.

**FIGURE 4-11**  
**STORMFLOW RECHARGED IN THE BASIN**



#### 4.2.2 Santiago Creek

Most of the natural flow of Santiago Creek is captured behind the impoundments described earlier. Water released into the creek flows downstream and recharges into the groundwater basin. Since 2000, OCWD has operated the Santiago Creek Recharge Project. A permit from the SWRCB (permit 19325) allows OCWD to collect and store up to 33,560 afy from Santiago Creek. Using controlled releases into the creek, up to approximately 15 cfs is recharged between the Santiago Basins and Hart Park in the City of Orange. In 2008, OCWD completed a project to grade the channel to smooth out the channel bottom. Over time the creek flows became confined to a relatively small notch in the channel. Removing this low-flow channel allowed water to spread out and cover a larger surface area, which increased the recharge rate.

In 2008-09, three monitoring wells were constructed to assess recharge conditions and water quality along Santiago Creek and the Santiago Basins. These wells will provide important information regarding recharge from the creek and the Santiago Basins.



### 4.2.2.1 Natural Recharge

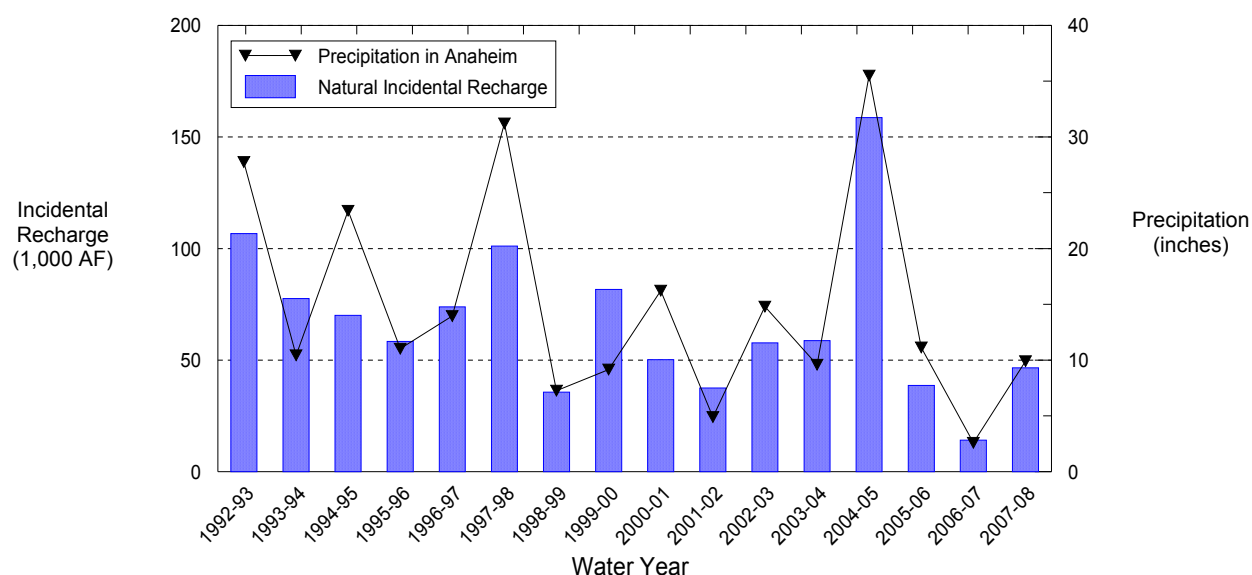
Natural infiltration of recharge, also referred to as incidental recharge, occurs from subsurface inflow from the local hills and mountains, infiltration of precipitation and irrigation water, unmeasured recharge from small flood control channels, and groundwater underflow to and from Los Angeles County and the ocean. Natural incidental recharge occurs outside the District's control.

Net incidental recharge refers to the net amount of incidental recharge that occurs after accounting for subsurface outflow to Los Angeles County. As described in Section 2, an increase in the accumulated overdraft in the basin decreases the estimated amount of outflow to Los Angeles County.

Estimated net incidental recharge and precipitation in Anaheim is shown in Figure 4-12. On average, approximately 60,000 af of net incidental recharge occurs each year. In very wet years such as 2004-2005, the amount of incidental recharge can be 100,000 afy or more.

The increase of impermeable surfaces reduces the amount of natural infiltration. New industrial, commercial, and residential developments may divert storm flows into channels that drain to the ocean instead of percolating into the ground. Decades of development with the emphasis on flood protection have encouraged rapid, efficient removal of stormwater. Concerns about the reduction in natural recharge as well as water quality impacts from landscape irrigation runoff and storm flow have increased interest in low-impact development (LID), the on-site capture and management of runoff. Utilization of LID, such as dry-wells, swales, wetlands, and other engineered systems can lead to an increase the rate of incidental recharge. Increasing infiltration, however, could have negative impacts if percolation of poor quality water would adversely impact the basin's water quality.

**FIGURE 4-12**  
**NET INCIDENTAL RECHARGE**





### 4.2.3 Purified Water

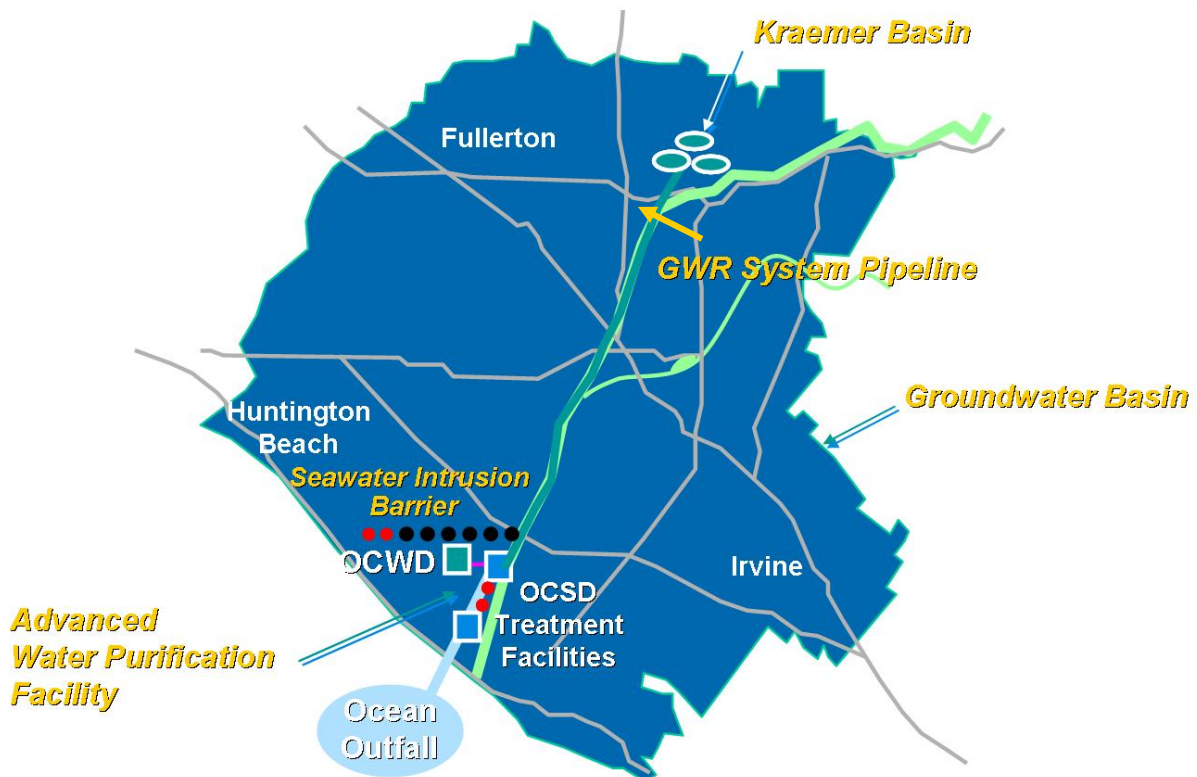
OCWD has been purifying wastewater to recharge the basin since 1975. Water Factory-21 (WF-21), in operation from 1975 to 2004, purified treated wastewater to provide a source for the Talbert Barrier. In 2008, the GWR System replaced WF-21 and began operation to provide water for groundwater recharge in Anaheim as well as for the Talbert seawater intrusion barrier.

#### 4.2.3.1 Groundwater Replenishment System

The GWR System is a joint project of OCWD and the OCSD. The GWR System creates a new source of recharge water that will increase the reliability and sustainability of local groundwater supplies.

The GWR System augments existing groundwater supplies by producing up to 72,000 afy of purified water to recharge the basin and provide a reliable supply of water for the Talbert Seawater Barrier. As shown in Figure 4-13, the GWR System consists of three major components: (1) Advanced Water Treatment (AWT) facilities and pumping stations, (2) a pipeline connection from the treatment facilities to existing recharge basins, and (3) expansion of the Talbert Barrier.

**FIGURE 4-13  
GROUNDWATER REPLENISHMENT SYSTEM MAP**



Secondary-treated effluent from the OCSD Wastewater Reclamation Plant No. 1 in Fountain Valley is pumped to the AWT facilities instead of to the ocean for disposal. The advanced water purification plant purifies the water with microfiltration (MF); reverse osmosis (RO); and advanced oxidation processes (AOP), which consist of ultraviolet (UV) and hydrogen peroxide ( $H_2O_2$ ).

The first step in the tertiary treatment process is MF membrane treatment. MF is a low-pressure membrane process that removes small suspended particles, protozoa, bacteria and some viruses from the water. Sodium hypochlorite, a bleach solution, is added to the MF feedwater to minimize MF membrane fouling.

Next, the MF filtrate is fed to the RO treatment system. Dissolved contaminants and minerals, including dissolved organics, total dissolved solids, silica, and virus, are removed in the RO treatment process.

The water then undergoes UV and  $H_2O_2$  treatments. UV light penetrates the cell walls of microorganisms, preventing replication and inducing cell death. This provides an additional barrier of protection against bacteria and viruses. More importantly, UV with  $H_2O_2$  oxidizes organic compounds. At this point, the product water is so pure that it can not be moved in conventional pipes. Small amounts of minerals are added back into the water so that it is stable in the concrete pipes.

Although the GWR System is capable of producing 72,000 afy of water, the first year of operation actually produced less than 45,000 af of water. Operation of the system is limited by the supply of secondary-treated wastewater from OCSD. OCSD is in the process of constructing a pump station, scheduled to be completed before the end of 2009, which will help provide additional flow into the GWR System. When the pump station becomes operational, District staff expects to operate the GWR System to full capacity.

In addition, OCSD anticipates that construction of an expansion to their secondary treatment processes will be complete in late 2011. With this increase of available supply of wastewater, OCWD plans to expand the GWR System. The initial expansion will be designed to increase production by 17,000 to 20,000 afy of water.

#### **4.2.3.2 Talbert and Alamitos Barriers**

The GWR System is the primary source of water used for injection at the Talbert Barrier. An additional source of water for the barrier is treated potable water purchased from Metropolitan. Water for the Alamitos Barrier is supplied from two sources: imported water from Metropolitan and purified wastewater purchased from the Water Replenishment District of Southern California (WRD) under a joint cost sharing agreement with OCWD, as explained in Section 4.2.4.2.

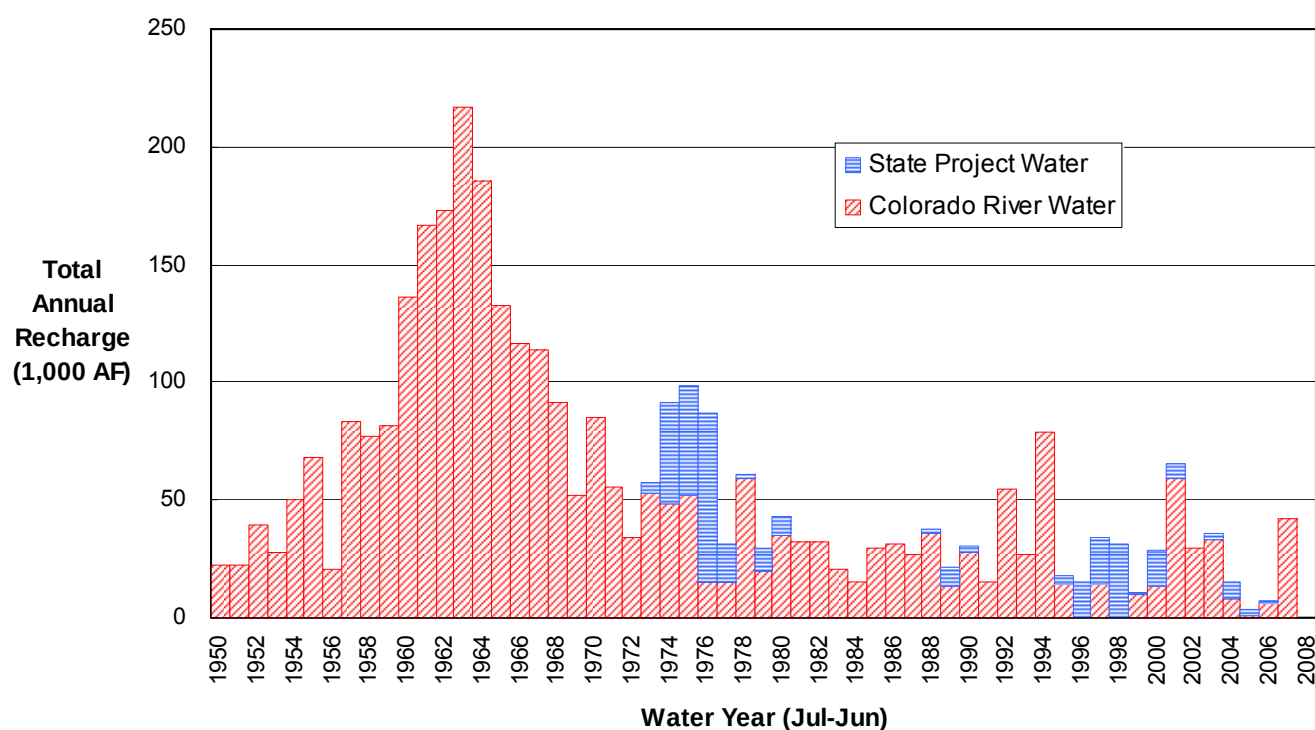
#### **4.2.4 Imported Water**

Water purchased by OCWD for recharge comes from a number of sources. This recharge water is also referred to as replenishment water, supplemental water or imported water. Total annual recharge of imported water from 1937 to 2008 is shown in Figure 4-14.

Metropolitan provides untreated replenishment water to the District when excess supplies are available. These supplemental supplies are an unreliable source of recharge water as they are typically unavailable to purchase during droughts. OCWD receives State Water Project (SWP) water from Northern California at a number of locations. Water released through a connection in Claremont flows down San Antonio Wash to Chino Creek, which drains into the Santa Ana River. Colorado River water can be delivered via the Santa Ana River upstream of OCWD's main recharge basins. A blend of SWP water and Colorado River waters can also be received directly into Anaheim Lake.

The District typically has recharge capacity available to receive this water during the summer/fall months. However, these supplies by nature are more frequently available during the winter season, which is when the District's recharge facilities are being used to capture and recharge Santa Ana River flows. The District can usually take between 50 cfs to 200 cfs (100 - 400 af/day) of direct replenishment water depending upon the operating condition of the recharge facilities.

**FIGURE 4-14**  
**ANNUAL RECHARGE OF IMPORTED WATER FROM METROPOLITAN, 1950-2008**



#### 4.2.4.1 Upper Watershed Imported Water

OCWD has historically entered into agreement with water agencies in the upper watershed to pay for excess upper watershed water that the agencies pump into the Santa Ana River that reaches Prado Dam. This water is captured for recharge in the OCWD facilities. The sources listed here are only available when the supplying water

agency has excess supplies. During times of drought, these sources become less available.

- The Arlington Desalter. When potable consumption does not match the output of the Arlington Desalter in Riverside, the District may purchase the excess water for groundwater recharge.
- The Bunker Hill Basin groundwater pump out project in San Bernardino is a cooperative project with the San Bernardino Valley Municipal Water District. The project was constructed to mitigate the negative impacts of high groundwater levels. Groundwater is pumped from the Bunker Hill Basin into the Santa Ana River.
- Western Municipal Water District provides to OCWD up to 7,000 afy of recharge water when available. This water is discharged into the Santa Ana River and is recharged into the groundwater basin in the District's recharge system.

#### **4.2.4.2 Alamitos Seawater Intrusion Barrier Source Water**

The WRD manages groundwater for nearly four million residents in 43 cities of southern Los Angeles County. The City of Long Beach, under contract with WRD, operates the Leo J. Vander Lans Treatment Facility, an advanced water treatment facility that treats effluent water from the Sanitation District of Los Angeles County using MF, RO, and UV treatment. About 2.7 million gallons of purified water are blended with imported water and pumped into the Alamitos Seawater Barrier.

#### **4.2.4.3 In Lieu Replenishment Water**

When recharge capacity is unavailable, OCWD can also receive replenishment water via an In-lieu program. In-lieu recharge refers to the practice of increasing groundwater storage by providing interruptible potable water supplies to a user who relies on groundwater as a primary supply. This treated potable water is made available to Producers who, in turn, use the supply in place of pumping an equal supply of groundwater. This program is revenue neutral for Producers and helps recharge the groundwater basin in a targeted manner.

### **4.3 Recharge Studies and Evaluations**

The District has an ongoing program to assess enhancements in existing recharge facilities, evaluate new recharge methods, and analyze potential new recharge facilities.

#### **4.3.1 OCWD RECHARGE ENHANCEMENT WORKING GROUP (REWG)**

The REWG is composed of staff from several departments that works to maximize the efficiency of existing recharge facilities and evaluate new concepts to increase recharge capacity. REWG, with staff from recharge operations, hydrogeology, engineering, research and development, regulatory affairs, and the planning departments, meets on a regular basis to review new data and evaluate potential new projects.

Proposed projects, such as reconfiguration of existing basins, operational improvements to increase flexibility in the management of the basins, alternative basin cleaning methods, potential sites for new basins, and control of sediment concentrations, are discussed and prioritized.

#### **4.3.2 COMPUTER MODEL OF RECHARGE FACILITIES**

OCWD is in the process of developing a computer model of the District's recharge system in Anaheim and Orange. The model will simulate Prado Dam operations, Santa Ana River flow, and each recharge facility in order to model how the recharge system operates in conjunction with storage of water behind Prado Dam and flows from the Santa Ana River. This planning tool will be used to evaluate various conditions including estimating recharge benefits if new recharge facilities are constructed, existing facilities are improved, increased storage is achieved at Prado Dam, or baseflow changes occur in the Santa Ana River.

Output from the model will include:

- Amount of water in storage at Prado Dam and storage and recharge rates at each recharge facility;
- Amount of water that could not be recharged and the frequency of water loss to the ocean;
- Optimal amount of cleaning operations; and
- Available (unused) recharge capacity.

The model will be constructed so that it can be operated by District staff from a desktop personal computer using a graphical user interface.

#### **4.4 Improvements to Recharge Facilities**

The District regularly evaluates potential projects to improve the existing recharge facilities and build new facilities. Changes to existing facilities may include:

- improving the ability to transfer water from one recharge basin to another;
- improving the ability to remove the clogging layer that forms on the bottom of the recharge basins;
- removing shallow low-permeability silt or clay layers that occur beneath recharge basins
- improving the shape or configuration of the basin to increase the infiltration rate or ability to clean the basin; and
- converting an existing underperforming recharge basin to a new type of recharge facility.

The District also regularly evaluates building new facilities. This effort includes:

- evaluating existing flood control facilities that could be utilized to increase recharge;

- evaluating potential sites for purchase and subsequent construction of new recharge facilities; and
- evaluating potential dual-use sites, where a subsurface recharge system could be built and remain compatible with the existing use, such as building a subsurface infiltration gallery under a parking lot.

#### **4.4.1 RECHARGE FACILITIES IMPROVEMENTS 2004-2008**

The following projects were completed between 2004 and 2008 by OCWD to improve recharge operations:

##### **La Jolla Basin**

OCWD purchased land along Carbon Creek east of Placentia Basin and west of Kraemer Basin and constructed a new 6-acre recharge basin. Water is diverted from Carbon Creek using a rubber dam. The six-foot deep basin can be easily drained by gravity flow back to Carbon Creek when necessary for maintenance. The basin was placed on line in 2008 and is expected to recharge as much as 9,000 afy.

##### **Olive Basin Intake Structure Improvements**

Prior to acquisition by OCWD, the Olive Basin was mined for sand and gravel. A corrugated metal transfer tube was installed to convey Santa Ana River water into the basin. However, this transfer tube was located mid-way up the side of the basin and the flow discharging into the basin eroded the sidewalls, causing sediment to rapidly clog the basin. Improvements that were completed in 2007 included the installation of a new transfer pipe and concrete box set at the bottom of the basin to allow water to flow into the basin from the bottom.

##### **Mini-Anaheim Recharge Basin Modifications**

Improvements to this small basin made in 2005 increased the efficiency of moving Santa Ana River water into the basin. A new pipeline also was constructed to allow discharge of imported water directly into the basin.

##### **Kraemer-Miller Basins Pipeline Improvements**

An existing 48-inch pipe in Kraemer Basin was replaced due to the potential for pipe failure that would have resulted in damage to adjacent property and a reduction in recharge capacity from loss of ability to fill the basin. An inlet pipe was installed in Miller basin.

##### **Lincoln-Burris Exploratory Wells**

Monitoring wells were constructed to characterize the ability of the natural sediments along the west walls of Lincoln and Burris Basins to percolate water. Data collected were used to support a feasibility study of re-contouring the Burris Basin to allow periodic cleaning of the western side wall in order to increase percolation rates.



### **Warner Basin Dam**

In order to clean Warner Basin, staff would construct an earthen dike to allow the draining of the basin while simultaneously transferring water to Anaheim Lake, Miller Basin, and Kraemer Basin. In 2007, a rubber dam was installed within the finger channel of the Little Warner Basin to eliminate the need to build the earthen dike each time the basin needed cleaning.

### **Santiago Creek Recharge Enhancement**

The recharge capacity of Santiago Creek was increased by grading the creek bed upstream of Hart Park in the City of Orange. Prior to grading, a low-flow channel developed in the channel bottom. Water flow was confined to this low-flow channel, limiting the amount of groundwater recharge. The grading project completed in 2008 created a flat cross-section allowing for flows to spread out over a larger surface area, thereby increasing groundwater recharge.

## **4.5 Potential Projects to Expand Recharge Operations**

The District's *Long-Term Facilities Plan* (2009) contains a list of potential new projects to expand recharge operations. Projects that are included range from those in the conceptual phase to those in the process of construction to improve operations of recharge facilities and to increase the amount of water recharged into the groundwater basin are described in this section.

### **Desilting Improvement Program**

The build up of sediment in recharge basins decreases infiltration rates and increases the need for basin cleanings. Approaches are being evaluated to remove sediment from Santa Ana River water in order to increase the performance of current recharge facilities. A feasibility study identified proposed treatment systems for pilot testing.

### **Mid-Basin Injection**

As the GWR System is expanded an increased supply of recharge water will be available. In order to recharge this supply of water, a mid-basin injection project is being considered. This would involve using high quality GWR System water for direct injection into the Principal aquifer in the central portions of the Basin. By directly injecting water into the Principal aquifer where most of the pumping occurs, low groundwater levels due to pumping can be reduced. Also, mid-basin injection would reduce the recharge requirement in Anaheim and Orange area recharge basins, thus providing more capacity to recharge Santa Ana River water.

### **Santiago Creek Enhanced Recharge**

Two improvements to Santiago Creek in the City of Orange are being considered to enhance recharge capacity. One project consists of cutting a water conveyance channel through a concrete-lined creek channel to deliver a flow of water downstream of Hart Park. The geology in this lower stretch of the creek is being studied to determine if the recharge would be beneficial to the groundwater

basin. The second project would investigate the feasibility of constructing three small new recharge basins adjacent to Santiago Creek.

### **Subsurface Recharge**

The subsurface recharge project would involve constructing horizontal recharge systems beneath areas with existing improvements, such as parks or school athletic fields. These infiltration galleries would allow percolation of recharge water through perforated pipes buried in gravel-filled trenches. Since there is no feasible way to clean the galleries, the source water would come from the GWR System, treated Metropolitan water, or filtered Santa Ana River water.

### **Recharge Basin Rehabilitation**

All of the recharge basins are subject to clogging due to the accumulation of sediments contained in recharge water. To maintain recharge rates, the basins are periodically drained, allowed to dry, and then mechanically cleaned using heavy equipment. This process removes most of the clogging layer but also removes a portion of the underlying layer of clean sand from the basin bottom. Some of the fine-grained clogging material on the basin sides remains while the bottom of the basin progressively deepens. Although cleaning procedures have been improved to minimize the burial of fine-grained clogging material, previous cleaning practices have left an irregular mantle of fine-grained material in the upper one to two feet of some recharge basins. This may be remedied by over-excavating and replacing removed sediments with clean sand.

### **Burris and Lincoln Basins Reconfiguration**

Modifications to Burris and Lincoln Basins will improve recharge capability. Plans include excavating low-permeability sediments from Lincoln Basin and the northern end of Burris Basin, reconfiguring the conveyance of water into Burris Basin, and expanding the size of Lincoln Basin. Also, a pilot transfer well will be drilled to transfer groundwater from the Shallow Aquifer to the Principal Aquifer at the southern end of Burris Basin.

### **Five Coves and Lincoln Basins Bypass Pipeline**

Santa Ana River flows are diverted into the Upper Five Coves Basin by an inflatable dam. Transfer pipes convey surface flows from the Upper Five Coves to the Lower Five Coves Basin. Construction of a pipeline within the Lower and Upper Five Coves, Lincoln, and Burris basins would allow water transfers between the four basins. This would allow the Upper Five Coves, Lower Five Coves, and Lincoln Basins to be isolated and taken out of service to conduct cleaning operations, while maintaining flow of water to Burris and Santiago Basins. In the current system, inflow to Burris Basin has to be terminated to allow cleaning of the other four basins.

### **Santiago Basins Pump Station**

A pump station was constructed to dewater the Santiago Basins to increase storm flow capture and percolation, to make storage available for winter season use, to provide water to the Santiago Creek for percolation, and to increase

operational flexibility by pumping water back to Burris Basin when necessary. Two of the four installed pumps failed to operate so the pump station needs to be redesigned and rebuilt. Reconstructing a pump station for the basins will increase recharge capacity and allow for more flexible and efficient operations.

### **Placentia and Raymond Basins Improvements**

Improvements to Placentia and Raymond Basins that would increase the amount of water recharged in these basins include construction of in-channel diversion structures, modification of inlets to increase flows, installation of submersible pumps, and addition of flow measuring devices, water level sensors, and equipment to remotely control and record water levels and flows.

### **Santiago Basins Intertie**

Constructing a connection between the Bond and Blue Diamond Basins would allow greater flexibility in managing recharge water. Conveyance of water from Blue Diamond Basin to Bond Basin is limited by a dirt berm that separates the two basins. This berm traps approximately 1,500 af of water in Blue Diamond Basin. Improvement would involve either removing a portion of the dirt berm or installing a pipe within the berm between the two basins at the bottom elevation of Blue Diamond Basin.

### **Olive Basin Pump Station**

Improvements to Olive Basin will allow the basin to be drained more rapidly for cleaning. Olive Basin does not have a dewatering pump. An intake structure with a 36-inch diameter fill pipe was constructed to allow water to flow from the Off-River System into the deepest part of the pit. This decreased the amount of sediment stirred up in the basin, thereby increasing the recharge performance. Installation of a pump station and drain pipe will allow for future draining of the basin so that the basin can be cleaned quickly and restored to service.

### **Prado-Recharge Facilities Model**

This project would create a mathematical model of Prado storage, Santa Ana River flow, and each recharge facility. The model would simulate how the recharge system operates in conjunction with Prado storage and the river. It is anticipated that the model would have a time step of one day. The model would allow the evaluation of changes in recharge that would occur if the District were to construct improvements to existing facilities, build new recharge facilities, or achieve increased levels of storage at Prado Dam.

## 5 WATER QUALITY MANAGEMENT

Water quality protection is a basic tenet of OCWD. The District manages the groundwater basin to protect water quality. This section describes the range of programs conducted by OCWD throughout the watershed including:

- Implementing OCWD's Groundwater Protection Policy;
- Participating in water quality management programs in the watershed;
- Managing levels of salinity and nitrate;
- Restoring contaminated water supplies;
- Developing programs to monitor constituents of emerging concern.

### 5.1 Groundwater Quality Protection

The District conducts an extensive program aimed at protecting the quality of the water in the basin. These programs include groundwater monitoring, participating in and supporting voluntary watershed water quality studies and regulatory programs, working with groundwater producers, providing technical assistance, and conducting public education programs.

#### 5.1.1 OCWD GROUNDWATER QUALITY PROTECTION POLICY

OCWD adopted the Groundwater Quality Protection Policy in May 1987, in recognition of the serious threat posed by groundwater contamination; passage was based on the statutory authority granted under Section 2 of the District Act. The objectives of the policy are to:

- Maintain groundwater quality suitable for all existing and potential beneficial uses;
- Prevent degradation of groundwater quality;
- Assist regulatory agencies in identifying the sources of contamination to assure cleanup by the responsible parties;
- Maintain or increase the basin's usable storage capacity; and
- Inform the general public, regulatory agencies and Producers of the condition of the groundwater basin and of water quality problems as they are discovered.

Eight specific programs established to achieve these objectives are:

- Water quality monitoring of surface and groundwater;
- Identification, interim containment, and cleanup of contamination;
- Coordinated operation with regulatory agencies;
- Control of toxic residuals;

- Hazardous waste management planning;
- Dissemination of technical information;
- Public disclosure; and
- Groundwater protection evaluation.

A key component of the policy describes circumstances under which the District will undertake contamination cleanup activities at District expense. This becomes necessary when contamination poses a significant threat and the party responsible for the contamination cannot be identified, is unable to cleanup the contamination, or is unwilling to cleanup the contamination. When appropriate to protect water quality in the basin, OCWD provides financial incentives for Producers to pump and treat groundwater that does not meet drinking water quality standards. These so-called “Basin Equity Assessment (BEA) Exemptions” are explained in Section 5.9.

### **5.1.2 WATER QUALITY TREATMENT GOALS FOR GROUNDWATER PROGRAMS**

OCWD encourages clean up of groundwater to maximize beneficial use of contaminated water in areas with high concentrations of TDS, nitrates, selenium, color, organic compounds, and other constituents exceeding drinking water standards. Treatment goals include:

- State primary and secondary drinking water standards must be met when water is used for potable supplies.
- Treatment for irrigation water shall meet criteria necessary for the intended beneficial use.
- The District shall pursue payment or reimbursement of cleanup costs from the responsible party when contamination originates from a known source.

### **5.1.3 REGULATION AND MANAGEMENT OF CONTAMINANTS**

A variety of federal, state, county and local agencies have jurisdiction over the regulation and management of hazardous substances and the remediation of contamination of groundwater and drinking water supplies. For example, the County of Orange Health Care Agency (OCHCA) regulates leaking underground fuel tanks except in cases where the city is the lead agency.

OCWD does not have regulatory authority to require responsible parties or potential responsible parties to clean up pollutants that have contaminated groundwater. In some cases, the District has pursued legal action against entities that have contaminated the groundwater basin to recover the District’s remediation costs. In other cases, the District coordinates and cooperates with regulatory oversight agencies that investigate sources of contamination and assess the potential threat that the contamination poses to public health and the environment in the Santa Ana River watershed and within the County of Orange. Some of these efforts include:

- Reviewing on-going groundwater cleanup site investigations and commenting on the findings, conclusions, and technical merits of progress reports.
- Providing knowledge and expertise to assess contaminated sites and evaluating the merits of proposed remedial activities.

- Conducting third party groundwater split samples at contaminated sites to assist regulatory agencies in evaluating progress of groundwater cleanup and/or providing confirmation data of the areal extent of contamination.

#### **5.1.4 LAND USE AND DEVELOPMENT**

Protecting groundwater from contamination protects public health and prevents loss of valuable groundwater resources. Managing land use and planning for future development are key management activities essential for protecting water quality and reducing the risk of contamination.

OCWD monitors, reviews, and comments on environmental documents such as Environmental Impact Reports (EIR), Notices of Preparation, proposed zoning changes, and land development projects. District staff also review draft National Pollution Discharge Elimination System (NPDES) and waste discharge permits issued by the Santa Ana Regional Water Quality Control Board (RWQCB). The proposed projects and programs may have elements that could cause short or long term water quality impacts to source water used for groundwater replenishment or have the potential to degrade groundwater resources. Monitoring and reviewing waste discharge permits provides the District with insight on activities in the watershed that could affect water quality.

The majority of the basin's land area is located in a highly urbanized setting and requires tailored water supply protection strategies. Reviewing and commenting on stormwater permits adopted by the RWQCB for the portions of Orange, Riverside, and San Bernardino Counties that are within the Santa Ana River watershed are important. These permits can affect the quality of water in the Santa Ana River and other water bodies, thereby impacting groundwater quality in the basin.

OCWD works with local agencies having oversight responsibilities on the handling, use, and storage of hazardous materials; underground tank permitting; well abandonment programs; septic tank upgrades; and drainage issues. Participating in basin planning activities of the RWQCB and serving on technical advisory committees and task forces related to water quality are also valuable activities to protect water quality.

#### **5.1.5 DRINKING WATER SOURCE ASSESSMENT AND PROTECTION PROGRAM**

To comply with federal Safe Drinking Water Act requirements regarding the protection of drinking water sources, the California Department of Public Health (CDPH) created the Drinking Water Source Assessment and Protection (DWSAP) program. Water suppliers must submit a DWSAP report as part of the drinking water well permitting process and have it approved before providing a new source of water from a new well. OCWD provides technical support to Producers in the preparation of these reports.

This program requires all well owners to prepare a drinking water source assessment and establish a source water protection program for all new wells. The source water program must include: (1) a delineation of the land area to be protected, (2) the identification of all potential sources of contamination to the well, and (3) a description of management strategies aimed at preventing groundwater contamination. Managing land use and planning for future development are key management activities essential



for protecting, preventing, and reducing contaminant risks to future drinking water supplies.

Developing management strategies to prevent, reduce, or eliminate risks of groundwater contamination is one component of the multiple barrier protection of source water. Contingency planning is an essential component of a complete DWSAP and includes developing alternate water supplies for unexpected loss of each drinking water source, by man-made or catastrophic events.

### **5.1.6 WELL CONSTRUCTION POLICIES**

Wells constructed by the District are built to prevent the migration of surface contamination into the subsurface. This is achieved through the placement of annular well seals and surface seals during construction. Also, seals are placed within the borehole annulus between aquifers to minimize the potential for flow between aquifers.

Well construction ordinances adopted and implemented by the OCHCA and municipalities follow state well construction standards established to protect water quality under California Water Code Section 231. To provide guidance and policy recommendations on these ordinances, the County of Orange established the Well Standards Advisory Board in the early 1970s. The five-member appointed Board includes the District's Hydrogeologist. Recommendations of the Board are used by the OCHCA and municipalities to enforce well construction ordinances within their jurisdictions.

### **5.1.7 WELL CLOSURE PROGRAM FOR ABANDONED WELLS**

A well is considered abandoned when either the owner has permanently discontinued its use or it is in such a condition that it can no longer be used for its intended purpose. This often occurs when wells have been forgotten by the owner, were not disclosed to a new property owner, or when the owner is unknown. Past research conducted by OCWD identified approximately 1,400 abandoned wells which were not properly closed. Many of these wells may not be able to be properly closed due to overlying structures, landscaping, or pavement. Some of them may pose a threat to water quality because they can be conduits for contaminant movement as well as physical hazards to humans and/or animals.

OCWD supports and encourages efforts to properly close abandoned wells. As part of routine monitoring of the groundwater basin, OCWD will investigate on a case-by-case basis any location where data suggests that an abandoned well may be present and may be threatening water quality. When an abandoned well is found to be a significant threat to the quality of groundwater, OCWD will work with the well owner to properly close the well.

The City of Anaheim has a well destruction policy and has an annual budget to destroy one or two wells per year. The funds are used when an abandoned well is determined to be a public nuisance or needs to be destroyed to allow development of the site. The city's well permit program requires all well owners to destroy their wells when they are no longer needed. When grant funding becomes available, the city uses the funds to

destroy wells where a responsible party has not been determined and where the well was previously owned by a defunct water consortium.

## **5.2 Salinity Management**

Increasing salinity is a significant water quality problem in many parts of the southwestern United States and Southern California, including Orange County. Elevated salinity levels can contaminate groundwater supplies, constrain implementation of water recycling projects and cause other negative economic impacts such as the need for increased water treatment by residential, industrial, commercial users, and water utilities. Often a component of salinity, elevated levels of nitrates pose a risk to human health.

### **5.2.1 SOURCES OF SALINITY**

Salinity is a measure of the dissolved minerals in water. Also referred to as salts or TDS, salinity is measured in the laboratory by evaporating a known volume of water to dryness and measuring the remaining salts.

Dissolved minerals are composed of positively charged cations and negatively charged anions. Principal cations include sodium, calcium, potassium, and magnesium. Key anions are chloride, sulfate, carbonate, and bicarbonate. Water's hardness, related to TDS, refers to the measure of divalent metallic cations, principally calcium and magnesium.

High salinity and hardness limit the beneficial uses of water for domestic, industrial, and agricultural applications. Hard water causes scale formation in boilers, pipes, and heat-exchange equipment as well as soap scum and an increase in detergent use. This can result in the need to replace plumbing and appliances and require increased water treatment. Some industrial processes, such as computer microchip manufacturers, must have low TDS in the process water and often must treat the municipal supply prior to use. High salinity water may reduce plant growth and crop yield, and clog drip irrigation lines.

In coastal areas, seawater intrusion can be a major source of increased salinity in groundwater. Other identified sources of coastal groundwater salinity include connate water (water trapped in the pores of the sediment at the time the sediments were deposited) and brines disposed from past oil production.

### **5.2.2 REGULATION OF SALINITY**

TDS is regulated by the EPA and the CDPH as a constituent that affects the aesthetic quality of water – notably, taste. The recommended secondary MCLs for key constituents comprising TDS are listed in Table 5-1.

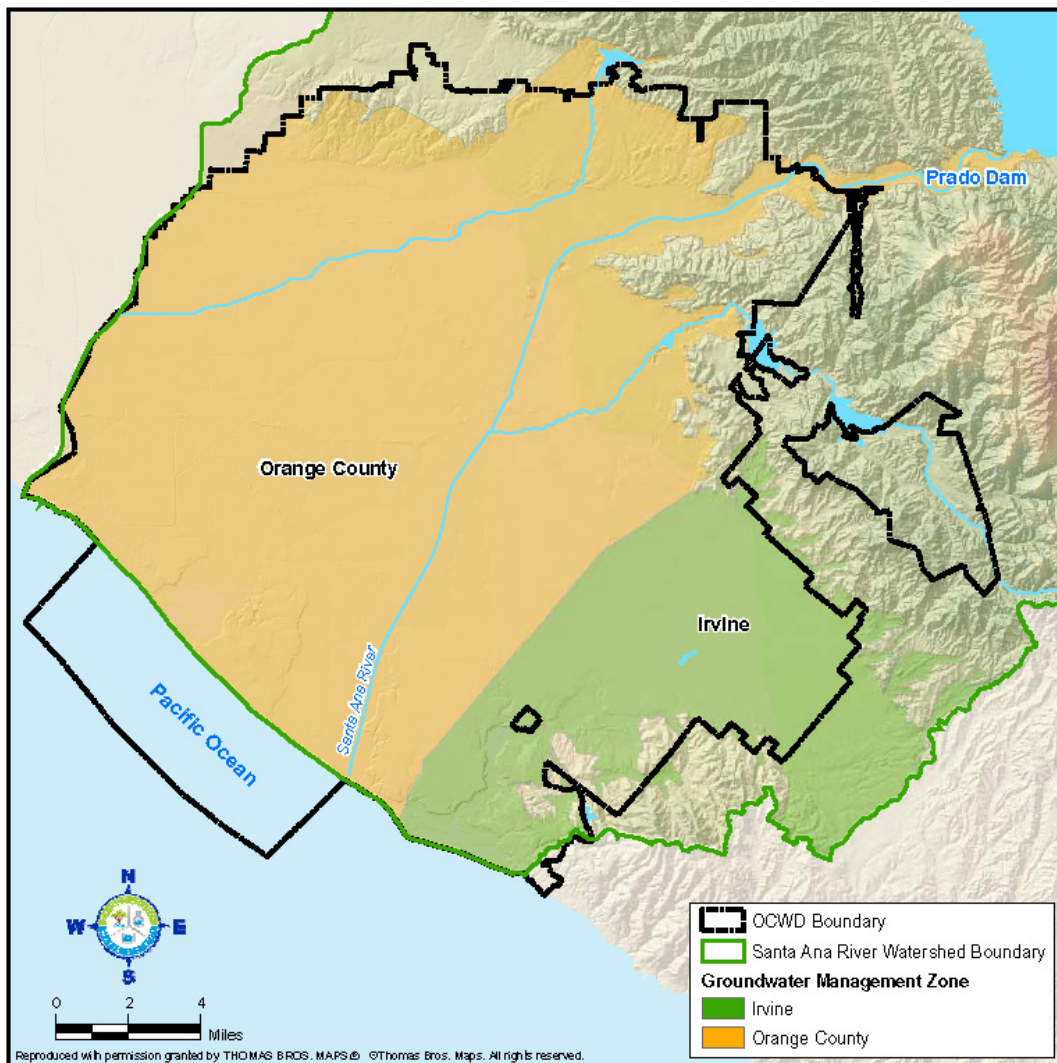
At the state level, TDS levels in groundwater are managed by the SWRCB which delegates this authority to the regional boards. The Santa Ana RWQCB salinity management program was developed with extensive stakeholder input. The Santa Ana Watershed is divided into management zones and allowable TDS levels are determined

for each of those zones. The Orange County groundwater basin is divided into two management zones as shown in Figure 5-1.

**TABLE 5-1**  
**SECONDARY DRINKING WATER STANDARDS FOR SELECTED CONSTITUENTS**

| Constituent                    | Recommended Secondary MCL, mg/L |
|--------------------------------|---------------------------------|
| Total Dissolved Solids (salts) | 500                             |
| Chloride                       | 250                             |
| Sulfate                        | 250                             |

**FIGURE 5-1**  
**Groundwater Management Zones**



To set the allowable levels of TDS for each management zone, historical ambient or baseline conditions were determined. These were used by the RWQCB to set ‘Water Quality Objectives’ for each management zone, which were officially adopted as part of the Water Quality Control Plan for the Santa Ana River Basin, also referred to as “the Basin Plan.” The levels of TDS in each groundwater management zone are measured periodically and compared to the adopted objectives.

When a newly determined ambient level is equal to or greater than the established objective, that management zone does not have an “assimilative capacity.” This means that the quality of the groundwater in that zone is determined to be incapable of successfully assimilating increased loads of TDS without degrading the water quality. Conversely, when an updated ambient level is lower than the established objective, that management zone has an assimilative capacity and is determined to be capable of receiving modest inputs of TDS without exceeding the Water Quality Objective.

The Water Quality Objectives and ambient quality levels for the two Orange County management zones are shown in Table 5-2. Comparing the ambient water quality to the TDS objectives indicates that neither one of these zones have assimilative capacity for TDS.

**TABLE 5-2**  
**TDS WATER QUALITY OBJECTIVES FOR LOWER SANTA ANA RIVER**  
**BASIN MANAGEMENT ZONES**

| Management Zone | Water Quality Objective (mg/L) | Ambient Quality (mg/L) |
|-----------------|--------------------------------|------------------------|
| Orange County   | 580                            | 590                    |
| Irvine          | 910                            | 920                    |

(Wildermuth, 2008)

### 5.2.3 SALINITY IN THE GROUNDWATER BASIN

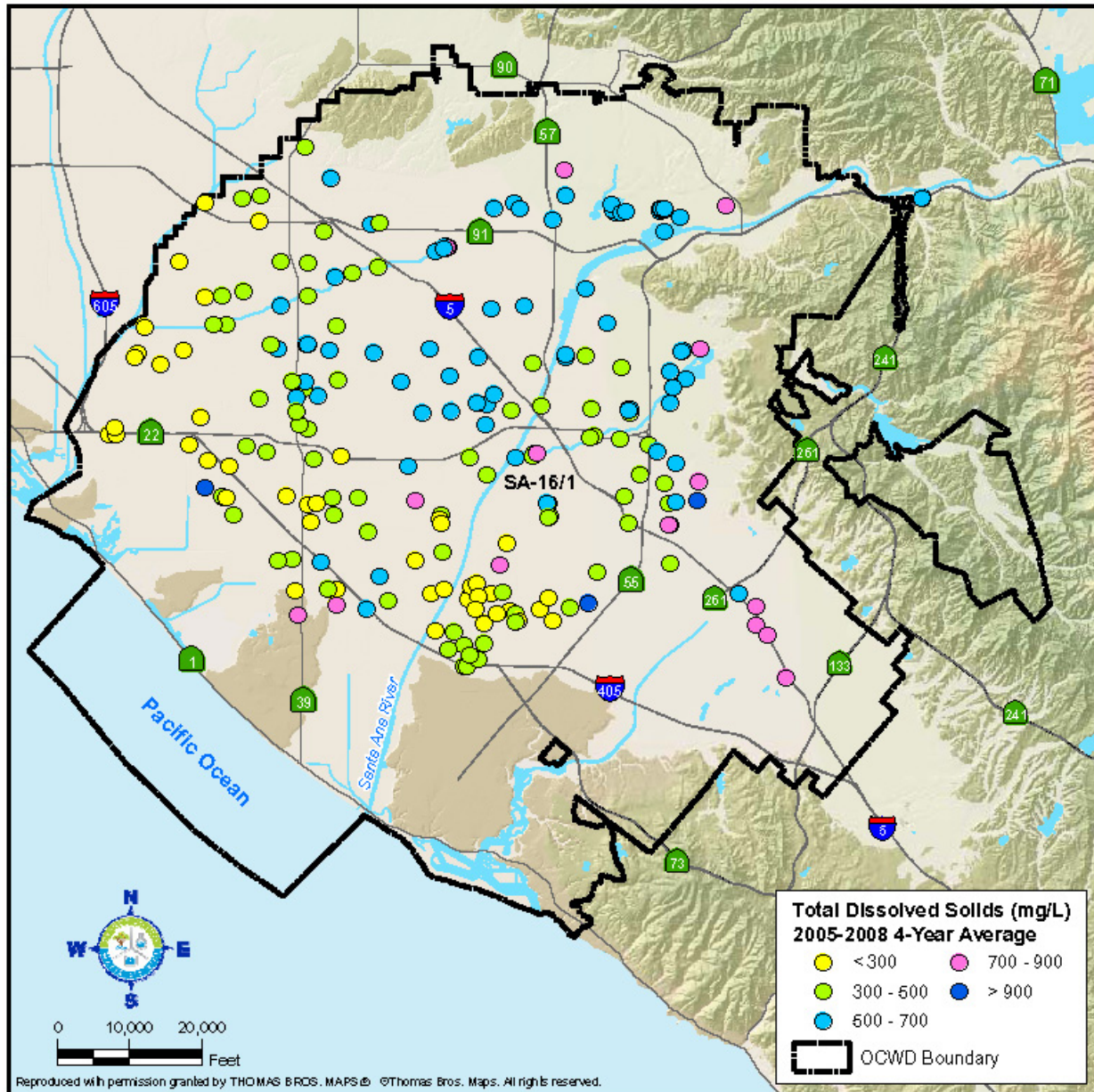
As explained in Section 3, OCWD monitors the levels of TDS in wells throughout the groundwater basin. Figure 5-2 shows the average TDS at production wells in the basin for the period of 2004 to 2008. In general, the portions of the basin with the highest TDS levels are located in areas of Irvine, Tustin, Yorba Linda, Anaheim and Fullerton. In addition, there is a broad area in the middle portion of the basin where the TDS generally ranges from 500 to 700 mg/L. Localized areas near the coast, where water production does not occur, contain relatively higher TDS concentrations.

Managing salinity levels in the basin and in recharge water is an important objective for the District. As explained in Section 4, water that recharges the Orange County groundwater basin includes:

- Santa Ana River baseflow and stormflow,
- Groundwater Replenishment System water, and
- Incidental recharge, including precipitation and irrigation return flows.



**FIGURE 5-2**  
**TDS IN GROUNDWATER PRODUCTION WELLS**



Understanding the sources of salt and measuring the concentrations of TDS in each of the recharge sources is an important aspect in managing salinity. Table 5-3 presents the estimated salt inflows for the basin using average recharge volumes.

The inflows used here are the same as those used in calculating the basin water budget as explained in Section 2.3 and displayed in Table 2-2. TDS concentrations for the inflows were based on flow and water quality data collected by the District and the USGS. The Talbert injection barrier was calculated with the assumption that barrier water is from the GWR System and the Alamitos injection barrier was calculated using

the assumption that injection water is a 50:50 blend of recycled water and imported water.

The flow-weighted TDS of local incidental recharge of 1,100 mg/L was calculated using estimates of the TDS concentration of each component listed in Table 2-2. For subsurface inflow and recharge from the foothills, the TDS concentration was estimated using data from the closest nearby wells.

As shown in Table 5-3, the District estimates that the flow-weighted average inflow TDS concentration is 536 mg/L. It is important to note that the TDS concentration of GWR System water is 60 mg/L. OCWD anticipates that over time the use of GWR System water for Talbert Barrier operations and groundwater recharge will have a positive impact on the salt balance of the groundwater basin.

**TABLE 5-3  
SALT INFLOWS FOR ORANGE COUNTY AND IRVINE MANAGEMENT ZONES**

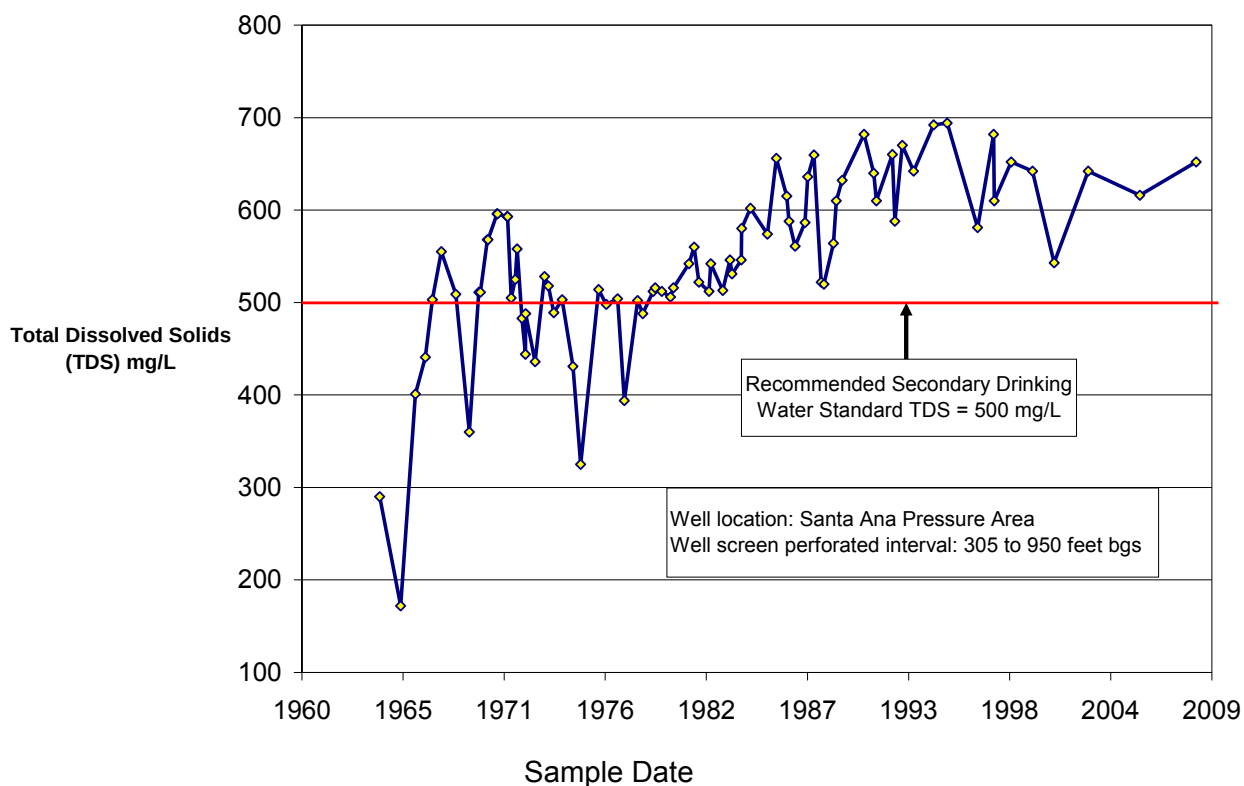
|                                         | <b>Inflow<br/>(afy)</b> | <b>TDS<br/>(mg/L)</b> | <b>Salt<br/>(tons/yr)</b> |
|-----------------------------------------|-------------------------|-----------------------|---------------------------|
| Recharged SAR Baseflow                  | 148,000                 | 620                   | 125,000                   |
| Recharged SAR Stormflow                 | 50,000                  | 200                   | 14,000                    |
| GWR System water recharge in<br>Anaheim | 37,000                  | 60                    | 3,000                     |
| Unmeasured Recharge (Incidental)        | 69,000                  | 1,100                 | 104,000                   |
| Injection Barriers                      |                         |                       |                           |
| Talbert                                 | 35,000                  | 60                    | 2,900                     |
| Alamitos                                | 2,500                   | 350                   | 1,200                     |
| Total:                                  | 341,500                 | 536*                  | 250,100                   |

\* Flow weighted

Figure 5-3 illustrates TDS concentrations through time at a well in Santa Ana. The location of well SA-16 is shown on Figure 5-2. The TDS concentration at well SA-16 increased from approximately 200 to 300 mg/L in the mid-1960s to approximately 600 mg/L by the mid-1980s. From the mid-1980s to 2008, the TDS concentration varied between 500 to 700 mg/L.



**FIGURE 5-3**  
**TDS IN A POTABLE SUPPLY WELL (SA-16/1)**



#### 5.2.4 ECONOMIC IMPACTS OF INCREASING SALINITY

Increasing salinity of water supplies directly impacts consumer costs. A technical investigation of salinity impacts on water supplies of Southern California was published in 1999 by the United States Department of Interior, U.S. Bureau of Reclamation and the Metropolitan Water District of Southern California. The *Salinity Management Study* assessed economic impacts of salinity increases in Colorado River water and State Water Project water. The model was developed to account for regional differences in water deliveries, demographics, TDS concentrations, and average water use per household or by agriculture or industry.

The study estimated a regional economic benefit of \$95 million per year (calculated in 1998 dollars) for a 100 mg/L decrease in imported water supply TDS in the Metropolitan region. Conversely, a 100 mg/L increase in TDS would increase consumer costs by \$95 million annually as shown in Figure 5-4. Approximately \$18 million annually would be realized in cost savings for groundwater supplies. Residential cost savings were estimated at \$35 million per year. Figure 5-5 shows \$64 million of benefits if most local groundwater (about 90 percent) and wastewater (about 80 percent) were to experience a 100 mg/L decrease in salinity.

FIGURE 5-4

**ANNUAL ECONOMIC BENEFITS OF 100 MG/L SALINITY DECREASE IMPORTED WATER SUPPLIES**

Source: MWD and Bureau of Reclamation Salinity Management Study (1999)

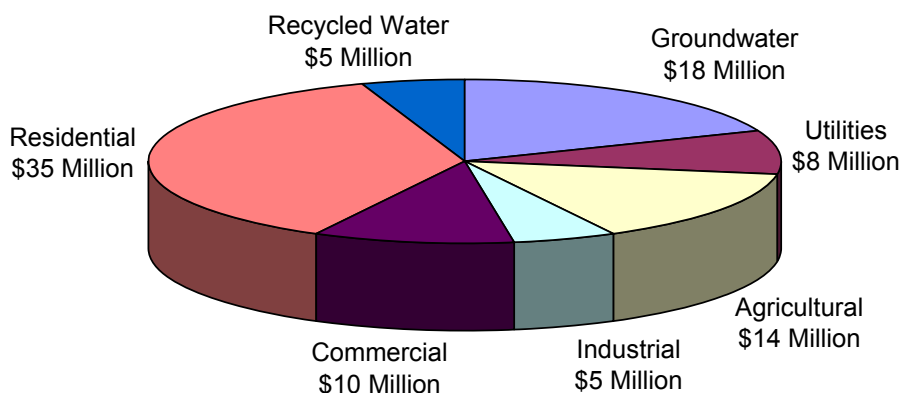
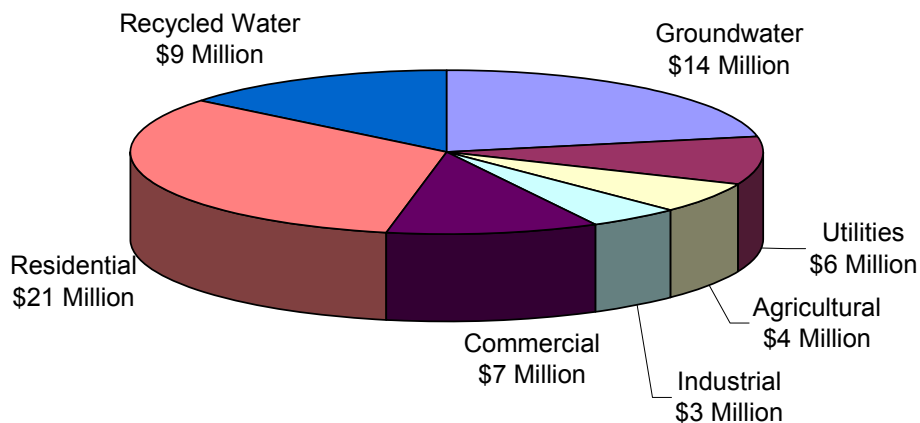


FIGURE 5-5

**ANNUAL ECONOMIC BENEFITS OF 100 MG/L SALINITY DECREASE GROUNDWATER AND WASTEWATER**



Source: MWD and Bureau of Reclamation Salinity Management Study (1999)

Table 5-4 summarizes the economic benefits to water users from salinity reduction. Cost savings include reduced need to construct desalting facilities and greater compliance of wastewater discharges with permit requirements. Residential consumer cost savings would be realized in longer lifespan for appliances and plumbing as well as the reduced need for water softening devices.

**TABLE 5-4**  
**SUMMARY OF ECONOMIC BENEFITS OF REDUCED SALINITY**

| User           | Economic Benefit                                                 |
|----------------|------------------------------------------------------------------|
| Residential    | Increased life of plumbing system and appliances                 |
|                | Reduced use of bottled water and water softeners                 |
| Commercial     | Decreased cost of water softening                                |
|                | Decreased use of water for cooling                               |
|                | Increased equipment service life                                 |
| Industrial     | Decreased cost of water treatment                                |
|                | Decreased water usage                                            |
|                | Decreased sewer fees                                             |
| Agricultural   | Increased crop yield                                             |
|                | Decreased water usage for leaching purposes                      |
| Utilities      | Increased life of treatment facilities and pipelines             |
| Groundwater    | Improved wastewater discharge requirements for permit compliance |
|                | Decreased desalination and brine disposal costs                  |
| Recycled Water | Decreased use of imported water for salt management              |
|                | Decreased desalination and brine disposal costs                  |

MWD/USBR 1999 Salinity Management Study

### 5.2.5 SALINITY MANAGEMENT PROJECTS IN THE UPPER WATERSHED

The District has a long-standing commitment to management of salinity in groundwater supplies, avoiding the loss of water supplies due to increased salinity, and developing projects to reduce salinity are District priorities. Since the Santa Ana River is the primary source of recharge water for the basin, salt management programs in the upper watershed are vital to protect the water quality in Orange County; success in this regard requires participation and cooperation of upper Santa Ana watershed stakeholders.

Several desalters, which are water treatment plants designed to remove salts, have been built in Riverside and San Bernardino Counties. These plants are effectively reducing the amount of salt buildup in the watershed. The Santa Ana Regional Interceptor (SARI), built by the Santa Ana Watershed Project Authority (SAWPA), began operation in 1975 to remove salt from the watershed by transporting industrial wastewater and brine produced by desalter operations directly to the OCSD for treatment. Approximately 75,000 tons of salt were removed by the SARI line in FY 2006-07.

The other “brine line” in the upper watershed, the Non-reclaimable Waste Line in the Chino Basin operated by the Inland Empire Utilities Agency (IEUA), segregates high TDS industrial wastewater.

### **5.2.6 OCWD SALINITY MANAGEMENT AND REMEDIATION PROGRAMS**

Within Orange County, operations of the GWR System and several local and regional groundwater desalters are working to reduce salt levels.

The GWR System, described in Section 4.2, purifies wastewater that is used for groundwater recharge and for injection into the Talbert Barrier to prevent seawater intrusion. The GWR System provides a dependable supply of low salinity water, whose quantity and quality will not be impacted by future drought conditions. The GWR System is expected to reduce the basin salt load by approximately 48,000 tons/year, based on the difference between recharging 72,000 afy of GWR System water at 60 mg/L and an equal amount of imported blended Colorado River and SPW water at 550 mg/L.

High salinity groundwater areas located in Tustin and Irvine are being treated through the operation of desalter plants; these projects are described in Section 5.8.

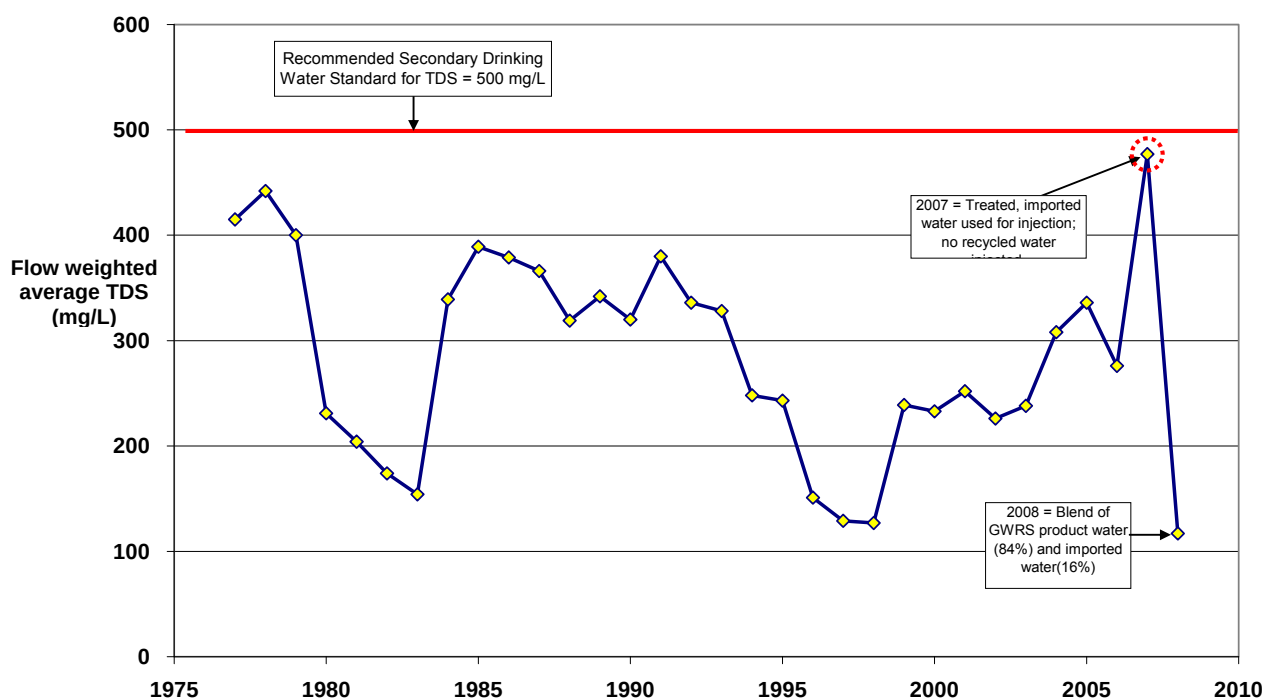
### **5.2.7 SEAWATER INTRUSION BARRIERS**

OCWD’s Talbert Barrier is composed of a series of injection wells that span the 2.5-mile-wide Talbert Gap between the Newport and Huntington mesas (see Figure 3-9). From 1975 until 2004, a blend of purified water from OCWD’s WF-21, deep aquifer water, and imported potable water was injected into the barrier. The Talbert Barrier wells were used to inject an average of 12 mgd of water into four aquifer zones to form a hydraulic barrier to seawater that would otherwise migrate inland toward areas of groundwater production.

The GWR System began operations in January 2008 to better control seawater intrusion as well as to recharge the coastal aquifers. Twelve new wells enable injection of up to 35 mgd of purified water into the expanded injection barrier.

Figure 5-6 shows the total flow-weighted average of TDS levels of the Talbert Barrier Injection Water. Prior to 2004, injection water was a blend of imported water, WF-21 purified water, and deep aquifer water. During the time that WF-21 was decommissioned and the GWR System was in construction, a blend of imported water, potable water, and deep aquifer water was injected into the barrier. In 2007, only treated, imported water was used resulting in a flow weighted average TDS of Talbert Barrier injection water of 477 mg/L. With 84 percent of injection water supplied by the GWR System, the flow weighted average for 2008 dropped to 117 mg/L.

**FIGURE 5-6**  
**TALBERT BARRIER INJECTION WATER - TOTAL DISSOLVED SOLIDS (TDS)**  
**Total Flow Weighted Average TDS of All Source Waters**



The Alamitos seawater intrusion barrier is composed of a series of injection wells that span the Los Angeles/Orange County line in the Seal Beach-Long Beach area. It is operated by the LACDPW in cooperation with OCWD and the WRD. The source of this water is a blend of purified water from WRD and potable supplies from Metropolitan.

### 5.3 Nitrate Management

Nitrate is one of the most common and widespread contaminants in groundwater supplies. OCWD conducts an extensive program to protect the basin from nitrate contamination. The District regularly monitors nitrate levels in groundwater, operates 465 acres of wetlands in the Prado Basin to remove nitrates in Santa Ana River water, and works with Producers to treat individual wells when nitrate levels exceed safe levels.

#### 5.3.1 SOURCES OF NITRATES

Nitrogen is an element essential for plant growth; in the environment it naturally converts to nitrate. Nitrate is a nitrogen-oxygen ion ( $\text{NO}_3^-$ ) that is very soluble and mobile in water. Elevated levels of nitrate in soil and water supplies originate from fertilizer use, animal feedlots, wastewater disposal systems, and other sources. Plants and bacteria break down nitrate but excess amounts can leach into groundwater; once in the groundwater, nitrate can remain relatively stable for years.

The primary concern for human health is not nitrate but its conversion to nitrite ( $\text{NO}_2^-$ ) in the body. Nitrite oxidizes iron in the hemoglobin of red blood cells to form methemoglobin, depriving the blood of oxygen. This is hazardous to infants as they do not yet have enzymes in their blood to counteract this process. They can suffer oxygen deficiency called methemoglobinemia, commonly known as “blue baby syndrome” named for its most noticeable symptom of bluish skin coloring.

### 5.3.2 REGULATION OF NITRATE

Both federal and state agencies regulate nitrate levels in water. The EPA and CDPH set the MCL in drinking water at 10 mg/L for nitrate-nitrogen. The Santa Ana Watershed is divided into management zones with nitrate-nitrogen water quality objectives set for each of those zones. These levels are determined after considering historical ambient or baseline conditions. Water quality objectives and ambient quality levels for Orange County’s management zones are shown in Table 5-5. The main Orange County basin has a minor amount of assimilative capacity but the Irvine subbasin has none. Efforts to reduce nitrate levels in the Irvine subbasin are described in Section 5.8.

**TABLE 5-5**  
**NITRATE-NITROGEN WATER QUALITY OBJECTIVE FOR LOWER SANTA ANA RIVER**  
**BASIN MANAGEMENT ZONES**

| Management Zone | Water Quality Objective | Ambient Quality |
|-----------------|-------------------------|-----------------|
| Orange County   | 3.4 mg/L                | 3.0 mg/L        |
| Irvine          | 5.9 mg/L                | 6.5 mg/L        |

Source: Recomputation of Ambient Water Quality for the Period 1987 to 2006 prepared by Wildermuth Environmental, August 2008.

### 5.3.3 OCWD NITRATE MANAGEMENT AND REMEDIATION PROGRAMS

One of the District’s programs to reduce nitrate levels in the groundwater basin is managing the nitrate concentration of water recharged by the District’s facilities. This includes managing the quality of surface water flowing to Orange County through Prado Dam. As explained in Section 4, the primary source of recharge water for the groundwater basin is the Santa Ana River. To reduce the level of nitrate entering Orange County from the Santa Ana River, OCWD operates an extensive system of wetlands in the Prado Basin as shown in Figure 4-3.

OCWD diverts river flows through a 465-acre system of constructed wetlands, shown in Figure 5-7, where nitrates are naturally removed from the water. The wetlands provide a natural treatment system that removes approximately 15 to 40 tons of nitrates a month depending on the season. The wetlands are more effective from May through October when the water temperatures are warmer. During summer months the wetlands reduce nitrate from nearly 10 mg/L to 1 to 2 mg/L. In 2004-05, the wetlands were damaged by flooding. The wetlands were reconstructed and placed back in service in 2008.

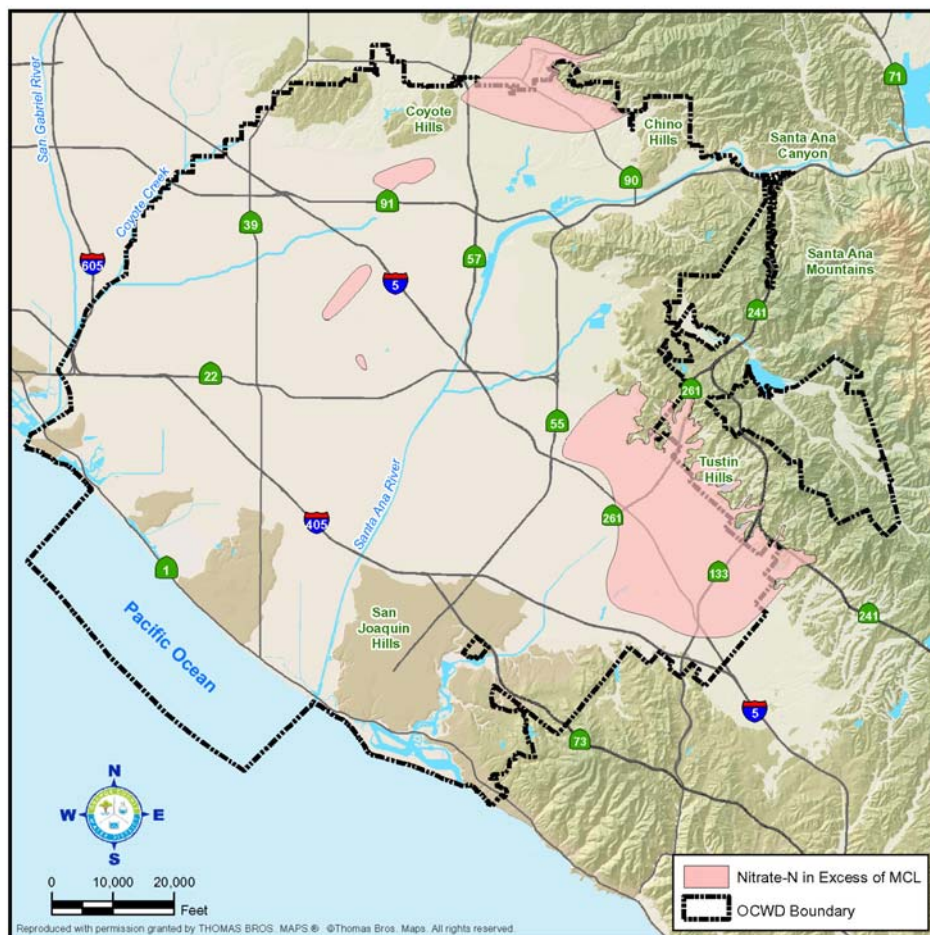


All production wells are tested annually for nitrate; wells with concentrations equal to or greater than 50 percent of the MCL are monitored on a quarterly basis. Areas where nitrate concentrations exceed the MCL are shown in Figure 5-8.

**FIGURE 5-7  
PRADO WETLANDS**

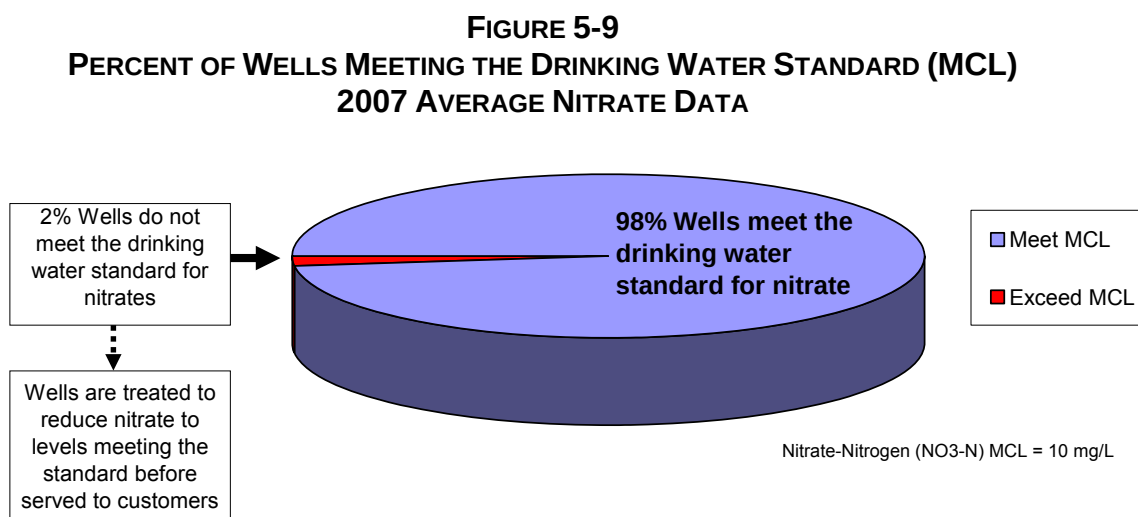


**FIGURE 5-8  
AREAS WITH ELEVATED NITRATE LEVELS**



Within Orange County, nitrate-nitrogen levels in groundwater generally range from 4 to 7 mg/L in the Forebay area and from 1 to 4 mg/L in the Pressure area. Ninety-eight percent of the drinking water wells meet drinking water standards for nitrate-nitrogen as shown in Figure 5-9. The two percent above MCL are treated to reduce nitrate levels prior to being served to customers. Areas in the basin where nitrate levels exceed the MCL are suspected to be impacted by historical fertilizer use.

OCWD works with the Producers to address areas of high nitrate levels. The Tustin Main Street Treatment Plant, described in Section 5.8, is an example of such an effort.



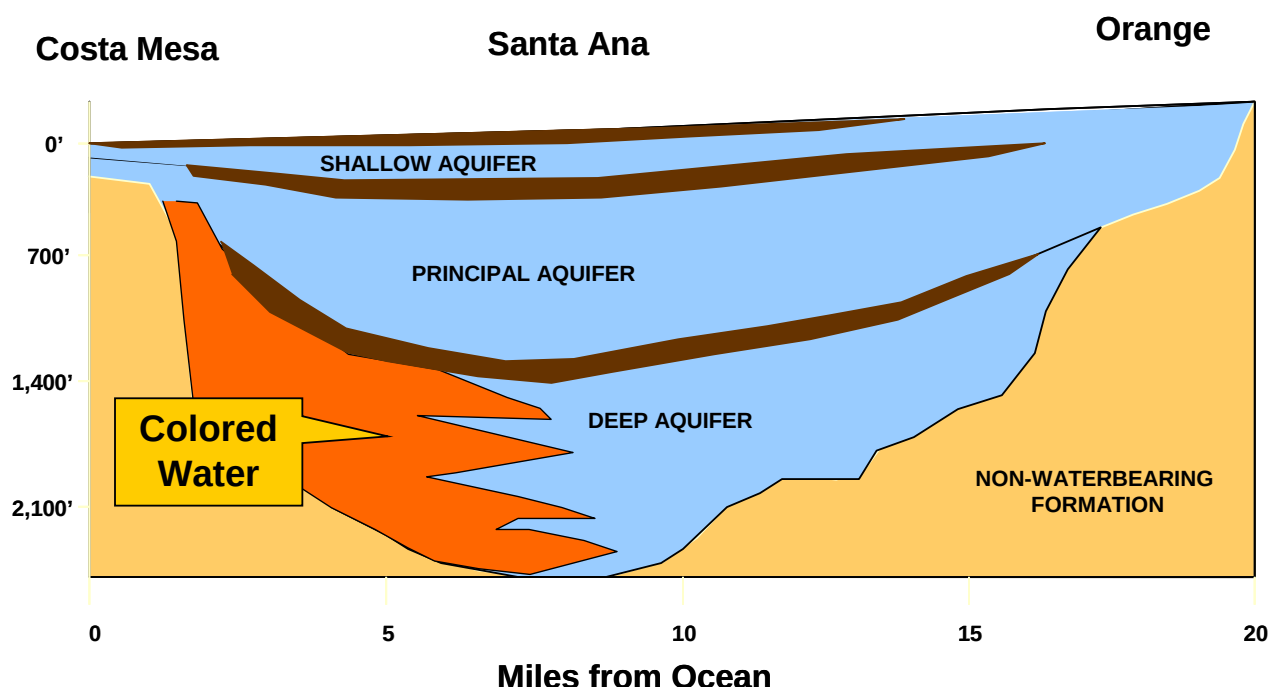
## 5.4 Colored Groundwater Management

This section discusses the occurrence of colored groundwater, the challenges of developing colored water sources, and production processes used to treat colored water.

### 5.4.1 OCCURRENCE OF COLORED WATER IN THE BASIN

Colored water is found in deep aquifers (600-2000 feet) over a broad region in the Lower Main aquifer, as shown in Figures 5-10 and 5-11. Natural organic material from ancient redwood forests and peat bogs gives the water an amber tint and a sulfur odor. Although colored water is of very high quality, negative aesthetic qualities, its color and odor, require treatment before use as drinking water.

**FIGURE 5-10**  
**CROSS-SECTION OF AQUIFERS SHOWING COLORED WATER AREAS**

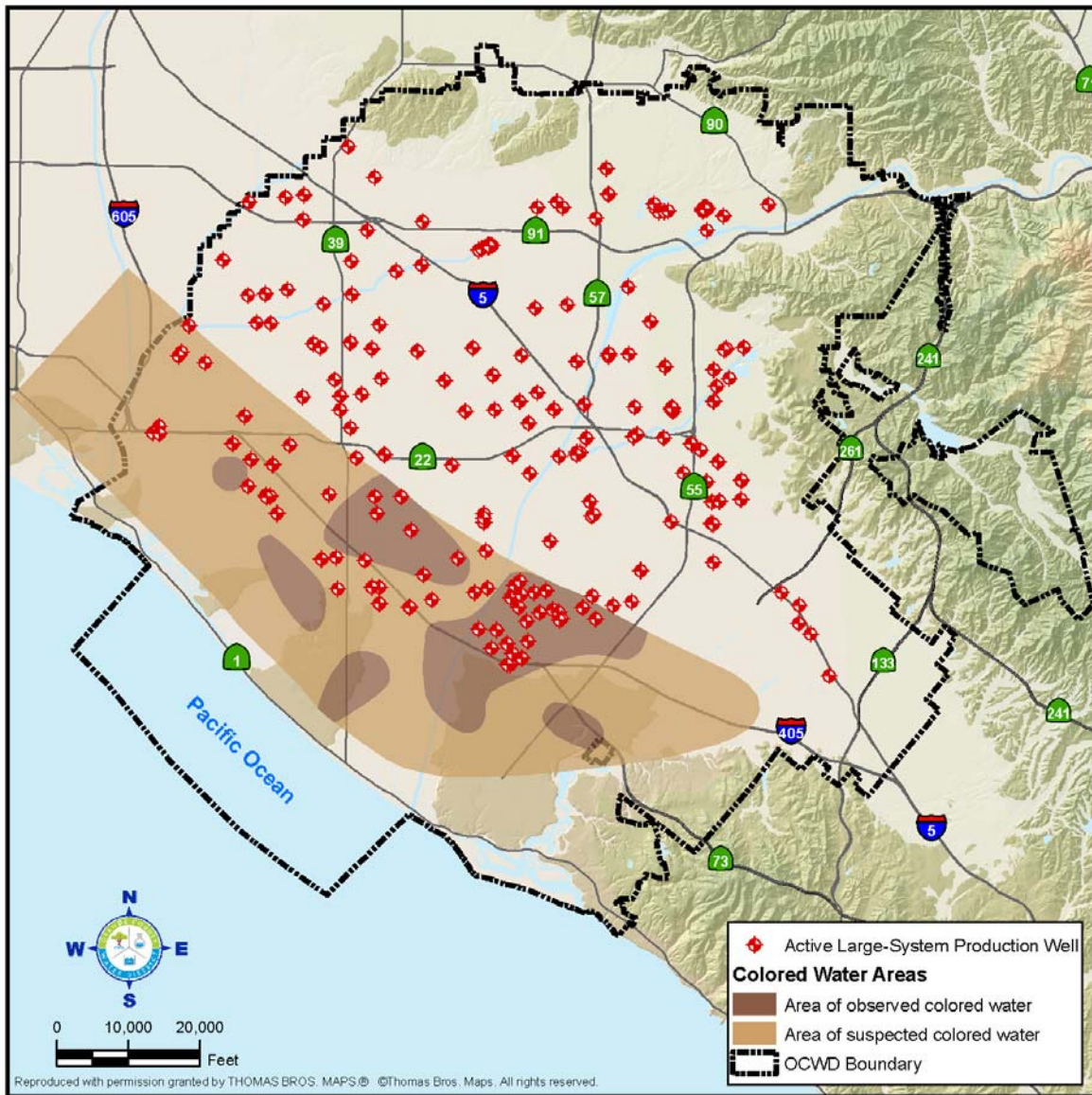


The total amount of colored groundwater is estimated to be over one million acre feet, perhaps as much as several million acre feet. Economic constraints pose challenges to developing colored water supplies as the water needs to be treated to remove the color and odor. Costs depend on the water quality (color and other parameters) and the type and extent of required treatment.

An additional factor that must be considered is the impact of water levels in the clear zone compared to water levels in the deeper aquifers with colored water. Monitoring wells reveal a correlation of clear/colored zone water level fluctuations, indicating a fairly strong hydrologic connection between the two zones in some areas of the basin. Three facilities currently treat colored groundwater in Orange County. Mesa Consolidated Water District (MCWD) has operated an ozone oxidation treatment facility since 1985 at its Well No. 4 site. In 2001, MCWD opened its Colored Water Treatment Facility (CWTF) using ozone treatment to produce 4,000 gallons per minute. The third facility is the Deep Aquifer Treatment System (DATS), a treatment facility using nano-filtration membranes operated by IRWD since 2002. This facility purifies 7.4 mgd of colored water.



FIGURE 5-11  
EXTENT OF COLORED WATER



## 5.5 Synthetic Organic Contaminants

Ninety-five percent of the basin's groundwater used for drinking water supplies is pumped from the main aquifer. Water from this aquifer continues to be of high quality. This section describes areas of the basin that are experiencing contamination threats, most of which occur in the shallow aquifer.

### 5.5.1 METHYL TERTIARY BUTYL ETHER (MTBE)

During the 1980s, gasoline hydrocarbons of greatest risk to drinking water were benzene, toluene, ethylbenzene, and xylenes, collectively known as BTEX chemicals.

Although leaking underground fuel tanks were identified throughout the basin, these chemicals typically were degraded by naturally-occurring microbes that allowed clean up by natural attenuation or passive bioremediation.

Unfortunately, a new additive to gasoline aimed at reducing air pollution has become a widespread contaminant in groundwater supplies. Methyl tertiary butyl ether (MTBE) is a synthetic, organic chemical that was added to gasoline to increase octane ratings during the phase-out of leaded gasoline. In the mid-1990s, the percentage of MTBE added to gasoline increased significantly to reduce air emissions. MTBE is a serious threat to groundwater quality; it sorbs weakly to soil and does not readily biodegrade. The greatest source of contamination comes from releases from underground fuel tanks.

The State of California banned the use of the additive in 2004 in response to its widespread detection in groundwater throughout the state. The CDPH set the primary MCL for MTBE in drinking water at 13 µg/L. The secondary MCL for MTBE is 5 µg/L.

Drinking water wells in the basin are tested annually for VOC analytes including MTBE. The District continues to work with local water agencies to monitor for MTBE and other fuel-related contaminants to identify areas that may have potential underground storage tank problems and releases resulting in groundwater contamination.

### **5.5.2 VOLATILE ORGANIC COMPOUNDS**

VOCs in groundwater come from a number of sources. From the late 1950s through early 1980s, VOCs were used for industrial degreasing in metals and electronics manufacturing. Other common sources include paint thinners and dry cleaning solvents.

VOC contamination is found in several locations in the basin. In 1985, a contamination site was discovered beneath the former El Toro MCAS. Monitoring wells at the El Toro site installed by the U.S. Navy and OCWD delineated a one-mile wide by three-mile long VOC plume, comprised primarily of trichloroethylene (TCE). Beneath the former Air Station, VOC contamination was primarily found in the shallow groundwater up to 150 feet below the ground surface. Off-base, to the west, the VOC plume is in deeper aquifers from 200 to 600 feet deep.

Another VOC contamination site was found in portions of the shallow aquifer in the northern portion of the Orange County in the cities of Fullerton and Anaheim. Although not directly used for drinking water supplies, groundwater in the shallow aquifer eventually flows into the deeper principal aquifer, which is used for potable water supplies. To date, two city of Fullerton production wells have been removed from service and destroyed due to VOC contamination in that area. Currently, there are no production wells in that area that extract water from the shallow aquifer. The North Basin Groundwater Protection Project, described in Section 5.8, was initiated in 2005 to clean up the groundwater in this portion of the basin.

Elevated concentrations of perchloroethylene (PCE), TCE, and perchlorate were detected in IRWD's well No. 3, located in Santa Ana. OCWD is currently working with the Regional Board and the California Department of Toxic Substances Control to require aggressive cleanup actions at nearby sites that are potential sources of the

contamination. OCWD has initiated the South Basin Groundwater Protection Project described in Section 5.8 to address this contamination.

### 5.5.3 N-NITROSODIMETHYLAMINE (NDMA)

NDMA is a low molecular weight compound that can form in influent water entering wastewater treatment plants and after chlorine disinfection of wastewater. It is also found in food products such as cured meat, fish, beer, milk, and tobacco smoke. OCWD is monitoring NDMA levels in the groundwater basin. The California Notification Level for NDMA is 10 nanograms per liter (ng/L). The concentration of NDMA is typically less than 2 ng/L in the Santa Ana River at Imperial Highway. At OCWD's GWR System in Fountain Valley, NDMA concentrations are maintained below California's Notification Level through a combination of source control measures, reverse osmosis treatment, and advanced oxidation treatment using ultraviolet light and hydrogen peroxide.

### 5.5.4 1,4-DIOXANE

A suspected human carcinogen, 1,4-dioxane, is used as a solvent in various industrial processes such as the manufacture of adhesive products and membranes and may occur in consumer products such as detergents, cosmetics, pharmaceuticals, and food products.

In 2002, OCWD detected elevated levels of 1,4-dioxane in nine production wells exceeding the California Action Level. These wells were temporarily shutdown with a loss of 34 mgd of water supply. Further investigation traced the contaminant to one industrial discharger that was discharging 1,4-dioxane into wastewater collected by OCSD. This discharge was affecting water that was treated by WF-21 and injected into the Talbert Seawater Barrier. The discharger voluntarily ceased discharge of 1,4-dioxane and concentrations declined. Additional monitoring data showed low concentrations, the CDPH determined that the water was not a significant risk to health, and the wells were returned to service.

## 5.6 *Perchlorate*

Perchlorate has been detected at wells distributed over a large area of the groundwater basin. Based on data from 217 active production wells over the last three years and a detection limit of 2.5 micrograms per liter, perchlorate was not detected at 83 percent of the wells. Seventeen percent of the wells had detectable concentrations of perchlorate. For those wells with detectable amounts of perchlorate, 89 percent of the wells have detected perchlorate concentrations below the California primary drinking water standard of 6 micrograms per liter. Four of the 217 active production wells had perchlorate concentrations greater than 6 micrograms per liter. It is important to note that water delivered for municipal purposes meets the primary drinking water standard. Groundwater from production wells that have perchlorate concentrations over the primary drinking water standard is treated to reduce the perchlorate concentration below the primary drinking water standard prior to delivery for municipal usage.

Sources of perchlorate in the groundwater basin may include:

- Fertilizer application;



- Water imported from the Colorado River (through the use of Colorado River water for groundwater recharge, irrigation, or water supplies that impact the groundwater basin through onsite wastewater disposal systems);
- Industrial or military sites that used, disposed of, or stored perchlorate. Perchlorate has historically been used as an ingredient in rocket propellant, explosives, fireworks, and road flares; and
- Naturally occurring perchlorate (e.g., perchlorate in rainfall).

The occurrence of perchlorate in Chilean fertilizer applied for agricultural purposes has been documented in various studies (see for example, the discussion in the December 1, 2006 publication of the journal *Analytical Chemistry* (Foubister, 2006); see also Urbansky et al (2001)).

The occurrence of perchlorate in historic supplies of Colorado River water has been documented in published studies (see for example, the report published by the National Research Council in 2005 titled “Health Implications of Perchlorate Ingestion” (National Research Council, 2006); see also Urbansky et al (2001)). Due to source remediation efforts near Henderson, Nevada, the concentration of perchlorate in Colorado River water has decreased (Nevada Division of Environmental Protection, 2009).

Perchlorate has been detected in groundwater at various sites in California in association with industrial or military sites (Interstate Technology & Regulatory Council, 2005). Perchlorate has been detected in rainfall (see for example, the report published by the Interstate Technology & Regulatory Council, 2005 and Dasgupta et al (2005)).

The District’s ongoing monitoring program is continuing to assess the distribution of perchlorate in the groundwater basin and how concentrations change through time. The District regularly reviews this information and will continue to work with the stakeholders to address this issue.

## **5.7 Constituents of Emerging Concern**

Constituents of emerging concern are synthetic or naturally occurring substances (chemicals and microorganisms) that are not regulated but may have negative impacts on the environment and/or human health. The newest group of constituents of emerging concern includes pharmaceuticals, personal care products, and endocrine disruptors.

Pharmaceuticals and personal care products (PPCPs) include thousands of chemicals contained in consumer and health related products such as drugs (prescription and over-the-counter), food supplements, fragrances, sun-screen agents, deodorants, flavoring agents, insect repellants, and inert ingredients. Important classes of high use prescription drugs include antibiotics, hormones, beta-blockers (blood pressure medicine), analgesics (pain-killers), steroids, antiepileptic, sedatives, and lipid regulators.

Endocrine Disrupting Compounds (EDCs) are compounds that can disrupt the endocrine system. They can occur in a wide variety of products such as pesticides and pharmaceuticals. Research investigations have documented that EDCs can interfere with the normal function of hormones that affect growth and reproduction in animals and

humans. Findings of secondary sex changes, poor hatching, decreased fertility, and altered behavior have been observed in fish following exposure to EDCs.

In general, these substances have been identified as a pollution threat or were previously detected in the environment. As new laboratory methods are developed, substances can be detected at much lower concentrations. When such detection occurs before regulatory limits are established and potential human health effects are still unknown, water suppliers and health officials face new challenges. In some cases, public awareness and concern is high because the compounds are detected but scientific-based information on potential health impacts of such low concentrations is not available.

Water quality concerns arise from the widespread use of PPCPs and EDCs. In most cases, the impacts on human health from exposure to low concentrations of these substances are not known. European studies in the 1990s confirmed the presence of some of these chemicals in the less than one microgram per liter range (ppb) in surface waters and groundwater and at low concentrations in wastewater treatment plant effluents.

A USGS report found detectable concentrations of hormones and PPCPs in many vulnerable waterways throughout the United States (Kolpin 2002). Due to the potential impact of EDCs on future water reclamation projects, the District prioritizes monitoring of these chemicals.

OCWD's state-certified laboratory is one of a few in the state that has a program to continuously develop capabilities to analyze for new compounds. Recognizing that the state CDPH has limited resources to focus on methods development, OCWD works on developing low detection levels for chemicals likely to be targeted for future regulation or monitoring.

OCWD advocates the following general principles as water suppliers and regulators develop programs to protect public health and the environment from adverse effects of these emerging contaminants:

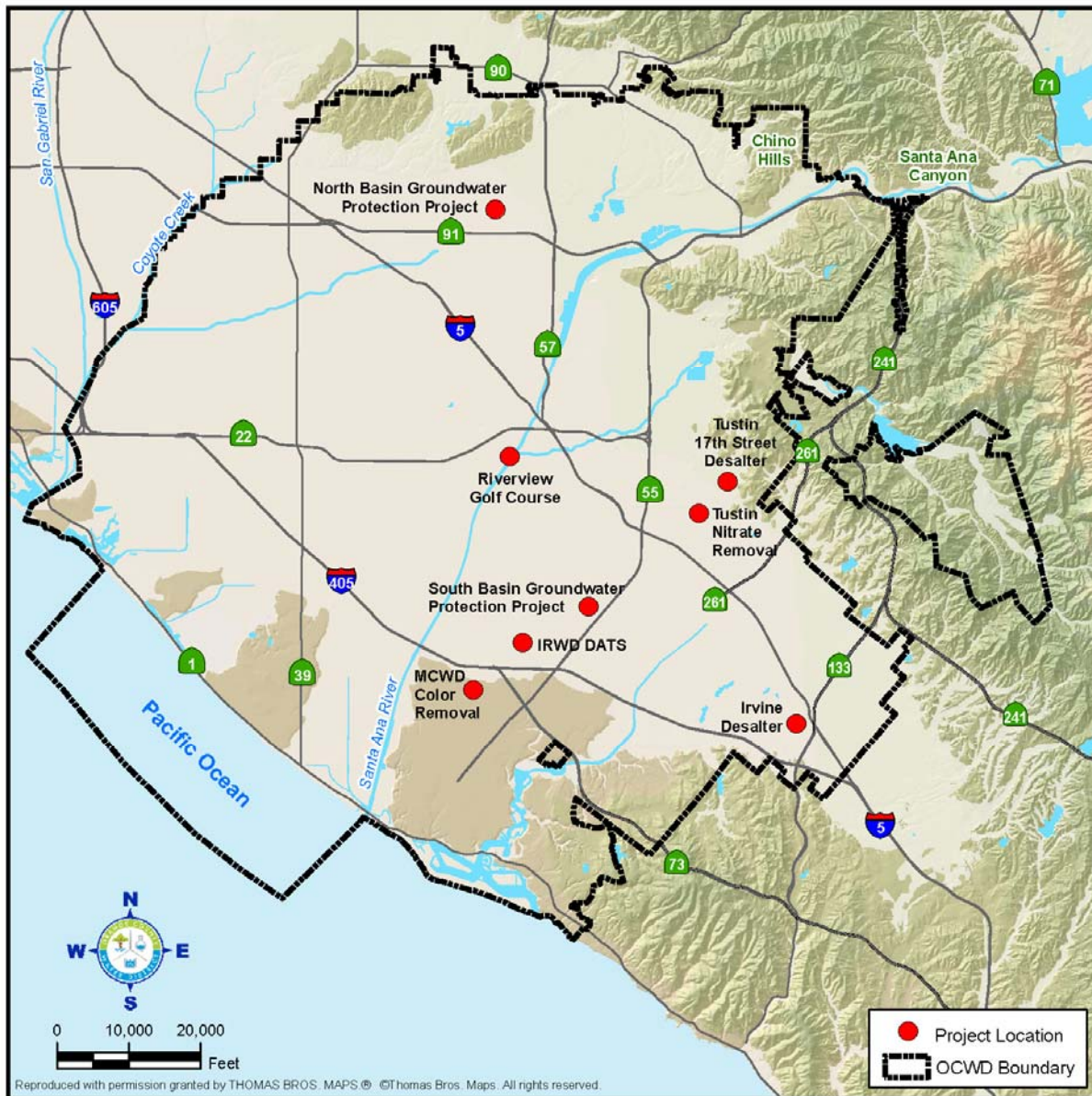
- Monitoring should focus on constituents that pose the greatest risk.
- Constituents that are prevalent, persistent in the environment, and may occur in unsafe concentrations should be prioritized.
- Analytical methods to detect these constituents should be approved by the state or federal government.
- Studies to evaluate the potential risk to human health and the environment should be funded by the state or federal government.
- The state and federal government should encourage programs to educate the public on waste minimization and proper disposal of unused pharmaceuticals.

OCWD is committed to (1) track new compounds of concern; (2) research chemical occurrence and treatment; (3) communicate closely with CDPH on prioritizing investigation and guidance; (4) coordinate with OCSD, upper watershed wastewater dischargers, and regulatory agencies to identify sources and reduce contaminant releases; and (5) inform the Producers on emerging issues.

### 5.8 Groundwater Quality Improvement Projects

This section describes specific projects that improve groundwater quality by removing TDS, nitrate, VOCs and other constituents as shown in Figure 5-12. Two water quality improvement projects discussed in the 2004 *Groundwater Management Plan* are no longer in operation. The Fullerton Iron and Manganese Removal Project was determined to be ineffective due to well capacity limitations. The Orange TCE project operated only on a temporary basis and has been permanently shut down.

**FIGURE 5-12**  
**WATER QUALITY IMPROVEMENT PROJECTS**

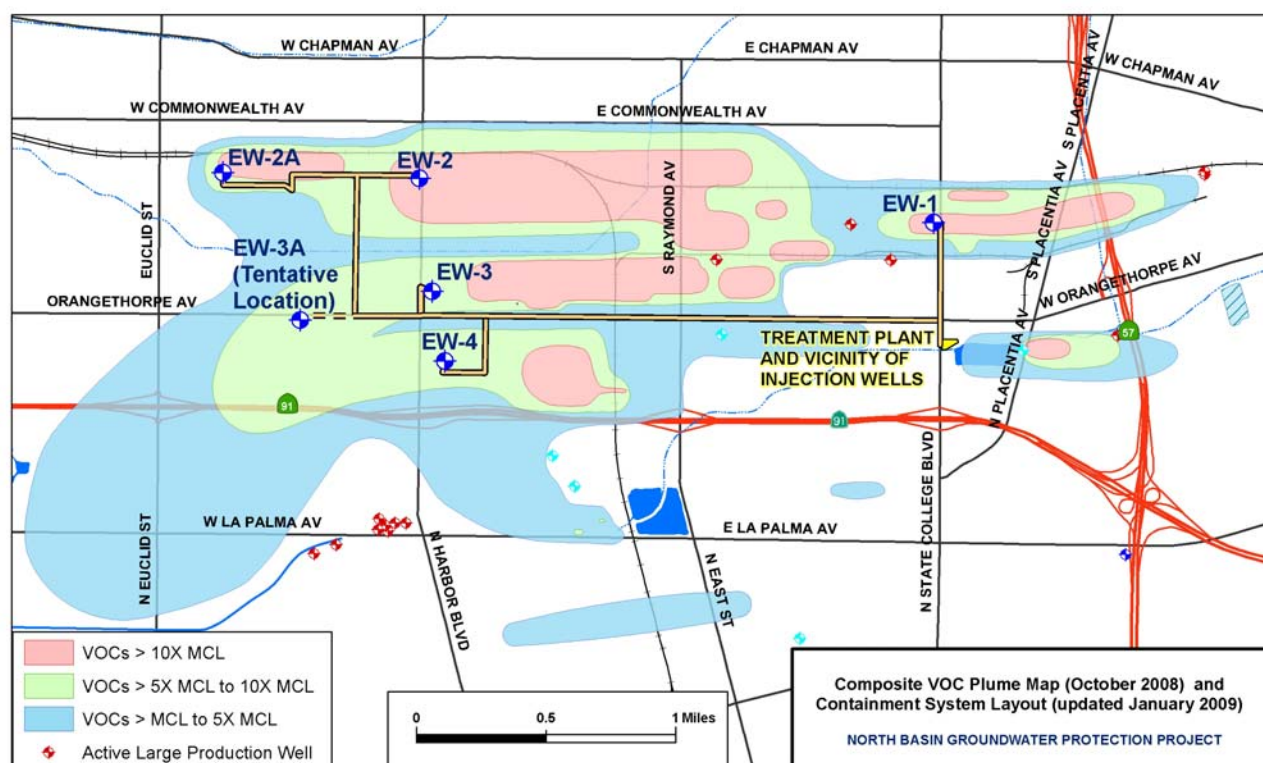




### 5.8.1 NORTH BASIN GROUNDWATER PROTECTION PROJECT (NBGPP)

In accordance with OCWD's groundwater cleanup policy, the District is implementing the NBGPP to protect drinking water supplies and the beneficial use of groundwater. OCWD has constructed five wells specifically to remove and contain contaminated groundwater in the shallow aquifer. Additional extraction wells may be needed. OCWD will also construct pipelines to bring the contaminated groundwater to a centralized treatment plant where the contaminants will be removed. The purified water will then be re-injected back into the shallow aquifer. An overview of the VOC plumes and the NBGPP is shown in Figure 5-13. OCWD has initiated legal action against the parties responsible for contamination to seek cost recovery so that the public does not have to pay for this project.

**FIGURE 5-13**  
**NORTH BASIN GROUNDWATER PROTECTION PROJECT**

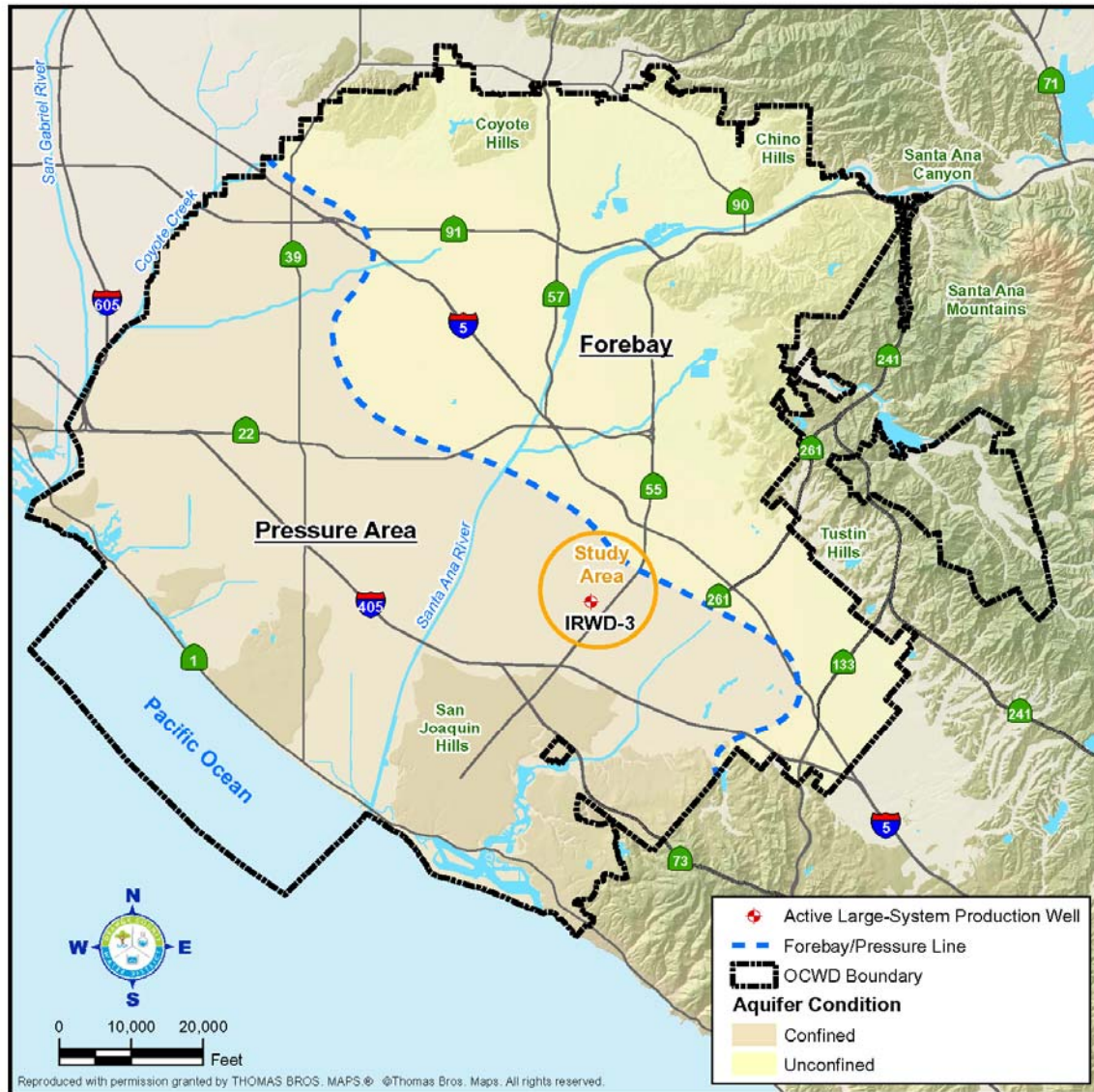


### 5.8.2 SOUTH BASIN GROUNDWATER PROTECTION PROJECT (SBGPP)

The District has initiated the SBGPP, a project similar to the NBGPP, to protect drinking water supplies in the south part of the Orange County groundwater basin. OCWD constructed six tri-nested monitoring wells to investigate the extent of VOC-contaminated groundwater in the Shallow Aquifer. Delineation of the contaminated groundwater will likely involve more than one phase of investigation. If "hot spots" or contaminated plumes are identified, the SBGPP may include comprehensive remediation systems to contain and remove the contamination similar to the NBGPP or

localized interim remedial measures. The study area for the SBGPP is shown in Figure 5-14.

**FIGURE 5-14**  
**SOUTH BASIN GROUNDWATER PROTECTION PROJECT**



### 5.8.3 MTBE REMEDIATION

In 2003, OCWD filed suit against numerous oil and petroleum-related companies that produce, refine, distribute, market, and sell MTBE and other oxygenates. The suit seeks funding from these responsible parties to pay for the investigation, monitoring, and removal of oxygenates from the basin.

Treatment technologies used to remove MTBE from groundwater include granular activated carbon (GAC) or advanced oxidation. Depending upon site-specific requirements, a treatment train of two or more technologies in series may be

appropriate (i.e., use one technology to remove the bulk of MTBE and a follow-up technology to polish the effluent water stream). If other contaminants (e.g., excessive nitrates or TDS) are also found in groundwater with MTBE, additional treatment processes (ion exchange membranes) would also need to be included in the process train.

#### **5.8.4 IRVINE DESALTER**

The Irvine Desalter was built in response to the discovery in 1985 of VOCs beneath the former El Toro MCAS and the central area of Irvine. The plume of improperly disposed cleaning solvents migrated off base and threatened the main basin. IRWD and OCWD cooperated in building production wells, pipelines, and two treatment plants, both of which are now owned and managed by IRWD. One plant removes VOCs by air-stripping and vapor-phase carbon adsorption with the treated water used for irrigation and recycled water purposes. A second plant treats groundwater outside the plume to remove excess nitrate and TDS concentrations using RO membranes for drinking water purposes. Combined production of the Irvine Desalter wells is approximately 8,000 afy.

#### **5.8.5 TUSTIN DESALTERS**

Tustin's Main Street Treatment Plant has operated since 1989 to reduce nitrate levels from the groundwater produced by Tustin's Main Street Wells Nos. 3 and 4. The untreated groundwater can undergo either RO or ion exchange treatment. The RO membranes and ion exchange unit operate in a parallel treatment train. Approximately 1 mgd is bypassed and blended with the treatment plant product water to produce up to 2 mgd or 2,000 afy. During fiscal year 2007-08, 55,700 pounds of nitrate were removed at this treatment plant.

The Tustin Seventeenth Street Desalter began operation in 1996 to reduce high nitrate and TDS concentrations from the groundwater pumped by Tustin's Seventeenth Street Wells Nos. 2 and 4 and Tustin's Newport well. The desalter utilizes two RO membrane trains to treat the groundwater. The treatment capacity of each RO train is 1 mgd. Approximately 1 mgd is bypassed and blended with the RO product water to produce up to 3 mgd or 3,000 afy. During fiscal year 2007-08, 154,800 pounds of nitrate were removed at this treatment facility.

#### **5.8.6 GARDEN GROVE NITRATE REMOVAL**

The Garden Grove Nitrate Removal Project was a blending project utilizing two wells in order to meet the MCL for nitrate. Garden Grove Well No. 28, containing high nitrate concentrations, was blended with water from Well No. 23. The blending project operated from 1990 to 2005. The city took the well off line and is considering construction of upgraded treatment facilities to expand the pumping of groundwater in this area.

#### **5.8.7 RIVER VIEW GOLF COURSE**

VOC contamination, originating from an upgradient source, was discovered in a well owned by River View Golf Course, located in the City of Santa Ana. The well was used



for drinking water but was converted into a supply for golf course irrigation due to the contamination. Continued operation of the well helps to remove VOC contamination from the basin.

### **5.8.8 COLORED WATER TREATMENT**

The 5-mgd MCWD ozone oxidation treatment plant removes the color from groundwater pumped from Well No. 6 and Well No. 11. One of the ozone by-products is assimilable organic carbon (AOC), which increases the microbiological regrowth potential within the distribution system. Pressurized biologically-active filtration is employed immediately after ozone oxidation in order to remove AOC and produce microbiologically stable water. In order to meet the stringent disinfection by-products MCLs, chloramination (a combination of chlorine and ammonia) is used to disinfect the product water prior to delivery to distribution system.

IRWD's DATS removes color from deep aquifer groundwater. A total of 8 mgd of colored groundwater is pumped from two wells (IRWD C8 and C9) to the DATS plant. Nanofiltration (NF) membranes remove color and organics. Three NF trains each produce 2.44 mgd at a recovery rate of 92 percent. The high quality NF product water is degasified, disinfected, and pumped into the Dyer Road Wellfield pipeline for potable use resulting in 7.4 mgd added to the drinking water system. The highly colored NF concentrate is sent to disposal by OCSD.

The colored water treatment projects operated by MCWD and IRWD provide benefit beyond the production of water supply. The aquifers with colored water are generally deeper than the primary clear water production zones, and upward vertical migration of the colored water into the clear water aquifers has been observed. Upward migration can impair water quality in the clear water zones. A large groundwater level difference between the colored water aquifer and clear water aquifers exacerbates this situation. By pumping from the colored water aquifer, the MCWD and IRWD projects reduce the groundwater level in the colored water aquifer, thus reducing the vertical migration of colored water into the clear water aquifers.

## **5.9 BEA Exemption for Improvement Projects**

In some cases, the District encourages the pumping of groundwater that does not meet drinking water standards in order to protect water quality. This is achieved by using a financial incentive called the BEA Exemption. The benefits to the basin include removing and beneficially using poor-quality groundwater and reducing or preventing the spread of poor-quality groundwater into non-degraded aquifer zones.

As explained in detail in Section 6, OCWD uses financial incentives to manage the level of pumping from the groundwater basin. Producers pay a Replenishment Assessment (RA) for water pumped from the basin. Each year the District sets an allowable amount of pumping and assesses an additional charge, called the BEA, on all water pumped above that limit.

A BEA Exemption is used to encourage pumping of groundwater that does not meet drinking water standards in order to clean up and contain the spread of poor quality

water. Section 38.1 of the District Act provides specific criteria for exemption of the BEA:

*“If the board of directors finds and determines that the water produced from the facility or facilities or any of them has or will have a beneficial effect upon the quality of water supplies of the district, the board of directors may make an order that water produced from the water-producing facility or facilities shall be exempted from either or both of the following:*

*(A) The payment of all or any portion of the basin equity assessment...*

*(B) The production requirements and limitations as provided in this act.”*

OCWD uses a partial or total exemption of the BEA to compensate a qualified participating agency or Producer for the costs of treating poor-quality groundwater. These costs typically include capital, interest, and operations and maintenance (O&M) costs for the treatment facilities.

Under this provision, the District has exempted all or a portion of the BEA for pumping and treating groundwater for removal of nitrates, TDS, VOCs, and other contaminants. Water quality improvement projects that have received a BEA exemption are listed in Table 5-6.

When the District authorizes a BEA exemption for a project, OCWD is obligated to provide the replenishment water for the production above the BPP and forgoes the BEA revenue that OCWD would otherwise receive from the producer.

**TABLE 5-6**  
**SUMMARY OF IMPROVEMENT PROJECTS AND REPLENISHMENT OBLIGATIONS**

| Project Name               | Project Description                                 | BEA Exemption Approval Date | Groundwater Production above BPP (afy) | OCWD Subsidy             |
|----------------------------|-----------------------------------------------------|-----------------------------|----------------------------------------|--------------------------|
| Irvine Desalter            | Removal of nitrates, TDS, and VOCs                  | 2001                        | 10,000                                 | BEA Exemption            |
| Tustin Desalter            | Removal of nitrates and TDS                         | 1998                        | 3,500                                  | BEA Exemption            |
| Garden Grove Nitrate       | Blending two Garden Grove wells to meet nitrate MCL | 1998                        | 4,000                                  | BEA Exemption            |
| Tustin Nitrate Removal     | Removal of nitrates                                 | 1998                        | 1,000                                  | BEA Exemption            |
| River View Golf Course     | Removal of VOCs                                     | 1998                        | 350                                    | \$50/af reduction in BEA |
| MCWD Colored Water Removal | Color removal                                       | 2000                        | 8,700                                  | BEA Exemption            |
| IRWD DATS                  | Color removal                                       | 1999                        | 8,000                                  | BEA Exemption            |

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## 6 INTEGRATED MANAGEMENT OF PRODUCTION AND RECHARGE

The District operates the groundwater basin in order to protect and increase the basin's sustainable yield in a cost effective manner. Accomplishing this goal requires careful management of recharge and water production. This section describes the methods and programs utilized by OCWD to maintain the long-term sustainability of the basin's groundwater supplies.

### 6.1 General Management Approach

OCWD is internationally known for its unique, proactive, supply-side management approach. This is a major factor that has enabled the District to develop one of the most advanced and progressive groundwater management systems in the world. The District seeks to expand the basin's yield by maximizing the amount of water recharged into the basin, developing new sources of water to recharge the basin, and increasing the effectiveness of the District's recharge facilities.

OCWD provides access to basin supplies at a uniform cost to all entities within the District without regard to the length of time they have been producing from the basin. After initiating this policy in 1954 with the establishment of the Replenishment Assessment (RA), OCWD witnessed a substantial growth in municipal and industrial water usage. This growth has not occurred without its accompanying challenges to OCWD: the need to augment recharge water supplies, establish methods to effectively manage demands on the basin, and balance the amount of total recharge and total pumping to protect the basin from being overdrafted.

The District's participation in a wide range of cooperative efforts with other water and waste water agencies as well as stakeholder organizations plays an important part in the management of the groundwater basin.

### 6.2 Cooperative Efforts to Protect Water Supplies and Water Quality

OCWD participates in cooperative efforts with state and federal regulatory agencies and stakeholders within the District boundaries, in Orange County, and in the Santa Ana River Watershed.

#### 6.2.1 SANTA ANA WATERSHED PROJECT AUTHORITY (SAWPA)

SAWPA is a Joint Powers Authority whose mission is to develop and maintain regional plans, programs, and projects that will protect the Santa Ana River basin water resources. OCWD, one of SAWPA's five member agencies, actively participates on a number of work groups that meet on a regular basis to discuss, plan, and make joint decisions on management of water resources in the Santa Ana Watershed. OCWD actively participates in the following SAWPA work groups:

**SAWPA Commission:**

The commission, composed of Board members from SAWPA's five member agencies including OCWD, meets on a monthly basis to set policy and oversee the management of SAWPA.

**Storm Water Quality Standards Task Force:**

The Task Force is evaluating water quality standards as they relate to stormwater and dry weather flows. Particular emphasis is being given to the water quality that is needed to protect recreational beneficial uses.

**Basin Monitoring Program Task Force:**

The Basin Monitoring Program Task Force was formed in 1995 to determine the extent of and evaluate the impact of increasing concentrations of Total Inorganic Nitrogen (TIN) and TDS in groundwater in the watershed. Formation of the Task Force was in response to concerns by the Regional Board that water quality objectives for nitrogen and TDS were being exceeded in some groundwater basins in the watershed.

The over 20 water and waste water agencies and local governments on the Task Force worked with RWQCB staff to develop an amendment to the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) that was adopted in 2004. This nearly ten-year effort involved collecting and analyzing data in twenty-five groundwater management zones in the watershed to recalculate nitrogen and TDS levels and to establish new Water Quality Objectives to protect Beneficial Uses.

An important component in this effort was the recognition by stakeholders that groundwater basins are interconnected and that water quality in one basin impacts other basins and the quality of the water in the Santa Ana River.

The Basin Plan amendment charges the Task Force with implementing a watershed-wide TDS/Nitrogen groundwater monitoring program. Task Force members agreed to fund and participate in a process to recalculate ambient water quality every three years in each of the twenty-five groundwater management zones and to compare water quality to the water quality objectives in order to measure compliance with the Basin Plan. The latest recalculation, the second since adoption of the amendment, was published in August 2008 (Wildermuth, 2008).

**Salinity Management and Imported Water Recharge Plenary Workgroup:**

This workgroup, in cooperation with the Regional Board, implements a Cooperative Agreement signed by water agencies that use imported water for groundwater recharge. The workgroup is analyzing water quality data and estimating future conditions to evaluate the impact of recharging imported water.

**Emerging Constituents Workgroup:**

This workgroup is developing a monitoring program for emerging constituents in water that is intentionally recharged to local aquifers. The group will develop a

water quality monitoring program aimed at protecting surface water quality and groundwater supplies.

**Santa Ana Sucker Conservation Team:**

Meeting monthly since 1998, a group of concerned public agencies from throughout the Santa Ana River watershed have been working to determine the reasons for the decline of the Santa Ana Sucker (*Catostomus santaanae*) and to devise strategies for recovering the species. The U.S. Fish & Wildlife Service (USFWS) and the California Department of Fish & Game (CDFG) are part of this effort.

**One Water One Watershed Initiative:**

A large and diverse group of interested citizens and organizations is participating in developing an updated Santa Ana Watershed Integrated Regional Water Management Plan.

### **6.2.2 WATER QUALITY AND NATURAL RESOURCE PROTECTION IN THE PRADO BASIN**

The water quality of the Santa Ana River and its tributary creeks has a direct impact on the quality of water that flows into Orange County. The operation of the Prado Wetlands, as described in Section 5.3.3, improves water quality through the removal of nitrates and other pollutants before the water reaches OCWD's groundwater recharge basins.

The Prado Basin contains the single largest stand of forested riparian habitat remaining in coastal southern California. The basin provides a variety of fish and bird habitats including several rare and endangered species. OCWD manages a large portion of this property and has undertaken numerous habitat restoration and species recovery projects.

As part of a cooperative agreement with the ACOE and the USFWS, OCWD has created more than 800 acres of habitat for the endangered least Bell's vireo and southwestern willow flycatcher and has funded more than \$3 million in mitigation and monitoring measures for the vireo program. Through these restoration activities, OCWD has made significant contributions towards the recovery of vireo. In the mid-eighties, the vireo population had dropped to less than 20 breeding pairs. A 2007 survey identified 420 vireo territories, 237 of which contained pairs. Plans are underway to create additional river edge habitat, the preferred habitat of the flycatcher, in order to increase the population of this endangered bird.

A significant amount of the Prado Basin is infested with exotic vegetation, including the Giant Reed (*Arundo donax*), shown in Figure 6-1. *Arundo* grows rapidly, obstructs flood flows, has no value for wildlife habitat, and consumes nearly three times the water of native vegetation. *Arundo* consumes an estimated 56,200 af of water annually from the Santa Ana River.

OCWD has invested over \$3 million in *Arundo* removal efforts. These efforts are coordinated by the Santa Ana Watershed Association (SAWA). The SAWA, of which OCWD is a founding member, is dedicated to improving environmental quality and habitat within the watershed. Other members of SAWA include the CDFG, Riverside



County Flood Control District, Riverside County Parks and Recreation, San Bernardino County Flood Control District, SAWPA, the RWQCB, the ACOE, the USFWS, and the U.S. Forest Service.

Approximately 3,100 acres of river bottom lands formerly infested by Arundo and other invasive weeds are now under management. It is estimated that by 2025, an annual minimum of 36,000 af of additional water will be available in the Santa Ana River as a result of removing Arundo (based on a minimum of 3.6 af of additional water per acre of Arundo removed).

**FIGURE 6-1**  
**ARUNDO REMOVAL**



Arundo Control Begins with Removal by Hand or Machine Followed by  
Treatment of Re-growth with a Systemic Herbicide

### **6.2.3 CHINO BASIN INTEGRATED PLANNING**

Chino Creek and Mill Creek are major tributaries that flow into the Santa Ana River in the Prado Basin. OCWD staff attends monthly meetings of stakeholders from this region to discuss and act upon issues of common concern. In 2006, the group, led by the IEUA and OCWD produced the *Chino Creek Integrated Plan: Guidance for Working Together to Protect, Improve, and Enhance the Lower Chino Creek Watershed*.

### **6.2.4 COOPERATIVE EFFORTS IN ORANGE COUNTY**

OCWD supports the watershed planning efforts of the County of Orange. The county created three watershed management areas in order to localize the development and implementation of integrated regional watershed plans. Two of the management areas are within the OCWD service area. The North Orange County Management Area covers the areas within the county that are located within the Santa Ana River Watershed and the coastal watersheds west of the Santa Ana River. The Central Orange County Management Area covers the Newport Bay Watershed and the Newport Coast area. OCWD participates in the development and implementation of the North Orange County and Central Orange County watershed plans.

### **6.2.5 COOPERATIVE EFFORTS IN OCWD SERVICE AREA**

OCWD participates in a variety of cooperative efforts with water retailers and cities within the OCWD service area as well as wastewater and flood control agencies, as described below.

#### **Groundwater Producers**

The Producers, the retail water agencies that produce the majority of the groundwater from the basin, meet with OCWD staff on a monthly basis to discuss issues related to management of the groundwater basin.

#### **Municipal Water District of Orange County (MWDOC)**

MWDOC, a member agency of the Metropolitan Water District of Southern California, provides imported water to 28 retail water agencies and cities in Orange County. MWDOC also supplies untreated imported water to OCWD when it is available for use as a supplemental source of water to recharge the groundwater basin. OCWD and MWDOC meet on a monthly basis and jointly plan for the maximum flexibility in the overall water supply, including:

- Coordinating mutual water resources planning, supply availability, and water use efficiency (conservation) programs for the benefit of the basin area in Orange County.
- Conducting and developing an Orange County Water Reliability Program to improve the overall water and emergency supply to Orange County.
- Evaluating ocean water desalination, water recycling, and other means to increase the supply and system reliability for the basin area.
- Evaluating water transfers and exchanges that would make surplus supplies from other areas available to the District.

#### **Water Advisory Committee of Orange County (WACO)**

WACO is a group of elected officials and water managers who meet on a monthly basis to provide advice to OCWD and MWDOC on water supply issues.

#### **Groundwater Replenishment System Steering Committee**

The GWR System is a joint project of the OCWD and the Orange County Sanitation District. Directors of the two districts meet on a monthly basis to coordinate joint operations.

#### **Orange County Flood Control District**

Three of the recharge basins used by OCWD for groundwater recharge are owned by the Orange County Flood Control District. OCWD also owns a six-mile section of the Santa Ana River that is used for conveyance of flood water. Quarterly meetings are held to discuss joint operations and planning.

### **6.3 Supply Management Strategies**

One of OCWD's management objectives is to maximize the amount of water recharged into the basin. This is achieved through maximizing the efficiency of and expanding the District's recharge facilities and increasing the supply of recharge water. The District constructed the GWR System to increase the supply of water available to recharge the basin. Additional District supply management programs include encouraging and using recycled water for irrigation and other non-potable uses, participating in water conservation efforts, participating in efforts to manage water and other natural resources in the upper watershed, and working with MWDOC in developing and conducting other supply augmentation projects and strategies.

#### **6.3.1 USE OF RECYCLED WATER**

OCWD's Green Acres Project is a non-potable water supply project that utilizes a dedicated set of pipelines to deliver irrigation and industrial water to users. Most of the recycled water is used on golf courses, greenbelts, cemeteries, and nurseries. The Green Acres Project, in operation since 1991, reduces demands on the basin by providing non-potable water for non-potable uses. Secondary wastewater effluent from the OCSD is filtered and disinfected with chlorine to produce approximately seven mgd of irrigation and industrial water.

#### **6.3.2 WATER CONSERVATION PROGRAMS**

Water conservation plays an important role in meeting future water demands. By implementing conservation programs, future water demand can be reduced, and less imported water will be necessary to meet the area's water requirements.

The District cooperated with MWDOC, OCSD, and other agencies in a low-flush toilet program that subsidized the replacement of old high-volume toilets with modern low-flow toilets. The District also supports MWDOC and Metropolitan in a Hotel/Motel Water Conservation Program to save water through minimizing water use at hotels. This program, active in over 30,000 hotel/motel rooms, offers free laminated towel rack hangers or bed cards that encourage guests to consider using their towels and bed linens more than once during their stay.

OCWD supports MWDOC and other local agencies in a similar program aimed at restaurant water conservation. Free laminated cards are provided for restaurants to place on their tables. The cards inform patrons that water will be served only upon request. This encourages environmental awareness and water and energy conservation.

#### **6.3.3 CONJUNCTIVE USE AND WATER TRANSFERS**

The existing Metropolitan storage program provides for Metropolitan to store 66,000 af of water in the basin in exchange for Metropolitan's contribution to improvements in basin management facilities. This water can be withdrawn over a three-year time period. The improvements contributed by Metropolitan included the construction of eight new extraction wells and new injection wells for the Talbert Barrier Expansion.

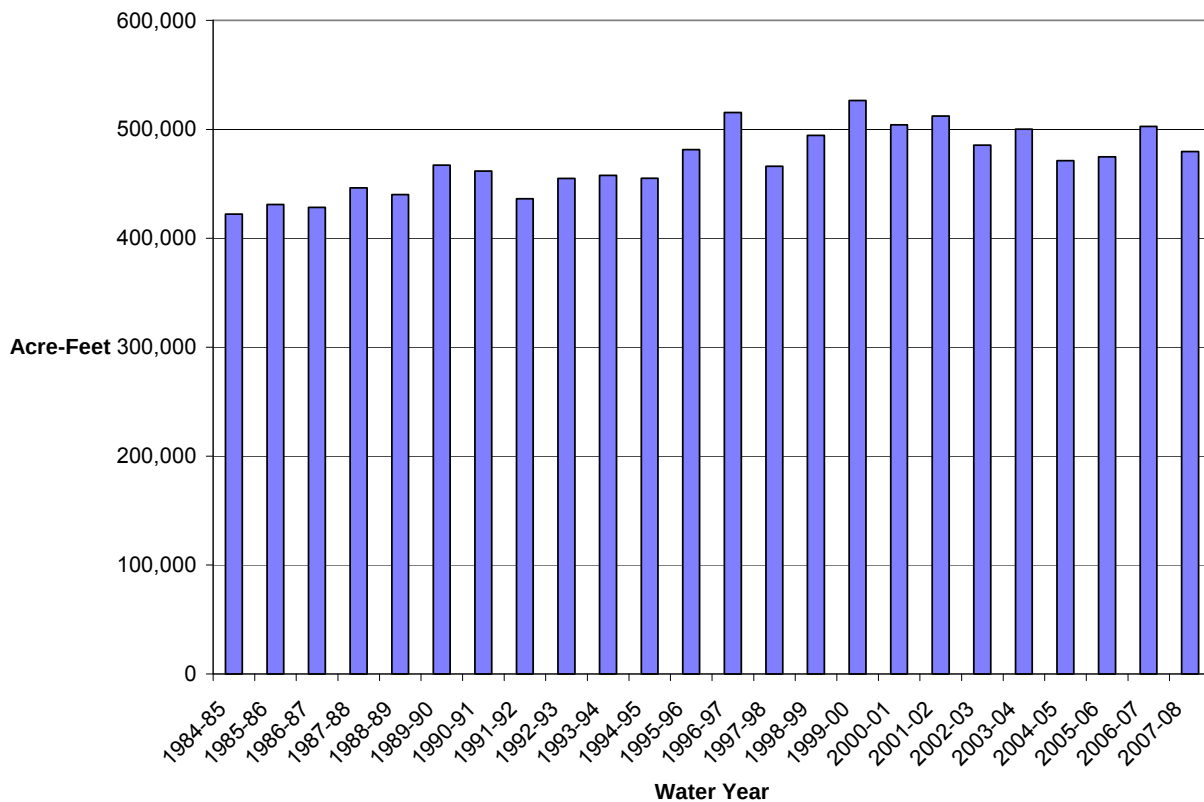
The District reviews opportunities for additional conjunctive use projects that would store water in the basin and could potentially store water in other groundwater basins. Additionally, the District reviews opportunities for water transfers that could provide additional sources of recharge water. Such projects are evaluated carefully with respect to their impact on available storage and their reliability and cost effectiveness.

## 6.4 Water Demands

Numerous factors influence water demands such as population growth, economic conditions, conservation programs, and hydrologic conditions. Estimates of future demands are therefore subject to some uncertainty and are updated on a periodic basis.

Total water demand within the District's boundary for water year 2007-08 (July 1-June 30) was 480,303 af. Total demand is met with a combination of groundwater, imported water, local surface water in Irvine Lake and Santiago Creek, and recycled water used for irrigation and industrial purposes. Figure 6-2 provides historical water demands in the District.

**FIGURE 6-2  
HISTORICAL TOTAL DISTRICT WATER DEMANDS**



Demand estimates are based on a number of factors including projected population increases. Population within OCWD's service area is expected to increase from 2.5 million currently to 2.7 million by the year 2035 as shown in Table 6-1. This population growth is expected to increase water demands from the current approximately 480,000 afy to 558,000 afy in 2035 as shown in Table 6-2. Future annual water demands will fluctuate, primarily due to factors such as the effectiveness of future water conservations programs, economic conditions, and hydrologic conditions.

**TABLE 6-1**  
**ESTIMATED POPULATION WITHIN OCWD BOUNDARY**

| 2010      | 2015      | 2020      | 2025      | 2030      | 2035      |
|-----------|-----------|-----------|-----------|-----------|-----------|
| 2,550,000 | 2,620,000 | 2,659,000 | 2,685,000 | 2,703,000 | 2,722,000 |

Source: MWDOC and Center for Demographics Research (2008)

**TABLE 6-2**  
**ESTIMATED FUTURE WATER DEMANDS IN OCWD BOUNDARY (AFY)**

| 2009    | 2010    | 2015    | 2020    | 2025    | 2030    | 2035    |
|---------|---------|---------|---------|---------|---------|---------|
| 490,000 | 500,000 | 519,000 | 538,000 | 548,000 | 553,000 | 558,000 |

Projections based on annual MWDOC survey completed by each Producer - Spring 2008

Expansion of the District's boundary through annexing additional land into the District has been a major factor in the growth of OCWD. From 1933 to now, the District's area has grown from 162,676 acres to over 229,000 acres (OCWD, 2006). Annexation requests by the City of Anaheim, Irvine Ranch Water District, and Yorba Linda Water District, if approved, could expand the District's boundary and increase water demands by approximately 48,000 afy.

## **6.5 Basin Operating Range**

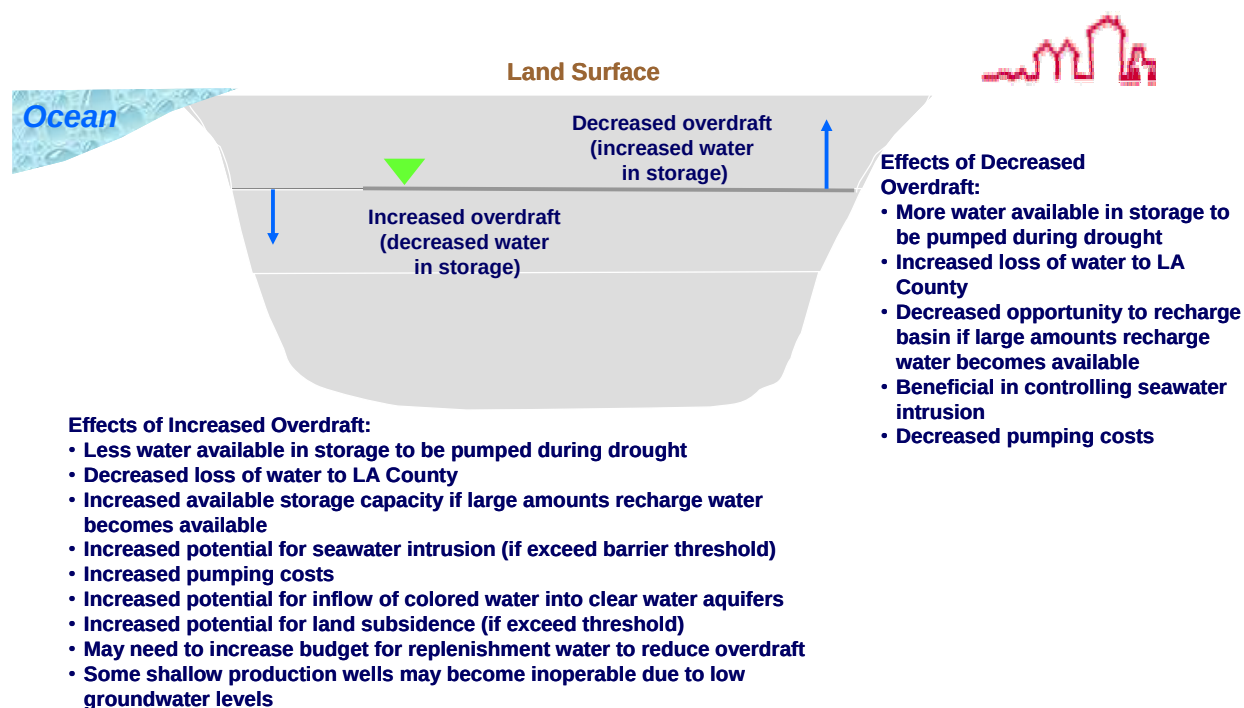
OCWD does not regulate pumping from the groundwater basin. Instead, total pumping is managed by a process that uses financial incentives to encourage Producers to pump an aggregate amount of water that is sustainable over the long term. The process that determines a sustainable level of pumping considers the basin's safe operating range and the amount of recharge water available to the District.

The basin operating range refers to the upper and lower levels of groundwater storage in the basin that can be reached without causing negative or adverse impacts. The basin is in the upper (higher) end of the operating range when groundwater levels are high. Conversely, the basin is near the low end of the operating range when groundwater levels are lower. Figure 6-3 schematically illustrates the impacts of changing the amount of groundwater in storage.



The storage level is quantified based on a benchmark defined as the full basin condition. The groundwater basin rarely, if ever, reaches the full basin condition. The degree to which the storage is below the full basin condition is defined as “accumulated overdraft.” Based on this definition of accumulated overdraft, it is anticipated that the accumulated overdraft would increase or decrease from year to year in response to hydrological variations. Provided that the accumulated overdraft is within the safe operating range, this approach is sustainable.

**FIGURE 6-3**  
**SCHEMATIC ILLUSTRATION OF IMPACTS OF CHANGING THE AMOUNT**  
**OF GROUNDWATER IN STORAGE**



Each year the District determines the optimum level of storage for the following year. For example, at small amounts of overdraft (greater total amount of water in storage), the amount of energy required to pump groundwater is less and groundwater outflow to Los Angeles County is greater. On the other hand, larger amounts of overdraft increase the potential for seawater intrusion. Factors that are considered in determining the optimum level of storage are shown in Table 6-3.

The accumulated overdraft is calculated and published in the annual District’s Engineer’s Report. Since 2007, the determination of accumulated overdraft is based on a full basin benchmark defined for each of the three aquifer layers as described in Section 2.

The shallow aquifer, the principal aquifer, and the aquitard between the shallow and principal aquifer stores approximately 66,000,000 af of water at the full condition. When the accumulated overdraft is 200,000 af, the Basin is approximately 99.7 percent full. When the overdraft increases from 200,000 to 400,000 af, the basin changes from 99.7 to 99.4 percent full. From a classical surface water reservoir perspective, the basin is

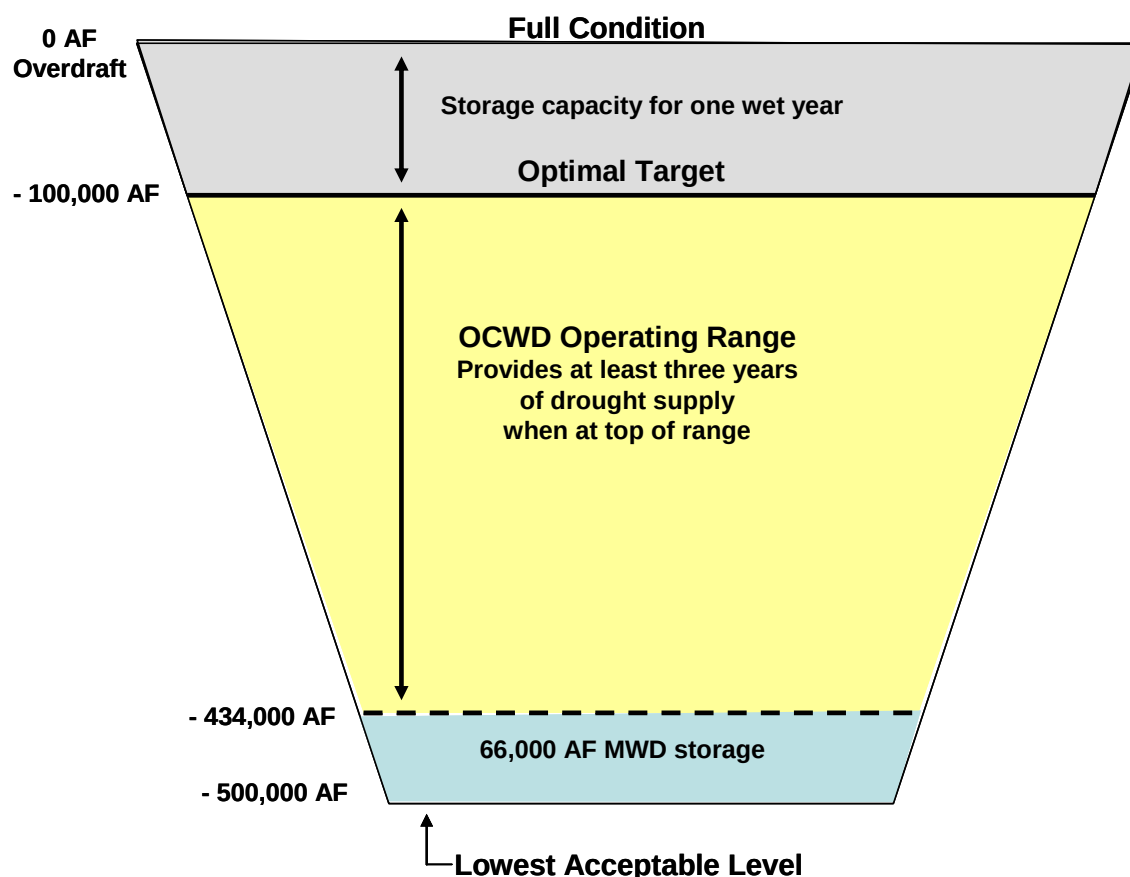


almost always nearly “full.” In spite of the large amount of water stored in the basin, there is a narrow operating range within which the Basin can safely operate, as illustrated in Figure 6-4, which is largely dictated by water quality issues and the need to prevent land subsidence.

**TABLE 6-3**  
**BENEFITS AND DETRIMENTS OF DIFFERENT STORAGE LEVELS**

| ACCUMULATED OVERDRAFT (AF) | BENEFITS                                                                                                                                                                                                                                                                                                                                                                                                                                                        | DETRIMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Less than 200,000          | <ul style="list-style-type: none"> <li>• Beneficial to controlling seawater intrusion</li> <li>• Lower pumping energy costs for producers</li> <li>• Easier to maintain stable BPP</li> <li>• Water available to be pumped from storage in shortage condition</li> <li>• Potential to temporarily increase BPP</li> <li>• Decreased potential for vertical migration of poor quality water</li> <li>• Opportunity to operate Basin to build reserves</li> </ul> | <ul style="list-style-type: none"> <li>• Increased loss of groundwater to Los Angeles County</li> <li>• Possible localized high groundwater levels if near full condition</li> <li>• Decreased opportunity to recharge Basin if large amount of low cost recharge water becomes available</li> <li>• Possible decrease in recharge capacity due to high groundwater levels (not observed at current recharge rates, but may be an issue with higher rates in future)</li> </ul>                                                                                                                                                                                                                                                                                                                     |
| 200,000 to 350,000         | <ul style="list-style-type: none"> <li>• Minimal to no problems with high groundwater levels</li> <li>• Increased available storage capacity if large amount of recharge water becomes available</li> <li>• Decreased groundwater outflow to Los Angeles County</li> </ul>                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• Limited amount of water in storage that can be pumped during drought or other shortage condition</li> <li>• Risk of seawater intrusion increases as overdraft increases from 200,000 to 350,000 af</li> <li>• Option for Metropolitan to call 20,000 afy from storage would further increase overdraft</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 350,000 to 500,000         | <ul style="list-style-type: none"> <li>• Minimal to no problems with high groundwater levels</li> <li>• Increased available storage capacity if large amount of recharge water becomes available</li> <li>• Further decrease in groundwater outflow to Los Angeles County</li> </ul>                                                                                                                                                                            | <ul style="list-style-type: none"> <li>• Little to no water in storage that can be pumped during drought or other shortage condition</li> <li>• Increased pumping energy costs</li> <li>• Further increased risk of seawater intrusion</li> <li>• Coastal pumping reductions potentially needed</li> <li>• Option for Metropolitan to call 20,000 afy from storage further worsens overdraft</li> <li>• Increased number of production wells inoperable due to low groundwater levels below 400,000 af overdraft</li> <li>• Potential risk of increased land subsidence</li> <li>• Potential increased risk of vertical migration of poor quality water.</li> <li>• Need to increase budget for replenishment water to reduce overdraft</li> <li>• More difficult to maintain stable BPP</li> </ul> |

FIGURE 6-4  
STRATEGIC BASIN OPERATING LEVELS AND OPTIMAL TARGET



Groundwater levels must be carefully managed to properly control seawater intrusion. With the water available for injection from the GWR System, seawater intrusion may be controlled in the Talbert Gap with a maximum overdraft of 500,000 af. Improvements to the Talbert Barrier may allow greater overdraft but the impact of greater withdrawals on the other gaps, Bolsa, Sunset and Alamitos, must also be evaluated.

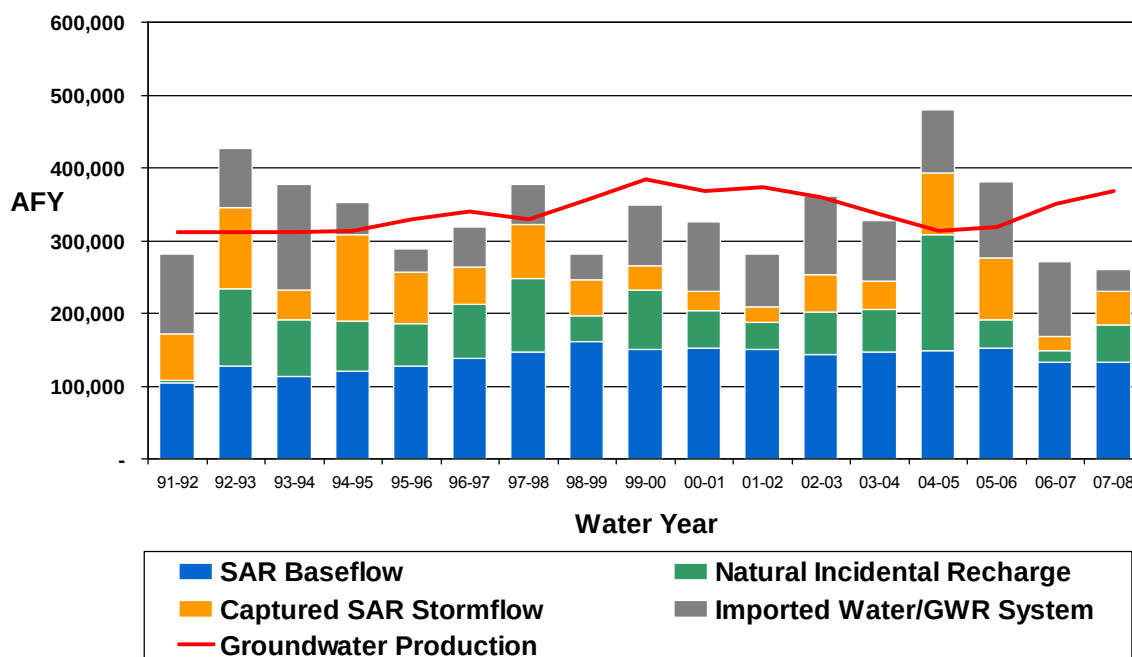
Additional issues that would need to be evaluated prior to increasing the amount of overdraft, assuming an effective seawater barrier was operating, would include the risk of land subsidence, inflow of colored water or poor quality groundwater into the principal aquifer from underlying or overlying aquifers, and the number of shallow production wells that would become inoperable due to lower groundwater levels.

## 6.6 Balancing Production and Recharge

Over the long term, the basin must be maintained in an approximate balance to ensure the long-term viability of basin water supplies. In one particular year, water withdrawals may exceed water recharged as long as over the course of a number of years this is

balanced by years where water recharged exceeds withdrawals. Levels of basin production and water recharged since water year 1991-92 are shown in Figure 6-5.

**FIGURE 6-5  
BASIN PRODUCTION AND RECHARGE SOURCES**



| Water Year | SAR Baseflow | Natural Incidental Recharge | Captured SAR Stormflow | Imported Water/GWR System | Groundwater Production |
|------------|--------------|-----------------------------|------------------------|---------------------------|------------------------|
| 91-92      | 105,000      | 2,000                       | 65,000                 | 109,000                   | 311,000                |
| 92-93      | 127,000      | 107,000                     | 111,000                | 82,000                    | 312,000                |
| 93-94      | 114,000      | 78,000                      | 41,000                 | 144,000                   | 312,000                |
| 94-95      | 120,000      | 70,000                      | 117,000                | 44,000                    | 314,000                |
| 95-96      | 128,000      | 58,000                      | 70,000                 | 32,000                    | 329,000                |
| 96-97      | 138,000      | 74,000                      | 51,000                 | 56,000                    | 339,000                |
| 97-98      | 146,000      | 101,000                     | 74,000                 | 55,000                    | 329,000                |
| 98-99      | 161,000      | 36,000                      | 50,000                 | 35,000                    | 356,000                |
| 99-00      | 150,000      | 82,000                      | 33,000                 | 84,000                    | 384,000                |
| 00-01      | 153,000      | 50,000                      | 27,000                 | 95,000                    | 369,000                |
| 01-02      | 150,000      | 38,000                      | 21,000                 | 73,000                    | 374,000                |
| 02-03      | 143,000      | 58,000                      | 52,000                 | 109,000                   | 359,000                |
| 03-04      | 146,000      | 59,000                      | 39,000                 | 84,000                    | 337,000                |
| 04-05      | 149,000      | 159,000                     | 85,000                 | 87,000                    | 314,000                |
| 05-06      | 153,000      | 39,000                      | 84,000                 | 104,000                   | 318,000                |
| 06-07      | 133,000      | 15,000                      | 19,000                 | 103,000                   | 350,000                |
| 07-08      | 132,000      | 52,000                      | 46,000                 | 30,000                    | 368,000                |

## 6.7 Managing Basin Pumping

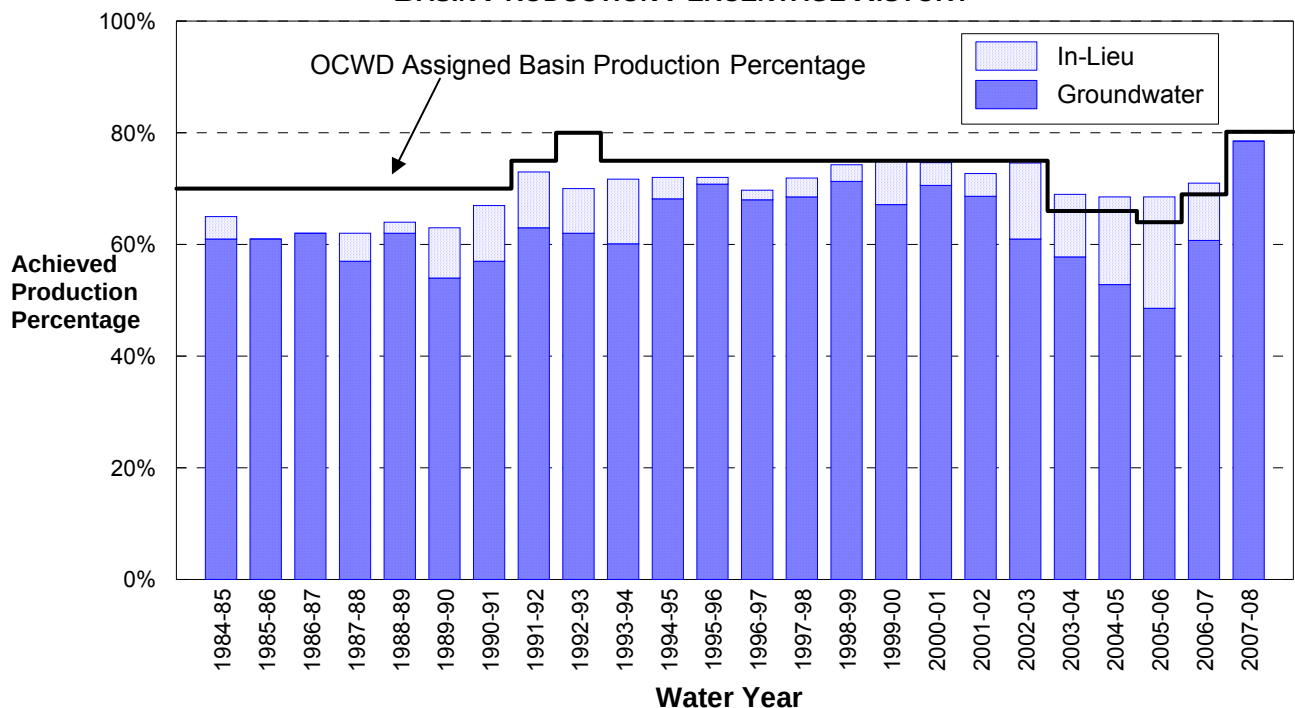
The primary mechanism used by OCWD to manage pumping is the Basin Production Percentage (BPP). Section 31.5 of the District Act empowers the Board to annually establish the BPP, defined as:

“the ratio that all water to be produced from groundwater supplies with 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. “

In other words, the BPP is a percentage of each Producer’s water supply that comes from groundwater pumped from the basin. The BPP is set uniformly for all Producers. Groundwater production at or below the BPP is assessed the RA. Any production above the BPP is charged the RA plus the BEA. The BEA is calculated so that the cost of groundwater production above the BPP is higher than purchasing imported potable supplies. This approach serves to discourage, but not eliminate, production above the BPP. The BEA can be increased as needed to discourage production above the BPP.

In simplified terms, the BPP is calculated by dividing groundwater production by total water demands. The BPP is set after evaluating groundwater conditions, availability of recharge water supplies, and basin management objectives. The BPP is also a major factor in determining the cost of groundwater production for that year. OCWD’s goal is to set the BPP as high as possible to allow Producers to maximize pumping and reduce their overall water supply cost. Figure 6-6 shows the history of the BPP along with the actual BPP that was achieved by the Producers.

**FIGURE 6-6  
BASIN PRODUCTION PERCENTAGE HISTORY**



Raising or lowering the BPP allows the District to manage the amount of pumping from the basin. The BPP is lowered when basin conditions necessitate a decrease in pumping. A lower BPP results in the need for Producers to purchase additional, more expensive imported water from Metropolitan.

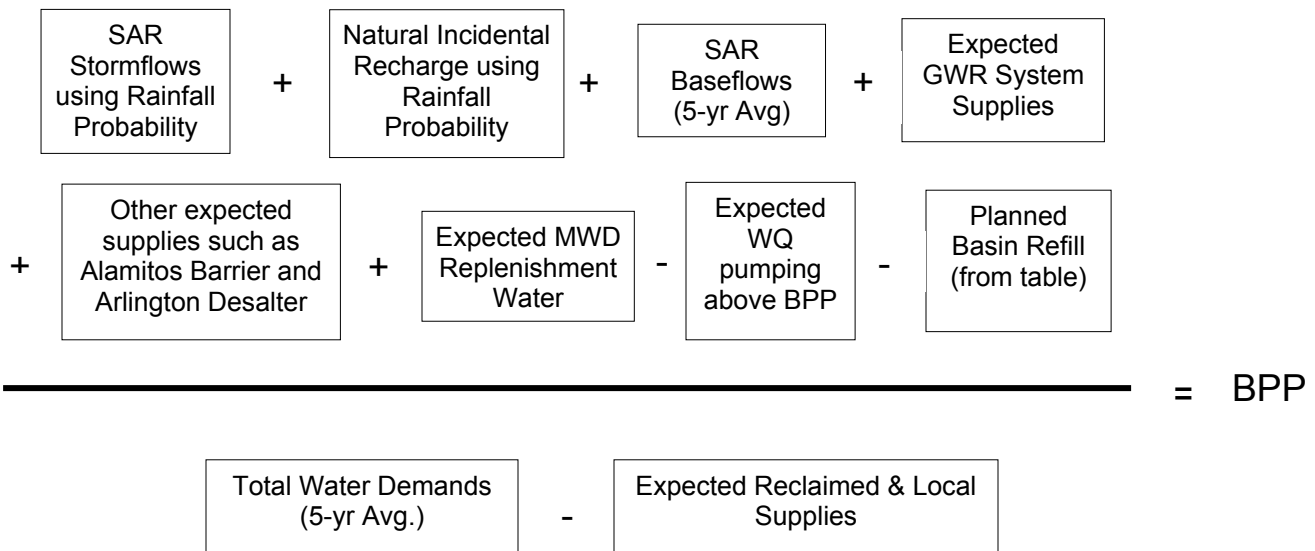
One example of a condition that could require a lowering of the BPP is to protect the basin from seawater intrusion. In this case, reduced pumping would allow groundwater levels to recover and seawater intrusion to be reduced. A change in the BPP affects the District's budget as less pumping reduces collected revenues.

### 6.7.1 METHODOLOGY FOR SETTING THE BASIN PRODUCTION PERCENTAGE

The formula used to estimate the BPP is shown in Figure 6-7. The formula is used as a guideline and the District's Board of Directors sets the BPP after considering the relevant information and input from the Producers and the public. To determine the BPP for a given year the amount of water available for basin recharge must be estimated. The supplies of recharge water that are estimated are:

- Santa Ana River stormflow
- Natural incidental recharge
- Santa Ana River baseflow
- GWR System supplies
- Other supplies such as Metropolitan and recycled water purchased for the Alamitos Barrier.

**FIGURE 6-7  
BPP CALCULATION**



MWD = Metropolitan Water District of Southern California

Probability factors are used to estimate recharge into the groundwater basin from Santa Ana River stormflow and natural incidental recharge. The probability percentages are based on over 100 years of rainfall data and represent the probability that the upcoming year will not be drier than the predicted rainfall amount. As the accumulated overdraft increases, a higher level of certainty or probability is used in the BPP calculation to ensure that the basin recharge estimates are attained or exceeded.

For example, if the accumulated overdraft is 500,000 af, then a 90 percent rainfall probability would be used to conservatively estimate that the upcoming year's rainfall will only be nine inches even though there is a 90 percent chance that it will be greater. With this methodology, there is 90 percent likelihood that the upcoming year's estimate of rainfall will be exceeded.

When the basin is nearly full, the ten percent probability of expected rainfall would be used. In other words, it would be determined that there is only a ten percent chance of having an upcoming year that is wetter than assumed, or conversely, a 90 percent chance that the upcoming year will be drier. For the San Bernardino rainfall station, the ten percent rainfall exceedance probability is 27 inches of rainfall. Therefore, assuming 27 inches of rainfall for the upcoming year's BPP calculation would ensure with 90 percent likelihood that it would actually be *drier*, less water would be recharged into the basin, and the accumulated overdraft would be *increased* so as to prevent overfilling the basin and losing water to the ocean.

When the basin is within the optimal range of 100,000 to 150,000 af of accumulated overdraft, the 50 percent probability of rainfall is suggested to be used. In other words, there would be an equal chance (50/50) of having either a wetter or drier year than assumed. In this case, the 50 percent rainfall exceedance probability is very similar to assuming average hydrology for the upcoming year.

This methodology provides a guideline for the upcoming year's recommended amount of basin refill, dependent of the level of accumulated overdraft. For each increasing level of accumulated overdraft, an increasing amount of basin refill is suggested, ranging from approximately five to ten percent of the accumulated overdraft. For example, at an accumulated overdraft level of 400,000 af, the suggested amount of basin refill or overdraft reduction for the upcoming year would range from 20,000 to 40,000 af. Therefore, at this assumed basin refill rate, it would take approximately 10 to 20 years to completely fill the basin and eliminate the overdraft.

Table 6-4 shows the established amount or range for the planned basin refill water (reduction to the basin's accumulated overdraft) that is used in the formula based upon the basin's accumulated overdraft. The range is based upon provisions in the District Act which call for refilling the groundwater basin in not less than 10 years and not greater than 20 years. For example; if the accumulated overdraft is 400,000 af, refilling the basin over a 20-year period would yield a value of 20,000 afy while refilling the basin over a 10-year period yields a value of 40,000 afy.



**TABLE 6-4**  
**ACCUMULATED OVERDRAFT, BASIN REFILL, PROBABILITY FACTOR & RAINFALL AMOUNT**

| Accumulated Overdraft (af) | Planned Basin Refill Amount (af) | San Bernardino Rainfall Projection (inches) | Probability Factor |
|----------------------------|----------------------------------|---------------------------------------------|--------------------|
| 0                          | -20,000                          | 27                                          | 10%                |
| 100,000                    | 0                                | 15                                          | 50%                |
| 200,000                    | 10,000 to 20,000                 | 14                                          | 60%                |
| 300,000                    | 15,000 to 30,000                 | 13                                          | 70%                |
| 400,000                    | 20,000 to 40,000                 | 11                                          | 80%                |
| 500,000                    | 25,000 to 50,000                 | 9                                           | 90%                |

For the 2008-09 water year, the estimated supply of recharge water is summarized in Table 6-5.

**TABLE 6-5**  
**RECHARGE WATER SUPPLIES ESTIMATED FOR 2008-09**

| Source                                      | Amount (afy) |
|---------------------------------------------|--------------|
| Santa Ana River Baseflows                   | 146,300      |
| Captured Santa Ana River Stormflows         | 50,000       |
| Natural Net Incidental Recharge             | 60,000       |
| Expected Groundwater Replenishment Supplies | 61,000       |
| Other Expected Supplies                     | 11,000       |
|                                             |              |
| Total                                       | 328,300      |

### **6.7.2 BASIN PRODUCTION LIMITATION**

Another management tool that enables OCWD to sustainably manage the basin is the Basin Production Limitation. Section 31.5(g) (7) of the District Act authorizes limitations on production and the setting of surcharges when those limits are exceeded. This provision can be used when it is necessary to shift pumping from one area of the basin to another. An example of this was the Temporary Coastal Pumping Transfer Program, which shifted approximately 20,000 afy of pumping from the coastal area to inland to minimize seawater intrusion.

## **6.8 Drought Management**

Drought is an extended period of below-average precipitation. There is no single, official definition of the time period associated with a drought. The magnitude of a drought depends on the extent of the deviation from average precipitation, the areal extent of the below-average precipitation, and other factors.

During a drought, flexibility to increase pumping from the basin becomes increasingly important. To the extent that the basin has water in storage that can be pumped out, the basin provides a valuable water supply asset during drought conditions. Ensuring that the basin can provide a buffer against drought conditions requires:

- Maintaining sufficient water in storage that can be pumped out in time of need;
- Operating the basin at the lower water storage in a safe manner; and
- Possessing a plan to refill the basin.

The San Bernardino precipitation station data, shown in Figure 4-11, is used to evaluate the extent of droughts in the Santa Ana River watershed. This station is selected because it is used in the Santa Ana River Watermaster reports (Santa Ana River Watermaster Report, 2008) and has a relatively long period of record.

During drought conditions, the District experiences a decline in the supply of recharge water. Replenishment water from Metropolitan is only available to OCWD when Metropolitan has excess supplies. In addition, the local supply of Santa Ana River recharge water and net incidental recharge water could decline up to 55,000 afy or more during drought years as shown in Table 6-6.

**TABLE 6-6**  
**IMPACT OF DROUGHTS ON RECHARGE WATER SUPPLIES**

| RECHARGE WATER SUPPLY     | ESTIMATED DECREASE IN SUPPLY DUE TO DROUGHT (AF/YR) |
|---------------------------|-----------------------------------------------------|
| Santa Ana River Baseflow  | 15,000                                              |
| Santa Ana River Stormflow | 20,000 or more                                      |
| Net Incidental Recharge   | 20,000 or more                                      |
| <b>Total</b>              | <b>55,000 or more</b>                               |

Note: does not include potential decline in Metropolitan replenishment supplies

### **6.8.1 MAINTAINING WATER IN STORAGE FOR DROUGHT CONDITIONS**

For the basin to serve as a safe, reliable buffer, sufficient groundwater must be stored before a drought occurs. As an example, assume the basin has an accumulated overdraft of 150,000 af and can be drawn down to 500,000 af without irreparable seawater intrusion. The basin has 350,000 af of water in storage. In a hypothetical five-year drought, recharge water supplies can decrease 55,000 afy without jeopardizing the long-term health of the basin. Since recharge water supplies are likely to decline during drought years, the water stored at the beginning of the drought is critical. If water is stored in Metropolitan's conjunctive use storage program, this stored water must also be accounted for.

### **6.8.2 BASIN OPERATION DURING DROUGHT**

When the basin overdraft is intentionally increased, the basin must be operated in a safe manner, considering the potential for land subsidence and seawater intrusion, the availability of sufficient excess recharge capacity to eventually refill the basin, the impact of low groundwater levels on shallow production wells, and a potential for

colored water to flow into clear water aquifers. Approaches for refilling the Basin are described in Table 6-7.

**TABLE 6-7**  
**APPROACHES TO REFILLING THE BASIN**

| APPROACH                     | DISCUSSION                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Decrease Total Water Demands | <ul style="list-style-type: none"> <li>• Increase water conservation measures (note this does not result in a 1:1 decrease in groundwater pumping because some of the increased conservation reduces Metropolitan demands); this decreases pumping from the basin if the BPP is held constant and all other factors remain the same.</li> </ul>                                                       |
| Decrease BPP                 | <ul style="list-style-type: none"> <li>• Allows groundwater levels to recover rapidly</li> <li>• Decreases revenue to the District</li> <li>• Increases water cost for producers</li> <li>• Does not require additional recharge facilities</li> <li>• Dependent upon other sources of water (e.g., water from Metropolitan) being available to substitute for reduced groundwater pumping</li> </ul> |
| Increase Recharge            | <ul style="list-style-type: none"> <li>• Dependent on increased supply of recharge water</li> <li>• Water transfers and exchanges could be utilized to provide the increased supply of recharge water</li> <li>• Dependent on building and maintaining excess recharge capacity (which would be under-utilized in non-drought years)</li> </ul>                                                       |
| Combination of the Above     | <ul style="list-style-type: none"> <li>• A combination of the approaches provides flexibility and a range of options for refilling the basin</li> </ul>                                                                                                                                                                                                                                               |

## 7 FINANCIAL MANAGEMENT

OCWD strives to improve the efficiency of all aspects of its operations in its continuing efforts to increase the water quality and reliability of Orange County's local water resources at the lowest possible cost. The District manages its finances to provide long-term fiscal stability. To achieve this objective OCWD:

- Manages finances to maintain high credit ratings.
- Manages District operations efficiently and effectively.
- Maintains reserves for purchase of supplemental water supplies when available.
- Recovers contamination clean up costs from responsible parties when possible.
- Sets the Basin Production Percentage to optimize sustainable use of groundwater.

### 7.1 Background Financial Information

The District's fiscal year (FY) begins on July 1 and ends on June 30. The annual operating budget for 2008-09 was approximately \$116.3 million; District revenues are expected to be approximately \$116.3 million. A significant increase in the budget to fund the operation of the GWR System was approved by the Board in 2007.

### 7.2 Operating Expenses

The District's budgeted operating expenses for FY 2008-09 are summarized in Table 7-1 and described below.

**TABLE 7-1**  
**FY 2008-09 BUDGETED OPERATING EXPENSES**

| <b>EXPENSES</b>                            | <b>AMOUNT<br/>(in millions)</b> |
|--------------------------------------------|---------------------------------|
| General Fund                               | \$57.2                          |
| Total Debt Service                         | 28.3                            |
| Water Purchases                            | 19.1                            |
| New Equipment/ Small Projects              | 2.2                             |
| Increase to Reserves                       | 0.9                             |
| Refurbishment and Replacement Expenditures | 8.6                             |
| <b>Total</b>                               | <b>\$116.3</b>                  |

### **7.2.1 GENERAL FUND**

The District's general fund account primarily allows the District to operate the recharge facilities in the cities of Anaheim and Orange, GWR System, the Talbert and Alamitos Injection Barriers, the Green Acres Project, and the Prado Wetlands. In addition, the District's Water Quality Laboratory, groundwater monitoring programs, watershed management, planning, and other miscellaneous activities are funded by this account.

### **7.2.2 DEBT SERVICE**

The debt service budget provides for repayment of the District's debt from issues of previous bonds. OCWD has a comprehensive long-range debt program, which provides for the funding of projects necessary to increase basin production and protect water quality, while providing predictable impacts to the RA. The annual project-related debt expense is approximately \$28.3 million.

The District holds very high credit ratings of AAA credit from Standard & Poor's, AAA from Fitch, along with an Aa2 rating from Moody's. Because of these excellent credit ratings, OCWD is able to borrow money at a substantially reduced cost.

### **7.2.3 WATER PURCHASES**

The District Act authorizes OCWD to purchase supplemental water for groundwater recharge to reduce overdraft of the basin. As described in Section 4, replenishment water is primarily purchased from Metropolitan, either as direct or in-lieu replenishment. This fund provides the flexibility to take advantage of surplus Metropolitan replenishment water or other surplus supplies when such supplies are available. During times of drought when replenishment water is unavailable for purchase, OCWD may budget funds for placement in reserve for future years. The District anticipates that surplus imported water will not be available for the next few years. A significant portion of the \$19.1 million in the FY 2008-09 budget to purchase replenishment water will be placed in reserve. Funds in this account are also used to purchase treated full service supplies from MWDOC to blend with GWR System purified water for injection into the seawater barrier.

### **7.2.4 NEW CAPITAL EQUIPMENT**

This category includes equipment items such as laboratory equipment, vehicles, fax machines, tools, computers, and software. These items are expensed and funded using current revenues.

### **7.2.5 REFURBISHMENT AND REPLACEMENT FUND**

OCWD has over \$700 million in existing plant and fixed assets. These facilities were constructed to provide a safe and reliable water supply. The Replacement and Refurbishment Fund was established to ensure that sufficient funds are available to repair and replace existing District infrastructure, such as pumps, heavy equipment, wells and water recycling facilities.

### 7.3 Operating Revenues

Expected operating revenues for FY 2008-09 are shown in Table 7-2 and described below.

**Table 7-2**  
**FY 2008-09 Operating Revenues**

| <b>REVENUES</b>             | <b>AMOUNT<br/>(in millions)</b> |
|-----------------------------|---------------------------------|
| Replenishment Assessments   | \$84.5                          |
| Basin Equity Assessment     | 1.0                             |
| Property Taxes              | 18.1                            |
| Other Miscellaneous Revenue | 12.7                            |
| <b>Total</b>                | <b>\$116.3</b>                  |

#### 7.3.1 REPLENISHMENT ASSESSMENTS

RAs are paid for all water pumped out of the basin. The District invoices Producers for their production in July and January. The amount of revenue generated by the RA is directly related to the amount of groundwater production. The RA is anticipated to generate \$84.5 million in FY 2008-09 based on 341,058 af of total anticipated basin production. The BEA is assessed annually for all groundwater production above the BPP. The BEA rate is calculated for each agency and is currently approximately \$381/af. Anticipated BEA revenues are budgeted at \$1.0 million for FY 2008-09.

#### 7.3.2 PROPERTY TAXES

The District receives a small percentage of the property taxes, also referred to as ad valorem taxes, collected in the service area. For 2008-09, the District expects to receive approximately \$18.1 million from property taxes. The County of Orange assesses and collects the property taxes and transmits them to the District at various times during the year. This revenue source has been dedicated to the District's annual debt service expense.

#### 7.3.3 OTHER MISCELLANEOUS REVENUE

Cash reserves generate interest revenues. The majority of cash reserves are invested in short-term securities. Yields on cash reserves are anticipated to be low and have been estimated at three percent for 2008-09, for anticipated revenue of \$4.2 million.

Miscellaneous revenues are primarily comprised of water sales from the Green Acres Project and loan repayments. The loan repayments originate from the Conjunctive Use Well Program in which the District loaned Producers money at low interest rates for construction of new production wells and related facilities. In addition, numerous small items such as rents, subsidies, and minor fees are grouped in this account. Approximately \$8.7 million is expected to be received in 2008-09.



## **7.4 Reserves**

The District maintains cash reserves to ensure its financial integrity so that the basin can be successfully managed and protected. Cash reserves ensure that:

- OCWD has sufficient funds for cash flow purposes;
- Funds are available for unexpected events such as contamination issues;
- Funds are available to make necessary replacements and repairs to infrastructure;
- OCWD has access to debt programs with low interest cost;
- A financial hedge is available to manage variable rate debt; and
- Funds are available to purchase Metropolitan replenishment water when available.

### **7.4.1 RESERVE POLICIES**

The District has reserve policies, which establish reserves in the following categories:

- Operating reserves
- The Replacement and Refurbishment Program
- The Toxic Cleanup Reserve
- Contingencies required by the District Act
- Bond reserve covenants

#### **7.4.1.1 Operating Reserves**

This reserve category helps the District maintain sufficient funds for cash flow purposes and helps sustain the District's excellent credit rating. Maintaining this reserve, which is set at 15 percent of the operating budget, is particularly important because the principal source of revenue, the RA, is only collected twice a year. Payments for significant activities, such as replenishment water purchases, are typically required on a monthly basis. The reserve provides the financial "bridge" to meet the District's financial obligations on a monthly basis.

#### **7.4.1.2 Replacement and Refurbishment Program**

The District maintains a Replacement and Refurbishment Fund to provide the financial resources for replacement and/or repair of the District capital assets. These assets include treatment facilities, monitoring and injection wells, and treatment facilities. The fund balance at the end of FY 2008-09 was projected to be approximately \$41.2 million.

#### **7.4.1.3 Toxic Cleanup Reserve**

Funds are reserved in this account to be used in the event that a portion of the basin becomes threatened by contamination. Over two million residents in the District rely on the basin as their primary source of water. Approximately \$7 million is projected to be available in this reserve fund at the end of FY 2008-09 to allow the District to respond immediately to contamination threats in the basin.

#### **7.4.1.4 General Contingencies**

Section 17.1 of the District Act requires the allocation of funds to cover annual expenditures that have not been provided for or that have been insufficiently provided for and for unappropriated requirements. This reserve amount is \$3 million.

#### **7.4.2 DEBT SERVICE ACCOUNT**

Restricted funds in this account have been set aside by the bonding institutions as a requirement to ensure financial solvency and to help guarantee repayment of any debt issuances. These funds cannot be used for any other purpose. The requirement varies from year to year depending on the District's debt issuance and outstanding state loans. The account currently has approximately \$5.5 million.

### **7.5 *Capital Improvement Projects***

The District prepares a Capital Improvements Project budget to support basin production by increasing recharge capacity and operational flexibility, protect the coastal portion of the basin, and provide water quality improvements. The FY 2008-09 budget includes \$20.5 million for this account.

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## 8 RECOMMENDATIONS

This section provides recommendations for the District to consider as part of ongoing management of the basin.

The District's programs to protect and increase the basin's sustainable yield in a cost-effective manner continue to evolve due to increasing water demands and changes in the availability of recharge water supplies. The occurrence of wet and dry periods, the future availability and cost of imported water for groundwater recharge, and changing water management practices of agencies in the watershed will continue to affect the District's management of the basin. The District's programs to protect and enhance water quality will also continue to change due to new regulations and requirements.

Recommendations for the District to continue its proactive management of the basin are summarized in Table 8-1. The table organizes these recommendations by general program area and also links the recommendations to the three management objectives of protecting and enhancing water quality, protecting and increasing the basin's sustainable yield, and increasing the efficiency of OCWD's operations.

Specific projects that may be developed as a result of these recommendations would be reviewed and approved by the District's Board of Directors and processed for environmental review prior to project implementation.

**TABLE 8-1  
RECOMMENDATIONS**

| PROGRAM/ACTIVITY                                                                                                                                                       | PROTECT<br>AND<br>ENHANCE<br>WATER<br>QUALITY | PROTECT<br>AND<br>INCREASE<br>SUSTAINABLE<br>YIELD | INCREASE<br>EFFICIENCY |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------|------------------------|
| <b>REPORTING AND MONITORING</b>                                                                                                                                        |                                               |                                                    |                        |
| Continue to monitor groundwater elevations and the amount of water in storage to provide information to manage pumping in the basin within safe and sustainable levels | ✓                                             | ✓                                                  |                        |
| Continue to monitor groundwater quality and the quality of recharge water sources                                                                                      | ✓                                             |                                                    |                        |
| Update the <i>Groundwater Management Plan</i> periodically                                                                                                             | ✓                                             | ✓                                                  | ✓                      |
| Update the <i>Long Term Facilities Plan</i> periodically                                                                                                               | ✓                                             | ✓                                                  | ✓                      |

| PROGRAM/ACTIVITY                                                                                                                                                                                                                                                                                           | PROTECT<br>AND<br>ENHANCE<br>WATER<br>QUALITY | PROTECT<br>AND<br>INCREASE<br>SUSTAINABLE<br>YIELD | INCREASE<br>EFFICIENCY |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------|------------------------|
| Continue annual publication of the <i>Santa Ana River Water Quality Report</i> ; the <i>Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization</i> ; the <i>Santa Ana River Watermaster Report</i> ; and the <i>Groundwater Replenishment System Operations Annual Report</i> | ✓                                             | ✓                                                  | ✓                      |
| Begin in 2009 periodic publication of the <i>Report on Managed Aquifer Recharge in the Orange County Groundwater Basin</i>                                                                                                                                                                                 |                                               | ✓                                                  |                        |
| <b>RECHARGE WATER SUPPLY MANAGEMENT</b>                                                                                                                                                                                                                                                                    |                                               |                                                    |                        |
| Increase storage of storm flows behind Prado Dam through cooperative efforts with the ACOE                                                                                                                                                                                                                 |                                               | ✓                                                  | ✓                      |
| Monitor water management and recycling plans in the watershed for their potential impact upon OCWD recharge operations                                                                                                                                                                                     | ✓                                             | ✓                                                  |                        |
| Complete a feasibility study on reducing sediment loads in recharge water                                                                                                                                                                                                                                  | ✓                                             |                                                    | ✓                      |
| Complete construction of the Initial Expansion of the GWR System                                                                                                                                                                                                                                           | ✓                                             | ✓                                                  |                        |
| Increase drought preparedness through utilization of the full capacity of the GWR System                                                                                                                                                                                                                   |                                               | ✓                                                  |                        |
| Develop improved tools to evaluate the efficiency of potential new recharge basins and proposed changes to existing recharge operations                                                                                                                                                                    |                                               | ✓                                                  | ✓                      |
| Evaluate new approaches to groundwater recharge and approaches to increasing the efficiency of the District's recharge facilities                                                                                                                                                                          |                                               | ✓                                                  | ✓                      |
| Maintain and expand efforts to remove non-native vegetation and plant native vegetation in the watershed.                                                                                                                                                                                                  | ✓                                             | ✓                                                  |                        |
| Promote incidental recharge to the extent feasible without negatively impacting groundwater quality                                                                                                                                                                                                        |                                               | ✓                                                  |                        |

| PROGRAM/ACTIVITY                                                                                                                                                    | PROTECT<br>AND<br>ENHANCE<br>WATER<br>QUALITY | PROTECT<br>AND<br>INCREASE<br>SUSTAINABLE<br>YIELD | INCREASE<br>EFFICIENCY |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------|------------------------|
| <b>WATER QUALITY MANAGEMENT</b>                                                                                                                                     |                                               |                                                    |                        |
| Manage recharge water supplies so that water recharged through District facilities meets or is better than Department of Public Health MCLs and Notification Levels | ✓                                             |                                                    |                        |
| Continue operation of Prado Wetlands in order to reduce nitrogen loads in Santa Ana River water                                                                     | ✓                                             |                                                    |                        |
| Complete and publish, in cooperation with Metropolitan and the NWRI, a research study on emerging constituents.                                                     | ✓                                             |                                                    |                        |
| Prevent future contamination through coordinated efforts with regulatory agencies and watershed stakeholders                                                        | ✓                                             |                                                    |                        |
| Complete construction and begin operation of the North Basin Groundwater Protection Project                                                                         | ✓                                             |                                                    |                        |
| Complete remedial investigation and begin construction of the South Basin Groundwater Protection Project                                                            | ✓                                             |                                                    |                        |
| Address MTBE contamination                                                                                                                                          | ✓                                             |                                                    |                        |
| Open and begin operations of a new water quality laboratory in Fountain Valley                                                                                      | ✓                                             |                                                    |                        |
| Maintain control of seawater intrusion in the Talbert Gap                                                                                                           | ✓                                             | ✓                                                  |                        |
| Improve the performance of the Alamitos Seawater Barrier through evaluating need for additional injection wells and to construct necessary facilities               | ✓                                             | ✓                                                  |                        |
| <b>INTEGRATED MANAGEMENT OF PRODUCTION AND RECHARGE</b>                                                                                                             |                                               |                                                    |                        |
| Continue to participate in cooperative efforts with watershed stakeholders                                                                                          | ✓                                             | ✓                                                  |                        |
| Operate the basin within a safe and sustainable operating range                                                                                                     |                                               | ✓                                                  |                        |



| PROGRAM/ACTIVITY                                                                   | PROTECT<br>AND<br>ENHANCE<br>WATER<br>QUALITY | PROTECT<br>AND<br>INCREASE<br>SUSTAINABLE<br>YIELD | INCREASE<br>EFFICIENCY |
|------------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------|------------------------|
| <b>FINANCIAL MANAGEMENT</b>                                                        |                                               |                                                    |                        |
| Set the Basin Production Percentage to optimize sustainable use of the groundwater |                                               |                                                    | ✓                      |
| Manage finances to maintain high credit ratings                                    |                                               |                                                    | ✓                      |
| Maintain reserves for purchase of supplemental water supplies when available       |                                               |                                                    | ✓                      |

## 9 References

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# APPENDICES

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| APPENDIX A | DOCUMENTS REGARDING PUBLIC PARTICIPATION                                                                               |
| APPENDIX B | REQUIRED AND RECOMMENDED COMPONENTS<br>FOR GROUNDWATER MANAGEMENT PLANS                                                |
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| APPENDIX E | OCWD MONITORING WELLS                                                                                                  |
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# APPENDIX A

## DOCUMENTS REGARDING PUBLIC PARTICIPATION

## APPENDIX A

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GROUNDWATER PRODUCERS MINUTES, JANUARY 14, 2009

WATER ISSUES COMMITTEE AGENDA, MAY 13, 2009

GROUNDWATER PRODUCERS MINUTES, MAY 13, 2009

OCWD WEBSITE NOTICE, MAY 13, 2009

OC REGISTER NOTICE, MAY 19, 2009

WATER ISSUES COMMITTEE AGENDA, JUNE 10, 2009

GROUNDWATER PRODUCERS MINUTES, JUNE 10, 2009

OCWD BOARD AGENDA, JUNE 17, 2009

COMMENTS FROM CITY OF ANAHEIM, JUNE 26, 2009

RESPONSES TO COMMENTS

NOTICE OF EXEMPTION

CERTIFICATION OF BOARD ACTION APPROVING GROUNDWATER MANAGEMENT PLAN

2009 UPDATE

MINUTES  
GROUNDWATER PRODUCERS MEETING  
Sponsored by the  
ORANGE COUNTY WATER DISTRICT  
Field Headquarters, Anaheim

Wednesday, January 14, 2009, 10 AM

**1. MTBE Sampling Update**

Roy Herndon informed the group that the latest round of sampling and low level testing had been completed with the lab hired by the District. And that low levels of MTBE had been detected in about 1/3 of the major production wells in the basin. The Producers were told to contact Roy if they wanted specific information on their individual wells.

**2. Long-Term Facilities Plan Report**

The Producers were asked to get any comment letters they may have on the final draft report to OCWD by January 21, 2009. OCWD will then respond to those letters. The LTFP final review will occur at the next Producers meeting on February 11, 2009 and could then go to the OCWD Board on February 18, 2009. The recent Golden State Water Company letter on the LTFP was distributed.

**3. Groundwater Management Plan – 5 Year Update**

Greg Woodside informed everyone of the need to update the GWMP to comply with state guidelines. The District is working to provide a draft of the updated document in late February and to take it to the OCWD Board in April. Greg reviewed potential basin management goals for the document.

**4. Santiago Pump Station Project**

The same presentation on this project provided to the Water Issues Committee was given to the Producers. It was suggested that OCWD should show the financial savings and the additional recharge created by the project.

**5. FY09-10 Budget process update**

John Kennedy provided an update on several budget related issues including:

- OCWD is working to provide FY09-10 RA and BPP projections by January 21.
- The District will also provide the draft FY09-10 Work Plans for each of the cost centers on January 21.

OCWD Staff was also asked to provide a BEA estimate and an estimate of what the Accumulated Overdraft would be at the end of FY09-10

**6. Follow-up on Producer letter regarding modeling for the Talbert Barrier and Basin Storage**

OCWD's response letter to the Producers regarding this issue was provided. Bob McVicker provided comments on the need to better understand color water upwelling in their part of the groundwater basin.

**7. Other**

## **AGENDA ITEM SUBMITTAL**

**Meeting Date:** May 13, 2009

**To:** Water Issues Committee  
Board of Directors

**From:** Mike Markus

**Staff Contact:** G. Woodside/C. Miller

**Budgeted:** N/A

**Budgeted Amount:** N/A

**Cost Estimate:** N/A

**Funding Source:** N/A

**Program/Line Item No.:** N/A

**General Counsel Approval:** N/A

**Engineers/Feasibility Report:** N/A

**CEQA Compliance:** Exemption to be  
filed upon Board receipt of final plan

**Subject: REVIEW OF UPDATED GROUNDWATER MANAGEMENT PLAN**

---

### **SUMMARY**

Staff has prepared a draft updated Groundwater Management Plan (Plan). The Plan was last updated in 2004. Staff will distribute the draft updated Plan for review by the Board and Producers. The Plan will also be posted on the District's web site.

### **RECOMMENDATION**

Informational

### **BACKGROUND/ANALYSIS**

The District prepared its first Groundwater Management Plan in 1989. The Plan was last updated in 2004. The Plan needs to be updated to remain consistent with guidelines established by the California Department of Water Resources.

The California Water Code sets forth the process for adopting and updating a Groundwater Management Plan. The Water Code lists components that must be included and requires the completion of plans in order for the state to grant public funds for construction of certain groundwater projects.

The 2009 Draft Update proposes the District's overall goals in managing the basin as follows:

- To protect and enhance groundwater quality,
- To protect and increase the sustainable yield of the basin in a cost-effective manner, and
- To increase the efficiency of OCWD's operations.

The updated Plan will be made available for public review. Staff will respond to comments from the Board, Producers, and the public and will prepare a revised version that addresses the comments received. Staff will then recommend that the Plan be adopted by the Board. The proposed schedule is:

|               |                                                          |
|---------------|----------------------------------------------------------|
| May 13, 2009  | Post Draft Updated Plan on OCWD website                  |
| May 14, 2009  | Post public notice in Orange County Register             |
| June 10, 2009 | Workshop at Water Issues Committee and Producers Meeting |
| June 17, 2009 | Public Hearing at OCWD Board meeting                     |
| June 24, 2009 | Deadline for public comment                              |
| July 15, 2009 | Consideration of adoption by Board of Directors          |

According to the Department of Water Resources, plan updates should provide a historical record of progress, including projects completed and how those projects improved resource management. The 2009 Update explains how OCWD manages the groundwater basin in order to accomplish the stated management objectives.

Major accomplishments since the adoption of the 2004 plan are listed and completed projects are described, examples of which are listed below:

- Analysis of 14,000 water quality samples in 2008.
- Completion of the Groundwater Replenishment System in 2008.
- Development of the three-layer method of determining maximum accumulated overdraft and publication of the *Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy* in 2007.
- Improvements to recharge operations such as completion of the La Jolla Recharge Basin, the Kraemer-Miller pipeline improvements, and the Santiago Creek Recharge Enhancement Project.
- Completion of water quality improvement projects such as the Irvine Desalter and the initiation of the North and South Basin Groundwater Protection Projects.

#### **PRIOR RELEVANT BOARD ACTION(S)**

None



Minutes  
GROUNDWATER PRODUCERS MEETING  
Sponsored by the  
ORANGE COUNTY WATER DISTRICT  
18700 Ward Street, Fountain Valley (714) 378-3200

**Wednesday, May 13, 2009, 10 AM**

**1. Groundwater Management Plan Update**

Greg Woodside gave an overview of the updated GWMP and how it would be processed this summer. A draft report was distributed. Greg reviewed the report recommendations.

**2. Review FY09-10 BPP/BEA/Pumping Limitation and Surcharge**

John Kennedy reviewed the new rates and charges for FY09-10

**3. Annexation Update**

John Kennedy provided a summary of how the District plans to terminate the 2004 annexation MOU with IRWD and the City of Anaheim. After responses are provided on the draft January 2006 Program EIR the District will formally inform IRWD and Anaheim of the termination as allowed for in Section 7 of the MOU. Future annexations could still be considered but under a different process from what was provided for in the 2004 MOU. Other comments included that Producers interested in annexing may be required to submit new applications. Additionally if annexations are considered individually, there is still a need to review the cumulative potential annexations.

With the MOU terminated the District can receive and file the Long-Term Facilities Plan Report. The LTFP will be reviewed with the Producers in June and taken to the OCWD Board in July.

#### **4. GWR System Update**

##### **a. Expansion**

Mike Markus gave an update on the process to select a design consultant for the expansion and some of the issues that need to be resolved. It was mentioned that OCWD should reassess the projects viability at key milestones prior to 100% design.

##### **b. Existing plant water supply unit cost for FY08-09**

A handout was provided which shows the existing unit cost at \$582/af after the first nine months of FY08-09

#### **5. Other**

Bob McVicker asked that OCWD provide BPP projections for future years.

Discussion on AB1100 also occurred regarding legislation that would allow OCWD to bottle a small amount of GWR System water.

**Information: OCWD May 20, 2009 Board meeting moved to May 27<sup>th</sup>.**



Orange County Water District  
Orange County's Groundwater Authority

EMPLOYMENT • SITE MAP • CONTACT • SEARCH Keyword(s)

GO

ABOUT BOARD & AGENDAS CONSERVATION & EDUCATION ENVIRONMENT PROGRAMS & PROJECTS GOVERNMENT AFFAIRS NEWS

## OCWD Public Notices

---

### May 13, 2009 - June 24, 2009

The Orange County Water District Draft Groundwater Management Plan 2009 Update is available for public review at [www.ocwd.com](http://www.ocwd.com) under "News & Publications." Written comments will be accepted until June 24, 2009 at:

Orange County Water District

Attn: Marsha Westropp

P.O. Box 8300

Fountain Valley, CA 92728-8300

Or via e-mail at [mwestropp@ocwd.com](mailto:mwestropp@ocwd.com)

A copy of the draft plan may be obtained by submitting a written request to OCWD at the above post office or e-mail address.

The public is invited to comment on the plan at the public hearing to be held at the regularly scheduled meeting of the Board of Directors at 5 p.m., June 17, 2009 in the Boardroom at OCWD's office at 18700 Ward Street, Fountain Valley, CA 92708. The Groundwater Management Plan 2009 Update is scheduled to be considered for adoption at the regularly scheduled meeting of the Board of Directors at 5 p.m., July 15, 2009. Any change to the schedule for the Board of Directors to adopt the updated plan will be posted on [www.ocwd.com](http://www.ocwd.com) under "Board Agendas."

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18700 Ward Street, Fountain Valley, California 92708 • Ph: (714) 378-3200 • Fx: (714) 378-3373 • [info@ocwd.com](mailto:info@ocwd.com)  
[Check your OCWD e-mail HERE](#) • [Directions & Map](#)



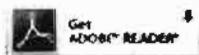
**Orange County Water District**  
Orange County's Groundwater Authority

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ABOUT BOARD & AGENDAS CONSERVATION & EDUCATION ENVIRONMENT PROGRAMS & PROJECTS GOVERNMENT AFFAIRS NEWS

## Publications & Newsletters

For easy viewing of our publications in the manner in which they were intended, we have converted our publications into Adobe® Acrobat PDF documents. If you do not already have the FREE Adobe Reader, please click the following button to get the latest version of Adobe® Reader from Adobe® before you attempt to download the files listed below.



### OCWD Draft Groundwater Management Plan 2009 Update (11.5 MB)

The Orange County Water District Draft Groundwater Management Plan 2009 Update is available for public review by downloading the linked document above. Written comments will be accepted until June 24, 2009 at OCWD, Attn: Marsha Westropp, P.O. Box 8300, Fountain Valley, CA 92728-8300, or via e-mail at [mwestropp@ocwd.com](mailto:mwestropp@ocwd.com). A copy of the draft plan may also be obtained by submitting a written request to OCWD at the above post office or email address.

The public is invited to comment on the plan at the public hearing held at the regularly scheduled meeting of the OCWD Board of Directors at 5 p.m., June 17, 2009. The Groundwater Management Plan 2009 Update is scheduled to be considered for adoption at the regularly scheduled meeting of the OCWD Board of Directors at 5 p.m., July 15, 2009. Any change to the schedule for the Board of Directors to adopt the updated plan will be posted on [www.ocwd.com](http://www.ocwd.com) under "Board Agendas."

Notice of Basin Equity Assessment, July 1 2009 to June 30 2010

Notice of Levy of Replenishment Assessments, July 1 2009 to June 30 2010

Board Resolution to Adopt Ticket Distribution Policy

Board Resolution Authorizing Payment for Meals

Comprehensive Annual Financial Report FY Ended 6-30-2008

OCWD 2006-2007 Engineer's Report; Groundwater Conditions, Water Supply and Basin Utilization

OCWD 2005-2006 Engineer's Report; Groundwater Conditions, Water Supply and Basin Utilization (5.43 MB)

OCWD Budget Report for Fiscal Year 07-08 (3.47 MB)

2004 - Santa Ana River Water Quality and Health Study (25.6 MB)

2004 - Santa Ana River Quality Health Study Final Report Appendices (2.64 MB)

2006 - 07 Fiscal Year Final Budget Report (3.33 MB)

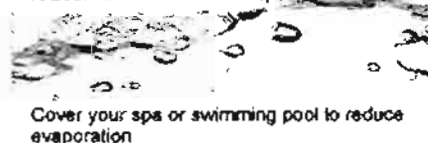
2004 Groundwater Management Plan (7.87 MB)

OCWD Fact Sheet - May 2008

The 1933 OCWD District Act (223 kb)

[Directions + Map](#)

### Water Conservation Tip:



Be an  
O.C. Water  
Hero!



Children's  
Water Education  
Festival



### OCWD 75th Anniversary Supplement Newsletters:

NEW-- Hydrospectives - Monthly E-Newsletter

2008 Year In Review

November 2008 E-Hydrospectives

October 2008 E-Hydrospectives

September 2008 E-Hydrospectives

August 2008 E-Hydrospectives

July 2008 E-Hydrospectives

June 2008 E-Hydrospectives

Hydrospectives - Quarterly Groundwater News

- Vol. V, Issue 2 - Fall 2007
- Vol. V, Issue 1 - Spring 2007
- Vol. IV, Issue 3 - Winter 2006
- Vol. IV, Issue 1 - Summer 2005
- Vol. III, Issue 3 - Fall 2004

## AFFIDAVIT OF PUBLICATION

STATE OF CALIFORNIA, )  
County of Orange ) ss.  
County of Orange )

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not a party to or interested in the above entitled matter. I am the principal clerk of **The Orange County Register**, a newspaper of general circulation, published in the city of Santa Ana, County of Orange, and which newspaper has been adjudged to be a newspaper of general circulation by the Superior Court of the County of Orange, State of California, under the date of 1/18/52, Case No. A-21046, that the notice, of which the annexed is a true printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

May 19, 26, 2009

"I certify (or declare) under the penalty of perjury under the laws of the State of California that the foregoing is true and correct".

Executed at Santa Ana, Orange County, California, on

Date: May 26, 2009

  
Signature

**The Orange County Register**  
625 N. Grand Ave.  
Santa Ana, CA 92701  
(714) 796-7000 ext. 2209

PROOF OF PUBLICATION

Proof of Publication of

### Notice of Public Hearing For the Purpose of Updating the Orange County Water District Groundwater Management Plan 2009

Notice is hereby given that the Orange County Water District ("District") will hold a public hearing on Wednesday, June 17, 2009 at 5 p.m., or as soon thereafter as the matter may be heard, in the Boardroom at the office of said District, 187161 West Street, Fountain Valley, California 92708.

The hearing is for the purpose of notifying the public of the intention of the District to update the District's Groundwater Management Plan and for soliciting public comments on the draft Groundwater Management Plan 2009 Update prior to adoption of the plan.

The draft plan may be viewed on the District's website, [www.ocwd.com](http://www.ocwd.com). Copies may be obtained by submitting a written request to Orange County Water District, P.O. Box 8500, Fountain Valley, CA 92708-8500. Attn: Michele Westropp. Copies will be available at the public hearing.

The public is invited to attend the public hearing and comment on the draft plan. Written comments must be submitted by June 24, 2009. Comments can be submitted to the above post office box address, Attn: Michele Westropp or via email at [mwestropp@ocwd.com](mailto:mwestropp@ocwd.com). For additional information call 714-373-8248.

The Groundwater Management Plan 2009 Update is scheduled to be considered for adoption by the District's Board of Directors at the regularly scheduled meeting of the Board of Directors to be held on July 15, 2009 at 5 p.m. Any change to the schedule for the Board of Directors to adopt the Groundwater Management Plan 2009 Update will be posted on the District's website, [www.ocwd.com](http://www.ocwd.com).

Published: Orange County Register, May 19, 26, 2009 / R-801

## **AGENDA ITEM SUBMITTAL**

**Meeting Date:** June 10, 2009

**To:** Water Issues Committee  
Board of Directors

**From:** Mike Markus

**Staff Contact:** G. Woodside/C. Miller

**Budgeted:** N/A

**Budgeted Amount:** N/A

**Cost Estimate:** N/A

**Funding Source:** N/A

**Program/Line Item No.:** N/A

**General Counsel Approval:** N/A

**Engineers/Feasibility Report:** N/A

**CEQA Compliance:** Exemption to be  
filed upon Board adoption of updated plan

**Subject: UPDATE: 2009 GROUNDWATER MANAGEMENT PLAN,  
PUBLIC COMMENT PERIOD AND PUBLIC HEARING**

---

### **SUMMARY**

Staff distributed draft copies of the updated Groundwater Management Plan (Plan) to the Board and Producers on May 13, 2009. Public notices were published in the Orange County Register and the draft plan was posted on the District's web site. A public hearing on the draft Plan will be held at the June 17 Board of Directors Meeting.

### **RECOMMENDATION**

Informational

### **BACKGROUND/ANALYSIS**

The District prepared its first Groundwater Management Plan in 1989. The Plan has been updated periodically to incorporate new information, and was last updated in 2004. The Plan needs to be periodically updated to remain consistent with guidelines established by the California Department of Water Resources.

The California Water Code lists components that must be included and requires the completion of plans in order for the state to grant public funds for construction of certain groundwater projects.

The 2009 Plan discusses the District's overall goals in managing the basin as follows:

- To protect and enhance groundwater quality,
- To protect and increase the sustainable yield of the basin in a cost-effective manner, and
- To increase the efficiency of OCWD's operations.



The comment period for the Plan is now open. Staff will respond to comments from the Board, Producers, and the public and will prepare a revised version that addresses comments received. The proposed schedule for adopting the plan is as follows:

|               |                                                          |
|---------------|----------------------------------------------------------|
| June 10, 2009 | Workshop at Water Issues Committee and Producers Meeting |
| June 17, 2009 | Public Hearing at OCWD Board meeting                     |
| June 24, 2009 | Deadline for public comment                              |
| July 15, 2009 | Consideration of Plan adoption by Board of Directors     |

According to the Department of Water Resources, plan updates should provide a historical record of progress, including projects completed and how those projects improved resource management. The 2009 Update explains how OCWD manages the groundwater basin in order to accomplish the stated management objectives.

Major accomplishments since the adoption of the 2004 Plan are listed and completed projects are described, examples of which are listed below:

- Analysis of 14,000 water quality samples in 2008.
- Completion of the Groundwater Replenishment System in 2008.
- Development of the three-layer method of determining maximum accumulated overdraft and publication of the *Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy* in 2007.
- Improvements to recharge operations such as completion of the La Jolla Recharge Basin, the Kraemer-Miller pipeline improvements, and the Santiago Creek Recharge Enhancement Project.
- Completion of water quality improvement projects such as the Irvine Desalter and the initiation of the North and South Basin Groundwater Protection Projects.

#### **PRIOR RELEVANT BOARD ACTION(S)**

None

Minutes  
GROUNDWATER PRODUCERS MEETING  
Sponsored by the  
ORANGE COUNTY WATER DISTRICT  
18700 Ward Street, Fountain Valley (714) 378-3200

**Wednesday, June 10, 2009, 10 AM**

**1. Water Quality Issues**

None

**2. Review Groundwater Management Plan**

Greg Woodside updated everyone on the processing of the GWMP. The Producers were provided a copy of the GWMP last month.

**3. Review Long-Term Facilities Plan**

Greg Woodside reviewed the LTFP and the schedule for completing the document. The document will be mailed and emailed to everyone this week.

**4. Update on Warner Basin Hopkins Development Study**

Mike Markus updated the group on the preliminary development work occurring with the Hopkins group and the District's likely plans to continuing exploring this idea for the next six months. Hopkins is looking at ideas to place retail development around Warner Basin but would need to compensate OCWD for any lost percolation.

**5. FY10-11 BPP Projections**

John Kennedy distributed some preliminary FY10-11 BPP projections for planning purposes. OCWD was asked to provide an RA projection also at next months meeting.

**6. Potential loss of Ad Valorem property tax – Prop 1A**

The District is closely monitoring the Sacramento budget discussions and the potential loss of a portion of our \$19 million in property tax income. We are unsure if the state plans to take or borrow some of these revenues. Eleanor Torres informed everyone that the District may have

discussions with some local City Councils on this issue and would coordinate such with the Producers.

**7. OCWD Long-Term Variable Rate Debt Program**

Mike Markus explained how the District's variable rate debt cost has increased due to a downgrading of the German Landesbank (who provides the letter of credit for the deal). OCWD may convert the debt to fixed rate debt.

**8. Garden Grove Well 28 & Laguna Beach potential program**

The Producers were informed that the District, Garden Grove and Laguna Beach have met to discuss a possible option to pump and treat the GG Well 28 which has high nitrates. The potential deal would incorporate an agreement the District has with LB to pump 2,025 afy of ground water. When additional details are developed they will be brought back to a future Producers meeting.

**9. Select a Vice Chair for the Producers Group in FY09-10**

Rick Shintaku of Anaheim was elected to be the Vice Chairman

**10. Other**

Mike Markus updated everyone on the GWR System flows and the plans to hire a design consultant to expand the plant from 70 mgd to 100 mgd.

## AGENDA ITEM SUBMITTAL

**Meeting Date:** June 17, 2009

**To:** Board of Directors

**From:** Mike Markus

**Staff Contact:** G. Woodside/C. Miller

**Budgeted:** N/A

**Budgeted Amount:** N/A

**Cost Estimate:** N/A

**Funding Source:** N/A

**Program/Line Item No.:** N/A

**General Counsel Approval:** N/A

**Engineers/Feasibility Report:** N/A

**CEQA Compliance:** N/A

**Subject: PUBLIC HEARING TO CONSIDER DRAFT UPDATED GROUNDWATER  
MANAGEMENT PLAN**

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### SUMMARY

The draft updated Groundwater Management Plan has been provided on the District's website and also to the Board and the Groundwater Producers. A Public Hearing has been noticed for 5 pm on June 17, 2009 to provide an opportunity for public input on the draft updated Plan.

### RECOMMENDATION

Open Public Hearing and receive comments.

### DISCUSSION

The District prepared its first Groundwater Management Plan in 1989. The Plan has been updated periodically to incorporate new information, and was last updated in 2004. The Plan needs to be periodically updated to remain consistent with guidelines established by the California Department of Water Resources.

The California Water Code lists components that must be included and requires the completion of plans in order for the state to grant public funds for construction of certain groundwater projects.

The 2009 Plan discusses the District's overall goals in managing the basin as follows:

- To protect and enhance groundwater quality,
- To protect and increase the sustainable yield of the basin in a cost-effective manner, and
- To increase the efficiency of OCWD's operations.

The comment period for the draft updated Plan is now open. After the public comment period is closed, staff will respond to comments from the Board, Producers, and the public and will prepare a revised version that addresses comments received. The proposed schedule for adopting the plan is as follows:

|               |                                                      |
|---------------|------------------------------------------------------|
| June 17, 2009 | Public Hearing at OCWD Board meeting                 |
| June 24, 2009 | Deadline for public comment                          |
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- Completion of water quality improvement projects such as the Irvine Desalter and the initiation of the North and South Basin Groundwater Protection Projects.

**PRIOR RELEVANT BOARD ACTION(S) N/A**

**From:** Dick Wilson [mailto:DWilson@anaheim.net]  
**Sent:** Friday, June 26, 2009 11:40 AM  
**To:** Woodside, Greg  
**Cc:** Rick Shintaku; Don Calkins  
**Subject:** Draft Groundwater Mgmt Plan

Greg, here are my comments on the Draft GWMP:

1. I would like to see an objective such as, "Promote incidental recharge to the extent feasible without impacting groundwater quality." This could be added to Section 1.8.2 and Section 8 and generally included throughout the document.
2. Section 4 should include a discussion of ways to increase incidental recharge. According to the document, incidental recharge accounts for about 20% of the total recharge, and this is with the vast majority of storm flows escaping over streets and into concrete storm drains. There's a huge volume of water that could be captured for future use via "dry wells," swales, wetlands, etc. If we are to sustain our groundwater basin, we will need to take advantage of this resource.
3. Section 5 should include a discussion of perchlorate contamination including where it came from, how its dispersing in the groundwater basin and how long before it is "gone."
4. Several of the figures are too small of scale. For example, on Figure ES-5, you cannot distinguish between monitoring wells and production wells. The figures should be larger, or less information provided on them. I concur that we should not disclose exact locations of production wells, but it's very important to know exactly where the monitoring wells are located.
5. In several cases it may be better to provide data in tables rather than graphs. For example, Figure ES-10 would be much easier to comprehend if the data were provided in a table. It is very difficult to assess trends for data in stacked bar graphs.
6. Overall, it's an excellent document and will be a valuable resource. OCWD should recognize that all water producers in the Basin will need to include this document in State and Federal grant applications and the Plan should include a broad spectrum of concepts for improving groundwater sustainability.

If you'd like to talk about any of these issues, please feel free to contact me.

**Dick Wilson**  
*Environmental Services Manager*  
*Anaheim Public Utilities Department*  
714-765-4277  
[dwilson@anaheim.net](mailto:dwilson@anaheim.net)

---

THIS MESSAGE IS INTENDED ONLY FOR THE USE OF THE INDIVIDUAL OR ENTITY TO WHICH IT IS ADDRESSED AND MAY CONTAIN INFORMATION THAT IS PRIVILEGED, CONFIDENTIAL, AND EXEMPT FROM DISCLOSURE UNDER APPLICABLE LAWS. If the reader of this message is not the intended recipient, or the employee or agent responsible for delivering the message to the intended recipient, you are hereby notified that any dissemination, distribution, forwarding, or copying of this communication is strictly prohibited. If you have received this communication in error, please notify the sender immediately by e-mail or telephone, and delete the original message immediately. Thank you.



**Response to Comments received June 26, 2009 from Dick Wilson, Environmental Services Manager, Anaheim Public Utilities Department**

| No. | <u>Comment</u>                                                                                                                                                                                                     | <u>Response to Comment</u>                                                                                                                                                                                                                                                                                                                 |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Add objective related to promoting incidental recharge such as "Promote incidental recharge to the extent feasible without impacting groundwater quality."                                                         | A new objective promoting incidental recharge has been added to Section 1.8.2. This new objective was added to Section 8.                                                                                                                                                                                                                  |
| 2   | Discuss ways to increase incidental recharge.                                                                                                                                                                      | A discussion of incidental recharge was added in Section 4.2.2.1.                                                                                                                                                                                                                                                                          |
| 3   | Add a discussion of perchlorate contamination to Section 5.                                                                                                                                                        | A new section on perchlorate, Section 5.6, was added.                                                                                                                                                                                                                                                                                      |
| 4   | The scale of several figures is too small. In Figure ES-5, it is difficult to distinguish between monitoring and production wells.                                                                                 | Several of the figures throughout the document were enlarged for improved readability. The clarity of Figure ES-5 was improved to enable the reader to distinguish between the production and monitoring wells. Please note that in Section 3, the production wells and monitoring wells appear in separate figures (Figures 3-1 and 3-2). |
| 5   | In some cases, data should be provided in tables rather than graphs. Figure ES-10 would be easier to comprehend if data were provided in a table. It is difficult to assess trends for data in stacked bar graphs. | Figure ES-10 appears also as Figure 6-5 in Section 6. A table with the data used to create Figure 6-5 was added in Section 6.6.                                                                                                                                                                                                            |
| 6   | Since water producers will need to include this document in state and federal grant applications, the plan should include a broad spectrum of concepts for improving groundwater sustainability.                   | Comment noted.                                                                                                                                                                                                                                                                                                                             |



Orange County Water District  
18700 Ward Street  
Fountain Valley, CA 92708  
(714) 378-3200

Recorded in Official Records, Orange County  
Tom Daly, Clerk-Recorder

NO FEE  
200985000650 08:03am 08/10/09  
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## NOTICE OF EXEMPTION

From the Requirements of the California Environmental Quality Act (CEQA)

TO: COUNTY CLERK/County of Orange  
P.O. Box 238  
Santa Ana, CA 92702

FROM: Orange County Water District  
Planning & Watershed Management  
18700 Ward Street  
Fountain Valley, CA 92708

FILED

AUG 10 2009

PROJECT TITLE: Orange County Water District Groundwater Management Plan

APPROVAL DATE: July 15, 2009

PROJECT LOCATION: Orange County Groundwater Basin

CITY: Various COUNTY: Orange

TOM DALY, CLERK-RECORDER  
By fv DEPUTY

DESCRIPTION OF THE PROJECT: The OCWD Groundwater Management Plan discusses the groundwater basin's physical features, OCWD facilities and monitoring and operating programs.

NAME & ADDRESS OF APPLICANT: Orange County Water District, 18700 Ward Street, Fountain Valley CA 92708

NAME OF PUBLIC AGENCY APPROVING PROJECT: Orange County Water District

POSTED

AUG 10 2009

### EXEMPT STATUS:

- ☐ Ministerial (Sec. 15268)
- ☐ Declared Emergency (Sec. 15269 (a) )
- ☐ Emergency Project (Sec. 15269(a)&(b) )
- ☐ General Rule (Sec. 15061(b)(3) )
- X Statutory Exemption: Section 15262
- X Categorical Exemption: Class 6 Section 15306, Class 7 Section 15307 Class 8 Section 15308

TOM DALY, CLERK-RECORDER  
By fv DEPUTY

### REASON(S) WHY PROJECT IS EXEMPT FROM CEQA:

The Groundwater Management Plan is an information document that discusses the Orange County Groundwater Basin and OCWD facilities and programs. The Groundwater Management Plan does not bind, commit or predispose OCWD to further consideration, approval or implementation of any potential project. Approval of the Groundwater Management Plan would not cause either a direct physical change to the environment or a reasonably foreseeable indirect physical change to the environment.

CONTACT PERSON: Greg Woodside

TELEPHONE No: 714 378-3275

SIGNATURE Dan Bath

DATE 8/6/09

TITLE Principal Planner

# 377417

w

### **CERTIFICATION OF BOARD ACTION**

I do hereby certify that at its meeting held July 15, 2009, the Orange County Water District Board of Directors approved the following action:

**MOTION NO. 09-80  
APPROVING GROUNDWATER MANAGEMENT PLAN 2009 UPDATE AND  
AUTHORIZING FILING OF NOTICE OF EXEMPTION**

The Groundwater Management Plan 2009 Update is approved and filing of Notice of Exemption is authorized.

*IN WITNESS WHEREOF, I have executed this Certificate on August 20, 2009.*

**ORANGE COUNTY WATER DISTRICT**



**Judy-Rae Karlsen  
Assistant District Secretary**

## APPENDIX B

# REQUIRED AND RECOMMENDED COMPONENTS FOR GROUNDWATER MANAGEMENT PLANS

**Appendix B**  
**Mandatory and Recommended Components of a**  
**Groundwater Management Plan**

| <b>No.</b> | <b>Mandatory Components of a GWMP</b>                                                                                                                                                                                                                                                                               | <b>Water Code Section</b> | <b>OCWD Plan Section</b>       |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|--------------------------------|
| 1.         | Basin management objectives for the groundwater basin that is subject to the plan                                                                                                                                                                                                                                   | 10753.7(a)(1)             | 1.8, 5.1.1, 5.1.2, 5.2.3, 6.3  |
| 2.         | Monitoring and management of groundwater levels within the groundwater basin                                                                                                                                                                                                                                        | 10753.7(a)(1)             | 1.8.2, 2.2, 2.3, 2.4, 2.6, 2.7 |
| 3.         | Monitoring protocols that are designed to detect changes in groundwater levels                                                                                                                                                                                                                                      | 10753.7(a)(4)             | 2.3, 2.4, 2.8, 3.1, 3.2, 3.4,  |
| 4.         | Groundwater quality degradation                                                                                                                                                                                                                                                                                     | 10753.7(a)(1)             | 1.8.1, 3.5, 5                  |
| 5.         | Monitoring protocols that are designed to detect groundwater quality                                                                                                                                                                                                                                                | 10753.7(a)(4)             | 3.1, 3.2, 3.3, 3.5, 3.6, 5     |
| 6.         | Inelastic land surface subsidence                                                                                                                                                                                                                                                                                   | 10753.7(a)(1)             | 2.7                            |
| 7.         | Monitoring protocols that are designed to detect inelastic land surface subsidence for basins for which subsidence has been identified as a potential problem                                                                                                                                                       | 10753.7(a)(4)             | 2.7                            |
| 8.         | Changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin                                                                                                                                                              | 10753.7(a)(1)             | 3.7, 4, 6.7                    |
| 9.         | Monitoring protocols that are designed to detect flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater pumping at the basin                                                                                                                             | 10753.7(a)(4)             | 3.7, 4, .6.5, 6.7              |
| 10.        | A plan to involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin                                                                                                                                       | 10753.7(a)(2)             | 1.2, 6.2                       |
| 11.        | A map that details the area of the groundwater basin, as defined in the department's Bulletin No. 118, and the area of the local agency, that will be subject to the plan, as well as the boundaries of other local agencies that overlie the basin in which the agency is developing a groundwater management plan | 10753.7(a)(3)             | Figures 1-1, 1-5, 2-1          |

**Appendix B**  
**Mandatory and Recommended Components of a**  
**Groundwater Management Plan**

| <b>Item</b> | <b>Optional Components of a GWMP</b>                                                                                                                              | <b>Water Code Section</b> | <b>OCWD Plan Section</b>                                          |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------|
| 12.         | The control of saline water intrusion                                                                                                                             | 10753.8(a)                | 3.6, 5.2                                                          |
| 13.         | Identification and management of wellhead protection areas and recharge areas                                                                                     | 10753.8(b)                | 4, 5.1.5, 6.2                                                     |
| 14.         | Regulation of the migration of contaminated groundwater                                                                                                           | 10753.8(c)                | 5                                                                 |
| 15.         | The administration of a well abandonment and well destruction program                                                                                             | 10753.8(d)                | 5.1.6, 5.1.7                                                      |
| 16.         | Mitigation of conditions of overdraft                                                                                                                             | 10753.8(e)                | 2.5, 6.5, 6.7, 6.8, 7.2.3                                         |
| 17.         | Replenishment of groundwater extracted by water producers                                                                                                         | 10753.8(f)                | 4, 6                                                              |
| 18.         | Monitoring of groundwater levels and storage                                                                                                                      | 10753.8(g)                | 1.8.2, 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 3.1, 3.2, 3.4, 6.5, 6.7, 6.8 |
| 19.         | Facilitating conjunctive use operations                                                                                                                           | 10753.8(h)                | 3.7.4, 6.3.3, 6.7, 6.8                                            |
| 20.         | Identification of well construction policies                                                                                                                      | 10753.8(i)                | Figures 3-4, 3-5, 5.1.5, 5.1.6                                    |
| 21.         | The construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling and extraction projects | 10753.8(j)                | 4, 5.2.5, 5.3.3, 5.8, 5.9, 6                                      |
| 22.         | The development of relationships with state and federal regulatory agencies                                                                                       | 10753.8(k)                | 5.1.3, 6.2                                                        |
| 23.         | The review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination    | 10753.8(l)                | 5.1.4, 5.1.5                                                      |



## APPENDIX C

### GOALS AND BASIN MANAGEMENT OBJECTIVES DESCRIPTION AND LOCATION

## Appendix C

### Goals and Basin Management Objectives

#### Description and Location

| Basin Management Objective (BMO)                                                                                                                                                                                                                                                                             | How Meeting BMO will Contribute to More Reliable Supply of Groundwater                                                                                                                                                                                                                                       | Location of Description of Planned Management Actions |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| General Basin Management Objectives to Accomplish All Goals                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                              |                                                       |
| Update the <i>Groundwater Management Plan</i> periodically                                                                                                                                                                                                                                                   | Regular publication of reports enables the District to plan for and manage the groundwater basin responsibly and efficiently, assure the timely construction of necessary projects to accomplish stated basin management objectives, and monitor the water quality of the basin and recharge water supplies. | Sections 1.4, 3.8                                     |
| Update the <i>Long-Term Facilities Plan</i> periodically                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                              | Sections 1.4 and 4.5                                  |
| Continue annual publication of the <i>Santa Ana River Water Quality Report</i> ; the <i>Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization</i> ; the <i>Santa Ana River Watermaster Report</i> ; and the <i>Groundwater Replenishment System Operations Annual Report</i> . |                                                                                                                                                                                                                                                                                                              | Sections 1.5, 2.8, 3.8, and 6.5                       |
| Goal: Protect and Enhance Groundwater Quality                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                              |                                                       |
| Conduct monitoring programs                                                                                                                                                                                                                                                                                  | Comprehensive monitoring of ground and surface water quality enables OCWD to discover contamination at an early stage and begin remediation efforts at the earliest feasible time and assures that operations are in compliance with federal, state, and local laws and regulations.                         | Section 3                                             |
| Monitor and manage quality of recharge water supplies so that water recharged through District facilities meets or is better than primary drinking water levels and notification levels                                                                                                                      |                                                                                                                                                                                                                                                                                                              | Section 4 and 5                                       |
| Monitor quality of Santa Ana River water                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                              | Section 3.7                                           |

## Appendix C

### Goals and Basin Management Objectives

#### Description and Location

| Basin Management Objective (BMO)                                                                         | How Meeting BMO will Contribute to More Reliable Supply of Groundwater                                                                                 | Location of Description of Planned Management Actions |
|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Implement the District's Groundwater Protection Policy                                                   | The Groundwater Protection Policy proactively protects the water quality of the basin and enables the District to work to clean up contaminated areas. | Section 5                                             |
| Construct and manage water quality treatment projects                                                    | Water quality treatment projects clean up contamination in order to protect the long-term quality of groundwater in the basin.                         | Section 5.8                                           |
| Operate seawater intrusion barriers                                                                      | Barriers prevent intrusion of high salinity water into the basin.                                                                                      | Section 3.6                                           |
| Support natural resource programs in the watershed                                                       | Improvement of natural resources in the watershed contributes to higher quality source water for OCWD recharge operations.                             | Section 6.2.2                                         |
| Participate in cooperative efforts with regulators and stakeholders within the Santa Ana River Watershed | Working with stakeholders in the watershed helps to protect the quality of source water used to recharge the groundwater basin.                        | Section 3.7, 5.2.5, and 6.2                           |

## Appendix C

### Goals and Basin Management Objectives

#### Description and Location

| Basin Management Objective (BMO)                                                                          | How Meeting BMO will Contribute to More Reliable Supply of Groundwater                                                                                                                                                                                                                                                                                                                                  | Location of Description of Planned Management Actions |
|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| <b>Goal: Protect and Increase the Basin's Sustainable Yield in a Cost Effective Manner</b>                |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                       |
| Monitor groundwater levels, recharge rates, and production rates                                          | Proper monitoring and operation of the groundwater basin improves groundwater management by establishing safe and sustainable levels of groundwater production, determines that extent of seawater intrusion so improvements to seawater barriers can be made, and allows for management of the basin for maximum pumping of groundwater at levels that assure sustainable supplies over the long-term. | Section 2 and 3                                       |
| Operate the basin in accordance with the <i>Groundwater Basin Storage and Operational Strategy</i>        |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                       |
| Manage recharge operations to maximize recharge of the groundwater basin                                  | Proper and efficient management of recharge operations sustains maximum pumping of groundwater supplies.                                                                                                                                                                                                                                                                                                | Section 4                                             |
| Research and implement new strategies and programs to increase recharge capacity                          | New strategies and programs increase the amount of groundwater available for pumping from the basin.                                                                                                                                                                                                                                                                                                    | Section 4.3 and 4.4                                   |
| Promote incidental recharge to the extent feasible without negatively impacting groundwater quality.      | Increasing incidental recharge increases the amount of water naturally percolating into the groundwater basin, which increases the amount of water available for pumping from the basin.                                                                                                                                                                                                                | Section 4.2.2.1                                       |
| Plan and conduct programs that maximize the capacity of the basin to respond to and recover from droughts | Increases the amount of water the basin can provide during a drought.                                                                                                                                                                                                                                                                                                                                   | Section 6.8                                           |

## Appendix C

### Goals and Basin Management Objectives

#### Description and Location

| Basin Management Objective (BMO)                                                                                                        | How Meeting BMO will Contribute to More Reliable Supply of Groundwater                                                                                                                                            | Location of Description of Planned Management Actions |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Support natural resource programs in the watershed                                                                                      | Natural resource programs, such as removal of Arundo, augment available supplies of recharge water.                                                                                                               | Sections 5.3.3 and 6.2.2                              |
| <b>Goal: Increase Operational Efficiency</b>                                                                                            |                                                                                                                                                                                                                   |                                                       |
| Manage the District's finances to provide long-term fiscal stability and to maintain financial resources to implement District programs | Fiscal stability is essential for the District to effectively manage the groundwater basin. Maintenance of reserves allows for the purchase of supplemental water supplies when they are available.               | Section 7                                             |
| Operate District programs in a cost-effective and efficient manner.                                                                     |                                                                                                                                                                                                                   |                                                       |
| Manage natural resource programs in the Santa Ana River watershed in an efficient manner.                                               | Removal of excessive nitrate levels through the operation of Prado Wetlands saves the cost of more expensive treatment plan construction and operation.<br>Removal of Arundo increases water supply availability. | Sections 5.3.3 and 6.2.2                              |
| Implement efficient environmental management programs, such as use of solar power where feasible.                                       | Replacing a portion of the District's use of electricity with generation of solar power will reduce costs in the long run.                                                                                        | Section 4.5                                           |

## APPENDIX D

# REPORT ON EVALUATION OF ORANGE COUNTY GROUNDWATER BASIN STORAGE AND OPERATIONAL STRATEGY, OCWD, FEBRUARY 2007



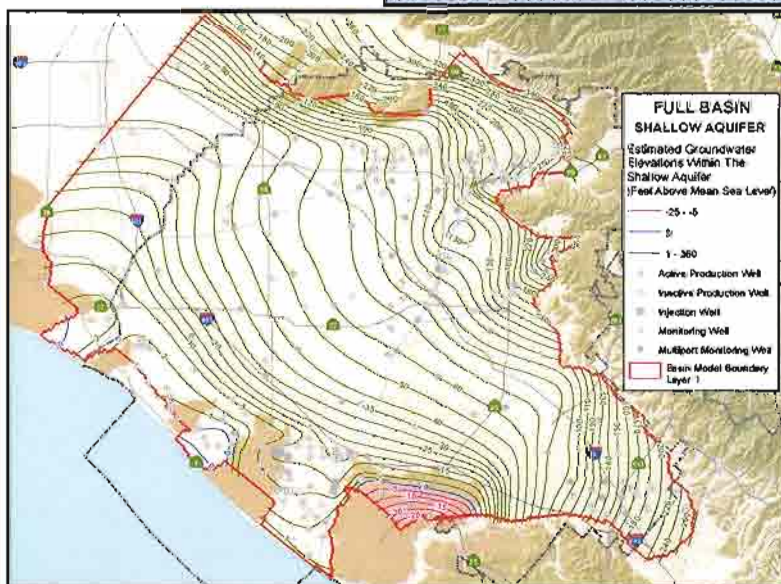
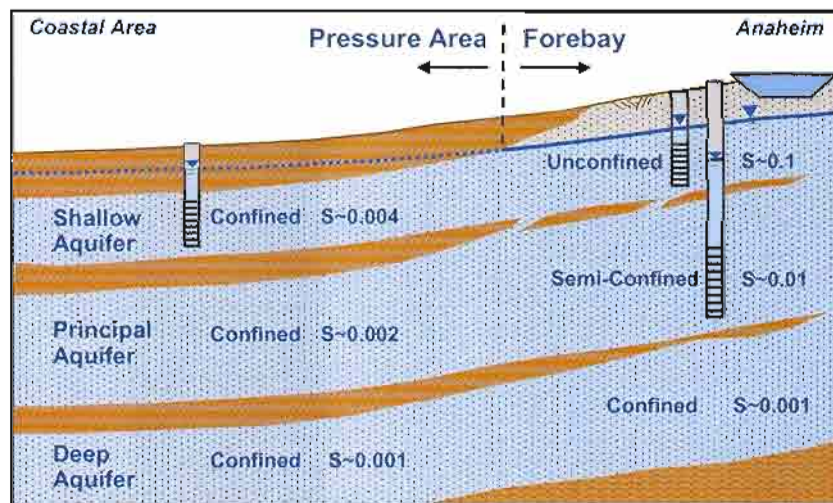


# ORANGE COUNTY WATER DISTRICT

## REPORT ON

## EVALUATION OF ORANGE COUNTY

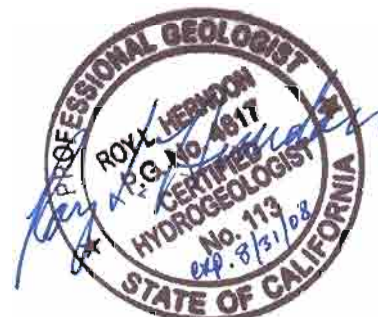
## GROUNDWATER BASIN STORAGE AND OPERATIONAL STRATEGY



Prepared By:

Timothy J. Sovich, PE – Principal Engineer  
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FEBRUARY, 2007



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## **Acknowledgment**

Much assistance was provided by District GIS staff Dan Lee and Linda Koki, specifically with implementation and automation of the new three-layer storage change algorithm, GIS programming, mapping, and graphical support.

## EXECUTIVE SUMMARY

The need for this study was largely driven by the record-setting wet year of 2004-05, in which an unprecedented storage increase of 170,000 af was estimated by OCWD staff. This led to a preliminary reassessment of the traditional storage calculation which, due to cumulative uncertainty over tens of years, could not be sufficiently rectified back to the traditional full-basin benchmark of 1969.

A new methodology has been developed, tested, and documented herein for calculating accumulated overdraft and storage change based on a three aquifer layer approach, as opposed to the previous single-layer method. Also, for calculating accumulated overdraft, a new full-basin benchmark was developed for each of the three aquifer layers, thereby replacing the traditional single-layer full benchmark of 1969. Also in this report, a basin management operational strategy is proposed that sets guidelines for planned refill or storage decrease amounts based on the level of accumulated overdraft.

The new three-layer storage change approach utilizes aquifer storage parameters supported by calibration of the District's basin-wide groundwater model ("basin model") along with actual measured water level data for each of the three aquifer systems that correspond to the three aquifer layers in the basin model: the Shallow, Principal, and Deep (colored water) aquifer systems. Traditionally, the storage change calculation was based solely on groundwater levels for the Principal aquifer, from which approximately 90 percent of basin pumping occurs.

The findings of this study are enumerated below.

1. The new three-layer storage change approach is technically feasible and provides a more accurate assessment than the traditional single-layer storage change method.
2. Using the new three-layer method, the majority of the storage change occurs in the Forebay area of the basin within the unconfined Shallow aquifer where rising or falling of the water table fills or drains empty pore space.
3. Accuracy of the storage change and accumulated overdraft estimates is dependent upon good spatial distribution of water level measurements as well as the storage coefficient values used in the calculations. Water level data for the Shallow aquifer were relatively sparse in outlying Forebay areas of the basin, leading to some uncertainty in preparing groundwater elevation contours in those areas.
4. 1969 no longer represents a truly full-basin benchmark. A new full-basin water level condition was developed based on the following prescribed conditions:
  - Observed historical high water levels
  - Present-day pumping and recharge conditions
  - Protective of seawater intrusion
  - Minimal potential for mounding at or near recharge basins

The new full-basin water levels in the Forebay area are essentially at or very near the bottom of the District's deep percolation basins (e.g., Anaheim Lake). Historical water level data from 1994 have shown that this condition is achievable without detrimental effects. Water levels slightly higher than this new full condition may be physically achievable in the Forebay area but not recommended due to the likelihood of groundwater mounding and reduced percolation in recharge basins.

5. Using the new three-layer storage change calculation in conjunction with the new full benchmark and June 2006 water levels, an accumulated overdraft of 135,000 af was calculated representing June 30, 2006. Similarly, using the new three-layer method to compare the new full water levels to those of June 2005, an accumulated overdraft of 201,000 af was calculated representing June 30, 2005. Subtracting the June 2006 accumulated overdraft from that of June 2005 yielded an annual storage increase of 66,000 af for WY 2005-06.
6. Comparing the current year's water level conditions to the full basin benchmark each successive year for calculating the basin storage will eliminate the potential for cumulative discrepancies over several years.
7. An accumulated overdraft of 500,000 af represents the lowest acceptable limit of the basin's operating range. This lower limit of 500,000 af assumes that stored MWD water (CUP and Super In-Lieu) has already been removed and is only acceptable for short durations due to drought conditions. It is not recommended to manage the basin for sustained periods at this lower limit for the following reasons:
  - Seawater intrusion likely
  - Drought supply depleted
  - Pumping levels detrimental to a handful of wells
  - Increased pumping lifts and electrical costs
  - Increased potential for color upwelling from the Deep aquifer
8. An optimal basin management target of 100,000 af of accumulated overdraft provides sufficient storage space to accommodate increased supplies from one wet year while also providing enough water in storage to offset decreased supplies during a two- to three-year drought.
9. The proposed operational strategy provides a flexible guideline to assist in determining the amount of basin refill or storage decrease for the coming water year based on using the BPP formula and considering storage goals based on current basin conditions and other factors such as water availability. This strategy is not intended to dictate a specific basin refill or storage decrease amount for a given storage condition but to provide a general guideline for the District's Board of Directors.

Based on the above findings, recommendations stemming from this study are as follows:

1. Adopt the new three-layer storage change methodology along with the associated new full-basin condition that will serve as a benchmark for calculating the basin accumulated overdraft.
2. Adopt the proposed basin operating strategy including a basin operating range spanning the new full condition to an accumulated overdraft of 500,000 af, and an optimal overdraft target of 100,000 af.
3. Include in the 2007-08 CIP budget the installation of six Shallow aquifer monitoring wells to increase accuracy of the three-layer storage change calculation.



## 1. INTRODUCTION

This report documents the methodology, findings, and recommendations of the basin storage and overdraft evaluation completed by District staff between May 2006 and January 2007.

Prior to this study, an unusually large annual increase in basin storage of 170,000 af was estimated for WY 2004-05, which was a record-setting wet year. During that year, water levels throughout the basin rose approximately 30 feet overall, and as much as 60 feet in the Santiago recharge area which receives significant storm runoff from Villa Park Dam releases during extremely wet years.

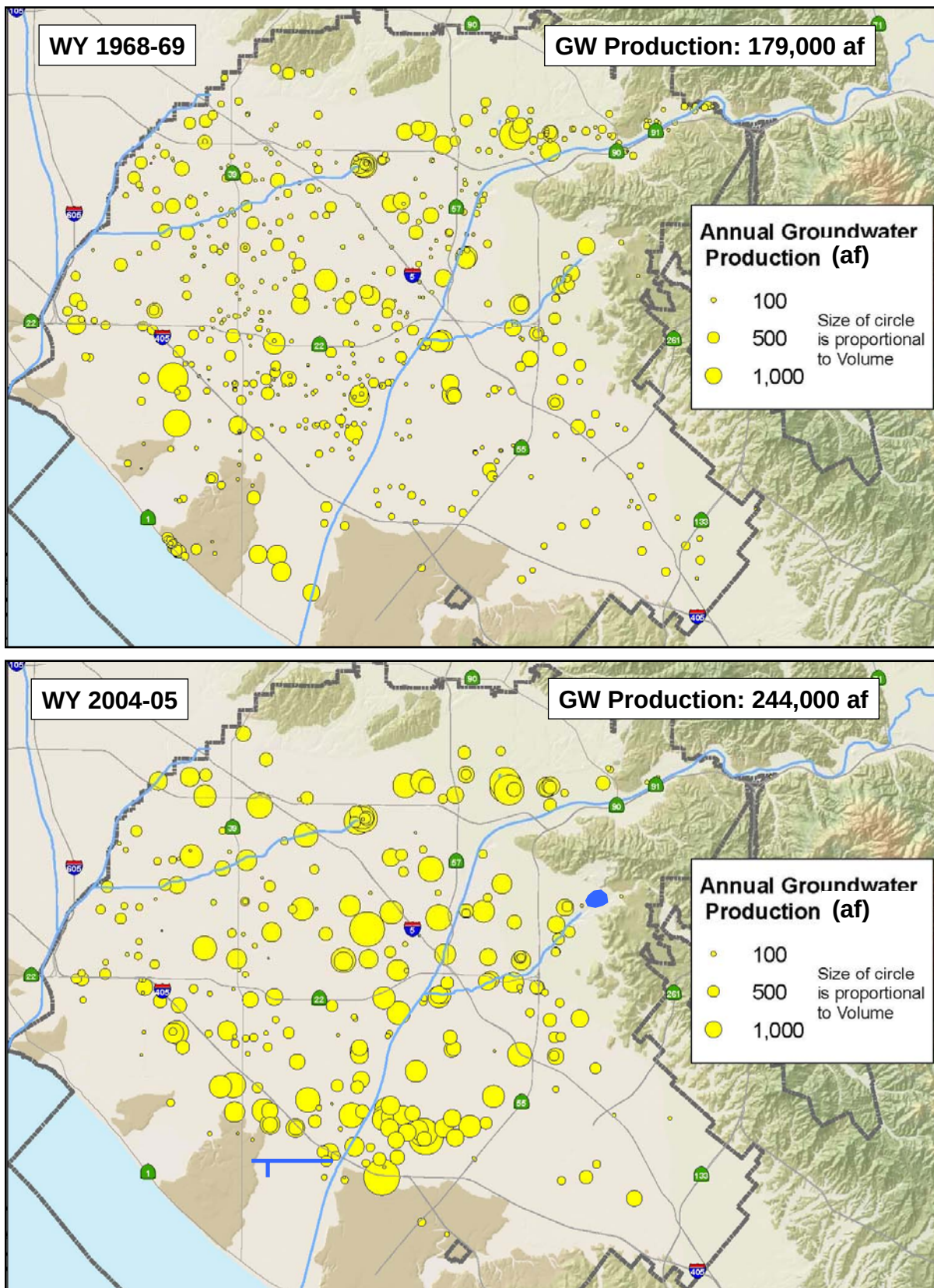
The estimated storage increase for WY 2004-05 was so large that it caused staff to re-examine the storage calculation. Also, the large water level rise during that year raised concern that the basin could be approaching a near-full condition, leading staff to compare 2005 water levels throughout the basin to 1969 in which the basin was historically considered full. This analysis showed that the basin may have had only 40,000 af less groundwater in storage in November 2005 as compared to the 1969 benchmark. However, the traditional method of cumulatively adding the annual storage change each year to the previous year's accumulated overdraft led to an accumulated overdraft of approximately 190,000 af for November 2005.

The discrepancy of 150,000 af in the two different 2005 overdraft calculations indicated that the current condition could not be properly rectified back to the 1969 benchmark. This dilemma provided the main impetus for the study documented herein and brought to light two important discoveries:

- The traditional storage change calculation contains considerable uncertainty that, when cumulatively added over tens of years, led to a large discrepancy in the accumulated overdraft relative to 1969.
- 1969 water level conditions no longer represent a full basin, primarily because of the different pumping and recharge conditions that exist today.

Figure 1-1 shows the distribution of groundwater production for WY 1968-69 (upper map) and WY 2004-05 (lower map). Each circle or "dot" represents an active production well for that year, with the size of each dot being proportional to each well's annual production. Total basin production for WY 2004-05 was only 179,000 af, whereas by WY 2004-05 it had increased to 244,000 af and would have been 70,000 af greater if not for supplemental imported water taken in-lieu of groundwater. By comparing the two production dot maps, heavy increases in pumping are evident in the coastal area since 1969, primarily due to MCWD and IRWD's Dyer Road Well Field (DRWF).

Figure 1-1. Groundwater Pumping Distribution: WY 1968-69 and WY 2004-05



In addition to changes in the amount and distribution of pumping since 1969, OCWD managed recharge operations have increased substantially such that much more water is recharged today as compared to 1969. In addition to increased Santa Ana River flows and new recharge basins being put into service in the Anaheim and Orange Forebay areas, new and improved cleaning methods have been implemented to enhance percolation rates, thus increasing the annual volume of water that is recharged annually.

Table 1-1 below summarizes the major pumping and recharge differences between WY 1968-69 and WY 2004-05.

**Table 1-1. Pumping and Recharge Conditions: WY 1968-69 vs. WY 2004-05**

|                 | <b>WY 1968-69</b>               | <b>WY 2004-05</b>              |
|-----------------|---------------------------------|--------------------------------|
| <b>Pumping</b>  | Total Pumping: 179,000 af       | Total Pumping: 244,000 af      |
|                 | Agricultural Pumping: 34,000 af | Agricultural Pumping: 3,400 af |
|                 | No DRWF                         | In-Lieu: 70,000 af             |
|                 | No MCWD municipal wells         | Increased coastal pumping      |
|                 | No Newport Beach wells          | Less Irvine pumping            |
| <b>Recharge</b> | No Talbert Barrier              | Enhanced Talbert Barrier       |
|                 | No Santiago Pits or Creek       | Enhanced percolation rates     |
|                 | No Kraemer or Miller Basins     | Basin Cleaning Vehicle         |
|                 | No Burris Pit or Five Coves     | Riverview Basin                |

Since 1969, the largest pumping increases have been in the coastal area while the largest recharge increases have been in the inland Forebay area. Therefore, this redistribution along with increased utilization of the groundwater basin has led to a steeper groundwater gradient or “tilt” from the inland Forebay down to the coast. Because of this increased basin tilt under present conditions, water levels higher than 1969 can be maintained in the Forebay area without exceeding 1969 water levels in the coastal area. Because higher Forebay water levels translate into more basin storage, 1969 no longer represents a full basin condition by today’s standards. In other words, a modern-day full condition could likely accommodate higher water levels than 1969 in the Forebay area, as schematically illustrated in Figure 1-2.

A review of historical water level data indicates that many wells in the Anaheim area experienced higher water levels in 1994 than in 1969. Figure 1-3 shows historical water levels for City of Anaheim Well A-27, indicating that in 1994 water levels at that location (adjacent to the south side of Anaheim Lake) were 5-10 feet higher than in 1969.

Figure 1-2. Schematic of Groundwater Level Profiles Across the Basin

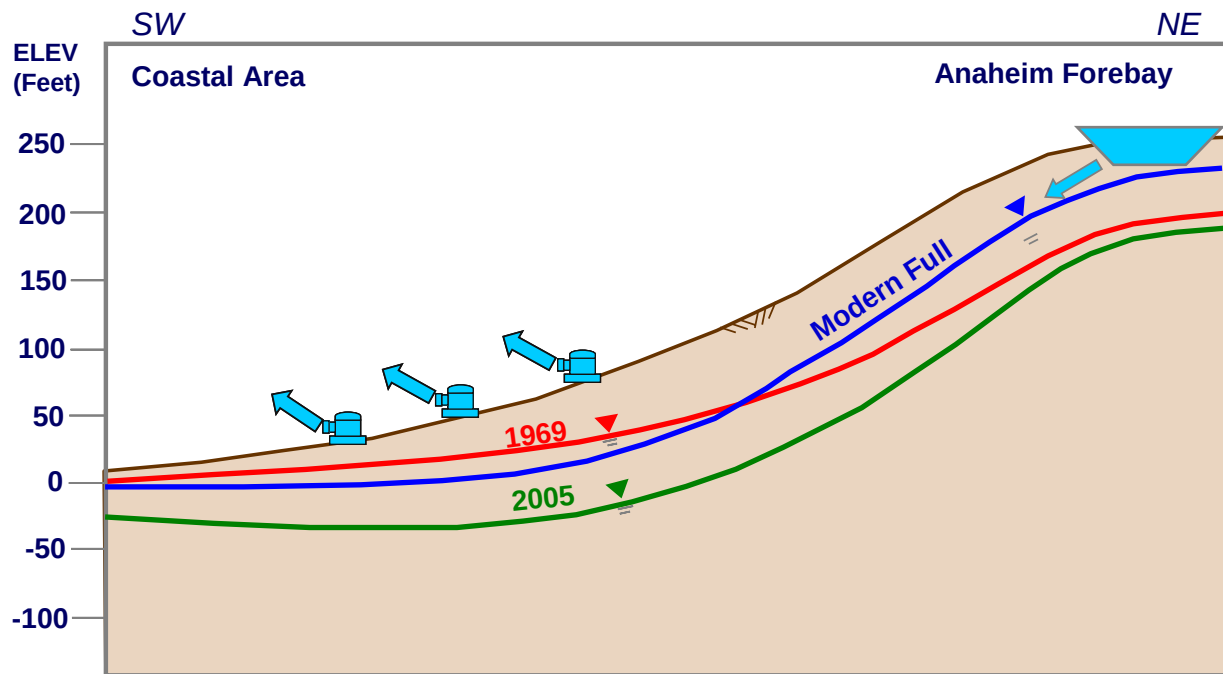
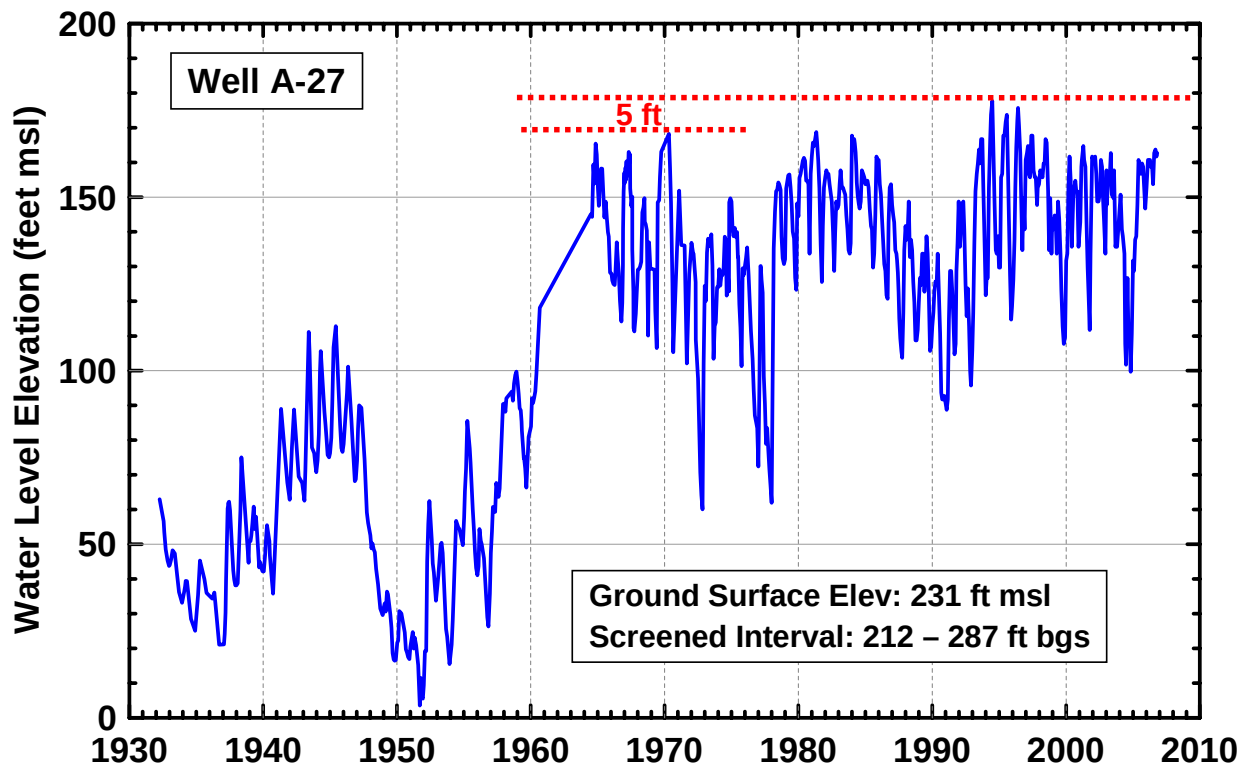


Figure 1-3. Water Level Hydrograph for City of Anaheim Well 27



## **2. STUDY OBJECTIVES AND WORK PLAN**

Objectives of this study were three-fold:

1. Reassess and recommend modifications as necessary to staff's traditional method for calculating the annual storage change and the accumulated overdraft.
2. Develop a technically-sound full basin water level condition that takes into account current basin management practices. This new full condition would replace 1969 and become the new full benchmark used to calculate the accumulated overdraft or available storage in current and upcoming years.
3. Determine an appropriate basin storage operating range and management goal for long-term basin management purposes.

The District Board of Directors approved staff's work plan in April 2006, and work commenced shortly thereafter. All work was completed by the District's Hydrogeology Department, with oversight, direction, and review provided by District management. At the request of the Board, monthly project updates were given at the Water Issues Committee meetings as well as the monthly groundwater producers meetings to facilitate the producers' involvement in the process.

The scope of work laid out in the work plan was generally followed. Initially, it was considered that conducting basin model simulations may be beneficial in validating project results. However, after making significant progress in developing a new storage change methodology and new full basin benchmark, it became evident that it was more appropriate to use aquifer parameters and specific knowledge gained from development of the basin model rather than running new model simulations per se. As such, findings enumerated in this report were based on actual water levels observed in the field coupled with a methodology based on aquifer structure and hydraulic parameters defined during development of the basin model.

## **3. STORAGE CHANGE CALCULATION METHODOLOGY**

In this section, the District's traditional storage change calculation is described along with its inherent limitations, followed by a discussion of the development of a new storage change calculation approach and comparison with the traditional method. But first, a conceptual explanation of aquifer storage is explained below.

### **3.1 Aquifer Storage Concept**

Aquifers not only transmit groundwater but also provide storage volume, sometimes being referred to as "underground reservoirs." However, unlike surface water reservoirs, approximately 70 to 80 percent of the aquifer's volume is occupied by the porous medium, typically consisting of various gradations of sand and gravel as well as

silts and clays. This leaves only 20 to 30 percent of the aquifer's total volume remaining as void space that groundwater can occupy. This percentage of void or pore space is referred to as *porosity*.

Over large areas and depths, the void space within aquifers can occupy huge amounts of water. Within the Orange County groundwater basin, which spans over 300 square miles and is over 2,000 feet deep in some areas, District staff have estimated that approximately 66 million acre-feet of water lies in storage. Unfortunately, the vast majority of this water cannot be feasibly drained from the basin without incurring detrimental impacts.

Excessive long-term pumping of basin aquifers without continual replenishment would lead to a lowering of water levels and a reduction in pore pressure, which would lead to seawater intrusion and irreversible compaction of the aquifer, resulting in subsidence of the land surface. The recommended “drainable” storage volume of the basin (without requiring concurrent replenishment) is 500,000 af acre-feet as discussed in Section 6.

The parameter used to define the storage capacity of an aquifer is known as the *storage coefficient (S)*. Unlike the porosity which is a measure of the entire void space regardless of whether or not it contains water, the storage coefficient is a measure of how much water can effectively be drained or squeezed out of the saturated pore space. The storage coefficient is defined as the volume of water yielded per unit horizontal area and per unit drop of water table (unconfined aquifers) or piezometric surface (confined aquifers).

### **3.2 Confined and Unconfined Aquifers**

A confined aquifer is an aquifer that is confined between two aquitards, which are typically clay or silt layers with low permeability. The water in a confined aquifer cannot freely rise above the overlying clay layer and is under confining pressure. When a well is drilled through the overlying clay layer down into the aquifer, the pressure in the confined aquifer causes the water to rise inside the well (see Figure 3-1) to a level higher than the overlying aquitard. Therefore, water levels measured in wells within confined aquifers – referred to as piezometric levels – may rise and fall but the confined aquifer remains saturated. In a confined aquifer, water is added to or removed from storage primarily through the rearrangement of the unconsolidated sediments via compression or decompression; the compressibility of water contributes significantly less to the storage process. A relatively large piezometric level change in a confined aquifer represents very little change in storage within that aquifer. Storage coefficients for a confined aquifer typically range from 0.01 to as low as 0.00005.

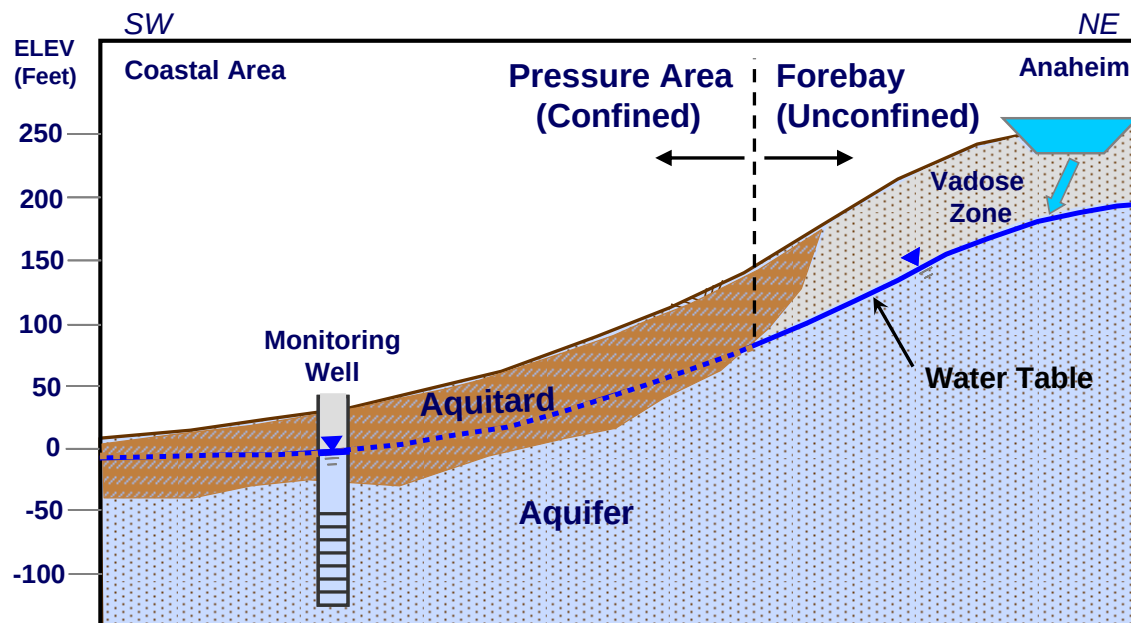
An unconfined aquifer is an aquifer in which the water table forms the upper boundary and there is no confining layer above it (see Figure 3-1). That is, the water table can freely rise or fall. Pore space is either filled or drained when the water table rises or falls. Therefore, a unit rise or decline in the water table in an unconfined aquifer represents a relatively large storage volume. For an equivalent water level rise, an



unconfined aquifer would exhibit at least 100 times greater storage increase than a confined aquifer. Storage coefficients for unconfined aquifers typically range from 0.01 to 0.3, also referred to as *specific yield*.

In the Orange County groundwater basin, the Shallow aquifer is confined in the coastal and mid-basin areas, commonly referred to as the Pressure Area. The overlying aquitard in the Pressure area thins further inland until it is generally gone. This inland area is referred to as the Forebay area. Since few continuous aquitards exist between the water table and ground surface, it is the “intake” area of the basin where surface water can percolate down to the water table and recharge the aquifers (see Figure 3-1).

**Figure 3-1. Forebay and Pressure Area Schematic Profile**



### 3.3 Traditional Storage Change Calculation Method

#### Water Level Change Method

Traditionally, the storage change calculation was based solely on the water level changes occurring in the Principal aquifer, which is the main production zone in the basin from which approximately 90 percent of basin pumping occurs. Dating back to the 1940s, District staff have prepared a November groundwater contour map of Principal aquifer water levels. By comparing the November contour map to that of the previous year, the annual water level change was then determined. The water level change was then multiplied by a set of storage coefficient values and by the area of the basin to obtain the resulting groundwater storage change for that year. Then, the annual storage change was added to the accumulated overdraft from the previous year to obtain the current accumulated overdraft.



Over the years, the overall approach has remained relatively the same, but several refinements were made along the way. In the 1970s, a FORTRAN computer program was developed, referred to as the “Randall Model,” which partially automated the storage change calculation by subdividing the basin into quarter-mile grid cells. The Randall Model computed the storage change calculation grid cell by grid cell. Although this process was somewhat automated, the water level maps had to be manually interpolated to obtain the average water level change for each quarter-mile grid cell. The storage coefficient values for each quarter-mile grid cell were referred to as “Randall” coefficients and are shown in Appendix 1. No documentation exists as to how these storage coefficient values were developed, but they were likely based on review of old well logs throughout the basin.

In the early 1990s, with improvements in computer hardware and software, District staff were able to further automate the traditional storage change calculation by using geographical information system (GIS) software to subdivide the basin into smaller, more refined grid cells. By digitizing the hand-drawn water level contour maps into the computer, the water level change at each refined grid cell could be computed without any manual interpolation. However, the overall approach remained the same and still used the same Randall storage coefficient values.

Over the last two years, an additional refinement included preparing an end-of-June water level contour map in addition to the annual November contour map. Although the November maps provide a good midpoint between the summer-high and winter-low water level conditions, the June maps coincided better with the District’s water year and fiscal year (July 1 through June 30) for the annual storage change calculation.

#### Water Budget Method

For the past 10 to 15 years, the annual storage change calculated using the traditional water level method has been checked using a water budget method (inflows minus outflows equal the change in storage). Therefore, the water budget method uses measured groundwater production and recharge data along with a rainfall-based estimate of incidental recharge (unmeasured recharge less underflow to LA County).

The water budget method provides a good check of the storage change estimate from the water level method but is based on an assumed (unmeasured) amount of incidental recharge. In most years, the two methods agree rather closely, and the storage change value from the water level method is generally used. The incidental recharge is then adjusted in the water budget method to exactly match the chosen storage change.

#### Limitations of the Traditional Storage Change Method

Although the traditional water level and water budget methods yield similar storage change results in most years, there are some anomalous years in which the two estimates are significantly different. In such years, typically very wet or very dry years,

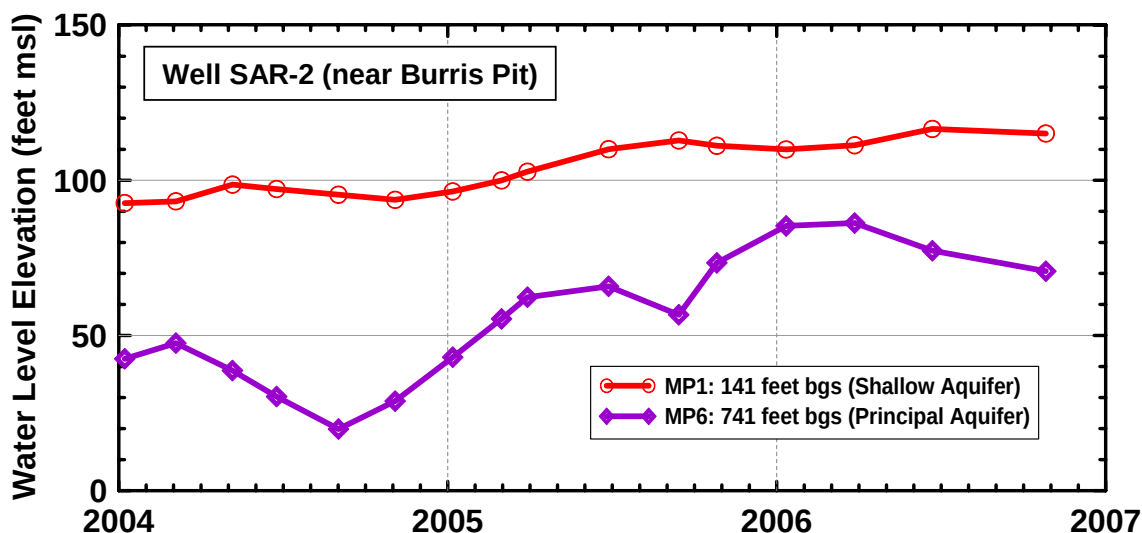
professional judgment must be exercised in determining the official change in storage. This can introduce significant uncertainty into the annual storage change estimate for those years, causing a cumulative effect after several years, which is why the current accumulated overdraft cannot be rectified back to 1969 as discussed in Section 1.

The biggest limitation of the traditional method is that it only uses the water level change in the Principal aquifer. Although most groundwater production is from the Principal aquifer, most of the storage change occurs in the Shallow aquifer where it is unconfined in the Forebay area of the basin. Where the Shallow aquifer is unconfined, large storage changes can occur due to the rising or falling of the water table which respectively fills or drains empty pore space, as was discussed in Section 3.2.

The Randall storage coefficients used in the traditional method are consistent with those of an unconfined aquifer in the Forebay area and thus are considered as being representative of the Shallow aquifer. Therefore, the traditional method uses Principal aquifer water levels as a surrogate for the Shallow aquifer, assuming that these two aquifers behave identically in the Forebay area. This is largely true in the Anaheim Lake area near the District's facilities, but in other portions of the Forebay, the Shallow and Principal aquifers often behave differently from one another, as shown in Figure 3-2. This indicates that these two aquifers are partially hydraulically separated by aquitards in portions of the Forebay and behave differently rather than as a single unconfined aquifer as the traditional method had assumed.

It should be pointed out that in earlier years, depth-specific water level data such as that presented in Figure 3-2 was simply not available to discern hydraulic differences between various aquifer zones, and in some areas of the Forebay, there are no noticeable vertical hydraulic differences. It has only been in the last few years through the use of the District's monitoring well network and development of the basin model that a better understanding of the basin has been gained.

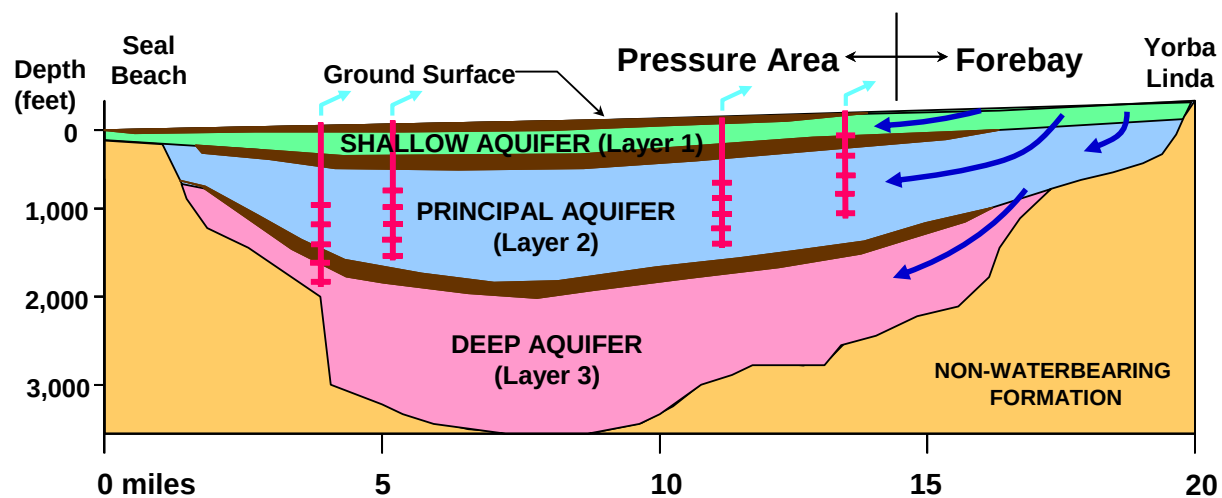
**Figure 3-2. Water Level Hydrograph for OCWD Monitoring Well SAR-2**



### 3.4 New Three-Layer Storage Change Approach

The new three-layer storage change approach uses all three aquifer systems of the basin: the Shallow, Principal, and Deep aquifer systems (see Figure 3-3). The Shallow aquifer generally ranges no deeper than approximately 250 feet below ground surface and overlies the Principal aquifer, which is generally over 1,000 feet thick throughout much of the basin and supports over 90 percent of basin pumping. The Deep aquifer contains colored water in the coastal area and is more than 2,000 feet deep throughout much of the basin. These three aquifer systems, from shallow to deep, are also referred to as aquifer layers 1, 2, and 3.

**Figure 3-3. Schematic Cross-Section of the Basin Showing Three Aquifer Layers**



#### Methodology

The new three-layer storage change approach is based largely on the aquifer configuration, structure, and storage coefficient parameter values defined during development of the basin model. Unlike the traditional method, all three of the basin's aquifer systems are included in this new methodology. Furthermore, the storage coefficient values used in this new method are specific to each aquifer layer and were refined during dynamic or transient calibration of the basin model until the resulting model-generated water levels achieved a close match with observed water level data throughout the basin.

The basic formula used to calculate the change in storage is very similar to the traditional method, but now must be carried out for each of the three aquifer layers. The storage change equation is defined as

$$\text{Storage Change} = (\text{Water Level Change}) \times (\text{storage coefficient}) \times (\text{horizontal area})$$

The storage change for each of the three aquifer layers is thereby calculated and the results of all three summed to get the total storage change in the basin.

Figure 3-4 shows a schematic cross-section illustrating the three aquifer layers of the basin and how they differ in terms of their respective storage coefficient (S) values. Whereas the traditional method had presumed that the Forebay area behaved entirely as one large unconfined aquifer without any intervening clay layers, our current understanding of the basin is that only the Shallow aquifer in the Forebay area is truly unconfined. As was discussed in Sections 3.1 and 3.2, the majority of the storage change in the basin occurs specifically in the Shallow aquifer within the Forebay area where the rising or falling unconfined water table respectively fills or drains empty pore space. Shallow aquifer storage coefficient values in the Forebay area are approximately 0.1, but in some specific Forebay locations can be as high as 0.25, which is approximately equivalent to the porosity of the sediments at the water table/vadose zone interface.

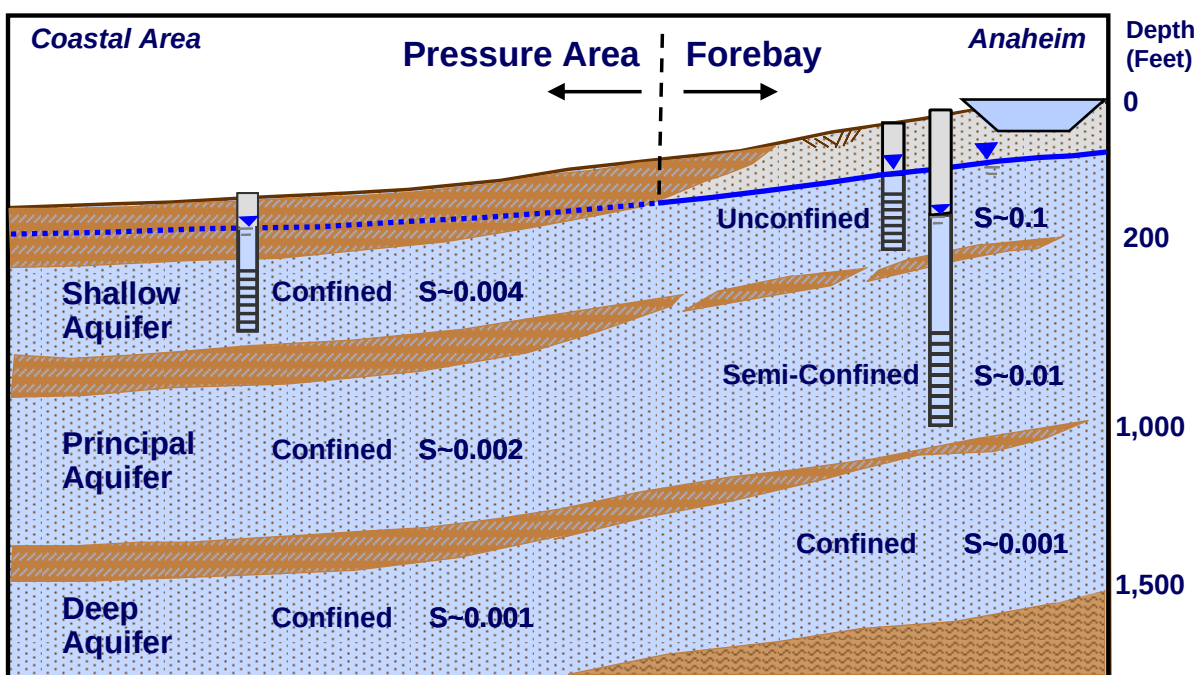
Figure 3-4 illustrates how the Shallow aquifer is confined in the Pressure area of the basin. By definition, the Pressure area ends where the water level drops below the elevation of the overlying aquitard and/or where the aquitard no longer exists. In the Pressure area, the Shallow aquifer storage coefficient values are approximately 0.004, or approximately 25 times smaller than in the unconfined Forebay area. This means that for a given water level change in the Pressure area, the resulting change in storage would be 25 times less than for that same water level change observed in the unconfined Forebay area.

As shown in Figure 3-4, the Principal aquifer is largely separated from the overlying Shallow aquifer by an extensive aquitard in the coastal and mid-basin areas. In the inland Forebay area, this intervening aquitard becomes intermittent but does not vanish completely, causing some hydraulic separation from the Shallow aquifer while still allowing large amounts of water to migrate downward into the Principal aquifer. As schematically shown in Figure 3-4, Principal aquifer water levels frequently differ from those in the Shallow aquifer due to the hydraulic separation, as was also shown in Figure 3-2 for multi-depth monitoring well SAR-2 near Burris Basin, where observed water levels in the Principal aquifer are noticeably lower than in the Shallow aquifer. The Principal aquifer is thus considered to be semi-confined in the Forebay area, with storage coefficient values of approximately 0.01, which is at least 10 times less than in the unconfined Shallow aquifer.

The Deep aquifer is generally confined throughout the entire basin and is separated from the overlying Principal aquifer by an extensive aquitard that thins somewhat in the Forebay area but remains laterally extensive. Therefore, since water level changes in the Deep aquifer represent pressure responses and thus do not involve filling or draining of pore space, storage coefficient values are typically small at approximately 0.001 throughout the entire basin.

The storage coefficient values shown in Figure 3-4 and discussed above are typical values for each of the three aquifer layers. The actual storage coefficients used in the storage change calculation not only vary for each aquifer layer but also vary spatially across the basin in both the Pressure and Forebay areas. From the basin model calibration, the different storage coefficient values within each aquifer layer are subdivided into detailed zones. For reference, these zonal storage coefficient maps are included in Appendix 2. These storage coefficient values in the Forebay area of the Shallow aquifer are generally consistent with the Randall coefficients traditionally used.

**Figure 3-4. Schematic cross-section showing storage coefficients (S) values**



The other component of the storage change formula not yet discussed is the water level change. To obtain the water level change involves constructing water level contour maps for each of the three aquifer layers, both for the previous and current year.

Preparation of the water level contour maps for each aquifer layer requires a considerable level of interpretation of the actual data points as well as interpolation between data points. The reported water level data is not always 100 percent accurate and must be reviewed on a well-by-well basis as the contour map is being constructed. Reasons for disqualifying or adjusting observed water level data during the contouring process may include:

- A static water level from a production well may have been measured only minutes after shutting off the well pump;
- Erroneous water level field measurement (e.g., bad equipment);

- Water level measurement taken too early or too late (for the June and November contour maps, attempt to measure all water levels within a two-week window);
- Wells are screened at different depths and some wells are screened across multiple aquifers such that water level data not entirely representative of any one aquifer layer being contoured.

In addition to the above reasons for screening the observed water level data points, extreme care and consistency must be exercised from one year to the next when contouring and interpolating between data points, especially in sparse areas lacking sufficient data to definitively define the shape of the contours. Barring any new wells or data, water levels should be similarly interpreted in these areas from year to year so that false storage changes are not artificially created. Knowledge of the aquifer's characteristics, presence of geologic faults, regional flow regime, and vertical relationship with the other aquifers have proven useful in determining the contour patterns in a given area.

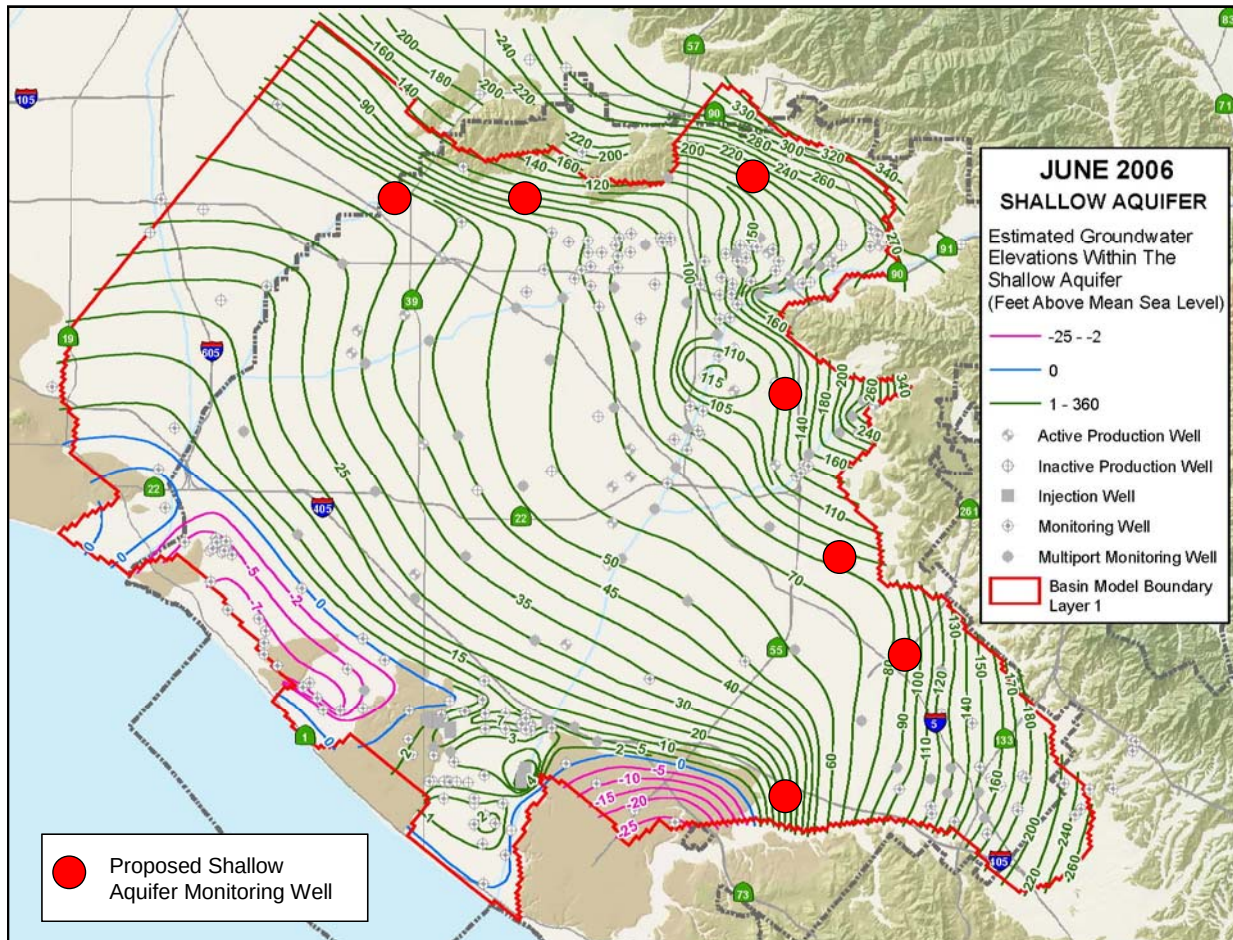
Of the three aquifer layers, the Principal aquifer has the best water level data coverage thanks to more than 200 large system production wells monitored by each respective groundwater producer, as well as District monitoring wells throughout the basin. Historically, this predominance of available water level data for the Principal aquifer and lack thereof for the Shallow and Deep aquifers is a likely reason that the traditional storage change method only considered the water level change in the Principal aquifer.

Much more water level data exists today for the Shallow aquifer than in the past, primarily due to the District's network of monitoring wells, many of which monitor multiple aquifer zones at one well site, helping to decipher the vertical relationship between the Shallow and deeper aquifers and their degree of hydraulic connection. Since the majority of the storage change in the basin occurs in the unconfined portion of the Shallow aquifer within the Forebay area, the constructed water level contours are of utmost importance in those inland areas. Unfortunately, data is sparse in a few of these outlying areas of the basin. Therefore, to increase the accuracy of the Shallow aquifer contour maps and thus the accuracy of the storage calculation, approximately six new shallow monitoring wells are recommended to fill data gaps in the areas of Buena Park, Costa Mesa, Fullerton, Orange, Irvine, and Yorba Linda. Figure 3-5 shows the approximate desired locations for these six proposed wells.

Figure 3-5 also shows the water level contours for the Shallow aquifer for June 2006. Just as for the other two aquifer layers, these contours were hand drawn based on observed water level data from wells screened in the Shallow aquifer (shown in light gray in Figure 3-5). The hand-drawn contours were then digitized into the computer for calculation purposes. Note that the contours were drawn out to the boundary of the basin model layer 1 which extends into LA County, but during the storage calculation process the LA County portion is excluded.



**Figure 3-5. June 2006 Shallow Aquifer Groundwater Elevations and Proposed Wells**



### GIS Application for Three-Layer Storage Change Calculation

A new GIS application was developed and programmed to automate the new three-layer storage change calculation utilizing the digitized water level contour maps for each aquifer layer as well as the storage coefficient values from the basin model.

The new GIS application consists of a series of steps governed by programs written in the AML scripting language within the Arc/Info environment. A detailed description of these steps, along with all the AML codes written for this application, is included in Appendix 4.

The digitized water level contours are converted into GIS compatible files (grids) at the same refined resolution as the basin model input parameters, essentially subdividing the entire basin into 500-foot square grid cells. The GIS application then carries out the storage change formula one grid cell at a time for each aquifer layer, calculating the water level change between the two years in question and multiplying by the storage



coefficient and horizontal area of the grid cell. Then, the storage change of all grid cells is summed for each layer. The total change in storage is then the corresponding sum of all three aquifer layers.

When calculating the storage change at each grid cell, the GIS application must check to determine if the conditions are confined or unconfined. Generally, the Principal and Deep aquifers are typically confined, but the Shallow aquifer is confined in the Pressure area and unconfined in the Forebay area, with the dividing line between these two areas being dependent upon the actual water level elevations at that time. If the water level is above the top of the aquifer layer (per the basin model layer elevations), then a confined storage coefficient is used for that grid cell; otherwise, if the water level is below the top of that aquifer layer, then a larger unconfined storage coefficient is used. To further complicate matters, the water level change in question from Year 1 to Year 2 may cause a given grid cell in the Shallow aquifer to switch from confined under Year 1 conditions to unconfined under the Year 2 conditions, or vice versa. The GIS application handles this type of condition by subdividing the water level change into two components: a confined portion and an unconfined portion. This is illustrated in the sketch and “pseudo-code” algorithm that was written for this application prior to formal programming of the GIS application (Appendix 4).

The new GIS application for the three-layer storage change calculation was thoroughly tested and necessary refinements were made to the AML codes. Water level change and storage change calculations were hand checked and verified at individual grid cells having both confined and unconfined conditions. Also, the storage change results for each aquifer layer were verified to be identical in magnitude but opposite in sign if switching the order of what is predefined as Year 1 or Year 2. For example, if the storage change from Year 1 to Year 2 was calculated to be 10,000 af, then the storage change from Year 2 to Year 1 calculates to be exactly -10,000 af.

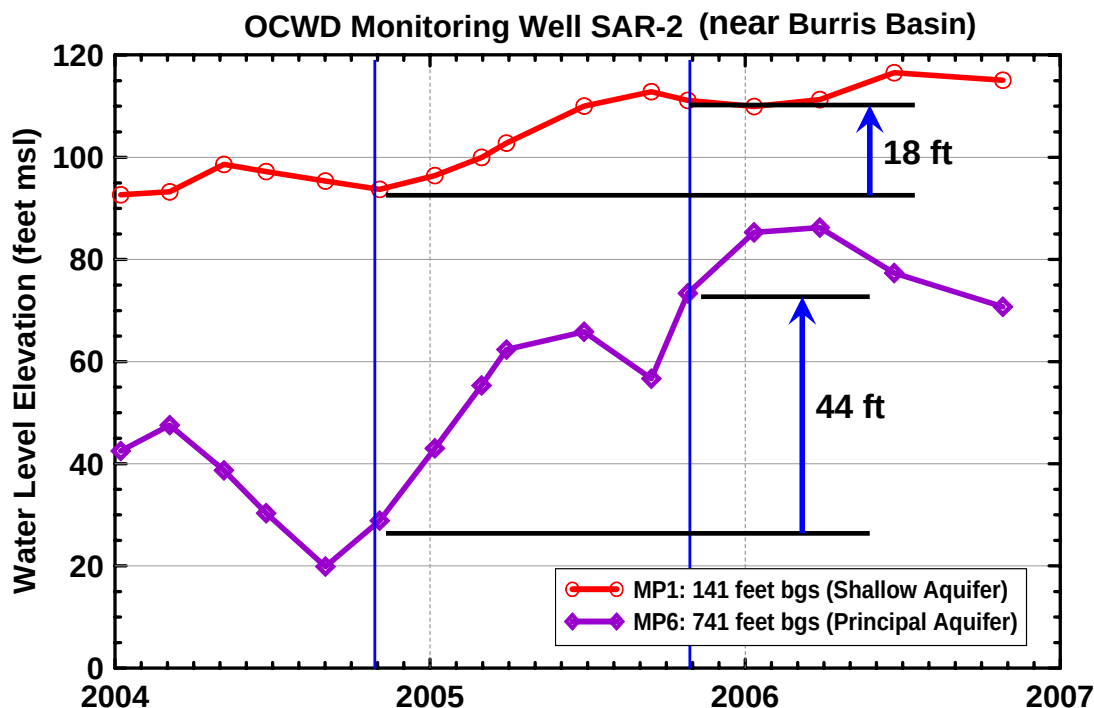
#### Testing the Three-Layer Method vs. the Traditional Method

Test Case 1 compared the new three-layer storage change calculation to the traditional method using the annual period November 2004 to November 2005. This first test case represented an extremely wet year with record-setting rainfall and a huge storage change of +187,000 af using the traditional method with the existing November contour maps of the Principal aquifer. Using the new three-layer approach led to a storage change of +147,000 af for the same period.

The rather large discrepancy of 40,000 af in Test Case 1 is primarily due to the inaccuracy of the traditional method presumption that Principal aquifer water levels behave identically to Shallow aquifer water levels in the Forebay area. As was shown in previous sections, this is not always the case and was especially not the case during 2004-05 when the Principal aquifer rose much more than the Shallow aquifer in most Forebay locations.

Figure 3-6 shows water levels for multi-depth monitoring well SAR-2 near Burris Basin in the Anaheim Forebay area. Notice that the water level change from November 2004 to November 2005 in the Principal aquifer zone was more than double that for the Shallow aquifer zone at that location. Since this was the case throughout much of the Forebay area, the traditional method overestimated the storage change by using Principal aquifer water levels as a surrogate for the Shallow aquifer.

**Figure 3-6. November 2004-05 Water Level Change at Monitoring Well SAR-2**



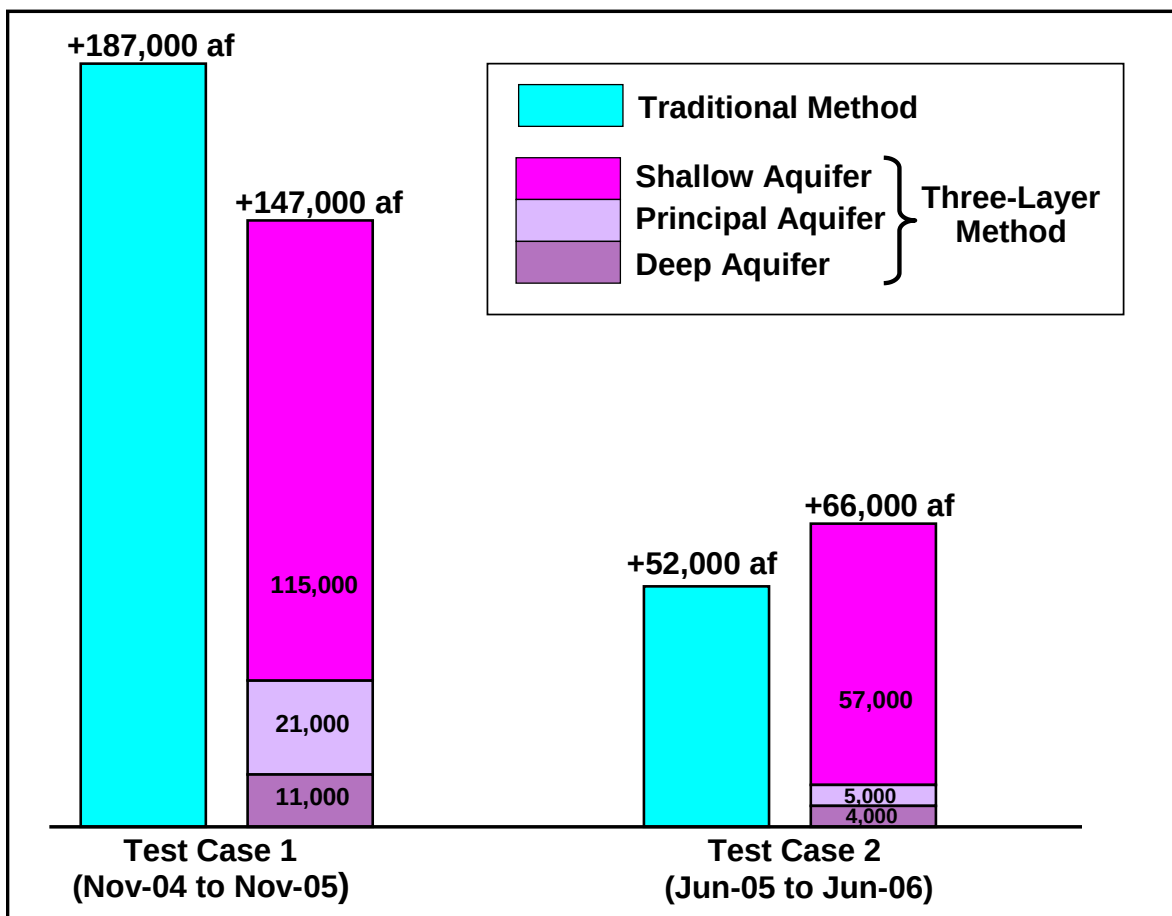
Test Case 2 compared the new three-layer method to the traditional method for the most recent water year, June 2005 through June 2006. This water year was chosen because it not only represented the most recent conditions but it was also an approximately average rainfall year in contrast to the extremely wet year in Test Case 1. As was mentioned in previous sections, care was exercised to maintain consistency of how the water level data was interpreted and hand contoured for both of these years to prevent any false or “manufactured” water level changes between the two conditions.

For Test Case 2, the traditional method yielded a storage change of +52,000 af, whereas the new three-layer method yielded a slightly higher storage change of +66,000 af. The two methods yielded much closer results for this average hydrology year, indicating that the traditional method is at least “in the ballpark” during more typical years when water levels are not as drastically rising or falling. In these closer-to-average years, the traditional method presumption that Principal aquifer water levels behave similarly to the Shallow aquifer is not grossly inaccurate. However, since the new three-layer approach is more comprehensive and utilizes all three aquifer layers, it

represents a technical improvement upon the traditional method and is the preferred approach.

Figure 3-7 summarizes the results from both test cases 1 and 2 and schematically shows the storage change per aquifer layer for the three-layer method. As expected and as was discussed in earlier sections, the majority of the storage change occurred in the Shallow aquifer. The majority of basin pumping (over 200,000 afy) occurs from the Principal aquifer, which is continuously being fed by the Shallow aquifer, which in turn is being fed by the District's recharge activities (typically over 200,000 afy). If basin pumping exceeds total recharge over a given year, then the Principal aquifer draws more water out of the Shallow aquifer than what is coming in from recharge, resulting in an annual storage decrease in the Shallow aquifer. Conversely, if recharge exceeds basin pumping over the course of a year (especially in a wet year), then more recharge is entering the Shallow aquifer than what is flowing down into the Principal aquifer, causing Shallow aquifer water levels to rise and a resulting storage increase.

**Figure 3-7. Summary of Traditional vs. Three-Layer Storage Change Results**

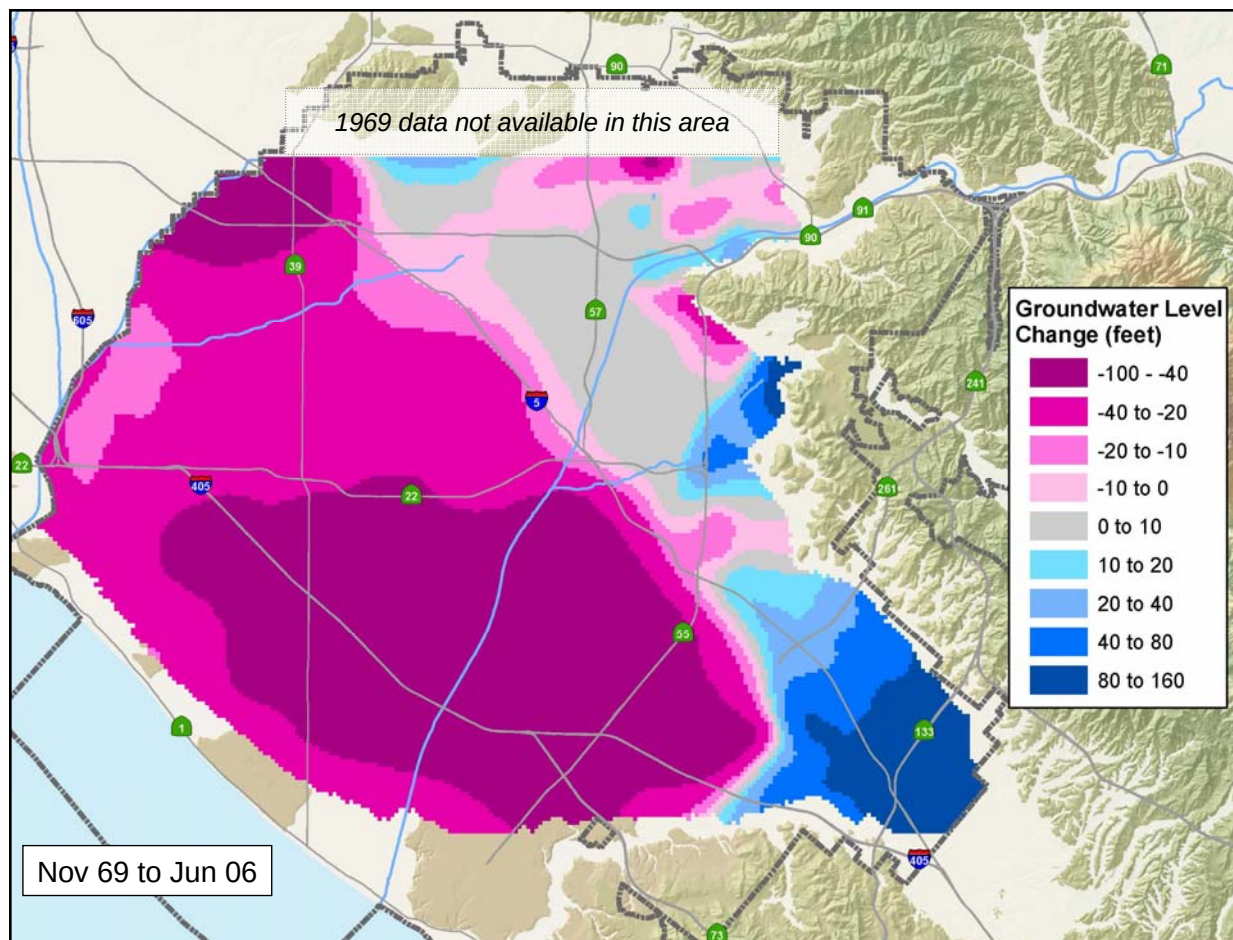


#### 4. NEW FULL BASIN BENCHMARK

Since a new three-layer method was developed and tested for calculating the change in storage, a new full basin benchmark must be defined for all three aquifer layers so that the accumulated overdraft can ultimately be calculated.

In Section 1, it was shown that 1969 water levels no longer represented a full basin given the significantly different pumping and recharge conditions that exist today. In fact comparing the November 1969 water level contour map to the recent June 2006 Principal aquifer contour map shows that in much of the Forebay area, Principal aquifer water levels are already higher in June 2006 than they were in November 1969 when the basin had historically been considered full (see Figure 4-1). The Irvine Forebay area was over 80 feet higher in June 2006 than 1969 due to reduced agricultural pumping over the years. As was discussed in Section 1, because of increased utilization of the groundwater basin, i.e., increased pumping and recharge, higher Forebay water levels can be achieved while coastal water levels remain lower, resulting in a steeper basin gradient.

**Figure 4-1. Principal Aquifer Water Level Change: November 1969 to June 2006**



## 4.1 Assumptions and Methodology

A water level contour map representing a reasonable full condition was developed for the Shallow, Principal, and Deep aquifers. The resulting full water levels represent a “snapshot” of a peak high water level condition throughout the basin that could possibly be exceeded but with potentially detrimental impacts.

Defining how high basin water levels can rise before being considered full was largely based on a comprehensive review of relatively recent historical high basin conditions that occurred approximately in 1994 and 2006. The high basin conditions that occurred in 1969 and 1983 were briefly reviewed but were deemed of less direct value since basin pumping and recharge patterns were significantly different then.

Much of the groundwater basin achieved historical highs during 1994, with the coastal area peaking in the winter and the Forebay area in late spring or early summer. A similar lag in the seasonal timing of the coastal and Forebay area water level peak was observed during the recent high condition of 2006. Typically after a very wet winter, surplus storm runoff impounded behind Prado Dam is still being released for OCWD recharge operations well into the summer months, thus increasing Forebay recharge amounts, which in turn raise Forebay water levels at a time when coastal water levels are already beginning to decline in response to summer pumping. However, also during wet years, MWD has surplus water; thus, taking additional imported water in-lieu of groundwater pumping can extend into the summer months, which would prevent or delay coastal water levels from declining. Therefore, for the purposes here of defining a basin-wide full condition, it is assumed that water levels can concurrently peak to a full condition throughout the basin.

The full condition that was developed for all three aquifer layers represents the highest achievable water levels throughout the basin under realistic present-day operating conditions without incurring any regional-scale detrimental impacts. In general, coastal water levels were assumed to be at or very near the 1994 and 2006 winter highs, whereas the Forebay area was assumed to be at or slightly above the 1994 and June 2006 highs. In so doing, the full basin coastal water levels were high enough to be protective against seawater intrusion but not unnecessarily high to where shallow groundwater seepage could become an issue. In the Forebay area, full basin water levels were generally well below ground surface and at or near the bottom of deep recharge basins (as occurred in June 1994). Therefore, in the Forebay area, water levels any higher than this full condition may be physically possible but would likely impact recharge operations and lead to considerable mounding problems.

Other assumptions that define the new full basin condition are enumerated below.

1. Full basin flow patterns (shape of the water level contours) are representative of present-day pumping and recharge conditions (except where specifically noted) and thus are largely based on and consistent with actual water level contour maps constructed for the recent high conditions of January 2006 and June 2006.

2. Water levels in the Irvine Sub-basin were at historical highs during 2006 because of the extremely wet year 2004-05 and reduced Irvine Company agricultural pumping. The new full condition in the Irvine Sub-basin is thus based on this recent high condition, which inherently then excludes the Irvine Desalter Project (IDP). The IDP will significantly lower Irvine area water levels for many years to come, but the regional drawdown and resulting water levels in that area are uncertain and may take several years to stabilize. Previous basin model scenarios including IDP pumping estimated that approximately 50,000 af of storage decline in the Irvine Sub-basin could occur after 20 years of full-scale IDP pumping. With this in mind, the new full condition will not likely be achievable in the Irvine Sub-basin after the IDP goes on-line.
3. Based on the earlier assumption that this new full condition is protective against seawater intrusion, full basin water levels in the MCWD area were based on the historical high of 1994 rather than the somewhat lower water levels during the 2006 high condition. The 1994 water levels in the MCWD area were higher than in 2006 because the MCWD colored water project was not yet active in 1994. Therefore, the new full basin water levels in that immediate area inherently assume no MCWD colored water project (i.e., no pumping from Well MCWD-6) in order to define a condition sufficiently protective against seawater intrusion.
4. Full basin water levels in the immediate area of the Talbert Barrier were adjusted slightly higher than recent high conditions to account for the GWR Phase 1 barrier expansion soon to be on-line. Some of these new injection wells, including the four wells along the Santa Ana River just north of Adams Avenue, are already on-line and thus the observed water level rise due to these wells was used in the full basin condition.
5. Full basin water levels were raised slightly higher than either of the historical highs of 1994 or 2006 in areas where other near-term recharge projects are already planned, including La Jolla Basin and Santiago Creek recharge enhancements. However, especially in the case of Santiago Creek, full basin water levels were kept sufficiently below ground surface and known landfill elevations.

## **4.2 Shallow Aquifer Full Basin Water Level Map**

Full basin water levels for the Shallow aquifer were based largely on the historical high water levels observed in 1994 and 2006. Only wells with a screened interval generally in the range from 100 to 250 feet below ground surface (depending on the specific area) were used to ensure that these wells were representative of the Shallow aquifer. This depth restriction excludes most large system production wells. Therefore, the majority of wells used to construct the Shallow aquifer full basin water level map were District monitoring wells, along with some small system and domestic wells having sufficient water level histories. Fortunately, the majority of the District's monitoring wells were constructed early enough so as to catch the 1994 high-basin condition.

Prior to this study, Shallow aquifer water levels were not regularly contoured, but Shallow aquifer contour maps (basin model layer 1) had been constructed during basin model development and much was learned about the hydraulic characteristics and flow patterns of the Shallow aquifer. Subsequently for testing the new three-layer storage change method described in Section 3, water level contour maps were constructed for all three aquifer layers using observed data for both June 2005 and June 2006. Fortunately, June 2006 also represented a high-basin condition from which to use as a base for making adjustments up to the new full condition.

In the coastal and mid-basin areas, high water levels that peaked in January 2006 were generally adhered to and used for the full condition in those areas. This represented a condition high enough to be protective of seawater intrusion, but anything appreciably higher could potentially result in shallow groundwater seepage problems in low-lying areas. In the immediate area surrounding portions of the Talbert Barrier, the observed January 2006 water levels were adjusted upward approximately 5 feet to account for increased injection from new GWRS Phase 1 injection wells. In the area surrounding the GWRS treatment plant site where considerable construction dewatering was occurring during January 2006, full water levels were based on earlier historical highs that were nearly 15 feet higher than January 2006 in this immediate area.

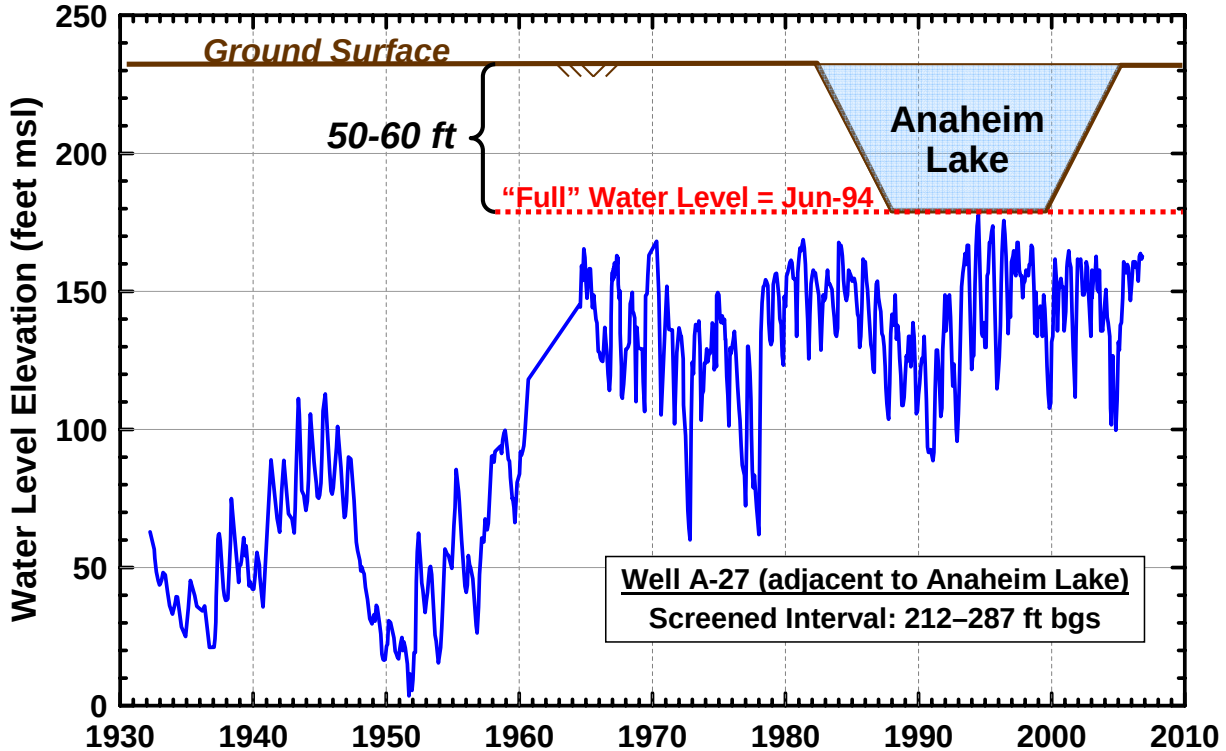
In the Forebay area, full basin water levels were generally set from 0 to 15 feet above the higher of the two historical peaks that occurred in June 1994 and June 2006. The magnitude of the upward adjustment between 0 and 15 feet depended on conditions at each well location and was most significantly influenced by the relative depth of the water table from ground surface. Since relatively little pumping occurs from the Shallow aquifer, the unconfined water table in the Forebay area is largely considered to be a subdued reflection of topography, with the exception of directly beneath recharge basins where the Shallow aquifer water table tends to rise in response to percolation. From analysis of the Forebay historical highs (June 1994 and/or June 2006), Shallow aquifer water levels generally peak at an elevation that corresponds to a depth of approximately 50 to 60 feet below ground surface. Therefore, when setting the full basin water level elevations at various well points and especially in areas where little or no data existed, the 50- to 60-foot depth to water rule of thumb was generally maintained.

Since the majority of the storage change in the basin occurs in the Shallow aquifer within the Forebay area, the full basin water level condition in this area is crucial. A discussion of the full basin Shallow aquifer water level adjustments for specific regions of the Forebay is described below.

At Anaheim Lake and Kraemer Basin, full basin water levels were set at June 1994 observed levels with no upward adjustment since these levels were essentially at or even a couple feet above the deepest portion of Anaheim Lake, which is approximately 50 to 60 feet deep (see Figure 4-2), which is consistent with the depth to water rule of thumb mentioned above. Water levels any higher at this location, if even achievable, would likely impede percolation from these basins and thus would not be desirable.



Figure 4-2. Full Basin Water Level at Anaheim Well 27



At Santiago Pits, full basin water levels were set at the historical high of March 1993 (just slightly higher than June 1994) with no upward adjustment. This same identical high was reached but not exceeded more recently in June 2005 after the extremely wet winter of 2004-05. Having the observed water levels peak at the same exact same level in 1993 and 2005 may likely indicate that this repeatable historical high may represent the highest physically achievable water level for this area.

In the Anaheim/Fullerton area west of the District's spreading grounds, full basin water levels were set 10 to 15 feet higher than the new historical high of June 2006. Water levels in June 2006 exceeded the previous historical high of June 1994 and appear to still be on an upward trend. The upward adjustment of 10 to 15 feet from the June 2006 observed condition once again brought the water table up to approximately 50-60 feet from ground surface.

Along the Santa Ana River downstream of Lincoln Avenue, full basin water levels were set 5 to 10 feet higher than the new historical high of June 2006, which exceeded the previous high of June 1994 in this area as well. The upward adjustment of 5 to 10 feet above the historical high once again brought the full condition up as shallow as 40-50 feet from ground surface, likely being influenced by the recharge from the Santa Ana River and Burris Basin. This full level also corresponds approximately to the bottom elevation of Burris Basin, analogous to the full level adjacent to Anaheim Lake.

In the Irvine Forebay area, full basin water levels were set within 5 feet of the historical high, which either occurred in 1994, 1999, or 2006 depending on the exact location within this general area. Recall from the previous section that this new full condition is prior to full-scale IDP pumping. Although the majority of IDP pumping will be from the Principal aquifer, Shallow aquifer water levels will likely also decline.

Finally, in the mid-basin Pressure area, full condition water levels were modestly adjusted upward 5 to 10 feet from the new historical high of June 2006, which again significantly exceeded the previous high of June 1994. This slight upward adjustment maintains a reasonable gradient from the coast to the upwardly adjusted full water levels in the Anaheim Forebay area.

After making all the full condition water level adjustments at monitoring well points in the various areas described, the resulting full water levels were plotted on a map and hand contoured similarly to the observed water levels of June 2006. In fact, the June 2006 contour map was used as a guide or backdrop on the light table while contouring the full condition to ensure consistency, especially in outlying areas lacking data.

Figure 4-3 shows the resulting full water level contour map constructed for the Shallow aquifer. Also shown for reference is the June 2006 Shallow aquifer contour map directly below it. Note the similarity in the shape of the contours between the two maps. The various well points screened in the Shallow aquifer that were used for constructing these contour maps are shown in light gray. The red boundary represents the basin model layer 1 boundary which represents the extent of the Shallow aquifer along the mountain fronts where the aquifer terminates and on the western boundary represents an arbitrary cutoff 5 miles into LA County. Contouring the water levels slightly into LA County adds confidence to the shape of the contours in west Orange County and at least qualitatively indicates the direction of flow across the county line.

Figure 4-4 shows the same two Shallow aquifer water level conditions (Full and June 2006), but in units of depth to water below ground surface rather than elevation. As was discussed above, notice that much of the Forebay area is within the 40 feet below ground surface or greater range since the Shallow aquifer water levels generally follow ground surface topography where the aquifer is unconfined (Forebay), except near recharge facilities where the depth to water is more shallow due to percolation raising the water table.

The depth to water also becomes shallower in the Pressure area of the basin where the Shallow aquifer is confined. However, these “water levels” are actually pressure or piezometric levels since the water is confined or trapped below the overlying aquitard. Water can only rise to this elevation if a well is drilled through the aquitard down into this aquifer or if the aquitard is thin or discontinuous. Notice that there is a large area in Irvine where the piezometric level is actually above ground surface in both the observed June 2006 and Full condition. This area has historically experienced artesian conditions when basin levels are relatively high.

Figure 4-3. Shallow Aquifer Groundwater Contours: Full Basin and June 2006

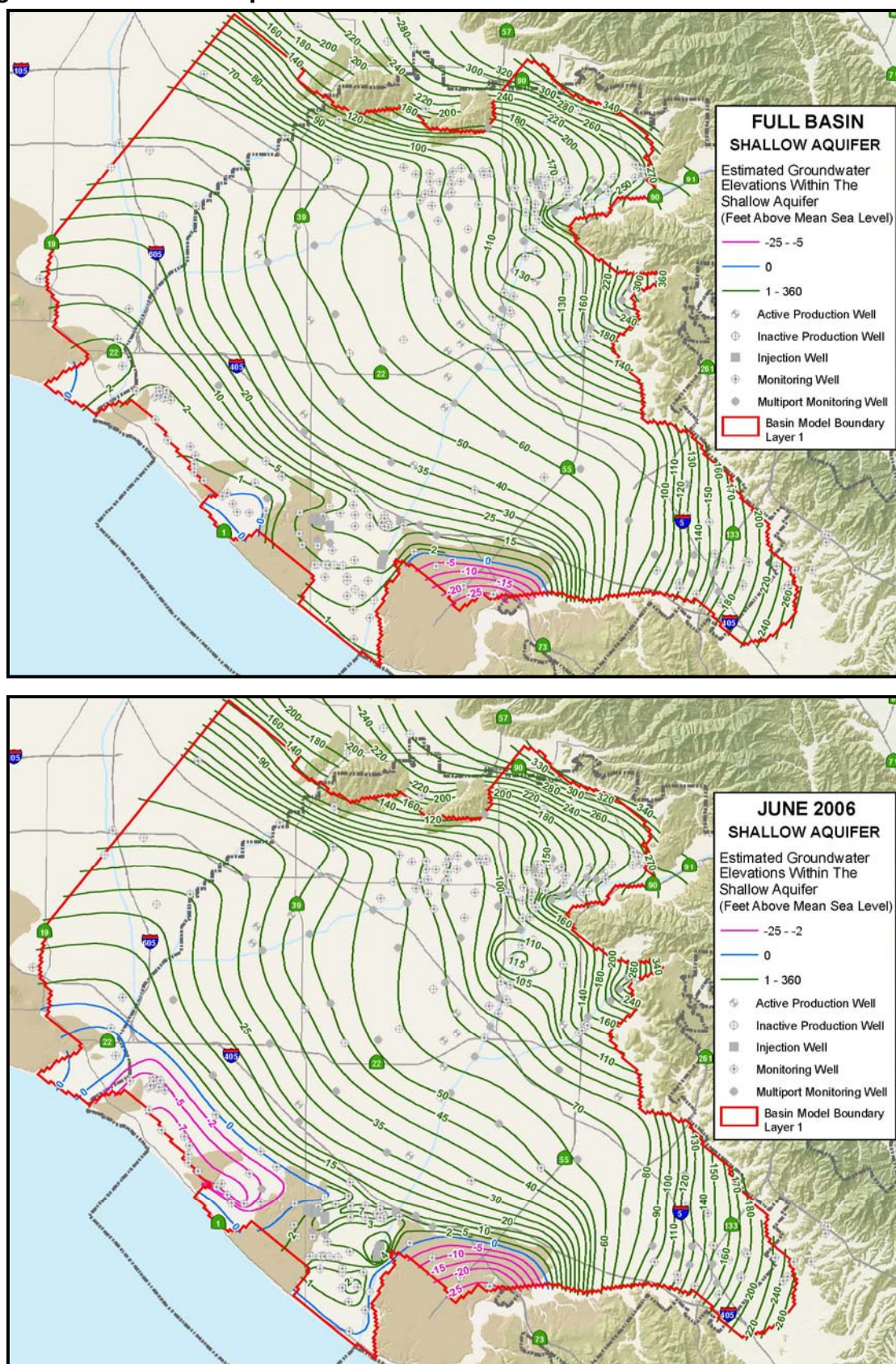
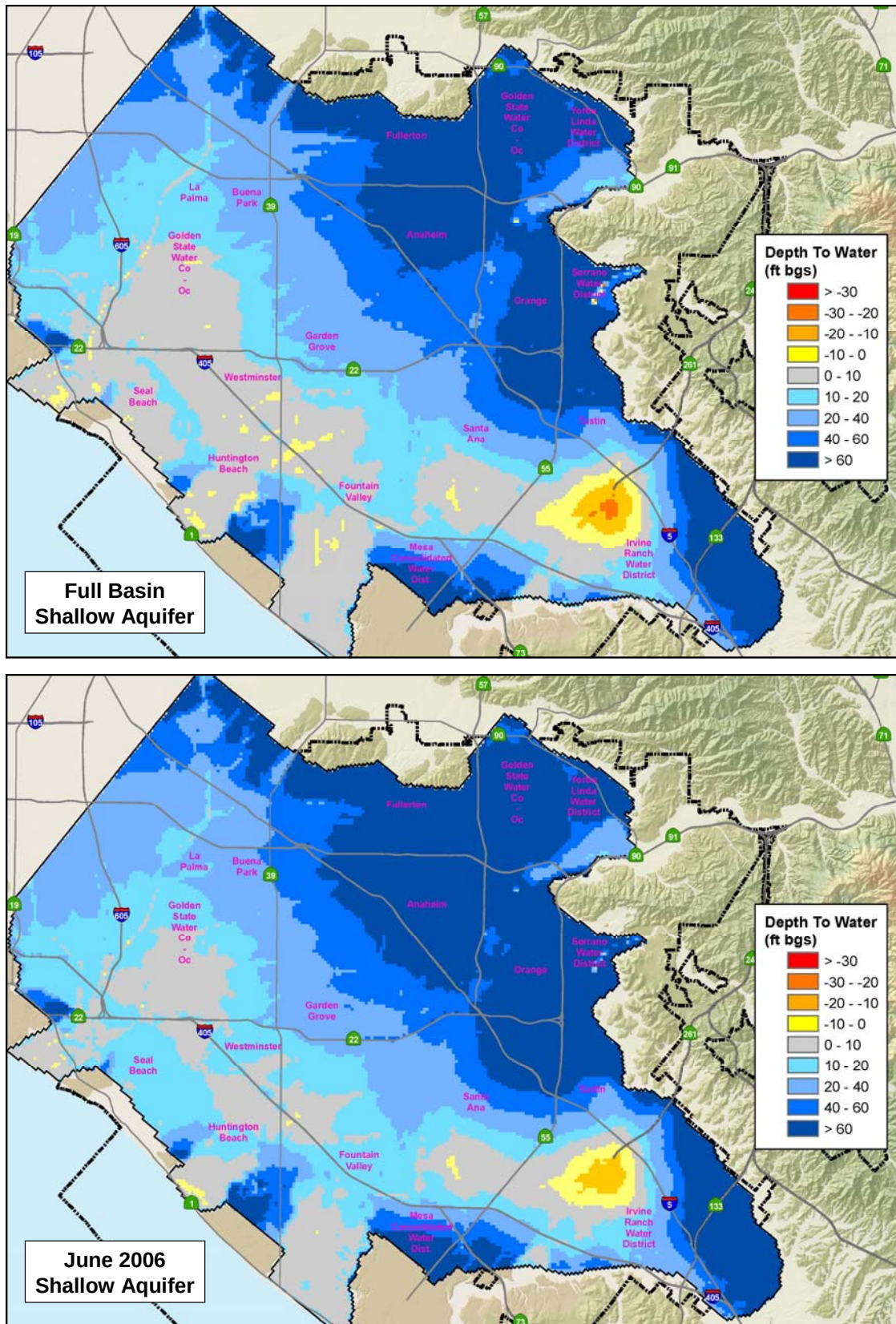




**Figure 4-4. Shallow Aquifer Depth to Water: Full Basin and June 2006**



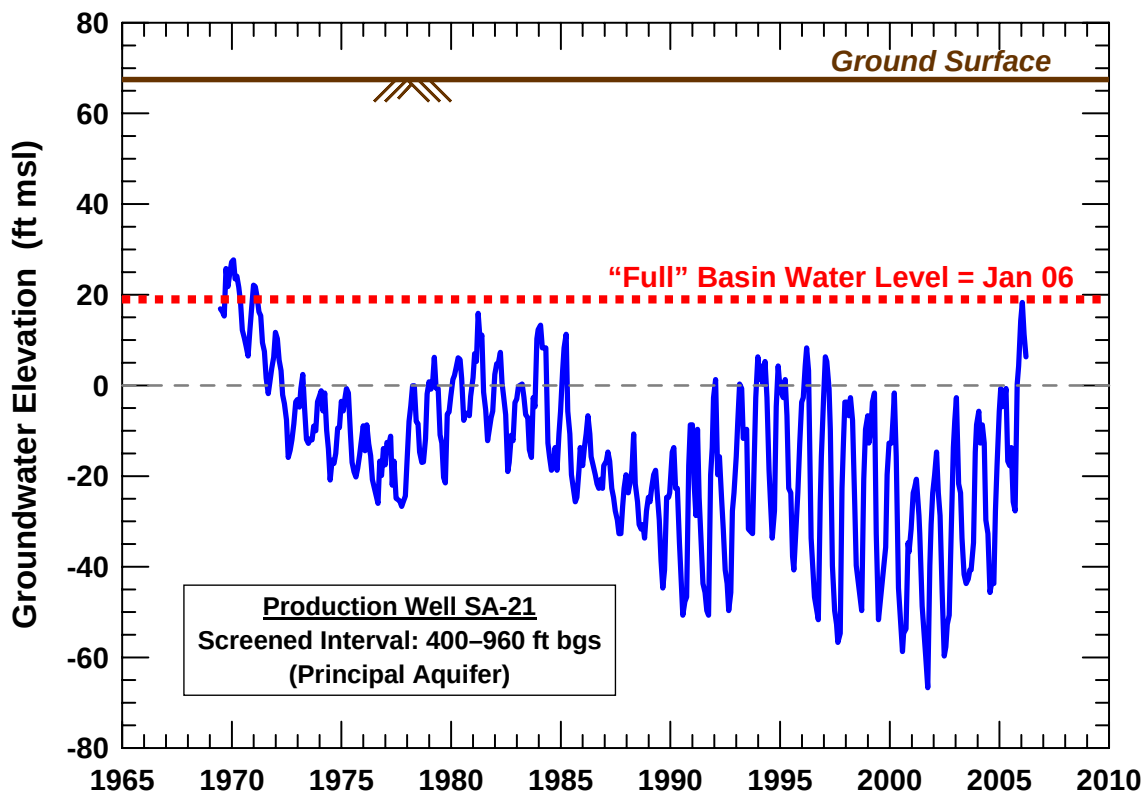
### 4.3 Principal Aquifer Full Basin Water Level Map

As with the Shallow aquifer, full basin water levels for the Principal aquifer were also based on the historical high water levels observed in 1994 and 2006. Wells with a screened interval generally within a range between 300 to 1,000 feet below ground surface (depending on the specific area) were used to represent the Principal aquifer. This depth interval includes most large system production wells, which along with District monitoring wells, were used to construct the Principal aquifer full basin water level map.

Prior to developing the full basin condition for the Principal aquifer, the high-basin water level condition of January 2006 was analyzed and contoured to determine the flow patterns and contour shapes for a most recent, near-full, actual condition. In subsequent months, observed water levels in the Forebay area increased further to a new historical high in June 2006, whereas in the coastal area January 2006 remained a historical high.

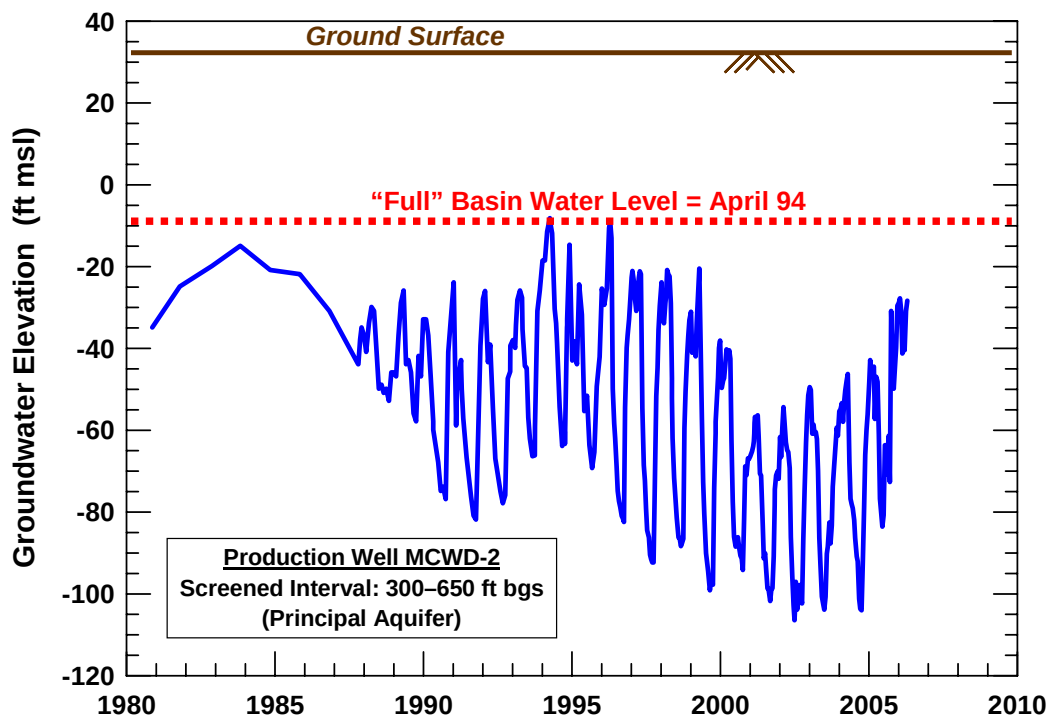
In the coastal area, full basin water levels were generally set at or within 5 feet of the observed peak January 2006 water levels, as was also done for the Shallow aquifer. In fact, this was the case for the majority of the Pressure area, where January 2006 water levels were noticeably higher than the previous high of 1994 (see Figure 4-5).

**Figure 4-5. Full Basin Water Level at Santa Ana Well 21**



The exception to using January 2006 water levels for the full condition in the Pressure area was in the MCWD area where the high condition of April 1994 was used. At this location, January 2006 water levels were 15 to 20 feet lower than April 1994 because of current pumping from the MCWD colored water project that did not exist in 1994. As was mentioned in the Section 4.1 assumptions, since the full condition must be sufficiently high in the coastal area to be protective of seawater intrusion, the older but higher April 1994 water levels were used in this area for the full condition even though it is not representative of present-day pumping in this immediate area (see Figure 4-6).

**Figure 4-6. Full Basin Water Level at Mesa Consolidated Water District Well 2**



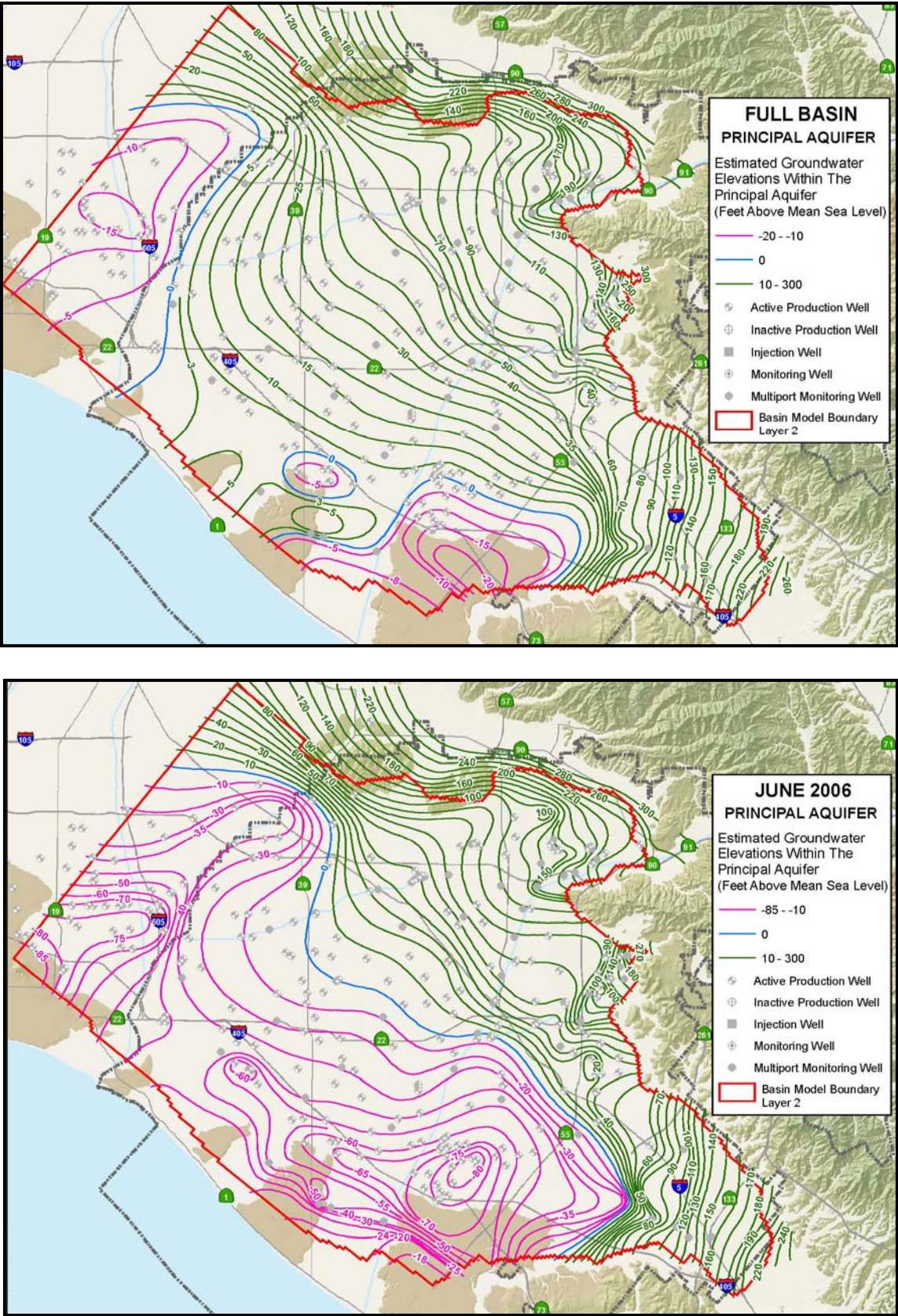
Throughout most of the Irvine Sub-basin, January 2006 represented a historical high similar to the rest of the Pressure area. Thus, full basin water levels in Irvine were also set within 5 feet of observed January 2006 levels. However, in north Irvine near the Santa Ana mountain front, 1999 water levels were used since they were nearly 15 feet higher than January 2006 in that immediate area.

In the Anaheim and Orange Forebay areas, full basin water levels were generally set at or within 5 feet of the historical high that occurred during March through June of 1994 depending on the exact location. For the majority of the Forebay area, 1994 still represented a historical high for the Principal aquifer, higher than January or June 2006.

Although the full water levels were based on different historical highs in different areas of the basin (coastal vs. inland), resulting gradients and flow patterns were reasonable and similar to those contoured for the observed data of June 2006 (see Figure 4.7).



Figure 4-7. Principal Aquifer Groundwater Contours: Full Basin and June 2006





#### **4.4 Deep Aquifer Full Basin Water Level Map**

For the Deep aquifer, the main data source for developing the full basin condition was water level data from the District's deep multi-port monitoring (Westbay) well network. Approximately two-thirds of these 56 wells were sufficiently deep and in appropriate locations overlying the Deep aquifer. Depending on the specific location, the monitoring ports of these wells that tap the Deep aquifer generally range from approximately 1,500 to 2,000 feet below ground surface.

In addition to the District's deep monitoring wells, a few other scattered well points that tap the Deep aquifer were used, such as two deep monitoring wells owned by the Water Replenishment District in LA County (very close to the county line).

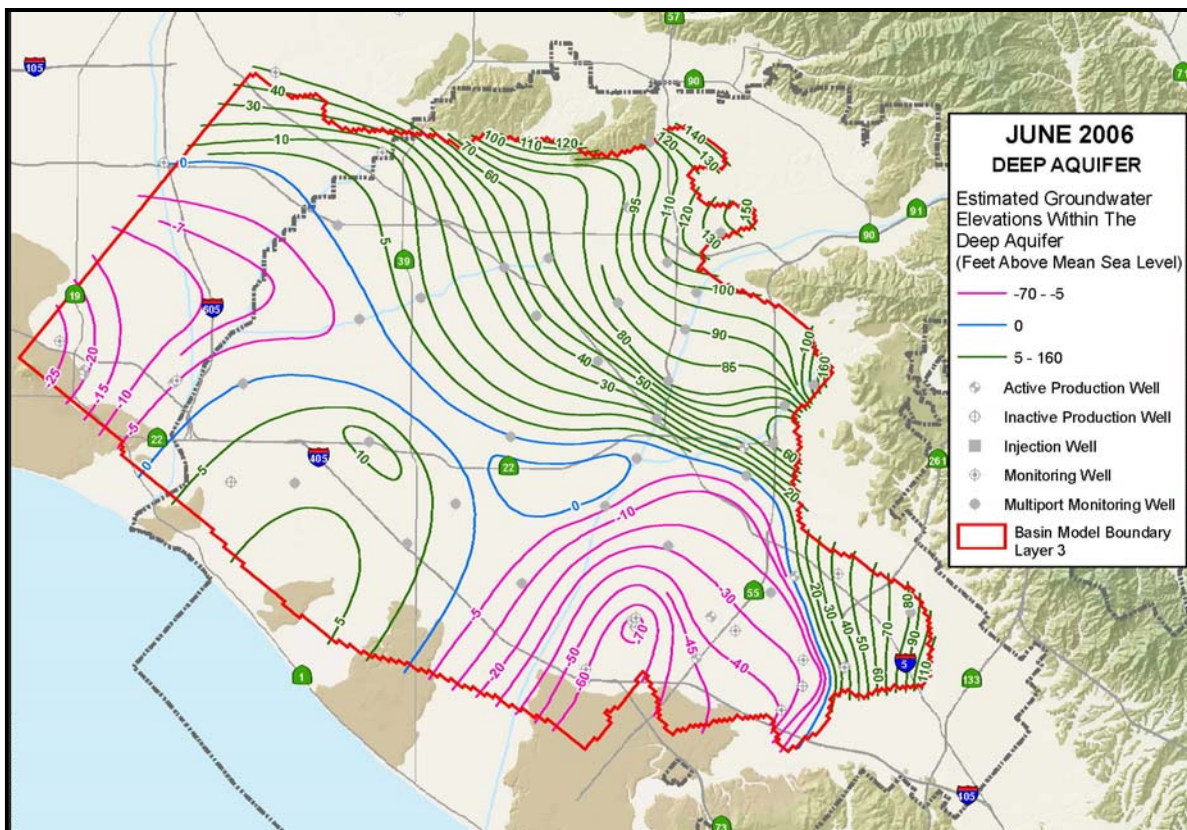
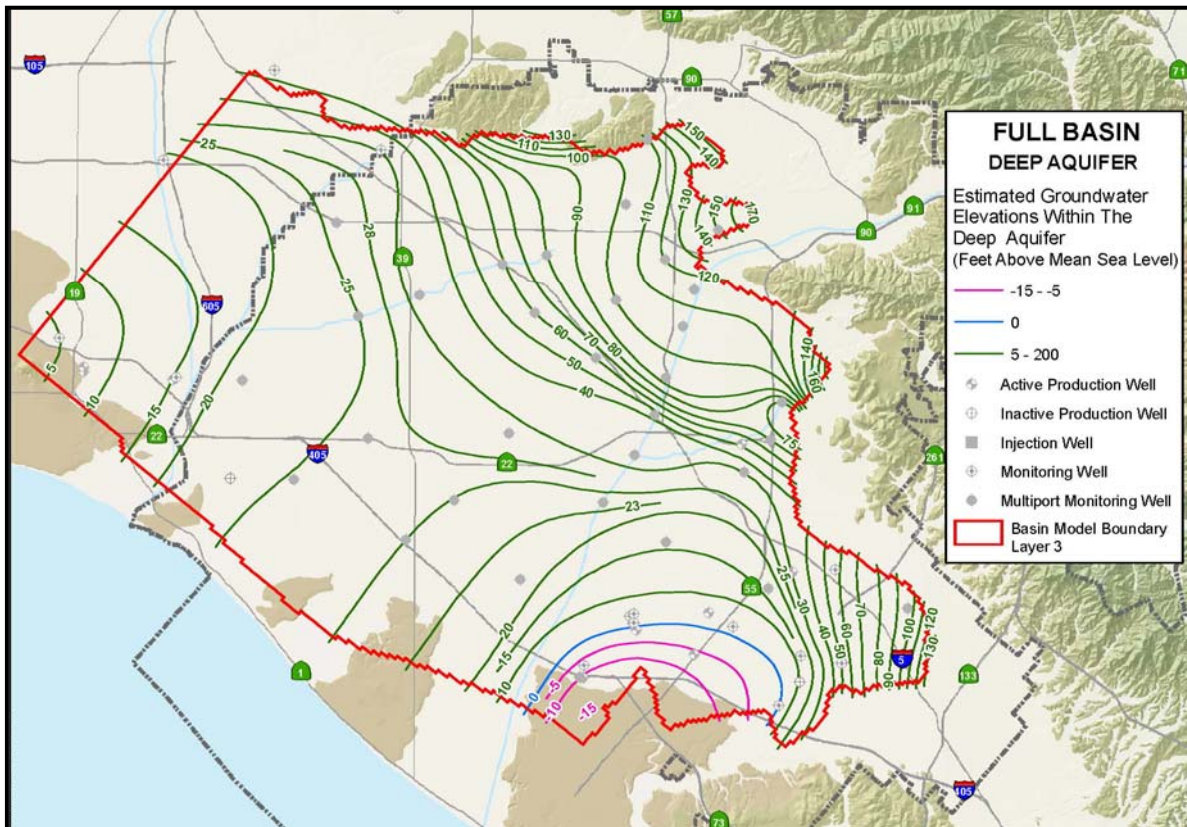
The new full condition for the Deep aquifer was predominantly based on the historical high that occurred in 1994. Throughout the basin, the recent June 2006 Deep aquifer water levels were still well below the historical high of 1994, likely due to the IRWD Deep Aquifer Treatment System (DATS) Project which began pumping approximately 8,000 afy of colored water in December 2001 from this otherwise little-used zone. Also, there was no MCWD colored water project yet in 1994. Fortunately, most of the District's deep monitoring wells are old enough to have captured the historical high condition of 1994.

It is somewhat speculative as to how high the piezometric level of the Deep aquifer can rise. Therefore, full water levels were conservatively adjusted only 0 to 5 feet higher than the observed historical peak that occurred April to June of 1994. In so doing, the observed vertical piezometric head difference between the overlying Principal aquifer and the Deep aquifer was maintained. Throughout most of the basin, Deep aquifer piezometric levels typically ranged from 10 to 30 feet higher than the more heavily pumped Principal aquifer, except in the furthest inland locations near the mountain front and near recharge facilities where the Deep aquifer levels are actually lower than the Principal aquifer due to being more vertically removed from surficial recharge.

While contouring the resulting Deep aquifer full basin piezometric levels (also referred to as water levels for simplicity), the Principal aquifer full condition contour map was used as a backdrop on the light table to ensure that the Deep aquifer full contours maintained the vertical head difference discussed above. Also, in areas lacking data, the contours were drawn with similar patterns as those predicted during basin model calibration.

Figure 4-8 shows the resulting contour maps for both the new full condition and also June 2006 for comparison. The contour shapes are quite similar for both maps except in the area near the aforementioned DATS wells. The Full map assumes no DATS pumping since it was based on the historical high water levels of 1994, whereas the June 2006 map shows a relatively deep pumping depression in that immediate area. However, due to the confined nature of the Deep aquifer, the storage coefficients of this zone are very small (see Appendix 2) and thus even a relatively large water level difference leads to a small storage change.

**Figure 4-8. Deep Aquifer Groundwater Contours: Full Basin and June 2006**



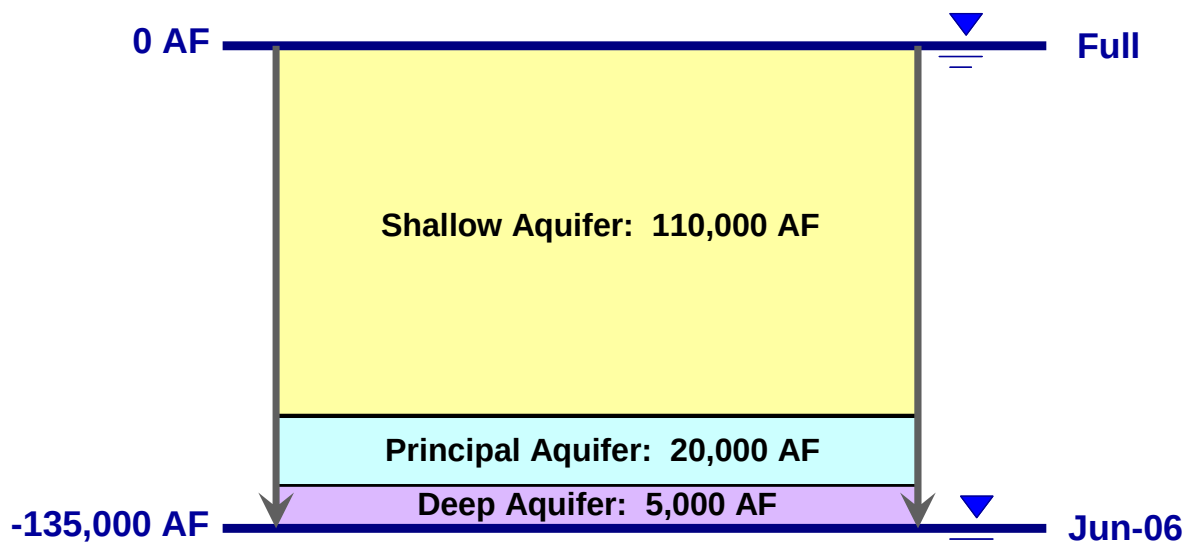
## 5. ACCUMULATED OVERDRAFT FROM NEW FULL CONDITION

The accumulated overdraft is the amount of storage capacity below full, sometimes referred to as dewatered storage or available storage capacity. In various literature, overdraft often has a negative connotation implying that a basin is in a steady state of decline or has been drawn-down below some critical threshold to where negative impacts such as subsidence and seawater intrusion begin to occur. In this report, use of the term “accumulated overdraft,” which is defined in the District Act, is not intended to have any negative connotation and is strictly used as a measure of available basin storage below the new full benchmark or zero-overdraft condition established in Section 4.

### 5.1 Accumulated Overdraft as of June 30, 2006

The new three-layer storage change methodology was used to calculate the accumulated overdraft for June 2006. Three groundwater contour maps (one for each aquifer layer) representing June 30, 2006 had already been constructed for testing the new three-layer approach described in Section 3. For the storage change calculation, Year 1 was set to the new full water level condition and Year 2 was set to the June 2006 water level condition. The resulting change in storage from the new full condition to June 2006 was -135,000 af, or in other words, the accumulated overdraft as of June 30, 2006 was 135,000 af below the new full benchmark. The breakdown per aquifer layer is schematically shown below in Figure 5-1.

**Figure 5-1. Three-Layer Accumulated Overdraft for June 2006**





Detailed water level change maps for June 2006 to the new full condition for all three aquifer layers are shown in Appendix 3.

**Forebay +15**

**Pressure Area +5 or less**

**+25**

**Shallow Aquifer Water Level Increase (ft) from Jun 2006 to Full Condition**

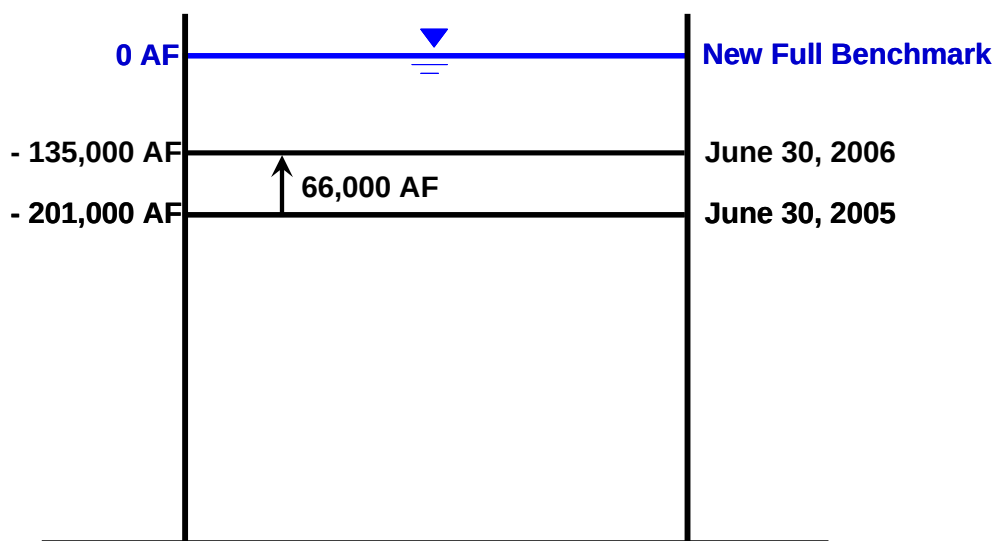
Using the new three-layer storage change method, the accumulated overdraft was calculated for June 2005 by directly comparing to the new full benchmark once again. In the storage change calculation, Year 1 was set to the new full water level condition and Year 2 was set to the June 2005 water level condition. The resulting total change in storage from the new full to June 2005 was -201,000 af, or in other words, the accumulated overdraft was 201,000 af below the new full benchmark.

The June 30, 2005 accumulated overdraft for each aquifer layer was as follows:

|                      |                  |
|----------------------|------------------|
| Shallow aquifer:     | 166,000 af       |
| Principal aquifer:   | 25,000 af        |
| <u>Deep aquifer:</u> | <u>10,000 af</u> |
| Total:               | 201,000 af       |

The difference between the June 2005 and June 2006 accumulated overdraft was 66,000 af, which represents the annual increase in storage from July 1, 2005 through June 30, 2006 (see figure 5-3). As a check, this storage change of 66,000 af was exactly the same as that calculated directly using the new three-layer method with Year 1 as June 2005 and Year 2 as June 2006 (see previous Figure 3-7). Therefore, this confirmed that the new three-layer approach yields exactly the same results summing the annual storage change over multiple years or calculating the storage change using the start and end of the multiple year period. In addition, the new method has been shown to yield the same identical storage change, but opposite in sign, when reversing the order of Year 1 vs. Year 2.

**Figure 5-3. Accumulated Overdraft Schematic for June 2005 and June 2006**

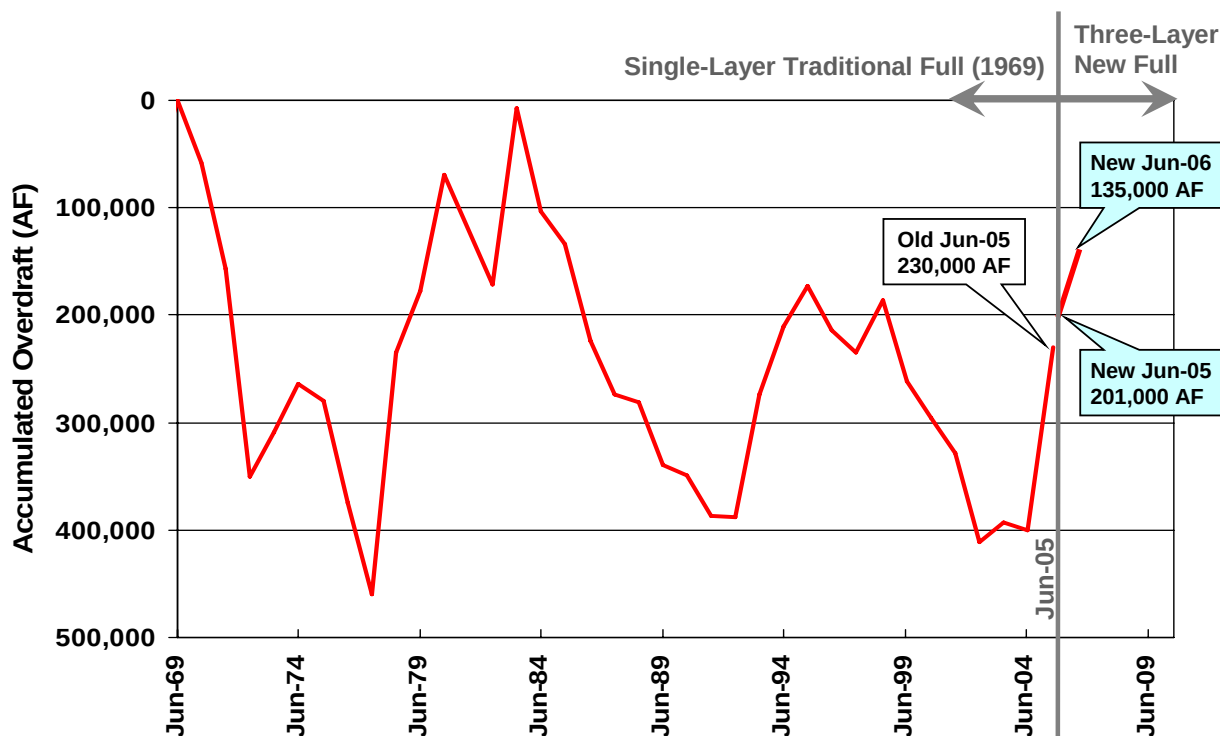


### 5.3 Historical vs. New Accumulated Overdraft Estimates

The new accumulated overdraft estimate of 201,000 af for June 2005 is 29,000 af less than the traditional method estimate of 230,000 af published in the 2004-05 OCWD Engineer's Report. This discrepancy is relatively minor when considering the major differences between the traditional single-layer and new three-layer storage change methods and also their two corresponding different full basin benchmarks. Since the historical accumulated overdraft levels are all relative to the 1969 condition as being the

zero-overdraft benchmark, the two new accumulated overdraft estimates for June 2005 and June 2006 are plotted on the same familiar historical overdraft graph in Figure 5-4. However, this graph has been divided at the June 2005 line due to the two different zero-overdraft benchmarks of 1969 water levels and the new full condition.

**Figure 5-4. Historical and New Accumulated Overdraft**



#### 5.4 Implementation of New Three-Layer Storage Change Method

To prevent or minimize any accumulation of potential discrepancy from year to year when implementing this new storage change method, it is important to follow the steps enumerated below.

1. Hand-contour water levels collected on or about June 30 for each of the three aquifer layers, maintaining consistency with how the water level data is interpreted from year to year, unless new well data in a specific area causes a different interpretation.
2. Use the GIS to calculate the water level change and corresponding storage change from the three-layer full benchmark to the current June condition. The resulting storage change below the full condition represents the accumulated overdraft for June of that year.



3. Subtract the previous year's accumulated overdraft from the current year to obtain the annual change in storage for that water year.
4. This step is a quality control check. Use the three-layer storage change method once again to calculate the water level change and storage change from the previous June (Year 1) to the current June (Year 2). This storage change should exactly equal the storage change calculated in Step 3.
5. Calculate incidental recharge for that water year by inputting the annual storage change estimate from Step 3 or 4 (if they are the same) into the water budget method described in Section 3.3. The resulting incidental recharge should be reasonable given the annual rainfall for the year in question; otherwise, additional error checking should be done for the water budget terms as well as the input data for the storage change calculation. It should be pointed out though that incidental recharge is not solely a function of rainfall because the flow across the LA County line – along with all other unknown inflows and outflows – is lumped into the incidental recharge term. That being said, incidental recharge for a somewhat typical year with average rainfall is thought to be approximately 60,000 afy but could vary by upwards of 20,000 af based on changes in outflow to LA County, which unfortunately is difficult to quantify.
6. The water budget method should not be used to determine or adjust the official storage change estimate calculated using the new three-layer method. It can be used to calculate preliminary monthly storage change estimates (using assumed incidental recharge) prior to performing the annual three-layer storage calculation. However, the annual storage change and accumulated overdraft official record for that year should be the exact value from the three-layer storage method steps above. This will prevent an accumulation of unknown discrepancy when rectifying back to previous years.

## **6. BASIN OPERATING RANGE AND STRATEGY**

The level of accumulated overdraft in the basin, both for the current and upcoming year, affects important basin management decisions, including determining imported water needs and setting the Basin Pumping Percentage (BPP), both of which have major financial effects on the District and groundwater producers. Therefore, it is crucial to have an operational strategy to ensure that the basin is managed within acceptable overdraft limits to prevent detrimental impacts to the basin while also striving to maximize water reliability and financial efficiency.

In the discussion that follows, all storage and overdraft conditions are defined for June 30 of a given year, which is the ending date of the water year (July 1 through June 30) and thus the date represented by the June annual contour maps used for the storage change calculation. Seasonal fluctuations in water levels and basin storage occur throughout the water year and are tracked monthly for reporting purposes, and are used, along with the end-of-year accumulated overdraft, in making management decisions.

## 6.1 Basin Operating Range and Optimal Target

The operating range of the basin is considered to be the maximum allowable storage range without incurring detrimental impacts. The upper limit of the operating range is defined by the new full basin condition, which represents the zero-overdraft benchmark. Although it may be physically possible to fill the basin higher than this full condition, it could lead to detrimental impacts such as percolation reductions in recharge facilities and increased risk of shallow groundwater seepage in low-lying coastal areas.

The lower limit of the operating range is considered to be 500,000 af overdraft and represents the lowest acceptable level in the basin, not the lowest achievable. This level also assumes that all MWD water stored in the basin (e.g., Conjunctive Use Storage Project and Super In-Lieu) has already been withdrawn. Although it is considered to be generally acceptable to allow the basin to decline to 500,000 af overdraft for brief periods due to severe drought conditions and lack of supplemental imported water supplies, it is not considered to be an acceptable management practice to intentionally manage the basin for sustained periods at this lower limit for the following reasons:

- Seawater intrusion likely
- Drought supply depleted
- Pumping levels detrimental to a handful of wells
- Increased pumping lifts and electrical costs
- Increased potential for color upwelling from the Deep aquifer

Of course, detrimental impacts like those listed above do not suddenly happen when the overdraft gets down to exactly 500,000 af; rather, they occur incrementally, or the potential for their occurrence grows as the basin declines to lower levels. However, basin model computer simulations indicate that many of these detrimental impacts become evident at an overdraft of approximately 500,000 af. For example, at 500,000 af overdraft, model-simulated water levels in the Talbert Gap area were marginally low and not protective of seawater intrusion, even with the increased injection from GWRS Phase 1. Furthermore, worst case basin model runs at 700,000 af overdraft indicated seawater intrusion becoming even worse and considerably more production wells being impacted by low pumping levels. Thus, an accumulated overdraft level of 700,000 af did not appear to be acceptable, not even for short durations. At overdraft levels significantly below 500,000 af overdraft, the potential for land subsidence could also become an issue.

Based on historical hydrology and recharge water availability, an accumulated overdraft of 100,000 af best represents an optimal basin management target. This optimal target level provides sufficient storage space to accommodate anticipated recharge from a single wet year while also providing water in storage for at least 2 or 3 consecutive years of drought.

Table 6-1 shows that basin storage could increase by as much as 100,000 af in a somewhat typical wet year based on predicted increased supplies. The Captured Santa Ana River Flows and Natural Incidental Recharge terms were both based on an average of four historical wet years: 1992-93, 1994-95, 1997-98, and 2004-05. Based on historical rainfall records for the Orange County area, wet years typically do not occur back-to-back. Therefore, the optimal overdraft target of 100,000 af provides the storage capacity to capture the increased supplies from this one typically wet year.

**Table 6-1. Anticipated Supply Increases for a Typical Wet Year**

| <b>Increased Supplies<br/>(Above Average Annual Amounts)</b> | <b>1 Year<br/>(AF)</b> |
|--------------------------------------------------------------|------------------------|
| Captured Santa Ana River Flows *                             | 50,000                 |
| Natural Incidental Recharge *                                | 30,000                 |
| Reduced Demand (Pumping)                                     | 20,000                 |
| <b>Potential Storage Increase **</b>                         | <b>100,000</b>         |

\* Average of four wet years: 92-93, 94-95, 97-98, 04-05

\*\* Assumes no mid-year BPP change

Table 6-2 shows that basin storage could decrease by approximately 90,000 af in a dry year based on reduced supplies. However, unlike wet years, historical rainfall records for this area show that dry years often occur for 2 or 3 consecutive years. Therefore, the 90,000 af of reduced supplies in a dry year could result in a 270,000 af decrease in basin storage after 3 consecutive years of drought. Assuming the basin to be at the optimal target of 100,000 af going into a three-year drought, the accumulated overdraft at the end of the drought would be 370,000 af, which is still within the acceptable operating range.

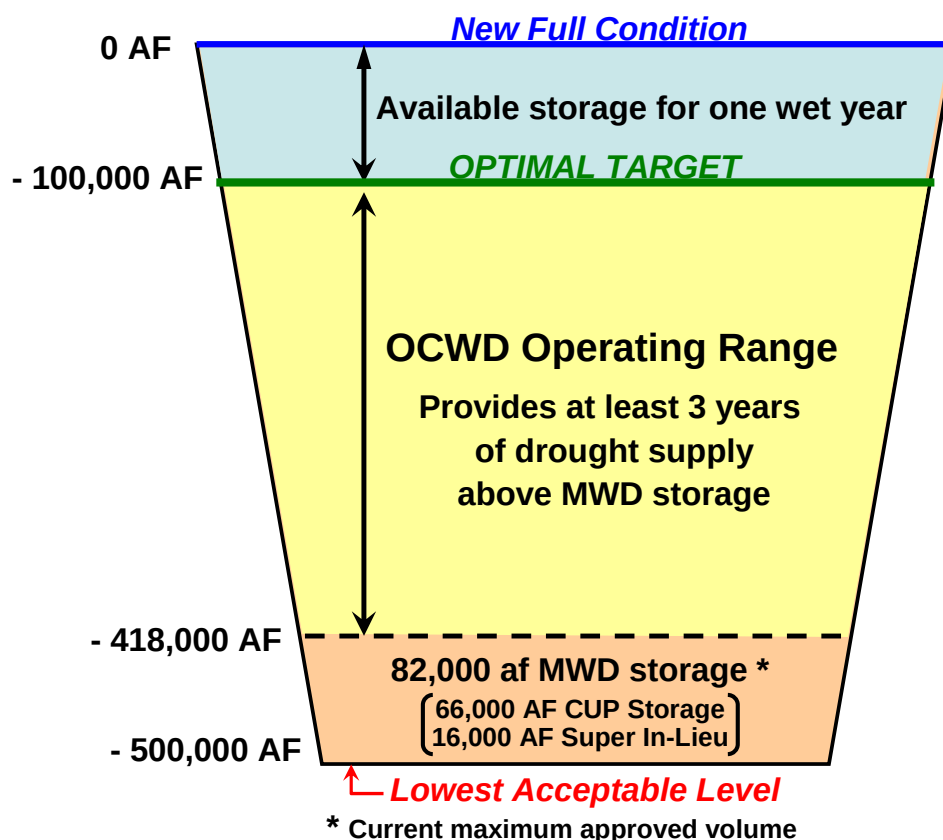
**Table 6-2. Anticipated Supply Reductions for Typical Dry Years**

| <b>Reduced Supplies<br/>(From Average Annual Amounts)</b> | <b>1 Year<br/>(AF)</b> | <b>3 Years<br/>(AF)</b> |
|-----------------------------------------------------------|------------------------|-------------------------|
| MWD Replenishment Water                                   | -30,000                | -90,000                 |
| Santa Ana River Flows                                     | -40,000                | -120,000                |
| Natural Incidental Recharge                               | -20,000                | -60,000                 |
| <b>Total Potential Storage Change*</b>                    | <b>-90,000</b>         | <b>-270,000</b>         |

\* Assumes no mid-year BPP change

Figure 6-1 schematically illustrates the various overdraft levels discussed above in relation to one another; namely, the new full benchmark, the optimal overdraft target of 100,000 af, and the lower limit of the operating range at 500,000 af accumulated overdraft.

**Figure 6-1. Strategic Basin Operating Levels and Optimal Target**



## 6.2 Basin Management Operational Strategy

The primary “tool” for managing the basin is the Basin Production Percentage (BPP). Each year in April, the District’s Board of Directors sets the BPP for the upcoming water year. In addition to purchasing replenishment water, adjusting the BPP allows the District to effectively increase or decrease basin storage. Figure 6-2 shows the formula used to calculate the BPP each year. Only the two terms highlighted in blue and red in the BPP formula are adjustable at the District’s discretion, namely the planned amount of recharge (including replenishment water purchases) and the planned amount of basin refill or storage decrease for the coming year.

The amount of recharge planned and budgeted for the coming year may be limited by factors outside the District’s control, such as the availability of imported water for either direct replenishment or In-Lieu. For example, following statewide wet years, MWD may

offer incentives (financial or otherwise) for local water agencies to take additional amounts of surplus imported water, whereas during a long-term statewide drought the surplus imported water may simply not be available.

**Figure 6-2. BPP Formula**

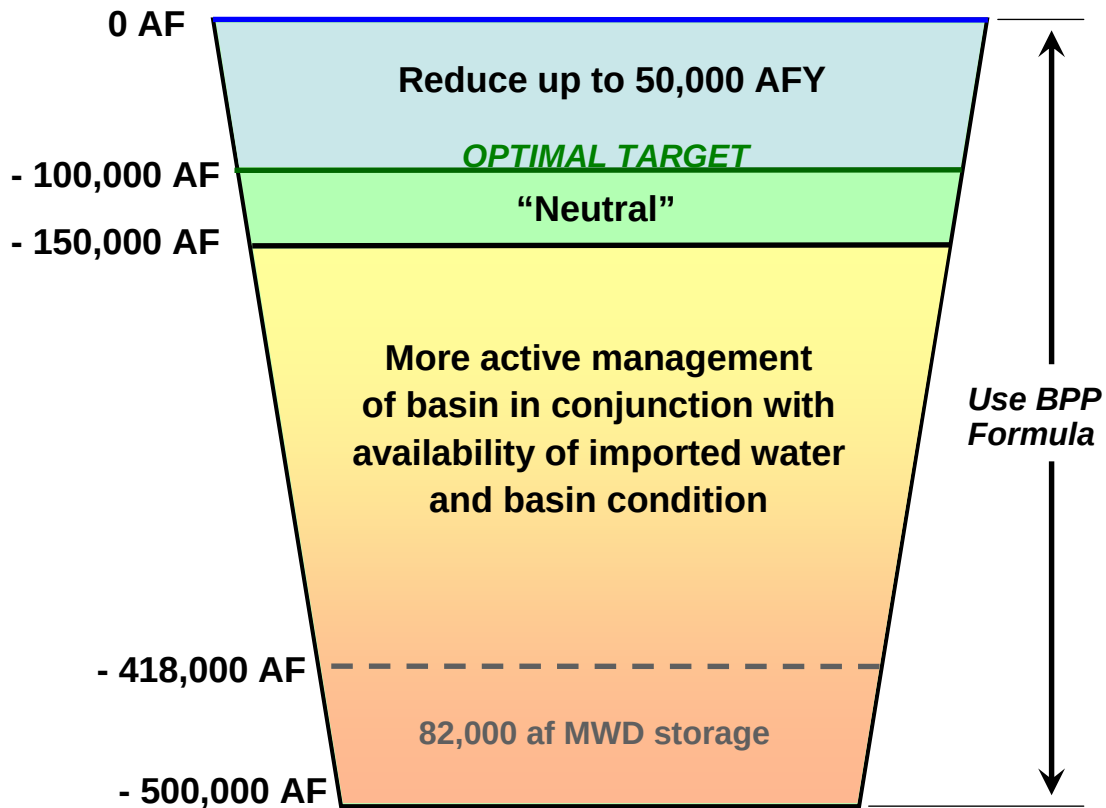
$$\text{BPP} = \frac{\text{Water Recharged} - \text{Basin Refill or Decrease} - \text{Water Quality Improvement Projects (Pumping Above BPP)}}{\text{Last Calendar Year's Total Water Demand} - \text{Reclaimed \& Local Supplies}}$$

The planned amount of basin refill or storage decrease for the coming year is within the District’s control but is also considered within the context of financial impacts to both the District and the groundwater producers. Therefore, unless the basin is near the bottom of the acceptable operating range or close to being full, a moderate amount of basin refill or decrease would typically be proposed that aims to move toward the optimal overdraft target. If the basin is already at or near the 100,000 af overdraft target, then a neutral stance can be taken that attempts to balance basin production and recharge with no planned storage change.

Figure 6-3 schematically illustrates the generalized basin refill or storage decrease strategy based on the accumulated overdraft. When the basin is higher than the optimal overdraft target and nearly full, the amount of planned storage decrease of up to 50,000 af for the coming year may be recommended. This may be accomplished by a combination of raising the BPP and reducing replenishment purchases.

The proposed operational strategy illustrated in Figure 6-3 provides a flexible guideline to assist in determining the amount of basin refill or storage decrease for the coming water year based on using the BPP formula and considering storage goals based on current basin conditions and other factors such as water availability. This strategy is not intended to dictate a specific basin refill or storage decrease amount for a given storage condition but to provide a general guideline for the District’s Board of Directors.

Figure 6-3. Basin Management Operational Strategy



## 7. FINDINGS

Findings of this study are enumerated below.

1. The new three-layer storage change approach is technically feasible and provides a more accurate assessment than the traditional single-layer storage change method.
2. Using the new three-layer method, the majority of the storage change occurs in the Forebay area of the basin within the unconfined Shallow aquifer where rising or falling of the water table fills or drains empty pore space.
3. Accuracy of the storage change and accumulated overdraft estimates is dependent upon good spatial distribution of water level measurements as well as the storage coefficient values used in the calculations. Water level data for the Shallow aquifer were relatively sparse in outlying Forebay areas of the basin, leading to some uncertainty in preparing groundwater elevation contours in those areas.



4. 1969 no longer represents a truly full-basin benchmark. A new full-basin water level condition was developed based on the following prescribed conditions:
  - Observed historical high water levels
  - Present-day pumping and recharge conditions
  - Protective of seawater intrusion
  - Minimal potential for mounding at or near recharge basins

The new full-basin water levels in the Forebay area are essentially at or very near the bottom of the District's deep percolation basins (e.g., Anaheim Lake). Historical water level data from 1994 have shown that this condition is achievable without detrimental effects. Water levels slightly higher than this new full condition may be physically achievable in the Forebay area but not recommended due to the likelihood of groundwater mounding and reduced percolation in recharge basins.

5. Using the new three-layer storage change calculation in conjunction with the new full benchmark and June 2006 water levels, an accumulated overdraft of 135,000 af was calculated representing June 30, 2006. Similarly, using the new three-layer method to compare the new full water levels to those of June 2005, an accumulated overdraft of 201,000 af was calculated representing June 30, 2005. Subtracting the June 2006 accumulated overdraft from that of June 2005 yielded an annual storage increase of 66,000 af for WY 2005-06.
6. Comparing the current year's water level conditions to the full basin benchmark each successive year for calculating the basin storage will eliminate the potential for cumulative discrepancies over several years.
7. An accumulated overdraft of 500,000 af represents the lowest acceptable limit of the basin's operating range. This lower limit of 500,000 af assumes that stored MWD water (CUP and Super In-Lieu) has already been removed and is only acceptable for short durations due to drought conditions. It is not recommended to manage the basin for sustained periods at this lower limit for the following reasons:
  - Seawater intrusion likely
  - Drought supply depleted
  - Pumping levels detrimental to a handful of wells
  - Increased pumping lifts and electrical costs
  - Increased potential for color upwelling from the Deep aquifer
8. An optimal basin management target of 100,000 af of accumulated overdraft provides sufficient storage space to accommodate increased supplies from one wet year while also providing enough water in storage to offset decreased supplies during a two- to three-year drought.

9. The proposed operational strategy provides a flexible guideline to assist in determining the amount of basin refill or storage decrease for the coming water year based on using the BPP formula and considering storage goals based on current basin conditions and other factors such as water availability. This strategy is not intended to dictate a specific basin refill or storage decrease amount for a given storage condition but to provide a general guideline for the District's Board of Directors.

## **8. RECOMMENDATIONS**

Based on the findings of this study are the following recommendations:

1. Adopt the new three-layer storage change methodology along with the associated new full-basin condition that will serve as a benchmark for calculating the basin accumulated overdraft.
2. Adopt the proposed basin operating strategy including a basin operating range spanning the new full condition to an accumulated overdraft of 500,000 af, and an optimal overdraft target of 100,000 af.
3. Include in the 2007-08 CIP budget the installation of six Shallow aquifer monitoring wells to increase accuracy of the three-layer storage change calculation.

## **9. BIBLIOGRAPHY**

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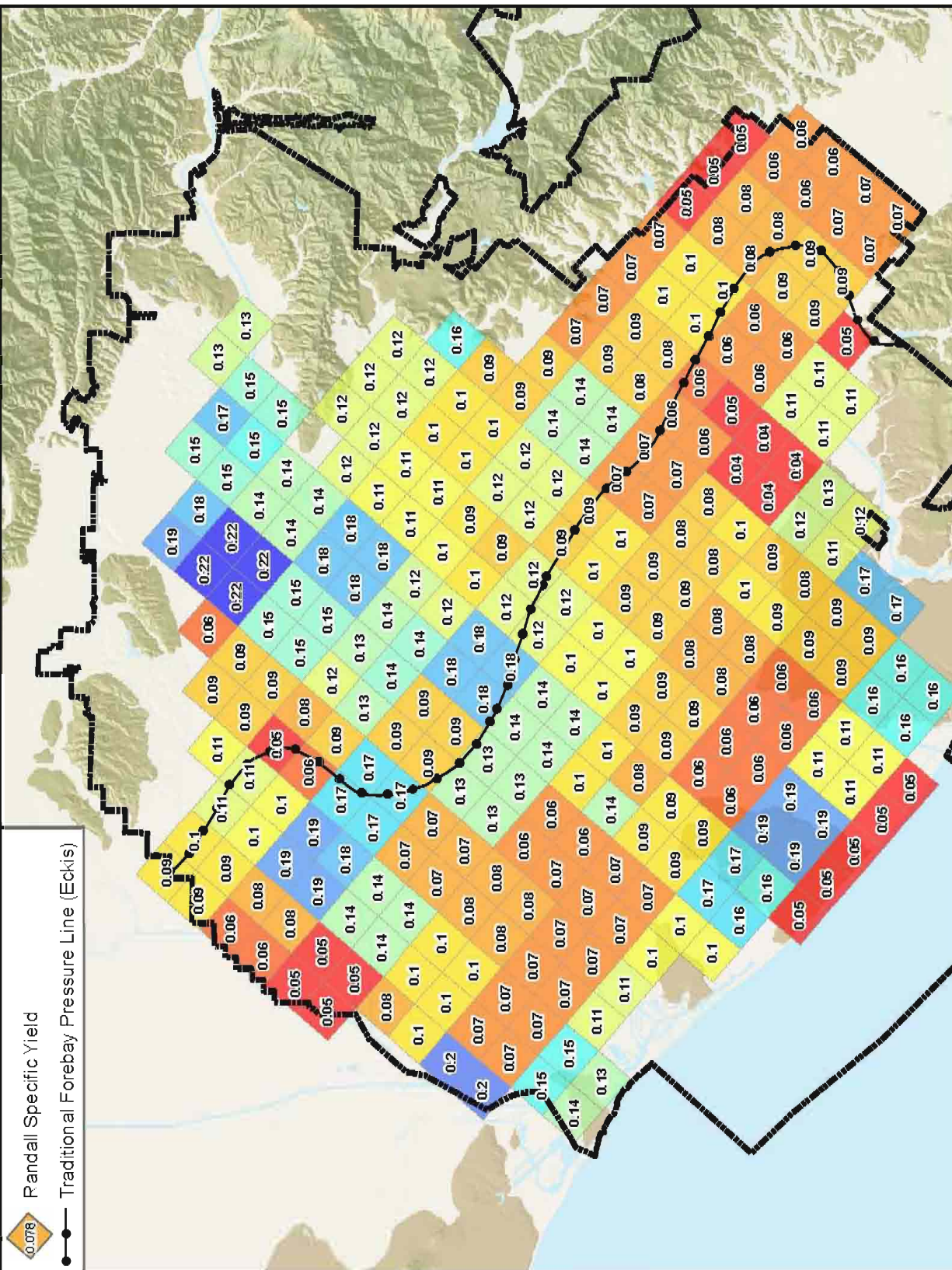
Phraner, R. W., B. Harley, E. G. Reichard, and B. Stollar. 2001. Letter from OCWD Basin Model Advisory Panel to OCWD: "Findings of Model Advisory Panel – Transient Calibration of Multi-layer Basin Flow Model," 7pp.

## **APPENDIX 1**

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### **“Randall” Specific Yield Values From Traditional Storage Change Method**

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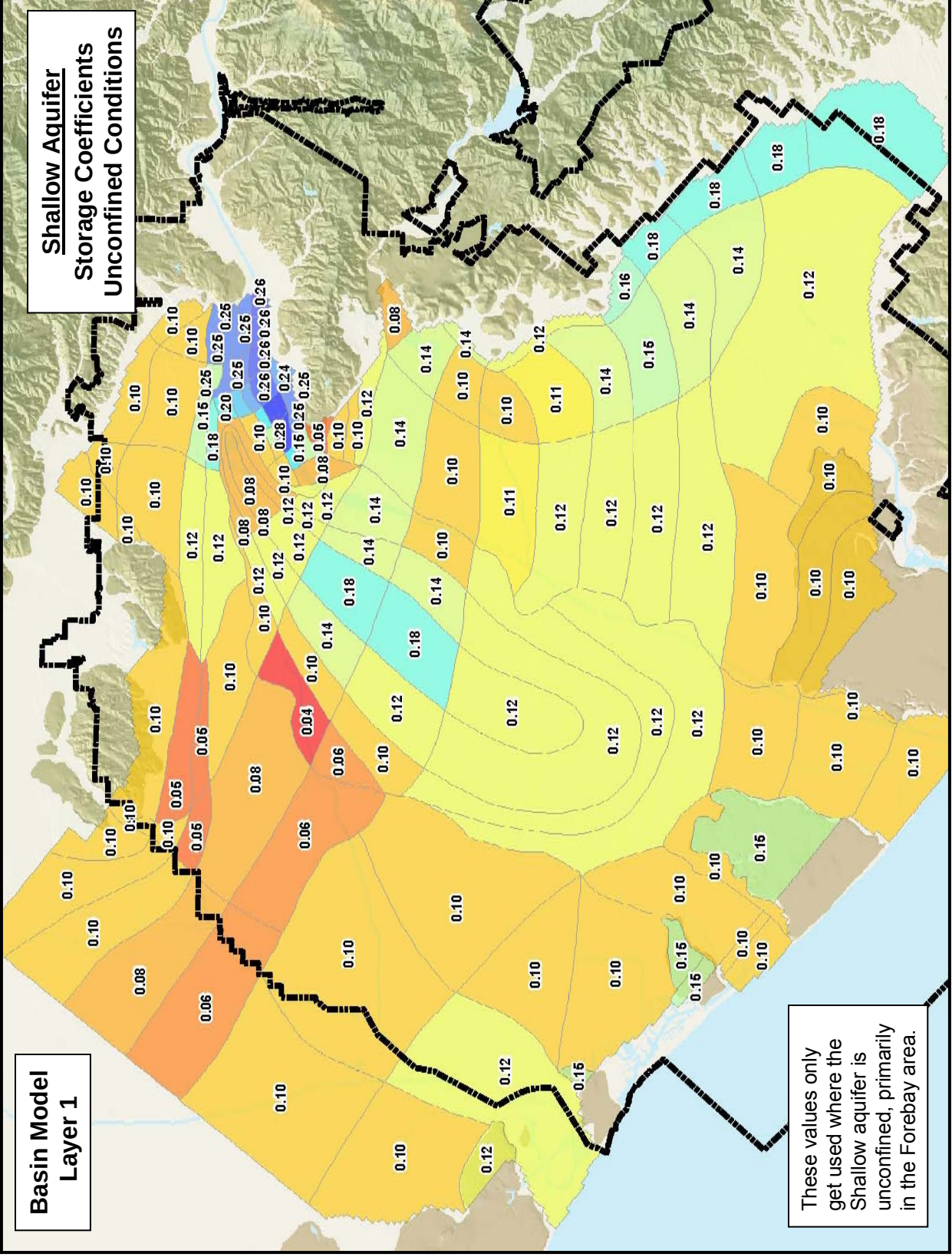
## **APPENDIX 2**

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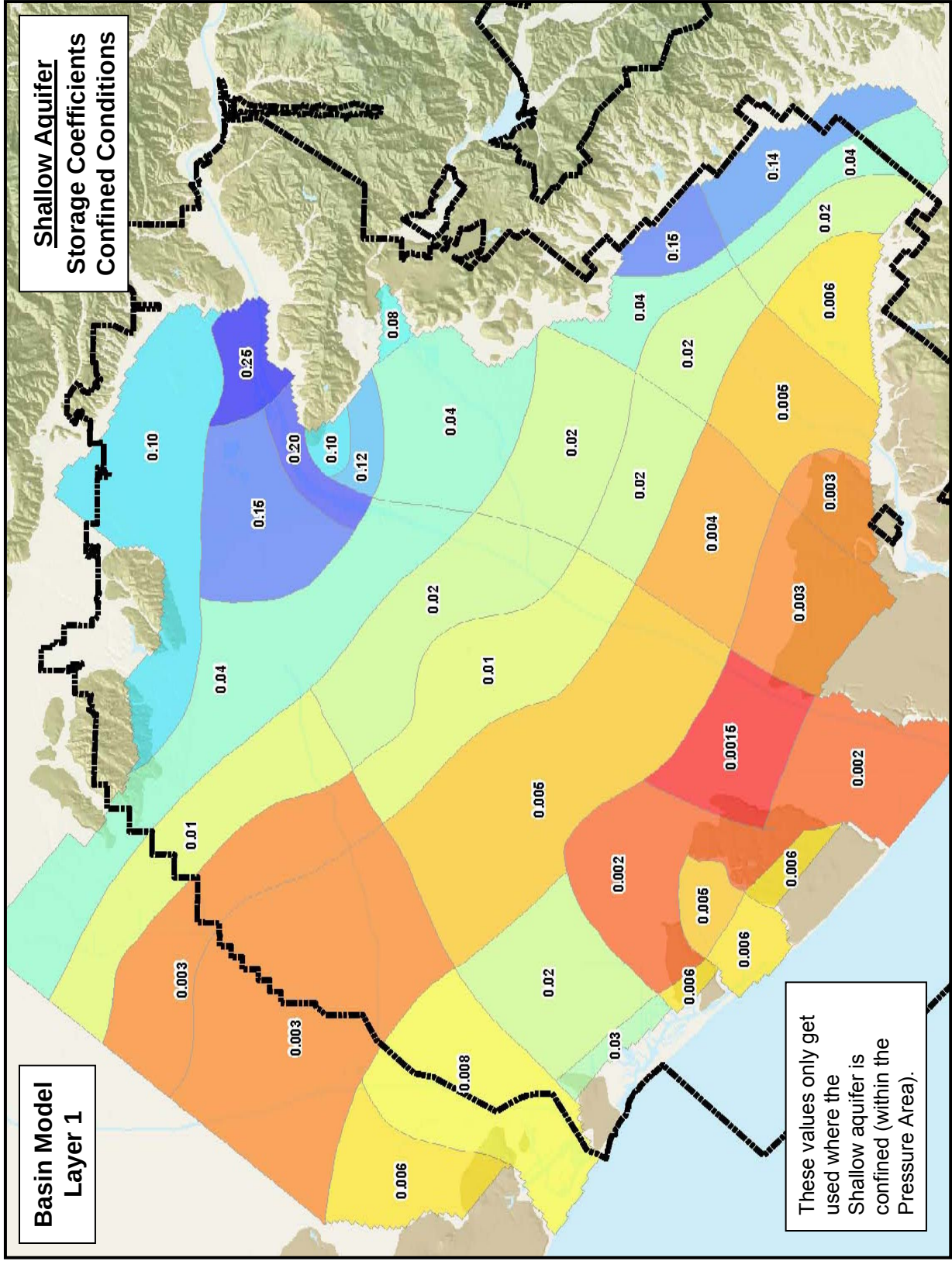
### **Basin Model Storage Coefficient Values For Three-Layer Storage Change Method**

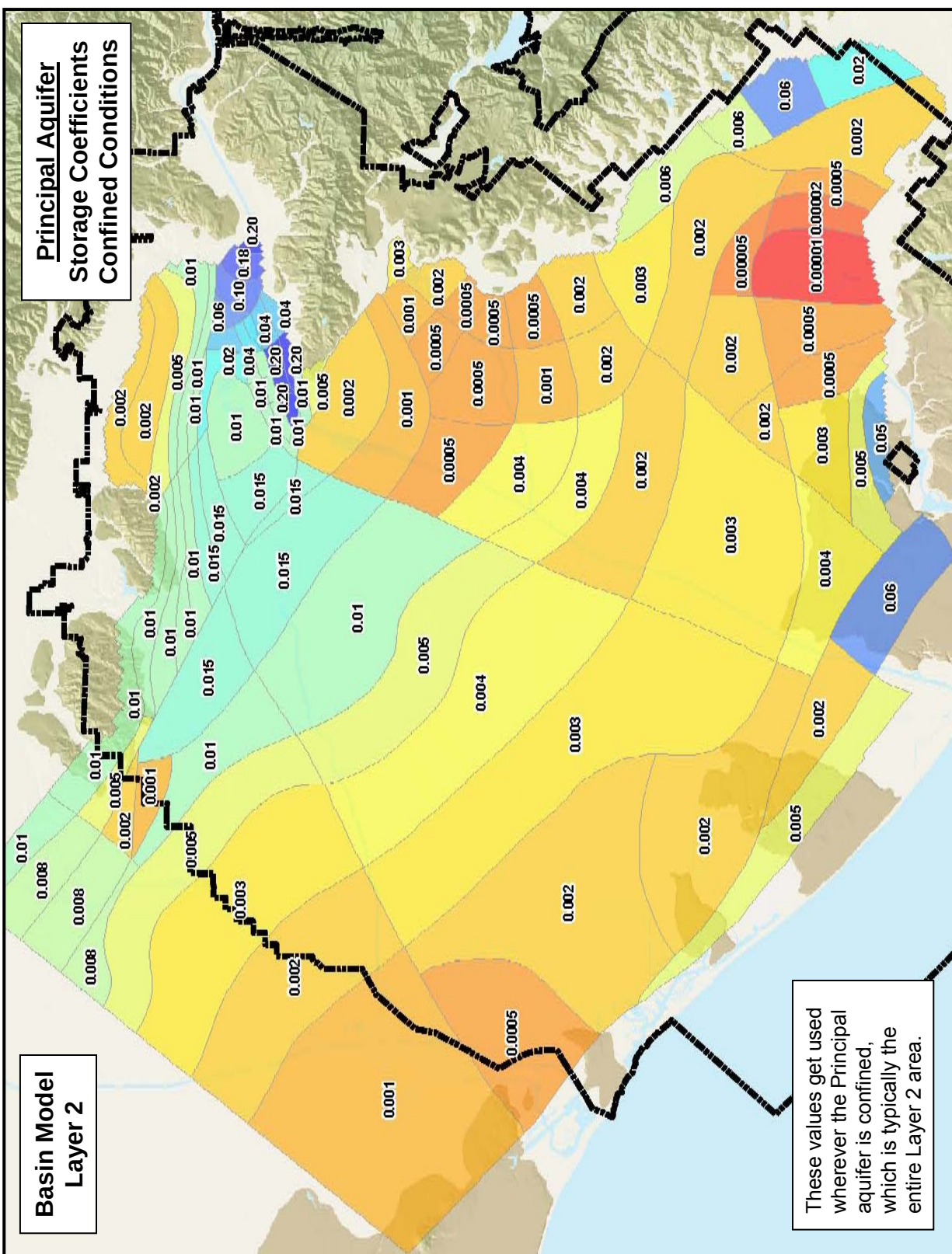
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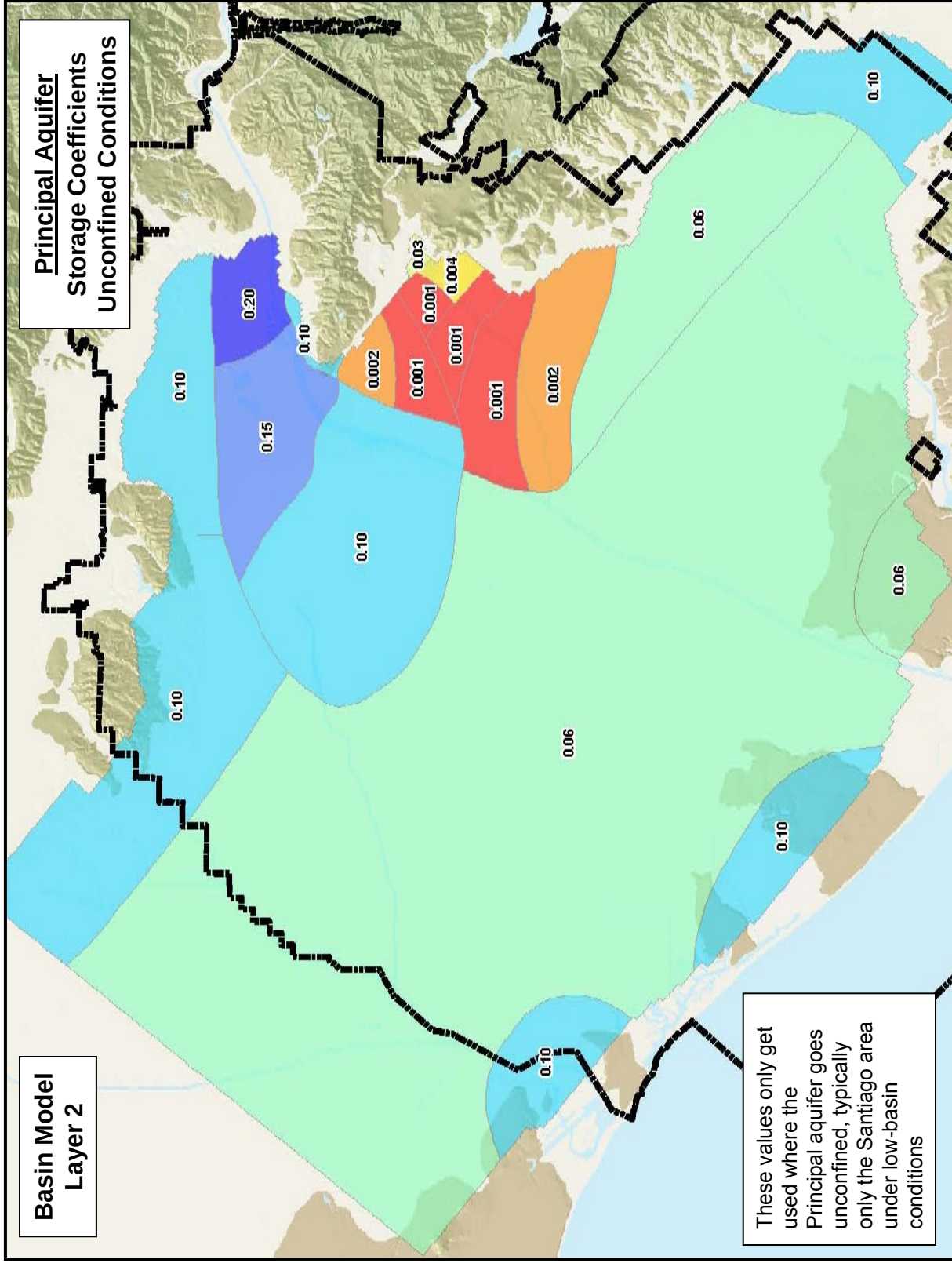


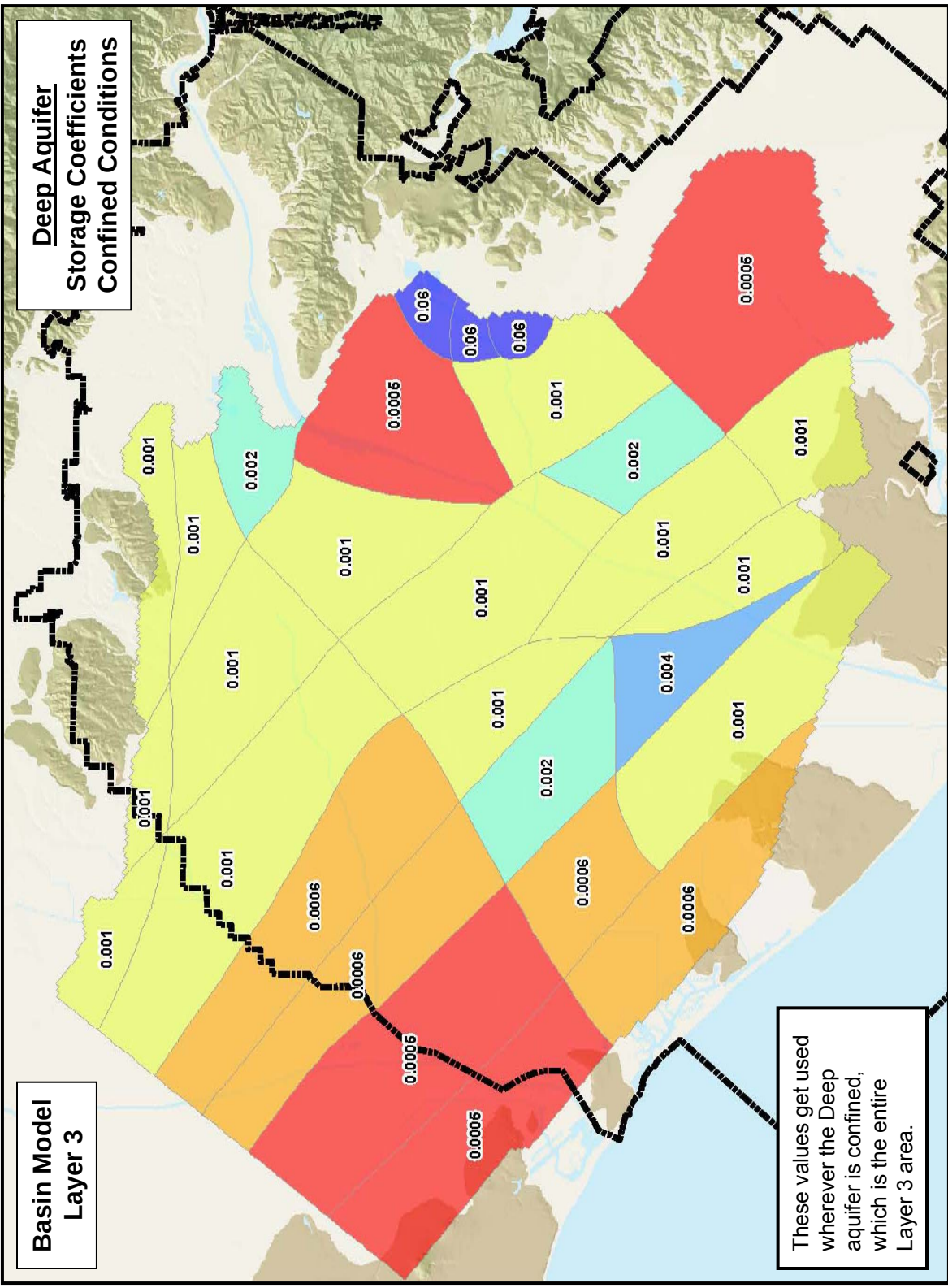


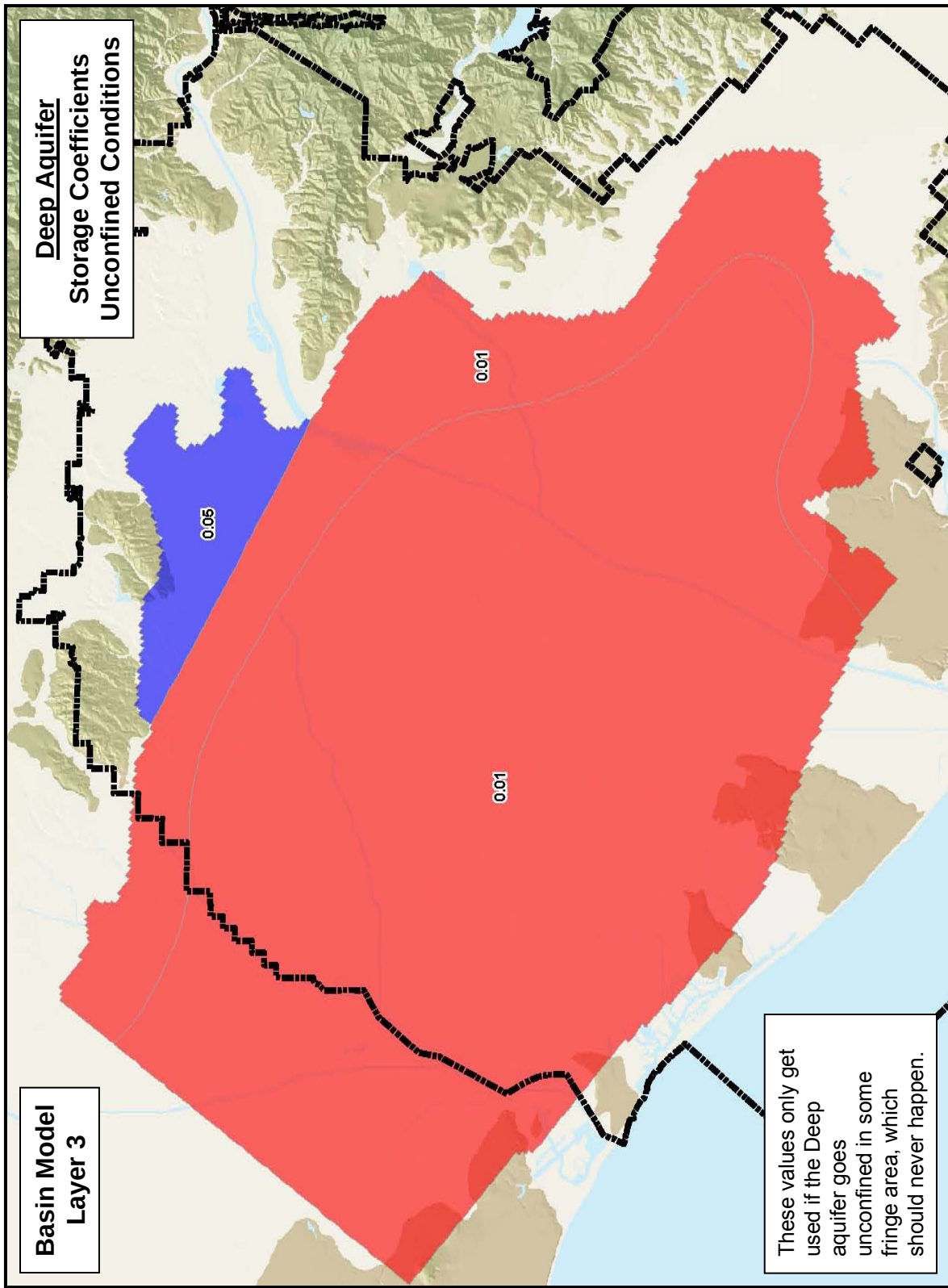












## **APPENDIX 3**

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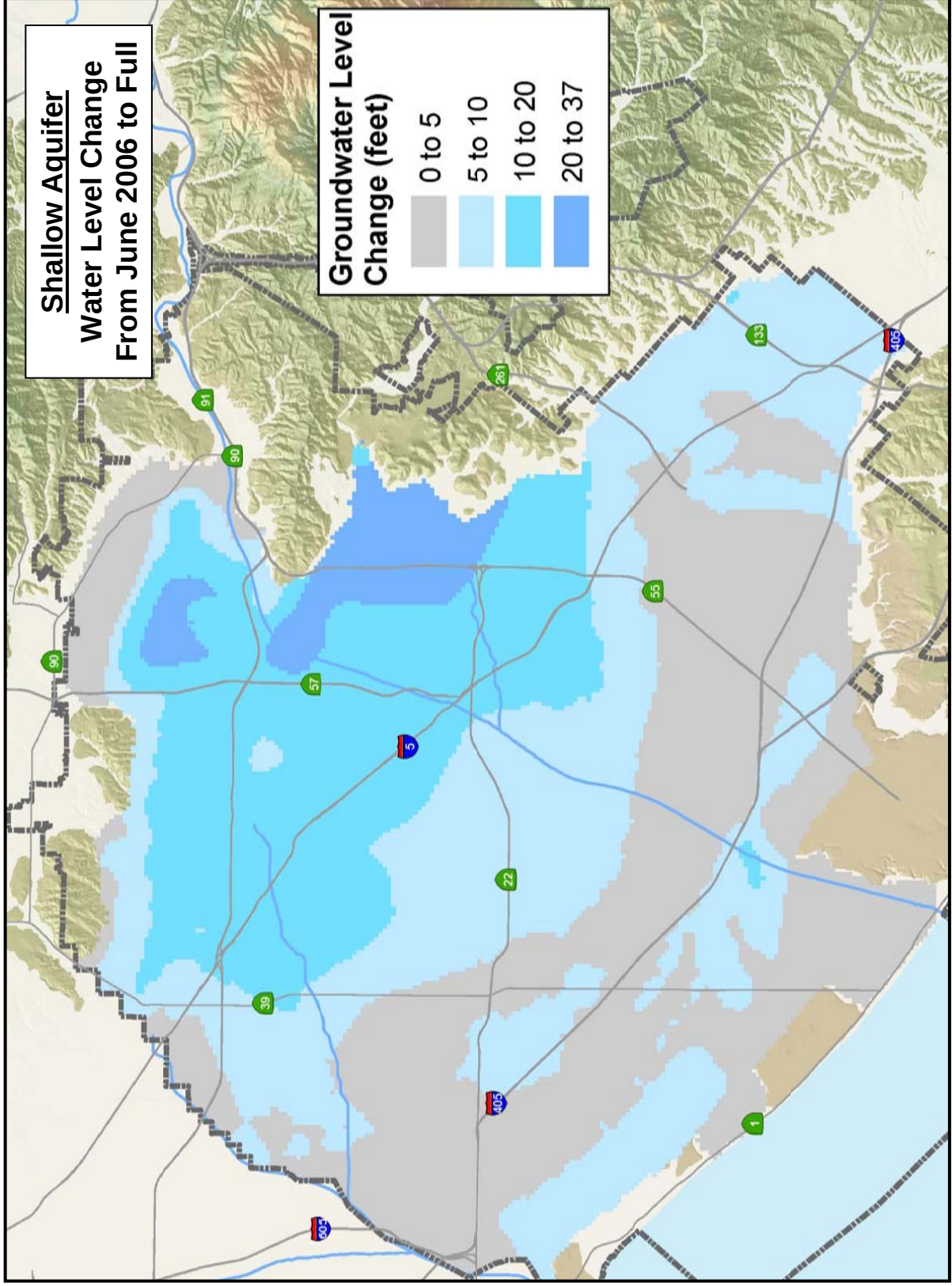
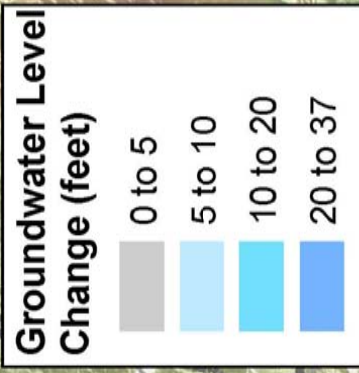
### **Water Level Change Maps**

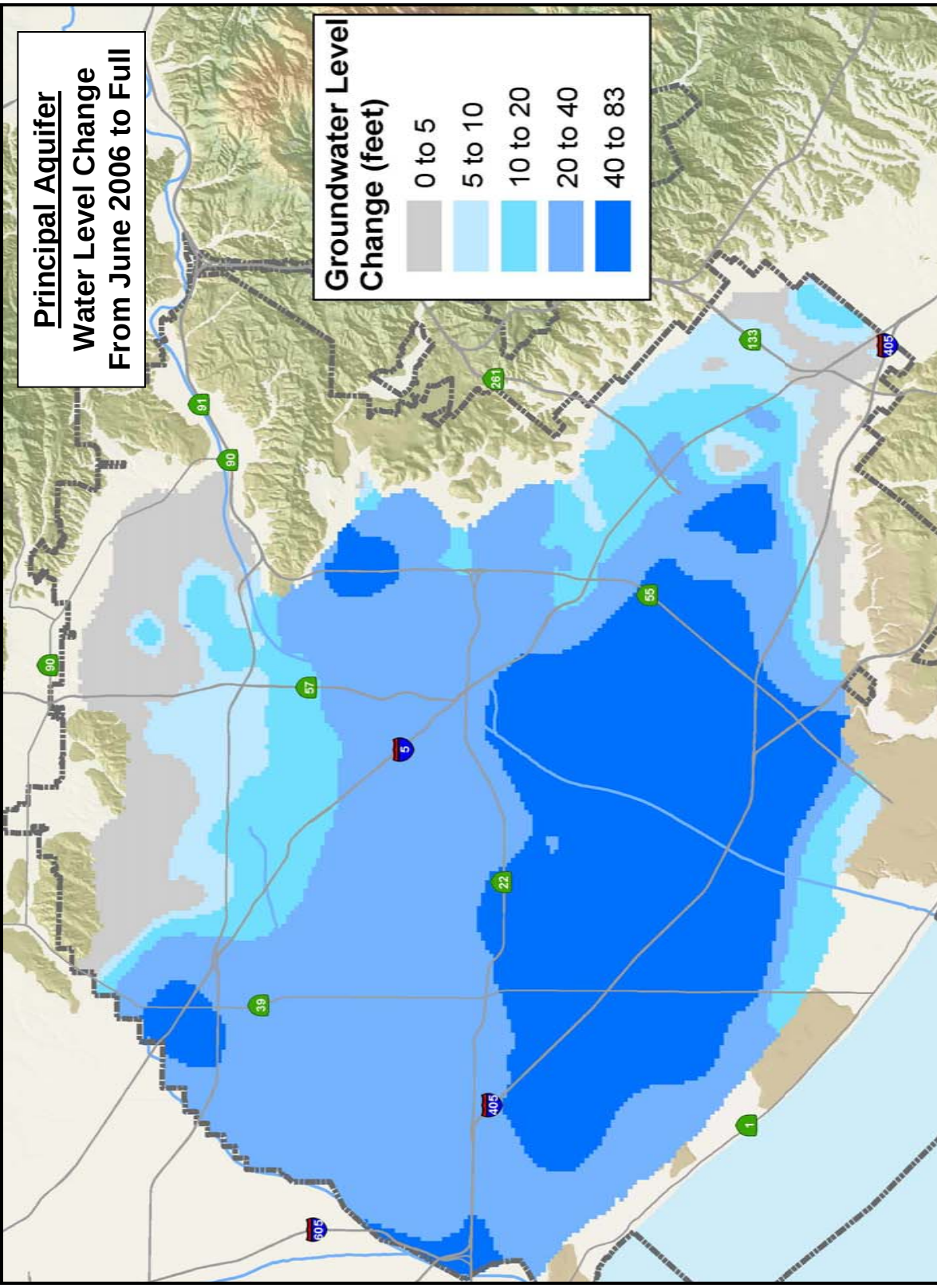
#### **For June 2006 to the New Full Condition**

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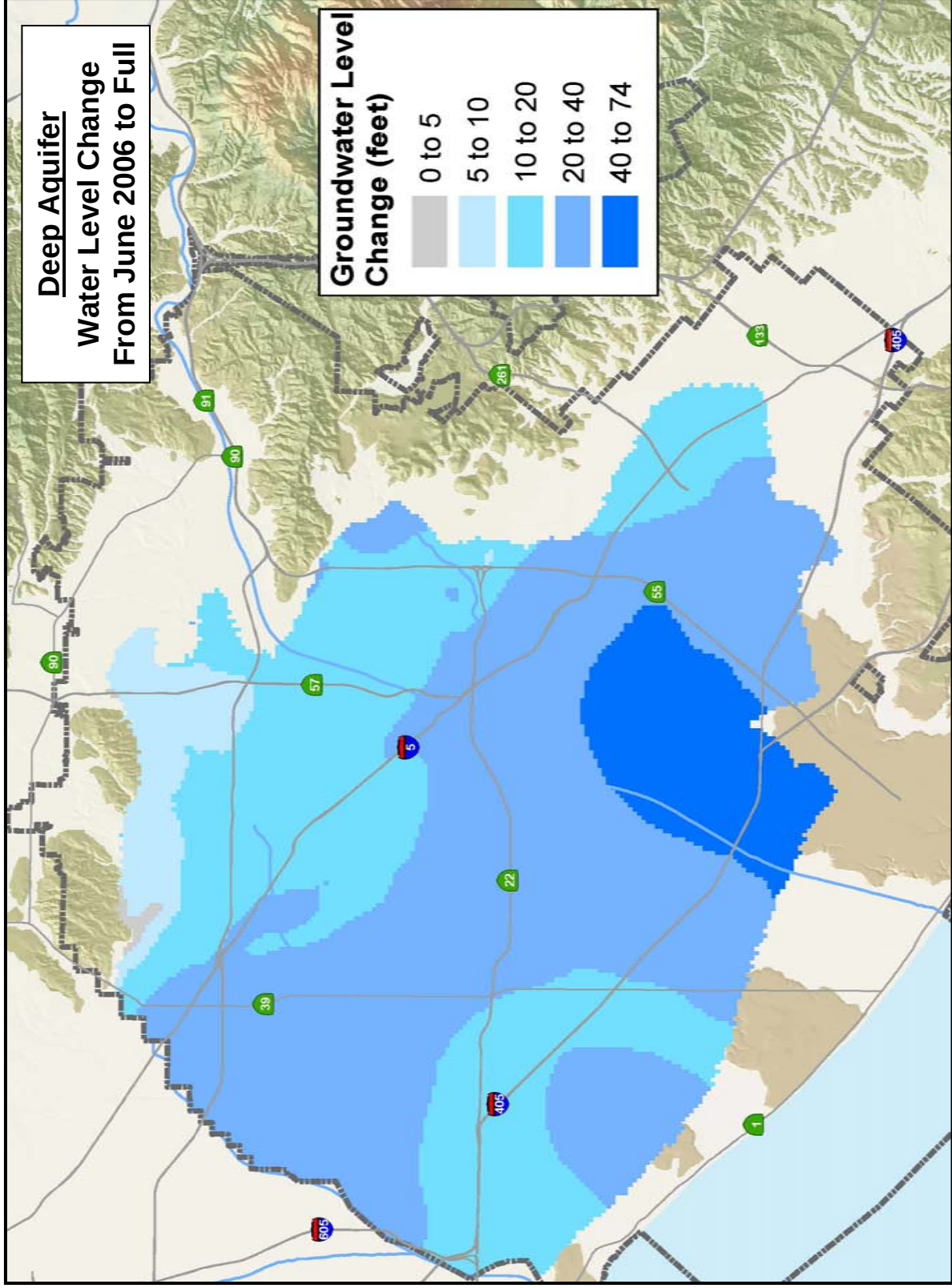
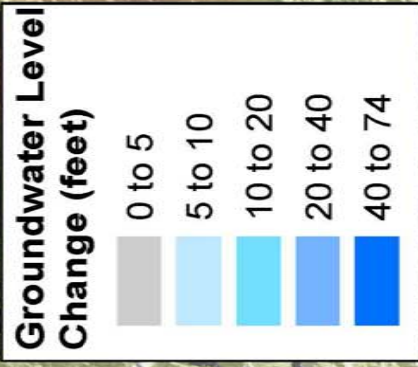
**Shallow Aquifer**  
**Water Level Change**  
**From June 2006 to Full**







**Deep Aquifer**  
**Water Level Change**  
**From June 2006 to Full**



# APPENDIX E

## OCWD MONITORING WELLS

**APPENDIX E - OCWD ACTIVE GROUNDWATER MONITORING WELLS  
(Excluding Westbay Multiport Wells)**

| Well Name | Well Type     | Casing Sequence No. | Cased Depth (ft.) | Top Perforation (ft.) | Bottom Perforation (ft.) |
|-----------|---------------|---------------------|-------------------|-----------------------|--------------------------|
| ABS-2     | SINGLE CASING | 1                   | 175               | 155                   | 165                      |
| AM-1      | SINGLE CASING | 1                   | 137               | 97                    | 115                      |
| AM-2      | SINGLE CASING | 1                   | 156               | 87                    | 100                      |
| AM-3      | SINGLE CASING | 1                   | 112               | 91                    | 107                      |
| AM-4      | SINGLE CASING | 1                   | 296               | 187                   | 205                      |
| AM-5      | SINGLE CASING | 1                   | 247               | 230                   | 245                      |
| AM-5A     | SINGLE CASING | 1                   | 180               | 168                   | 175                      |
| AM-6      | SINGLE CASING | 1                   | 296               | 232                   | 250                      |
| AM-7      | SINGLE CASING | 1                   | 297               | 210                   | 225                      |
| AM-8      | SINGLE CASING | 1                   | 297               | 268                   | 285                      |
| AM-9      | SINGLE CASING | 1                   | 317               | 285                   | 303                      |
| AM-10     | SINGLE CASING | 1                   | 298               | 217                   | 235                      |
| AM-11     | SINGLE CASING | 1                   | 276               | 218                   | 240                      |
| AM-12     | SINGLE CASING | 1                   | 294               | 210                   | 225                      |
| AM-13     | SINGLE CASING | 1                   | 275               | 252                   | 270                      |
| AM-14     | SINGLE CASING | 1                   | 317               | 297                   | 315                      |
| AM-15     | SINGLE CASING | 1                   | 318               | 300                   | 317                      |
| AM-15A    | SINGLE CASING | 1                   | 231               | 214                   | 220                      |
| AM-16     | SINGLE CASING | 1                   | 320               | 300                   | 315                      |
| AM-16A    | SINGLE CASING | 1                   | 227               | 215                   | 222                      |
| AM-17     | SINGLE CASING | 1                   | 318               | 290                   | 308                      |
| AM-18     | SINGLE CASING | 1                   | 316               | 291                   | 309                      |
| AM-18A    | SINGLE CASING | 1                   | 234               | 208                   | 215                      |
| AM-19     | SINGLE CASING | 1                   | 237               | 217                   | 225                      |
| AM-19A    | SINGLE CASING | 1                   | 126               | 115                   | 123                      |
| AM-20     | SINGLE CASING | 1                   | 397               | 361                   | 379                      |
| AM-20A    | SINGLE CASING | 1                   | 268               | 250                   | 258                      |
| AM-21     | SINGLE CASING | 1                   | 269               | 250                   | 258                      |
| AM-21A    | SINGLE CASING | 1                   | 179               | 157                   | 165                      |
| AM-22     | SINGLE CASING | 1                   | 356               | 339                   | 353                      |
| AM-22A    | SINGLE CASING | 1                   | 239               | 216                   | 224                      |
| AM-23     | SINGLE CASING | 1                   | 351               | 330                   | 347                      |
| AM-24     | SINGLE CASING | 1                   | 378               | 335                   | 350                      |
| AM-24A    | SINGLE CASING | 1                   | 306               | 279                   | 294                      |
| AM-25     | SINGLE CASING | 1                   | 362               | 340                   | 358                      |
| AM-25A    | SINGLE CASING | 1                   | 219               | 188                   | 195                      |
| AM-26     | SINGLE CASING | 1                   | 388               | 377                   | 383                      |
| AM-27     | SINGLE CASING | 1                   | 336               | 287                   | 305                      |
| AM-28     | SINGLE CASING | 1                   | 398               | 358                   | 376                      |
| AM-29     | SINGLE CASING | 1                   | 367               | 340                   | 358                      |
| AM-29A    | SINGLE CASING | 1                   | 95                | 75                    | 95                       |
| AM-30     | SINGLE CASING | 1                   | 375               | 349                   | 367                      |
| AM-30A    | SINGLE CASING | 1                   | 398               | 152                   | 159                      |
| AM-31     | SINGLE CASING | 1                   | 358               | 335                   | 353                      |
| AM-31A    | SINGLE CASING | 1                   | 360               | 162                   | 170                      |
| AM-32     | SINGLE CASING | 1                   | 398               | 335                   | 353                      |
| AM-33     | SINGLE CASING | 1                   | 378               | 354                   | 372                      |
| AM-33A    | SINGLE CASING | 1                   | 238               | 206                   | 221                      |
| AM-34     | SINGLE CASING | 1                   | 354               | 317                   | 335                      |
| AM-34A    | SINGLE CASING | 1                   | 271               | 252                   | 260                      |
| AM-35     | SINGLE CASING | 1                   | 400               | 332                   | 350                      |

**APPENDIX E - OCWD ACTIVE GROUNDWATER MONITORING WELLS  
(Excluding Westbay Multiport Wells)**

| Well Name | Well Type     | Casing Sequence No. | Cased Depth (ft.) | Top Perforation (ft.) | Bottom Perforation (ft.) |
|-----------|---------------|---------------------|-------------------|-----------------------|--------------------------|
| AM-36     | SINGLE CASING | 1                   | 398               | 369                   | 387                      |
| AM-37     | SINGLE CASING | 1                   | 378               | 349                   | 367                      |
| AM-38     | SINGLE CASING | 1                   | 358               | 316                   | 334                      |
| AM-39     | SINGLE CASING | 1                   | 188               | 168                   | 188                      |
| AM-39A    | SINGLE CASING | 1                   | 135               | 115                   | 135                      |
| AM-40     | SINGLE CASING | 1                   | 191               | 175                   | 190                      |
| AM-40A    | SINGLE CASING | 1                   | 166               | 145                   | 165                      |
| AM-41     | SINGLE CASING | 1                   | 200               | 190                   | 200                      |
| AM-41A    | SINGLE CASING | 1                   | 166               | 156                   | 166                      |
| AM-42     | SINGLE CASING | 1                   | 190               | 180                   | 190                      |
| AM-42A    | SINGLE CASING | 1                   | 130               | 115                   | 130                      |
| AM-43     | SINGLE CASING | 1                   | 100               | 80                    | 100                      |
| AM-44     | SINGLE CASING | 1                   | 160               | 140                   | 160                      |
| AM-44A    | SINGLE CASING | 1                   | 88                | 78                    | 88                       |
| AM-45     | SINGLE CASING | 1                   | 132               | 102                   | 132                      |
| AM-46     | SINGLE CASING | 1                   | 124               | 94                    | 124                      |
| AM-47     | SINGLE CASING | 1                   | 247               | 227                   | 242                      |
| AM-47A    | SINGLE CASING | 1                   | 170               | 160                   | 170                      |
| AM-48     | SINGLE CASING | 1                   | 305               | 270                   | 300                      |
| AM-48A    | SINGLE CASING | 1                   | 151               | 116                   | 146                      |
| AM-49     | SINGLE CASING | 1                   | 155               | 120                   | 150                      |
| AMD-9     | NESTED        | 1                   | 230               | 200                   | 220                      |
| AMD-9     | NESTED        | 2                   | 480               | 450                   | 470                      |
| AMD-9     | NESTED        | 3                   | 610               | 580                   | 600                      |
| AMD-9     | NESTED        | 4                   | 926               | 896                   | 916                      |
| AMD-10    | NESTED        | 1                   | 322               | 292                   | 312                      |
| AMD-10    | NESTED        | 2                   | 470               | 440                   | 460                      |
| AMD-10    | NESTED        | 3                   | 580               | 550                   | 570                      |
| AMD-10    | NESTED        | 4                   | 804               | 774                   | 794                      |
| AMD-10    | NESTED        | 5                   | 964               | 934                   | 954                      |
| AMD-11    | NESTED        | 1                   | 328               | 298                   | 318                      |
| AMD-11    | NESTED        | 2                   | 426               | 396                   | 416                      |
| AMD-11    | NESTED        | 3                   | 630               | 600                   | 620                      |
| AMD-11    | NESTED        | 4                   | 716               | 686                   | 706                      |
| AMD-11    | NESTED        | 5                   | 936               | 906                   | 926                      |
| AMD-12    | NESTED        | 1                   | 360               | 330                   | 350                      |
| AMD-12    | NESTED        | 2                   | 530               | 490                   | 520                      |
| AMD-12    | NESTED        | 3                   | 625               | 595                   | 615                      |
| AMD-12    | NESTED        | 4                   | 755               | 725                   | 745                      |
| AMD-12    | NESTED        | 5                   | 970               | 940                   | 960                      |
| FM-1      | SINGLE CASING | 1                   | 359               | 348                   | 356                      |
| FM-1A     | SINGLE CASING | 1                   | 197               | 164                   | 172                      |
| FM-2      | SINGLE CASING | 1                   | 352               | 320                   | 338                      |
| FM-2A     | SINGLE CASING | 1                   | 237               | 226                   | 234                      |
| FM-3      | SINGLE CASING | 1                   | 298               | 257                   | 263                      |
| FM-4      | SINGLE CASING | 1                   | 355               | 327                   | 345                      |
| FM-4A     | SINGLE CASING | 1                   | 170               | 142                   | 160                      |
| FM-5      | SINGLE CASING | 1                   | 141               | 121                   | 141                      |
| FM-6      | SINGLE CASING | 1                   | 320               | 150                   | 310                      |
| FM-7      | SINGLE CASING | 1                   | 197               | 187                   | 197                      |
| FM-7A     | SINGLE CASING | 1                   | 170               | 160                   | 170                      |



**APPENDIX E - OCWD ACTIVE GROUNDWATER MONITORING WELLS  
(Excluding Westbay Multiport Wells)**

| Well Name | Well Type     | Casing Sequence No. | Cased Depth (ft.) | Top Perforation (ft.) | Bottom Perforation (ft.) |
|-----------|---------------|---------------------|-------------------|-----------------------|--------------------------|
| FM-8      | SINGLE CASING | 1                   | 139               | 114                   | 134                      |
| FM-9      | SINGLE CASING | 1                   | 245               | 220                   | 240                      |
| FM-9A     | SINGLE CASING | 1                   | 191               | 166                   | 186                      |
| FM-10     | SINGLE CASING | 1                   | 240               | 215                   | 235                      |
| FM-10A    | SINGLE CASING | 1                   | 176               | 151                   | 171                      |
| FM-11     | SINGLE CASING | 1                   | 261               | 236                   | 256                      |
| FM-11A    | SINGLE CASING | 1                   | 159               | 134                   | 154                      |
| FM-12     | SINGLE CASING | 1                   | 231               | 206                   | 226                      |
| FM-12A    | SINGLE CASING | 1                   | 160               | 135                   | 155                      |
| FM-13     | SINGLE CASING | 1                   | 235               | 210                   | 230                      |
| FM-13A    | SINGLE CASING | 1                   | 165               | 140                   | 160                      |
| FM-14     | SINGLE CASING | 1                   | 259               | 234                   | 254                      |
| FM-14A    | SINGLE CASING | 1                   | 172               | 147                   | 167                      |
| FM-15     | SINGLE CASING | 1                   | 243               | 218                   | 238                      |
| FM-15A    | SINGLE CASING | 1                   | 145               | 120                   | 140                      |
| FM-16     | SINGLE CASING | 1                   | 273               | 248                   | 268                      |
| FM-16A    | SINGLE CASING | 1                   | 150               | 125                   | 145                      |
| FM-17     | SINGLE CASING | 1                   | 275               | 250                   | 270                      |
| FM-18     | SINGLE CASING | 1                   | 254               | 224                   | 244                      |
| FM-18A    | SINGLE CASING | 1                   | 156               | 121                   | 151                      |
| FM-19A    | SINGLE CASING | 1                   | 140               | 115                   | 135                      |
| FM-19B    | SINGLE CASING | 1                   | 265               | 230                   | 260                      |
| FM-19C    | SINGLE CASING | 1                   | 390               | 365                   | 385                      |
| FM-20     | SINGLE CASING | 1                   | 246               | 221                   | 241                      |
| FM-20A    | SINGLE CASING | 1                   | 155               | 130                   | 150                      |
| FM-21     | SINGLE CASING | 1                   | 275               | 260                   | 270                      |
| FM-21A    | SINGLE CASING | 1                   | 165               | 140                   | 160                      |
| FM-22     | SINGLE CASING | 1                   | 267               | 242                   | 265                      |
| FM-22A    | SINGLE CASING | 1                   | 175               | 150                   | 170                      |
| FM-23     | SINGLE CASING | 1                   | 253               | 234                   | 249                      |
| FM-23A    | SINGLE CASING | 1                   | 149               | 128                   | 143                      |
| FM-24     | SINGLE CASING | 1                   | 295               | 271                   | 291                      |
| FM-24A    | SINGLE CASING | 1                   | 184               | 154                   | 174                      |
| FM-25     | SINGLE CASING | 1                   | 152               | 132                   | 152                      |
| FM-26     | SINGLE CASING | 1                   | 155               | 145                   | 155                      |
| FM-27     | SINGLE CASING | 1                   | 125               | 105                   | 125                      |
| IDM-3     | NESTED        | 1                   | 214               | 174                   | 194                      |
| IDM-3     | NESTED        | 2                   | 330               | 290                   | 310                      |
| IDM-3     | NESTED        | 3                   | 682               | 652                   | 672                      |
| IDM-4     | NESTED        | 1                   | 166               | 136                   | 156                      |
| IDM-4     | NESTED        | 2                   | 302               | 272                   | 292                      |
| IDM-4     | NESTED        | 3                   | 684               | 654                   | 674                      |
| IDP-2R    | NESTED        | 1                   | 205               | 155                   | 195                      |
| IDP-2R    | NESTED        | 2                   | 350               | 300                   | 340                      |
| IDP-3     | SINGLE CASING | 1                   | 525               | 125                   | 505                      |
| IDP-4     | SINGLE CASING | 1                   | 430               | 125                   | 410                      |
| KBS-1     | SINGLE CASING | 1                   | 230               | 209                   | 219                      |
| KBS-3     | SINGLE CASING | 1                   | 90                | 80                    | 90                       |
| KBS-4     | SINGLE CASING | 1                   | 158               | 138                   | 158                      |
| KBS-4A    | SINGLE CASING | 1                   | 90                | 80                    | 90                       |
| MCAS-4    | SINGLE CASING | 1                   | 275               | 181                   | 238                      |

**APPENDIX E - OCWD ACTIVE GROUNDWATER MONITORING WELLS  
(Excluding Westbay Multiport Wells)**

| Well Name     | Well Type     | Casing Sequence No. | Cased Depth (ft.) | Top Perforation (ft.) | Bottom Perforation (ft.) |
|---------------|---------------|---------------------|-------------------|-----------------------|--------------------------|
| MCAS-5A       | SINGLE CASING | 1                   | 133               | 120                   | 130                      |
| MCAS-6        | SINGLE CASING | 1                   | 285               | 167                   | 222                      |
| MCAS-8        | SINGLE CASING | 1                   | 435               | 392                   | 410                      |
| MCAS-9        | SINGLE CASING | 1                   | 450               | 372                   | 445                      |
| MCAS-10       | SINGLE CASING | 1                   | 389               | 347                   | 377                      |
| MSP-10P       | SINGLE CASING | 1                   | 50                | 40                    | 50                       |
| MSP-10T       | SINGLE CASING | 1                   | 140               | 70                    | 140                      |
| OCWD-7        | SINGLE CASING | 1                   | 48                | 28                    | 48                       |
| OCWD-33Z11    | NESTED        | 1                   | 384               | 338                   | 379                      |
| OCWD-33Z11    | NESTED        | 2                   | 490               | 435                   | 485                      |
| OCWD-34F10    | NESTED        | 1                   | 231               | 215                   | 225                      |
| OCWD-34F10    | NESTED        | 2                   | 291               | 270                   | 285                      |
| OCWD-34F10    | NESTED        | 3                   | 346               | 315                   | 340                      |
| OCWD-34F10    | NESTED        | 4                   | 465               | 420                   | 460                      |
| OCWD-34H25    | NESTED        | 1                   | 356               | 300                   | 350                      |
| OCWD-34H25    | NESTED        | 2                   | 470               | 410                   | 465                      |
| OCWD-34H5     | NESTED        | 1                   | 360               | 300                   | 340                      |
| OCWD-34H5     | NESTED        | 2                   | 475               | 405                   | 455                      |
| OCWD-34L10    | NESTED        | 1                   | 191               | 165                   | 185                      |
| OCWD-34L10    | NESTED        | 2                   | 266               | 225                   | 260                      |
| OCWD-34L10    | NESTED        | 3                   | 371               | 311                   | 365                      |
| OCWD-34L10    | NESTED        | 4                   | 455               | 405                   | 450                      |
| OCWD-34N21    | NESTED        | 1                   | NA                | 329                   | 366                      |
| OCWD-34N21    | NESTED        | 2                   | NA                | 424                   | 464                      |
| OCWD-34U8     | NESTED        | 1                   | 180               | 149                   | 174                      |
| OCWD-34U8     | NESTED        | 2                   | 240               | 224                   | 234                      |
| OCWD-34U8     | NESTED        | 3                   | 325               | 279                   | 319                      |
| OCWD-34U8     | NESTED        | 4                   | 389               | 359                   | 384                      |
| OCWD-34V20    | NESTED        | 1                   | 313               | 235                   | 307                      |
| OCWD-34V20    | NESTED        | 2                   | 422               | 387                   | 417                      |
| OCWD-35F20    | NESTED        | 1                   | NA                | 70                    | 95                       |
| OCWD-35F20    | NESTED        | 2                   | NA                | 115                   | 125                      |
| OCWD-35F20    | NESTED        | 3                   | NA                | 145                   | 180                      |
| OCWD-35F20    | NESTED        | 4                   | NA                | 235                   | 265                      |
| OCWD-35H11    | NESTED        | 1                   | 225               | 200                   | 220                      |
| OCWD-35H11    | NESTED        | 2                   | 163               | 125                   | 158                      |
| OCWD-35H11    | NESTED        | 3                   | 82                | 44                    | 77                       |
| OCWD-35H12    | SINGLE CASING | 1                   | 159               | 137                   | 147                      |
| OCWD-35J1     | NESTED        | 1                   | 260               | 190                   | 240                      |
| OCWD-35J1     | NESTED        | 2                   | 190               | 130                   | 170                      |
| OCWD-35K1     | NESTED        | 1                   | 263               | 193                   | 243                      |
| OCWD-35K1     | NESTED        | 2                   | 190               | 130                   | 170                      |
| OCWD-35N01    | NESTED        | 1                   | 90                | 80                    | 85                       |
| OCWD-35N01    | NESTED        | 2                   | 80                | 39                    | 79                       |
| OCWD-35T9     | SINGLE CASING | 1                   | 432               | 390                   | 411                      |
| OCWD-36FP1Z   | SINGLE CASING | 1                   | NA                | 504                   | 514                      |
| OCWD-36FP14Z1 | SINGLE CASING | 1                   | 135               | 115                   | 125                      |
| OCWD-AIR1     | NESTED        | 1                   | 255               | 200                   | 250                      |
| OCWD-AIR1     | NESTED        | 2                   | 515               | 410                   | 510                      |
| OCWD-AIR1     | NESTED        | 3                   | 855               | 675                   | 850                      |
| OCWD-AIR1     | NESTED        | 4                   | 1485              | 1375                  | 1460                     |

**APPENDIX E - OCWD ACTIVE GROUNDWATER MONITORING WELLS  
(Excluding Westbay Multiport Wells)**

| Well Name  | Well Type     | Casing Sequence No. | Cased Depth (ft.) | Top Perforation (ft.) | Bottom Perforation (ft.) |
|------------|---------------|---------------------|-------------------|-----------------------|--------------------------|
| OCWD-AN1   | SINGLE CASING | 1                   | 115               | 35                    | 115                      |
| OCWD-AN2   | SINGLE CASING | 1                   | 115               | 35                    | 115                      |
| OCWD-BP1   | SINGLE CASING | 1                   | 40                | 20                    | 40                       |
| OCWD-BP2   | SINGLE CASING | 1                   | 70                | 50                    | 70                       |
| OCWD-BP3   | SINGLE CASING | 1                   | 205               | 185                   | 205                      |
| OCWD-BP4   | SINGLE CASING | 1                   | 180               | 140                   | 180                      |
| OCWD-BP5   | NESTED        | 1                   | 75                | 55                    | 75                       |
| OCWD-BP5   | NESTED        | 2                   | 167               | 147                   | 167                      |
| OCWD-BP6   | SINGLE CASING | 1                   | 168               | 148                   | 168                      |
| OCWD-BP7   | NESTED        | 1                   | 57                | 47                    | 57                       |
| OCWD-BP7   | NESTED        | 2                   | 168               | 148                   | 168                      |
| OCWD-BS15  | SINGLE CASING | 1                   | 75                | 60                    | 70                       |
| OCWD-BS16  | SINGLE CASING | 1                   | 85                | 60                    | 80                       |
| OCWD-BS18  | SINGLE CASING | 1                   | 87                | 72                    | 82                       |
| OCWD-BS19  | SINGLE CASING | 1                   | 88                | 63                    | 83                       |
| OCWD-CTG1  | NESTED        | 1                   | 265               | 160                   | 260                      |
| OCWD-CTG1  | NESTED        | 2                   | 725               | 420                   | 720                      |
| OCWD-CTG1  | NESTED        | 3                   | 1025              | 800                   | 1025                     |
| OCWD-CTG1  | NESTED        | 4                   | 1225              | 1060                  | 1220                     |
| OCWD-CTG5  | NESTED        | 1                   | 620               | 420                   | 620                      |
| OCWD-CTG5  | NESTED        | 2                   | 1000              | 880                   | 1000                     |
| OCWD-CTG5  | NESTED        | 3                   | 1120              | 1040                  | 1120                     |
| OCWD-CTK1  | NESTED        | 1                   | 660               | 410                   | 655                      |
| OCWD-CTK1  | NESTED        | 2                   | 1020              | 780                   | 1015                     |
| OCWD-CTK1  | NESTED        | 3                   | 1320              | 1260                  | 1315                     |
| OCWD-FBM1  | SINGLE CASING | 1                   | 140               | 38                    | 138                      |
| OCWD-FBM2  | SINGLE CASING | 1                   | 140               | 39                    | 139                      |
| OCWD-FC1   | SINGLE CASING | 1                   | 185               | 165                   | 185                      |
| OCWD-FC2   | SINGLE CASING | 1                   | 115               | 95                    | 115                      |
| OCWD-FH1   | SINGLE CASING | 1                   | 140               | 120                   | 140                      |
| OCWD-GA1   | SINGLE CASING | 1                   | 40                | 30                    | 40                       |
| OCWD-GA2   | SINGLE CASING | 1                   | 40                | 30                    | 40                       |
| OCWD-GA3   | SINGLE CASING | 1                   | 40                | 30                    | 40                       |
| OCWD-GA4   | SINGLE CASING | 1                   | 40                | 30                    | 40                       |
| OCWD-GA5   | SINGLE CASING | 1                   | 40                | 30                    | 40                       |
| OCWD-GA6   | SINGLE CASING | 1                   | 40                | 30                    | 40                       |
| OCWD-GA7   | SINGLE CASING | 1                   | 40                | 30                    | 40                       |
| OCWD-GA9   | SINGLE CASING | 1                   | 29                | 19                    | 29                       |
| OCWD-I27M1 | SINGLE CASING | 1                   | 22                | 17                    | 22                       |
| OCWD-I28M1 | SINGLE CASING | 1                   | 24                | 19                    | 24                       |
| OCWD-KB1   | SINGLE CASING | 1                   | 200               | 180                   | 200                      |
| OCWD-KR2   | SINGLE CASING | 1                   | 394               | NA                    | NA                       |
| OCWD-LB1   | NESTED        | 1                   | 35                | 25                    | 35                       |
| OCWD-LB1   | NESTED        | 2                   | 168               | 148                   | 168                      |
| OCWD-LB2   | SINGLE CASING | 1                   | 30                | 15                    | 30                       |
| OCWD-LB3   | NESTED        | 1                   | 46                | 36                    | 46                       |
| OCWD-LB3   | NESTED        | 2                   | 165               | 145                   | 165                      |
| OCWD-LV1   | SINGLE CASING | 1                   | 155               | 135                   | 155                      |
| OCWD-M1    | SINGLE CASING | 1                   | 115               | 75                    | 110                      |
| OCWD-M2    | SINGLE CASING | 1                   | 155               | 85                    | 150                      |
| OCWD-M4    | NESTED        | 1                   | 125               | 80                    | 120                      |

**APPENDIX E - OCWD ACTIVE GROUNDWATER MONITORING WELLS  
(Excluding Westbay Multiport Wells)**

| Well Name | Well Type     | Casing Sequence No. | Cased Depth (ft.) | Top Perforation (ft.) | Bottom Perforation (ft.) |
|-----------|---------------|---------------------|-------------------|-----------------------|--------------------------|
| OCWD-M4   | NESTED        | 2                   | 180               | 145                   | 175                      |
| OCWD-M4   | NESTED        | 3                   | 275               | 235                   | 270                      |
| OCWD-M4   | NESTED        | 4                   | 335               | 295                   | 330                      |
| OCWD-M5   | NESTED        | 1                   | 100               | 65                    | 95                       |
| OCWD-M5   | NESTED        | 2                   | 165               | 115                   | 160                      |
| OCWD-M5   | NESTED        | 3                   | 265               | 215                   | 260                      |
| OCWD-M5   | NESTED        | 4                   | 310               | 285                   | 305                      |
| OCWD-M6A  | NESTED        | 1                   | 130               | 65                    | 125                      |
| OCWD-M6A  | NESTED        | 2                   | 170               | 150                   | 165                      |
| OCWD-M6A  | NESTED        | 3                   | 290               | 260                   | 285                      |
| OCWD-M6B  | SINGLE CASING | 1                   | 240               | 185                   | 235                      |
| OCWD-M7A  | NESTED        | 1                   | 140               | 70                    | 135                      |
| OCWD-M7A  | NESTED        | 2                   | 175               | 155                   | 170                      |
| OCWD-M7A  | NESTED        | 3                   | 225               | 190                   | 220                      |
| OCWD-M7B  | SINGLE CASING | 1                   | 265               | 240                   | 260                      |
| OCWD-M8   | NESTED        | 1                   | 155               | 50                    | 150                      |
| OCWD-M8   | NESTED        | 2                   | 210               | 185                   | 205                      |
| OCWD-M8   | NESTED        | 3                   | 255               | 225                   | 250                      |
| OCWD-M8   | NESTED        | 4                   | 315               | 275                   | 310                      |
| OCWD-M9   | NESTED        | 1                   | 120               | 90                    | 115                      |
| OCWD-M9   | NESTED        | 2                   | 160               | 135                   | 155                      |
| OCWD-M9   | NESTED        | 3                   | 230               | 185                   | 225                      |
| OCWD-M9   | NESTED        | 4                   | 300               | 250                   | 295                      |
| OCWD-M10  | NESTED        | 1                   | 165               | 80                    | 160                      |
| OCWD-M10  | NESTED        | 2                   | 200               | 175                   | 195                      |
| OCWD-M10  | NESTED        | 3                   | 245               | 215                   | 240                      |
| OCWD-M10  | NESTED        | 4                   | 310               | 280                   | 305                      |
| OCWD-M11  | NESTED        | 1                   | 110               | 70                    | 105                      |
| OCWD-M11  | NESTED        | 2                   | 155               | 125                   | 150                      |
| OCWD-M11  | NESTED        | 3                   | 230               | 170                   | 225                      |
| OCWD-M11  | NESTED        | 4                   | 295               | 260                   | 290                      |
| OCWD-M12  | NESTED        | 1                   | 115               | 70                    | 110                      |
| OCWD-M12  | NESTED        | 2                   | 225               | 130                   | 220                      |
| OCWD-M12  | NESTED        | 3                   | 265               | 240                   | 260                      |
| OCWD-M12  | NESTED        | 4                   | 355               | 330                   | 350                      |
| OCWD-M13  | NESTED        | 1                   | 100               | 65                    | 95                       |
| OCWD-M13  | NESTED        | 2                   | 205               | 140                   | 200                      |
| OCWD-M13  | NESTED        | 3                   | 300               | 230                   | 295                      |
| OCWD-M13  | NESTED        | 4                   | 400               | 360                   | 395                      |
| OCWD-M14A | NESTED        | 1                   | 95                | 60                    | 90                       |
| OCWD-M14A | NESTED        | 2                   | 185               | 120                   | 180                      |
| OCWD-M14A | NESTED        | 3                   | 305               | 200                   | 300                      |
| OCWD-M14B | SINGLE CASING | 1                   | 345               | 320                   | 340                      |
| OCWD-M15A | NESTED        | 1                   | 90                | 60                    | 85                       |
| OCWD-M15A | NESTED        | 2                   | 180               | 115                   | 175                      |
| OCWD-M15A | NESTED        | 3                   | 295               | 195                   | 290                      |
| OCWD-M15B | SINGLE CASING | 1                   | 340               | 310                   | 335                      |
| OCWD-M16  | NESTED        | 1                   | 95                | 65                    | 90                       |
| OCWD-M16  | NESTED        | 2                   | 165               | 115                   | 160                      |
| OCWD-M16  | NESTED        | 3                   | 275               | 180                   | 270                      |
| OCWD-M16  | NESTED        | 4                   | 320               | 295                   | 315                      |

**APPENDIX E - OCWD ACTIVE GROUNDWATER MONITORING WELLS  
(Excluding Westbay Multiport Wells)**

| Well Name | Well Type     | Casing Sequence No. | Cased Depth (ft.) | Top Perforation (ft.) | Bottom Perforation (ft.) |
|-----------|---------------|---------------------|-------------------|-----------------------|--------------------------|
| OCWD-M17A | NESTED        | 1                   | 100               | 60                    | 95                       |
| OCWD-M17A | NESTED        | 2                   | 190               | 130                   | 185                      |
| OCWD-M17A | NESTED        | 3                   | 350               | 330                   | 345                      |
| OCWD-M17B | SINGLE CASING | 1                   | 310               | 210                   | 305                      |
| OCWD-M18  | NESTED        | 1                   | 95                | 65                    | 90                       |
| OCWD-M18  | NESTED        | 2                   | 180               | 110                   | 175                      |
| OCWD-M18  | NESTED        | 3                   | 295               | 195                   | 290                      |
| OCWD-M18  | NESTED        | 4                   | 340               | 310                   | 335                      |
| OCWD-M19  | NESTED        | 1                   | 115               | 60                    | 110                      |
| OCWD-M19  | NESTED        | 2                   | 200               | 130                   | 195                      |
| OCWD-M19  | NESTED        | 3                   | 270               | 215                   | 265                      |
| OCWD-M20  | NESTED        | 1                   | 110               | 60                    | 105                      |
| OCWD-M20  | NESTED        | 2                   | 200               | 170                   | 195                      |
| OCWD-M20  | NESTED        | 3                   | 275               | 255                   | 270                      |
| OCWD-M21  | NESTED        | 1                   | 105               | 65                    | 100                      |
| OCWD-M21  | NESTED        | 2                   | 190               | 150                   | 185                      |
| OCWD-M21  | NESTED        | 3                   | 265               | 205                   | 260                      |
| OCWD-M21  | NESTED        | 4                   | 345               | 320                   | 340                      |
| OCWD-M22  | NESTED        | 1                   | 110               | 70                    | 105                      |
| OCWD-M22  | NESTED        | 2                   | 215               | 140                   | 210                      |
| OCWD-M22  | NESTED        | 3                   | 275               | 230                   | 270                      |
| OCWD-M23A | NESTED        | 1                   | 95                | 65                    | 90                       |
| OCWD-M23A | NESTED        | 2                   | 170               | 110                   | 165                      |
| OCWD-M23A | NESTED        | 3                   | 265               | 190                   | 260                      |
| OCWD-M23B | SINGLE CASING | 1                   | 325               | 295                   | 320                      |
| OCWD-M24  | NESTED        | 1                   | 100               | 70                    | 95                       |
| OCWD-M24  | NESTED        | 2                   | 170               | 115                   | 165                      |
| OCWD-M24  | NESTED        | 3                   | 235               | 185                   | 230                      |
| OCWD-M24  | NESTED        | 4                   | 315               | 290                   | 310                      |
| OCWD-M25  | SINGLE CASING | 1                   | 195               | 65                    | 185                      |
| OCWD-M26  | SINGLE CASING | 1                   | 145               | 70                    | 135                      |
| OCWD-M27  | SINGLE CASING | 1                   | 120               | 60                    | 110                      |
| OCWD-M28  | SINGLE CASING | 1                   | 155               | 80                    | 145                      |
| OCWD-M30  | SINGLE CASING | 1                   | 120               | 90                    | 110                      |
| OCWD-M31  | SINGLE CASING | 1                   | 172               | 82                    | 162                      |
| OCWD-M36  | NESTED        | 1                   | 95                | 80                    | 90                       |
| OCWD-M36  | NESTED        | 2                   | 180               | 165                   | 175                      |
| OCWD-M36  | NESTED        | 3                   | 255               | 240                   | 250                      |
| OCWD-M36  | NESTED        | 4                   | 305               | 290                   | 300                      |
| OCWD-M37  | NESTED        | 1                   | 135               | 120                   | 130                      |
| OCWD-M37  | NESTED        | 2                   | 195               | 180                   | 190                      |
| OCWD-M37  | NESTED        | 3                   | 245               | 230                   | 240                      |
| OCWD-M37  | NESTED        | 4                   | 312               | 297                   | 307                      |
| OCWD-M37  | NESTED        | 5                   | 353               | 338                   | 348                      |
| OCWD-M38  | NESTED        | 1                   | 114               | 94                    | 104                      |
| OCWD-M38  | NESTED        | 2                   | 176               | 156                   | 166                      |
| OCWD-M38  | NESTED        | 3                   | 254               | 234                   | 244                      |
| OCWD-M38  | NESTED        | 4                   | 356               | 336                   | 346                      |
| OCWD-M38  | NESTED        | 5                   | 536               | 516                   | 526                      |
| OCWD-M39  | NESTED        | 1                   | 90                | 70                    | 80                       |
| OCWD-M39  | NESTED        | 2                   | 130               | 100                   | 120                      |

**APPENDIX E - OCWD ACTIVE GROUNDWATER MONITORING WELLS  
(Excluding Westbay Multiport Wells)**

| Well Name | Well Type     | Casing Sequence No. | Cased Depth (ft.) | Top Perforation (ft.) | Bottom Perforation (ft.) |
|-----------|---------------|---------------------|-------------------|-----------------------|--------------------------|
| OCWD-M39  | NESTED        | 3                   | 180               | 150                   | 170                      |
| OCWD-M39  | NESTED        | 4                   | 220               | 200                   | 210                      |
| OCWD-M39  | NESTED        | 5                   | 280               | 250                   | 270                      |
| OCWD-M40  | NESTED        | 1                   | 115               | 85                    | 105                      |
| OCWD-M40  | NESTED        | 2                   | 190               | 160                   | 180                      |
| OCWD-M40  | NESTED        | 3                   | 235               | 205                   | 225                      |
| OCWD-M40  | NESTED        | 4                   | 530               | 330                   | 520                      |
| OCWD-M41  | NESTED        | 1                   | 86                | 66                    | 76                       |
| OCWD-M41  | NESTED        | 2                   | 115               | 95                    | 105                      |
| OCWD-M41  | NESTED        | 3                   | 220               | 200                   | 210                      |
| OCWD-M41  | NESTED        | 4                   | 256               | 236                   | 246                      |
| OCWD-M41  | NESTED        | 5                   | 400               | 370                   | 390                      |
| OCWD-M42  | NESTED        | 1                   | 130               | 100                   | 120                      |
| OCWD-M42  | NESTED        | 2                   | 157               | 137                   | 147                      |
| OCWD-M42  | NESTED        | 3                   | 230               | 210                   | 220                      |
| OCWD-M42  | NESTED        | 4                   | 290               | 260                   | 280                      |
| OCWD-M42  | NESTED        | 5                   | 530               | 500                   | 520                      |
| OCWD-M42  | NESTED        | 6                   | 638               | 608                   | 628                      |
| OCWD-M43  | NESTED        | 1                   | 156               | 136                   | 146                      |
| OCWD-M43  | NESTED        | 2                   | 320               | 290                   | 310                      |
| OCWD-M43  | NESTED        | 3                   | 360               | 340                   | 350                      |
| OCWD-M43  | NESTED        | 4                   | 410               | 380                   | 400                      |
| OCWD-M43  | NESTED        | 5                   | 550               | 520                   | 540                      |
| OCWD-M44  | NESTED        | 1                   | 65                | 50                    | 60                       |
| OCWD-M44  | NESTED        | 2                   | 125               | 100                   | 120                      |
| OCWD-M44  | NESTED        | 3                   | 155               | 140                   | 150                      |
| OCWD-M44  | NESTED        | 4                   | 280               | 245                   | 275                      |
| OCWD-M44  | NESTED        | 5                   | 310               | 295                   | 305                      |
| OCWD-M44A | SINGLE CASING | 1                   | 125               | 100                   | 125                      |
| OCWD-M44  | NESTED        | 1                   | 65                | 50                    | 60                       |
| OCWD-M44  | NESTED        | 2                   | 125               | 100                   | 120                      |
| OCWD-M44  | NESTED        | 3                   | 155               | 140                   | 150                      |
| OCWD-M44  | NESTED        | 4                   | 280               | 245                   | 275                      |
| OCWD-M44  | NESTED        | 5                   | 310               | 295                   | 305                      |
| OCWD-M45  | NESTED        | 1                   | 215               | 195                   | 205                      |
| OCWD-M45  | NESTED        | 2                   | 270               | 250                   | 260                      |
| OCWD-M45  | NESTED        | 3                   | 355               | 335                   | 345                      |
| OCWD-M45  | NESTED        | 4                   | 400               | 380                   | 390                      |
| OCWD-M45  | NESTED        | 5                   | 800               | 780                   | 790                      |
| OCWD-M46  | NESTED        | 1                   | 380               | 350                   | 370                      |
| OCWD-M46  | NESTED        | 2                   | 440               | 420                   | 430                      |
| OCWD-M46  | NESTED        | 3                   | 545               | 515                   | 535                      |
| OCWD-M46  | NESTED        | 4                   | 670               | 640                   | 660                      |
| OCWD-M46  | NESTED        | 5                   | 920               | 890                   | 910                      |
| OCWD-M46A | SINGLE CASING | 1                   | 380               | 350                   | 370                      |
| OCWD-M46  | NESTED        | 1                   | 380               | 350                   | 370                      |
| OCWD-M46  | NESTED        | 2                   | 440               | 420                   | 430                      |
| OCWD-M46  | NESTED        | 3                   | 545               | 515                   | 535                      |
| OCWD-M46  | NESTED        | 4                   | 670               | 640                   | 660                      |
| OCWD-M46  | NESTED        | 5                   | 920               | 890                   | 910                      |
| OCWD-M47  | NESTED        | 1                   | 385               | 355                   | 375                      |



**APPENDIX E - OCWD ACTIVE GROUNDWATER MONITORING WELLS  
(Excluding Westbay Multiport Wells)**

| Well Name  | Well Type     | Casing Sequence No. | Cased Depth (ft.) | Top Perforation (ft.) | Bottom Perforation (ft.) |
|------------|---------------|---------------------|-------------------|-----------------------|--------------------------|
| OCWD-M47   | NESTED        | 2                   | 490               | 470                   | 480                      |
| OCWD-M47   | NESTED        | 3                   | 610               | 580                   | 600                      |
| OCWD-M47   | NESTED        | 4                   | 775               | 745                   | 765                      |
| OCWD-M47   | NESTED        | 5                   | 970               | 940                   | 960                      |
| OCWD-M48   | NESTED        | 1                   | 110               | 80                    | 100                      |
| OCWD-M48   | NESTED        | 2                   | 205               | 175                   | 195                      |
| OCWD-M48   | NESTED        | 3                   | 490               | 470                   | 480                      |
| OCWD-MOOR  | SINGLE CASING | 1                   | 470               | NA                    | NA                       |
| OCWD-RVW1  | SINGLE CASING | 1                   | 78                | 67                    | 77                       |
| OCWD-RVW1A | SINGLE CASING | 1                   | 49                | 39                    | 49                       |
| OCWD-T2    | NESTED        | 1                   | 33                | 20                    | 30                       |
| OCWD-T2    | NESTED        | 2                   | 180               | 70                    | 170                      |
| OCWD-T2    | NESTED        | 3                   | 370               | 300                   | 360                      |
| OCWD-T3    | NESTED        | 1                   | 95                | 65                    | 85                       |
| OCWD-T3    | NESTED        | 2                   | 180               | 110                   | 170                      |
| OCWD-T4    | SINGLE CASING | 1                   | 176               | 68                    | 168                      |
| OCWD-T5    | NESTED        | 1                   | 200               | 110                   | 190                      |
| OCWD-T5    | NESTED        | 2                   | 305               | 285                   | 295                      |
| OCWD-W1    | SINGLE CASING | 1                   | 398               | NA                    | NA                       |
| OCWD-YLR1  | SINGLE CASING | 1                   | 40                | 35                    | 40                       |
| OCWD-YLR2  | SINGLE CASING | 1                   | 37                | 32                    | 37                       |
| OCWD-YLR3  | SINGLE CASING | 1                   | 36                | 31                    | 36                       |
| OM-1       | SINGLE CASING | 1                   | 245               | 217                   | 235                      |
| OM-2       | SINGLE CASING | 1                   | 250               | 211                   | 219                      |
| OM-2A      | SINGLE CASING | 1                   | 130               | 118                   | 125                      |
| OM-4       | SINGLE CASING | 1                   | 237               | 221                   | 230                      |
| OM-4A      | SINGLE CASING | 1                   | 119               | 112                   | 117                      |
| OM-6       | SINGLE CASING | 1                   | 249               | 196                   | 204                      |
| OM-8       | SINGLE CASING | 1                   | 319               | 285                   | 293                      |
| OM-8A      | SINGLE CASING | 1                   | 178               | 156                   | 164                      |
| SCS-3      | SINGLE CASING | 1                   | 42                | 31                    | 42                       |
| SCS-4      | SINGLE CASING | 1                   | 32                | 21                    | 32                       |
| SCS-5      | SINGLE CASING | 1                   | 43                | 22                    | 43                       |
| SCS-6      | NESTED        | 1                   | 29                | 23                    | 29                       |
| SCS-6      | NESTED        | 2                   | 153               | 147                   | 153                      |
| SCS-7      | NESTED        | 1                   | 36                | 20                    | 36                       |
| SCS-7      | NESTED        | 2                   | 141               | 125                   | 141                      |
| SCS-8      | SINGLE CASING | 1                   | 129               | 108                   | 129                      |
| SCS-9      | SINGLE CASING | 1                   | 178               | 153                   | 173                      |
| SCS-10     | SINGLE CASING | 1                   | 221               | 206                   | 216                      |
| SCS-B1     | NESTED        | 1                   | 43                | 18                    | 43                       |
| SCS-B2     | NESTED        | 1                   | 10                | 5                     | 10                       |
| SCS-B2     | NESTED        | 2                   | 29                | 19                    | 29                       |
| SCS-B3     | NESTED        | 1                   | 10                | 5                     | 10                       |
| SCS-B3     | NESTED        | 2                   | 25                | 16                    | 26                       |
| TIC-67     | SINGLE CASING | 1                   | 902               | 245                   | 900                      |
| W-14659    | SINGLE CASING | 1                   | 27                | 12                    | 27                       |
| W-15061    | SINGLE CASING | 1                   | NA                | NA                    | NA                       |

**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| ABS-1/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 27                              | 25                       | 35                          |
| ABS-1/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 77                              | 75                       | 85                          |
| ABS-1/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 257                             | 255                      | 265                         |
| AMD-1/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 105                             | 104                      | 114                         |
| AMD-1/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 135                             | 135                      | 145                         |
| AMD-1/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 180                             | 180                      | 190                         |
| AMD-1/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 245                             | 246                      | 256                         |
| AMD-1/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 329                             | 330                      | 340                         |
| AMD-1/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 383                             | 384                      | 394                         |
| AMD-1/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 523                             | 524                      | 534                         |
| AMD-1/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 762                             | 760                      | 770                         |
| AMD-1/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1037                            | 1038                     | 1048                        |
| AMD-1/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1392                            | 1390                     | 1400                        |
| AMD-2/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 157                             | 156                      | 166                         |
| AMD-2/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 262                             | 260                      | 270                         |
| AMD-2/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 387                             | 384                      | 394                         |
| AMD-2/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 512                             | 510                      | 520                         |
| AMD-2/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 659                             | 658                      | 668                         |
| AMD-2/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 824                             | 820                      | 830                         |
| AMD-2/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 1014                            | 1012                     | 1022                        |
| AMD-2/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1154                            | 1150                     | 1160                        |
| AMD-2/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1294                            | 1290                     | 1300                        |
| AMD-2/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1444                            | 1440                     | 1450                        |
| AMD-3/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 65                              | 66                       | 76                          |
| AMD-3/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 135                             | 134                      | 144                         |
| AMD-3/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 210                             | 210                      | 220                         |
| AMD-3/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 360                             | 360                      | 370                         |
| AMD-3/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 480                             | 480                      | 490                         |
| AMD-3/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 569                             | 570                      | 580                         |
| AMD-3/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 823                             | 820                      | 830                         |
| AMD-3/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 923                             | 920                      | 930                         |
| AMD-3/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1173                            | 1170                     | 1180                        |
| AMD-3/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1283                            | 1282                     | 1292                        |
| AMD-4/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 206                             | 204                      | 214                         |
| AMD-4/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 296                             | 295                      | 305                         |
| AMD-4/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 381                             | 380                      | 390                         |
| AMD-4/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 561                             | 560                      | 570                         |
| AMD-4/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 702                             | 700                      | 710                         |
| AMD-4/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 794                             | 790                      | 800                         |
| AMD-4/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 939                             | 935                      | 945                         |
| AMD-4/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1059                            | 1055                     | 1065                        |
| AMD-4/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1124                            | 1120                     | 1130                        |
| AMD-4/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1269                            | 1265                     | 1275                        |
| AMD-4/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1409                            | 1405                     | 1415                        |
| AMD-5/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 101                             | 100                      | 110                         |
| AMD-5/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 201                             | 200                      | 210                         |
| AMD-5/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 301                             | 300                      | 310                         |
| AMD-5/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 415                             | 414                      | 424                         |
| AMD-5/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 497                             | 495                      | 505                         |
| AMD-5/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 642                             | 640                      | 650                         |
| AMD-5/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 754                             | 750                      | 760                         |

**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| AMD-5/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 924                             | 920                      | 930                         |
| AMD-5/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1029                            | 1025                     | 1035                        |
| AMD-5/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1214                            | 1210                     | 1220                        |
| AMD-5/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1324                            | 1320                     | 1330                        |
| AMD-5/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1424                            | 1420                     | 1430                        |
| AMD-6/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 112                             | 110                      | 120                         |
| AMD-6/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 152                             | 150                      | 160                         |
| AMD-6/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 222                             | 220                      | 230                         |
| AMD-6/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 277                             | 275                      | 285                         |
| AMD-6/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 372                             | 370                      | 380                         |
| AMD-6/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 497                             | 495                      | 505                         |
| AMD-6/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 622                             | 620                      | 630                         |
| AMD-6/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 714                             | 710                      | 720                         |
| AMD-6/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 794                             | 790                      | 800                         |
| AMD-6/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 904                             | 900                      | 910                         |
| AMD-6/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1094                            | 1090                     | 1100                        |
| AMD-6/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1264                            | 1260                     | 1270                        |
| AMD-6/1/WB1/MP13                    | WESTBAY MULTIPOINT | 13                         | 1409                            | 1405                     | 1415                        |
| AMD-7/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 121                             | 120                      | 130                         |
| AMD-7/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 221                             | 220                      | 230                         |
| AMD-7/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 271                             | 270                      | 280                         |
| AMD-7/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 311                             | 310                      | 320                         |
| AMD-7/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 371                             | 370                      | 380                         |
| AMD-7/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 471                             | 470                      | 480                         |
| AMD-7/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 580                             | 578                      | 588                         |
| AMD-7/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 694                             | 690                      | 700                         |
| AMD-7/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 809                             | 805                      | 815                         |
| AMD-7/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 934                             | 930                      | 940                         |
| AMD-7/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1074                            | 1070                     | 1080                        |
| AMD-7/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1169                            | 1165                     | 1175                        |
| AMD-7/1/WB1/MP13                    | WESTBAY MULTIPOINT | 13                         | 1299                            | 1295                     | 1305                        |
| AMD-7/1/WB1/MP14                    | WESTBAY MULTIPOINT | 14                         | 1424                            | 1420                     | 1430                        |
| AMD-8/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 80                              | 78                       | 88                          |
| AMD-8/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 180                             | 178                      | 188                         |
| AMD-8/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 315                             | 314                      | 324                         |
| AMD-8/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 525                             | 524                      | 534                         |
| AMD-8/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 662                             | 660                      | 670                         |
| AMD-8/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 764                             | 760                      | 770                         |
| AMD-8/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 859                             | 856                      | 866                         |
| AMD-8/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1004                            | 1000                     | 1010                        |
| AMD-8/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1164                            | 1160                     | 1170                        |
| AMD-8/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1289                            | 1286                     | 1296                        |
| AMD-8/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1454                            | 1450                     | 1460                        |
| AMD-8/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1569                            | 1564                     | 1574                        |
| AMD-8/1/WB1/MP13                    | WESTBAY MULTIPOINT | 13                         | 1764                            | 1760                     | 1770                        |
| AMD-8/1/WB1/MP14                    | WESTBAY MULTIPOINT | 14                         | 1949                            | 1944                     | 1954                        |
| AMD-8/1/WB1/MP15                    | WESTBAY MULTIPOINT | 15                         | 2014                            | 2010                     | 2020                        |
| BPM-1/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 129                             | 128                      | 138                         |
| BPM-1/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 249                             | 248                      | 258                         |
| BPM-1/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 458                             | 456                      | 466                         |
| BPM-1/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 613                             | 612                      | 622                         |

**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| BPM-1/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 780                             | 776                      | 786                         |
| BPM-1/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 890                             | 886                      | 896                         |
| BPM-1/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 1040                            | 1036                     | 1046                        |
| BPM-1/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1267                            | 1264                     | 1274                        |
| BPM-1/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1392                            | 1388                     | 1398                        |
| BPM-1/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1502                            | 1498                     | 1508                        |
| BPM-1/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1687                            | 1684                     | 1694                        |
| BPM-1/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1804                            | 1800                     | 1810                        |
| BPM-1/1/WB1/MP13                    | WESTBAY MULTIPOINT | 13                         | 1934                            | 1930                     | 1940                        |
| BPM-1/1/WB1/MP14                    | WESTBAY MULTIPOINT | 14                         | 2109                            | 2105                     | 2115                        |
| BPM-2/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 181                             | 180                      | 190                         |
| BPM-2/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 336                             | 336                      | 346                         |
| BPM-2/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 496                             | 494                      | 504                         |
| BPM-2/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 581                             | 580                      | 590                         |
| BPM-2/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 778                             | 774                      | 784                         |
| BPM-2/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 903                             | 900                      | 910                         |
| BPM-2/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 1028                            | 1024                     | 1034                        |
| BPM-2/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1243                            | 1240                     | 1250                        |
| BPM-2/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1367                            | 1364                     | 1374                        |
| BPM-2/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1494                            | 1490                     | 1500                        |
| BPM-2/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1614                            | 1610                     | 1620                        |
| BPM-2/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1764                            | 1760                     | 1770                        |
| BPM-2/1/WB1/MP13                    | WESTBAY MULTIPOINT | 13                         | 1931                            | 1928                     | 1938                        |
| BPM-2/1/WB1/MP14                    | WESTBAY MULTIPOINT | 14                         | 2073                            | 2070                     | 2080                        |
| BPM-2/1/WB1/MP15                    | WESTBAY MULTIPOINT | 15                         | 2173                            | 2170                     | 2180                        |
| CB-1/1/WB2/MP1                      | WESTBAY MULTIPOINT | 1                          | 78                              | 76                       | 86                          |
| CB-1/1/WB2/MP2                      | WESTBAY MULTIPOINT | 2                          | 143                             | 140                      | 150                         |
| CB-1/1/WB2/MP3                      | WESTBAY MULTIPOINT | 3                          | 443                             | 440                      | 450                         |
| CB-1/1/WB2/MP4                      | WESTBAY MULTIPOINT | 4                          | 663                             | 659                      | 669                         |
| CB-1/1/WB2/MP5                      | WESTBAY MULTIPOINT | 5                          | 873                             | 870                      | 880                         |
| CB-1/1/WB2/MP6                      | WESTBAY MULTIPOINT | 6                          | 1053                            | 1050                     | 1060                        |
| CB-1/1/WB2/MP7                      | WESTBAY MULTIPOINT | 7                          | 1193                            | 1190                     | 1200                        |
| CB-1/1/WB2/MP8                      | WESTBAY MULTIPOINT | 8                          | 1333                            | 1329                     | 1339                        |
| CB-1/1/WB2/MP9                      | WESTBAY MULTIPOINT | 9                          | 1463                            | 1460                     | 1470                        |
| COSM-1/1/WB1/MP1                    | WESTBAY MULTIPOINT | 1                          | 92                              | 90                       | 100                         |
| COSM-1/1/WB1/MP2                    | WESTBAY MULTIPOINT | 2                          | 154                             | 152                      | 162                         |
| COSM-1/1/WB1/MP3                    | WESTBAY MULTIPOINT | 3                          | 271                             | 270                      | 280                         |
| COSM-1/1/WB1/MP4                    | WESTBAY MULTIPOINT | 4                          | 351                             | 350                      | 360                         |
| COSM-1/1/WB1/MP5                    | WESTBAY MULTIPOINT | 5                          | 451                             | 450                      | 460                         |
| COSM-1/1/WB1/MP6                    | WESTBAY MULTIPOINT | 6                          | 541                             | 540                      | 550                         |
| COSM-1/1/WB1/MP7                    | WESTBAY MULTIPOINT | 7                          | 621                             | 620                      | 630                         |
| COSM-1/1/WB1/MP8                    | WESTBAY MULTIPOINT | 8                          | 723                             | 720                      | 730                         |
| COSM-1/1/WB1/MP9                    | WESTBAY MULTIPOINT | 9                          | 853                             | 850                      | 860                         |
| COSM-1/1/WB1/MP10                   | WESTBAY MULTIPOINT | 10                         | 983                             | 980                      | 990                         |
| COSM-1/1/WB1/MP11                   | WESTBAY MULTIPOINT | 11                         | 1103                            | 1100                     | 1110                        |
| COSM-1/1/WB1/MP12                   | WESTBAY MULTIPOINT | 12                         | 1215                            | 1212                     | 1222                        |
| COSM-1/1/WB1/MP13                   | WESTBAY MULTIPOINT | 13                         | 1435                            | 1432                     | 1442                        |
| COSM-1/1/WB1/MP14                   | WESTBAY MULTIPOINT | 14                         | 1599                            | 1594                     | 1604                        |
| COSM-1/1/WB1/MP15                   | WESTBAY MULTIPOINT | 15                         | 1764                            | 1760                     | 1770                        |
| COSM-2/1/WB1/MP1                    | WESTBAY MULTIPOINT | 1                          | 60                              | 58                       | 68                          |
| COSM-2/1/WB1/MP2                    | WESTBAY MULTIPOINT | 2                          | 115                             | 113                      | 123                         |

**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| COSM-2/1/WB1/MP3                    | WESTBAY MULTIPOINT | 3                          | 202                             | 198                      | 208                         |
| COSM-2/1/WB1/MP4                    | WESTBAY MULTIPOINT | 4                          | 309                             | 307                      | 317                         |
| COSM-2/1/WB1/MP5                    | WESTBAY MULTIPOINT | 5                          | 409                             | 406                      | 416                         |
| COSM-2/1/WB1/MP6                    | WESTBAY MULTIPOINT | 6                          | 541                             | 540                      | 550                         |
| COSM-2/1/WB1/MP7                    | WESTBAY MULTIPOINT | 7                          | 651                             | 649                      | 659                         |
| COSM-2/1/WB1/MP8                    | WESTBAY MULTIPOINT | 8                          | 763                             | 757                      | 767                         |
| COSM-2/1/WB1/MP9                    | WESTBAY MULTIPOINT | 9                          | 890                             | 886                      | 896                         |
| COSM-2/1/WB1/MP10                   | WESTBAY MULTIPOINT | 10                         | 1055                            | 1051                     | 1061                        |
| FFS-1/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 181                             | 180                      | 190                         |
| FFS-1/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 361                             | 360                      | 370                         |
| FFS-1/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 530                             | 529                      | 539                         |
| FFS-1/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 820                             | 819                      | 829                         |
| FFS-1/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 1060                            | 1059                     | 1069                        |
| FFS-1/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 1160                            | 1159                     | 1169                        |
| FFS-1/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 1300                            | 1299                     | 1309                        |
| FFS-1/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 1420                            | 1419                     | 1429                        |
| FVM-1/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 136                             | 134                      | 145                         |
| FVM-1/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 173                             | 172                      | 182                         |
| FVM-1/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 223                             | 220                      | 230                         |
| FVM-1/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 360                             | 360                      | 370                         |
| FVM-1/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 450                             | 450                      | 460                         |
| FVM-1/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 500                             | 500                      | 510                         |
| FVM-1/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 560                             | 560                      | 570                         |
| FVM-1/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 632                             | 630                      | 640                         |
| FVM-1/1/WB2/MP9                     | WESTBAY MULTIPOINT | 9                          | 814                             | 810                      | 820                         |
| FVM-1/1/WB2/MP10                    | WESTBAY MULTIPOINT | 10                         | 896                             | 894                      | 904                         |
| FVM-1/1/WB2/MP11                    | WESTBAY MULTIPOINT | 11                         | 1003                            | 1000                     | 1010                        |
| FVM-1/1/WB2/MP12                    | WESTBAY MULTIPOINT | 12                         | 1123                            | 1120                     | 1130                        |
| FVM-1/1/WB2/MP13                    | WESTBAY MULTIPOINT | 13                         | 1178                            | 1175                     | 1185                        |
| FVM-1/1/WB2/MP14                    | WESTBAY MULTIPOINT | 14                         | 1233                            | 1230                     | 1240                        |
| FVM-1/1/WB2/MP15                    | WESTBAY MULTIPOINT | 15                         | 1323                            | 1320                     | 1330                        |
| FVM-1/1/WB2/MP16                    | WESTBAY MULTIPOINT | 16                         | 1497                            | 1492                     | 1502                        |
| FVM-1/1/WB2/MP17                    | WESTBAY MULTIPOINT | 17                         | 1587                            | 1582                     | 1592                        |
| FVM-1/1/WB2/MP18                    | WESTBAY MULTIPOINT | 18                         | 1837                            | 1834                     | 1844                        |
| GGM-1/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 150                             | 150                      | 160                         |
| GGM-1/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 300                             | 300                      | 310                         |
| GGM-1/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 465                             | 464                      | 474                         |
| GGM-1/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 552                             | 550                      | 560                         |
| GGM-1/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 744                             | 740                      | 750                         |
| GGM-1/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 829                             | 825                      | 835                         |
| GGM-1/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 954                             | 950                      | 960                         |
| GGM-1/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1074                            | 1070                     | 1080                        |
| GGM-1/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1264                            | 1260                     | 1270                        |
| GGM-1/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1519                            | 1515                     | 1525                        |
| GGM-1/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1654                            | 1650                     | 1660                        |
| GGM-1/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1771                            | 1768                     | 1778                        |
| GGM-1/1/WB1/MP13                    | WESTBAY MULTIPOINT | 13                         | 2011                            | 2008                     | 2018                        |
| GGM-2/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 213                             | 212                      | 222                         |
| GGM-2/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 295                             | 294                      | 304                         |
| GGM-2/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 462                             | 460                      | 470                         |
| GGM-2/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 719                             | 715                      | 725                         |

**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| GGM-2/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 954                             | 950                      | 960                         |
| GGM-2/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 1049                            | 1045                     | 1055                        |
| GGM-2/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 1149                            | 1145                     | 1155                        |
| GGM-2/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1254                            | 1250                     | 1260                        |
| GGM-2/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1489                            | 1485                     | 1495                        |
| GGM-2/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1629                            | 1625                     | 1635                        |
| GGM-2/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1744                            | 1740                     | 1750                        |
| GGM-2/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1904                            | 1900                     | 1910                        |
| GGM-2/1/WB1/MP13                    | WESTBAY MULTIPOINT | 13                         | 1994                            | 1990                     | 2000                        |
| GGM-3/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 197                             | 195                      | 205                         |
| GGM-3/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 312                             | 310                      | 320                         |
| GGM-3/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 547                             | 545                      | 555                         |
| GGM-3/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 642                             | 640                      | 650                         |
| GGM-3/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 842                             | 837                      | 847                         |
| GGM-3/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 1007                            | 1004                     | 1014                        |
| GGM-3/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 1107                            | 1104                     | 1114                        |
| GGM-3/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1279                            | 1274                     | 1284                        |
| GGM-3/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1544                            | 1539                     | 1549                        |
| GGM-3/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1684                            | 1680                     | 1690                        |
| GGM-3/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1784                            | 1780                     | 1790                        |
| GGM-3/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1954                            | 1950                     | 1960                        |
| HBM-1/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 91                              | 90                       | 100                         |
| HBM-1/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 191                             | 190                      | 200                         |
| HBM-1/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 321                             | 320                      | 330                         |
| HBM-1/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 483                             | 482                      | 492                         |
| HBM-1/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 562                             | 560                      | 570                         |
| HBM-1/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 702                             | 700                      | 710                         |
| HBM-1/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 924                             | 920                      | 930                         |
| HBM-1/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1038                            | 1034                     | 1044                        |
| HBM-1/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1130                            | 1126                     | 1136                        |
| HBM-1/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1352                            | 1348                     | 1358                        |
| HBM-1/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1464                            | 1460                     | 1470                        |
| HBM-1/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1544                            | 1540                     | 1550                        |
| HBM-1/1/WB1/MP13                    | WESTBAY MULTIPOINT | 13                         | 1644                            | 1640                     | 1650                        |
| HBM-1/1/WB1/MP14                    | WESTBAY MULTIPOINT | 14                         | 1934                            | 1930                     | 1940                        |
| HBM-2/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 112                             | 110                      | 120                         |
| HBM-2/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 162                             | 160                      | 170                         |
| HBM-2/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 247                             | 245                      | 255                         |
| HBM-2/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 307                             | 305                      | 315                         |
| HBM-2/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 362                             | 360                      | 370                         |
| HBM-2/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 447                             | 445                      | 455                         |
| HBM-2/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 522                             | 520                      | 530                         |
| HBM-2/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 572                             | 570                      | 580                         |
| HBM-2/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 677                             | 675                      | 685                         |
| HBM-2/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 739                             | 735                      | 745                         |
| HBM-2/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 849                             | 845                      | 855                         |
| HBM-2/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 929                             | 925                      | 935                         |
| HBM-4/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 75                              | 75                       | 85                          |
| HBM-4/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 120                             | 120                      | 130                         |
| HBM-4/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 179                             | 180                      | 190                         |
| HBM-4/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 231                             | 230                      | 240                         |



**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| HBM-4/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 296                             | 295                      | 305                         |
| HBM-4/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 351                             | 350                      | 360                         |
| HBM-4/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 416                             | 415                      | 425                         |
| HBM-4/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 551                             | 550                      | 560                         |
| HBM-4/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 691                             | 690                      | 700                         |
| HBM-5/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 86                              | 70                       | 90                          |
| HBM-5/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 71                              | 70                       | 90                          |
| HBM-5/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 76                              | 70                       | 90                          |
| HBM-5/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 126                             | 125                      | 135                         |
| HBM-5/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 171                             | 170                      | 180                         |
| HBM-5/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 216                             | 215                      | 225                         |
| HBM-5/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 248                             | 245                      | 255                         |
| HBM-5/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 273                             | 270                      | 280                         |
| HBM-6/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 53                              | 52                       | 62                          |
| HBM-6/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 85                              | 84                       | 94                          |
| HBM-6/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 110                             | 108                      | 118                         |
| HBM-6/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 215                             | 214                      | 224                         |
| HBM-6/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 264                             | 263                      | 273                         |
| HBM-6/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 296                             | 294                      | 304                         |
| HBM-6/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 508                             | 506                      | 516                         |
| HBM-6/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 578                             | 576                      | 586                         |
| IDM-1/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 86                              | 85                       | 95                          |
| IDM-1/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 271                             | 270                      | 280                         |
| IDM-1/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 336                             | 335                      | 345                         |
| IDM-1/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 436                             | 435                      | 445                         |
| IDM-1/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 631                             | 630                      | 640                         |
| IDM-1/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 703                             | 700                      | 710                         |
| IDM-1/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 763                             | 760                      | 770                         |
| IDM-1/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 878                             | 875                      | 885                         |
| IDM-1/1/WB2/MP9                     | WESTBAY MULTIPOINT | 9                          | 993                             | 990                      | 1000                        |
| IDM-1/1/WB2/MP10                    | WESTBAY MULTIPOINT | 10                         | 1053                            | 1050                     | 1060                        |
| IDM-2/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 129                             | 126                      | 136                         |
| IDM-2/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 236                             | 234                      | 244                         |
| IDM-2/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 286                             | 284                      | 294                         |
| IDM-2/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 353                             | 352                      | 362                         |
| IDM-2/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 493                             | 492                      | 502                         |
| IDM-2/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 613                             | 612                      | 622                         |
| IDM-2/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 713                             | 710                      | 720                         |
| IDM-2/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 890                             | 886                      | 896                         |
| IDM-2/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1055                            | 1050                     | 1060                        |
| IDM-2/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1182                            | 1178                     | 1188                        |
| IDM-2/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1259                            | 1256                     | 1266                        |
| IDM-2/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1404                            | 1400                     | 1410                        |
| KBS-2/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 99                              | 96                       | 106                         |
| KBS-2/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 214                             | 210                      | 220                         |
| LAM-1/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 72                              | 70                       | 80                          |
| LAM-1/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 222                             | 220                      | 230                         |
| LAM-1/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 272                             | 270                      | 280                         |
| LAM-1/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 472                             | 470                      | 480                         |
| LAM-1/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 572                             | 570                      | 580                         |
| LAM-1/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 834                             | 830                      | 840                         |

**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| LAM-1/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 996                             | 992                      | 1002                        |
| LAM-1/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1073                            | 1070                     | 1080                        |
| LAM-1/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1153                            | 1150                     | 1160                        |
| LAM-1/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1253                            | 1250                     | 1260                        |
| LAM-1/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1498                            | 1494                     | 1504                        |
| LAM-1/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1613                            | 1610                     | 1620                        |
| MCAS-1/1/WB2/MP1                    | WESTBAY MULTIPOINT | 1                          | 65                              | 60                       | 70                          |
| MCAS-1/1/WB2/MP2                    | WESTBAY MULTIPOINT | 2                          | 155                             | 150                      | 160                         |
| MCAS-1/1/WB2/MP3                    | WESTBAY MULTIPOINT | 3                          | 215                             | 210                      | 220                         |
| MCAS-1/1/WB2/MP4                    | WESTBAY MULTIPOINT | 4                          | 275                             | 270                      | 280                         |
| MCAS-1/1/WB2/MP5                    | WESTBAY MULTIPOINT | 5                          | 335                             | 330                      | 340                         |
| MCAS-1/1/WB2/MP6                    | WESTBAY MULTIPOINT | 6                          | 455                             | 450                      | 460                         |
| MCAS-1/1/WB2/MP7                    | WESTBAY MULTIPOINT | 7                          | 545                             | 540                      | 550                         |
| MCAS-2/1/WB2/MP1                    | WESTBAY MULTIPOINT | 1                          | 45                              | 40                       | 50                          |
| MCAS-2/1/WB2/MP2                    | WESTBAY MULTIPOINT | 2                          | 135                             | 130                      | 140                         |
| MCAS-2/1/WB2/MP3                    | WESTBAY MULTIPOINT | 3                          | 205                             | 200                      | 210                         |
| MCAS-2/1/WB2/MP4                    | WESTBAY MULTIPOINT | 4                          | 375                             | 370                      | 380                         |
| MCAS-2/1/WB2/MP5                    | WESTBAY MULTIPOINT | 5                          | 425                             | 420                      | 430                         |
| MCAS-2/1/WB2/MP6                    | WESTBAY MULTIPOINT | 6                          | 495                             | 490                      | 500                         |
| MCAS-2/1/WB2/MP7                    | WESTBAY MULTIPOINT | 7                          | 555                             | 550                      | 560                         |
| MCAS-2/1/WB2/MP8                    | WESTBAY MULTIPOINT | 8                          | 625                             | 620                      | 630                         |
| MCAS-3/1/WB2/MP1                    | WESTBAY MULTIPOINT | 1                          | 91                              | 80                       | 90                          |
| MCAS-3/1/WB2/MP2                    | WESTBAY MULTIPOINT | 2                          | 166                             | 160                      | 170                         |
| MCAS-3/1/WB2/MP3                    | WESTBAY MULTIPOINT | 3                          | 226                             | 220                      | 230                         |
| MCAS-3/1/WB2/MP4                    | WESTBAY MULTIPOINT | 4                          | 346                             | 340                      | 350                         |
| MCAS-3/1/WB2/MP5                    | WESTBAY MULTIPOINT | 5                          | 426                             | 420                      | 430                         |
| MCAS-3/1/WB2/MP6                    | WESTBAY MULTIPOINT | 6                          | 496                             | 490                      | 500                         |
| MCAS-7/1/WB3/MP1                    | WESTBAY MULTIPOINT | 1                          | 92                              | 90                       | 100                         |
| MCAS-7/1/WB3/MP2                    | WESTBAY MULTIPOINT | 2                          | 192                             | 190                      | 200                         |
| MCAS-7/1/WB3/MP3                    | WESTBAY MULTIPOINT | 3                          | 352                             | 350                      | 360                         |
| MCAS-7/1/WB3/MP4                    | WESTBAY MULTIPOINT | 4                          | 442                             | 440                      | 450                         |
| MCAS-7/1/WB3/MP5                    | WESTBAY MULTIPOINT | 5                          | 512                             | 510                      | 520                         |
| MCAS-7/1/WB3/MP6                    | WESTBAY MULTIPOINT | 6                          | 802                             | 800                      | 810                         |
| MCAS-7/1/WB3/MP7                    | WESTBAY MULTIPOINT | 7                          | 912                             | 910                      | 920                         |
| MCAS-7/1/WB3/MP8                    | WESTBAY MULTIPOINT | 8                          | 982                             | 980                      | 990                         |
| MCAS-7/1/WB3/MP9                    | WESTBAY MULTIPOINT | 9                          | 1082                            | 1100                     | 1110                        |
| SAR-1/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 162                             | 150                      | 170                         |
| SAR-1/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 297                             | 290                      | 300                         |
| SAR-1/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 327                             | 320                      | 330                         |
| SAR-1/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 367                             | 360                      | 370                         |
| SAR-1/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 519                             | 510                      | 530                         |
| SAR-1/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 584                             | 580                      | 590                         |
| SAR-1/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 829                             | 820                      | 840                         |
| SAR-1/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 894                             | 890                      | 900                         |
| SAR-1/1/WB2/MP9                     | WESTBAY MULTIPOINT | 9                          | 914                             | 910                      | 920                         |
| SAR-1/1/WB2/MP10                    | WESTBAY MULTIPOINT | 10                         | 1014                            | 1010                     | 1020                        |
| SAR-1/1/WB2/MP11                    | WESTBAY MULTIPOINT | 11                         | 1114                            | 1110                     | 1120                        |
| SAR-1/1/WB2/MP12                    | WESTBAY MULTIPOINT | 12                         | 1284                            | 1280                     | 1290                        |
| SAR-1/1/WB2/MP13                    | WESTBAY MULTIPOINT | 13                         | 1374                            | 1370                     | 1380                        |
| SAR-1/1/WB2/MP14                    | WESTBAY MULTIPOINT | 14                         | 1446                            | 1441                     | 1451                        |
| SAR-2/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 141                             | 140                      | 150                         |

**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| SAR-2/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 271                             | 270                      | 280                         |
| SAR-2/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 311                             | 310                      | 320                         |
| SAR-2/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 417                             | 470                      | 480                         |
| SAR-2/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 611                             | 610                      | 620                         |
| SAR-2/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 741                             | 740                      | 750                         |
| SAR-2/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 881                             | 880                      | 890                         |
| SAR-2/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 981                             | 980                      | 990                         |
| SAR-2/1/WB2/MP9                     | WESTBAY MULTIPOINT | 9                          | 1021                            | 1020                     | 1030                        |
| SAR-2/1/WB2/MP10                    | WESTBAY MULTIPOINT | 10                         | 1101                            | 1100                     | 1110                        |
| SAR-2/1/WB2/MP11                    | WESTBAY MULTIPOINT | 11                         | 1231                            | 1230                     | 1240                        |
| SAR-2/1/WB2/MP12                    | WESTBAY MULTIPOINT | 12                         | 1351                            | 1350                     | 1360                        |
| SAR-3/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 164                             | 160                      | 170                         |
| SAR-3/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 234                             | 230                      | 240                         |
| SAR-3/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 414                             | 410                      | 420                         |
| SAR-3/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 514                             | 510                      | 520                         |
| SAR-3/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 644                             | 640                      | 650                         |
| SAR-3/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 774                             | 770                      | 780                         |
| SAR-3/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 954                             | 950                      | 960                         |
| SAR-3/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 1074                            | 1070                     | 1080                        |
| SAR-3/1/WB2/MP9                     | WESTBAY MULTIPOINT | 9                          | 1199                            | 1195                     | 1205                        |
| SAR-3/1/WB2/MP10                    | WESTBAY MULTIPOINT | 10                         | 1269                            | 1265                     | 1275                        |
| SAR-3/1/WB2/MP11                    | WESTBAY MULTIPOINT | 11                         | 1393                            | 1390                     | 1400                        |
| SAR-4/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 123                             | 115                      | 125                         |
| SAR-4/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 328                             | 320                      | 330                         |
| SAR-4/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 478                             | 470                      | 480                         |
| SAR-4/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 598                             | 590                      | 600                         |
| SAR-4/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 738                             | 730                      | 740                         |
| SAR-4/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 868                             | 860                      | 870                         |
| SAR-4/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 978                             | 970                      | 980                         |
| SAR-4/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 1068                            | 1060                     | 1070                        |
| SAR-4/1/WB2/MP9                     | WESTBAY MULTIPOINT | 9                          | 1168                            | 1160                     | 1170                        |
| SAR-4/1/WB2/MP10                    | WESTBAY MULTIPOINT | 10                         | 1398                            | 1395                     | 1405                        |
| SAR-5/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 80                              | 80                       | 90                          |
| SAR-5/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 170                             | 170                      | 180                         |
| SAR-5/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 360                             | 360                      | 370                         |
| SAR-5/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 617                             | 616                      | 626                         |
| SAR-5/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 764                             | 760                      | 770                         |
| SAR-5/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 944                             | 940                      | 950                         |
| SAR-5/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 1084                            | 1080                     | 1090                        |
| SAR-5/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 1193                            | 1190                     | 1200                        |
| SAR-5/1/WB2/MP9                     | WESTBAY MULTIPOINT | 9                          | 1293                            | 1290                     | 1300                        |
| SAR-5/1/WB2/MP10                    | WESTBAY MULTIPOINT | 10                         | 1543                            | 1540                     | 1550                        |
| SAR-5/1/WB2/MP11                    | WESTBAY MULTIPOINT | 11                         | 1733                            | 1730                     | 1740                        |
| SAR-5/1/WB2/MP12                    | WESTBAY MULTIPOINT | 12                         | 1823                            | 1820                     | 1830                        |
| SAR-6/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 206                             | 200                      | 210                         |
| SAR-6/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 366                             | 360                      | 370                         |
| SAR-6/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 476                             | 470                      | 480                         |
| SAR-6/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 581                             | 574                      | 584                         |
| SAR-6/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 706                             | 700                      | 710                         |
| SAR-6/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 786                             | 780                      | 790                         |
| SAR-6/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 1086                            | 1080                     | 1090                        |

**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| SAR-6/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 1186                            | 1180                     | 1190                        |
| SAR-6/1/WB2/MP9                     | WESTBAY MULTIPOINT | 9                          | 1276                            | 1270                     | 1280                        |
| SAR-6/1/WB2/MP10                    | WESTBAY MULTIPOINT | 10                         | 1501                            | 1500                     | 1510                        |
| SAR-7/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 111                             | 110                      | 120                         |
| SAR-7/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 171                             | 170                      | 180                         |
| SAR-7/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 310                             | 310                      | 320                         |
| SAR-7/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 440                             | 440                      | 450                         |
| SAR-7/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 605                             | 604                      | 614                         |
| SAR-7/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 742                             | 740                      | 750                         |
| SAR-7/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 862                             | 856                      | 866                         |
| SAR-7/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 1194                            | 1190                     | 1200                        |
| SAR-7/1/WB2/MP9                     | WESTBAY MULTIPOINT | 9                          | 1354                            | 1350                     | 1360                        |
| SAR-8/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 44                              | 34                       | 44                          |
| SAR-8/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 94                              | 84                       | 94                          |
| SAR-8/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 159                             | 150                      | 160                         |
| SAR-9/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 150                             | 148                      | 160                         |
| SAR-9/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 239                             | 236                      | 248                         |
| SAR-9/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 409                             | 406                      | 418                         |
| SAR-9/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 491                             | 488                      | 500                         |
| SAR-9/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 606                             | 604                      | 616                         |
| SAR-9/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 730                             | 724                      | 736                         |
| SAR-9/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 877                             | 872                      | 884                         |
| SAR-9/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1072                            | 1068                     | 1080                        |
| SAR-9/1/WB1/MP9                     | WESTBAY MULTIPOINT | 9                          | 1262                            | 1258                     | 1270                        |
| SAR-9/1/WB1/MP10                    | WESTBAY MULTIPOINT | 10                         | 1477                            | 1473                     | 1484                        |
| SAR-9/1/WB1/MP11                    | WESTBAY MULTIPOINT | 11                         | 1572                            | 1567                     | 1578                        |
| SAR-9/1/WB1/MP12                    | WESTBAY MULTIPOINT | 12                         | 1724                            | 1719                     | 1730                        |
| SAR-9/1/WB1/MP13                    | WESTBAY MULTIPOINT | 13                         | 1821                            | 1815                     | 1826                        |
| SAR-9/1/WB1/MP14                    | WESTBAY MULTIPOINT | 14                         | 1893                            | 1889                     | 1900                        |
| SBM-1/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 79                              | 74                       | 84                          |
| SBM-1/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 149                             | 144                      | 154                         |
| SBM-1/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 244                             | 240                      | 250                         |
| SBM-1/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 374                             | 370                      | 380                         |
| SBM-1/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 514                             | 510                      | 520                         |
| SBM-1/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 706                             | 696                      | 706                         |
| SBM-1/1/WB1/MP7                     | WESTBAY MULTIPOINT | 7                          | 916                             | 910                      | 920                         |
| SBM-1/1/WB1/MP8                     | WESTBAY MULTIPOINT | 8                          | 1256                            | 1250                     | 1260                        |
| SC-1/1/WB1/MP1                      | WESTBAY MULTIPOINT | 1                          | 48                              | 44                       | 54                          |
| SC-1/1/WB1/MP2                      | WESTBAY MULTIPOINT | 2                          | 93                              | 90                       | 100                         |
| SC-1/1/WB1/MP3                      | WESTBAY MULTIPOINT | 3                          | 153                             | 150                      | 160                         |
| SC-1/1/WB1/MP4                      | WESTBAY MULTIPOINT | 4                          | 197                             | 194                      | 204                         |
| SC-1/1/WB1/MP5                      | WESTBAY MULTIPOINT | 5                          | 299                             | 294                      | 304                         |
| SC-1/1/WB1/MP6                      | WESTBAY MULTIPOINT | 6                          | 394                             | 390                      | 400                         |
| SC-2/1/WB2/MP1                      | WESTBAY MULTIPOINT | 1                          | 49                              | 46                       | 56                          |
| SC-2/1/WB2/MP2                      | WESTBAY MULTIPOINT | 2                          | 96                              | 94                       | 104                         |
| SC-2/1/WB2/MP3                      | WESTBAY MULTIPOINT | 3                          | 148                             | 146                      | 156                         |
| SC-2/1/WB2/MP4                      | WESTBAY MULTIPOINT | 4                          | 192                             | 190                      | 200                         |
| SC-2/1/WB2/MP5                      | WESTBAY MULTIPOINT | 5                          | 251                             | 248                      | 258                         |
| SC-2/1/WB2/MP6                      | WESTBAY MULTIPOINT | 6                          | 303                             | 300                      | 310                         |
| SC-3/1/WB2/MP1                      | WESTBAY MULTIPOINT | 1                          | 227                             | 224                      | 234                         |
| SC-3/1/WB2/MP2                      | WESTBAY MULTIPOINT | 2                          | 412                             | 410                      | 420                         |

**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| SC-3/1/WB2/MP3                      | WESTBAY MULTIPOINT | 3                          | 577                             | 576                      | 586                         |
| SC-3/1/WB2/MP4                      | WESTBAY MULTIPOINT | 4                          | 712                             | 710                      | 720                         |
| SC-3/1/WB2/MP5                      | WESTBAY MULTIPOINT | 5                          | 1022                            | 1018                     | 1028                        |
| SC-3/1/WB2/MP6                      | WESTBAY MULTIPOINT | 6                          | 1154                            | 1150                     | 1160                        |
| SC-3/1/WB2/MP7                      | WESTBAY MULTIPOINT | 7                          | 1234                            | 1230                     | 1240                        |
| SC-3/1/WB2/MP8                      | WESTBAY MULTIPOINT | 8                          | 1374                            | 1370                     | 1380                        |
| SC-3/1/WB2/MP9                      | WESTBAY MULTIPOINT | 9                          | 1459                            | 1460                     | 1470                        |
| SC-4/1/WB1/MP1                      | WESTBAY MULTIPOINT | 1                          | 102                             | 100                      | 111                         |
| SC-4/1/WB1/MP2                      | WESTBAY MULTIPOINT | 2                          | 201                             | 198                      | 209                         |
| SC-4/1/WB1/MP3                      | WESTBAY MULTIPOINT | 3                          | 271                             | 268                      | 279                         |
| SC-4/1/WB1/MP4                      | WESTBAY MULTIPOINT | 4                          | 393                             | 391                      | 402                         |
| SC-4/1/WB1/MP5                      | WESTBAY MULTIPOINT | 5                          | 483                             | 482                      | 493                         |
| SC-4/1/WB1/MP6                      | WESTBAY MULTIPOINT | 6                          | 573                             | 572                      | 583                         |
| SC-4/1/WB1/MP7                      | WESTBAY MULTIPOINT | 7                          | 660                             | 658                      | 669                         |
| SC-4/1/WB1/MP8                      | WESTBAY MULTIPOINT | 8                          | 830                             | 827                      | 838                         |
| SC-4/1/WB1/MP9                      | WESTBAY MULTIPOINT | 9                          | 1082                            | 1078                     | 1089                        |
| SC-5/1/WB1/MP1                      | WESTBAY MULTIPOINT | 1                          | 124                             | 123                      | 133                         |
| SC-5/1/WB1/MP2                      | WESTBAY MULTIPOINT | 2                          | 196                             | 196                      | 206                         |
| SC-5/1/WB1/MP3                      | WESTBAY MULTIPOINT | 3                          | 291                             | 290                      | 300                         |
| SC-5/1/WB1/MP4                      | WESTBAY MULTIPOINT | 4                          | 470                             | 468                      | 478                         |
| SC-5/1/WB1/MP5                      | WESTBAY MULTIPOINT | 5                          | 670                             | 667                      | 677                         |
| SC-5/1/WB1/MP6                      | WESTBAY MULTIPOINT | 6                          | 807                             | 804                      | 814                         |
| SC-5/1/WB1/MP7                      | WESTBAY MULTIPOINT | 7                          | 937                             | 932                      | 942                         |
| SC-5/1/WB1/MP8                      | WESTBAY MULTIPOINT | 8                          | 1024                            | 1020                     | 1030                        |
| SC-5/1/WB1/MP9                      | WESTBAY MULTIPOINT | 9                          | 1238                            | 1234                     | 1244                        |
| SC-5/1/WB1/MP10                     | WESTBAY MULTIPOINT | 10                         | 1430                            | 1426                     | 1436                        |
| SC-6/1/WB1/MP1                      | WESTBAY MULTIPOINT | 1                          | 92                              | 90                       | 100                         |
| SC-6/1/WB1/MP2                      | WESTBAY MULTIPOINT | 2                          | 202                             | 200                      | 210                         |
| SC-6/1/WB1/MP3                      | WESTBAY MULTIPOINT | 3                          | 302                             | 300                      | 310                         |
| SC-6/1/WB1/MP4                      | WESTBAY MULTIPOINT | 4                          | 542                             | 540                      | 550                         |
| SC-6/1/WB1/MP5                      | WESTBAY MULTIPOINT | 5                          | 789                             | 785                      | 795                         |
| SC-6/1/WB1/MP6                      | WESTBAY MULTIPOINT | 6                          | 964                             | 960                      | 970                         |
| SC-6/1/WB1/MP7                      | WESTBAY MULTIPOINT | 7                          | 1124                            | 1120                     | 1130                        |
| SC-6/1/WB1/MP8                      | WESTBAY MULTIPOINT | 8                          | 1329                            | 1325                     | 1335                        |
| SC-6/1/WB1/MP9                      | WESTBAY MULTIPOINT | 9                          | 1464                            | 1460                     | 1470                        |
| SC-6/1/WB1/MP10                     | WESTBAY MULTIPOINT | 10                         | 1544                            | 1540                     | 1550                        |
| SC-6/1/WB1/MP11                     | WESTBAY MULTIPOINT | 11                         | 1684                            | 1680                     | 1690                        |
| SC-6/1/WB1/MP12                     | WESTBAY MULTIPOINT | 12                         | 1894                            | 1890                     | 1900                        |
| SC-6/1/WB1/MP13                     | WESTBAY MULTIPOINT | 13                         | 2029                            | 2025                     | 2035                        |
| SC-6/1/WB1/MP14                     | WESTBAY MULTIPOINT | 14                         | 2119                            | 2115                     | 2125                        |
| SCS-1/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 29                              | 24                       | 34                          |
| SCS-1/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 94                              | 90                       | 100                         |
| SCS-1/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 146                             | 142                      | 152                         |
| SCS-1/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 183                             | 178                      | 188                         |
| SCS-1/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 223                             | 220                      | 230                         |
| SCS-1/1/WB1/MP6                     | WESTBAY MULTIPOINT | 6                          | 298                             | 295                      | 305                         |
| SCS-2/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 139                             | 134                      | 145                         |
| SCS-2/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 179                             | 174                      | 185                         |
| SCS-2/1/WB1/MP3                     | WESTBAY MULTIPOINT | 3                          | 218                             | 212                      | 223                         |
| SCS-2/1/WB1/MP4                     | WESTBAY MULTIPOINT | 4                          | 265                             | 260                      | 270                         |
| SCS-2/1/WB1/MP5                     | WESTBAY MULTIPOINT | 5                          | 330                             | 325                      | 335                         |

**APPENDIX E - OCWD WESTBAY GROUNDWATER MONITORING WELLS  
MONITORING PORT INFORMATION**

| <b>Westbay Monitoring Port Name</b> | <b>Well Type</b>   | <b>Monitoring Port No.</b> | <b>Westbay Port Depth (ft.)</b> | <b>Top of Zone (ft.)</b> | <b>Bottom of Zone (ft.)</b> |
|-------------------------------------|--------------------|----------------------------|---------------------------------|--------------------------|-----------------------------|
| WBS-2A/1/WB1/MP1                    | WESTBAY MULTIPOINT | 1                          | 54                              | 50                       | 60                          |
| WBS-2A/1/WB1/MP2                    | WESTBAY MULTIPOINT | 2                          | 94                              | 90                       | 100                         |
| WBS-2A/1/WB1/MP3                    | WESTBAY MULTIPOINT | 3                          | 139                             | 135                      | 145                         |
| WBS-3/1/WB1/MP1                     | WESTBAY MULTIPOINT | 1                          | 79                              | 75                       | 85                          |
| WBS-3/1/WB1/MP2                     | WESTBAY MULTIPOINT | 2                          | 219                             | 215                      | 225                         |
| WMM-1/1/WB2/MP1                     | WESTBAY MULTIPOINT | 1                          | 111                             | 109                      | 119                         |
| WMM-1/1/WB2/MP2                     | WESTBAY MULTIPOINT | 2                          | 361                             | 359                      | 369                         |
| WMM-1/1/WB2/MP3                     | WESTBAY MULTIPOINT | 3                          | 483                             | 480                      | 490                         |
| WMM-1/1/WB2/MP4                     | WESTBAY MULTIPOINT | 4                          | 603                             | 600                      | 610                         |
| WMM-1/1/WB2/MP5                     | WESTBAY MULTIPOINT | 5                          | 745                             | 740                      | 750                         |
| WMM-1/1/WB2/MP6                     | WESTBAY MULTIPOINT | 6                          | 815                             | 810                      | 820                         |
| WMM-1/1/WB2/MP7                     | WESTBAY MULTIPOINT | 7                          | 895                             | 889                      | 899                         |
| WMM-1/1/WB2/MP8                     | WESTBAY MULTIPOINT | 8                          | 985                             | 980                      | 990                         |
| WMM-1/1/WB2/MP9                     | WESTBAY MULTIPOINT | 9                          | 1065                            | 1060                     | 1070                        |
| WMM-1/1/WB2/MP10                    | WESTBAY MULTIPOINT | 10                         | 1215                            | 1210                     | 1220                        |
| WMM-1/1/WB2/MP11                    | WESTBAY MULTIPOINT | 11                         | 1315                            | 1309                     | 1319                        |
| WMM-1/1/WB2/MP12                    | WESTBAY MULTIPOINT | 12                         | 1370                            | 1364                     | 1374                        |
| WMM-1/1/WB2/MP13                    | WESTBAY MULTIPOINT | 13                         | 1435                            | 1430                     | 1440                        |
| WMM-1/1/WB2/MP14                    | WESTBAY MULTIPOINT | 14                         | 1570                            | 1565                     | 1575                        |
| WMM-1/1/WB2/MP15                    | WESTBAY MULTIPOINT | 15                         | 1625                            | 1619                     | 1629                        |
| WMM-1/1/WB2/MP16                    | WESTBAY MULTIPOINT | 16                         | 1745                            | 1740                     | 1750                        |
| WMM-1/1/WB2/MP17                    | WESTBAY MULTIPOINT | 17                         | 1805                            | 1800                     | 1810                        |
| WMM-1/1/WB2/MP18                    | WESTBAY MULTIPOINT | 18                         | 1945                            | 1940                     | 1950                        |



# APPENDIX F

## ACRONYMS AND ABBREVIATIONS

## **Abbreviations and Acronyms**

The following abbreviations and acronyms are used in this report:

|                               |                                                    |
|-------------------------------|----------------------------------------------------|
| ACOE                          | U.S. Army Corps of Engineers                       |
| af                            | acre-feet                                          |
| afy                           | acre-feet per year                                 |
| AOC                           | assimiable organic carbon                          |
| AOP                           | advanced oxidation processes                       |
| AWT                           | advanced water treatment                           |
| basin                         | Orange County groundwater basin                    |
| Basin Model                   | OCWD groundwater model                             |
| BEA                           | Basin Equity Assessment                            |
| BPP                           | Basin Production Percentage                        |
| CDFG                          | California Department of Fish & Game               |
| CDPH                          | California Department of Public Health             |
| cfs                           | cubic feet per second                              |
| CWTF                          | Colored Water Treatment Facility                   |
| DATS                          | Deep Aquifer Treatment System                      |
| District                      | Orange County Water District                       |
| DOC                           | dissolved organic compound                         |
| DWR                           | Department of Water Resources                      |
| DWSAP                         | Drinking Water Source Assessment and Protection    |
| EDCs                          | Endocrine Disrupting Compounds                     |
| EIR                           | Environmental Impact Report                        |
| EPA                           | U.S. Environmental Protection Agency               |
| FY                            | fiscal year                                        |
| GAC                           | granular activated carbon                          |
| GIS                           | geographic information system                      |
| GWR                           | Groundwater Replenishment                          |
| H <sub>2</sub> O <sub>2</sub> | hydrogen peroxide                                  |
| IEUA                          | Inland Empire Utilities Agency                     |
| IRWD                          | Irvine Ranch Water District                        |
| K                             | model layer hydraulic conductivity                 |
| LACDWP                        | Los Angeles County Department of Power & Water     |
| maf                           | million acre feet                                  |
| MCAS                          | Marine Corps Air Station                           |
| MCL                           | maximum contaminant level                          |
| MCWD                          | Mesa Consolidated Water District                   |
| MWDOC                         | Municipal Water District of Orange County          |
| MF                            | microfiltration                                    |
| MODFLOW                       | Computer program developed by USGS                 |
| mgd                           | million gallons per day                            |
| mg/L                          | milligrams per liter                               |
| MTBE                          | methyl tertiary-butylether                         |
| Metropolitan                  | Metropolitan Water District of Southern California |

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## Abbreviations and Acronyms

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|                              |                                                     |
|------------------------------|-----------------------------------------------------|
| MWDOC                        | Municipal Water District of Orange County           |
| NDMA                         | n-Nitrosodimethylamine                              |
| NF                           | nanofiltration                                      |
| ng/L                         | nanograms per liter                                 |
| NBGPP                        | North Basin Groundwater Protection Program          |
| NO <sub>2</sub>              | nitrite                                             |
| NO <sub>3</sub> <sup>-</sup> | Nitrate                                             |
| NPDES                        | National Pollution Discharge Elimination System     |
| NWRI                         | National Water Research Institute                   |
| O&M                          | operations and maintenance                          |
| OCHCA                        | Orange County Health Care Agency                    |
| OCSO                         | Orange County Sanitation District                   |
| OCWD                         | Orange County Water District                        |
| PCE                          | perchloroethylene                                   |
| Plan                         | Groundwater Management Plan                         |
| ppb                          | less than one microgram per liter                   |
| PPCPs                        | pharmaceuticals and personal care products          |
| Producers                    | Orange County groundwater producers                 |
| RA                           | replenishment assessment                            |
| REWG                         | Recharge Enhancement Working Group                  |
| RO                           | reverse osmosis                                     |
| RWQCB                        | Regional Water Quality Control Board                |
| SARI                         | Santa Ana River Interceptor                         |
| SARWQH                       | Santa Ana Regional Water Quality and Health         |
| SAWA                         | Santa Ana Watershed Association                     |
| SAWPA                        | Santa Ana Watershed Project Authority               |
| SBGPP                        | South Basin Groundwater Protection Project          |
| SDWA                         | Safe Drinking Water Act                             |
| SOCs                         | synthetic organic chemicals                         |
| SWP                          | State Water Project                                 |
| SWRCB                        | State Water Resource Control Board                  |
| TCE                          | trichloroethylene                                   |
| TDS                          | total dissolved solids                              |
| TIN                          | total inorganic nitrogen                            |
| µg/L                         | micrograms per liter                                |
| USFWS                        | U.S. Fish & Wildlife Service                        |
| USGS                         | U.S. Geological Survey                              |
| UV                           | ultraviolet light                                   |
| VOCs                         | volatile organic compounds                          |
| WACO                         | Water Advisory Committee of Orange County           |
| WF-21                        | Water Factory 21                                    |
| WRD                          | Water Replenishment District of Southern California |
| WRMS                         | Water Resources Management System                   |

## Appendix C

### Calculation of Dry Year Demands

## Demand “Bump” Factors for 2010 UWMP

### Description of Methodology

Water agencies must develop estimates of the impacts of single dry years (Single-Dry) and multiple consecutive dry years (Multiple-Dry) on both supplies and demands in future years. In these cases, demands increase somewhat above the normal or average level. The increase can be expressed as a percent “bump” up from the normal level. For example, if dry year demand was 105 percent of normal, this would be a 5% “bump”. As the methodology to estimate the Single-Dry and Multiple-Dry “bumps” was developed, several issues needed to be decided, as follows:

1. The methodology used existing data from MWDOC records for each agency, to allow the estimates to reflect the characteristics and differences of demands relative to the makeup of each retail entity. The overall MWDOC estimate was developed from a weighted sum of all of OC’s agencies.
2. Total potable demands, including agricultural demands, were used to derive the “bumps” because Orange County agencies have opted to have water that is used for agricultural uses be considered as full service demands. Non-potable demands are included; these demands will be met with non-potable supplies.
3. The methodology focused on per-capita usage (in units of AF/capita) because this removes the influence of growth from the analysis. Overall population growth in Orange County has been about 1% per year over the past two decades, creating about a 20% increase in demand over two decades. Some of the agencies have had even higher growth.
4. The period that was used for the analysis was limited to FY 1992-93 thru FY 2008-09 because fiscal years 1991-92 and 2009-10 were years of extraordinary conservation-- pricing disincentives for using over the allocated amounts were implemented in order to curtail demands-- and so these years were not considered. The Orange County total per-capita water usage in the period FY 1992-93 thru FY 2008-09 is plotted in Figure 1. Per-capita water use in Orange County has been on a decreasing trend in recent years as shown by the trend line in Figure 1. The downward trend is likely due to water use efficiency efforts, principally the plumbing codes since 1992 that have required low-flush toilets in all new construction and prohibited the sale of high-flush toilets for replacement purposes. Because of this drop in per-capita usage over time, the more recent data is a better predictor of future usage than the earlier data. Therefore, we narrowed the focus to the period FY 2001-02 thru FY 2008-09.
5. **Single-Dry “Bump” Methodology:** Per-capita usage for each participant agency from FY 2001-02 thru FY 2008-09 is shown in Table 1. The Single-Dry Bump for each agency was derived using the highest per-capita usage in the period, divided by average per-capita usage for that period. Because of suspect data for Fountain Valley and Santa Ana, the highest year data was eliminated and the second-highest usage in the period was used (when data was suspect, it was also removed from the average for the agency). The resulting Single-Dry “bumps” are shown in Table 2. The OC-average Single-Dry “bump” came to 6.6%
6. **Multiple-Dry “Bump” Methodology:** DWR guidelines recommend that “multiple” years is three years. There are various methods that can be used to derive demand “bumps” for those three years. The same “bump” can be used for all three years, or different “bumps” can be assumed for each of the three years. A pattern can be selected based on historical demand data or on historical water supply data or on another basis. MWDOC selected a Multiple-Dry Bump as the same as the Single-Dry Bump for each agency. This means having three highest-demand years in a row. This is conservative because it would be extremely unlikely for three driest years to occur in a row. However, it should be noted that future demand in any particular year depends on other factors in addition to rainfall, such as the economic situation, and cloudiness, windiness, etc. The OC-average Multiple-Dry “bump” came to 6.6%.

**Figure 1**  
**Per-Capita Water Use in Orange County (AF/person)**

| FY Ending | OC Actual<br>AF/person | Least Sq<br>AF/person | approx<br>high | approx<br>"bump" |
|-----------|------------------------|-----------------------|----------------|------------------|
| 1993      | 0.223327               | 0.233                 | 0.250          | 7%               |
| 1994      | 0.223528               | 0.232                 |                |                  |
| 1995      | 0.221986               | 0.230                 |                |                  |
| 1996      | 0.235919               | 0.229                 |                |                  |
| 1997      | 0.244071               | 0.228                 |                |                  |
| 1998      | 0.217014               | 0.226                 |                |                  |
| 1999      | 0.228797               | 0.225                 |                |                  |
| 2000      | 0.242408               | 0.224                 |                |                  |
| 2001      | 0.223537               | 0.222                 |                |                  |
| 2002      | 0.228534               | 0.221                 |                |                  |
| 2003      | 0.214602               | 0.219                 |                |                  |
| 2004      | 0.222155               | 0.218                 |                |                  |
| 2005      | 0.204941               | 0.217                 |                |                  |
| 2006      | 0.207720               | 0.215                 |                |                  |
| 2007      | 0.223599               | 0.214                 |                |                  |
| 2008      | 0.211873               | 0.212                 |                |                  |
| 2009      | 0.202396               | 0.211                 | 0.225          | 7%               |

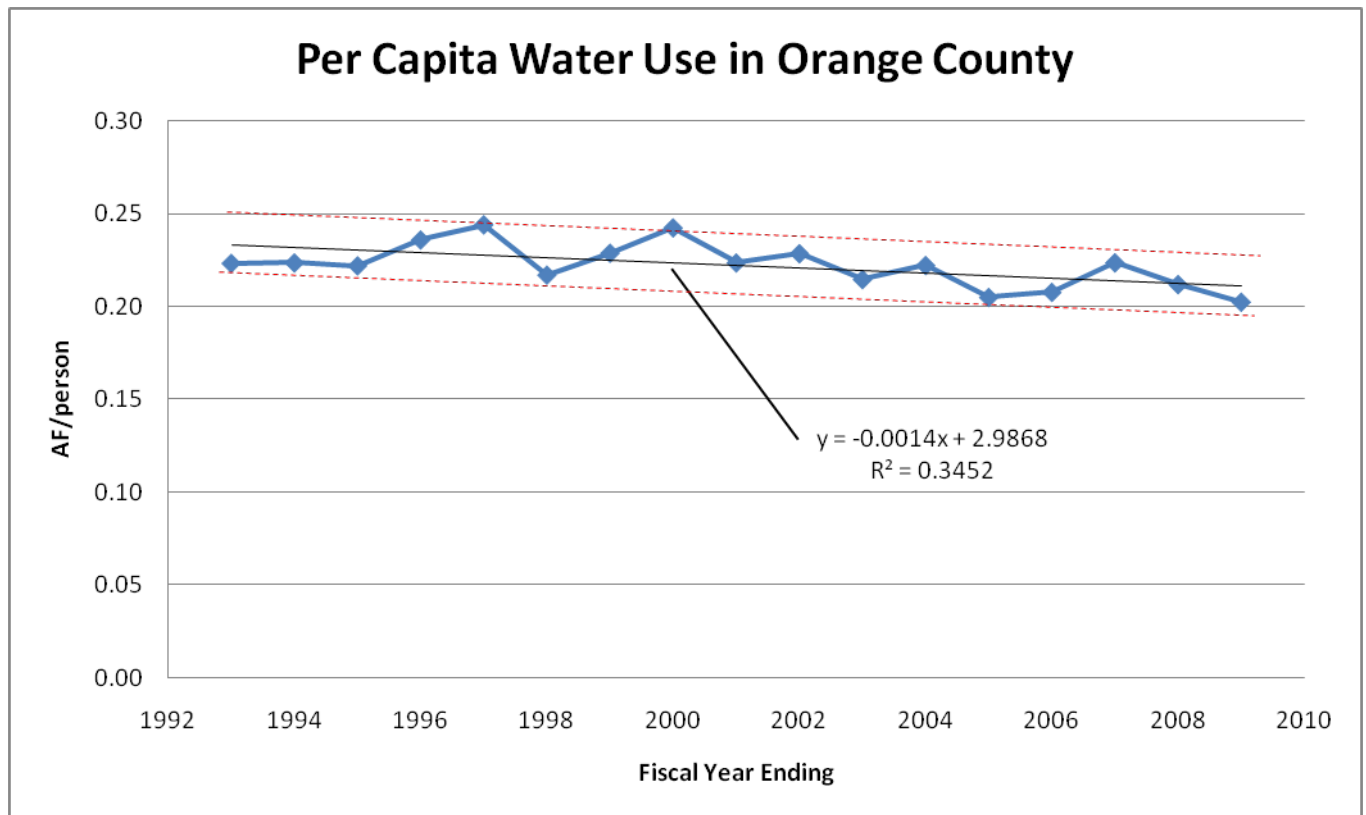




**Table 1. Per-Capita Retail Water Usage by Retail Water Agency [1] [2]**

| Fiscal Year -> | 2001-02                                          | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|----------------|--------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|
|                | <b>Per Capita Retail Water Usage (AF/person)</b> |         |         |         |         |         |         |         |
| Newport Beach  | 0.27970                                          | 0.27706 | 0.28054 | 0.27020 | 0.26973 | 0.28798 | 0.27601 | 0.26185 |

[1] Retail water usage (includes recycled water and Agricultural usage) divided by population.

[2] Population is for Jan. 1 of each fiscal year ending. Source: Center for Demographic Research, CSU Fullerton.

**Table 2**

**Demand Increase "Bump" Factors for Single Dry Years and Multiple Dry Years**  
for OC Water Agencies participating in MWDOC's 2010 UWMP group effort

|               | Single | Multiple |                                           |
|---------------|--------|----------|-------------------------------------------|
| Newport Beach | 4.6%   | 4.6%     |                                           |
| OC Average    | 6.6%   | 6.6%     | weighted average of all OC water agencies |

## Appendix D

### CUWCC BMP Retail Coverage Report 2009-2010



## CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

### Foundation Best Management Practices for Urban Water Efficiency

Agency: **City of Newport Beach** District Name: **City of Newport Beach** CUWCC Unit #: **6988**  
Retail  
Primary Contact: **Shane Burckle** Telephone: **949-644-3214** Email: **sburckle@newportbeachca.gov**

Compliance Option Chosen By Reporting Agency:  
(Traditional, Flex Track or GPCD)  
GPCD if used:

|                      |     |
|----------------------|-----|
| GPCD in 2010         | 216 |
| GPCD Target for 2018 | 207 |

| Year | Report | Target | Highest Acceptable Bound |      |        |      |
|------|--------|--------|--------------------------|------|--------|------|
|      |        |        | % Base                   | GPCD | % Base | GPCD |
| 2010 | 1      | 96.4%  | 243                      | 100% | 252    |      |
| 2012 | 2      | 92.8%  | 234                      | 96%  | 243    |      |
| 2014 | 3      | 89.2%  | 225                      | 93%  | 234    |      |
| 2016 | 4      | 85.6%  | 216                      | 89%  | 225    |      |
| 2018 | 5      | 82.0%  | 207                      | 82%  | 207    |      |

Not on Track if 2010 GPCD is  $\geq$  than target

GPCD in 2010 **216**

Highest

Acceptable GPCD **252**

for 2010

**On Track**

Agency: **City of Newport Beach**  
Retail

District Name: **City of Newport Beach**

CUWCC Unit #: **6988**



## CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

### Foundation Best Management Practices for Urban Water Efficiency

#### Foundational BMPs

##### BMP 1.1 Operational Practices

|                                                                                  |                               | 2009                                                   | 2010                                                                                                                                    | Conservation Coordinator provided with necessary resources to implement BMPs?             |
|----------------------------------------------------------------------------------|-------------------------------|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| 1. Conservation Coordinator provided with necessary resources to implement BMPs? | Name                          | Shane Burckle                                          | Shane Burckle                                                                                                                           |                                                                                           |
|                                                                                  | Title                         | Water Conservation Coordinator                         | Water Conservation Coordinator                                                                                                          |                                                                                           |
|                                                                                  | Email                         |                                                        | sburckle@newpo                                                                                                                          |                                                                                           |
|                                                                                  |                               | On Track                                               | On Track                                                                                                                                |                                                                                           |
| 2. Water waste prevention documentation                                          |                               |                                                        |                                                                                                                                         | On Track if any one of the 6 ordinance actions done, plus documentation or links provided |
|                                                                                  | Descriptive File              | .PDF attachments of municipal                          |                                                                                                                                         |                                                                                           |
|                                                                                  | Descriptive File 2010         |                                                        | .PDF attachments of municipal codes and supporting documents have been sent to as a separate files included in the reporting submittal. |                                                                                           |
|                                                                                  | URL                           | The City of Newport Beach has amended and adopted NBMC |                                                                                                                                         |                                                                                           |
|                                                                                  | URL 2010                      |                                                        | www.newportbeachca.gov, www.watersmartnewport.org, www.cleanwaternewport.com                                                            |                                                                                           |
|                                                                                  | Describe Ordinance Terms      | The City of Newport Beach has amended and adopted NBMC |                                                                                                                                         |                                                                                           |
|                                                                                  | Describe Ordinance Terms 2010 |                                                        | The City of Newport Beach has amended and adopted NBMC 14.16 Water Conservation and Supply Level Regulations in 2009. Included in       |                                                                                           |
|                                                                                  |                               | On Track                                               | On Track                                                                                                                                |                                                                                           |

Agency: **City of Newport Beach**  
Retail

District Name: **City of Newport Beach**

CUWCC Unit #: **6988**



## CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

### Foundation Best Management Practices for Urban Water Efficiency

#### BMP 1.2 Water Loss Control

| 2009                                                                                                                                                                                              |                   |                       |                |                 |                       |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------|----------------|-----------------|-----------------------|-------------|
| Compile Standard Water Audit using AWWA Software?                                                                                                                                                 | Yes               |                       |                |                 | On Track              |             |
| AWWA file provided to CUWCC?                                                                                                                                                                      | 1                 |                       |                |                 | On Track              |             |
| AWWA Water Audit Validity Score?                                                                                                                                                                  | 82                |                       |                |                 |                       |             |
| Completed Training in AWWA Audit Method?                                                                                                                                                          | no                |                       |                |                 |                       |             |
| Completed Training in Component Analysis Process?                                                                                                                                                 | yes               |                       |                |                 |                       |             |
| Complete Component Analysis?                                                                                                                                                                      | yes               |                       |                |                 |                       |             |
| Repaired all leaks and breaks to the extent cost effective?                                                                                                                                       | yes               |                       |                |                 | On Track              |             |
| Locate and repair unreported leaks to the extent cost effective.                                                                                                                                  | Yes               |                       |                |                 | On Track              |             |
| Maintain a record-keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. |                   |                       |                |                 |                       |             |
| Provided 7 types of Water Loss Control Info                                                                                                                                                       |                   |                       |                |                 |                       |             |
| Leaks Repaired                                                                                                                                                                                    | Value Real Losses | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost of Interventions | Water Saved |
| 54                                                                                                                                                                                                | \$ -              | \$ 453,749            | 0              | 0               | \$ -                  | 0           |

On Track if Yes, Not on Track if No

On Track if Yes, Not on Track if No  
Info only until 2012

Info only until 2012

Info only until 2012  
On Track if Yes, Not on Track if No

On Track if Yes, Not on Track if No

Info only until 2012

Info only until 2012

| 2010                                                                                                                                                                                              |                          |                       |                |                 |                       |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------------|----------------|-----------------|-----------------------|-------------|
| Compile Standard Water Audit using AWWA Software?                                                                                                                                                 | Yes                      |                       |                |                 | On Track              |             |
| AWWA file provided to CUWCC?                                                                                                                                                                      | AWWA WLCC WaterAudit_New |                       |                |                 | On Track              |             |
| AWWA Water Audit Validity Score?                                                                                                                                                                  | 82                       |                       |                |                 |                       |             |
| Completed Training in AWWA Audit Method?                                                                                                                                                          | no                       |                       |                |                 |                       |             |
| Completed Training in Component Analysis Process?                                                                                                                                                 | Yes                      |                       |                |                 |                       |             |
| Complete Component Analysis?                                                                                                                                                                      | Yes                      |                       |                |                 |                       |             |
| Repaired all leaks and breaks to the extent cost effective?                                                                                                                                       | Yes                      |                       |                |                 | On Track              |             |
| Locate and repair unreported leaks to the extent cost effective.                                                                                                                                  | Yes                      |                       |                |                 | On Track              |             |
| Maintain a record-keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. |                          |                       |                |                 |                       |             |
| Provided 7 types of Water Loss Control Info                                                                                                                                                       |                          |                       |                |                 |                       |             |
| Leaks Repaired                                                                                                                                                                                    | Value Real Losses        | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost of Interventions | Water Saved |
| 39                                                                                                                                                                                                | \$ -                     | \$ 389,485            | 0              | Off             | \$ -                  | 0           |

On Track if Yes, Not on Track if No

On Track if Yes, Not on Track if No  
Info only until 2012

Info only until 2012

Info only until 2012  
On Track if Yes, Not on Track if No

On Track if Yes, Not on Track if No

Info only until 2012

Info only until 2012

Agency: **City of Newport Beach**  
Retail

District Name: **City of Newport Beach**

CUWCC Unit #: **6988**



## CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

### Foundation Best Management Practices for Urban Water Efficiency

#### 1.3 METERING WITH COMMODITY RATES FOR ALL NEW CONNECTIONS AND RETROFIT OF EXISTING CONNECTIONS

Exemption or 'At least as Effective As' accepted by CUWCC

Numbered Unmetered Accounts

Metered Accounts billed by volume of use

Number of CII accounts with Mixed Use meters

Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters?

Feasibility Study provided to CUWCC?

Completed a written plan, policy or program to test, repair and replace meters

| 2009 | 2010 |
|------|------|
| 0    | 0    |
| Yes  | Yes  |
| 0    | 0    |
| No   | No   |
| No   | No   |
| Yes  | Yes  |

If signed MOU prior to 31 Dec 1997, On Track if all connections metered; If signed after 31 Dec 1997, complete meter installations by 1 July 2012 or within 6 yrs of signing and 20% biannual reduction of unmetered connections.

On Track if no unmetered accounts

Volumetric billing required for all connections on same schedule as metering

Info only

Info only, due 2011

Info only, due 2011

On Track if Yes, Not on Track if No





# CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

## Foundation Best Management Practices for Urban Water Efficiency

Agency: **City of Newport Beach** District Name: **City of Newport Beach** CUWCC Unit #: **6988**  
 Retail Coverage Report Date: **May 19, 2011**  
 Primary Contact: **Shane Burckle** Email: **sburckle@newportbeachca.gov**

### 1.4 Retail Conservation Pricing

#### Metered Water Rate Structure

Date 2009 data received **June 1, 2011**

Date 2010 data received **June 1, 2011**

On Track if: Increasing Block, Uniform, Allocation, Standby Service; Not on Track if otherwise

| Customer Class | 2009 Rate Type | Conserving Rate? | Customer Class | 2010 Rate Type | Conserving Rate? |
|----------------|----------------|------------------|----------------|----------------|------------------|
| Single-Family  | Uniform        | Yes              | Single-Family  | Uniform        | Yes              |
| Multi-Family   | Uniform        | Yes              | Multi-Family   | Uniform        | Yes              |
| Commercial     | Uniform        | Yes              | Commercial     | Uniform        | Yes              |
| On Track       |                |                  | On Track       |                |                  |

Year Volumetric Rates began for Agencies with some Unmetered Accounts

Info only

Agencies with Partially Metered Service Areas: If signed MOU prior to 31 Dec. 1997, implementation starts no later than 1 July 2010. If signed MOU after 31 Dec. 1997, implementation starts no later than 1 July 2013, or within seven years of signing the MOU,

Agency: **City of Newport Beach**  
Retail

District Name: **City of Newport Beach**

CUWCC Unit #: **6988**  
Coverage Report Date: **May 19, 2011**



## CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

### Foundation Best Management Practices for Urban Water Efficiency

Adequacy of Volumetric Rates) for Agencies with No Unmetered Accounts

| Customer Class                       | 2009 Rate Type | 2009 Volumetric Revenues \$1000s | 2010 Rate Type | 2010 Volumetric Revenues \$1000s |
|--------------------------------------|----------------|----------------------------------|----------------|----------------------------------|
| Single-Family                        | Uniform        | \$ 7,013                         | Uniform        | \$ 6,445                         |
| Multi-Family                         | Uniform        | \$ 2,202                         | Uniform        | \$ 2,034                         |
| Commercial                           | Uniform        | \$ 2,884                         | Uniform        | \$ 2,639                         |
|                                      |                | \$ -                             |                |                                  |
|                                      |                | \$ -                             |                |                                  |
|                                      |                | \$ -                             |                |                                  |
|                                      |                | \$ -                             |                |                                  |
| Total Revenue Commodity Charges (V): |                | \$ 12,099                        |                | \$ 11,118                        |
| Total Revenue Fixed Charges (M):     |                | \$ 2,153                         |                | \$ 3,780                         |
| Calculate: V / (V + M):              |                | 85%                              |                | 75%                              |
|                                      |                | <b>On Track</b>                  |                | <b>On Track</b>                  |

Agency Choices for rates:

A) Agencies signing MOU prior to 13 June2007, implementation starts 1 July2007: On Track if  $(V / (V + M)) \geq 70\% \times .8 = 56\%$  for 2009 and  $70\% \times 0.90 = 63\%$  for 2010; Not on track if  $(V / (V + M)) < 70\%$ ;

B) Use Canadian model. Agencies signing MOU after 13June2007, implementation starts July 1 of year following signing.

Canadian Water & Wastewater Rate Design Model Used and Provided to CUWCC  
If Canadian Model is used, was 1 year or 3 year period applied?

**No**  
**On Track**

**No**  
**On Track**

#### Wastewater Rates

Does Agency Provide Sewer Service?

**2009**  
**Yes**

If 'No', then wastewater rate info not required.

**2010**  
**Yes**

| Customer Class  | 2009 Rate Type | Conserving Rate? | Customer Class  | 2010 Rate Type | Conserving Rate? |
|-----------------|----------------|------------------|-----------------|----------------|------------------|
| Single-Family   | Uniform        | Yes              | Single-Family   | Uniform        | Yes              |
| Multi-Family    | Uniform        | Yes              | Multi-Family    | Uniform        | Yes              |
| Commercial      | Uniform        | Yes              | Commercial      | Uniform        | Yes              |
| <b>On Track</b> |                |                  | <b>On Track</b> |                |                  |

On Track if: 'Increasing Block', 'Uniform', 'based on long term marginal cost' or 'next unit of capacity'



## CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

### Foundation Best Management Practices for Urban Water Efficiency

#### BMP 2. EDUCATION PROGRAMS

##### BMP 2.1 Public Outreach Actions Implemented and Reported to CUWCC

1) Contacts with the public (minimum = 4 times per year)

2) Water supplier contacts with media (minimum = 4 times per year, i.e., at least quarterly).

3) An actively maintained website that is updated regularly (minimum = 4 times per year, i.e., at least quarterly).

4) Description of materials used to meet minimum requirement.

5) Annual budget for public outreach program.

6) Description of all other outreach programs

| 2009                                                                                                                                                                                                                                                                               | 2010                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 66                                                                                                                                                                                                                                                                                 | 650,000                                                                                                                                                                                                                                                                                                        |
| 16                                                                                                                                                                                                                                                                                 | 4                                                                                                                                                                                                                                                                                                              |
| Yes                                                                                                                                                                                                                                                                                | yes                                                                                                                                                                                                                                                                                                            |
| Website<br>Flyers and/or brochures, bill stuffers, messages<br>Landscape water conservation media campaigns<br>General water conservation information<br>Newsletter articles on conservation<br>Articles or stories resulting from outreach<br>News releases<br>Newspaper contacts | Newsletter articles on conservation<br>Flyers and/or brochures, bill stuffers, messages<br>Landscape water conservation media campaigns<br>General water conservation information<br>Newsletter articles on conservation<br>Articles or stories resulting from outreach<br>News releases<br>Newspaper contacts |
| \$ 10,870,000                                                                                                                                                                                                                                                                      | \$ 1,000,000                                                                                                                                                                                                                                                                                                   |
| Description is too large for text area. Data will be stored in the BMP Reporting database when online.                                                                                                                                                                             | Description is too large for text area. Data will be stored in the BMP Reporting database when online.                                                                                                                                                                                                         |
| On Track for 6 Actions                                                                                                                                                                                                                                                             | On Track for 6 Actions                                                                                                                                                                                                                                                                                         |

All 6 action types implemented and reported to CUWCC to be 'On Track')



## CUWCC BMP RETAIL COVERAGE REPORT 2009-2010

### Foundation Best Management Practices for Urban Water Efficiency

#### 2.2 School Education Programs Implemented and Reported to CUWCC

|                                                                                           | 2009                                                                                                                                                                                            | 2010                                                                                                   |                                                                        |
|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Does a wholesale agency implement School Education Programs for this utility's benefit?   | Yes                                                                                                                                                                                             | Yes                                                                                                    |                                                                        |
| Name of Wholesale Supplier?                                                               | City of Newport Beach works with MWDOC and SARWQCB to reach out to schools and                                                                                                                  | City of Newport Beach works with MWDOC and SARWQCB to reach                                            |                                                                        |
| 1) Curriculum materials developed and/or provided by agency                               | City of Newport Beach works with MWDOC and SARWQCB to reach out to schools and teachers, e.g. Discovery Science Center, project WET. Water science camp etc.activity books, question and answer | Project WET                                                                                            | Yes/ No                                                                |
| 2) Materials meet state education framework requirements and are grade-level appropriate? | yes                                                                                                                                                                                             | No                                                                                                     | All 5 actions types implemented and reported to CUWCC to be 'On Track' |
| 3) Materials Distributed to K-6?                                                          | yes                                                                                                                                                                                             | No                                                                                                     |                                                                        |
| Describe K-6 Materials                                                                    | Ricky the Raindrop - water series; the forms of water; The water Cycle; Underground Water; How We Get Our water; California's Water. Love Blue Live Green                                       |                                                                                                        | 0<br>Describe materials to meet minimum requirements                   |
| Materials distributed to 7-12 students?                                                   | yes                                                                                                                                                                                             | No                                                                                                     | Info Only                                                              |
| 4) Annual budget for school education program.                                            | \$ 6,000                                                                                                                                                                                        | \$ -                                                                                                   |                                                                        |
| 5) Description of all other water supplier education programs                             | Description is too large for text area. Data will be stored in the BMP Reporting database when online.                                                                                          | Description is too large for text area. Data will be stored in the BMP Reporting database when online. |                                                                        |
|                                                                                           | See Wholesale Report<br>0<br>On Track                                                                                                                                                           | See Wholesale Report<br>1<br>On Track                                                                  |                                                                        |

## Appendix E

Chapter 14.16 Water Conservation and Supply Level Regulations, Chapter  
14.17 Water Efficient Landscaping Regulations, Chapter 14.36 Water  
Quality

## Chapter 14.16 Water Conservation and Supply Level Regulations



## ORDINANCE NO. 2009-24

DATE:

6-8-11

**AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF NEWPORT  
BEACH, CALIFORNIA AMENDING CHAPTER 14.16 OF THE NEWPORT  
BEACH MUNICIPAL CODE PERTAINING TO WATER CONSERVATION  
AND SUPPLY LEVEL REGULATIONS**

The City Council of the City of Newport Beach, California, HEREBY ORDAINS as follows:

**SECTION 1:** Chapter 14.16 of the Newport Beach Municipal code is hereby amended to read as follows:

**Chapter 14.16**

**WATER CONSERVATION AND SUPPLY LEVEL REGULATIONS**

- 14.16.010 Findings and Purpose.**
- 14.16.020 Definitions.**
- 14.16.030 Applicability.**
- 14.16.040 Permanent Mandatory Water-Conservation Requirements.**
- 14.16.050 Procedure for Declaration of Water Supply Shortage; Continued Monitoring of Conditions.**
- 14.16.060 Level One Mandatory Water-Conservation Requirements.**
- 14.16.070 Level Two Mandatory Water-Conservation Requirements.**
- 14.16.080 Level Three Mandatory Water-Conservation Requirements.**
- 14.16.090 Level Four Mandatory Water-Conservation Requirements.**
- 14.16.100 Exemptions.**
- 14.16.110 Relief from Compliance.**
- 14.16.120 Enforcement.**

**Section 14.16.010 Findings and Purpose.**

A. The purpose of this chapter is to establish a Water Conservation and Supply Shortage Program that, to the greatest extent possible, will reduce water consumption within the City of Newport Beach, enable effective water supply planning, assure reasonable and beneficial use of water, prevent waste of water, maximize the efficient use of water and minimize the effect and hardship of water shortage.

B. The Water Conservation and Supply Shortage Program created by this chapter establishes permanent water-conservation requirements intended to alter behavior related to water use efficiency for non-shortage conditions and further establishes four levels of water supply shortage response actions to be implemented during times of declared water shortage.

C. The City Council finds as follows:

1. A reliable minimum supply of water is essential to the public health, safety and welfare of the people and economy of the Southern California Region.
2. Southern California is a semi-arid region and is largely dependent upon imported water supplies. A growing population, climate change, environmental concerns and other factors in other parts of the State and western United States make the region highly susceptible to water supply reliability issues.
3. Careful water management that includes active water conservation measures, not only in times of drought but at all times, is essential to ensure a reliable minimum supply of water to meet current and future supply needs.

4. Article X, section 2, of the California Constitution declares that the general welfare requires that water resources be put to beneficial use, that waste or unreasonable use or unreasonable method of use of water is prevented and that conservation of water be fully exercised with a view to the reasonable and beneficial use thereof.

5. Article XI, section 7 of the California Constitution declares that a city or county may make and enforce within its limits all local, police, sanitary and other ordinances and regulations not in conflict with general laws.

6. California Water Code section 375 authorizes a water supplier to adopt and enforce a comprehensive water conservation program to reduce water consumption and conserve supplies.

7. The adoption and enforcement of the Water Conservation and Supply Shortage Program is necessary to manage the City's water supply in the short and long term and to avoid or minimize the effects of a supply shortage within the City's service area. Such a program is essential to ensure a reliable and sustainable minimum supply of water for public health, safety and welfare.

8. Recycled water is supplied in various areas throughout the City to conserve potable water. Recycled water, like potable water, must be used efficiently and is therefore included in this Program.

#### **Section 14.16.020 Definitions.**

In this chapter, the following words and phrases shall have the following meanings:

"Base amount" means a base amount of water usage per billing period to be determined for each customer. For any particular billing period, the base amount shall be as indicated on the customer's municipal services statement for the prior billing cycle. For customers occupying premises for which the City's water billing history is more than three years, the base amount shall be the three-year moving average, which is calculated by the City for each water customer. For customers occupying premises for which the City's water billing history is less than three years, the base amount shall be the estimate of the water usage per billing period of similar premises and users. Notwithstanding the foregoing, in calculating the base amount, the base amount shall exclude any billing periods during which water consumption restrictions were in effect.

"Billing period" means the period of time for which the City calculates monthly water service rates for a particular customer under section 14.12.020 of this code.

"City" shall mean the City of Newport Beach.

"City Council" shall mean the City Council of the City of Newport Beach.

"Commercial kitchen" means a facility containing a kitchen in which food is prepared for sale, such as a restaurant, cafe, hotel, catering establishment, or other food preparation establishment.

"Customer" shall mean any person using or receiving water service from the City. The term "customer" shall not include a person receiving water service within the City from the Irvine Ranch Water District or from the Mesa Consolidated Water District.

"Department of Public Health" shall mean the Orange County Department of Health.

"Excessive flow or runoff" shall mean frequent and/or large amounts of runoff from irrigation and/or other outdoor water use.

"Fire Marshall" shall mean the City of Newport Beach's Fire Marshall or his or her designee.

"Fuel modification zone" shall mean combustible native or ornamental vegetation that has been modified and partially or totally replaced with drought tolerant, fire retardant plants and maintained per Fire Code guidelines.

"Implementation Plan" shall mean the plan developed by the Utilities Director that provides the resources (staffing and equipment) required to ensure the fair and timely execution of these requirements, as well as a detailed execution strategy.

"Irrigate" means any exterior application of water, other than for firefighting purposes, including but not limited to the watering of any vegetation whether it be natural or planted.

"Landscape irrigation system" means an irrigation system with pipes, hoses, spray heads, or sprinkling devices that are operated by and/or through an automated system.

"MET" shall mean the Metropolitan Water District of Southern California.

"Person" shall have the meaning ascribed to it by section 1.08.120 of this code.

"Potable water" means water that is suitable for drinking and excludes recycled water from any source.

"Premises" means a parcel of land, or portion of a parcel, including any improvements located there, that are served by a City water meter.

"Recirculating" means the reuse of existing water, by means of capturing/containing water used, then circulating back to point of origin.

"Recycled water" means the reclamation and reuse of non-potable water and/or wastewater for beneficial use, such as irrigation.

"Safety/Sanitary hazards" means the condition that may cause or threaten to cause injury to any person or persons.

"Single pass cooling system" means equipment where water is circulated only once to cool equipment before being disposed.

"Utilities Director" shall mean the Director of the City of Newport Beach's Utilities Department or his or her designee.

"Water" shall mean potable water and recycled water.

"Water-conserving kitchen spray valve" means a dishwashing spray valve that uses 1.6 gallons of water or less per minute of use.

"Water conservation plan" means a plan submitted by a customer for the approval of the Utilities Director, in conjunction with a request for an exemption or partial exemption, that proposes the maximum feasible reduction in consumption.

"Water consumption restrictions" shall mean those provisions in this chapter that require customers to reduce the amount of water consumed during a water supply shortage in relation to the base amount.

"Water supply shortage" means the effective period of time during which the City Council, by resolution adopted under section 14.16.050, has declared the existence of a water supply shortage or threatened

shortage. The City Council, depending on the severity of conditions, may declare a Level One, Level Two, Level Three, or Level Four Water Supply Shortage.

**Section 14.16.030 Applicability.**

- A. The provisions of this chapter shall apply to all persons using water in the City.
- B. For the purposes of this chapter, the use of water by a tenant, employee, agent, contractor, representative or person acting on behalf of a customer, may, at the City's election, be imputed to the customer.

**Section 14.16.040 Permanent Mandatory Water-Conservation Requirements.**

The following prohibitions and mandatory water-conservation requirements are effective at all times, including during a Water Supply Shortage. Violations of this section will be considered waste and an unreasonable use of water.

- A. No customer shall use potable water to irrigate any lawn and/or ornamental landscape area using a landscape irrigation system or a watering device that is not continuously attended unless such irrigation is limited to no more than fifteen (15) minutes watering per day per station.

- 1. This restriction does not apply to the following unless the City has determined that recycled water is available and may be lawfully applied to the use.

- a) Landscape irrigation systems that exclusively use very low-flow drip type irrigation systems in which no emitter produces more than two (2) gallons of water per hour or weather based controllers or stream rotor sprinklers that meet a 70 percent efficiency standard.

- B. No person shall use water to irrigate any lawn and/or ornamental landscape area in a manner that causes or allows excessive flow or runoff onto an adjoining sidewalk, driveway, street, alley, gutter or ditch.

- C. No person shall use water to wash down hard or paved surfaces, including, but not limited to, sidewalks, walkways, driveways, parking areas, tennis courts, patios or alleys, except when necessary to alleviate safety or sanitary hazards, and then only by use of a hand-held bucket or similar container, a hand-held hose equipped with a positive self-closing water shut-off device, or a low-volume, high-pressure cleaning machine (e.g., "water broom") equipped to recycle any water used.

- D. No person shall permit excessive use, loss or escape of water through breaks, leaks or other malfunctions in the person's plumbing or distribution system for any period of time after such escape of water should have reasonably been discovered and corrected and in no event more than seven (7) days after receiving notice of the condition from the City.

- E. No customer shall use potable water to irrigate lawns, groundcover, shrubbery or other ornamental landscape material during a rainfall event.

- F. By July 1, 2012, all landscape irrigation systems connected to dedicated landscape meters shall include rain sensors that automatically shut off such systems during periods of rain or include evapotranspiration systems that schedule irrigation based on climatic conditions.

- G. No customer shall operate a water fountain or other decorative water feature that does not use a recirculating water system.

H. No customer shall use water to clean a vehicle, including but not limited to any automobile, truck, van, bus, motorcycle, boat or trailer, whether motorized or not, except by use of a hand-held bucket or similar container or a hand-held hose equipped with a positive self-closing water shut-off nozzle or device.

1. This subsection does not apply to any commercial car washing facility.

I. Effective January 1, 2010, all new commercial conveyor car wash systems in commercial car washing facilities shall be operational recirculating water systems.

J. By January 1, 2013, all commercial conveyor car wash systems in commercial car washing facilities shall be operational recirculating water systems, or the customer must have secured an exemption from this requirement pursuant to section 14.16.100.

K. Customers operating eating or drinking establishments, including but not limited to restaurants, hotels, cafes, cafeterias, bars, or other public places where food or drinks are sold, served, or offered for sale, shall not provide drinking water to any person unless expressly requested by the person.

L. Customers operating hotel, motel, and other commercial lodging establishments shall provide persons the option of not having towels and linen laundered daily. Commercial lodging establishments must prominently display notice of this option.

M. No customer shall install a new single pass cooling system in a building or premises requesting new water service. This provision shall not prevent the replacement or repair of single pass cooling systems that were installed prior to December 31, 2009.

N. Effective January 1, 2010, all new washing machines installed in commercial and/or coin-operated laundries shall be ENERGY STAR® and CEE Tier III qualified. By January 1, 2014, all washing machines installed in commercial and/or coin-operated laundries shall be ENERGY STAR® and CEE Tier III qualified.

O. No customer shall use water from any fire hydrant for any purpose other than fire suppression or emergency aid without first: 1) Requesting and posting the appropriate fees at the City and, 2) Obtaining a hydrant meter to record all water consumption for a specified project. Absent a meter, water theft and meter tampering fees will be applied as appropriate.

P. Construction Site Requirements. The requirements of this subsection apply to persons engaged in construction activities. A permittee's refusal or failure to comply with these requirements shall constitute grounds for revocation of a construction or grading permit. In addition, the City may withhold occupancy and inspections until such time as the permit holder has complied.

1. No person shall use potable water for soil compaction or dust control in a construction site where there is an available and feasible source of recycled water or non-potable water approved by the Department of Public Health and appropriate for such use.

2. No person shall operate a hose within a construction site that is not equipped with an automatic shut-off nozzle, provided that such devices are available for the size and type of hose in use.

Q. Commercial Kitchen Requirements. No customer may operate a commercial kitchen that does not comply with the following requirements.

1. Water-Conserving Pre-Rinse Kitchen Spray Valves. New or remodeled commercial kitchens shall be equipped with water-conserving kitchen spray valves. By January 1, 2010, all

commercial kitchens shall either remove all existing kitchen spray valves or retrofit kitchen spray valves with water-conserving kitchen spray valves.

2. **Best-Available Water-Conserving Technology.** New or remodeled commercial kitchens shall ensure that all water-using equipment in new or remodeled commercial kitchens uses the best-available, water-conserving technology.

3. No customer operating a commercial kitchen shall defrost food or allow food to be defrosted with running water.

4. Scoop sinks shall be set at minimum water flow at all times of use and shut off during non-working hours.

5. When hosing or washing kitchen or garbage areas or other areas for sanitary reasons as required by the Department of Health, hoses shall be equipped with positive self-closing nozzles.

#### **Section 14.16.050 Procedure for Declaration of Water Supply Shortage; Continued Monitoring of Conditions.**

A. From time to time, the City Council may declare by resolution the existence of a Level One, a Level Two, a Level Three, or a Level Four water supply shortage. In so doing, the Council shall determine that a water supply shortage or threatened shortage exists, due to drought or other water supply conditions, and that it is necessary to impose the mandatory conservation requirements applicable to the particular level of water supply shortage. It will be necessary to make more efficient use of water and appropriately respond to conditions created by the water supply shortage. Prior to adopting a resolution declaring the existence of a water supply shortage, the City Council shall enact a resolution indicating its intention to do so, the conditions necessitating the declaration, the nature of the mandatory conservation restrictions proposed to be imposed, including the specifics of any proposed water consumption restrictions, and the day, hour and place when and where persons may appear before the City Council and be heard on whether resolution declaring the water supply shortage should be enacted. The resolution of intention shall direct the City Clerk to publish said resolution at least once, within fifteen days of the passage thereof, in a newspaper of general circulation in the City. Said notice shall be published at least ten days prior to the date of hearing. Within ten (10) days of the adoption of a resolution declaring a water supply shortage, the City Clerk shall cause the resolution to be published or posted in the manner required by California Water Code section 376.

B. The mandatory conservation requirements that become effective following the adoption of a resolution declaring the existence of a particular level of water supply shortage shall remain in full force and effect until the resolution is repealed or until new mandatory conservation requirements become effective following the adoption of a subsequent resolution declaring the existence of a water supply shortage.

C. During the existence of a water supply shortage, the Utilities Director shall provide periodic reports to the City Council regarding compliance with the mandatory conservation requirements of the level of water supply shortage, current and anticipated allocations of water from MET, and any change in circumstances that could warrant a position of more stringent measures or relaxation of measures then in effect.

#### **Section 14.16.060 Level One Mandatory Water-Conservation Requirements.**

On the tenth day after a resolution declaring the existence of a Level One water supply shortage becomes effective, the following mandatory water-conservation requirements shall take effect.



A. No customer shall use potable water to irrigate any lawn, landscape or other vegetated area except on the scheduled irrigation days established for each customer by the Utilities Director. During a Level One water supply shortage, the schedule established by the Utilities Director shall specify for each customer (a) four (4) irrigation days per week during the months of April, May, June, July, August, September, and October and (b) two (2) irrigation days per week during the months of November, December, January, February, and March. Prior to the foregoing restriction becoming effective, the Utilities Director shall have notified the customer of the scheduled irrigation days by mail, which may be done by an indication on the customer's municipal services statement. This restriction does not apply to the following unless the City has determined that recycled water is available and may be lawfully applied to the use:

1. Maintenance of vegetation, including trees and shrubs, that is watered using a hand-held bucket or similar container, a hand-held hose equipped with a positive self-closing water shut-off nozzle or device, or a very low-flow drip type irrigation system when no emitter produces more than two (2) gallons of water per hour.
2. Irrigation of food crops (including fruit trees and vegetable gardens).
3. Short periods of irrigation for the exclusive purpose of adjusting or repairing an irrigation system.

B. No customer shall use more water during any billing period than the percentage of the base amount established in the resolution declaring the Level One water supply shortage, which percentage shall be in the range from 100% and 90% of the base amount.

C. No person shall permit excessive use, loss or escape of water through breaks, leaks or other malfunctions in the user's plumbing or distribution system for more than seventy-two (72) hours after receiving notice of the condition from the City.

D. No customer may use potable water to fill or refill an ornamental lake, pond, or fountain, more than once per week, except to the extent needed to sustain aquatic life, provided that such animals were being actively managed within the water feature at the time of the City's initial declaration of a then-continuing water supply shortage.

E. No customer may use potable water to fill or refill by more than one foot a residential swimming pool or outdoor spa more than once a week.

#### **Section 14.16.070 Level Two Mandatory Water-Conservation Requirements.**

On the tenth day after a resolution declaring the existence of a Level Two water supply shortage becomes effective, the following mandatory water-conservation requirements shall take effect.

A. No customer shall use potable water to irrigate any lawn, landscape or other vegetated area between the hours of 9:00 a.m. and 5:00 p.m. Pacific Standard Time on any day, except by use of a hand-held bucket or similar container, a hand-held hose equipped with a positive self-closing water shut-off nozzle or device, or for short periods of irrigation for the exclusive purpose of adjusting or repairing an irrigation system.

B. No customer shall use potable water to irrigate any lawn, landscape or other vegetated area except on the scheduled irrigation days established by City Council resolution. During a Level Two water supply shortage, the schedule established by City Council resolution shall specify for each customer (a) three (3) irrigation days per week during the months of April, May, June, July, August, September, and October and (b) one (1) irrigation day per week during the months of November, December, January, February, and March. Prior to the foregoing restriction becoming effective, the City shall notify the



customer of the scheduled irrigation days by mail, which may be done by an indication on the customer's municipal services statement. This restriction does not apply to the following unless the City has determined that recycled water is available and may be lawfully applied to the use:

1. Maintenance of vegetation, including trees and shrubs, that is watered using a hand-held bucket or similar container, a hand-held hose equipped with a positive self-closing water shut-off nozzle or device, or a very low-flow drip type irrigation system when no emitter produces more than two (2) gallons of water per hour.
2. Irrigation of food crops (including fruit trees and vegetable gardens), provided that such irrigation does not exceed five (5) times per week on a schedule established and posted by the City's Utilities Department.
3. Short periods of irrigation for the exclusive purpose of adjusting or repairing an irrigation system.

C. No customer shall use more water during any billing period than the percentage of the base amount established in the resolution declaring the Level Two water supply shortage, which percentage shall be in the range from 90% and 75% of the base amount.

D. No person shall permit excessive use, loss or escape of water through breaks, leaks or other malfunctions in the user's plumbing or distribution system for more than forty-eight (48) hours after receiving notice of the condition from the City.

E. No customer may use potable water to fill or refill an ornamental lake, pond, or fountain, more than once every other week, except to the extent needed to sustain aquatic life, provided that such animals were being actively managed within the water feature at the time of the City's declaration of the water supply shortage under this chapter.

F. No customer may use potable water to fill or refill by more than one foot a residential swimming pool or outdoor spa more than once every other week.

#### **Section 14.16.080 Level Three Mandatory Water-Conservation Requirements.**

On the tenth day after a resolution declaring the existence of a Level Three water supply shortage becomes effective, the following mandatory water-conservation requirements shall take effect.

A. No customer shall use potable water to irrigate any lawn, landscape or other vegetated area between the hours of 9:00 a.m. and 5:00 p.m. Pacific Standard Time on any day, except by use of a hand-held bucket or similar container, a hand-held hose equipped with a positive self-closing water shut-off nozzle or device, or for short periods of irrigation for the exclusive purpose of adjusting or repairing an irrigation system.

B. No customer shall use potable water to irrigate any lawn, landscape or other vegetated area except on the scheduled irrigation days established by City Council resolution. During a Level Three water supply shortage, the schedule established by City Council resolution shall specify for each customer (a) two (2) irrigation days per week during the months of April, May, June, July, August, September, and October and (b) one (1) irrigation day per week during the months of November, December, January, February, and March. Prior to the foregoing restriction becoming effective, the City shall notify the customer of the scheduled irrigation days by mail, which may be done by an indication on the customer's municipal services statement. This restriction does not apply to the following unless the City has determined that recycled water is available and may be lawfully applied to the use:

1. Maintenance of vegetation, including trees and shrubs, that is watered using a hand-held bucket or similar container, a hand-held hose equipped with a positive self-closing water shut-off nozzle or device, or a very low-flow drip type irrigation system when no emitter produces more than two (2) gallons of water per hour.

2. Irrigation of food crops (including fruit trees and vegetable gardens), provided that such irrigation does not exceed three (3) days per week on a schedule established and posted by the City's Utilities Department.

3. Short periods of irrigation for the exclusive purpose of adjusting or repairing an irrigation system.

C. No customer shall use more water during any billing period than the percentage of the base amount established in the resolution declaring the Level Three water shortage, which percentage shall be in the range from 75% and 60% of the base amount.

D. No person shall permit excessive use, loss or escape of water through breaks, leaks or other malfunctions in the user's plumbing or distribution system for more than twenty-four (24) hours after receiving notice from the City.

E. No customer may use potable water to fill or refill an ornamental lake, pond, or fountain, except to the extent needed to sustain aquatic life, provided that such animals were being actively managed within the water feature at the time of the City's declaration of the water supply shortage under this chapter.

F. No customer may use potable water to fill or refill a residential swimming pool or outdoor spa.

#### **Section 14.16.090 Level Four Mandatory Water-Conservation Requirements.**

On the tenth day after a resolution declaring the existence of a Level Four water supply shortage becomes effective, the following mandatory water-conservation requirements shall take effect.

A. No customer shall use potable water to irrigate any lawn, landscape or other vegetated area. This restriction does not apply to the following categories of use unless the City has determined that recycled water is available and may be lawfully applied to the use:

1. Maintenance of vegetation, including trees and shrubs, that are watered using a hand-held bucket or similar container or a hand-held hose equipped with a positive self-closing water shut-off nozzle or device;

2. Maintenance of existing landscape to the extent necessary for fire protection;

3. Maintenance of existing landscape to the extent necessary for soil erosion control;

4. Maintenance of plant materials identified to be rare or essential to the well being of rare animals;

5. Maintenance of landscape within active public parks and playing fields, day care centers, school grounds, cemeteries, and golf course greens, provided that such irrigation does not exceed two (2) times per week on a schedule established by resolution of the City Council and posted by the Utilities Director.

6. Public works projects and actively irrigated environmental mitigation projects.

7. Food crops (including fruit trees and vegetable gardens), provided that such irrigation does not exceed two (2) times per week on a schedule established and posted by the City's Utilities Department.

B. The City will not (a) provide new potable water service, new temporary meters, or new permanent meters or (b) issue statements of immediate ability to serve or to provide potable water service, except under the following circumstances:

1. A valid, unexpired building permit has been issued for the project; or
2. The project is necessary to protect public health, safety, and welfare; or
3. The applicant provides substantial evidence of an enforceable commitment that, ensures, to the satisfaction of the Utilities Director, the water demands for the project will be offset prior to the provision of a new water meter(s).

This restriction does not preclude the resetting or turn-on of meters to provide continuation of water service or the restoration of service that has been interrupted for a period of one year or less.

C. No customer shall use more water during any billing period than the percentage of the base amount established in the resolution declaring the Level Four water shortage, which percentage shall be less than 60% of the base amount.

D. No person shall permit excessive use, loss or escape of water through breaks, leaks or other malfunctions in the user's plumbing or distribution system for more than twenty-four (24) hours after receiving notice from the City.

E. No customer may use potable water to fill or refill an ornamental lake, pond, or fountain, except to the extent needed to sustain aquatic life, provided that such animals were being actively managed within the water feature at the time of the City's declaration of the water supply shortage under this chapter.

F. No customer may use potable water to fill or refill a residential swimming pool or outdoor spa.

#### **Section 14.16.100 Exemptions.**

A. The provisions of this chapter do not apply to any of the following.

1. Uses of water necessary to protect public health and safety or for essential government services, such as police fire and other similar emergency services.
2. The filling, operation, and maintenance of a swimming pool that is open to the public at rates of charge deemed reasonable by the City Council.
3. The washing of refuse, sanitation and service vehicles owned and operated by a public entity to the extent necessary to insure public health, safety and welfare, provided that recycled water or a recirculating water system will be used where feasible.

B. Any restrictions imposed by this chapter that require the reduction of consumption shall not be applicable to any of the following.

1. Customers who have participated in a fuel load modification program and have received an exemption from the Utilities Director and Fire Marshall. The Utilities Director and Fire Marshal

shall only grant exemptions necessary to mitigate the impacts of participation in the fuel modification zone program, such as the need to irrigate replacement vegetation.

2. Customers that operate hospitals, medical care facilities, nurseries or other businesses whose main stock and trade consists of the sale or cultivation of plants and vegetation, and businesses in which water consumption is an integral part of production or manufacturing, provided that such customers shall first submit a water conservation plan to, and obtain the approval of, the Utilities Director. This exemption does not extend to the use of potable water for the irrigation of landscape areas.

C. The Utilities Director shall approve a water conservation plan only if the plan proposes the maximum feasible reduction in consumption. As a condition of approving the water conservation plan, the Utilities Director may require the use of water conservation devices or practices as he or she deems appropriate to result in the maximum feasible reduction in consumption.

#### **Section 14.16.110 Relief from Compliance.**

A. Intent and Purpose. The City Council recognizes that water consumption can increase or decrease because of factors unrelated to wasteful water use practices. Many customers have installed water-saving devices and adopted water conservation practices that make it difficult to satisfy the water consumption restrictions required by this chapter. This section recognizes that adjustments to the base amount may be necessary to ensure that application of this chapter to any particular customer does not produce unjust or inequitable results. In addition, the section recognizes unique circumstances may result in undue or disproportionate hardship as to a person using water which is different from the impacts to water users generally. As a general rule, the Utilities Director should not grant relief to any person or customer for any reason in the absence of showing that the person or customer has achieved the maximum feasible reduction in water consumption other than in the specific area or areas for which relief is requested.

B. Procedures. A person or customer may file an application for relief from the provisions of this chapter with the Utilities Director. The application shall be submitted in writing to the Utilities Department. The application must be filed within ninety (90) days after the effective date of this chapter or ninety (90) days after implementation of the then-current water supply shortage level, whichever shall occur last. The Utilities Director may require the submission of additional supporting documentation that he or she deems necessary to grant the application for relief. The Utilities Director shall approve or disapprove the application for relief within thirty (30) days after it is filed and deemed complete.

C. Factors to Be Considered.

1. Relief from Water Consumption Restrictions. In determining whether relief should be granted from water consumption restrictions, the Utilities Director shall consider all relevant factors including, but not limited to, the following:

a. Whether compliance with the water-conservation requirements then in effect would result in unemployment or layoff of workers;

b. Whether additional persons are now living or working in the customer's premises that were not living or working in the premises during all or a portion of the billing periods used to calculate the base amount;

c. Whether customer had, during all or a portion of the billing periods used to calculate the base amount, begun using water conservation practices that remain in use and that reduced the customer's water usage by an amount equivalent to the reduction required by the water supply shortage;

- d. Whether any current or anticipated increase in production or manufacturing will require the use of additional water;
  - e. The extent to which irrigation or watering of landscaping has been made necessary by compliance with fuel load modification programs; and
  - f. The extent to which customer needs to use water to mitigate any emergency health or safety hazards.
2. Relief from All Other Requirements. In determining whether relief should be granted from all requirements other than water consumption restrictions, the Utilities Director must find, based on the application and supporting documentation, that:
- a. the relief does not constitute a grant of special privilege inconsistent with the limitations imposed by this chapter on other persons and customers;
  - b. because of special circumstances applicable to the customer or person's property or its use, the strict application of this chapter would have an impact on the person or customer that is disproportionate to the impact on other similarly situated persons or customers;
  - c. the condition or situation of the person or customer's premises for which the relief is sought is not common or general in nature; and
  - d. the person or customer has achieved or will achieve the maximum feasible reduction in water consumption other than in the specific area or areas from which relief is requested
- D. Agreement. The Utilities Director is empowered to enter into an agreement with any person or customer to resolve the application for relief. The agreement shall be memorialized in writing signed by the person or customer. The agreement shall fix the rights of the person or customer and the City. During the effectiveness of the agreement, the person or customer shall have no further right to seek relief pursuant to the provisions of this section.
- E. Final Decision. The Utilities Director shall notify the person or customer of the decision on the application for relief by mailing a notice of the decision to the person or customer by means of, first class, postage prepaid, to the address specified on the application.
- F. Appeal of Final Decision. A person or customer may appeal the decision of the Utilities Director by submitting a written request within (90) days of the date of the Utilities Director's written decision. A written appeal request shall be submitted to the City Manager and include the reasons for the request and signature of the person or customer submitting the request. The City Manager may approve or disapprove the appeal within (30) days from receipt of a request. The decision of the City Manger shall be final.
- G. Willful Misrepresentation. Notwithstanding any other provision of law, no person shall make any willful misrepresentation of a material fact with respect to any application for relief submitted pursuant to this section. Any violation of the provisions of this subsection shall be considered a misdemeanor, punishable as otherwise provided in this Code.

## **Section 14.16.120 Enforcement.**

A. **Responsibility; Implementation Plan.** The Utilities Director shall be responsible for the enforcement of this chapter. The Utilities Director shall develop an Implementation Plan to be used as a guideline for enforcing the provisions of this chapter. The Implementation Plan shall provide the resources (staffing and equipment) required to ensure the fair and timely execution of these requirements, as well as a detailed execution strategy. In addition, the Implementation Plan shall ensure, so far as is reasonable under the circumstances, that persons are notified of violations and are provided an opportunity to cure the violation prior to being cited.

B. **Additional Enforcement Options.** In addition to the means of ensuring compliance set forth in section 1.04.010 of this code, the City may elect to impose the following requirements on a customer in the event of a continuing violation:

1. **Water Flow Restrictors.** The City may install a water flow restrictor of approximately one gallon per minute for services up to one and one-half inches in size and comparatively sized restrictors for larger services. Prior to doing so, the City shall first provide a minimum of forty-eight (48) hours' notice of its intent to install a water flow restrictor. In the event that a customer refuses to permit the installation of a water flow restrictor following the City's election to do so, the City may terminate the customer's water service.
2. **Termination of Service.** The City may disconnect a customer's water service for willful violations of mandatory restrictions in this chapter.

**SECTION 2:** If any section, subsection, sentence, clause or phrase of this ordinance is, for any reason, held to be invalid or unconstitutional, such decision shall not affect the validity or constitutionality of the remaining portions of this ordinance. The City Council hereby declares that it would have passed this ordinance, and each section, subsection, clause or phrase hereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses and phrases be declared unconstitutional.

**SECTION 3:** The City Council finds that this ordinance is not subject to the California Environmental Quality Act ("CEQA") pursuant to Sections 15060(c)(2) (the activity will not result in a direct or reasonably foreseeable indirect physical change in the environment) and 15060(c)(3) (the activity is not a project as defined in Section 15378) of the CEQA Guidelines, California Code of Regulations, Title 14, Chapter 3, because it has no potential for resulting in physical change to the environment, directly or indirectly.

**SECTION 4:** The Mayor shall sign and the City Clerk shall attest to the passage of this ordinance. The City Clerk shall cause the same to be published once in the official newspaper of the City, and it shall be effective thirty (30) days after its adoption.

**SECTION 5:** This ordinance was introduced at a regular meeting of the City Council of the City of Newport Beach held on the 27th day of October, 2009, and adopted on the 10th day of November, 2009, by the following vote, to wit:

AYES, COUNCILMEMBERS

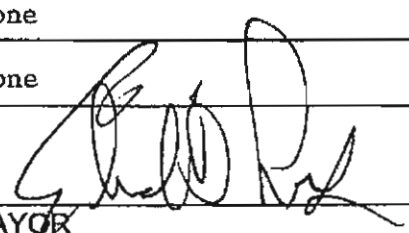
Henn, Rosansky, Curry, Webb, Gardner, Daigle, Mayor Selich

NOES, COUNCILMEMBERS

None

ABSENT COUNCILMEMBERS

None

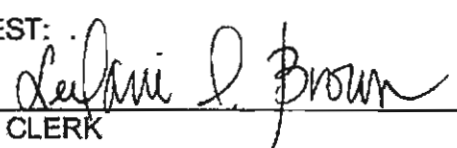
  
MAYOR

APPROVED AS TO FORM:

OFFICE OF THE CITY ATTORNEY

by: 

MYNETTE BEAUCHAMP  
ASSISTANT CITY ATTORNEY

ATTEST: 

CITY CLERK





STATE OF CALIFORNIA                    }  
COUNTY OF ORANGE                    }  
CITY OF NEWPORT BEACH                }           ss.

I, Leilani I. Brown, City Clerk of the City of Newport Beach, California, do hereby certify that the whole number of members of the City Council is seven; that the foregoing ordinance, being Ordinance No. 2009-24 was duly and regularly introduced on the 27th day of October, 2009, and adopted by the City Council of said City at a regular meeting of said Council, duly and regularly held on the 10th day of November, 2009, and that the same was so passed and adopted by the following vote, to wit:

Ayes:       Henn, Rosansky, Curry, Webb, Gardner, Daigle, Mayor Selich

Noes:       None

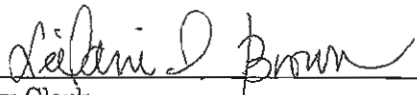
Absent:     None

Abstain:   None

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed the official seal of said City this 11th day of November, 2009.



(Seal)

  
\_\_\_\_\_  
City Clerk  
City of Newport Beach, California

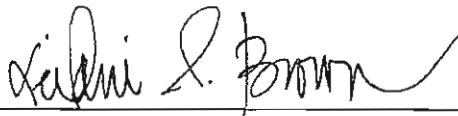
#### CERTIFICATE OF PUBLICATION

STATE OF CALIFORNIA                    }  
COUNTY OF ORANGE                    }  
CITY OF NEWPORT BEACH                }           ss.

I, LEILANI I. BROWN, City Clerk of the City of Newport Beach, California, do hereby certify that Ordinance No. 2009-24 has been duly and regularly published according to law and the order of the City Council of said City and that same was so published in *The Daily Pilot*, a daily newspaper of general circulation on the following dates:

Introduced Ordinance:           October 31, 2009  
Adopted Ordinance:           November 14, 2009

In witness whereof, I have hereunto subscribed my name this 20<sup>th</sup> day of November 2009.

  
\_\_\_\_\_  
City Clerk  
City of Newport Beach, California

## Chapter 14.17 Water Efficient Landscaping Regulations

## ORDINANCE NO. 2010-1

DATE:

6-8-11

**AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF  
NEWPORT BEACH, CALIFORNIA, AMENDING IN ITS  
ENTIRETY CHAPTER 14.17 OF TITLE 14 OF THE  
NEWPORT BEACH MUNICIPAL CODE REGULATIONS  
PERTAINING TO WATER-EFFICIENT LANDSCAPING  
REGULATIONS**

**WHEREAS**, the State Legislature has found that the continuation of California's economic prosperity is dependent on the availability of adequate supplies of water for future uses; and

**WHEREAS**, it is the policy of the State to promote the conservation and efficient use of water and to prevent the waste of this valuable resource; and

**WHEREAS**, landscapes are essential to the quality of life in California by providing areas for active and passive recreation and as an enhancement to the environment by cleaning air and water, preventing erosion, offering fire protection, and replacing ecosystems lost to development; and

**WHEREAS**, landscape design, installation, maintenance, and management can and should be water efficient; and

**WHEREAS**, Article X, Section 2 of the California Constitution specifies that the right to use water is limited to the amount reasonably required for the beneficial use to be served, and the right does not and shall not extend to waste or unreasonable method of use of water; and

**WHEREAS**, the City finds that: the average rainfall in Orange County is approximately 12 inches per year; and

**WHEREAS**, Orange County has an established, large reclaimed water infrastructure system; and

**WHEREAS**, current local area design practices in new landscapes typically achieve the State Model Water Efficient Landscape Ordinance water use goals; and

**WHEREAS**, incentive-based water use efficiency programs have been actively implemented within Orange County since before 1991; and

**WHEREAS**, the City has further found that all water services within the City are metered; and

**WHEREAS**, the City is implementing enforcement of water waste prohibitions for all existing metered landscaped areas within its jurisdiction; and

**WHEREAS**, it is required that the City adopt a Water Efficient Landscape Ordinance "as least as effective as" the State Model Ordinance or implement the State Model Ordinance by January 1, 2010; and

**WHEREAS**, the City has drafted an ordinance incorporating the minimum requirements of and which is "at least as effective as" the State Model Ordinance; and

**WHEREAS**, this agenda item has been noticed in accordance with the Ralph M. Brown Act (72 hours in advance of the public meeting). The item appeared upon the agenda for this meeting which was posted at City Hall and on the City website.

**NOW THEREFORE, THE CITY COUNCIL OF THE CITY OF NEWPORT BEACH, CALIFORNIA, HEREBY ORDAINS AS FOLLOWS:**

**SECTION 1:** Chapter 14.17 of Title 14 of the Newport Beach Municipal Code is hereby amended in its entirety to read as follows:

**CHAPTER 14.17: WATER EFFICIENT LANDSCAPING**

14.17.005: Purpose  
14.17.010: Definitions  
14.17.020: Applicability  
14.17.030: Landscape Water Use Standards  
14.17.040: Implementation Procedures

**14.17.005: Purpose**

The purpose of the City's Water Efficient Landscape Ordinance and related Design Standards document is to establish an alternative model acceptable under AB 1881 (2006) as being at least as effective as the State Model Water Efficient Landscape Ordinance, in order to:

- (1) promote the benefits of consistent landscape ordinances with neighboring local and regional agencies;
- (2) promote the values and benefits of landscapes while recognizing the need to invest water and other resources as efficiently as possible;

- (3) establish a structure for planning, designing, installing, and maintaining and managing water efficient landscapes in new construction and rehabilitated projects;
- (4) establish provisions for water management practices and water waste prevention for existing landscapes;
- (5) use water efficiently without waste by setting a Maximum Applied Water Allowance as an upper limit for water use and reduce water use to the lowest practical amount;
- (6) encourage the use of economic incentives that promote the efficient use of water.

#### **14.17.010: Definitions**

For the purposes of this chapter, the following words and phrases shall have the meaning set forth in this section.

(a) **Applied water:** the portion of water supplied by the irrigation system to the landscape.

(b) **Budget-based tiered-rate structure:** tiered or block rates for irrigation accounts charged by the retail water agency in which the block definition for each customer is derived from lot size or irrigated area and the evapotranspiration requirements of landscaping.

(c) **Design Standards:** refers to the Design Standards for Implementation of the Water Efficient Landscape Ordinance which describes procedures, calculations, and requirements for landscape projects subject to this Water Efficient Landscape Ordinance.

(d) **Ecological restoration project:** a project where the site is intentionally altered to establish a defined, indigenous, historic ecosystem.

(e) **Estimated Applied Water Use (EAWU):** the average annual total amount of water estimated to be necessary to keep plants in a healthy state, calculated as provided in the Design Standards. It is based on the reference evapotranspiration rate, the size of the landscape area, plant water use factors, and the relative irrigation efficiency of the irrigation system.

(f) **ET adjustment factor or "ETAF":** is equal to the plant factor divided by the irrigation efficiency factor for a landscape project, as described in the Design Standards. The ETAF is calculated in the context of local reference evapotranspiration, using site-specific plant factors and irrigation efficiency factors that influence the amount of water that needs to be applied to the specific landscaped area. -- A combined plant mix with a site-wide

average plant factor of 0.5 (indicating a moderate water need) and average irrigation efficiency of 0.71 produces an ET adjustment factor of  $(0.7) = (0.5/0.71)$ , which is the standard of water use efficiency generally required by this Water Efficient Landscape Ordinance and the Design Standards, except that the ETAF for a special landscape area shall not exceed 1.0.

(g) **Hardscapes:** any durable material or feature (pervious and non-pervious) installed in or around a landscaped area, such as pavements or walls. Surface area of pools and other water features are considered part of the landscaped area and not considered hardscapes for purposes of this Water Efficient Landscape Ordinance.

(h) **Homeowner installed landscape:** any landscaping either installed by a private individual for a single family residence or installed by a licensed contractor hired by a homeowner. A homeowner, for purposes of this ordinance, is a person who occupies the dwelling he or she owns. This definition excludes speculative homes, which are not owner-occupied dwellings and which are subject under this ordinance to the requirements applicable to developer-installed residential landscape projects.

(i) **Irrigation efficiency:** the measurement of the amount of water beneficially used divided by the amount of water applied. Irrigation efficiency is derived from measurements and estimates of irrigation system characteristics and management practices. The minimum average irrigation efficiency for purposes of this Water Efficient Landscape Ordinance is 0.71. Greater irrigation efficiency can be expected from well designed and maintained systems. An average plant factor of 0.5 (indicating a moderate water need) and average irrigation efficiency of 0.71 produces an ET adjustment factor of  $(0.7) = (0.5/0.71)$

(j) **Landscape Documentation Package:** the documents required to be provided to the City for review and approval of landscape design projects, as described in the Design Standards.

(k) **Landscape rehabilitation project:** any re-landscaping project that meets the criteria of Section 14.17.020 (Applicability), where the modified landscaped area is greater than 2,500 square feet (or 5,000 square feet for home owner installed) , is 50% of the total landscaped area, and the modifications are planned to occur within one year.

(l) **Landscaped area:** all the planting areas, *turf* areas, and *water features* (including pools, ponds, fountains, and any other water feature) in a Landscape Design Plan which are subject to and must be included in the *Maximum Applied Water Allowance* and *Estimated Applied Water Use* calculations. The *landscaped area* does not include footprints of buildings or structures, sidewalks, driveways, parking lots, decks, patios, gravel or stone walks, other *pervious* or *non-pervious hardscapes*, and other non-irrigated areas designated for non-development (e.g., open spaces and existing native vegetation).

(m) **Licensed professional:** a licensed landscape architect, California licensed landscape contractor, civil engineer, architect, or any other person authorized to design or construct a landscape pursuant to Sections 5500.1, 5615, 5641, 5641.1, 5641.2, 5641.3, 5641.4, 5641.5, 5641.6, 6701, 7027.5 of the California Business and Professions Code, Section 832.27 of Title 16 of the California Code of Regulations, and Section 6721 of the California Food and Agriculture Code.

(n) **Local water supplier:** any entity, including a public agency, city, county, or private water company that provides retail water service.

(o) **Maximum Applied Water Allowance (MAWA):** is the upper limit of annual applied water for the established landscaped area as specified in Section 2.2 of the Design Standards. It is based upon the area's reference evapotranspiration, the ET Adjustment Factor, and the size of the landscaped area. The Estimated Applied Water Use shall not exceed the Maximum Applied Water Allowance.

(p) **Ministerial Permit:** an authorizing document issued by the City of Newport Beach Building Department in conjunction with a landscape project which may include, but is not limited to: grading, pools, spas, fountains, ponds, retaining walls, fences and walls, shade structures, trellis structures, barbecues, outdoor fireplaces, etc.

(q) **New landscape installation project:** a landscape installed in conjunction with any type of new development, whether or not the new development includes construction of new building(s). (Examples of a new development not associated with a new building could include parks, playgrounds, greenbelts).

(r) **Non-pervious:** any surface or natural material that does not allow for the passage of water through the material and into the underlying soil.

(s) **Pervious:** any surface or material that allows the passage of water through the material and into the underlying soil.

(t) **Plant factor or plant water use factor:** is a factor, when multiplied by ETo, which estimates the amount of water needed by plants. For purposes of this Water Efficient Landscape Ordinance, the plant factor range for low water use plants is 0 to 0.3; the plant factor range for moderate water use plants is 0.4 to 0.6; and the plant factor range for high water use plants is 0.7 (70%) to 1.0 (100%). Plant factors cited in this Water Efficient Landscape Ordinance are derived from the Department of Water Resources 2000 publication "Water Use Classification of Landscape Species."

(u) **Recycled water or reclaimed water:** a wastewater which, as a result of treatment, is suitable for non-potable uses not intended for human consumption such as landscape irrigation and water features.



(v) **Reference evapotranspiration or “ETo”:** a standard measurement of environmental parameters which affect the water use of plants. ETo is given expressed in inches per day, month, or year as represented in Appendix A of the Design Standards and is an estimate of the evapotranspiration of a large field of four-to seven-inch tall, cool-season grass that is well watered. Reference evapotranspiration is used as the basis of determining the Maximum Applied Water Allowances (MAWA).

(w) **Smart automatic irrigation controller:** an automatic timing device used to remotely control valves that operate an irrigation system and which schedules irrigation events using either evapotranspiration (weather-based) or soil moisture data.

(x) **Special Landscaped Area or SLA:** an area of the landscape dedicated solely to edible plants such as orchards and vegetable gardens, areas irrigated with *recycled water*, *water features* using *recycled water*, or areas dedicated to active play such as parks, sports fields, golf courses, or areas where *turf* provides a playing surface. These areas may have an ET adjustment factor (ETAF) to 1.0 (100%).

(y) **Turf:** a ground cover surface of mowed grass. Annual bluegrass, Kentucky bluegrass, Perennial ryegrass, Red fescue, and Tall fescue are cool-season grasses. Bermudagrass, Kikuyugrass, Seashore Paspalum, St. Augustinegrass, Zoysiagrass, and Buffalo grass are warm-season grasses.

(z) **Valve:** a device used to control the flow of water in an irrigation system.

(aa) **Water feature:** a design element where open water performs an aesthetic or recreational function. Water features include ponds, lakes, waterfalls, fountains, artificial streams, spas, and swimming pools (where water is artificially supplied). The surface area of water features is included in the high water use hydrozone of the landscaped area. Constructed wetlands used for on-site wastewater treatment, habitat protection or storm water best management practices that are not irrigated and used solely for water treatment or storm water retention are not water features and, therefore, are not subject to the water budget calculation.

#### **14.17.020: Applicability.**

- (a) All planting, irrigation, and landscape-related improvements required by this Water Efficient Landscape Ordinance shall apply to the following:
  - (1) New landscape installations or landscape rehabilitation projects by public agencies or private non-residential developers with a landscaped area (see definition) equal to or greater than 2,500 square feet, and which are otherwise subject to a discretionary approval of a landscape plan, or which otherwise require a ministerial permit for a landscape or water feature;

- (2) New landscape installations or landscape rehabilitation projects by developers or property managers of single-family and multi-family residential projects or complexes with a landscaped area (see definition) equal to or greater than 2,500 square feet, and which are otherwise subject to a discretionary approval of a landscape plan, or which otherwise require a ministerial permit for a landscape or water feature;
  - (3) New landscape installation projects or landscape rehabilitation projects installed by individual homeowners on single-family or multi-family residential lots with a total project landscaped area (see definition) equal to or greater than 5,000 square feet and which are otherwise subject to a discretionary approval of a landscape plan, or which otherwise require a ministerial permit for a landscape or water feature;
  - (4) New landscape installation projects or landscape rehabilitation projects installed at cemeteries shall be subject to the following sections of the Design Standards: Sections 2.2: Water Efficient Landscape Calculations and Alternatives, 2.8 Post-Installation Irrigation Scheduling, and 2.9 Post-Installation Landscape and Irrigation Maintenance, but shall not require a Landscape Design Package (Design Standards: Section 2.1).
- (b) This Water Efficient Landscape Ordinance does not apply to:
- (1) landscape rehabilitation projects that consist of replacement plantings with equal or lower water needs and the irrigation system is designed, operable and programmed to comply with the City's water conservation regulations;
  - (2) registered local, state, or federal historical sites;
  - (3) ecological restoration projects that do not require a permanent irrigation system;
  - (4) plant collections, as part of botanical gardens and arboretums open to the public; or
  - (5) landscape in Hazard Reduction and Fuel Modification Zones, where applicable.
- (c) Section 14.17.030(b) of the of the Landscape Water Use Standards of this Water Efficient Landscape Ordinance (requiring compliance with the City's Water Conservation Ordinance) shall apply to:

- (1) All landscaped areas, whether installed prior to (existing landscapes) or after adoption of this ordinance.

**14.17.030: Landscape Water Use Standards.**

- (a) For new landscape installation or rehabilitation projects subject to Section 14.17.020) (Applicability) of this Water Efficient Landscape Ordinance, the Estimated Applied Water Use allowed for the landscaped area shall not exceed the MAWA calculated using an ET adjustment factor of 0.7, except for special landscaped areas where the MAWA is calculated using an ET adjustment factor of 1.0; or the design of the landscaped area shall otherwise be shown to be equivalently water-efficient in a manner acceptable to the City; as provided in the Design Standards.
- (b) Irrigation of all landscaped areas shall be conducted in a manner conforming to the rules and requirements, and shall be subject to penalties and incentives for water conservation and water waste prevention, as determined and implemented by the City's Water Conservation Ordinance (NBMC Chapter 14.16).

**14.17.040: Implementation Procedures.**

- (a) A Landscape Documentation Package shall be submitted to the City for review and approval of all landscape projects subject to the provisions of this Water Efficient Landscape Ordinance. Any Landscape Documentation Package submitted to the City shall comply with the provisions of the Design Standards.
- (b) The Landscape Documentation Package shall include a Certification of Design by a professional appropriately licensed in the State of California stating that the landscape design and water use calculations have been prepared by or under the supervision of the licensed professional and are certified to be in compliance with the provisions of this Water Efficient Landscape Ordinance and the Design Standards.
  - (1) Landscape and irrigation plans shall be submitted to the City for review and approval with appropriate water use calculations. Water use calculations shall be consistent with the procedures and calculations provided in the Design Standards document.
  - (2) Verification of compliance of the landscape installation with the approved plans shall be obtained through a Certification of Completion which shall be submitted to the City prior to final of the

permit, per the procedures provided in the Design Standards document.

**SECTION 2:** The City Council hereby determines that this Ordinance is exempt from review under the California Environmental Quality Act (CEQA) (California Public Resources Code Section 21000 et seq.), because pursuant to State CEQA Regulation 15307 (14 Cal. Code Regs., § 15307), this Ordinance is covered by the CEQA Categorical Exemption for actions taken to assure the maintenance, restoration, enhancement, or protection of a natural resource where the regulatory process involves procedures for protection of the environment. The adoption of this Ordinance will result in the enhancement and protection of water resources in the City, and will not result in cumulative adverse environment impacts. It is therefore exempt from the provisions of CEQA. The City Council hereby directs the City Manager or designee to prepare and file a Notice of Exemption as soon as possible following adoption of this Ordinance.

**SECTION 3:** If any section, subsection, sentence, clause or phrase of this ordinance is, for any reason, held to be invalid or unconstitutional, such decision shall not affect the validity or constitutionality of the remaining portions of this ordinance. The City Council hereby declares that it would have passed this ordinance, and each section, subsection, clause or phrase hereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses and phrases be declared unconstitutional.

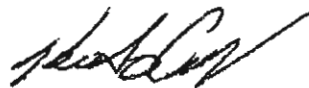
**SECTION 4:** The Mayor shall sign and the City Clerk shall attest to the passage of this ordinance. The City Clerk shall cause the same to be published once in the official newspaper of the City, and it shall be effective thirty (30) days after its adoption.

**SECTION 5:** This Ordinance was introduced at a regular meeting of the City Council of the City of Newport Beach held on the 26th day of January, 2010, and adopted on the 9th day of February, 2010, by the following vote, to wit:

AYES, COUNCIL MEMBERS Selich, Rosansky, Henn, Webb, Gardner, Daigle, Mayor Curry

NOES, COUNCIL MEMBERS None

ABSENT, COUNCIL MEMBERS None



Keith D. Curry, Mayor

ATTEST:

*Leilani L. Brown*

Leilani Brown, City Clerk  
APPROVED AS TO FORM,  
OFFICE OF CITY ATTORNEY:

*David R. Hunt* 1.26.10

David R. Hunt, City Attorney  
For the City of Newport Beach



STATE OF CALIFORNIA                    }  
COUNTY OF ORANGE                    }       ss.  
CITY OF NEWPORT BEACH                }

I, Leilani I. Brown, City Clerk of the City of Newport Beach, California, do hereby certify that the whole number of members of the City Council is seven; that the foregoing ordinance, being Ordinance No. 2010-1 was duly and regularly introduced on the 26th day of January, 2010, and adopted by the City Council of said City at a regular meeting of said Council, duly and regularly held on the 9th day of February, 2010, and that the same was so passed and adopted by the following vote, to wit:

Ayes:       Selich, Rosansky, Henn, Webb, Gardner, Daigle, Mayor Curry

Noes:       None

Absent:     None

Abstain:   None

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed the official seal of said City this 10th day of February, 2010.

(Seal)



*Leilani I. Brown*

City Clerk  
City of Newport Beach, California

#### CERTIFICATE OF PUBLICATION

STATE OF CALIFORNIA                    }  
COUNTY OF ORANGE                    }       ss.  
CITY OF NEWPORT BEACH                }

I, LEILANI I. BROWN, City Clerk of the City of Newport Beach, California, do hereby certify that Ordinance No. 2010-1 has been duly and regularly published according to law and the order of the City Council of said City and that same was so published in *The Daily Pilot*, a daily newspaper of general circulation on the following dates:

Introduced Ordinance:               January 30, 2010  
Adopted Ordinance:               February 13, 2010

In witness whereof, I have hereunto subscribed my name this 22<sup>nd</sup> day of February 2010.

*Leilani I. Brown*

City Clerk  
City of Newport Beach, California

## Chapter 14.36 Water Quality



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## Chapter 14.36 WATER QUALITY

### Sections:

|                           |                                                |
|---------------------------|------------------------------------------------|
| <a href="#">14.36.010</a> | Purpose and Intent.                            |
| <a href="#">14.36.020</a> | Definitions.                                   |
| <a href="#">14.36.030</a> | Illicit Connections and Prohibited Discharges. |
| <a href="#">14.36.040</a> | Control of Urban Runoff.                       |
| <a href="#">14.36.050</a> | Inspections.                                   |
| <a href="#">14.36.060</a> | Enforcement.                                   |
| <a href="#">14.36.070</a> | Permits.                                       |
| <a href="#">14.36.080</a> | Compliance Disclaimer.                         |

### **14.36.010 Purpose and Intent.**

The United States Congress passed the Clean Water Act (33 USC Section 1251 et seq., as amended, including Section 402(p) therein) as a mandate, in part, that municipalities separate storm water runoff and sanitary sewer systems, in areas such as in Orange County, obtain permits to “effectively prohibit non-storm water discharges into the storm sewers” and “require controls to reduce the discharge of pollutants to the maximum extent practicable ....” This permitting authority has been delegated by the United States Environmental Protection Agency (“EPA”) to the State of California, which has authorized the State Water Resources Control Board and its local regulatory agencies, the Regional Water Quality Control Boards, to control non-point source discharges to California’s waterways.

The Santa Ana and San Diego Regional Water Quality Control Boards have addressed the obligation to implement the Clean Water Act by issuing Waste Discharge Requirements governing storm water runoff for the County of Orange. These permits shall be referred to collectively herein as the National Pollution Discharge Elimination System Permit or “NPDES Permits”.

The City of Newport Beach is participating as a “Co-permittee” under the NPDES Permits in the development and adoption of an ordinance to accomplish the requirements of the Clean Water Act.

Storm water runoff is one step in the natural cycle of water. However, human activities, such as agriculture, construction and the operation and maintenance of an urban infrastructure may result in undesirable discharges of pollutants and certain sediments, which may accumulate in local drainage channels and waterways and eventually may be deposited in the waters of the United States.

The purpose of this chapter is to participate in the improvement of water quality and comply with federal requirements for the control of urban pollutants to storm water runoff, which enters the network of storm drains throughout Orange County. (Ord. 97-26 § 2 (part), 1997)

### **14.36.020 Definitions.**

“Authorized Inspector” means the City Manager and persons designated by and under his/her instruction and supervision, who are assigned to investigate compliance with, detect violations of and/or take actions pursuant to this chapter.

“City” means the City of Newport Beach, Orange County, California.

“City Manager” means the City Manager of the City or his/her designee.

“Co-permittee” means the County of Orange, the Orange County Flood Control District, and/or any one of the thirty-one (31) municipalities, including the City of Newport Beach which are responsible for compliance with the terms of the NPDES Permit.

“DAMP” means the Orange County Drainage Area Management Plan, as the same may be amended from time to time.

“Development project guidance” means DAMP Chapter VII and the Appendix thereto, entitled Best Management Practices for New Development Including Non-Residential Construction Projects, as the same may be amended from time to time.

“Discharge” means any release, spill, leak, pump, flow, escape, leaching (including subsurface migration or deposition to groundwater), dumping or disposal of any liquid, semi-solid or solid substance.

“Discharge exception” means the group of activities not restricted or prohibited by this Chapter, including only:

1. Discharges composed entirely of storm water;
2. Discharges subject to regulation under current EPA or Regional Water Quality Control Board issued NPDES permits, State General Permits, or other waivers, permits or approvals granted by an appropriate government agency;
3. Discharges from property for which best management practices set forth in the development project guidance are being implemented and followed;
4. Discharges to the Storm Water Drainage System from potable water line flushing, fire fighting activities, landscape irrigation systems, diverted stream flows, rising groundwater, and de minimis groundwater infiltration to the Storm Water Drainage System (from leaks in joints or connections or cracks in water drainage pipes or conveyance systems);
5. Discharges from potable water sources, passive foundation drains, air conditioning condensation and other building roof runoff; agricultural irrigation water runoff; water from crawl space pumps, passive footing drains, lawn watering, noncommercial vehicle and boat washing; noncommercial animal washing; flows from riparian habitats and wetlands; dechlorinated swimming pool discharges;
6. Discharges of reclaimed water generated by a lawfully permitted water treatment facility; public street wash waters when related to cleaning and maintenance by, or on behalf of, the City;
7. Discharges authorized pursuant to a permit issued under Section [14.36.070](#);
8. Discharges allowable under the domestic sewage exception;
9. Discharges for which the discharger has reduced to the extent feasible the amount of pollutants in such discharge;
10. Discharges authorized pursuant to federal or state laws or regulations. In any action taken to enforce this chapter, the burden shall be on the person who is the subject of such action to establish that a discharge was within the scope of this discharge exception.

“Domestic sewage exception” means discharges which are exceptions to this chapter and excluded from the definition of prohibited discharge, as defined herein, including only:

1. Discharges composed entirely of accidental spills of untreated sanitary wastes (commonly called domestic sewage) and other wastes, but limited solely to wastes that are controlled by and are within publicly owned wastewater treatment system collection facilities immediately prior to the accidental spill.

“Enforcing Attorney” means the City Attorney or District Attorney acting as counsel to the City of Newport Beach and his/her designee, which counsel is authorized to take enforcement action. For purposes of criminal prosecution, the District Attorney, or his/her designee, shall act as the Enforcing Attorney.

“EPA” means the Environmental Protection Agency of the United States.

“Hearing Officer” means the City Manager who shall preside at the administrative hearings authorized by this chapter and issue final decisions on the matters raised therein.

“Invoice for costs” means the actual costs and expenses of the City including but not limited to administrative overhead, salaries and other expenses recoverable under State law, incurred during any Inspection conducted pursuant to Section [14.36.050](#) or where a notice of noncompliance, administrative compliance order or other enforcement option under Section [14.36.060](#), or this Code is utilized to obtain compliance with this chapter.

“Illicit connection” means any man-made conveyance or drainage system, pipeline, conduit, inlet or outlet through which the discharge of any pollutant to the Storm Water Drainage System occurs or may occur. The term illicit connection shall not include legal nonconforming connections or connections to the Storm Water Drainage System that are hereinafter authorized by the agency with jurisdiction over the system at the location at which the connection is made.

“Legal nonconforming connection” means connections to the Storm Water Drainage System existing as of the adoption of this chapter that were in compliance with all federal, State and local rules, regulations, statutes and administrative requirements in effect at the time the connection was established, including but not limited to any discharge permitted pursuant to the terms and conditions of an individual discharge permit issued pursuant to the Industrial Waste Ordinance, County Ordinance No. 703.

“New development” means all public and private residential (whether single-family, multi-unit or planned unit development), industrial, commercial, retail and other non-residential construction projects, or grading for future construction, for which either a discretionary land use approval, grading permit, building permit or nonresidential plumbing permit is required.

“Nonresidential plumbing” permit means a plumbing permit authorizing the construction and/or installation of facilities for the conveyance of liquids other than storm water, potable water, reclaimed water or domestic sewage.

“NPDES Permit” means the currently applicable municipal discharge permit(s) issued by the Regional Water Quality Control Board, Santa Ana Region which permit(s) establishes waste discharge requirements applicable to storm water runoff in the city.

“Person” means any natural person as well as any corporation, partnership, government entity or subdivision, trust, estate, cooperative association, joint venture, business entity, or other similar entity, or the agent, employee or representative of any of the above.

“Pollutant” means any liquid, solid or semi-solid substances, or combination thereof, including and not limited to:

1. Artificial materials (such as floatable plastics, wood products or metal shavings);
2. Household waste (such as trash, paper and plastics; cleaning chemicals; yard wastes; animal fecal materials; used oil and fluids from vehicles, lawn mowers and other common household equipment);
3. Metals and nonmetals, including compounds of metals and nonmetals, (such as cadmium, lead, zinc, copper, silver, nickel, chromium, cyanide, phosphorus and arsenic), with characteristics which cause an adverse effect on living organisms;
4. Petroleum and related hydrocarbons (such as fuels, lubricants, surfactants, waste oils, solvents, coolants and grease);

5. Animal wastes (such as discharge from confinement facilities, kennels, pens and recreational facilities, including stables, show facilities or polo fields);
6. Substances having a pH less than 6.5 or greater than 8.6, or unusual coloration, turbidity or odor;
7. Waste materials and wastewater generated on construction sites and by construction activities (such as painting and staining; use of sealants and glues; use of lime; use of wood preservatives and solvents; disturbance of asbestos fibers, paint flakes or stucco fragments; application of oils, lubricants, hydraulic, radiator or battery fluids; construction equipment washing; concrete pouring and cleanup; use of concrete detergents; steam cleaning or sand blasting; use of chemical degreasing or diluting agents; and use of super chlorinated water for potable water line flushing);
8. Materials causing an increase in biochemical oxygen demand, chemical oxygen demand or total organic carbon;
9. Materials which contain base/neutral or acid extractable organic compounds;
10. Those pollutants defined in Section 1362(6) of the Federal Clean Water Act; and
11. Any other constituent or material, including but not limited to pesticides, herbicides, fertilizers, fecal coliform, fecal streptococcus or enterococcus, or eroded soils, sediment and particulate materials, in quantities that will interfere with or adversely affect the beneficial uses of the receiving waters, flora or fauna of the State.

“Prohibited discharge” means any discharge which contains any pollutant, from public or private property to (1) the Storm Water Drainage System; (2) any upstream flow, which is tributary to the Storm Water Drainage System; (3) any groundwater, river, stream, creek, wash or dry weather arroyo, wetlands area, marsh, coastal slough, or (4) any coastal harbor, bay, or the Pacific Ocean. The term prohibited discharge shall not include discharges allowable under the discharge exception.

“Significant redevelopment” means the rehabilitation or reconstruction of public or private residential (whether single-family, multi-unit or planned unit development), industrial, commercial, retail, or other nonresidential structures, for which either a discretionary land use approval, grading permit, building permit or nonresidential plumbing permit is required.

“State General Permit” means either the State General Industrial Storm Water Permit or the State General Construction Permit and the terms and requirements of either or both. In the event the U.S. Environmental Protection Agency revokes the in-lieu permitting authority of the State Water Resources Control Board, then the term State General Permit shall also refer to any EPA administered storm water control program for industrial and construction activities.

“Storm Water Drainage System” means street gutter, channel, storm drain, constructed drain, lined diversion structure, wash area, inlet, outlet or other facility, which is a part of or tributary to the County-wide storm water runoff system and owned, operated, maintained or controlled by County of Orange, the Orange County Flood Control District or any Co-permittee City, and used for the purpose of collecting, storing, transporting or disposing of storm water. (Ord. 97-26 § 2 (part), 1997)

#### **14.36.030 Illicit Connections and Prohibited Discharges.**

A. No person shall:

1. Construct, maintain, operate and/or utilize any illicit connection;
2. Cause, allow or facilitate any prohibited discharge;
3. Act, cause, permit or suffer any agent, employee or independent contractor, to construct, maintain,

operate or utilize any illicit connection, or cause, allow or facilitate any prohibited discharge.

B. The prohibition against illicit connections shall apply irrespective of whether the illicit connection was established prior to the date of enactment of this chapter; however, legal nonconforming connections shall not become illicit connections until the earlier of the following:

1. For all structural improvements to property installed for the purpose of discharge to the Storm Water Drainage System, the expiration of five years from the adoption of this chapter;
2. For all nonstructural improvements to property existing for the purpose of discharge to the Storm Water Drainage System, the expiration of six months following delivery of a notice to the owner or occupant of the property, which states a legal nonconforming connection has been identified. The notice of a legal nonconforming connection shall state the date of expiration of use under this chapter.
3. A reasonable extension of use may be authorized by the city manager upon consideration of the following factors:
  - a. The potential adverse effects of the continued use of the connection upon the beneficial uses of receiving waters;
  - b. The economic investment of the discharger in the legal nonconforming connection; and
  - c. The financial effect upon the discharger of a termination of the legal nonconforming connection.

C. A civil or administrative violation of this section shall occur irrespective of the negligence or intent of the violator to construct, maintain, operate or utilize an illicit connection or to cause, allow or facilitate any prohibited discharge.

D. If an authorized inspector reasonably determines that a discharge, which is otherwise within the discharge exception, may adversely affect the beneficial uses of receiving waters, then the Authorized Inspector may give written notice to the owner of the property or facility that the discharge exception shall not apply to the subject discharge following expiration of the thirty (30) day period commencing upon delivery of the notice. Upon expiration of the thirty (30) day period any such discharge shall constitute a violation of this section. (Ord. 97-26 § 2 (part), 1997)

#### **14.36.040 Control of Urban Runoff.**

A. New Development and Significant Redevelopment.

1. All new development and significant redevelopment within the City of Newport Beach shall be undertaken in accordance with:
  - a. The DAMP, including but not limited to the development project guidance; and
  - b. Any conditions and requirements established by the planning department, engineering department or building department, which are reasonably related to the reduction or elimination of pollutants in storm water runoff from the project site.
2. Prior to the issuance by the City of a grading permit, building permit or nonresidential plumbing permit for any new development or significant redevelopment, the planning department, engineering department or building department shall review the project plans and impose terms, conditions and requirements on the project in accordance with this section. If the new development or significant redevelopment will be approved without application for a grading permit, building permit or nonresidential plumbing permit, the planning agency planning department, engineering department or building department shall review the project plans and impose terms, conditions and requirements on

the project in accordance with this section prior to the issuance of a discretionary land use approval or, at the city's discretion, prior to recordation of a subdivision map.

3. Notwithstanding the foregoing, this compliance with the development project guidance shall not be required for construction of a (one) single-family detached residence or duplex unless the City Planning Department, engineering department or building department determines that the construction may result in the discharge of significant levels of a pollutant into a tributary to the Storm Water Drainage System.

4. Compliance with the conditions and requirements of the DAMP shall not exempt any person from the requirement to independently comply with each provision of this chapter.

5. If the City Planning Department, engineering department or building department determines that the project will have a de minimis impact on the quality of storm water runoff, then it may issue a written waiver of the requirement for compliance with the provisions of the development project guidance.

6. The owner of a new development or significant redevelopment project, or upon transfer of the property, its successors and assigns, shall implement and adhere to the terms, conditions and requirements imposed pursuant to this section on a new development or significant redevelopment project.

a. Each failure by the owner of the property or its successors or assigns, to implement and adhere to the terms, conditions and requirements imposed pursuant to this section on a new development or significant redevelopment project shall constitute a violation of this chapter.

7. The City Planning Department, engineering department or building department may require that the terms, conditions and requirements imposed pursuant to this section be recorded with the County Recorder's office by the property owner. The signature of the owner of the property or any successive owner shall be sufficient for the recording of these terms, conditions and requirements and a signature on behalf of the City shall not be required for recordation.

B. **Cost Recovery.** The City shall be reimbursed by the project applicant for all costs and expenses incurred by the Planning Agency (Planning Department, Engineering Department or Building Department) in the review and inspection of new development or significant development projects for compliance with the DAMP. The City Planning Agency (Planning Department, Engineering Department or Building Department) may elect to require a deposit of estimated costs and expenses, and the actual costs and expenses shall be deducted from the deposit, and the balance, if any, refunded to the project applicant. (Ord. 2004-5 § 1, 2004: Ord. 97-26 § 2 (part), 1997)

#### **14.36.050 Inspections.**

##### **A. Scope of Inspections.**

1. **Right to Inspect.** Prior to commencing any inspection as authorized below, the Authorized Inspector shall obtain either the consent of the owner or occupant of the property or shall obtain an administrative inspection warrant or criminal search warrant.

2. **Entry to Inspect.** The Authorized Inspector may enter property to investigate the source of any discharge to any public street, inlet, gutter, storm drain or the Storm Water Drainage System located within the jurisdiction of the City of Newport Beach.

3. **Compliance Assessments.** The Authorized Inspector may inspect property for the purpose of verifying compliance with this chapter, including but not limited to: (i) identifying products produced, processes conducted, chemicals used and materials stored on or contained within the property; (ii) identifying point(s) of discharge of all wastewater, process water systems and pollutants; (iii) investigating the natural slope at the location, including drainage patterns and man-made conveyance

systems; (iv) establishing the location of all points of discharge from the property, whether by surface runoff or through a storm drain system; (v) locating any illicit connection or the source of prohibited discharge; (vi) evaluating compliance with any permit issued pursuant to Section [14.36.070](#); and (vii) investigating the condition of any legal nonconforming connection.

4. **Portable Equipment.** For purposes of verifying compliance with this chapter, the Authorized Inspector may inspect any vehicle, truck, trailer, tank truck or other mobile equipment.

5. **Records Review.** The Authorized Inspector may inspect all records of the owner or occupant of property relating to chemicals or processes presently or previously occurring on-site, including material and/or chemical inventories, facilities maps or schematics and diagrams, material safety data sheets, hazardous waste manifests, business plans, pollution prevention plans, State General Permits, Storm Water Pollution Prevention Plans, Monitoring Program Plans and any other record(s) relating to illicit connections, prohibited discharges, a legal nonconforming connection or any other source of contribution or potential contribution of pollutants to the Storm Water Drainage System.

6. **Sample and Test.** The Authorized Inspector may inspect, sample and test any area runoff, soils area (including groundwater testing), process discharge, materials within any waste storage area (including any container contents), and/or treatment system discharge for the purpose of determining the potential for contribution of pollutants to the Storm Water Drainage System. The Authorized Inspector may investigate the integrity of all storm drain and sanitary sewer systems, any legal nonconforming connection or other pipelines on the property using appropriate tests, including but not limited to smoke and dye tests or video surveys. The Authorized Inspector may take photographs or video tape, make measurements or drawings, and create any other record reasonably necessary to document conditions on the property.

7. **Monitoring.** The Authorized Inspector may erect and maintain monitoring devices for the purpose of measuring any discharge or potential source of discharge to the Storm Water Drainage System.

8. **Test Results.** The owner or occupant of property subject to inspection shall, on submission of a written request, receive copies of all monitoring and test results conducted by the Authorized Inspector. (Ord. 97-26 § 2 (part), 1997)

#### **14.36.060 Enforcement.**

##### **A. Administrative Remedies.**

1. **Notice of Noncompliance.** In addition to any other remedy or means of enforcement authorized by law or this code, the Authorized Inspector may deliver to the owner or occupant of any property, or to any person responsible for an illicit connection or prohibited discharge a notice of noncompliance. The notice of noncompliance shall be delivered in accordance with this section.

a. The notice of noncompliance shall identify the provision(s) of this chapter or the applicable permit which has been violated. The notice of noncompliance shall state that continued noncompliance may result in additional enforcement actions against the owner, occupant and/or person.

b. The notice of noncompliance shall state a compliance date that must be met by the owner, occupant and/or person; provided, however, that the compliance date may not exceed ninety (90) days unless the Authorized Inspector extends the compliance deadline an additional ninety (90) days where good cause exists for the extension.

2. **Administrative Compliance Orders.**

a. The Authorized Inspector may issue an administrative compliance order, which shall be delivered in accordance with this section of this chapter. The administrative compliance order may



be issued to:

- i. The owner or occupant of any property requiring abatement of conditions on the property that cause or may cause a prohibited discharge or an illicit connection in violation of this chapter;
    - ii. The owner of property subject to terms, conditions or requirements imposed on a project in accordance with this section to ensure adherence to those terms, conditions and requirements;
    - iii. A permittee subject to the requirements of any permit issued pursuant to Section [14.36.070](#) to ensure compliance with the terms, conditions and requirements of the permit;
    - iv. Any person responsible for an illicit connection or prohibited discharge.
  - b. The administrative compliance order may include the following terms and requirements:
    - i. Specific steps and time schedules for compliance as reasonably necessary to eliminate an existing prohibited discharge, or to prevent the imminent threat of a prohibited discharge, including but not limited to a prohibited discharge from any pond, pit, well, surface impoundment, holding or storage area;
    - ii. Specific steps and time schedules for compliance as reasonably necessary to discontinue any illicit connection;
    - iii. Specific requirements for containment, cleanup, removal, storage, installation of overhead covering, or proper disposal of any pollutant having the potential to contact storm water runoff;
    - iv. Any other terms or requirements reasonably calculated to prevent the imminent threat of or continuing violations of this chapter, including, but not limited to requirements for compliance with best management practices guidance documents promulgated by any federal, State of California or regional agency;
    - v. Any other terms or requirements reasonably calculated to achieve full compliance with the terms, conditions and requirements of any permit issued pursuant hereto.
3. Cease and Desist Orders.
- a. The Authorized Inspector may issue a cease and desist order. A cease and desist order shall be delivered in accordance with this section. A cease and desist order may direct the owner or occupant of any property and/or other person responsible for a violation of this chapter to:
    - i. Immediately discontinue any illicit connection or prohibited discharge to the Storm Water Drainage System;
    - ii. Immediately contain or divert any flow of water off the property, where the flow is occurring in violation of any provision of this chapter;
    - iii. Immediately discontinue any other violation of this chapter;
    - iv. Clean up the area affected by the violation.
  - b. The Authorized Inspector may direct by cease and desist order that the owner of any property or his successor-in-interest, which property is subject to any conditions or requirements issued pursuant to Section [14.36.040](#) of this chapter or any permittee under any permit issued pursuant to Section [14.36.070](#), immediately cease any activity not in compliance with the conditions or

requirements issued pursuant to Section [14.36.040](#) of this chapter, or the terms, conditions and requirements of the applicable permit.

4. **Recovery of Costs.** The Authorized Inspector may deliver to the owner or occupant of any property, any permittee or any other person who becomes subject to a notice of noncompliance, administrative or cease and desist order, an invoice for costs. An invoice for costs shall be delivered in accordance with this section. An invoice for costs shall be immediately due and payable to the City in issuing and enforcing any notice or order. If any owner or occupant, permittee or any other person subject to an invoice for costs fails to either pay the invoice for costs or appeal successfully the invoice for costs in accordance with this section then the Enforcing Attorney may institute collection proceedings.
5. **Delivery of Notice.** Any notice of noncompliance, administrative compliance order, cease and desist order or invoice of costs to be delivered pursuant to the requirements of this chapter shall be subject to the following:
  - a. The notice shall state that the recipient has a right to appeal the matter as set forth in this section;
  - b. Delivery shall be deemed complete upon (i) personal service to the recipient; (ii) deposit in the U.S. mail, postage prepaid for first class delivery; or (iii) facsimile service with confirmation of receipt;
  - c. Where the recipient of notice is the owner of the property, the address for notice shall be the address from the most recently issued equalized assessment roll for the property or as otherwise appears in the current records of the City;
  - d. Where the owner or occupant of any property cannot be located after the reasonable efforts of the Authorized Inspector, a notice of noncompliance, administrative compliance or cease and desist order shall be deemed delivered after posting on the property for a period of ten (10) business days.
6. **Administrative Hearing for Notices of Noncompliance, Administrative Compliance Orders, Invoices for Costs and Adverse Determinations.** Any person receiving a notice of noncompliance, administrative compliance order, a notice of legal nonconforming connection, an invoice for costs, or any person who is subject to any adverse determination made pursuant to this chapter, may appeal the matter by requesting an administrative hearing. Notwithstanding the foregoing, these administrative appeal procedures shall not apply to criminal proceedings initiated to enforce this chapter.
7. **Request for Administrative Hearing.** Any person appealing a notice of noncompliance, an administrative compliance order, a notice of legal nonconforming connection, an invoice for costs or an adverse determination shall, within fifteen (15) days of the correction date, file a written request for an administrative hearing, accompanied by an administrative hearing fee as established by separate resolution of the City Council, with the Office of the City Clerk, with a copy of the request for administrative hearing mailed on the date of filing to the City Manager, or the Authorized Inspector and the City Attorney. Thereafter, a hearing on the matter shall be held before the Hearing Officer within forty-five (45) business days of the date of filing of the written request unless, in the reasonable discretion of the Hearing Officer and pursuant to a written request by the appealing party, a continuance of the hearing is granted.
8. **Administrative Hearing for Cease and Desist Orders and Emergency Abatement Actions.** An administrative hearing on the issuance of a cease and desist order or following an emergency abatement action shall be held within five business days following the issuance of the order or the action of abatement, unless the hearing (or the time requirement for the hearing) is waived in writing by the party subject to the cease and desist order or the emergency abatement. A request for an

administrative hearing shall not be required from the person subject to the cease and desist order or the emergency abatement action.

9. Hearing Proceedings. The Authorized Inspector shall appear in support of the notice, order, determination, invoice for costs or emergency abatement action, and the appealing party shall appear in support of withdrawal of the notice, order, determination, invoice for costs, or in opposition to the emergency abatement action.

10. Final Decision and Appeal. The final decision of the Hearing Officer shall issue within ten business days of the conclusion of the hearing and shall be delivered by first-class mail, postage prepaid, to the appealing party. The final decision shall include notice that any legal challenge to the final decision shall be made pursuant to the provisions of Code of Civil Procedure Sections [1094.5](#) and [1094.6](#) and shall be commenced within ninety (90) days following issuance of the final decision. If the appellant is the prevailing party, the administrative hearing fee paid by Appellant shall be refunded. Notwithstanding the foregoing, the final decision of the Hearing Officer in any proceeding determining the validity of a cease and desist order or following an emergency abatement action shall be mailed within five business days following the conclusion of the hearing.

11. City Abatement. In the event the owner of property, the operator of a facility, a permittee or any other person fails to comply with any provision of a compliance schedule issued to such owner, operator, permittee or person pursuant to this chapter, the Authorized Inspector may request the Enforcing Attorney to obtain an abatement warrant or other appropriate judicial authorization to enter the property, abate the condition and restore the area. Any costs incurred by the City in obtaining and carrying out an abatement warrant or other judicial authorization may be recovered pursuant to this section.

B. Nuisance. Any condition in violation of the prohibitions of this chapter, including but not limited to the maintenance or use of any illicit connection or the occurrence of any prohibited discharge, shall constitute a threat to the public health, safety and welfare, and is declared and deemed a nuisance and may be abated pursuant to Chapter 10.50 of this Code.

1. Emergency Abatement. In the event the nuisance constitutes an imminent danger to public safety or the environment, the City Manager may enter the property from which the nuisance emanates, abate the nuisance and restore any property affected by the nuisance. To the extent reasonably practicable, informal notice shall be provided to the owner or occupant prior to abatement. If necessary to protect the public safety or the environment, abatement may proceed without prior notice to or consent from the owner or occupant thereof and without judicial warrant.

a. An imminent danger shall include, but is not limited to, exigent circumstances created by the dispersal of pollutants, where the same presents a significant and immediate threat to the public safety or the environment.

b. Notwithstanding the authority of the City to conduct an emergency abatement action, an administrative hearing pursuant to this section hereinabove shall follow the abatement action.

2. Reimbursement of Costs. All costs incurred by the City in responding to any nuisance, all administrative expenses and all other expenses recoverable under State law, shall be recoverable from the person(s) creating, causing, committing, permitting or maintaining the nuisance, including costs relating to restoration of the environment.

3. Nuisance Lien. All costs shall become a lien against the property from which the nuisance emanated and a personal obligation against the owner thereof who shall be given notice of the lien as provided in Chapter 10.50 of this Code.

- a. At the direction of the City Manager or the Authorized Inspector, the Enforcing Attorney is authorized to collect nuisance abatement costs or enforce a nuisance lien in an action brought for a money judgment or by delivery to the County Assessor of a special assessment against the property in accord with the conditions and requirements of Government Code [38773.5](#).

C. Consecutive Violations. Each day in which a violation occurs and each separate failure to comply with either a separate provision of this chapter, an administrative compliance order, a cease and desist order or a permit issued pursuant to this chapter, shall constitute a separate violation of this chapter punishable by fines or sentences issued in accordance with Chapter 1.04 of this Code.

D. Nonexclusive Remedies. Each and every remedy available for the enforcement of this chapter shall be nonexclusive and it is within the discretion of the Authorized Inspector or Enforcing Attorney to seek cumulative remedies, except that multiple monetary fines or penalties shall not be available for any single violation of this chapter.

E. Citations. Pursuant to Penal Code Section [836.5](#), the Authorized Inspector shall have the authority to cause the arrest of any person committing a violation of this chapter. The person shall be released and issued a citation to appear before a magistrate in accordance with Penal Code Sections [853.5](#), [853.6](#) and [853.9](#), unless the person demands to be taken before a magistrate. Following issuance of any citation, the Authorized Inspector shall refer the matter to the Enforcing Attorney.

Each citation to appear shall state the name and address of the violator, the provisions of this chapter violated, and the time and place of appearance before the court, which shall be at least ten business days after the date of violation. The person cited shall sign the citation giving his or her written promise to appear as stated therein. If the person cited fails to appear, the Enforcing Attorney may request issuance of a warrant for the arrest of the person cited.

F. Violations of Other Laws. Any person acting in violation of this chapter also may be acting in violation of the Federal Clean Water Act or the State Porter-Cologne Act and other laws and also may be subject to sanctions including civil liability. Accordingly, the Enforcing Attorney is authorized to file a citizen suit pursuant to Federal Clean Water Act Section 505(a), seeking penalties, damages and orders compelling compliance, and other appropriate relief. The Enforcing Attorney may notify EPA Region IX, the Santa Ana or San Diego Regional Water Quality Control Boards, or any other appropriate state or local agency, of any alleged violation of this chapter.

G. Injunctions. At the request of the City Manager, the Enforcing Attorney may cause the filing in a court of competent jurisdiction, of a civil action seeking an injunction against any threatened or continuing noncompliance with the provisions of this chapter. Any temporary, preliminary or permanent injunction issued pursuant hereto may include an order for reimbursement to the City of all costs incurred in enforcing this chapter, including costs of inspection, investigation and monitoring, the costs of abatement undertaken at the expense of the City, costs relating to restoration of the environment and all other expenses as authorized by law. (Ord. 2005-06 § 1, 2005: Ord. 97-26 § 2 (part), 1997)

#### **14.36.070 Permits.**

##### **A. Discharge Permit Procedure.**

1. Permit. On application of the owner of property or the operator of any facility, which property or facility is not otherwise subject to the requirements of a State General Permit or a National Pollution Discharge Elimination System Permit regulating storm water discharges, the City Manager or designee may issue a permit authorizing the release of nonstorm water discharges to the Storm Water Drainage System if:

- a. The discharge of material or constituents is reasonably necessary for the conduct of otherwise legal activities on the property; and

- b. The discharge will not cause a nuisance, impair the beneficial uses of receiving waters, or cause any reduction in established water quality standards.
2. Application. The applicant shall provide all information requested by the City Manager for review and consideration of the application, including but not limited to specific detail as to the activities to be conducted on the property, plans and specifications for facilities located on the property, identification of equipment or processes to be used onsite and other information as may be requested in order to determine the constituents, and quantities thereof, which may be discharged if permission is granted.
3. Permit Issuance. The permit shall be granted or denied by the City Manager or his or her designated representative, no later than sixty (60) business days following the receipt of a completed application as determined by the City Manager. The applicant shall be notified in person or by first-class mail, postage prepaid, of the action taken.
4. Permit Conditions. The permit may include terms, conditions and requirements to ensure compliance with the objectives of this chapter and as necessary to protect the receiving waters, including but not limited to:
  - a. Identification of the discharge location on the property and the location at which the discharge will enter the Storm Water Drainage System;
  - b. Identification of the constituents and quantities thereof to be discharged into the Storm Water Drainage System;
  - c. Specification of pollution prevention techniques and structural or nonstructural control requirements as reasonably necessary to prevent the occurrence of potential discharges in violation of this chapter;
  - d. Requirements for self-monitoring of any discharge;
  - e. Requirements for submission of documents or data, such as technical reports, production data, discharge reports, selfmonitoring reports and waste manifests; and
  - f. Other terms and conditions appropriate to ensure compliance with the provisions of this chapter and the protection of receiving waters, including requirements for compliance with best management practices guidance documents approved by any federal, State of California or regional agency.
5. General Permit. In the discretion of the City Manager the permit may, in accordance with the conditions identified in this section, be prepared as a general permit applicable to a specific category of activities. If a general permit is issued, any person intending to discharge within the scope of the authorization provided by the general permit may do so by filing an application with the City Manager. No discharge within the scope of the general permit shall occur until such application is so filed, unless, the City Manager in his discretion, has, as a condition of the general permit eliminated the requirement that an application for a general permit be filed.
6. Permit Fees. The permission to discharge shall be conditioned upon the applicant's payment of the City's costs, in accordance with a fee schedule adopted by separate resolution of the City Council, as follows:
  - a. For individually issued permits, the costs of reviewing the permit application, preparing and issuing the permit, and the costs reasonably related to administrating the permit program;
  - b. For general permits, the costs of reviewing the permit application, that portion of the costs of preparing the general permit which is reasonably attributable to the permittee's application for the

general permit, and the costs reasonably related to administering the general permit program, unless the general permit does not require an application.

B. Permit Suspension, Revocation or Modification.

1. The City Manager may suspend or revoke any permit when it is determined that:
  - a. The permittee has violated any term, condition or requirement of the permit or any applicable provision of this chapter; or
  - b. The permittee's discharge or the circumstances under which the discharge occurs have changed so that it is no longer appropriate to except the discharge from the prohibitions on prohibited discharge contained within this chapter; or
  - c. The permittee fails to comply with any schedule for compliance issued pursuant to this chapter; or
  - d. Any regulatory agency, including EPA or a Regional Water Quality Control Board having jurisdiction over the discharge, notifies the City that the discharge should be terminated.
2. The City Manager may modify any permit when it is determined that:
  - a. Federal or State law requirements have changed in a manner that necessitates a change in the permit; or
  - b. The permittee's discharge or the circumstances under which the discharge occurs have changed so that it is appropriate to modify the permit's terms, conditions or requirements; or
  - c. A change to the permit is necessary to ensure compliance with the objectives of this chapter or to protect the quality of receiving waters.

The permittee, or in the case of a general permit, each person who has filed an application pursuant to this section, shall be informed of any change in the permit terms and conditions at least sixty (60) days prior to the effective date of the modified permit. In the case of a general permit issued pursuant to Section [14.36.070\(A\)\(1\)](#), any change in the permit terms and conditions shall be published in newspaper of general circulation within the City (County) at least sixty (60) days prior to the effective date of the modified permit.

3. The determination that a permit shall be denied, suspended, revoked or modified may be appealed by a permittee pursuant to the same procedures applicable to appeal of an administrative compliance order hereunder. In the absence of a judicial order to the contrary, the permittee may continue to discharge pending issuance of the final administrative decision by the Hearing Officer.

C. Permit Enforcement.

1. Penalties. Any violation of the terms, conditions and requirements of any permit issued by the City Manager shall constitute a violation of this chapter and subject the violator to the administrative, civil and criminal remedies available under this chapter.

D. Compliance with the terms, conditions and requirements of a permit issued pursuant to this section shall not relieve the permittee from compliance with all federal, State and local laws, regulations and permit requirements, applicable to the activity for which the permit is issued.

1. Limited Permittee Rights. Permits issued under this section are for the person or entity identified therein as the "Permittee" only, and authorize the specific operation at the specific location identified in the permit. The issuance of a permit does not vest the permittee with a continuing right to discharge.

2. Transfer of Permits. No permit issued to any person may be transferred to allow:
  - a. A discharge to the Storm Water Drainage System at a location other than the location stated in the original permit; or
  - b. A discharge by a person other than the person named in the permit; provided however, that the City may approve a transfer if written approval is obtained, in advance, from the City Manager. (Ord. 97-26 § 2 (part), 1997)

**14.36.080 Compliance Disclaimer.**

Full compliance by any person or entity with the provisions of this chapter shall not preclude the need to comply with other local, state or federal statutory or regulatory requirements, which may be required for the control of the discharge of pollutants into storm water and/or the protection of storm water quality. (Ord. 97-26 § 2 (part), 1997)

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**This page of the Newport Beach Municipal Code is current through Ordinance 2010-12, passed July 6, 2010.**

Disclaimer: The City Clerk's Office has the official version of the Newport Beach Municipal Code. Users should contact the City Clerk's Office for ordinances passed subsequent to the ordinance cited above.

City Website: <http://www.newportbeachca.gov/>  
City Telephone: (949) 644-3005  
[Code Publishing Company](#)



## Appendix F

### 60 Day Notification Letters



# City of Newport Beach

Municipal Operations Department – Utilities Division

March 22, 2011

County of Orange  
Clerk-Recorder  
12 Civic Center Plaza, Room 101  
Santa Ana, CA 92701

Attention: Tom Daly, Clerk Recorder and Alisa Drakodaidis, Deputy CEO, OC Infrastructure

**Re: The City of Newport Beach 2010 Urban Water Management Plan Update**

Dear Mr. Daly,

The City of Newport Beach (the City) is in the process of preparing its 2010 Urban Water Management Plan (UWMP). UWMPs are prepared by California's urban water suppliers to support their long-term resource planning and ensure adequate water supplies are available to meet existing and future water demands. Every urban water supplier that either provides over 3,000 acre-feet of water annually or serves 3,000 or more connections is required to prepare an UWMP every five years.

A public hearing on the City's 2010 UWMP is tentatively scheduled for June 14, 2011. The draft plan will be available for review beginning May 10, 2011 on the City's website ([www.newportbeachca.gov](http://www.newportbeachca.gov)) and at City Hall located at 3300 Newport Blvd, Newport Beach, CA, 92663. The deadline for adopting the UWMP is July 1, 2011. A copy of the 2010 UWMP will be provided to the County of Orange no later than 30 days after its adoption.

Sincerely,

A handwritten signature in blue ink, which appears to read "George Murdoch".

George Murdoch, Utilities General Manager

Appendix G  
Public Hearing Notice

STATE OF CALIFORNIA) ) ss.  
COUNTY OF ORANGE )

May 28 and June 4, 2011

Executed on June 10, 2011)  
at Los Angeles, California

  
Signature

**NOTICE OF PUBLIC HEARING**  
**NOTICE IS HEREBY GIVEN** that the City Council of the City of Newport Beach will hold a public hearing to provide opportunity for public input on the draft update of Newport Beach's 2010 Urban Water Management Plan (UWMP). UWMPs are prepared by California's urban water suppliers to support their long-term resource planning and ensure adequate water supplies are available to meet existing and future water demands. Every urban water supplier that either provides over 3,000 acre-feet of water annually or serves 3,000 or more connections is required to prepare an UWMP every five years.

**NOTICE IS HEREBY FURTHER GIVEN** that said public hearing will be held on June 14, 2011, at 7 p.m. in the City Council Chambers (Building A) at 3300 Newport Boulevard, Newport Beach, at which time and place any and all persons interested may appear and be heard thereon. A copy of the draft UWMP is currently available for public review at the City Clerk's Office (Building B), 3300 Newport Boulevard, Newport Beach, California, 92663, or at the City of Newport Beach website at [www.newportbeach.ca.gov](http://www.newportbeach.ca.gov) on the Thursday prior to the hearing. For information please contact George Murdoch at (949) 644-3011.

/s/  
Leilani Brown, City Clerk  
City of Newport Beach  
Published Newport Beach/Costa Mesa Daily Pilot June 4, 2011

Appendix H  
Copy of Plan Adoption

RESOLUTION NO. 2011-53

**A RESOLUTION OF THE CITY COUNCIL OF THE CITY  
OF NEWPORT BEACH ADOPTING THE 2010 URBAN  
WATER MANAGEMENT PLAN**

WHEREAS, the California Legislature enacted Assembly Bill 797 (Water Code Section 10610 et seq., known as the Urban Water Management Planning Act) during the 1983-84 Regular Session, and subsequent amendments mandate every supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually, to prepare an Urban Water Management Plan (Plan), the primary objective of which is to plan for the conservation and efficient use of water; and

WHEREAS, the City of Newport Beach (City) is an urban supplier of water providing water to a population of over 67,000 persons within its service area; and

WHEREAS, the Plan shall be periodically reviewed at least once every five years, and that the City shall make any amendments or changes to its Plan which are indicated by the review; and

WHEREAS, the Plan must be adopted after a public review and hearing and filed with the California Department of Water Resources within thirty day of adoption; and

WHEREAS, the City has therefore, prepared and circulated for public review a draft Urban Water Management Plan, and a properly noticed public hearing regarding said Plan held on June 14, 2011, and;

WHEREAS, the City did prepare and shall file said Plan with the California Department of Water Resources and submit said Plan to the California State Library and County of Orange by July 14, 2011

NOW, THEREFORE BE IT RESOLVED by the City Council of the City of Newport Beach that the 2010 Urban Water Management Plan is hereby adopted and order filed with the City Clerk. The Municipal Operations Department Director is hereby authorized and directed to file the 2010 Urban Water Management Plan with the California Department of Water Resources within 30 days of this date and before July 14, 2011.

ADOPTED, this 14th day of June 2011.



MAYOR

ATTEST:



CITY CLERK



STATE OF CALIFORNIA                    }  
COUNTY OF ORANGE                    }  
CITY OF NEWPORT BEACH                }       ss.

I, Leilani I. Brown, City Clerk of the City of Newport Beach, California, do hereby certify that the whole number of members of the City Council is seven; that the foregoing resolution, being Resolution No. 2011-53 was duly and regularly introduced before and adopted by the City Council of said City at a regular meeting of said Council, duly and regularly held on the 14th day of June, 2011, and that the same was so passed and adopted by the following vote, to wit:

Ayes:       Hill, Rosansky, Gardner, Selich, Curry, Daigle, Mayor Henn

Noes:       None

Absent:     None

Abstain:   None

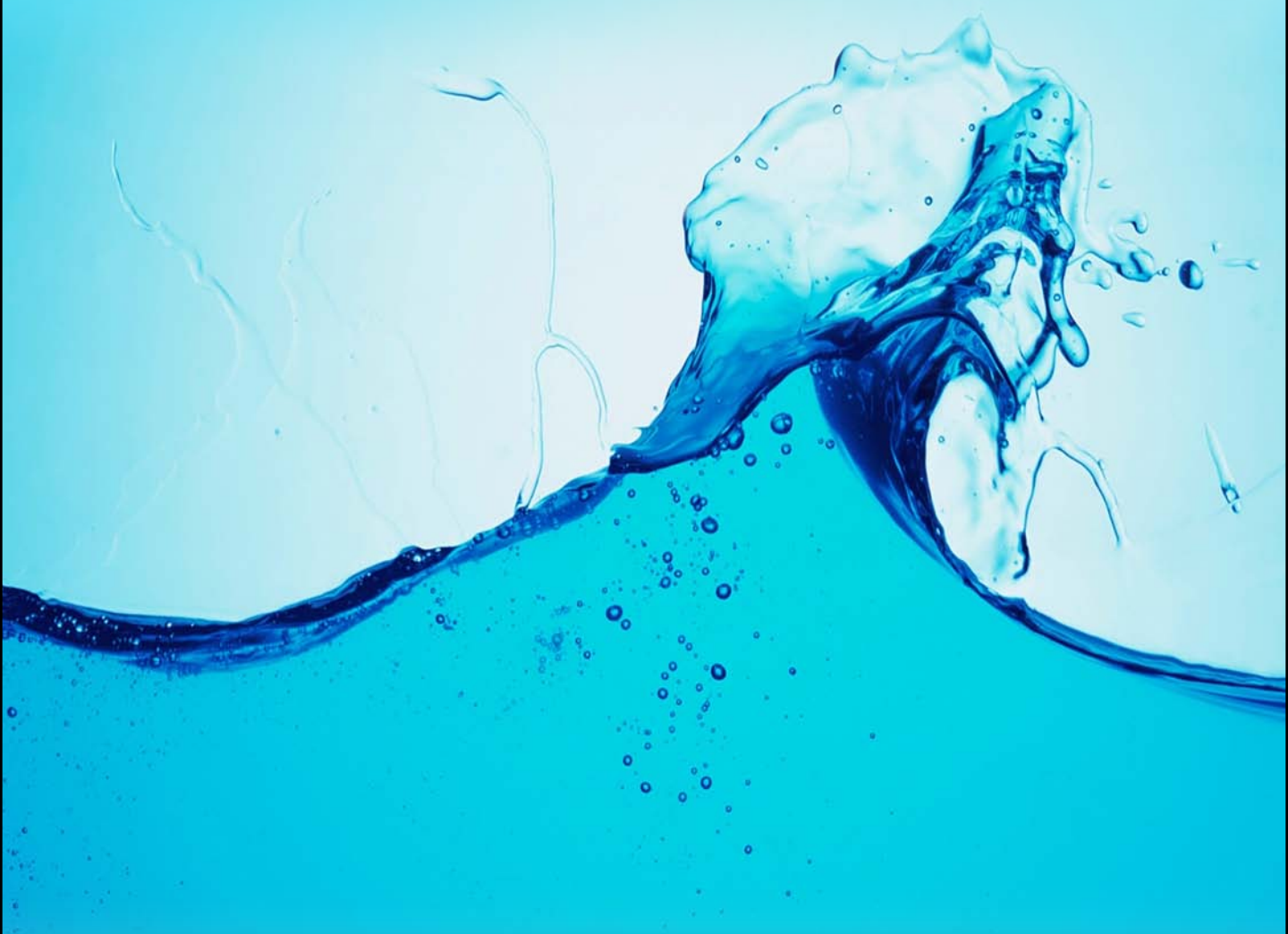
IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed the official seal of said City this 15th day of June, 2011.

  
\_\_\_\_\_  
City Clerk  
Newport Beach, California

(Seal)







8001 Irvine Center Drive, Suite 1100  
Irvine, CA 92618  
949.450.9901 Fax 949.450..9902

**MALCOLM  
PIRNIE**

 **ARCADIS**

*The Water Division of ARCADIS*