CHAPTER IV

GROUNDWATER BASIN REPORTS

NORTHWEST METROPOLITAN SERVICE AREA BASINS

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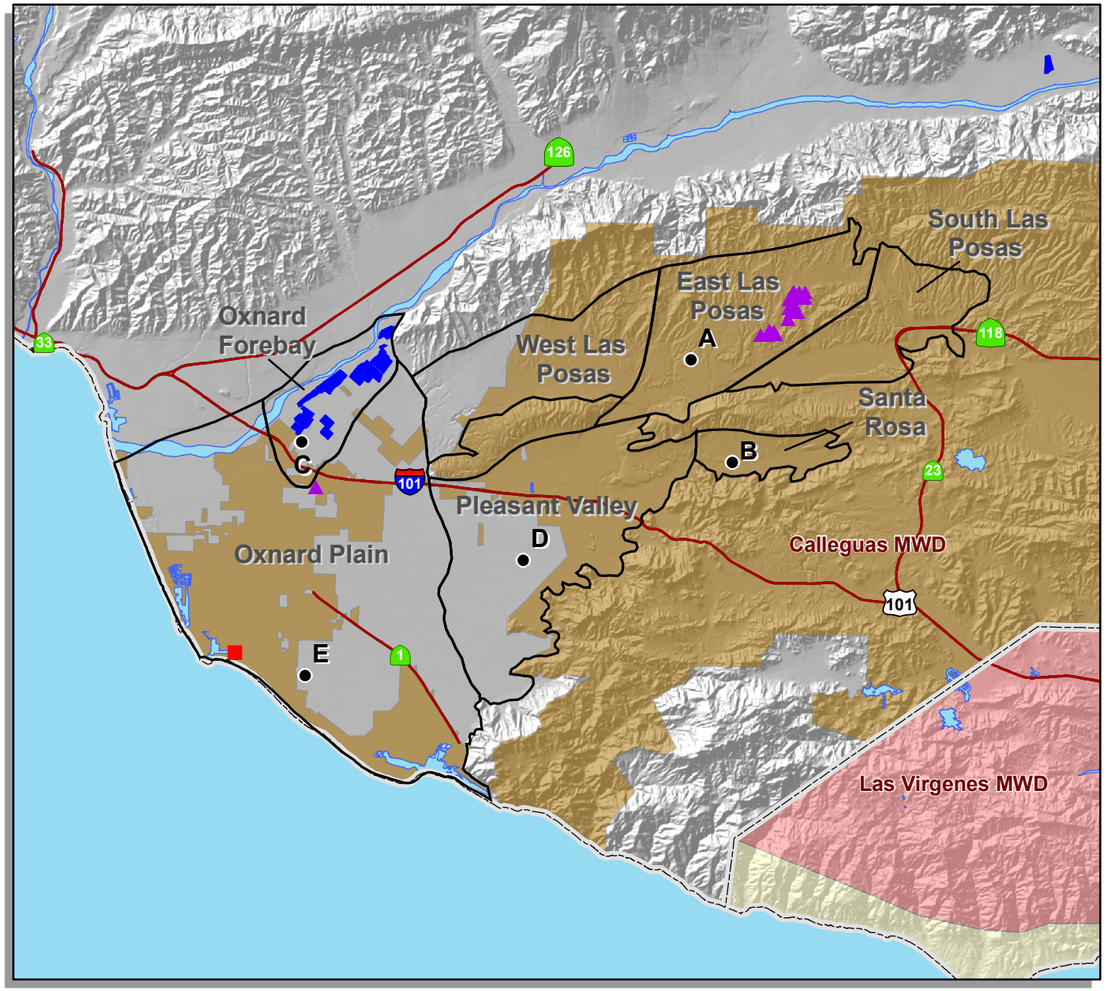

Ventura County Basins

A ● Key wells
▲ ASR Wells
■ Desalter
Recharge Basins
County
Freeways
Water Body
Groundwater Basins
MWD Member Agency Boundary (color varies)

N W E S

2 1 0 2 Miles

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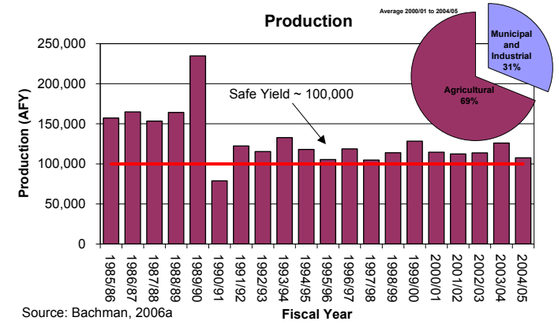
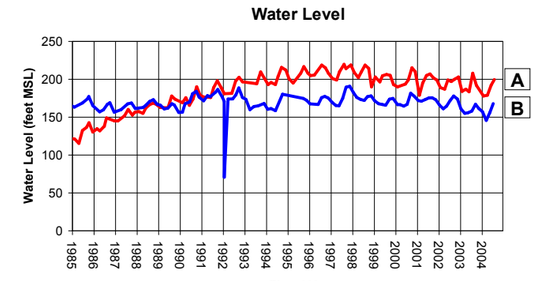
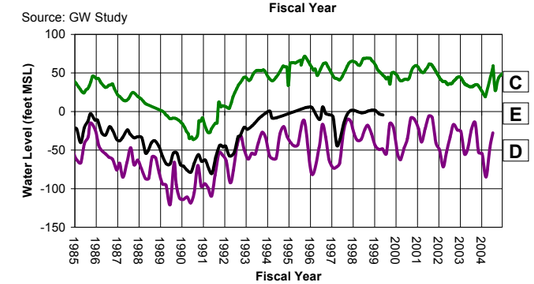
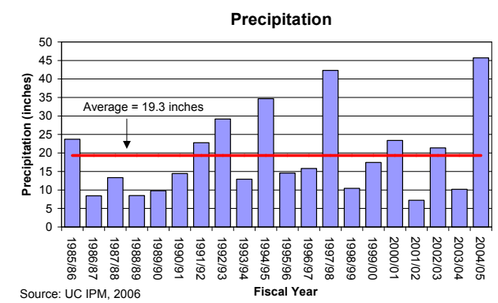


Source: Bachman, 2006a

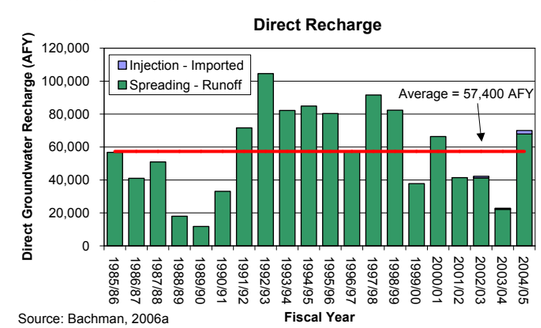


Source: GW Study





Source: UC IPM, 2006



Source: Bachman, 2006a

BASIN FACTS

Ventura County Basins

Description
Location: Ventura County
Watershed Surface Area: ~ 177 square miles
Subbasins:
Oxnard Plain,
Oxnard Forebay
Pleasant Valley
Las Posas
Santa Rosa
Management: Managed.
Managed by Fox Canyon Groundwater Management Agency since 1983.
MWD Member Agencies:
Calleguas MWD

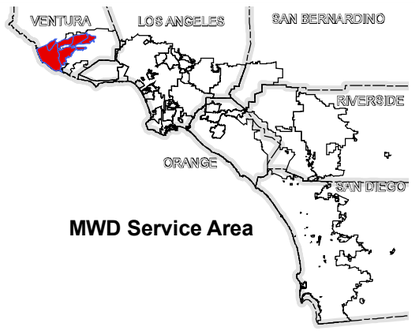
	Ventura
Safe Yield	100,000 AFY
Total Storage	3 to >6 million AF
Unused Storage Space	Unknown
Portion of Unused Storage Available for Storage (2005)	~1 million AF

Storage and Extraction Facilities

	Ventura
Production Wells	
Production Capacity	~470,000 AFY
Average 1985/86-2004/05	~129,000 AFY
Injection Wells	
Injection Capacity	~45,600 AFY
Average 2002/03-2004/05	~1,200 AFY
Spreading Basins	
Spreading Capacity	~160,000 AFY
Average 1985/86-2004/05	~57,200 AFY

Basin Management Considerations

- Groundwater production in Oxnard Plain limited by seawater intrusion
- TDS and nitrate concentrations may limit groundwater production.
- Subsidence potential limits groundwater production
- Production is limited by GMA
- SWRCB requirements for surface water recharge when groundwater levels drop below specified levels during droughts affect amount of recharge.



MWD Service Area

Plate 1-1
Overview of Ventura County Basins

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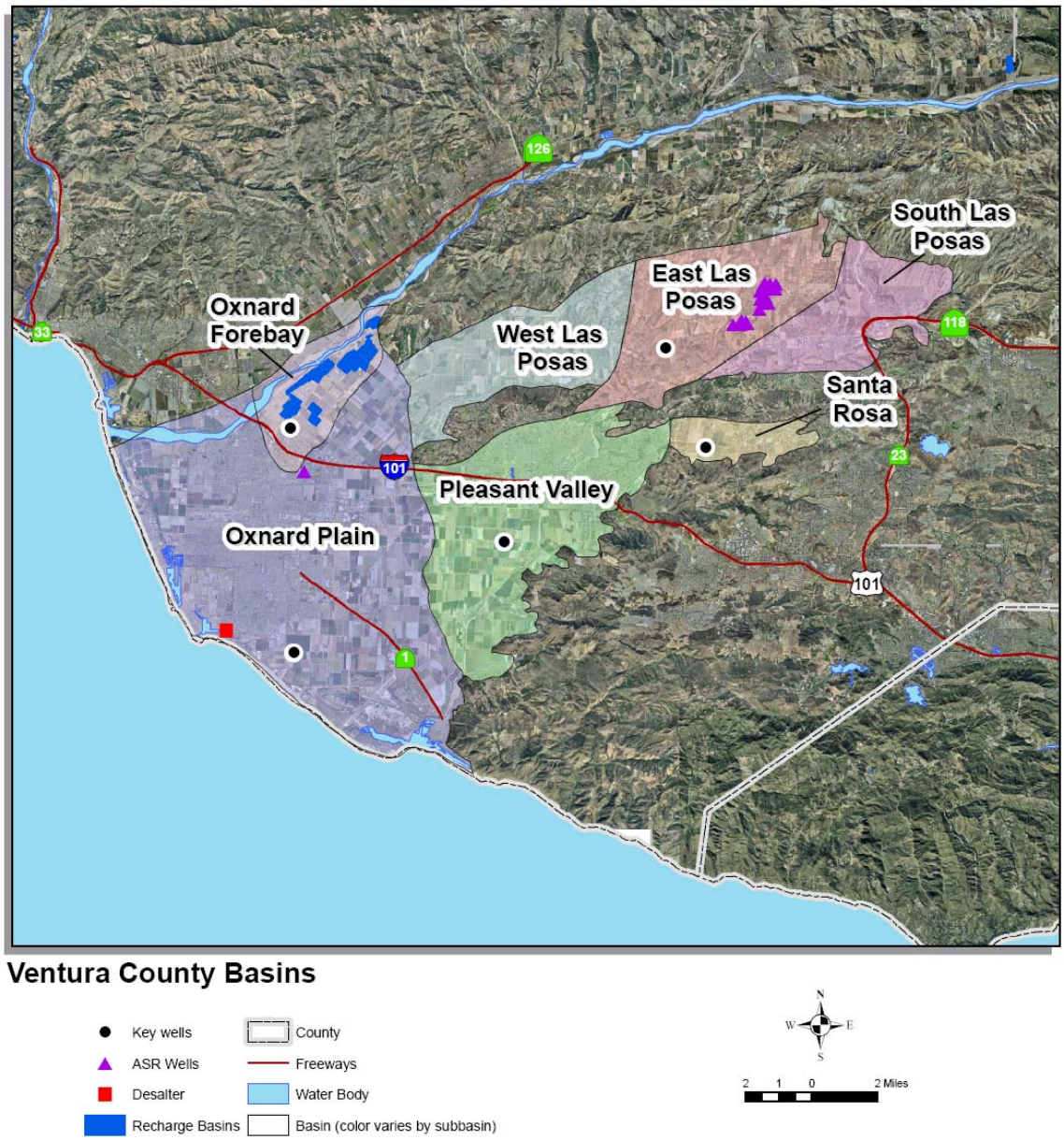
The Ventura County Basins include seven groundwater basins located within the Metropolitan service area in southern Ventura County, portions of which underlie the Santa Clara River Valley. The groundwater basins include: Oxnard Plain, Oxnard Forebay, Pleasant Valley, Santa Rosa and West, East and South Las Posas Basins. The location of the Ventura County Basins is shown in **Figure 1-1**.

Figure 1-1
Map of the Ventura County Basins



BASIN CHARACTERIZATION

The following section provides a physical description of the Ventura County Basins and their hydrogeologic character. The basins comprise a series of east-west trending valleys that drain westerly to the Pacific Ocean by the Santa Clara River, Calleguas Creek and Conejo Creek. The river and creeks drain the Santa Monica Mountains on the south, the Santa Susana Mountains on the east and the intervening Camarillo Hills, Las Posas Hills, South Mountain, and Oak Ridge.

Basin Producing Zones and Storage Capacity

A summary of the general hydrogeologic characteristics of the basins is provided in **Table 1-1** (Fox Canyon GMA, 2006; Bachman, 2006a).

Basin Producing Zones

The Ventura County Basins generally contain two major aquifer systems: the Upper Aquifer System (UAS) and the Lower Aquifer System (LAS). The UAS consists of late Pleistocene to Holocene-age sands and gravels that locally comprise the Oxnard and Mugu aquifers. The LAS includes the Hueneme, Fox Canyon and Grimes Canyon aquifers. The aquifers are unconfined in the Oxnard Forebay and confined beneath the Oxnard Plain and Pleasant Valley basins. Aquifers in the Las Posas and Santa Rosa basins generally are unconfined where the aquifers reach the surface and adjacent to surface water streams and confined elsewhere. The nature and extent of the aquifers within each subbasin is discussed below.

Oxnard Forebay and Oxnard Plain Basins

Both UAS and LAS are present in these basins. The Oxnard Plain Forebay Basin is the main source of recharge to aquifers beneath the Oxnard Plain. Recharge to the Forebay basin comes from a combination of percolation of Santa Clara River flows, artificial recharge at spreading grounds, irrigation return flows, percolation of rainfall, and underflow from adjacent basins. The Oxnard aquifer is the primary aquifer used for groundwater supply in the Oxnard Plain (Fox Canyon GMA, 2006). Seawater intrusion into the Oxnard Plain Basin has long been a primary concern of the Fox Canyon Groundwater Management Agency (Fox Canyon GMA, 2006). **Figure 1-2** shows a cross section through the Oxnard Forebay and Oxnard Plain basins showing areas of seawater intrusion.

Pleasant Valley Basin

The Fox Canyon aquifer is the major water-bearing unit in this basin. The groundwater hydrology of portions of this basin are little understood, and additional monitoring and studies are needed (Fox Canyon GMA, 2006).

Santa Rosa Basin

Santa Rosa Basin is the smallest of the Ventura County basins. Aquifers in the basin include a shallow alluvial aquifer and portions of the LAS. Groundwater levels are heavily influenced by

flows in the overlying Conejo Creek. Discharges from a wastewater treatment plant and dewatering wells in Thousand Oaks have considerably increased year-round flows in the creek. Elevated nitrate and sulfate have been a problem in the basin (Fox Canyon GMA, 2006).

Table 1-1
Summary of Hydrogeologic Parameters of Ventura County Basins

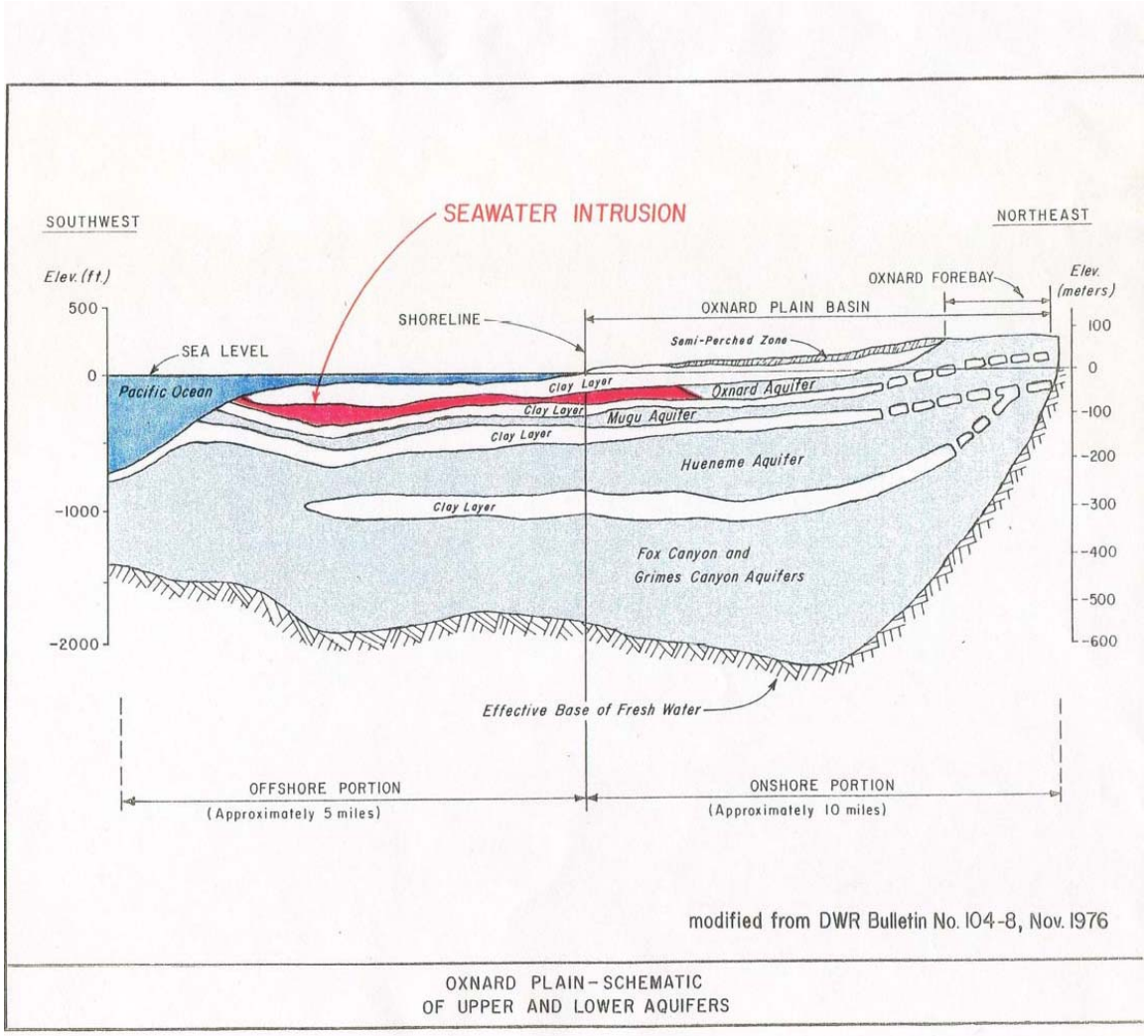
Parameter	Description
Structure	
Basins	Oxnard Plain, Oxnard Plain Forebay, Pleasant Valley, Santa Rosa, and East, West and South Las Posas basins
Aquifer(s)	Upper Aquifer System • Oxnard aquifer • Mugu aquifer Lower Aquifer System • Hueneme aquifer • Fox Canyon aquifer • Grimes Canyon aquifer
Depth of groundwater basin	~ 300 to 3,000 feet
Depth of producing zones or screen intervals	100 to 700 feet (to top of producing zone)
Thickness of water-bearing units	Several 10s to several 100s of feet
Yield and Storage	
Natural Safe Yield	~ 45,000 AFY
Operational Safe Yield	~100,000 AFY
Total Storage	~ 3 to > 6 million AF
Unused Storage Space	Unknown
Portion of Unused Storage Space Available for Storage	~ 1 million AF

Source: Bachman, 2006a and 2006b

Las Posas Basin

The Las Posas Basin has been previously subdivided into north and south, and more recently into west, east, and south basins. The GMA is now utilizing the more recent delineation developed by the USGS in the late 1990s, and basin maps and discussion in this overview have been adjusted to reflect the USGS terminology.

Figure 1-2
Geologic Cross Section in Oxnard Forebay and Oxnard Plain



Source: Fox Canyon GMA, 2006

The South Las Posas Basin is separated from East Las Posas Basin by an east-west trending rise in the subsurface. Over the past 40 years groundwater levels in South Las Posas Basin have risen more than 100 feet due to recharge from wastewater treatment plant discharges. Salts in the South Las Posas Basin groundwater have also increased, apparently leached from shallow aquifer sediments as groundwater levels reached historic highs (Fox Canyon GMA, 2006).

The East Las Posas Basin is separated from West Las Posas by a north-trending unnamed fault, across which groundwater levels differ by as much as 400 feet. Recharge of East Las Posas Basin is also now dominated by wastewater treatment plant discharges and groundwater levels have risen 125 to 200 feet over the past 30 years (Fox Canyon GMA, 2006).

West Las Posas Basin is isolated from the South and East Las Posas basins by a north-south fault, and is hydrologically connected to the Oxnard Plain Basin (Fox Canyon GMA, 2006).

Storage Capacity

The estimated total storage capacity of the Ventura County Basins is not clearly known because a large portion of this volume is located beneath the Pacific Ocean. Estimates range between 3 and 6 million AF. The amount of usable storage has been affected by seawater intrusion along the coastal plain, impact of saline plumes from marine sediments and contamination in the UAS by nitrates from overlying fertilizer use and septic system discharges.

The available storage capacity has not been calculated for all basins (except in the Las Posas basin, where it has been calculated at about 300,000 AF). However, the USGS and United Water Conservation District (UWCD) have calculated that about 1 million AF of water has been overdrafted from the coastal Ventura County Basins, with subsidence reducing the replaceable storage volume to about 800,000 AF. This storage volume is not all available, however, because seawater has filled a portion of this storage space. Much of this replaced storage occurs in offshore portions of the aquifers where it cannot be monitored and, therefore, the remaining available storage space is unknown. However, the available storage capacity is likely to be substantial with a rough estimate of 1 million AF (Bachman, 2006a).

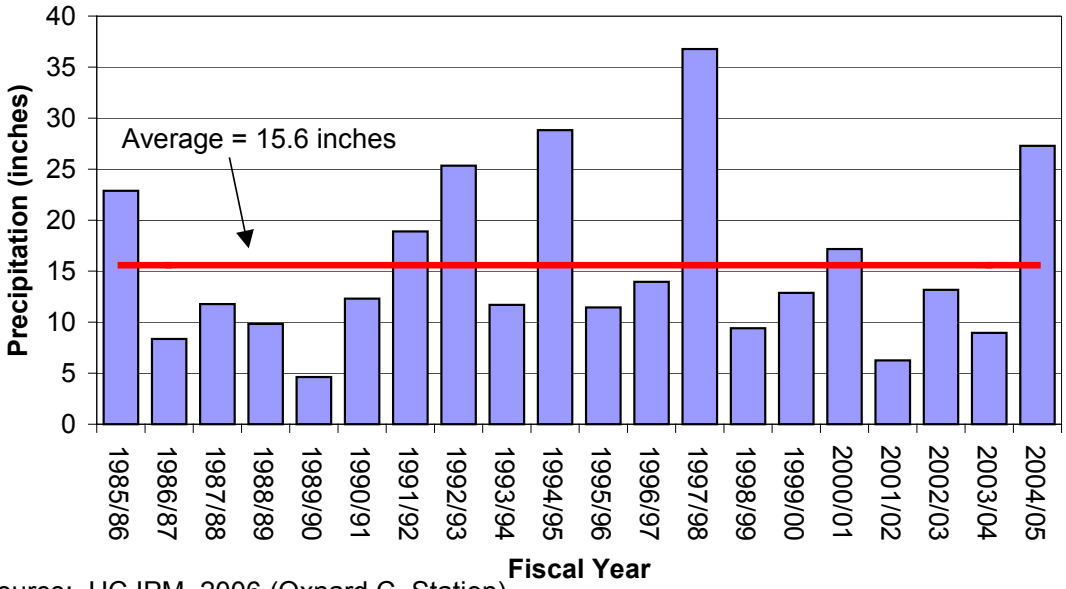
Safe Yield/Long-Term Balance of Recharge and Discharge

Natural groundwater recharge to the Ventura County Basins occurs through infiltration of rainfall and percolation of surface runoff along the main drainages (primarily the Santa Clara River) in areas where the underlying aquifer is unconfined.

Natural recharge from precipitation and runoff is the largest inflow to the basin. Precipitation over the watershed of the Ventura County Basins varies significantly from year to year and by elevation. Historical precipitation at the Oxnard rain gauge between fiscal years 1985/86 and 2004/05 is shown in **Figure 1-3**. Over this time period the precipitation at the Oxnard gauge ranged between about 5 and 37 inches per year and averaged about 15.6 inches per year (UC IPM, 2006). These data suggest below average precipitation between 1986 and 1990 and between 1999 and 2003, above average precipitation between 1991 and 1998. Groundwater discharge occurs predominantly through pumping.

In 1985, the operational safe yield (the amount of production that the basin can sustain without incurring negative impacts) for the Ventura County Basins was estimated to be 120,000 AFY (Bachman, 2006b). In 2006, the operational safe yield estimate was updated using a groundwater model to be approximately 100,000 AFY (Fox Canyon GMA, 2006). This operational safe yield is based upon historical recharge with additional pumping reductions in the Oxnard Plain and Pleasant Valley subbasins. As discussed below, historically, production from the Ventura County Basins has exceeded the basins' yield and the basins have been in overdraft for decades (Fox Canyon GMA, 2006).

Figure 1-3
Historical Precipitation in the Ventura County Basins



Source: UC IPM, 2006 (Oxnard C. Station)

GROUNDWATER MANAGEMENT

The following section provides a brief description of the groundwater management activities and governing structure for the Ventura County Basins.

Basin Governance

The Ventura County Basins are managed. In 1982, the California State Legislature established the Fox Canyon Groundwater Management Agency (GMA) under the State Water Code for the overall management of the southern Ventura County Basins. The statute specifies the GMA's activities as "planning, managing, controlling, preserving, and regulating the extraction and use of groundwater within the territory of the agency" and distinguished those duties of the GMA from those of the other agencies providing flood control, operating spreading grounds, water distribution and the sale of water. Under this legislative act, the GMA has worked closely with other districts and county agencies to study and control the groundwater resources in these basins. The agencies and their roles and responsibilities for the Ventura County Basins are summarized in **Table 1-2**.

The GMA adopted its first management plan in 1987. The Groundwater Management Plan has been recently updated with a current draft published in October 2006. The plan reviews the status of the basins, identifies problems, documents knowledge of their causes, and sets out specific basin management objectives for resolution.

Table 1-2
Summary of Management Agencies in the Ventura County Basins

Agency	Role
Fox Canyon Groundwater Management Agency (GMA)	Establishes policy Sets pumping allocations, phased reductions, water level and water quality criteria through its Groundwater Management Plan
United Water Conservation District (UWCD)	Operates river diversions, spreading basins, in-lieu pipelines, and reservoir to capture winter runoff. Conducts seawater intrusion monitoring, area-wide monitoring database management, area-wide studies and reporting, maintenance of area-wide groundwater model, and technical analyses for GMA
Calleguas Municipal Water District (Calleguas MWD)	Operates the Las Posas ASR project. Performs duties specified in the East Las Posas Basin Management Plan (included within the GMA Groundwater Management Plan) with local pumpers in the Las Posas Basin Users Group. Performs regional water supply planning with United Water Conservation District.
Ventura County Water Resources Dept.	Issues well permits and ordinances (including which aquifers to pump). Shares monitoring responsibilities with UWCD.
State Water Resources Control Board	Controls conditions for the Oxnard Forebay Basin: when groundwater levels fall below a specified level, all diverted surface waters must go to spreading
Las Posas Basin Users Group	Forum for discussion of issues related to Las Posas ASR Project

In 1990, to address continuing seawater intrusion in the Oxnard Plain due to overpumping, the GMA adopted an ordinance that requires a 25 percent phased reduction in groundwater pumping throughout the GMA (the phasing will be complete in 2010). In 2006, the pumping allocation reduction was adjusted to 20 percent. In addition, storage projects require GMA approval (time and place of extraction); new wells are restricted to certain aquifers depending on seawater intrusion limits and coastal pumping patterns (Bachman, 2006a). Further, the State Water

Resources Control Board directed that all surface water be channeled to the spreading basins when groundwater levels drop below a certain level during drought periods (Bachman, 2006a). The 2006 Groundwater Management Plan builds on these prior efforts and seeks additional success in managing seawater intrusion in the Oxnard Plain, nitrate levels in the Oxnard Plain Forebay and Santa Rosa basins, and chloride concentrations in the Pleasant Valley and Las Posas basins.

In 1987, the GMA adopted an ordinance that limited new production in the Los Posas Basin. The Las Posas Basin Users Group, consisting of representatives of the well owners and Calleguas MWD discuss issues related to the Las Posas Aquifer Storage and Recovery (ASR) Project and wells within the Las Posas Basin (Bachman, 2006b). The 2006 Groundwater Management Plan includes a draft East Las Posas Basin Management Plan specifying a management process and reporting and meeting requirements for coordinating the operation of the ASR wells and other production within the basin. (Fox Canyon GMA, 2006).

Interactions with Adjoining Basins

The Santa Clara River is a major source of natural recharge to the Oxnard Plain Forebay, Oxnard Plain, and Pleasant Valley groundwater basins. As such, there is a Memorandum of Understanding among the United Water Conservation District and the water purveyors of the Santa Clarita area in Los Angeles County that calls for flows of the Santa Clara River across the Los Angeles-Ventura county line not to be diminished by water management policies in Santa Clarita.

WATER SUPPLY FACILITIES AND OPERATIONS

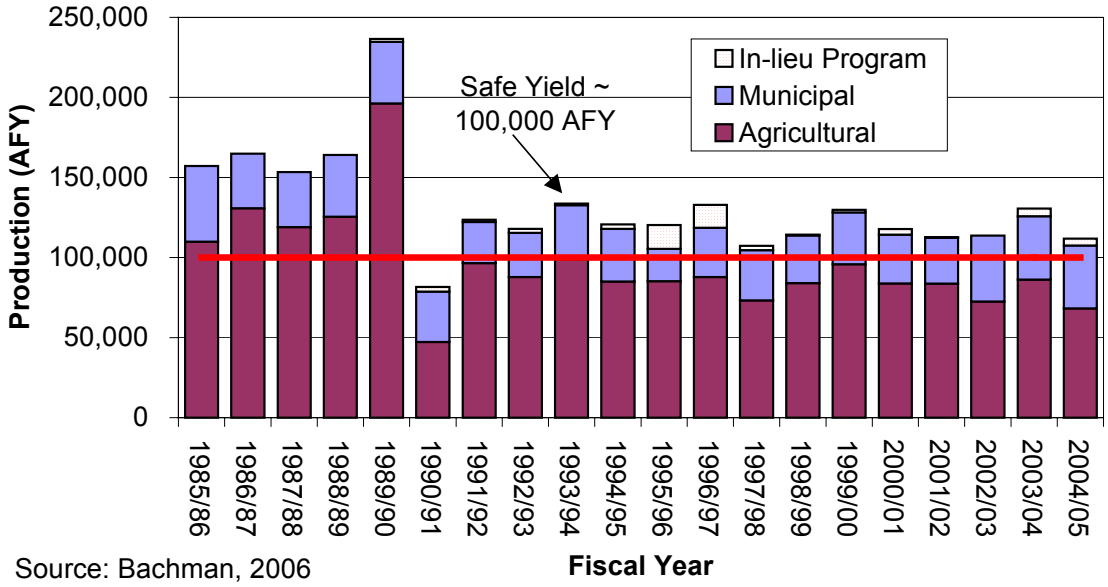
Facilities within the Ventura County Basins include: Approximately 600 groundwater production wells, 18 ASR wells in the East Las Posas Basin and one injection well in the Oxnard Plain Basin, and 220 acres of spreading basins in the Oxnard Forebay Basin.

Active Production Wells

Table 1-3 summarizes the details of the production wells in the Ventura County Basins. There are approximately 94 active municipal supply wells in the Ventura County Basins that produce only about 1/3 of the total production. Out of the 94 municipal wells, 10 are scheduled for rehabilitation or replacement in the next 5 years (Bachman, 2006a). The operational costs of the municipal wells are summarized in **Table 1-3**.

Figure 1-4 summarizes the historical production data between 1985 and 2004. Basin production decreased from an average of about 150,000 AFY between 1985 and 1989 and a peak of about 240,000 in the 1989/90 water year to an approximate average near 114,000 AFY between the 1990/91 and 2004/05 water years (Bachman, 2006a). Note that agricultural production decreased from an average of more than 136,000 AFY between 1985 and 1990 to about 82,500 AFY after 1990. This decrease in production is largely due to pumping reductions implemented by the GMA in 1990 and some agricultural to municipal land use changes (Bachman, 2006b).

Figure 1-4
Historical Groundwater Production in the Ventura County Basins



Source: Bachman, 2006

Table 1-3
Summary of Production Wells in the Ventura County Basins

Category	Number of Active Wells	Estimated Production Capacity [2] (AFY)	Average Production 1985-1989 (AFY)	Average Production 1990-2004 (AFY)	Well Operation Cost ($/AF)
Municipal/Industrial/ Domestic Wells	120	94, 000	38,500	31,700	
Other Wells (Agricultural)	491	393,000	136,300	82,500	$85
Total	611	487,000	174,800	114,200	

Source: CMWD (2006)
1. Active wells have production within past 5 years
2. Estimated production capacity is based upon maximum semi-annual production for the past 5 years.

Ventura County Basin producers participate in a variety of in-lieu groundwater storage programs whereby they receive imported water from Metropolitan in lieu of pumping groundwater. Historically, these programs have included Metropolitan's replenishment water and conjunctive use programs. The long-term in-lieu storage is included in **Figure 1-4.** Between fiscal years 1985/86 and 2004/05, about 3,500 AFY was stored for long-term storage via in-lieu. These and other storage programs are discussed in more detail below.

Other Production

As discussed above, agricultural production within the Ventura County Basins is more than 2/3 of the total production. To help manage this production, the GMA is working to limit export of groundwater to lands that do not directly overlie the groundwater basins (Fox Canyon GMA, 2006).

ASR Wells

Of the 94 municipal wells, 18 are active ASR wells, all located in the Las Posas Basin. The well locations are shown in **Figure 1-1**. The Las Posas ASR wells have a total injection capacity of 63 cfs and a total extraction capacity of 90 cfs for the ASR Project (Bachman, 2006a). The annual recharge amounts from these wells are shown in **Figure 1-5**. An average of about 1,500 AFY was injected as part of the ASR Project in the Las Posas Basin between 2002 and 2005.

The City of Oxnard currently owns and operates an injection well in the Oxnard Plain. Details regarding operation of this well are not available at this time.

Spreading Basins

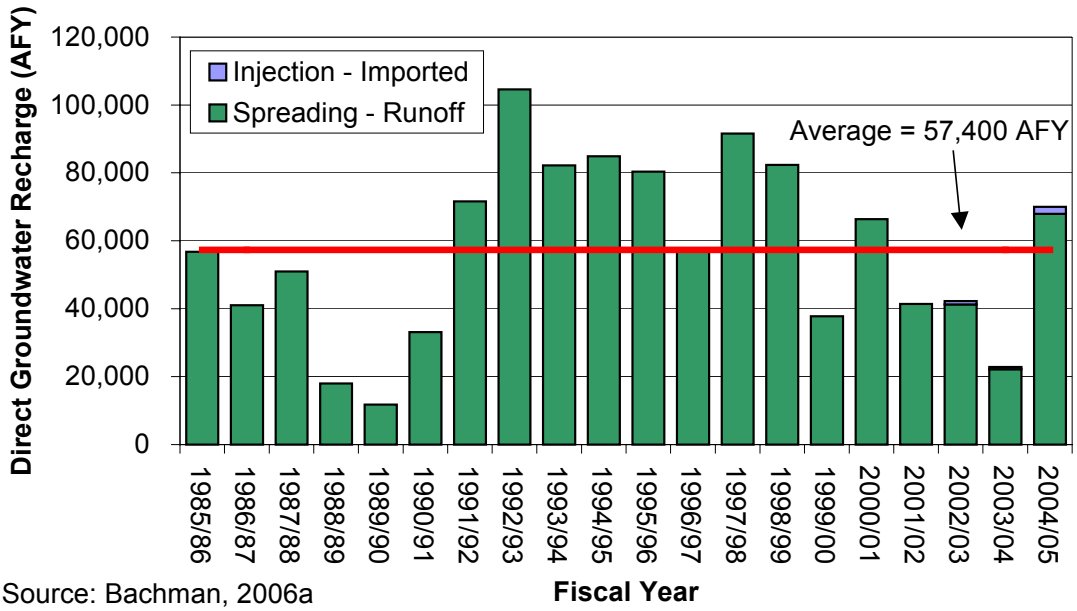
There are approximately 220 acres of spreading basins in the Ventura County. Data related to these basins are summarized in **Table 1-4.** Groundwater recharge from 1985 to 2005 is shown on **Figure 1-5**. An average of about 57,200 AFY of runoff was recharged in the Oxnard Forebay between fiscal years 1985/86 and 2004/05.

Table 1-4
Summary of Spreading Basins in the Ventura County Basins

Spreading Basin	Area (acres)	Recharge Capacity (cfs)	Recharge capacity[1] (AF/month)	Source water	Owner
Saticoy	120	Data not available	7,500	Runoff Recycled [2]	United Water CD
El Rio	100	Data not available	6,000	Runoff Recycled [2]	United Water CD

Source: Bachman, 2006a
1. Based on existing recharge; 2. Incidental recycled water recharge only

Figure 1-5
Historical Groundwater Recharge in the Ventura County Basins



Source: Bachman, 2006a

Seawater Intrusion Barriers

There are no seawater intrusion barriers in the Ventura County Basins.

Desalters

The City of Port Hueneme operates a desalter using reverse osmosis to reduce TDS concentrations in the Oxnard Plain Basin. This desalter came online in 1997. This desalter is discussed in more detail in the water quality section below.

GROUNDWATER LEVELS

Figures 1-6 and 1-7 summarize historical groundwater levels in the Ventura County Basins. Water levels have risen in the Las Posas Basin in both the UAS and the LAS. Note that water levels in the LAS are generally as much as 100 feet lower than the UAS. This is consistent throughout the Ventura County Basins.

As shown in **Figure 1-7**, groundwater levels in the coastal basins (Oxnard Forebay, Oxnard Plain and Pleasant Valley) have begun to recover since the implementation of pumping restrictions in 1990. However, at the present low groundwater levels, seawater intrusion and other contaminants are continuing to invade the potable water aquifers in the Oxnard and Pleasant Valley basins (Bachman, 2006a). Water levels in many areas remain below sea level. It is also important to note that water levels in the LAS are generally lower than the UAS resulting in a downward gradient, which has led to increasing saline intrusion in the LAS.

Figure 1-6
Historical Water Levels in the Las Posas and Santa Rosa Basins

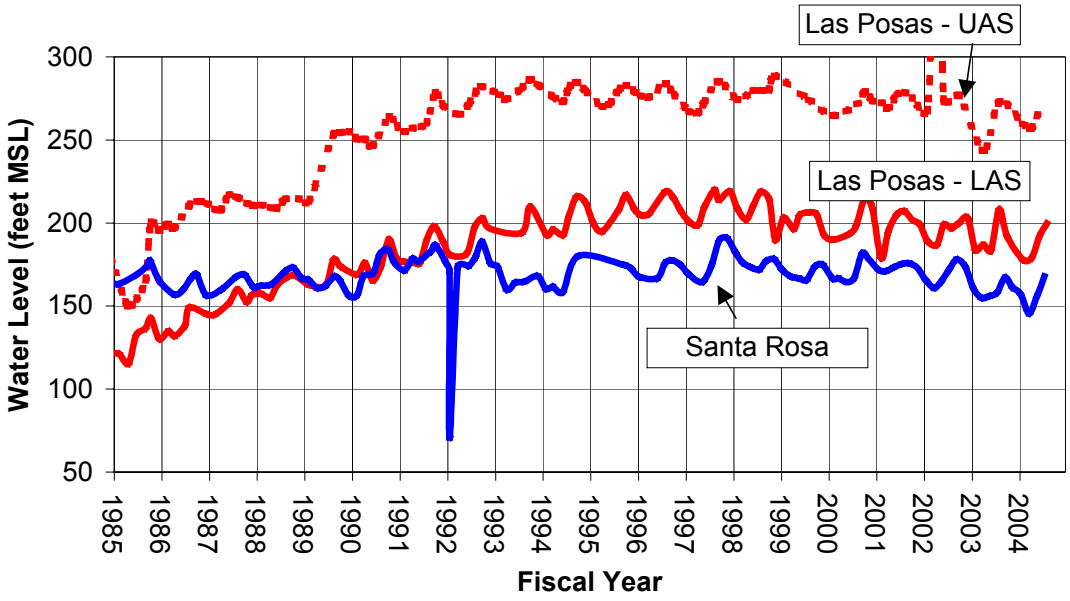
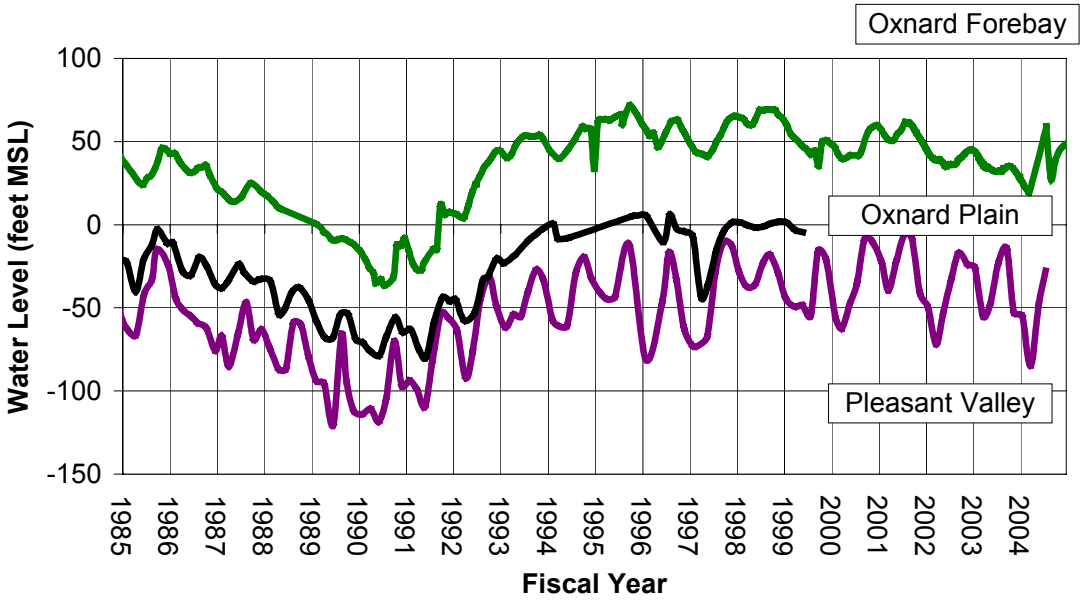


Figure 1-7
Historical Water Levels in the Oxnard Forebay, Oxnard Plain and Pleasant Valley Basins



In addition, areas of subsidence have been observed in the coastal basins. As much as 2.7 feet of land subsidence has been observed in the Oxnard and Pleasant Valley basins.

Groundwater levels have also increased in the Las Posas and Santa Rosa subbasins. As discussed in more detail below, these increases have resulted in leaching of salts from the previously unsaturated sediments into the groundwater.

GROUNDWATER QUALITY

The following section describes the water quality issues in the Ventura County Basins. General water quality issues include seawater intrusion in the coastal aquifers and nitrate and sulfate concerns in the agricultural areas. TDS concentrations throughout much of the Ventura County Basins exceed 1,000 mg/L.

Groundwater Quality Monitoring

Water quality is measured on a regular basis at key wells throughout the Ventura County Basins. In addition over 100 non-drinking water production wells are monitored for water quality (Bachman, 2006a). In 1989, the U.S. Geological Survey initiated their Regional Aquifer-System Analysis (RASA) study in a cooperative effort with local agencies. As part of this and companion cooperative studies, a series of 14 nested well sites with three or more wells installed at each site, were drilled and completed at specific depths in the Oxnard Plain, Oxnard Plain Forebay, Pleasant Valley, and Las Posas basins (Fox Canyon GMA, 2006).

Groundwater Contaminants

Constituents of concern for the Ventura County Basins include: total dissolved solids (TDS), nitrate, chloride, iron, manganese and sulfate. Concentrations of these constituents since 2000 are summarized in **Table 1-5**. In addition, constituents of regional concern (volatile organic compounds, or VOCs, and perchlorate) are also included for reference.

Seawater intrusion has long been the primary water concern within the GMA and was the problem for which the GMA was originally formulated to help fix. The intrusion occurs exclusively along the coastline in the Oxnard Plain basin. The U.S. Geological Survey also identified another type of saline intrusion on the Oxnard Plain – salts moving from the surrounding marine clays and older geologic units as pressure in the aquifers is reduced from overpumping. This type of intrusion may also be occurring on a minor scale in the Pleasant Valley basin. Chloride has also become a problem along Arroyo Las Posas, where groundwater from an area in the East and South Las Posas basins must be blended with lower-chloride water to meet irrigation suitability. This problem appears to have migrated downstream, with some of the City of Camarillo's wells now affected.

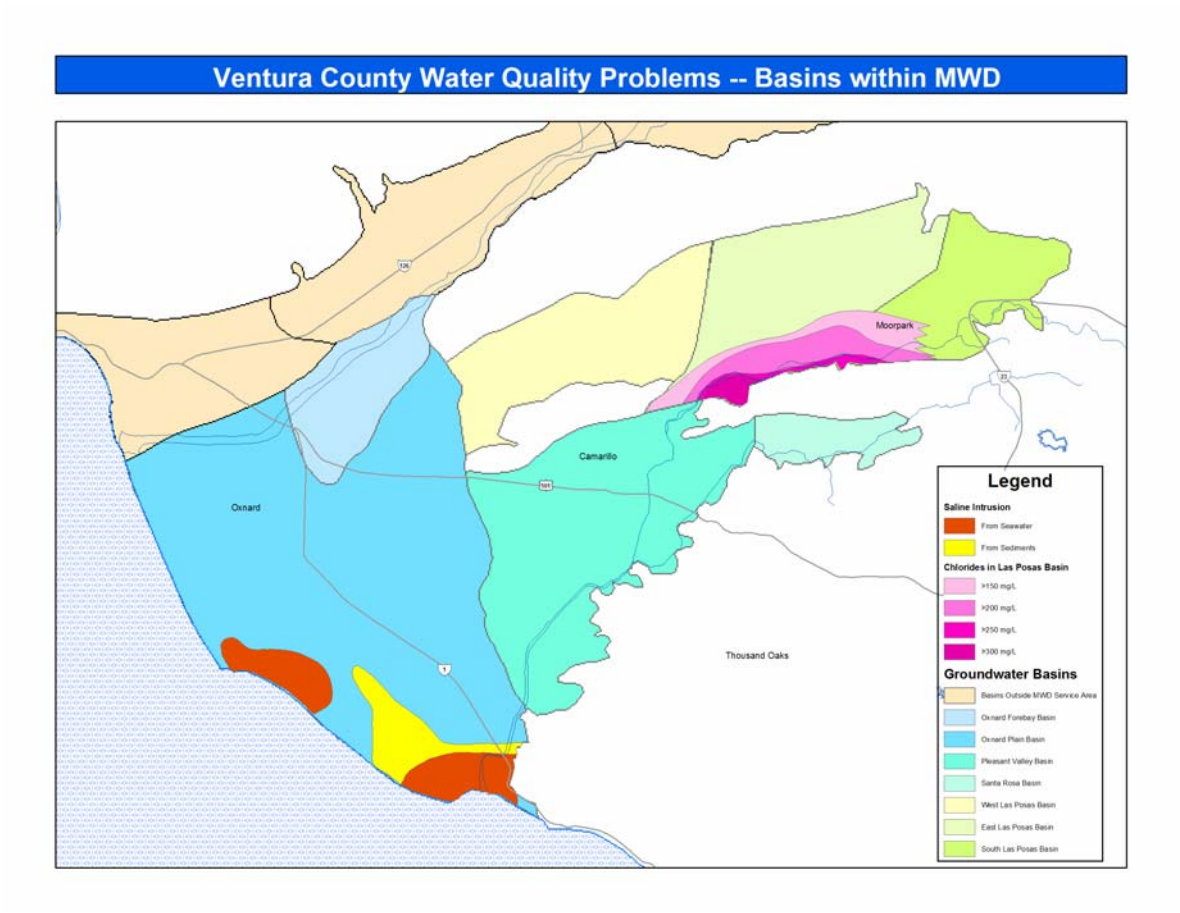
Figure 1-8 shows the areas impacted by TDS and chloride due to seawater intrusion or leaching of minerals salts from marine sediments. TDS concentrations in many locations are greater than 1,000 mg/L throughout the basins with maximum concentrations 32,600 mg/L reported for several wells in the Oxnard Plain. Seawater intrusion has occurred along the coastline due to

Table 1-5
Summary of Constituents of Concern in the Ventura County Basins

Constituent	Units	Range[1]	Description
TDS Secondary MCL = 500	mg/L	Oxnard Plain: 340 to 32,600 Oxnard Forebay: 490 to 1,750 Pleasant Valley: 525 to 2,515 West Las Posas: 330 to 1,410 East Las Posas: 270 to 1,800	TDS concentrations in many locations are greater than 1,000 mg/L throughout the basins with maximum concentrations of 32,600 mg/L reported for wells in the Oxnard Plain.
Nitrate (as N) Primary MCL = 10	mg/L	Oxnard Plain: <0.1 to 44.4 Oxnard Forebay: <0.1 to 34.4 Pleasant Valley: <0.1 to 18.9 West Las Posas: <0.1 to 15.6 East Las Posas: <0.1 to 27.8	Reported as an issue resulting from use of agricultural fertilizers and septic systems in the Oxnard Forebay and Oxnard Plain Basins
VOCs	µg/L	Data not available	No significant or widespread contamination reported
Perchlorate Notification level = 6	µg/L	Pleasant Valley: 2 to 5[2] South Las Posas: up to 2[3]	No significant or widespread contamination reported
Iron Secondary MCL = 300	µg/L	Oxnard Plain: <50 to 16,700 Oxnard Forebay: <50 to 9,300 Pleasant Valley: <50 to 3,250 West Las Posas: <50 to 9,760 East Las Posas: <0.1 to 15,000	Concentrations in many wells are above the MCL.
Manganese Secondary MCL = 50	µg/L	Oxnard Plain: <10 to 4,010 Oxnard Forebay: <10 to 780 Pleasant Valley: <10 to 355 West Las Posas: <30 to 1,400 East Las Posas: <30 to 730	Concentrations in many active wells are above the 50 µg/L MCL
Chloride Secondary MCL = 500	mg/L	Oxnard Plain: 11 to 19,000 Oxnard Forebay: 20 to 110 Pleasant Valley: 42 to 340 West Las Posas: 10 to 275 East Las Posas: 10 to 220	Significant concern in the Oxnard Plain and Pleasant Valley basins due to seawater intrusion. Also an issue in the Las Posas Basin due to rising groundwater levels and leaching from marine sediments.
Sulfate Secondary MCL = 500	mg/L	Oxnard Plain: 32 to 2,910 Oxnard Forebay: 20 to 820 Pleasant Valley: 55 to 1,005 West Las Posas: 55 to 675 East Las Posas: 14 to 840	Could limit ability to use for agricultural purposes. Issue for municipal supply in Camarillo area.

[1]Bachman, 2006b
[2,3]Geotracker, Camarillo and Moorpark wells, 2006

Figure 1-8
Water Quality Issues in the Ventura County Basins



decades of over drafting in the Oxnard Plain Basin, which has reversed groundwater gradients within both the UAS and LAS (Bachman, 2006a). Also along the southern flank of the East and South Los Posas groundwater basins and in the Pleasant Valley Basin high levels of chlorides and sulfates have been detected due to higher groundwater levels leaching salts from shallow aquifers and transporting them into deeper aquifers (Bachman, 2006a).

Nitrate concentrations (as N) exceeding the 10 mg/L MCL occur within the basins and are of greatest concern in the Oxnard Plain Forebay. High nitrate levels (as high as 44.4 mg/L) in this area have resulted from agricultural applications of fertilizers and septic waste discharges. Nitrate concentrations tend to spike during dry periods when recharge to the basin is reduced. Nitrate concentrations as high as 44 mg/L have also been detected in the Santa Rosa Basin.

Iron and manganese, as shown on **Table 1-5** have also been detected at concentrations above applicable MCLs in the Ventura County Basins. Concentrations of iron and manganese are highest in the Oxnard Plain Basin. In addition, as described below, the ASR wells in the Las Posas Basin could require treatment for iron and manganese.

Perchlorate has been detected at levels of 5 µg/L or less in several wells in the Pleasant Valley and South Las Posas basins, although no widespread or significant contamination has been reported. Significant contamination associated with VOCs in the basins has not been reported.

Blending Needs

The cities of Oxnard and Port Hueneme use on average about 10,000 AFY of imported water from Metropolitan to blend with native groundwater that has about 1,000 mg/L TDS. The City of Camarillo is also increasing its usage of Metropolitan water to blend with its groundwater (Bachman, 2006a).

Groundwater Treatment

The City of Port Hueneme treats groundwater before it is blended with imported water from Metropolitan at its desalter as summarized in **Table 1-6**. Groundwater from the ASR wells in the Las Posas basin may require treatment to remove iron and manganese (Bachman, 2006a).

Table 1-6
Summary of Groundwater Treatment in the Ventura County Basins

Treatment Type	Number of Wells	Constituents(s) of Concern	Treatment Target*	Treatment Cost ($/AF)	Amount Treated (AFY)
Reverse Osmosis	Data not available	TDS	500-1000 mg/L	$600-800	2,800

Bachman, 2006a
*When blended

CURRENT GROUNDWATER STORAGE PROGRAMS

In 1995, Calleguas MWD and Metropolitan entered into an agreement for the North Las Posas ASR Project. The ASR Project allows Metropolitan to store up to 210,000 AF in the Las Posas Basin via injection or in-lieu methods to be taken later by Metropolitan in-lieu of imported supplies during water shortage events. As of June 30, 2006, the account balance in the storage account was approximately 55,000 AF (about 49,000 AF via in-lieu and 6,000 AF via injection).

In-lieu replenishment deliveries of imported water from Metropolitan are another means for maintaining groundwater storage in the basin when producers are able to reduce their pumping by the amount of the delivery. Ventura County Basin producers participate in a variety of in-lieu groundwater storage programs with Metropolitan since 1985. These include Metropolitan's replenishment water programs for purchase of imported water for direct recharge and in-lieu. Direct recharge volumes are discussed above. An average of approximately 850 AFY was stored in-lieu as part of the long-term replenishment program between fiscal year 1985/86 and 2004/05.

BASIN MANAGEMENT CONSIDERATIONS

The primary management issues within the Ventura County Basins include:

- Production limitations by the GMA
  - With no physical or hydraulic barriers to seawater intrusion, groundwater levels must be managed to minimize contaminating the potable water resources (Bachman, 2006a). The resulting GMA policies to control over drafting has required 20 percent phased reductions in groundwater pumping throughout the GMA (the phasing will be complete in 2010). In addition, new storage projects require GMA approval and new well restrictions have been imposed on specific aquifers to limit coastal pumping and seawater intrusion (Bachman, 2006a).
- Land subsidence in the coastal areas may limit ability to extract water
- Water quality
  - As discussed above, many areas throughout the Ventura County Basins have concentrations of TDS above 1,000 mg/L. These concentrations limit the ability to store and extract water from these basins.
  - In addition, seawater intrusion or migration of saline water through adjacent sediments also play a significant role in the management of the Ventura County Basins.

References:

Bachman, S.B, 2006a, Calleguas Municipal Water District (Calleguas MWD) - Groundwater Study Questionnaire for the Fox Canyon Groundwater Management Agency Groundwater Basins

Bachman, S.B., 2006b, Calleguas Municipal Water District (Calleguas MWD) – Comments and Supplemental Data for Draft Ventura County Basin Report – October 2006.

Calleguas Municipal Water District (CMWD), 2006. Production data.

Fox Canyon Groundwater Management Agency, (Fox Canyon GMA), 2004, Water Quality Summary found at website.

Fox Canyon Groundwater Management Agency (Fox Canyon GMA), 2006, Fox Canyon Groundwater Management Plan, Public Review Draft

University of California Integrated Pest Management (UC IPM), 2006. Oxnard.C Station Website:http://www.ipm.ucdavis.edu/calludt.cgi/WXDESCRIPTION?STN=OXNARD.C

CHAPTER IV

GROUNDWATER BASIN REPORTS

SAN FERNANDO VALLEY BASINS

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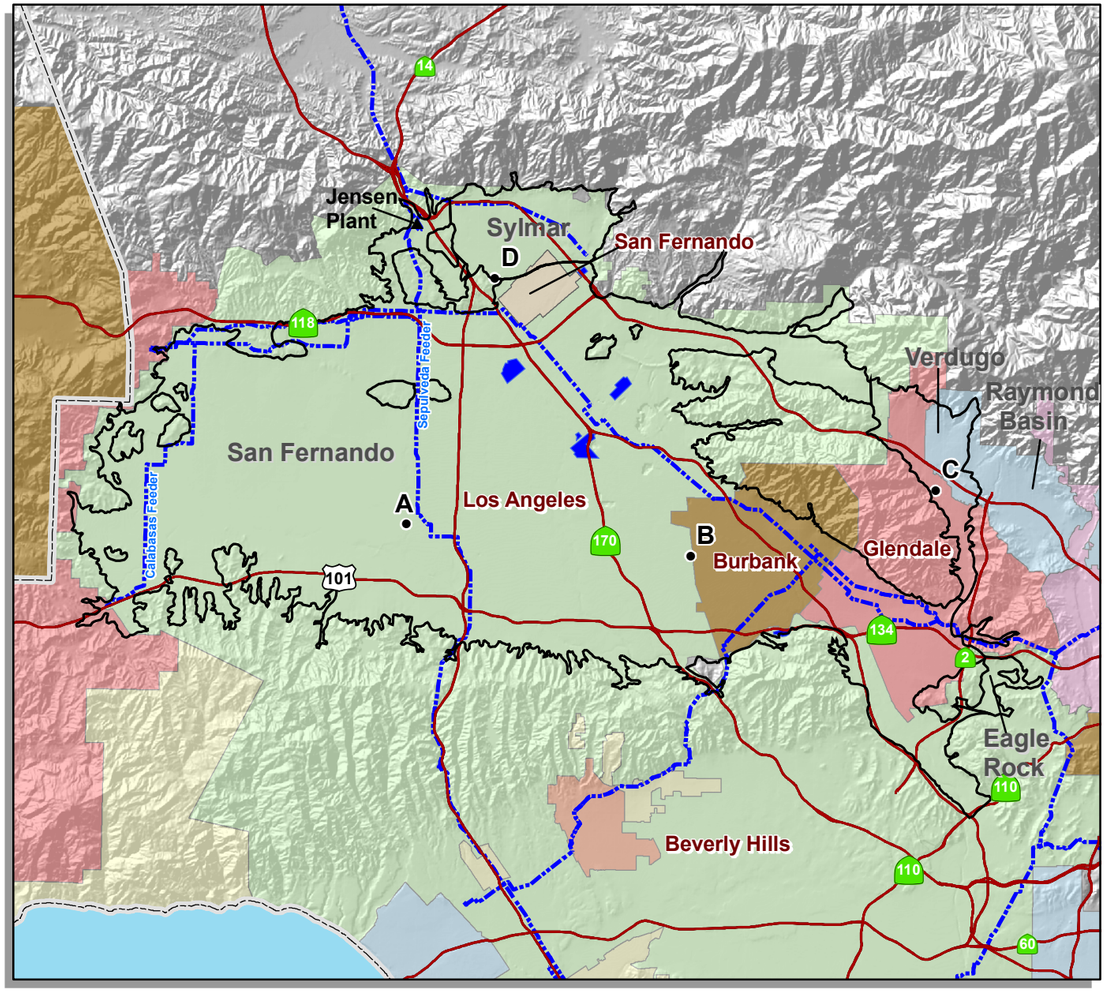

Upper Los Angeles River Area Basins

A ● Key Well
Recharge Basins
Freeways
County
MWD Pipeline
MWD Facility
Groundwater Basin
MWD Member Agency Boundary (color varies)

Note: This map was prepared by the Metropolitan Water District of Southern California for its own use. No warranty is expressed or implied as to the correctness, timeliness, or content of the information shown herein.

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Additional Data Sourse(s): Santa Ana Watershed Project Authority (SAWPA); California Spatial Information Library (CaSIL).

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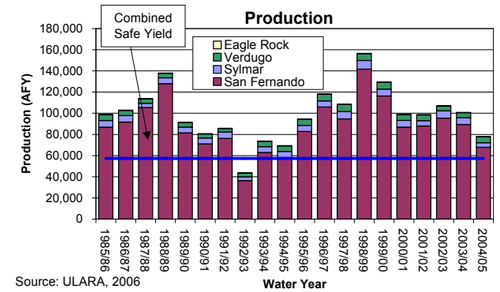
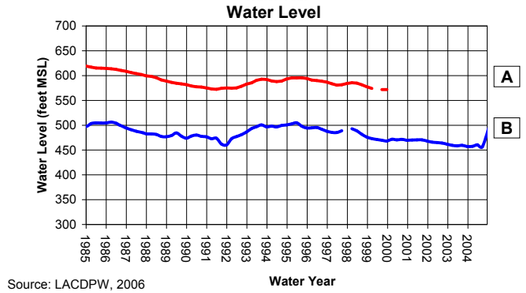
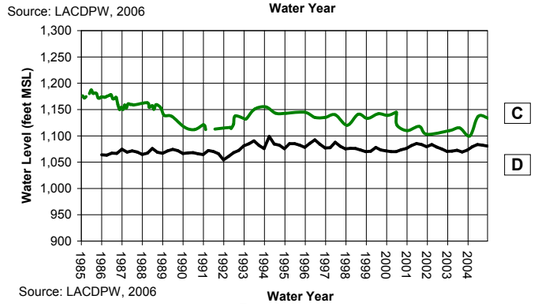


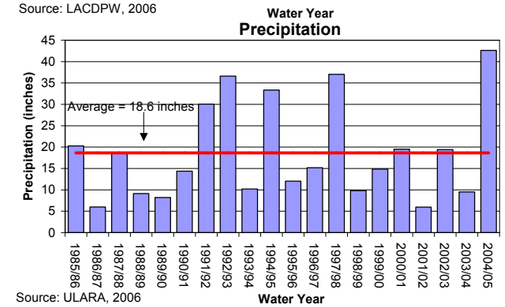
Source: ULARA, 2006



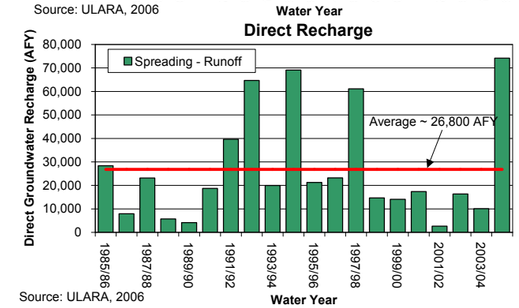
Source: LACDPW, 2006



Source: LACDPW, 2006



Source: ULARA, 2006



Source: ULARA, 2006

BASIN FACTS

Upper Los Angeles River Area Basin

Description
Location: Los Angeles County
Surface Area: 226 square miles
Subbasins:
San Fernando
Sylmar
Eagle Rock
Verdugo
Management: Adjudicated
Basin is adjudicated by 1979 Final San Fernando Judgment and 1984 Stipulated Sylmar Judgment
MWD Member Agencies:
City of Los Angeles
City of Burbank
City of Glendale
City of San Fernando
Foothill MWD

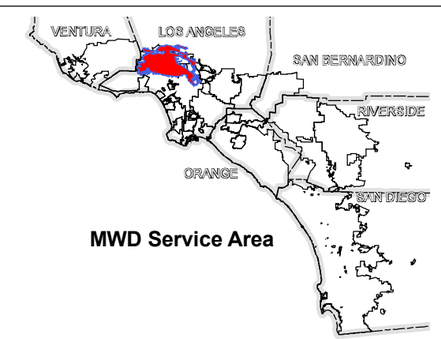
	San Fernando	Sylmar	Verdugo	Eagle Rock
Native Safe Yield	43,660 AFY	--	--	Negligible
Safe Yield	90,680 AFY	6,810 AFY	7,150 AFY	Negligible
Extraction Rights (2005//06)	96,838 AFY	6,510 AFY	7,150 AFY	Negligible
Total Storage	3.2 million AF	310,000 AF	160,000 AF	Unknown
Unused Storage	Unknown	Unknown	Unknown	Unknown
Portion of Unused Storage Space Available (end of 2004/05)	504,475 AF	Unknown	Unknown	Unknown

Storage and Extraction Facilities

	San Fernando	Sylmar	Verdugo	Eagle Rock
Production Wells				
Production Capacity	220,000 AFY	8,700 AFY	7,400 AFY	230 AFY
Average 1985-2004	88,370 AFY	5,770 AFY	5,090 AFY	224 AFY
Injection Wells				
Injection Capacity	None	None	None	None
Average 1985-2004	None	None	None	None
Spreading Basins				
Spreading Capacity	104,000 AFY	None	None	None
Average 1985-2004	26,800 AFY	None	None	None

Basin Management Considerations

- 1979 Final San Fernando Judgment and 1984 Sylmar Judgment limit amount of water that can be pumped
- Water quality concerns related to the Superfund sites in the east-central portion of the basin could limit ability to store and extract water in the basin
- Shallow groundwater and liquefaction potential are concerns in western portion of San Fernando Basin
- Rising groundwater could increase losses to Central Basin



MWD Service Area

Plate 2-1
Overview of Upper Los Angeles River Basins

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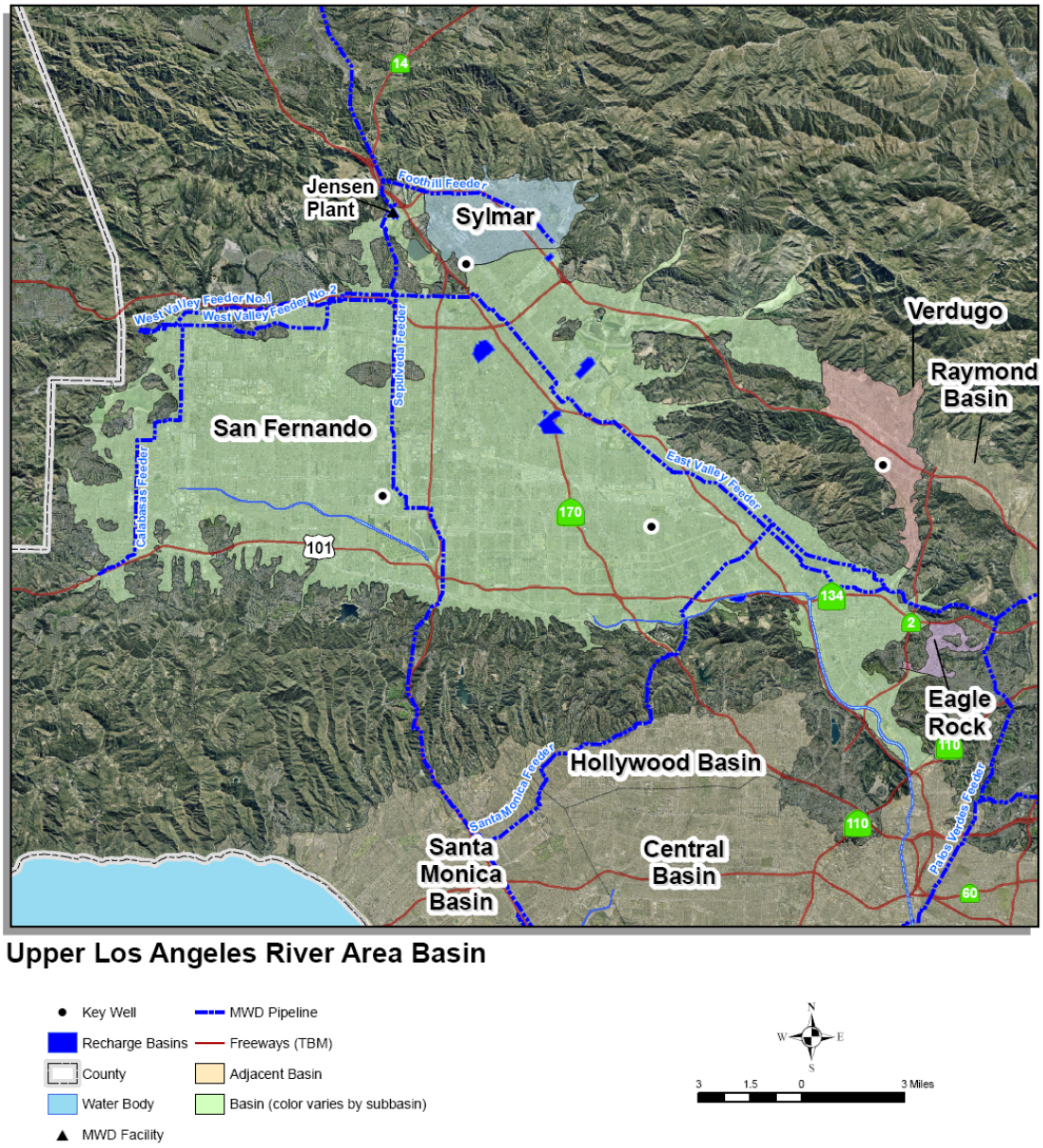
The Upper Los Angeles River Area (ULARA) Basins are located within Los Angeles River Watershed in Los Angeles County. The ULARA Basins include the San Fernando, Sylmar, Verdugo and Eagle Rock Basins and underlie the Metropolitan member agencies of the cities of Los Angeles, San Fernando, Burbank, and Glendale and Foothill Municipal Water District (Foothill MWD). A map of the basins with the ULARA is provided in **Figure 2-1**.

Figure 2-1
Map of the ULARA Basins



BASIN CHARACTERIZATION

The following section provides a physical description of the groundwater basins within the ULARA including their location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

The groundwater basins within ULARA are nearly surrounded by impermeable sedimentary, granitic and metamorphic bedrock underlying the surrounding San Gabriel and Santa Monica mountains. **Table 2-1** provides a summary of the characteristics of the ULARA Basins.

The San Fernando Basin, the largest of the four basins within the ULARA, is an unconfined aquifer contained by the Santa Monica Mountains on the south, the Simi Hills to the West, the Santa Susana Mountains to the northwest, and the San Gabriel Mountains and Verdugo Hills on the northeast with a relatively thin finger extending eastward into the Tujunga Canyon between the San Gabriel Mountains and the Verdugo Hills. The Sylmar Basin, is a confined aquifer system separated from the San Fernando Basin by the Sylmar Fault Zone in the underlying geology. The Verdugo Basin is located in Crescenta Valley, a down-dropped block between the San Gabriel Mountains to the northeast, and the Verdugo Mountains to the southwest and east of the groundwater divide that separates it from the finger of the San Fernando Basin in Tujunga Canyon. In contrast to the other nearby groundwater basins, the Verdugo Basin (1) is relatively small in area and relatively steeply sloping, (2) the aquifer units are relatively thin, and (3) the aquifer units have relatively low hydraulic conductivity (Geomatrix, 2005). The smallest basin within the ULARA and least significant in terms of groundwater storage is the Eagle Rock basin, located in the extreme southeastern edge of the San Fernando Basin.

The State Water Rights Board in the Report of the Referee for the Judgment over the ULARA estimated approximately 3.2 million AF of total groundwater storage capacity in the San Fernando Basin. The estimated storage capacities of the Sylmar and Verdugo Basins are 310,000 AF and 160,000 AF, respectively. Considering the relatively insignificant total storage capacity of the Eagle Rock groundwater basin, these combined volumes lead to an estimated total of about 3.67 million AF for the storage capacity of the groundwater basins within the ULARA.

Safe Yield/Long Term Balance of Recharge and Discharge

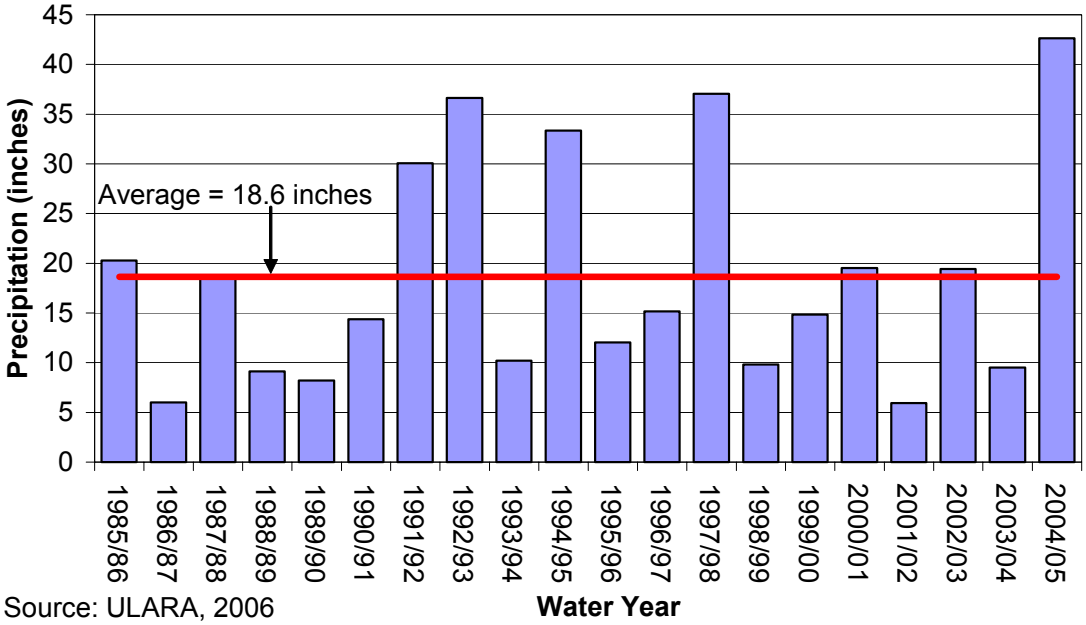
The primary inflows to the ULARA groundwater basins are imported water and natural precipitation and runoff during the rain season. Because the runoff is seasonal in nature, natural recharge is limited. **Figure 2-2** provides the historical precipitation data from the San Fernando Basin between the 1985/86 to 2004/05 water years. Over this time period, rainfall varied between 6 to about 43 inches per year, with an average of about 18.6 inches per year. The data on **Figure 2-2** shows above average precipitation between 1991 and 1993, in 1994/95, in 1997/98, with the highest of about 43 inches occurring in the 2004/05 water year. In contrast, the historical annual precipitation for water years 1949 through 2003 in the Verdugo Basin has ranged from 8.95 to 55.16 inches with a long-term average of 23.37 inches (Geomatrix, 2005).

Table 2-1
Summary of the Hydrogeologic Parameters of the ULARA Basins

Parameter	Description
Structure	
Aquifer(s)	Unconfined to confined
Depth of groundwater basin	San Fernando: 0 to 1,200 feet Sylmar: 50 to 6,000 feet Verdugo: 40 to 400 feet Eagle Rock: Data not available
Depth of producing zones or screen intervals	San Fernando: 58 to 800 feet Sylmar: 64 to 435 feet Verdugo: 150 to 400 feet Eagle Rock: Data not available
Yield and Storage	
Native Safe Yield	San Fernando: 43,660 AFY
Safe Yield	San Fernando: 90,680 AFY Sylmar: 6.810 AFY [2] Verdugo: 7,150 AFY Eagle Rock: Negligible
Extraction Rights [1] (2005-06 water year)	San Fernando: 96,838 AFY Sylmar: 6,510 AFY Verdugo: 7,150 AFY Eagle Rock: Negligible
Total Storage	San Fernando: 3.2 million AF Sylmar: 310,000 AF Verdugo: 160,000 AF Eagle Rock: Negligible
Unused Storage Space	Data not available
Portion of Unused Storage Available for Storage.(Following the 2004/05 water year)	San Fernando: 504,475 AF Sylmar: Limited Verdugo: Limited Eagle Rock: Negligible

Source: Watermaster 2006a and Watermaster, 2006b
[1]Does not include stored water credits or physical solution water
[2]Safe yield of Sylmar Basin was increased from 6,510 to 6,810 AFY in December 2006.

Figure 2-2
Historical Precipitation in the ULARA Basins

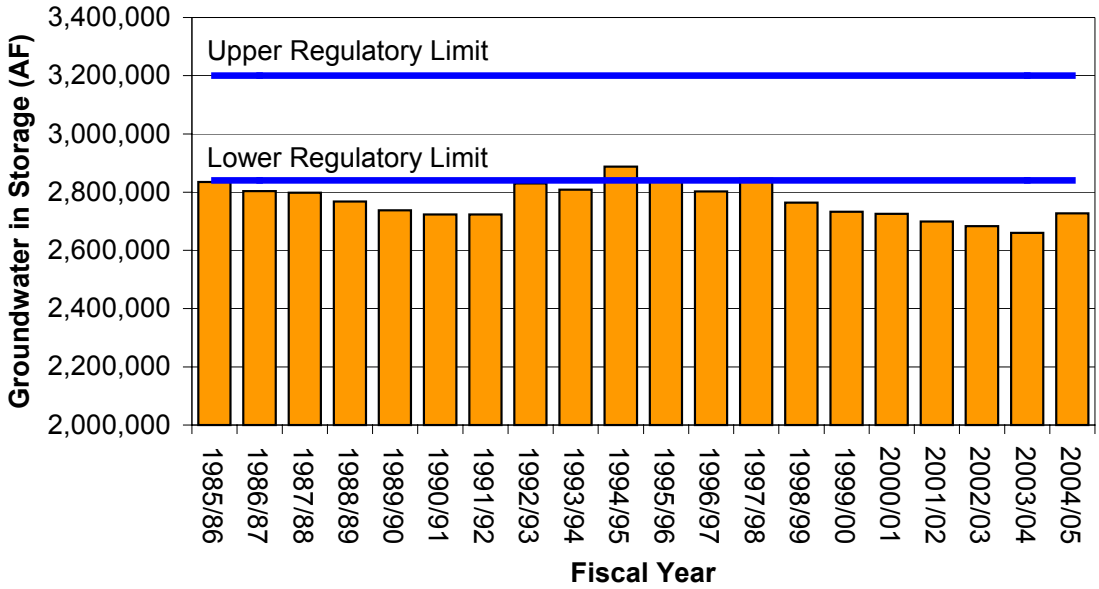


Source: ULARA, 2006

The native safe yield for the ULARA Basins is summarized in **Table 2-1**. These amounts have been fixed by the adjudication of the basins, as discussed below. In the San Fernando Basin, the Judgment (described below) distinguishes between native safe yield (portion of safe yield derived from native waters) and safe yield (includes return flows from imported water), and divides annual extraction rights based on native and imported water origins. The annual extraction right, which is also summarized in **Table 2-1**, includes the native safe yield plus imported water return credits in the San Fernando Basin. The total extraction rights within the ULARA Basins for water year 2005/06 were 110,498 AF (Watermaster, 2006a). At the end of the 2004/05 water year, there were nearly 419,000 AF in stored water credits in the ULARA Basins, increasing the allowable pumping to more than 529,000 AF. As discussed below, stored groundwater can be extracted by the parties in excess of annual pumping rights with approval of the Watermaster.

Figure 2-3 provides a summary of the groundwater in storage in the San Fernando Basin, the largest of the ULARA Basins, from water year 1985/86 to 2004/05. The State Water Rights Board derived a regulatory storage requirement of 360,000 AF for the San Fernando Basin, spanning the interval of 210,000 AF above and 150,000 AF below amount of water in storage in 1954 (2.99 million AF). Despite the heavy rains of the 2004/05 water year, the storage volume at the end of water year 2004/05 was about 113,000 AF below the lowest level of the regulatory storage requirement. Due to the currently depleted groundwater in the San Fernando Basin it is estimated that approximately 504,475 AF (decline in storage since 1928) is available as additional storage capacity (Watermaster, 2006a).

Figure 2-3
Historical Groundwater in Storage Estimates for the San Fernando Basin



GROUNDWATER MANAGEMENT

The following section describes how the ULARA Basins are managed. This discussion includes a brief description of the governing structure and the relationship with other groundwater basins.

Basin Governance

The ULARA Basins are adjudicated. Groundwater production in the ULARA Basins is constrained by the 1979 Final San Fernando Judgment (1979 Judgment) and the 1984 Sylmar Basin Stipulation (1984 Stipulation). This adjudication limits groundwater extraction from all four groundwater basins and established a court appointed Watermaster and Administrative Committee to administer the Court's rulings. The Administrative Committee, as summarized in **Table 2-2,** is made up of a representative from each of the five public agencies overlying the ULARA.

The 1979 Judgment upheld the Pueblo Water Rights of the city of Los Angeles to all groundwater in the San Fernando Basin derived from precipitation within the ULARA and all surface and groundwater underflows from the Sylmar and Verdugo basins (Watermaster, 2005). Furthermore the cities of Burbank, Glendale and Los Angeles were given rights to all San Fernando groundwater derived from water imported by these cities from outside the ULARA and either spread or delivered within the San Fernando Basin. Return credits are granted in the San Fernando Basin. The city of San Fernando was not granted return flow rights in the San Fernando Basin because they where not able to import water until becoming a member of Metropolitan in 1971. The Judgment also contains provisions and stipulations regarding

storage of water, stored water credit and arrangements for physical solution water for certain parties (Watermaster, 2006a). There are no storage rights in either the Verdugo or the Eagle Rock Basins.

Under the 1984 Stipulation, the cities of Los Angeles and San Fernando were assigned equal rights to the safe yield of the Sylmar Basin. In 1996, the safe yield was increased from 6,210 AFY to 6,510 AFY. In addition, the safe yield was increased again in December 2006 to 6,810 AFY. These cities also have the right to store groundwater via in-lieu methods and the right to extract equivalent amounts.

Table 2-2
Summary of Management Agencies in the ULARA Basins

Agency	Role
ULARA Watermaster	Overall management authority under the California Superior Court
The City of Burbank	MWD member agency, water retailer and ULARA administrative committee member
The City of Glendale	MWD member agency, water retailer and ULARA administrative committee member
The City of Los Angeles	MWD member agency, water retailer and ULARA administrative committee member. Owns Tujunga Spreading Grounds
The City of San Fernando	MWD member agency, water retailer and ULARA administrative committee member
The Crescenta Valley Water District (CVWD)	Water retailer and ULARA administrative committee member
Los Angeles County Public Works (LACDPW)	Owns and operates spreading facilities

Interactions with Adjoining Basins

Groundwater outflow from the Verdugo Basin into the San Fernando Basin occurs beneath Verdugo Wash at the extreme eastern edge of the ULARA. Groundwater outflow from the ULARA occurs through the Los Angeles River Narrows in the southeast corner of the San Fernando Basin where approximately 400 AF of underflow passes downstream into the Central Basin. In addition, approximately 2,000 to 4,000 AFY of rising groundwater leaves the San Fernando Basin as surface flow into the Central Basin (Watermaster, 2007). An average of

about 300 to 400 AF of underflow passes into the Raymond Basin from the Verdugo Basin (DWR, 2004 and Geomatrix, 2005). These flows are accounted for in each basin's adjudication so there are no separate agreements regarding these flows.

WATER SUPPLY FACILITIES AND OPERATIONS

The following section describes the existing water supply facilities in the ULARA Basins. These include 146 groundwater production wells and 314 acres of recharge ponds for groundwater recharge.

Active Production Wells

There are 146 active production wells within the ULARA Basins. A total of 77,995 AF were pumped from the ULARA groundwater basins during the 2004/05 water year. Approximately 94 percent or 73,500 AF of the total volume was pumped from municipal production with the remaining production from private wells. A summary of production from these wells is provided in **Table 2-3**. Historical production is also summarized on **Figure 2-4**.

Table 2-3
Summary of Production Wells in the ULARA Basins

Basin	Number of Wells	Estimated Production Capacity (AFY) [1]	Average Production 1985-2004 (AFY)	Well Operation Cost [2] ($/AF)
San Fernando	122	220,000	88,370	$24 to $165 Average $63 (2004)
Sylmar	6	8,700	5,770	
Verdugo	17	7,400	5,090	Data not available
Eagle Rock	3	230	224	Data not available
Total	**146**	**236,330**	**99,454**	--

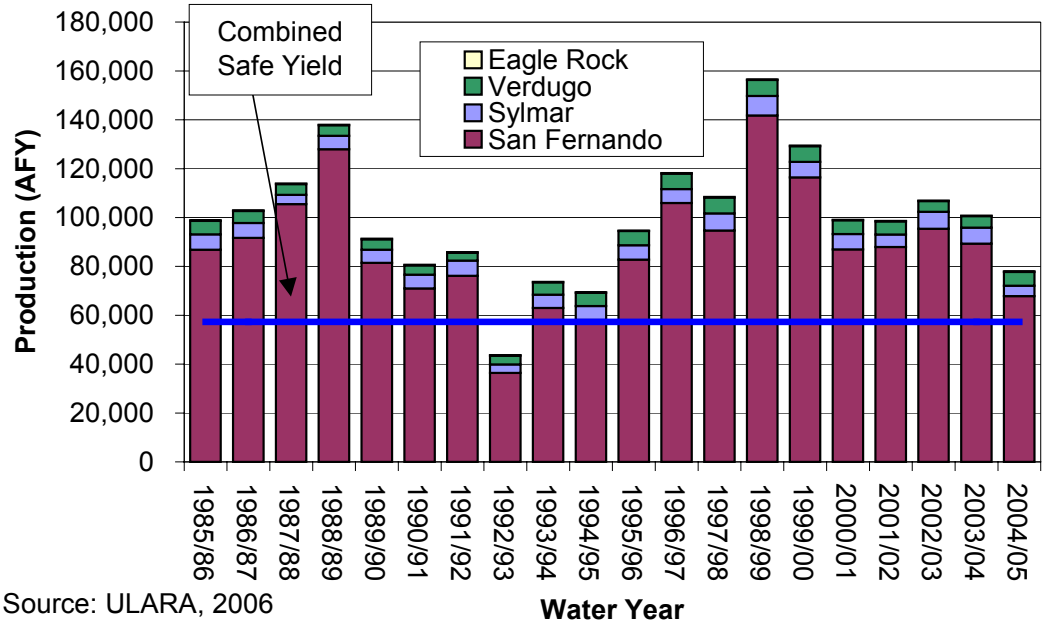
Source: Watermaster, 2006a and 2006b; LA, 2006c
1. Based on maximum annual basin production over the past 5 years for Eagle Rock Basin; Other Basins Watermaster, 2006c, LA, 2006c based upon 10 month per year operation.
2. LA, 2006a

Within the Verdugo Basin, CVWD groundwater production has generally declined since the late-1990s, from about 4,000 AFY in 1999 to about 3,000 AFY in 2002 (Geomatrix, 2005). CVWD pumps groundwater from 11 supply wells in Verdugo Basin. Five wells (6, 8, 10, 12, and 14) pump water to the Glenwood Ion Exchange Nitrate Removal Facility where nitrate is removed from the water. Discharge from five other wells (1, 5, 7, 9, and 11) is pumped without nitrate treatment into the CVWD system. Well 2 is used for standby or emergency supply and is not pumped on an ongoing basis (Geomatrix, 2005).

In the ULARA groundwater basins there were a total of 75 inactive wells. The City of Los Angeles reports that 8 of the inactive wells in the San Fernando groundwater basin are planned to be online within the next 5 years (LA, 2006a).

Table 2-3 also summarizes the general pumping and disinfection costs of municipal production wells in the San Fernando Basin. These costs do not include annual maintenance.

Figure 2-4
Historical Groundwater Production in the ULARA Basins



Source: ULARA, 2006

Other Production

The relatively small percentage of the total production is from private or non-municipal wells as summarized in **Table 2-3**.

ASR Wells

There are no ASR wells reported in the ULARA Basins.

Spreading Basins

Approximately 314 acres of recharge spreading basins are located over the San Fernando Basin with an estimated total capacity of approximately 104,000 AFY, as summarized in **Table 2-4**. The locations of the spreading areas are shown on **Figure 2-1**.

Table 2-4
Summary of Spreading Basins in the ULARA Basins

Spreading Basins	Area (acres)	Recharge Capacity (cfs) [1]	Recharge Capacity (AFY) [1]	Source Water	Owner
Hansen	105	49	35,000	Runoff	LACDPW
Pacoima	107	40	23,000	Runoff	LACDPW
Lopez	12	7	2,000	Runoff	LACDPW
Branford	7	1	1,000	Runoff	LACDPW
Tujunga	83	99	43,000	Runoff	LADWP
Total	**314**	**196**	**104,000**	--	--

Source: LA, 2006a.

These basins are used for spreading both imported water and surface water diversions, through mostly surface water runoff from the Pacoima, Big Tujunga and Hansen Dams which are operated by LACDPW both as flood control dams as well as to regulate storm flows to allow recapture of the flows in the downstream spreading basins (LA, 2006a; ULARA, 2005).

Figure 2-5 provides a summary of the spreading of surface water runoff to recharge groundwater in the ULARA Basins, principally the San Fernando Basin, over the 1985/86 to 2004/05 water years.

Recharge spreading basins do not currently exist in the Sylmar, Verdugo or Eagle Rock groundwater basins. However, within the Verdugo Basin, modifications and improvements to existing debris basins are being considered in order to retain water and increase the rate of recharge (Geomatrix, 2005).

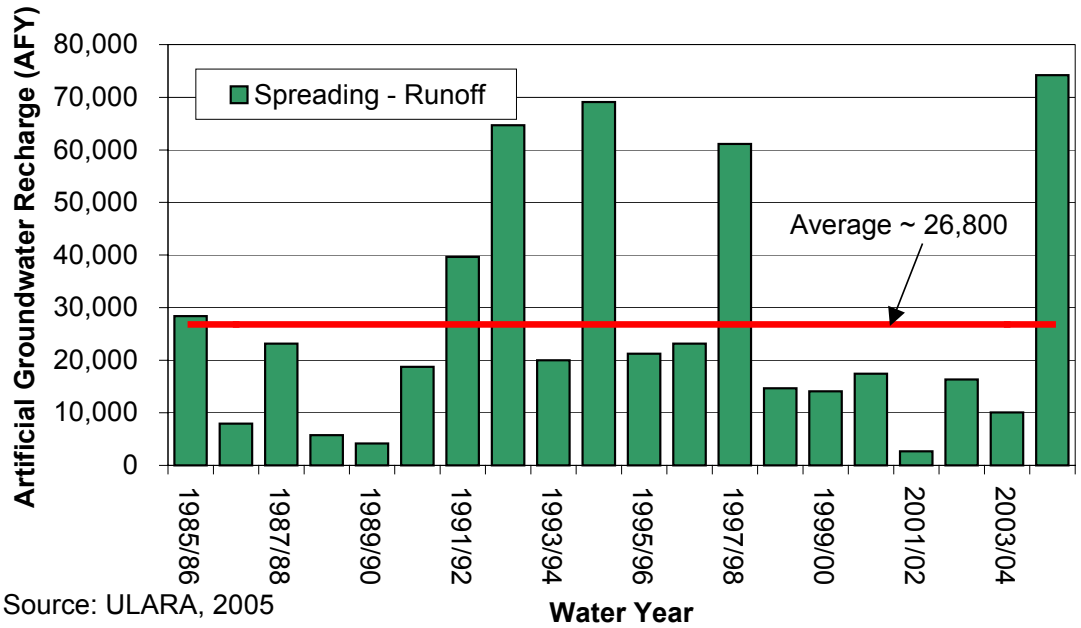
Seawater Intrusion Barriers

There are no seawater intrusion barriers in the ULARA Basins.

Desalters

There are no desalters in the ULARA Basins.

Figure 2-5
Summary of Groundwater Recharge in the ULARA Basins



Source: ULARA, 2005

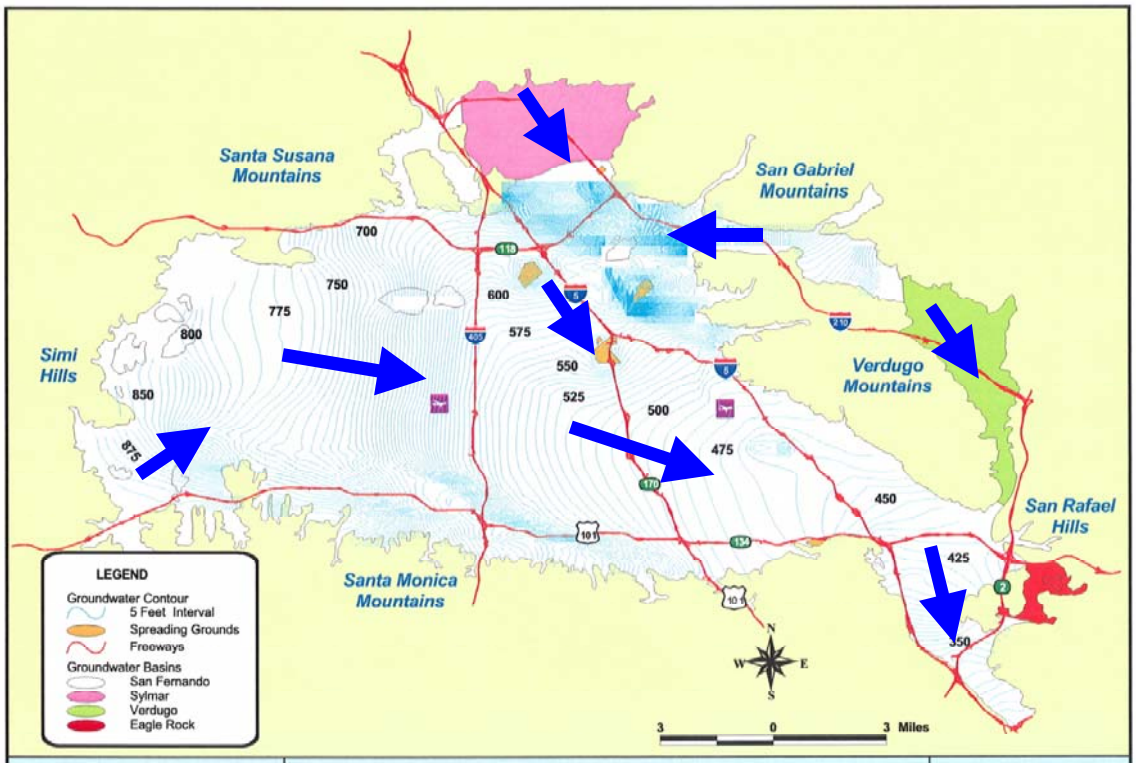
GROUNDWATER LEVELS

The depth to groundwater in the San Fernando, Sylmar, and Verdugo basins range between 24 to 400 feet, 50 to 115 feet, and 17 to 190 feet bgs, respectively. Shallow groundwater conditions are encountered in the western end of the San Fernando Basin. These areas are subject to rising groundwater and high liquefaction potential. However, because of finer sediments and naturally occurring high TDS in this portion of the basin, these areas are not produced. A groundwater contour map during the spring of 2005 is shown in **Figure 2-6**. Groundwater flow is generally from west to east across the majority of the San Fernando Basin. Groundwater flows turns southward in the eastern and southeastern portion of the basin where groundwater flows into the Central Basin. Groundwater flow is generally toward the south-southeast into the San Fernando Basin from the Verdugo and Sylmar Basins as water levels are substantially higher in these basins.

Figures 2-7 and 2-8 show the changes in groundwater level in representative areas within the ULARA from 1985 to 2004. Locally, groundwater levels have risen or remained reasonably constant due to reduction in specific well field production. In other areas, groundwater levels have fallen due to increased production from specific well fields and/or diminished recharge from specific spreading grounds. However, in general, groundwater storage has been steadily declining since the early 1980s in the San Fernando Basin due to heavy pumping, limited

artificial recharge and low precipitation. Due to the heavy rains and decreased pumping during water year 2004/05, water levels in the basin have begun to recover, but this effect may be temporary. Despite a positive balance in stored water credits in the San Fernando Basin, groundwater levels and storage continued to decline. This imbalance is being addressed by the pumping parties and the Watermaster.

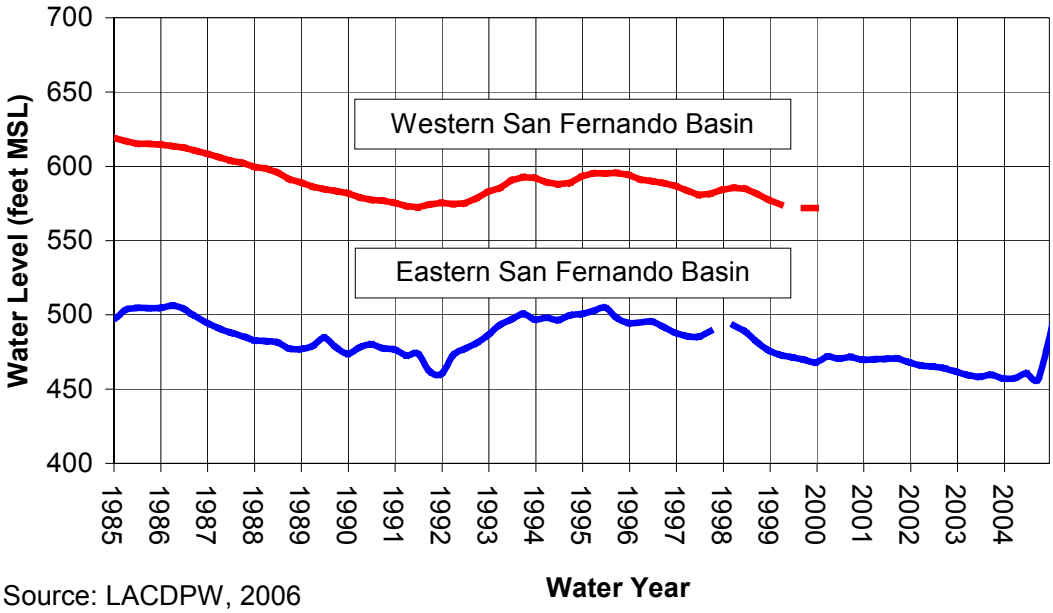
Figure 2-6
Groundwater Contour Map in the ULARA Basins – Spring 2005



Source: ULARA, 2006a

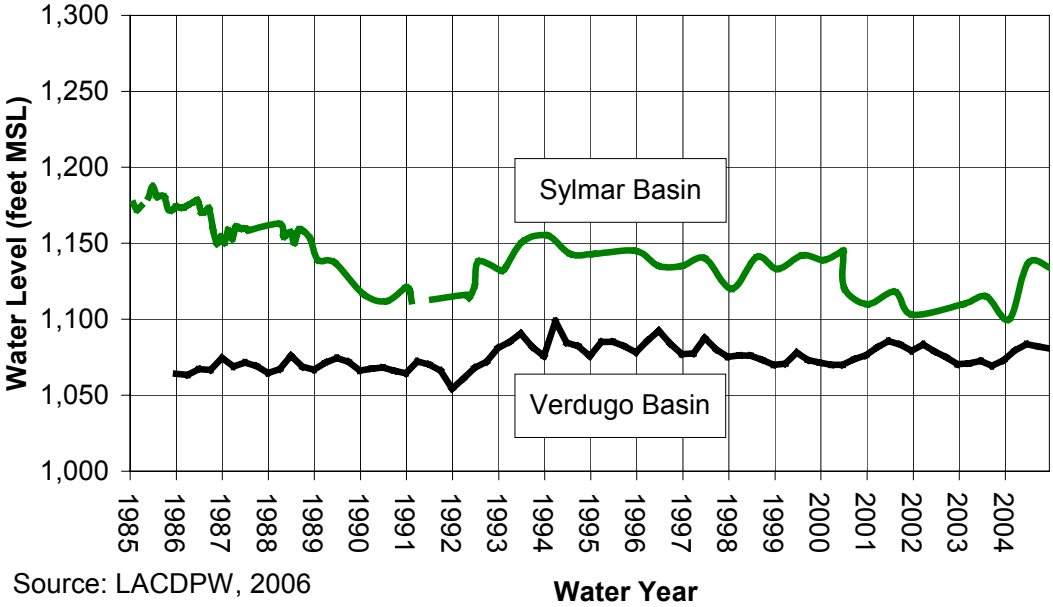
Groundwater levels show seasonal variation in response to precipitation, runoff and pumping. In the Verdugo Basin, depth to groundwater ranged from about 17 to approximately 190 feet below ground surface between 1981 and 2002. Between 1983 and 1992, groundwater level elevations declined following a prolonged dry period and cessation of septic system recharge. A significant rise occurred between 1992 and 1995, along with wetter climatic conditions. Since 1995 groundwater elevations have gradually declined throughout the basin. Water levels in the basin declined in recent years due to lower precipitation and increases in groundwater pumping (Geomatrix, 2005).

Figure 2-7
Historical Water Levels in the San Fernando Basin



Source: LACDPW, 2006

Figure 2-8
Historical Water Levels in the Verdugo and Sylmar Basins



Source: LACDPW, 2006

GROUNDWATER QUALITY

The following provides a brief description of the groundwater quality issues in the ULARA Basins.

Groundwater Quality Monitoring

The various cities and agencies operating municipal wells and responsible parties remediating contaminated groundwater are sampling their wells for water quality on a regular basis and the results are submitted to the California Department of Health Services (DHS) (LA, 2006a). The USEPA also samples approximately 100 monitoring wells in the eastern portion of the San Fernando Basin on a quarterly and annual basis (LA, 2006a). The results are also cataloged and monitored by the ULARA Watermaster and the Regional Board.

Groundwater Contaminants

Groundwater in the ULARA Basins has significant contamination issues. A number of the groundwater production wells are located with the bounds of a Superfund area. Elevated concentrations of volatile organic compounds (VOCs), such as trichloroethylene (TCE) and tetrachloroethylene (PCE), as well as other contaminants, such as hexavalent chromium have prompted the city of Los Angeles to discontinue pumping at numerous production wells. Maps depicting the locations of these plumes and nitrate are shown in **Figure 2-9** through **Figure 2-11** (LA, 2006a and Watermaster, 2006). Emerging contaminants, such as 1,4 dioxane, have also been found in concentrations high enough to necessitate the alteration of groundwater pumping operations. **Table 2-5** summarizes the constituents of concern within the ULARA Basins.

In addition, perchlorate, a constituent of regional concern has been detected in 2 wells above the notification level of 6 µg/L, one in the Sylmar Basin and one in eastern end of the San Fernando Basin. In these areas of contamination, wells have been removed from service or the groundwater is being blended or treated to meet State Drinking Water Standards as discussed below (LA, 2006a). In the San Fernando Basin, the estimated capacity of all the wells that have been removed from service due to elevated contamination levels is approximately 200 cfs or 396 AF/day. In addition to the contaminants in the San Fernando groundwater basin, one well was removed from service in the Sylmar basin due to elevated TCE levels (LA, 2006a).

As discussed in more detail below, continuing efforts to expand groundwater extraction capability, improve groundwater source quality, and treat extracted groundwater are underway in the basin. The USEPA, the Department of Toxic Substances Control, and the Los Angeles Regional Water Quality Control Board are working with the cities of Los Angeles, Glendale, and Burbank to identify and resolve San Fernando Basin contamination concerns. The City of Los Angeles' Department of Water and Power is currently undertaking a comprehensive study of the San Fernando Basin to fully characterize the extent and composition of known and emerging contaminants.

Figure 2-9
Location of VOC Contaminant Plumes in the ULARA Basins

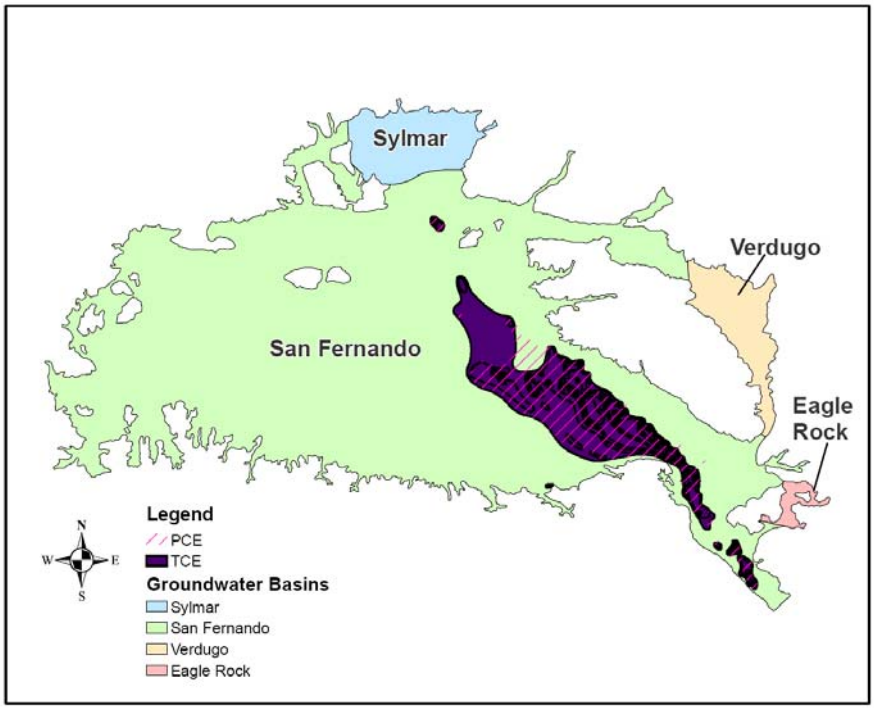


Figure 2-10
Location of Hexavalent Chromium Plumes in the ULARA Basins

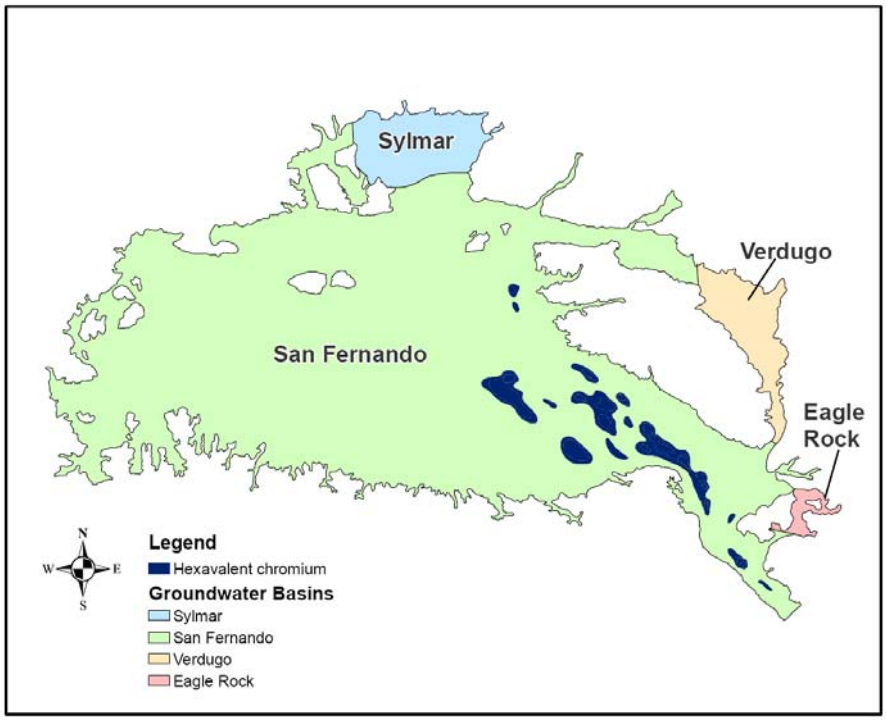
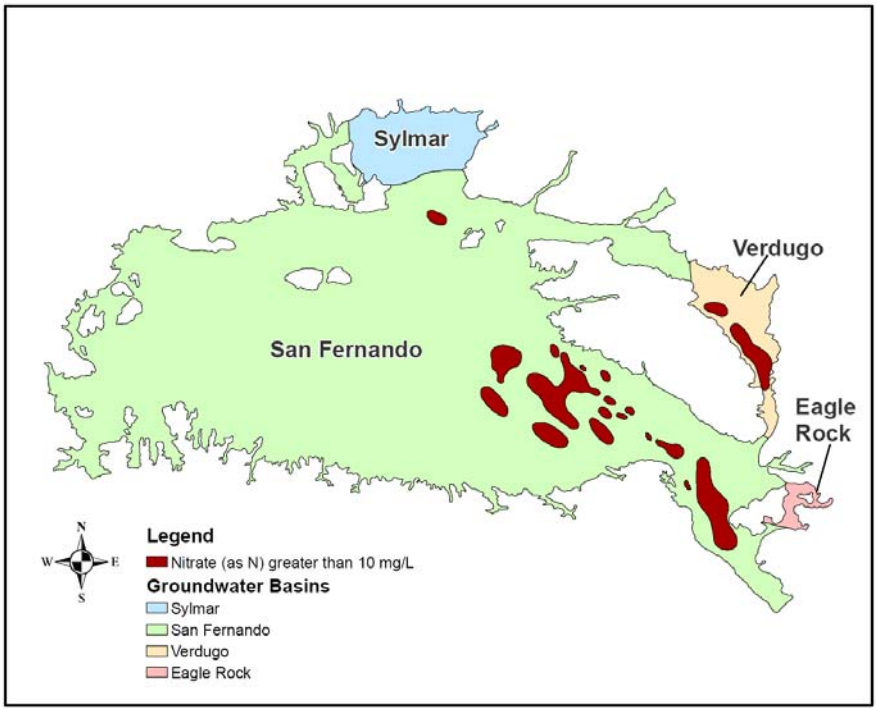


Figure 2-11
Location of Nitrate Plumes in the ULARA Basins



Blending Needs

All the cities and agencies are blending Metropolitan imported water with the groundwater extracted from selected wells to meet water quality standards. For example, the city of Los Angeles has blended imported water with groundwater contaminated with nitrate and VOC extracted from wells within the San Fernando groundwater basin, as summarized below in **Table 2-6**. These data suggest that nearly all the groundwater produced from the San Fernando Basin is blended with other sources of water.

For CVWD, in the Verdugo Basin, imported water purchased from Foothill MWD is received through a connection at the Paschall Blending Station and is blended with groundwater to reduce the nitrate concentration of the delivered water. Imported water is also received via the Briggs Meter Station, and the Ocean View Meter Station. Blending with imported water is used to help manage the nitrate concentration in water delivered to consumers (Geomatrix, 2005).

Groundwater Treatment

The cities of Burbank, Glendale and Los Angeles, and the CVWD are treating groundwater extracted from selected wells to meet water quality standards. For example, the city of Los Angeles operates treatment facilities for VOC-contaminated groundwater from wells in the San Fernando groundwater basin, as summarized below in **Table 2-7** (LA, 2006a). Costs of treatment range from $250 to $288 per AF.

Table 2-5
Summary of Constituents of Concern in the ULARA Basins

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	280 to 729	Highest levels reported in the North Hollywood area of the San Fernando Basin.
Nitrate (as N) Primary MCL = 10	mg/L	2.6 to 79.2	Highest levels reported in the Verdugo Basin and eastern portion of the San Fernando Basin
VOCs **(TCE and PCE)** TCE Primary MCL = 5 PCE Primary MCL = 5	µg/L	<5 to over 100	The highest concentrations in Glendale and Burbank areas of the eastern San Fernando Basin are being treated. Other areas in the San Fernando Basin, which have levels significantly above the MCL, are currently being addressed through treatment or other means, while long-term solutions are being developed.
Total and Hexavalent Chromium Total Cr MCL = 50 Hexavalent Cr MCL = TBD	µg/L	ND to 423	Highest concentrations are in the Burbank and Glendale areas. These areas are currently being investigated. The city of Los Angeles discontinued pumping from one San Fernando Basin production well after total hexavalent chromium levels as high as 423 µg/L were detected.
Perchlorate Notification Level = 6	µg/L	ND to 8.9	Detected in 2 wells above notification level since 2000.

Source: Watermaster, 2006a; Regional Board 2006

In 1987, the USEPA initiated a remedial investigation of VOC (TCE and PCE) contamination in San Fernando and Verdugo basins. Operable Units for long-term groundwater remediation of VOCs have been established in North Hollywood, Burbank, Glendale North, and Glendale South. The operation of these treatment facilities has become more complex with the identification of nearby hexavalent chromium plumes. Remediation treatment facility operations are summarized in **Table 2-7**.

Within the Verdugo Basin, CVWD pumps groundwater from 11 supply wells in Verdugo Basin. Five of the wells pump water to the Glenwood Ion Exchange Nitrate Removal Facility where nitrate is removed from the water (Geomatrix, 2005).

Table 2-6
Summary of Blending Needs in the San Fernando Basin

Agency	Wellfield(s)	Constituent Blended	Average Annual Groundwater Blended (AFY)
City of Los Angeles	Tujunga	Nitrate and VOC(s)	21,778
City of Los Angeles	Rinaldi-Toluca North Hollywood Erwin Verdugo Whitnall	Nitrate and VOC(s)	66,932
City of Los Angeles	Pollock	Nitrate	1,697
Total		**--**	**90,407**

Source: LA, 2006a

Table 2-7
Summary of Groundwater Treatment in the ULARA Basins

Treatment Facility	Constituent Treated	Treatment Type	Amount Treated (AFY)	Comments
North Hollywood Operable Unit	VOC	Air stripping with air phase GAC	1,800 AF in 2002/03 1,228 AF in 2003/04 1,042 AF in 2004/05	Consent decree expired in 2004, but remediation incomplete. Declining water levels resulting in reduced treatment capacity. Concern with intercepting nearby chromium plume.
Burbank Operable Unit	VOC	Aeration and liquid phase GAC	Design capacity of 9,000 gpm 9,660 AF in 2003/04 6,398 AF in 2004/05	Effluent blended with Metropolitan water to reduce nitrate and chromium concentrations Additional well capacity needed to maintain design capacity.
Glendale North and South Operable Units	VOC	Aeration and liquid phase GAC	North: Design capacity of 3,300 gpm South: Design capacity of 1,700 gpm 7,283 AF in 2003/04 7,541 AF in 2004/05	Effluent blended with Metropolitan water

Table 2-7 (continued)
Summary of Groundwater Treatment in the ULARA Basins

Treatment Facility	Constituent Treated	Treatment Type	Amount Treated (AFY)	Comments
Glenwood Nitrate Water Treatment Plant	Nitrate	Ion Exchange	164 AF in 2003/04 782 AF in 2004/05	Operates in Verdugo Basin
Pollock Wells Treatment Plant	VOC	Liquid phase GAC	1,137 AF in 2003/04 1,752 AF in 2004/05	Treats rising groundwater in the Los Angeles River

ULARA Watermaster, 2005, 2006a

CURRENT GROUNDWATER STORAGE PROGRAMS

There are no formal groundwater storage programs in the ULARA Basins. The City of Los Angeles has regularly participated in Metropolitan's in-lieu replenishment program whereby the City takes imported water from Metropolitan at a discounted rate in lieu of pumping groundwater. An average of 10,400 AFY has been recharged via these programs since 1997.

BASIN MANAGEMENT CONSIDERATIONS

Not all of the 3.67 million AF for the storage capacity is usable and limitations are imposed on the volume of extraction. The primary considerations in the management of the ULARA groundwater basins are:

- The 1979 San Fernando Judgment and 1984 Sylmar Basin Stipulation, which limit production from the basin to the native safe yield plus any imported recharge.

- Rising groundwater levels may also increase surface flow losses out of the ULARA through the Los Angeles River Narrows to Central Basin, liquefaction potential and other factors resulting from near surface groundwater levels.

- In the Verdugo Basin, the vadose zone thickness affects the amount of available storage capacity (being reduced during wet periods). The basin's relatively small size and the basin area suitable for recharge also limit the potential storage capacity (Geomatrix, 2005).

- Widespread contamination with VOCs, hexavalent chromium and nitrate may limit the ability to store and extract water in this basin.

- The imbalance between stored water credits and the actual water in storage in the San Fernando Basin is being addressed by the management parties and the Watermaster.

References:

California Department of Water Resources (DWR), 2004. California's Groundwater Bulletin 118 – San Fernando Valley Groundwater Basin. Updated 2/27/2004. Website: http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/4-12.pdf Accessed 6/27/07.

City of Los Angeles (LA), 2005, Urban Water Management Plan.

City of Los Angeles (LA), 2006a, Groundwater Study Questionnaire, San Fernando Basin.

City of Los Angeles (LA), 2006b, Groundwater Study Questionnaire, Sylmar Basin.

City of Los Angeles (LA), 2006c, Comments on the Groundwater Assessment Study for the Upper Los Angeles River Area Basins (ULARA), December 2006.

GeoMatrix, 2005. Verdugo Basin Groundwater Recharge Storage and Conjunctive Use Feasibility Study. Prepared for Crescenta Valley Water District. May 2005.

Regional Water Quality Control Board (Regional Board), 2006. Geotracker database. Accessed at: http://www.geotracker.swrcb.ca.gov/reports/well_search.asp. October 31, 2006.

San Fernando, California Earthquake of 9 February 1971. Pub. 1974. Oakshott, G.B. editor.

State Water Rights Board, 1962. Report of Referee, City of Los Angeles vs. City of San Fernando, et al.

Upper Los Angeles River Area Watermaster (Watermaster), 2005, Watermaster Service in the Upper Los Angeles River Area, 2003-04 Water Year, Los Angeles County, California.

Upper Los Angeles River Area Watermaster (Watermaster), 2006a, Watermaster Service in the Upper Los Angeles River Area, 2004-05 Water Year, Los Angeles County, California.

Upper Los Angeles River Area Watermaster (Watermaster), 2006b. Pump and Spread Plan. July 2006.

Upper Los Angeles River Area Watermaster (Watermaster), 2007. Comments to March 2007 Draft Groundwater Assessment Study from Mark Mackowski dated May 16, 2007.

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CHAPTER IV

GROUNDWATER BASIN REPORTS

LOS ANGELES COUNTY COASTAL PLAIN BASINS

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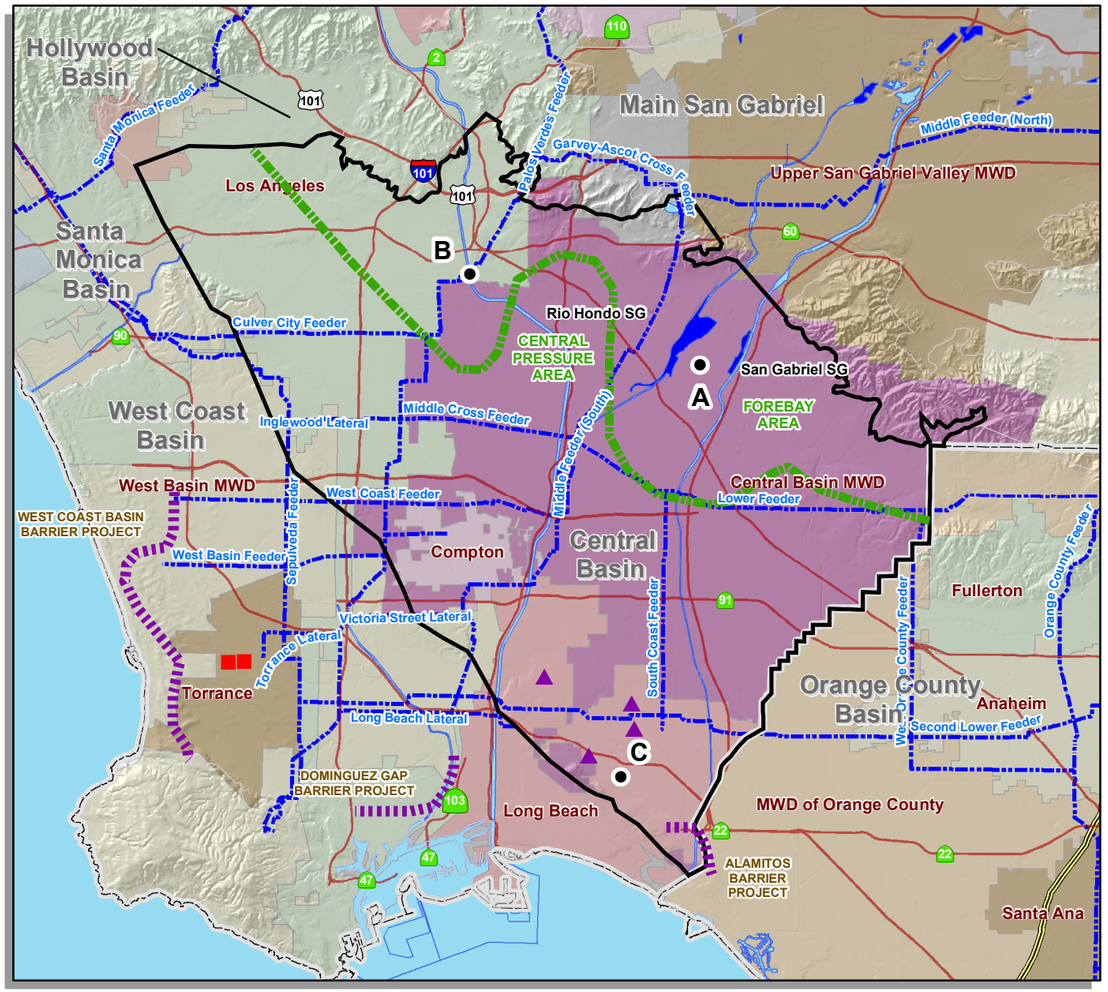

Central Basin

A ● Key Well
▲ ASR Wells
Desalter
Recharge Basin
Seawater Intrusion Barrier
County
Freeways
Water Body
Central Pressure Area
MWD Pipeline
Santa Ana Regional Interceptor Line
Adjacent Basin
Basin
MWD Member Agency Boundary (color varies)

N W E S

5 2.5 0 5 Miles

Note: This map was prepared by the Metropolitan Water District of Southern California for its own use. No warranty is expressed or implied as to the correctness, timeliness, or content of the information shown herein.

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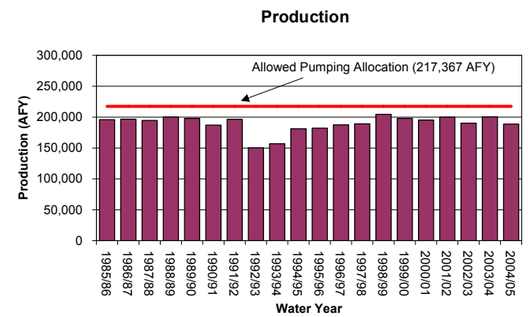
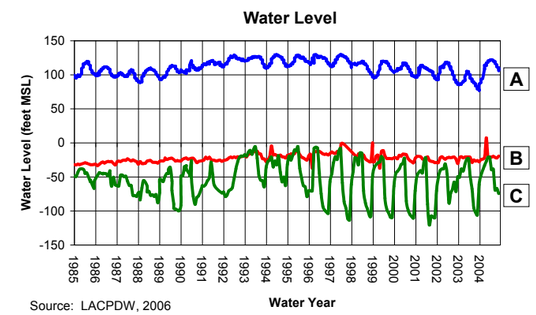
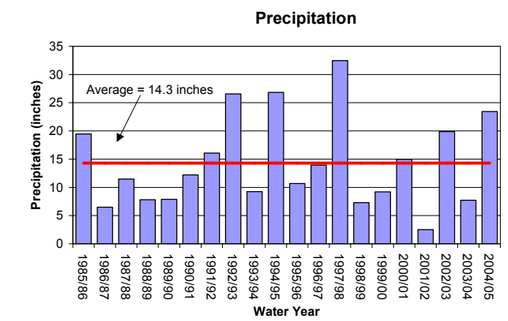
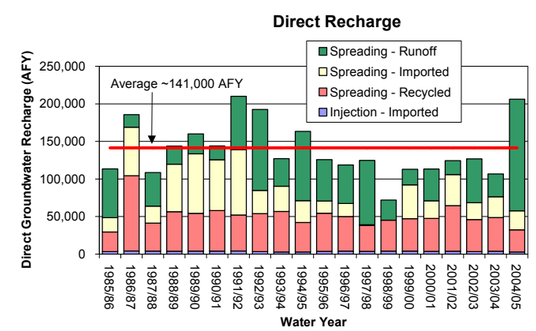
Additional Data Sourse(s): Santa Ana Watershed Project Authority (SAWPA); California Spatial Information Library (CaSIL).





Source: LACPDW, 2006





BASIN FACTS

Central Basin

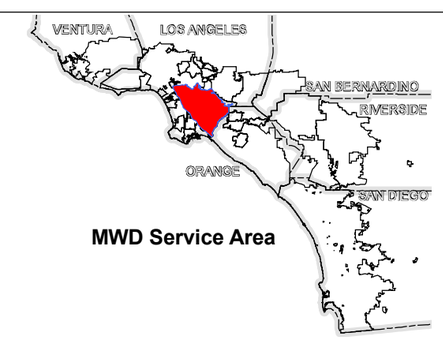
Description
Location: Los Angeles County
Watershed Surface Area: 227 square miles
Management: Adjudicated
Basin was adjudicated in 1965. Department of Water Resources is the Watermaster. The Water Replenishment District of Southern California purchases artificial replenishment water to make up the annual overdraft and has statutory authority to address water quality issues.
MWD Member Agencies:
City of Los Angeles
City of Compton
City of Long Beach
Central Basin MWD

	Central Basin
Natural Safe Yield	125,805 AFY
Allowable Pumping Allocation	213,367 AFY
Total Storage	13.8 million AF
Usable Storage Space	1.1 million AF
Portion of Unused Storage Space Available for Storage (2005)	330,000 AF

Storage and Extraction Facilities	**Central Basin**
Production Wells	
Production Capacity	Data not available
Average 1985-2004	~190,000 AFY
Injection Wells	
Injection Capacity	~4,300 AFY
Average 1985-2004	None
Spreading Basins	
Spreading Capacity	~398,000 AFY
Average 1985-2004	~135,000 AFY
Seawater Intrusion Barriers	
Injection Capacity	6,000 AFY
Average 1985-2004	~3,700 AFY

Basin Management Considerations

- Extraction is limited by the Judgment and the Allowable Pumping Allocation.
- Regional Board limits the amount of recycled water that can be spread.
- Disagreements related to groundwater storage space allocations in the Central and West Coast Basins may limit the ability to store water in the Central Basin.
- Potential for liquefaction and water quality concerns may limit ability to store water



MWD Service Area

Plate 3-1
Overview of Central Basin

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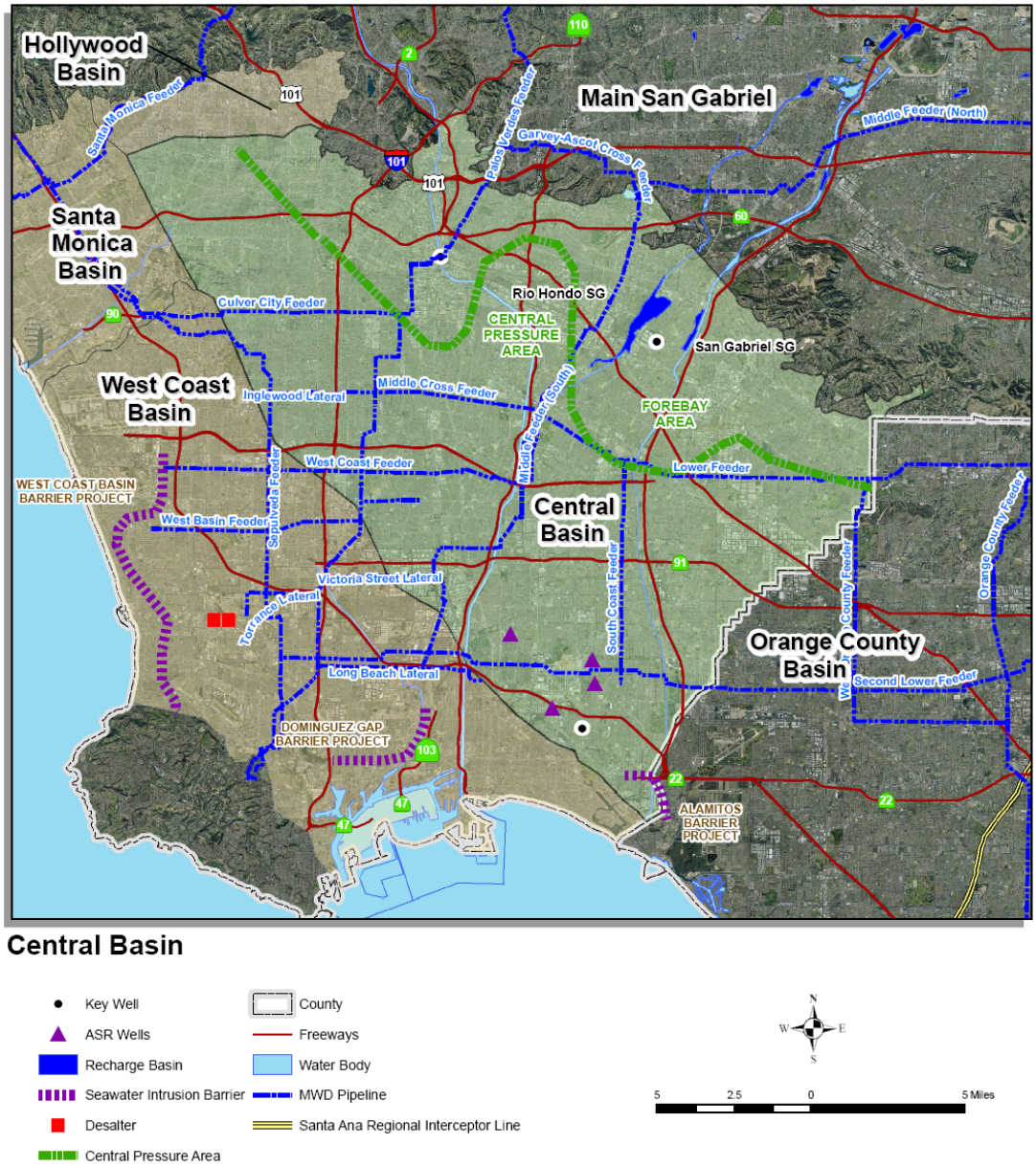
The Central Basin lies within central Los Angeles County, California. It underlies the service areas of Metropolitan member agencies Central Basin Municipal Water District (Central Basin MWD), West Basin Municipal Water District (West Basin MWD), the City of Compton, the City of Los Angeles, and the City of Long Beach. The cities of Artesia, Bellflower, Cerritos, Compton, Downey, Huntington Park, Lakewood, Los Angeles, Long Beach, Montebello, Paramount, Pico Rivera, Norwalk, Santa Fe Springs, Signal Hill, South Gate, Vernon and Whittier overlie the basin. A map of the Central Basin is provided in **Figure 3-1**.

Figure 3-1
Map of Central Basin



BASIN CHARACTERIZATION

The following section provides a physical description of the Central Basin, including its geographic location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

The Central Basin is bounded on the northeast and east by the Elysian, Repetto, Merced and Puente Hills. The southeast boundary of the Central Basin is along Coyote Creek, which is used to separate the Central Basin from the Orange County Basin, although there is no physical barrier between the two basins. The southwest boundary is the Newport, Inglewood fault system. The hydrogeologic parameters of the Central Basin are summarized in **Table 3-1 and Figure 3-2**.

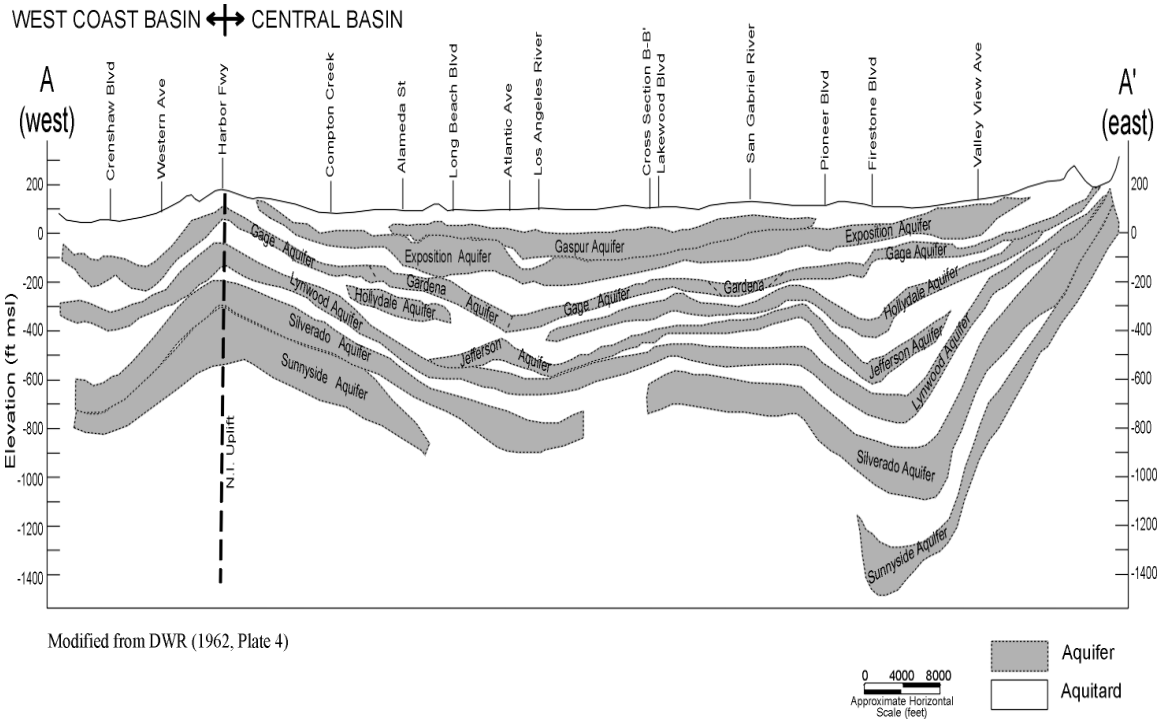
Table 3-1
Summary of Hydrogeologic Parameters of Central Basin

Parameter Structure	**Description**
Aquifer(s)	Forebay areas (unconfined) Pressure area (confined) • Alluvium (Gaspur and Semi-perched aquifers) • Lakewood Formation (Gardena and Gage aquifers) • San Pedro Formation (Lynwood, Silverado, and Sunnyside aquifers)
Depth of groundwater basin	Forebay areas – up to 1,600 feet Pressure area – up to 2,200 feet
Thickness of water-bearing units	Alluvium (up to 180 feet) Lakewood Formation (up to 280 feet) San Pedro Formation (up to 800 feet)
Yield and storage	
Natural safe yield	125,805 AFY
Allowable Pumping Allocation and Managed Safe Yield	217,367 AFY
Total Storage	13.8 million AF
Unused Storage Space	1.1 million AF
Portion of Unused Storage Available for Storage	330,000 AF

WRD, 2006a and WRD, 2006e

The depth of the Central Basin ranges from 1,600 to more than 2,200 feet. The main source of potable groundwater in the Central Basin is from the deeper aquifers of the San Pedro Formation (including from top to bottom, the Lynwood, Silverado and Sunnyside aquifers), which generally correlate with the Main and Lower San Pedro aquifers of Orange County. The shallower aquifers of the Alluvium and the Lakewood Formation (including the Gaspur, Exposition, Gardena-Gage, Hollydale and Jefferson aquifers) locally produce smaller volumes of potable water. In the northern portions of the Central Basin, referred to as the Forebay Area, many of the aquifers are merged and allow for direct recharge into the deeper aquifers. In the area referred to as the Pressure Area, the aquifers are separated by thick aquitards, which create confined aquifer conditions and protection from surface contamination.

Figure 3-2
Generalized Cross Section of Central Basin



Source: WRD, 2006

Total storage in the Central Basin is estimated to be approximately 13.8 million AF. Unused storage space is estimated to be approximately 1.1 million AF. Of the unused storage space, the amount available is approximately 330,000 AF assuming that up to 75 feet below the ground surface is actually available (WRD, 2006e).

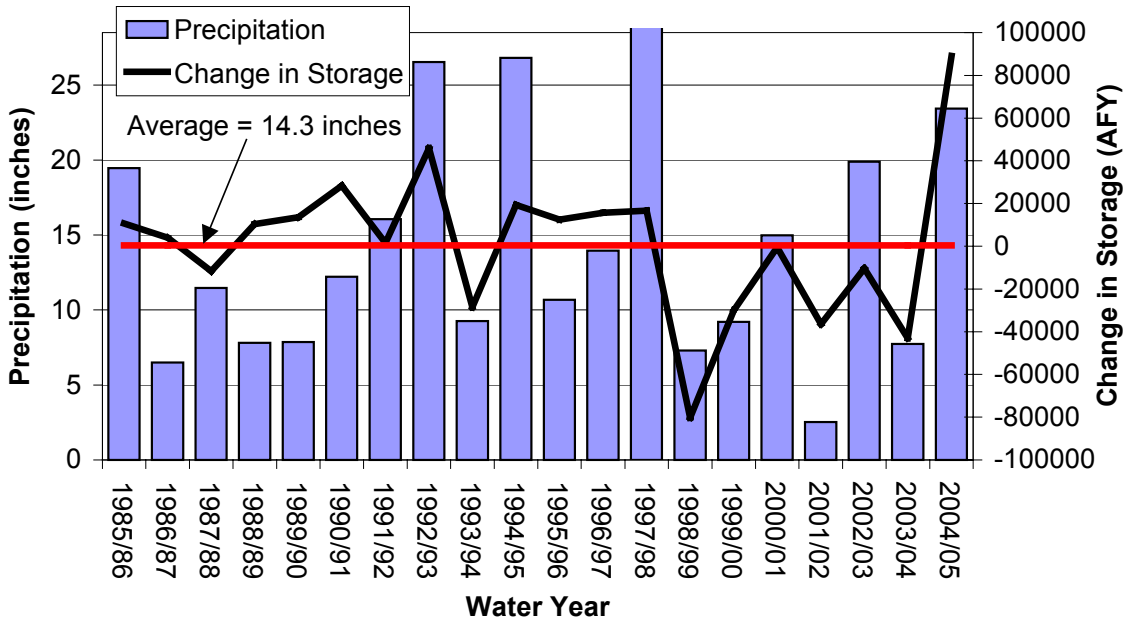
Safe Yield/Long-Term Balance of Recharge and Discharge

According to the California Department of Water Resources (DWR), groundwater enters the Central Basin through surface and subsurface flow and by direct percolation of precipitation, stream flow, and applied water in the forebay areas. Natural replenishment of the groundwater is largely from surface and subsurface inflow through Whittier Narrows. Percolation in the

Los Angeles Forebay from the north is restricted as a result of urbanization at the surface, which prevents downward percolation (DWR, 2004). The natural safe yield of the Central Basin is approximately 125,805 AFY (WRD, 2006e), which represents the amount of water from native waters alone. The managed safe yield of Central Basin is equal to the allowable pumping allocation amount of 217,367 AFY, which is substantially higher than the natural safe yield. This higher yield is possible because of artificial recharge maintained by the Water Replenishment District of Southern California (WRD).

Figure 3-3 shows the historical precipitation as it relates to the change in storage calculated by WRD (2006c). These data show that the average precipitation over the Central Basin is approximately 14.3 inches per year. In general, storage in the Central Basin increases during wet years and decreases during dry years. As discussed below, the amount of recharge in the forebay areas is also a controlling factor in the change in storage that may or may not be related to wet year and dry year cycles. The average change in storage between water year 1985/86 and water year 2004/05 was approximately 1,300 AFY, suggesting that the basin was nearly balanced.

Figure 3-3
Historical Precipitation and Change in Storage for Central Basin



GROUNDWATER MANAGEMENT

The following section describes how the Central Basin is currently managed.

Basin Governance

The Central Basin is an adjudicated basin. It was adjudicated in October 1965 with adjudicated rights set at 267,900 AFY (WRD, 2006f). The amount of the adjudicated water rights that can be

pumped each year (Allowable Pumping Allocation, or APA) is limited to approximately 80 percent of the total adjudicated amount (217,367 AFY).

The Judgment allows annual overpumping of 20 percent of the APA as well as carryover of up to 20 percent of the APA. The DWR serves as Watermaster. The Water Replenishment District of Southern California (WRD), established in 1959, has the statutory authority to replenish the groundwater basin and address water quality issues. The Los Angeles County Department of Public Works (LACDPW) owns and operates the Montebello Forebay Spreading Grounds and the portion of the Alamitos Barrier Project located within Los Angeles County; Orange County Water District operates the Orange County section. WRD procures imported and recycled water to be recharged by LACDPW at these facilities. Table 3-2 provides a list of the management agencies in the Central Basin.

As discussed above, the Judgment APA is 217,367 AFY. However, natural recharge does not support this annual amount of pumping, and the APA exceeds the natural safe yield of the basin and is dependent upon artificial recharge of imported and reclaimed water. Each year WRD makes a determination of the amount of supplemental recharge that is needed based on an estimation of the ensuing year's groundwater production and an estimation of the annual change in storage based on groundwater levels collected throughout the basin.

Table 3-2
Summary of Management Agencies for Central Basin

Agency	Role
California Department of Water Resources	Court appointed Watermaster to administer the Judgment
Water Replenishment District of Southern California	Replenish groundwater, address water quality, administer storage in Central and West Coast Basins
Los Angeles County Department of Public Works	Operation of spreading facilities and Alamitos Barrier facilities
Sanitation Districts of Los Angeles County	Producer of recycled water for Montebello Forebay Spreading Grounds
California Regional Water Quality Control Board – Los Angeles Region (Regional Board)	Issuance of permits for spreading of recycled water in Montebello Forebay and injection of recycled water in seawater intrusion barriers

Note: WRD's authority to administer storage is the subject of disagreement among basin parties.

The WRD adopted Interim Rules for Conjunctive Use Storage and In-Lieu Exchange and Recovery in the Central and West Coast Basins in May 2005. The rules govern storage in the basins outside and above the adjudicated water rights that would utilize up to 450,000 AF of

unused space in the two basins. As of June 2006, the interim rules were the subject of on-going controversy among some groundwater producers in the basins and WRD.

Available storage capacity addressed by WRD Interim Rules is 450,000 AF (330,000 AF in Central Basin and 120,000 AF in West Coast Basin). This estimated capacity is based upon modeling and takes into account requirements that the water level be 75 feet or more below ground surface. However, this analysis did not include potential water quality impacts from contaminated sites in the basin. These could reduce the amount of storage space available if rising water can interact with the contamination. Detailed studies to look at these issues and others are part of the review process prior to approval of a storage project.

Interactions with Adjoining Basins

Central Basin receives subsurface inflow from the San Fernando Basin via downward percolation from the Los Angeles River (Los Angeles Forebay). The Los Angeles Forebay was historically a recharge area from the Los Angeles River. This forebay's recharge capacity has been substantially reduced since the river channel was lined. Recharge is now limited to deep percolation of precipitation, in-lieu when available, and subsurface inflow from the Montebello Forebay to the east, the Hollywood Basin and relatively small amounts from the San Fernando Valley through the Los Angeles Narrows.

The Montebello Forebay, located in the northeastern portion of the Central Basin, connects the Main San Gabriel Basin to the north with the Central Basin via the Whittier Narrows. The Rio Hondo and San Gabriel River spreading grounds in the forebay provide the vast majority of surface recharge to the Central Basin aquifers. Judgment in Case No. 722647 entered in September 1965, provides an adjudication of Upper and Lower Areas on the San Gabriel River. The San Gabriel River Watermaster prepares an annual Watermaster Report providing an accounting of water received, credits, and make-up water.

The Newport Inglewood Uplift separates the Central Basin from the West Coast Basin. Groundwater moves across the uplift, but its movement is slow and restricted because of low permeability sediments and offset of aquifers along the fault.

The boundary with Orange County Basin is not a barrier to flow. Therefore, water can flow between the two basins.

WATER SUPPLY FACILITIES AND OPERATIONS

The following provides a summary of the facilities within the Central Basin. Key storage and extraction facilities include nearly 500 production wells and associated facilities, the Rio Hondo and San Gabriel River spreading grounds and the Alamitos Barrier Project.

Municipal Production Wells

Table 3-3 provides a summary of the production wells in the Central Basin.

There are approximately 497 production wells in the Central Basin (WRD, 2006d). Of the 384 municipal wells identified by WRD (2006d), 367 of these are active and 17 are inactive. Poor water quality is the primary reason for inactive wells. Capacity of wells is not available at this time. WRD estimates that typical groundwater pumping costs for energy are about $65/AF.

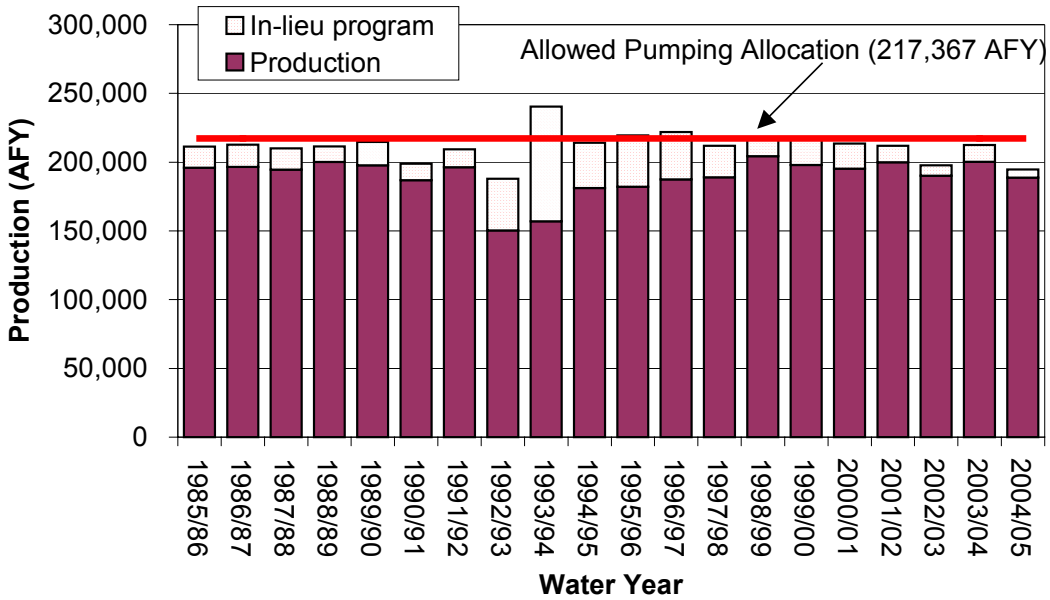
Table 3-3
Summary of Production Wells in the Central Basin

Category	Number of Wells	Estimated Production Capacity (AFY)	Average Production 1985-2004 (AFY)	Well Operation Cost ($/AF)
Municipal	384	Data not available	189,597	$65 Pumping cost
Active	367			
Inactive	17			
Other	113			
Total	**497**			

Source: WRD, 2006d

Production between 1985 and 2004 has ranged from 150,386 AFY to 204,418 AFY with an average of 189,597 AFY. These data are summarized in **Figure 3-4**.

Figure 3-4
Summary of Historical Production in Central Basin



The majority of groundwater production is from the deeper San Pedro Formation including the Lynwood, Silverado, and Sunnyside aquifers (WRD, 2006b). Note that production has been below the APA for the past 20 years.

Central Basin producers participate in an in-lieu groundwater replenishment program whereby they receive imported water purchased from Metropolitan in lieu of pumping groundwater and administered by WRD. In-lieu storage is included in **Figure 3-4**. Between water year 1985/86 and 2004/05, about 22,000 AFY was stored in-lieu. These and other storage programs are discussed in more detail below.

Other Production

According to WRD (2006d), there are approximately 113 other non-municipal wells in the Central Basin. Status information for these wells is not available.

ASR Wells

Two new ASR wells have recently been constructed in the City of Long Beach. In addition, two existing wells have been converted to ASR. The combined extraction capacity of the four wells is estimated to be at least 4,333 AFY. Injection capacity of the ASR wells is estimated to exceed 3,250 AFY.

Spreading Basins

There are currently three primary spreading areas, covering more than 1,000 acres within the Central Basin. The details of these facilities are summarized in **Table 3-4**. The gross capacity of the spreading areas is nearly 398,000 AFY but is limited by mounding and other factors. LACDPW spreads runoff, imported water from Metropolitan and recycled water on behalf of WRD for recharge in the Central Basin.

Total average annual spreading at the Rio Hondo and San Gabriel River Spreading Grounds in the Montebello Forebay for the 20-year period between water years 1985/86 and 2004/05 was approximately 135,000 AFY, with a range of approximately 68,000 AFY to more than 205,000 AFY. Spreading utilizes local runoff, untreated imported water, and recycled water. These data are summarized in **Figure 3-5**.

The Regional Board permit for recharge of recycled water limits recycled water spreading to the lesser of 60,000 AFY or an amount not to exceed 50 percent of the total inflow into the Montebello Forebay for that year. In addition, recycled water shall not exceed 150,000 AF in any three-year period or 35 percent of the total inflow to the forebay.

Seawater Intrusion Barriers

The Alamitos Barrier Project consists of 43 wells with a combined injection capacity of 15 cfs and four extraction wells in the Alamitos Gap in Long Beach (DWR, 2005;WRD, 2006d). The barrier utilizes imported water purchased from the City of Long Beach or recycled water from WRD's Leo J. Vander Lans Advanced Water Treatment Facility that went on-line in 2006.

Figure 3-5
Historical Direct Groundwater Recharge in Central Basin

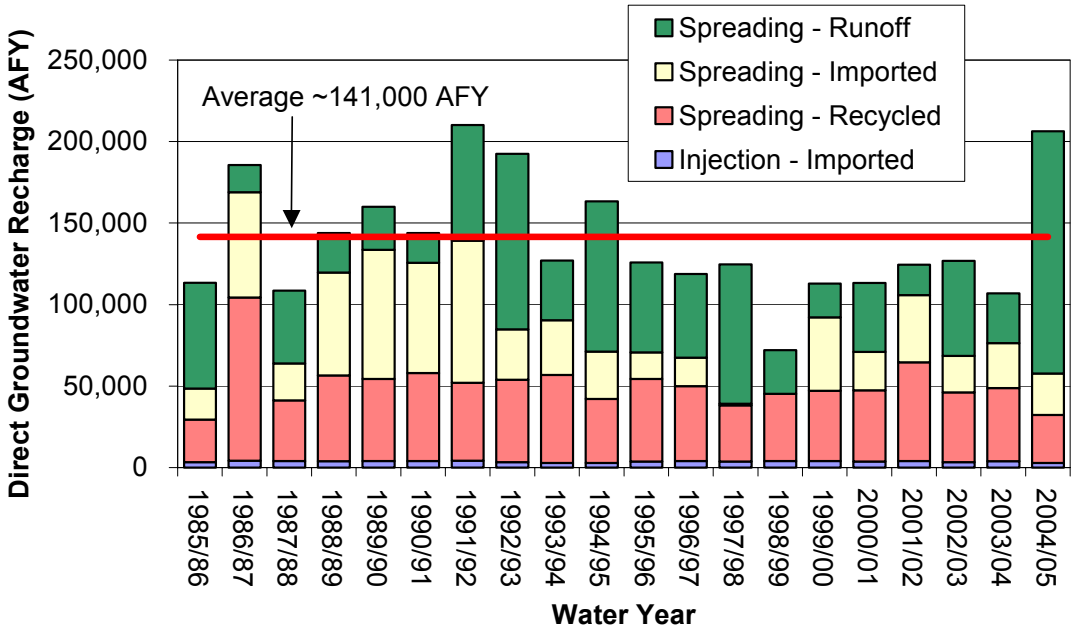


Table 3-4
Summary of Recharge Basins in the Central Basin

Spreading Basin	Area (acres)	Wetted Area (acres)	Recharge Capacity (cfs)	Recharge Capacity (AFY)	Source Water	Owner
Rio Hondo Spreading Grounds	570	430	400	~290,000	Runoff Imported Recycled	LACDPW
San Gabriel River (Basins)	128	96	75	54,000	Runoff Imported Recycled	LACDPW
San Gabriel River (River)	308	308	75	54,000	Runoff Imported Recycled	LACDPW
Total	**1,006**	**834**	**550**	**~398,000**	**--**	**--**

Source: LACDPW, 2006

Injection of imported water at the Alamitos Barrier Project in Central Basin has averaged about 3,711 AFY with a range of 2,800 AFY to 4,200 AFY.

Desalters

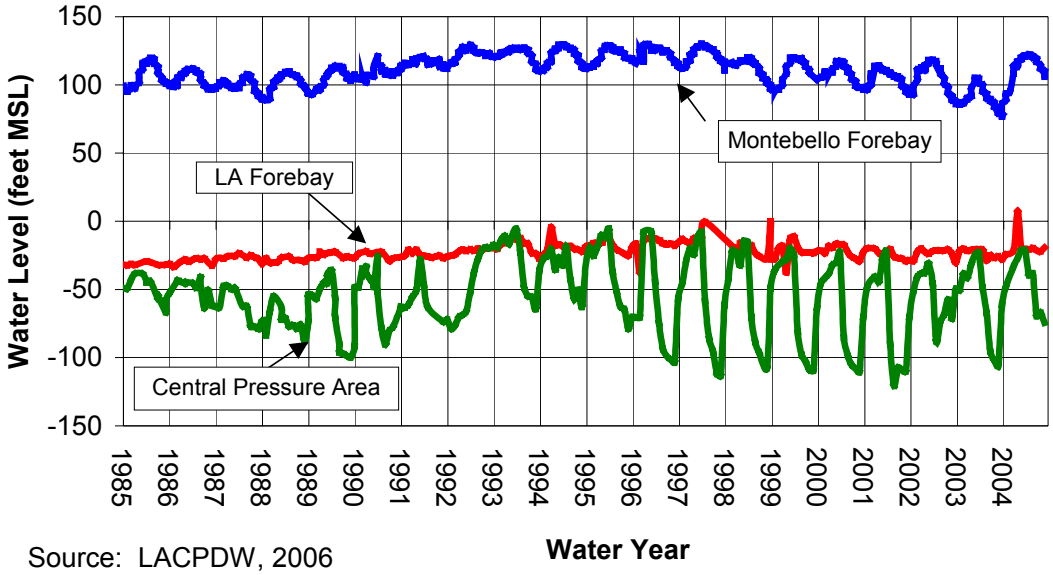
There are no desalters in Central Basin.

GROUNDWATER LEVELS

Historically, groundwater flow in the Central Basin has been from the recharge areas in the northeast toward the Pacific Ocean on the southwest. Pumping patterns have lowered the water level in large portions of the Central Basin. Historical water levels in key wells in various locations in the basin are summarized in **Figure 3-6**. These data, like the precipitation and storage data discussed above, suggest that the water levels have been relatively stable over the past 20 years.

As shown in **Figure 3-7**, in 2005, Central Basin water levels ranged from a high of about 160 feet above mean sea level (MSL) in the northeast portion of the basin upgradient of the spreading grounds to a low of about 90 feet below MSL in the Long Beach area.

Figure 3-6
Historical Water Levels in the Central Basin



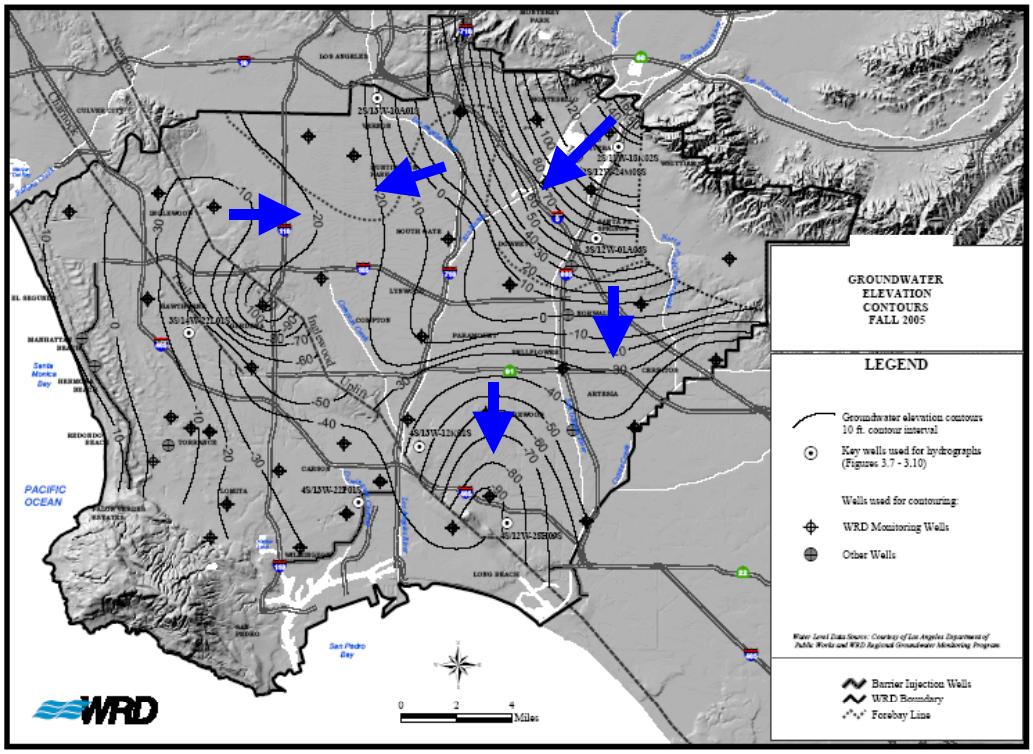
Source: LACPDW, 2006

GROUNDWATER QUALITY

In general, groundwater in the main producing aquifers of the basin is of good quality. Localized areas of marginal to poor water quality exist, primarily on the basin margins and in the shallower

and deeper aquifers impacted by seawater intrusion. The following section provides a brief description of the groundwater quality issues in the Central Basin.

Figure 3-7
Groundwater Elevation Contours – Fall 2005



Groundwater Quality Monitoring

In 1995, WRD and the U.S. Geological Survey (USGS) began a cooperative study to improve the understanding of the geohydrology and geochemistry of Central and West Coast Basins. Out of this effort, came WRD's geographic information system (GIS) and the Regional Groundwater Monitoring Program. Twenty-one depth-specific, nested monitoring wells located throughout the basin, allow water quality and groundwater levels to be evaluated on an aquifer-specific basis. Regional Groundwater Monitoring Reports are published by WRD for each water year. Constituents monitored include: TDS, iron, manganese, nitrate, TCE, PCE, arsenic, chromium including hexavalent chromium, MTBE, and perchlorate.

Groundwater Contaminants

As shown in **Table 3-5**, volatile organic compounds (VOCs), primarily tetrachlororoethylene (PCE) and trichloroethylene (TCE), are present in the Central Basin and have impacted many production wells. However, most of the wells that have the VOCs do not exceed drinking water quality standards (WRD, 2006b). Those with higher levels require treatment prior to use as drinking water. Treatment programs in Central Basin are discussed in more detail below.

Table 3-5
Summary of Constituents of Concern in Central Basin

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	170 to 2,770 Average: 500	WRD is conducting studies to identify potential sources of high TDS, which may be caused by localized seawater intrusion or connate and oil field brines. Range in production wells 250 mg/L to 750 mg/L. Higher TDS concentrations located in northern portion of basin.
VOCs **(TCE and PCE)** TCE MCL = 5 PCE MCL = 5	µg/L	ND to 32 for TCE ND to 8.3 for PCE	Concentrations in 15 wells exceeded MCL for TCE Concentrations in 68 wells exceed MCL for PCE
Perchlorate Notification level =6	µg/L	Less than 6 µg/L	Detected in 5 monitoring wells and three production wells below notification level
Nitrate (as N) MCL = 10	mg/L	ND to 12	Higher concentrations tend to be limited to the uppermost zones and are likely due to localized infiltration and leaching. One production well in the Los Angeles Forebay area has exceed the 10 mg/L MCL. No wells in Silverado aquifer exceeded the 10 mg/L MCL.
Iron and manganese Secondary MCL for iron = 0.3 Secondary MCL manganese = 0.05	mg/L	ND to 8.4 for iron ND to 1.3 for manganese	Some localized wells exceed secondary standard (0.3 mg/L and 0.05, respectively) for iron and manganese.
Chromium MCL = 50	µg/L	Not available	Detected above MCL in one monitoring well and three production wells in the vicinity of the forebay areas

Source: WRD, 2006b

WRD has taken a proactive approach to protecting the basins in the face of emerging water quality issues. Through its monitoring and sampling program and evaluation of current water quality regulations, WRD has determined that the special interest constituents including arsenic, hexavalent chromium, methyl tertiary butyl ether (MTBE), total organic carbon, color and perchlorate do not pose a substantive threat to the basins (WRD, 2006b).

Blending Needs

Data related to blending needs and practices are not available for the Central Basin.

Groundwater Treatment

As discussed above, VOCs including TCE and PCE have been detected and are currently treated in the Central Basin. To mitigate this problem, the WRD established a Safe Drinking Water Program as part of its Clean Water Program in 1991. This program began as a means to provide basin pumpers with wellhead treatment equipment to remove VOCs from the groundwater, allowing affected wells to meet public drinking water standards. The program promotes the cleanup of groundwater resources at specific well locations and is accomplished through partnerships with well owners. The WRD Safe Drinking Water Program also makes local groundwater reserves available that would otherwise be lost to contamination. There are a total of eleven facilities online with several projects in various stages of completion (WRD, 2007).

About 9,200 AF was treated in fiscal year 2004/05 for VOCs, iron and manganese. This represents about five percent of the total water produced in Central Basin during 2004/05. About 330 AF of the water treated in Central Basin in 2004/05 was treated for iron and manganese under Metropolitan's LRP Groundwater Recovery Projects Program (Metropolitan, 2006).

EXISTING STORAGE PROGRAMS

WRD operates an in-lieu replenishment program in the Central Basin. An average of about 21,000 AFY of in-lieu storage was generated through this program between water years 1985/86 and 2004/05. In addition, as discussed below, a few member agencies participate in Metropolitan's conjunctive use storage program. These in-lieu data are summarized in **Figure 3-8**.

Metropolitan has recently implemented three conjunctive programs under the Proposition 13 program in the Central Basin. These include programs in the cities of Long Beach, Lakewood, and Compton. Each of these programs is described in **Table 3-6**. Total storage from these programs is 18,895 AF. About 15,394 AF, or about 80 percent of the programs, is currently in storage under these combined programs.

Figure 3-8
Historical In-lieu Storage for Central Basin

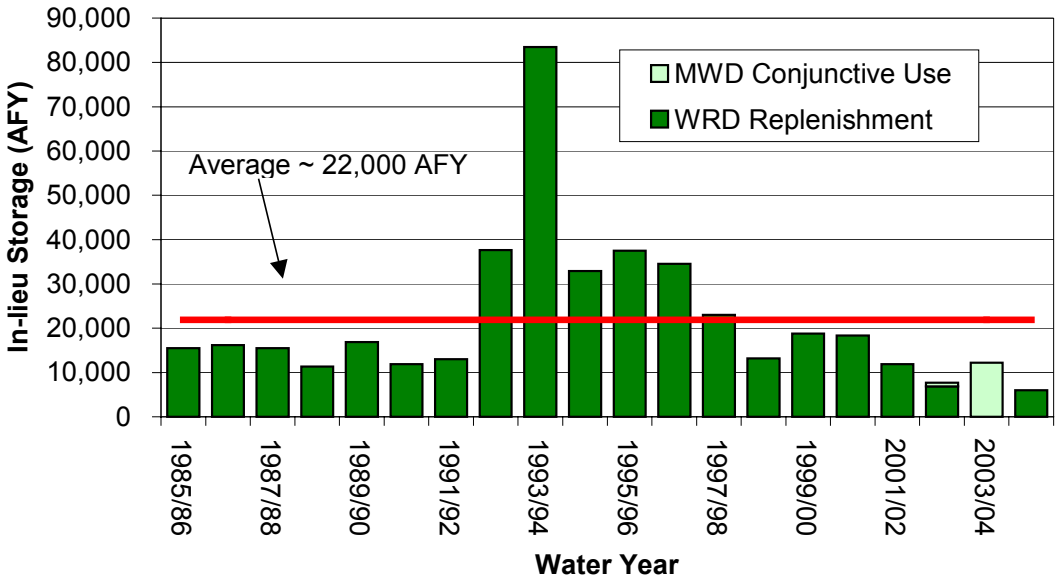


Table 3-6
Conjunctive Use Programs in the Central Basin

Program	Member Agencies	Year Began	Total Storage (AF)	Amount in storage [1] (AF)
Long Beach Conjunctive Use Program (Phase 1)	City of Long Beach	2002	13,000	13,000
Long Beach Conjunctive Use Program (Phase 2)	City of Long Beach	2005	3,600	1,800
Compton Conjunctive Use Program	City of Compton	2005	2,295	1,144
Total	--	--	**18,895**	**15,944**

Notes: 1 Amount in storage at end of fiscal year 2005/06

BASIN MANAGEMENT CONSIDERATIONS

Considerations in the Central Basin include:

- Extraction is limited by the Judgment and the APA. The 20 percent allowed over pumping and carryover is administered by the Watermaster and subject to the provisions of the Central Basin Judgment.
- Disagreements related to the Interim Rules for Conjunctive Use Storage and In-Lieu Exchange and Recovery in the Central and West Coast Basins may limit the ability to store and extract water in the Central Basin. At this time, the approval of storage projects is administered by WRD using the framework defined in the Interim Rules for Conjunctive Use Storage and In-Lieu Exchange and Recovery in the Central and West Coast Basins.
- Spreading of recycled water is regulated by the Regional Board and limits the amount of recycled water that can be spread. The Regional Board permit for recharge of recycled water limits recycled water spreading to the lesser of 60,000 AFY or an amount not to exceed 50 percent of the total inflow into the Montebello Forebay for that year. In addition, recycled water shall not exceed 150,000 AF in any three-year period or 35 percent of the total inflow to the forebay.
- Potential for liquefaction and water quality concerns could limit the ability to store water.

References:

California State Superior Court for the County of Los Angeles (Long Beach Judgment), 1964. Case No. 722647, Board of Water Commissioners for the City of Long Beach et al. vs. San Gabriel Valley Water Company et al.

California Department of Water Resources (DWR), 2004. California's Groundwater Bulletin 118 – Los Angeles County Coastal Plain Central Basin. Updated 2/27/04. Website: http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/4-11.04.pdf. Accessed June 12, 2007.

California Department of Water Resources (DWR), 2005. Watermaster Service In the Central Basin, Los Angeles County – July 1, 2004 to June 30, 2005, October 2005.

Los Angeles County Department of Public Works (LADPW), 2006. Spreading basin data. Website. http://ladpw.org/wrd/report/0304/conserv/index.cfm Accessed September 15, 2006.

Metropolitan Water District of Southern California (Metropolitan), 2006. Local Resource Program Recycled Water and Groundwater Recovery Projects – Summary Report August 2006.

Water Replenishment District of Southern California (WRD), 2006a. Website: http://www.wrd.org/articles/Century%20of%20Groundwater.htm Accessed August 24, 2006.

Water Replenishment District of Southern California (WRD), 2006b. Regional Groundwater Monitoring Report – Water Year 2004-2005, Central and West Coast Basins Los Angeles County, California, March 2006.

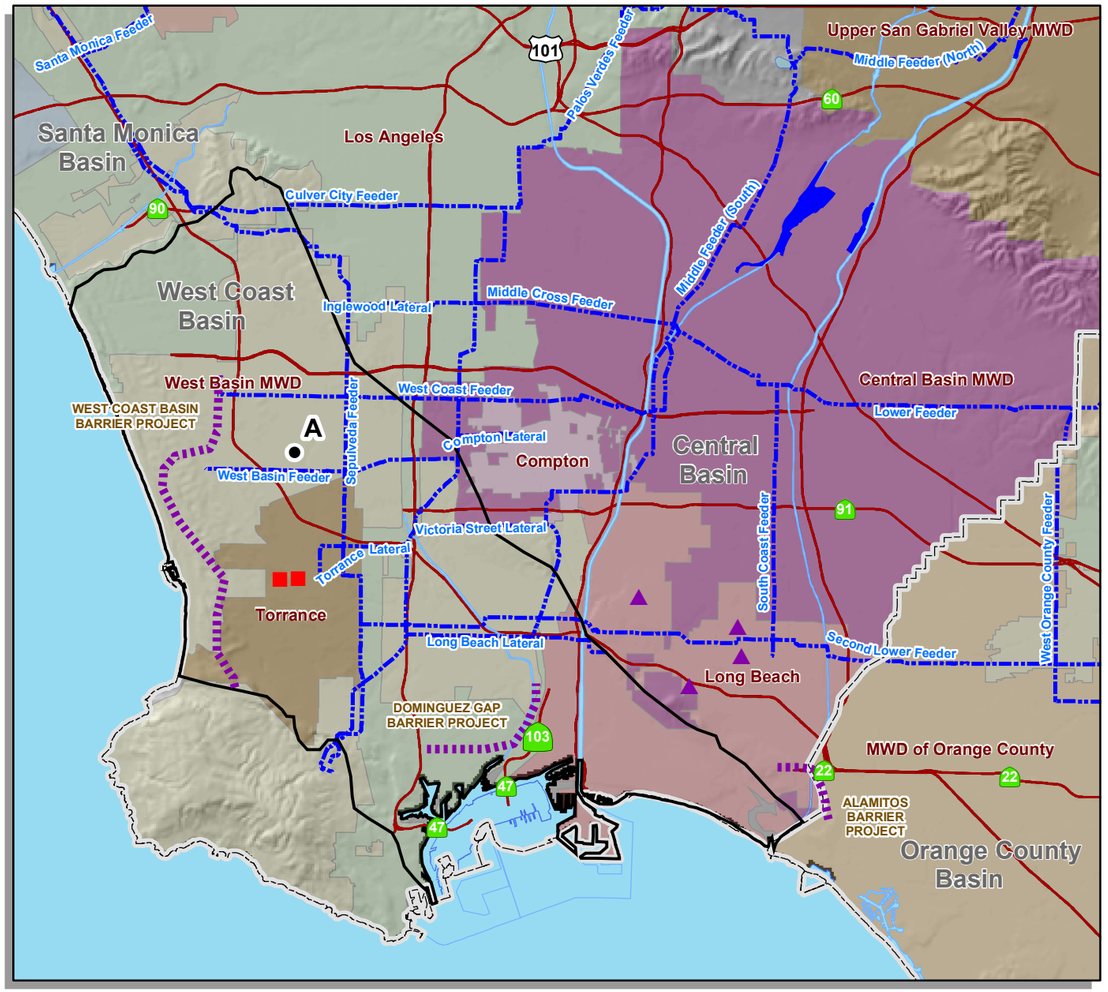
Water Replenishment District of Southern California (WRD), 2006c. Engineering Survey and Report, Updated June 21, 2006.

Water Replenishment District of Southern California (WRD), 2006d. Groundwater Study Questionnaire.

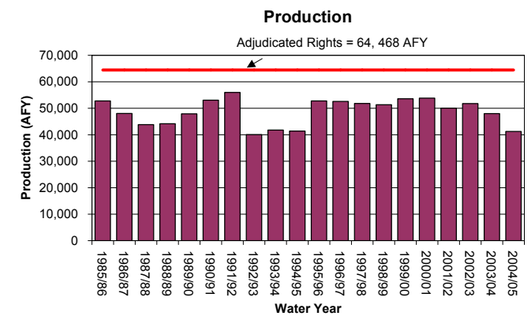
Water Replenishment District of Southern California (WRD), 2006e. Personal communication with Ted Johnson, September 21, 2006.

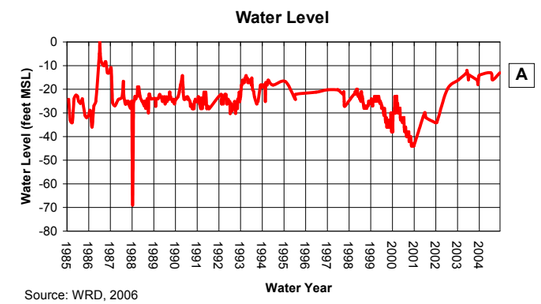
Water Replenishment District of Southern California (WRD), 2006f. Comments on draft Groundwater Assessment Study, November 2006.

Water Replenishment District of Southern California (WRD), 2007. Website: http://www.wrd.org/Project_SDWP.htm Accessed February 20, 2007.

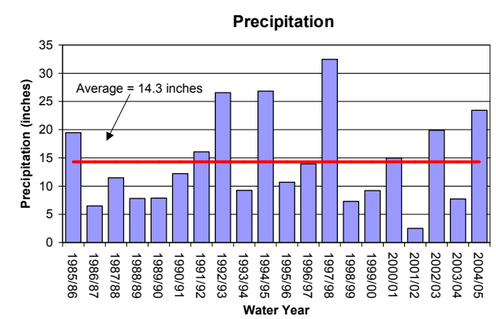


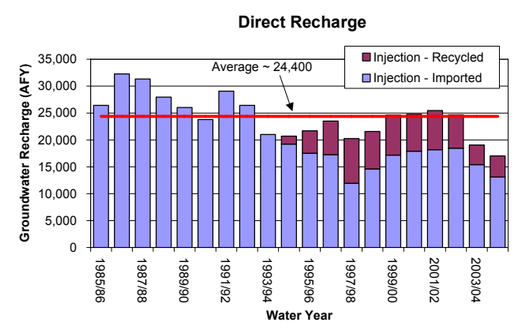
West Coast Basin





Source: WRD, 2006





BASIN FACTS

West Coast Basin

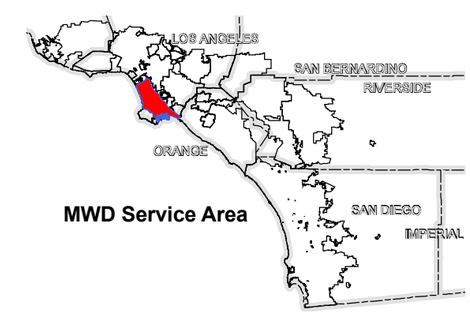
Description
Location: Los Angeles County
Watershed Surface Area: 142 square miles
Management: Adjudicated
Basin was adjudicated in 1961 with a maximum pumping of 64,468.25 AFY. Department of Water Resources is the Watermaster. The Water Replenishment District of Southern California purchases artificial replenishment water to make up the annual overdraft and has statutory authority to address water quality issues.
MWD Member Agencies:
West Basin MWD
City of Torrance
City of Long Beach
City of Los Angeles

	West Coast Basin
Natural Safe Yield	26,300 AFY
Total Storage	6.5 million AF
Usable Storage Space	1.1 million AF
Portion of Unused Storage Space Available for Storage	120,000 AF

Storage and Extraction Facilities

	West Coast Basin
Production Wells	
Production Capacity	Data not available
Average 1985-2004	~49,000 AFY
Injection Wells	
Injection Capacity	None
Average 1985-2004	None
Spreading Basins	
Spreading Capacity	None
Average 1985-2004	None
Seawater Intrusion Barriers	
Injection Capacity	Not available
Average 1985-2004	~24,000 AFY

Basin Management Considerations
- Extraction is limited by the Judgment
- Regional Board limits the amount of recycled water injected.
- Disagreements related to groundwater storage space allocations in the Central and West Coast Basins may limit the ability to store water in the Central Basin.
- Seawater intrusion and TDS concentrations could prevent full utilization of basin



MWD Service Area

A ● Key Well
▲ ASR Wells
■ Desalter
Recharge Basins
Seawater Intrusion Barrier
County
Freeways
Water Body
MWD Pipeline
Basin
MWD Member Agency Boundary (color varies)

N W E S

4 2 0 4 Miles

Note: This map was prepared by the Metropolitan Water District of Southern California for its own use. No warranty is expressed or implied as to the correctness, timeliness, or content of the information shown herein.

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Additional Data Sourse(s): Santa Ana Watershed Project Authority (SAWPA); California Spatial Information Library (CaSIL).

Plate 4-1
Overview of West Coast Basin

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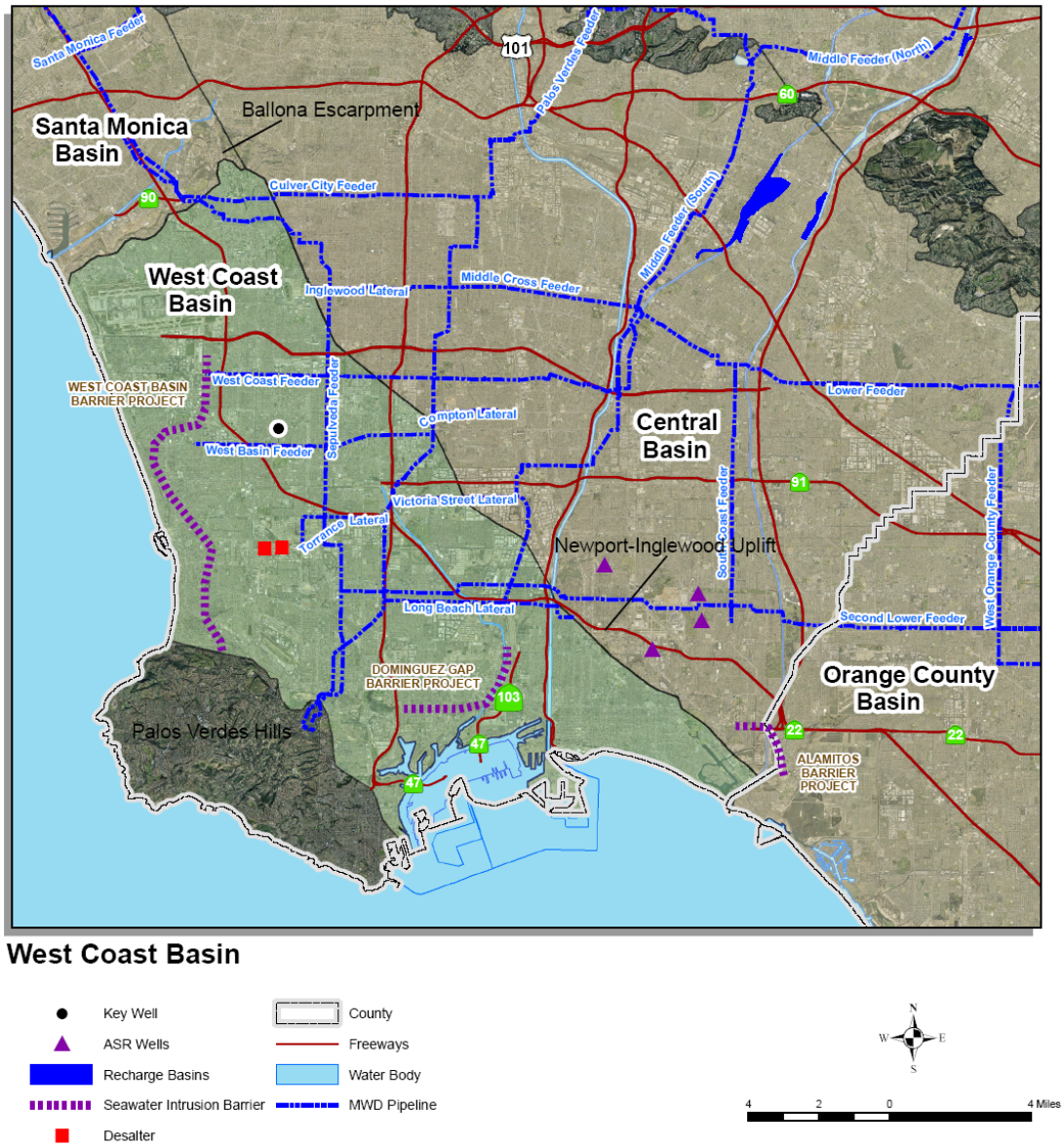
The West Coast Basin lies along the coast in western Los Angeles County. It overlies the service areas of Metropolitan member agencies: West Basin Municipal Water District (WBMWD), City of Los Angeles, City of Torrance, and the City of Long Beach. The cities of El Segundo, Manhattan Beach, Hermosa Beach, Redondo Beach, Torrance, Inglewood, Hawthorne, Gardena, Lomita, Carson and Long Beach overlie the basin. A map of the West Coast Basin is provided in **Figure 4-1**.

Figure 4-1
Map of the West Coast Basin



BASIN CHARACTERIZATION

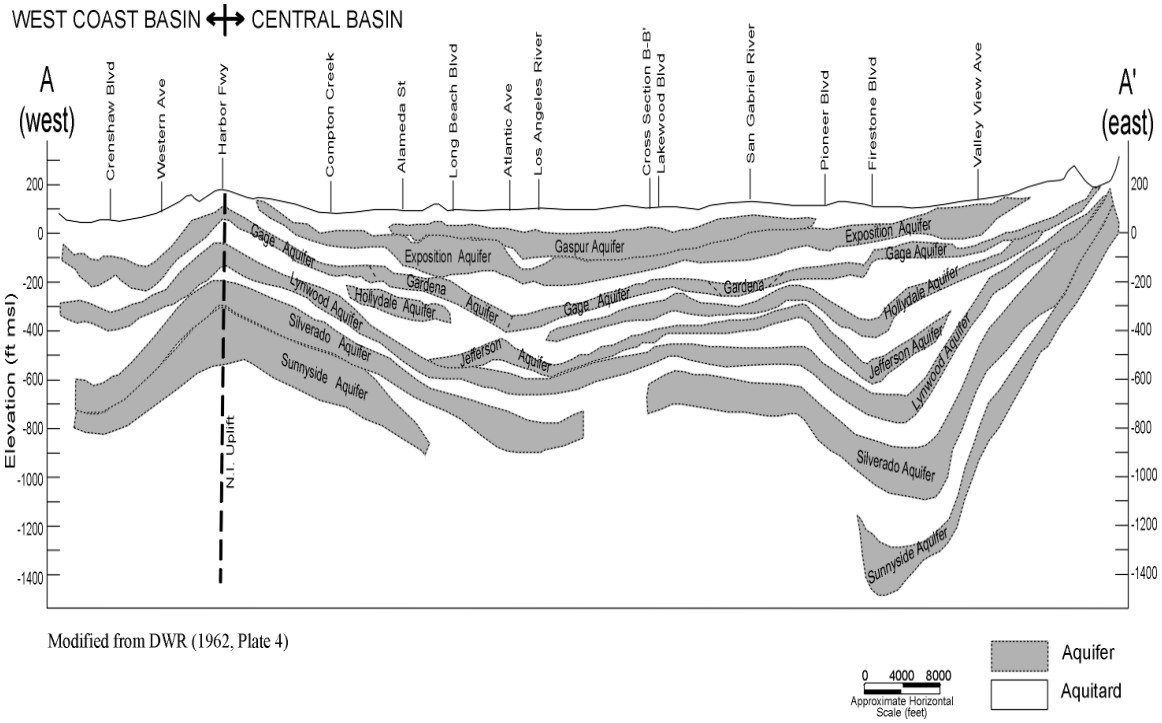
The following section provides a physical description of the West Coast Basin, including its geographic location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

The West Coast Basin is bounded on the south and west by the Pacific Ocean, on the north by the Ballona Escarpment, on the east by the Newport-Inglewood Uplift, and on the south by the Palos Verdes Hills (DWR, 2005). Hydrogeologic parameters for the West Coast Basin are summarized in **Table 4-1**.

Groundwater in the West Coast Basin is generally confined. The Silverado aquifer underlying most of West Coast Basin is the most productive aquifer in the basin. It ranges from 100 to 500 feet thick and yields 80 to 90 percent of the groundwater extracted annually (DWR, 2004). This aquifer generally correlates with the Main aquifer of Orange County. A generalized cross section is shown in **Figure 4-2**. Minor yield also comes from the Gage, or "200-foot sand", aquifer, the Lynwood, or "400-foot gravel", aquifer and the Sunnyside, or Lower San Pedro aquifer.

Figure 4-2
Generalized Hydrogeologic Cross Section of West Coast Basin and Central Basin



Source: WRD, 2004

Table 4-1
Summary of Hydrogeologic Parameters of West Coast Basin

Parameter	Description
Structure	
Aquifer(s)	Pressure area (confined) • Alluvium (Gaspur and Semi-perched aquifers) • Lakewood Formation (Gardena and Gage "200-foot sand" aquifers) • San Pedro Formation (Lynwood "400-foot gravel", Silverado, and Sunnyside aquifers)
Depth of groundwater basin	~800 to 2,000 feet
Thickness of water-bearing units	Alluvium (up to 180 feet) Lakewood Formation (up to 320 feet) San Pedro Formation (up to 1,050 feet)
Yield and storage	
Natural safe yield	26,300 AFY (WRD, 2006e)
Adjudicated Rights	64,468.25 AFY
Total Storage	6.5 million AF
Unused Storage Space	1.1 million AF
Portion of Unused Storage Space Available for Storage	120,000 AF

Source: WRD, 2006c and 2006e and DWR, 2004.

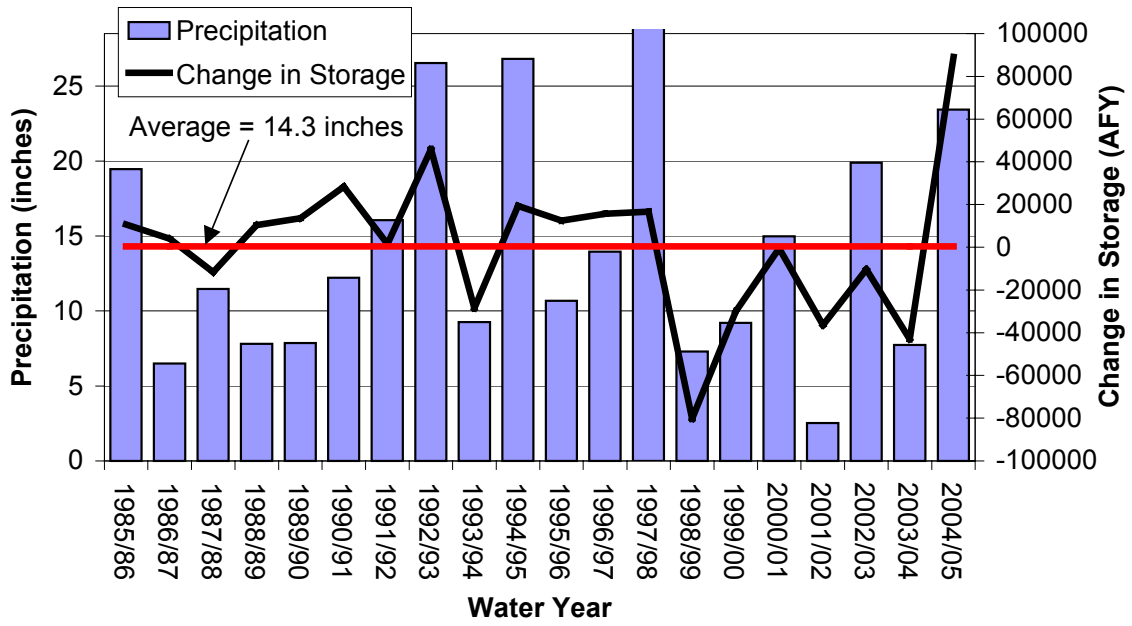
Total storage in the West Coast Basin is estimated to be approximately 6.5 million AF. Unused storage space is estimated to be approximately 1.1 million AF. Of the unused storage space, the amount available for groundwater storage is approximately 120,000 AF assuming that up to 75 feet below the ground surface is actually available (WRD, 2006e).

Safe Yield/Long-Term Balance of Recharge and Discharge

Figure 4-3 shows the historical precipitation as it relates to the change in storage calculated by WRD (2006c). These data show that the average precipitation in the West Coast Basin is approximately 14.3 inches per year. In general, storage in the West Coast Basin increases during wet years and decreases during dry years. The average change in storage in the combined Central and West Coast Basins since 1985 was approximately 1,300 AFY, suggesting that the basins are nearly balanced.

The primary source of natural recharge to the West Coast Basin is subsurface inflow from the Central Basin and surface inflow into the uppermost aquifers from rainfall. This natural safe yield, which represents the yield as a result of native waters alone, of the West Coast Basins has been estimated by WRD to be approximately 26,300 AFY (WRD, 2006e), of which approximately 7,100 AFY is from seawater intrusion (WRD, 2006e). The managed safe yield of West Coast Basin is equal to the 64,468.25 AFY (the adjudicated production limit discussed below), which is substantially higher than the natural safe yield. This higher yield is possible because of artificial recharge maintained by the Water Replenishment District of Southern California (WRD).

Figure 4-3
Historical Precipitation and Change in Storage for West Coast Basin



GROUNDWATER MANAGEMENT

The following section describes how the West Coast Basin is currently managed.

Basin Governance

The West Coast Basin is adjudicated. The West Coast Basin adjudication (Judgment) was finalized in 1961 and capped annual production at 64,468 AFY. The Judgment allows annual carryover of unpumped adjudicated right not to exceed 20 percent and also allows up to 20 percent excess production to be made up by under-production the following year. The Judgment also allows up to 10,000 AF of emergency overpumping under specified conditions. The California Department of Water Resources (DWR) serves as Watermaster. The Water Replenishment District of Southern California (WRD), established in 1959, has the statutory authority to replenish the groundwater basin and address water quality issues. The

Los Angeles County Department of Public Works (LACDPW) owns and operates the West Coast Barrier Project and the Dominguez Gap Barrier Project. WRD procures imported and recycled water to be recharged by LACDPW at these facilities.

Table 4-2 provides a list of the management agencies in the West Coast Basin.

Each year WRD makes a determination of the amount of supplemental recharge that is needed based on an estimation of the ensuing year's groundwater production and an estimation of the annual change in storage based on groundwater levels collected throughout the basin.

The WRD adopted Interim Rules for Conjunctive Use Storage and In-Lieu Exchange and Recovery in the Central and West Coast Basins in May 2005. The rules govern storage in the basins outside and above the adjudicated water rights that would utilize up to 450,000 AF (120,000 AF in West Coast Basin and 330,000 AF in Central Basin) of unused space in the two basins. As of June 2006, the interim rules were the subject of on-going controversy among some groundwater producers in the basins and WRD.

Table 4-2
Summary of Management Agencies in the West Coast Basin

Agency	Role
California Department of Water Resources	Court appointed Watermaster to administer the Judgment
Water Replenishment District of Southern California	Replenish groundwater, address water quality, administer storage in Central and West Coast Basins
Los Angeles County Department of Public Works	Operation of West Coast Barrier Project and Dominguez Gap Barrier Project facilities
California Regional Water Quality Control Board – Los Angeles Region (Regional Board)	Issuance of permit for injection of recycled water in seawater intrusion barriers

Note: WRD's authority to administer storage is the subject of disagreement among basin parties.

Available storage capacity addressed by WRD Interim Rules is 450,000 acre-feet (a portion of this is in Central Basin). This estimated capacity is based upon modeling and takes into account water level requirements but not soil or water quality issues that could reduce the available storage capacity.

Interactions with Adjoining Basins

The Newport Inglewood Uplift is a major structural feature that acts as a partial barrier to groundwater flow between the Central and West Coast Basins. Discontinuities associated with Charnock and Overland faults in West Coast Basin also appear to affect groundwater flow

(USGS, 2003). Approximately 7,100 AFY is estimated to enter the West Coast Basin from the ocean (WRD, 2006e;USGS, 2003). Most of this occurs on the seaward side of the barriers or in areas where production does not occur.

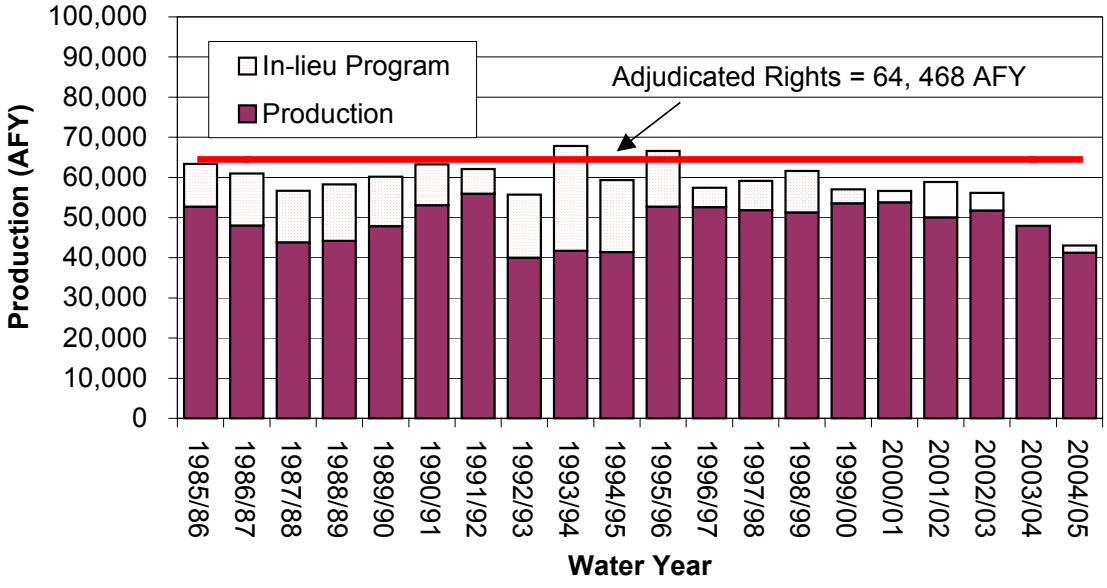
WATER SUPPLY FACILITIES AND OPERATIONS

The following provides a summary of the facilities within the West Coast Basin. Key storage and extraction facilities include 111 production wells and associated facilities, 247 injection wells associated with the Dominguez Gap and West Coast Basin Barrier Projects, 514 monitoring wells and two desalters (DWR, 2005).

Municipal Production Wells

There are currently 111 municipal production wells in the West Coast Basin, 63 active wells and 48 inactive wells (DWR, 2005). There are also 761 other wells in the basin that include groundwater monitoring wells or seawater intrusion barrier wells. These data are provided in **Table 4-3**. Historical production from all sources between water years 1985/86 and 2004/05 is shown in **Figure 4-4**. An average of approximately 48,797 AFY was produced from the West Coast Basin between water years 1985/86 and 2004/05. This average is nearly 16,000 AFY less than the allowable extractions under the Judgment.

Figure 4-4
Historical Groundwater Production in the West Coast Basin



West Coast Basin producers participate in an in-lieu groundwater replenishment programs whereby they receive imported water from Metropolitan in lieu of pumping groundwater.

Between water years 1985/86 and 2004/05, about 9,800 AFY was stored in-lieu. These and other storage programs are discussed in more detail below.

Table 4-3
Summary of Production Wells in the West Coast Basin

Category	Number of Wells	Estimated Production Capacity (AFY)	Average Production 1985-2004 (AFY)	Well Operation Cost ($/AF)
Municipal	111	Data not available	48,797	$65 Pumping Cost
Active	63			
Inactive	48			
Other	761			
Total	**872**			

Source: WRD, 2006d and DWR, 2005

Other Production

Production data provided above includes water that is desalted by the Goldsworthy and Brewer desalters. These facilities are discussed in more detail below.

ASR Wells

There are no ASR wells in the West Coast Basin.

Spreading Basin

There are no spreading basins in the West Coast Basin.

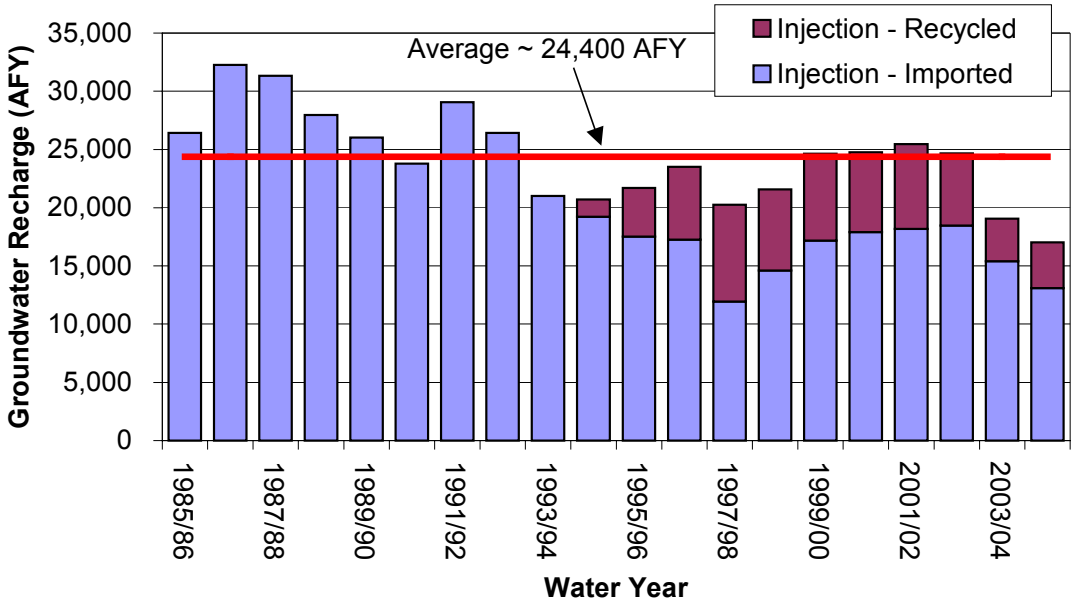
Seawater Intrusion Barriers

There are two seawater intrusion barriers in the West Coast Basin: the West Coast Basin Barrier Project and the Dominguez Gap Barrier Project. Amounts of water injected are summarized in **Figure 4-5**. An average of about 24,400 AFY was injected into these barriers between water years 1985/86 and 2004/05.

The West Coast Basin Barrier Project, which began operation in 1953, is a line of 153 injection wells that parallels the coastline from Los Angeles International Airport to the Palos Verdes Hills. It is owned and operated by the Los Angeles County Department of Public Works. Since 1995, the West Coast Basin Barrier Project has injected an approximate 35 percent blend of imported water from Metropolitan and tertiary (including reverse osmosis) treated wastewater from the Hyperion Plant. It injects water into the "200-foot sand", Silverado and Lower San Pedro aquifers to impede seawater intrusion (LACDPW, 2006).

The Dominguez Gap Barrier Project began operation in 1971. The barrier currently comprises a line of 41 injection wells and 107 observation wells along the Dominguez Channel to the 110 Freeway in the City of Carson (LACDPW, 2006). Imported water from Metropolitan is currently injected into the "200-foot sand," "400-foot gravel" and Silverado aquifers in this area. WRD, LACDPW, and LADWP initiated delivery of recycled water to this barrier in 2006.

Figure 4-5
Historical Groundwater Recharge in the West Coast Basin



Desalters

Two desalter projects used to treat brackish groundwater trapped within the Silverado aquifer on the landward side of the West Coast Basin Barrier Project are operating within the City of Torrance: Brewer Desalter and the Goldsworthy Desalter. An average of about 2,500 AFY was treated by the two desalters as of 2004/05. The Brewer Desalter was constructed by WBMWD in 1993 and is now operated by California Water Service Company. The capacity of the Brewer Desalter is 1.5 MGD. The Brewer Desalter was offline during 2004 and 2005 during the construction of a new desalter well.

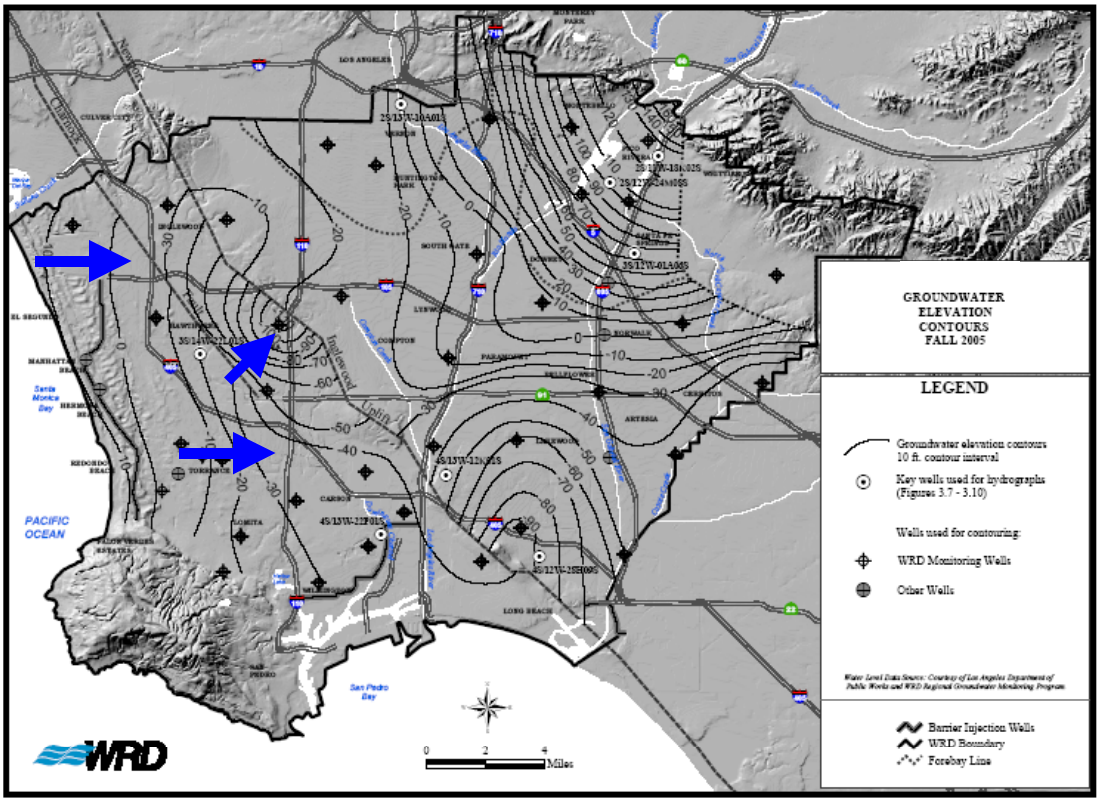
WRD constructed and has operated the Goldsworthy Desalter since 2001. An average of approximately 1,900 AFY was treated between 2001 and the end of water year 2004/05.

GROUNDWATER LEVELS

As shown in **Figure 4-6** groundwater levels in fall 2005 range from about 10 feet above MSL in the northern part of the basin to more than 110 feet below MSL inland near the community of Gardena. Groundwater levels throughout most of the West Coast Basin are below sea level and

generally flow from the west-northwest to the east-southeast. In the key well shown in **Figure 4-7**, water levels increased about 10 feet between water years 1985/86 and 2004/05, which is consistent with the water balance discussed above.

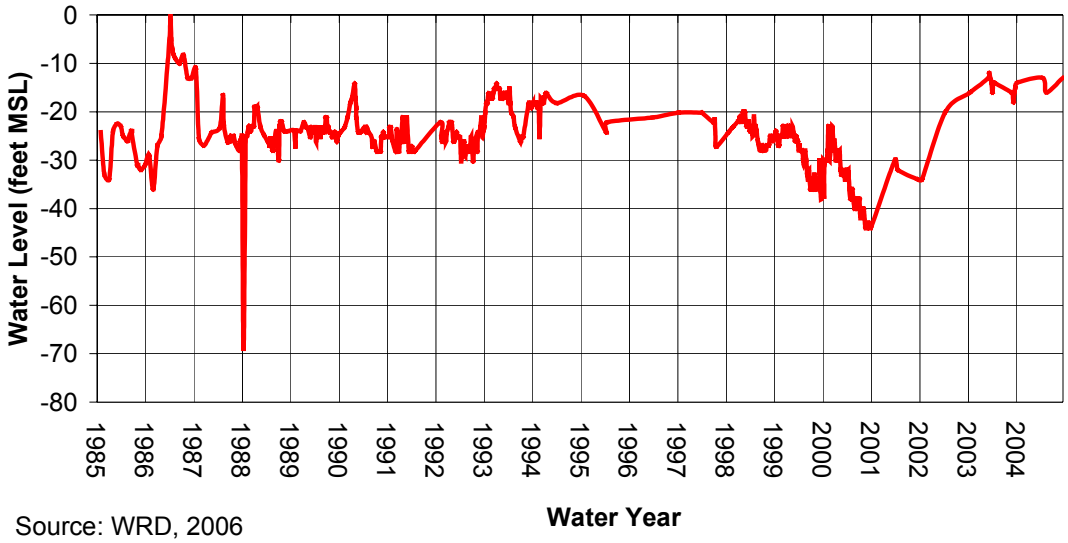
Figure 4-6
Groundwater Contour Map in the West Coast Basin – Fall 2005



GROUNDWATER QUALITY

In general, groundwater in the main producing aquifers of the basins is of good quality with average total dissolved solids (TDS) concentrations around 500 mg/L. Localized areas of marginal to poor water quality exist, primarily on the basin margins and in the shallower and deeper aquifers impacted by seawater intrusion. The following section provides a brief description of the groundwater quality issues in the West Coast Basin.

Figure 4-7
Historical Water Levels in West Coast Basin



Source: WRD, 2006

Groundwater Quality Monitoring

In 1995, WRD and the U.S. Geological Survey (USGS) began a cooperative study to improve the understanding of the geohydrology and geochemistry of Central and West Coast Basins. Out of this effort, came WRD's geographic information system (GIS) and the Regional Groundwater Monitoring Program. Twenty-one depth-specific, nested monitoring wells located throughout the basin allow water quality and groundwater levels to be evaluated on an aquifer-specific basis. Regional Groundwater Monitoring Reports are published by WRD for each water year. Constituents monitored include: TDS, iron, manganese, nitrate, TCE, PCE, arsenic, chromium including hexavalent chromium, MTBE, and perchlorate.

Groundwater Contaminants

Constituents of concern TDS, TCE, PCE, perchlorate, nitrate, iron, manganese and chloride are summarized in **Table 4-4**. Most production wells have TDS concentrations less than 750 mg/L with a range of 150 to 13,600 mg/L in the monitoring wells measured by WRD. Higher TDS concentrations found in production wells in Torrance/Hawthorne area and in monitoring wells within the brackish plume.

Organic constituents of concern (TCE, PCE, or perchlorate) were not detected in concentrations above applicable MCLs in the West Coast Basin. Neither TCE nor PCE were detected in any production well in the West Coast Basin. TCE was detected in three monitoring wells and PCE was detected in one monitoring well.

Nitrate (as nitrogen) concentrations range from non-detect to 12 mg/L in the monitoring wells in the West Coast Basin. Higher concentrations tend to be limited to the uppermost zones and are

likely due to localized infiltration and leaching. Production wells have nitrate concentrations less than 3 mg/L.

Table 4-4
Summary of Constituents of Concern in the West Coast Basin

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	150 to 13,600 Average: 500	Most production wells have TDS less than 750 mg/L. Higher TDS concentrations found in production wells in Torrance/Hawthorne area and in monitoring wells within saline plume.
VOCs **(TCE and PCE)** Primary MCL for TCE = 5 Primary MCL for PCE = 5	µg/L	ND to 18 for TCE ND to 0.8 for PCE	TCE nor PCE not detected in production wells. TCE detected in three monitoring wells. PCE detected in one monitoring well.
Perchlorate Notification level = 6	µg/L	Data not available	Detected in three monitoring wells below action level in shallow zones
Nitrate (as N) Primary MCL = 10	mg/L	ND to 12 mg/L	Higher concentrations tend to be limited to the uppermost zones and are likely due to localized infiltration and leaching. Production wells have concentrations less than three mg/L.
Iron and manganese Secondary MCL for iron =0.3 Secondary MCL for Mn = 0.05	mg/L	ND to 1.2 for iron and manganese	Nearly 1/3 of all production wells in northwestern portion of West Coast Basin exceed secondary MCL for iron. 17 of 30 production wells tested had concentrations above secondary MCL for manganese
Chloride Secondary MCL = 500	mg/L	5.8 to 6,180 mg/L	Chloride concentrations exceed chloride MCL in five of 15 nested monitoring wells due to seawater intrusion. One production well had concentrations above MCL.

Source: WRD, 2006b

Iron and manganese were detected in concentrations above the secondary MCL for these constituents in both monitoring wells and production wells in the basin. Nearly one-third of all production wells in northwestern portion of West Coast Basin have concentrations that exceed secondary MCL for iron. Seventeen of 30 production wells tested had concentrations above secondary MCL for manganese.

As discussed above, seawater has invaded the Silverado Aquifer along the coastal stretch of the West Coast Basin and chloride concentrations range from 1,000 to 6,000mg/l. (DWR, 2005). Chloride concentrations exceed the chloride MCL in five of 15 nested monitoring wells due to seawater intrusion. One production well had chloride concentrations above MCL.

Blending Needs

Data related to blending needs and practices are not available for the West Coast Basin.

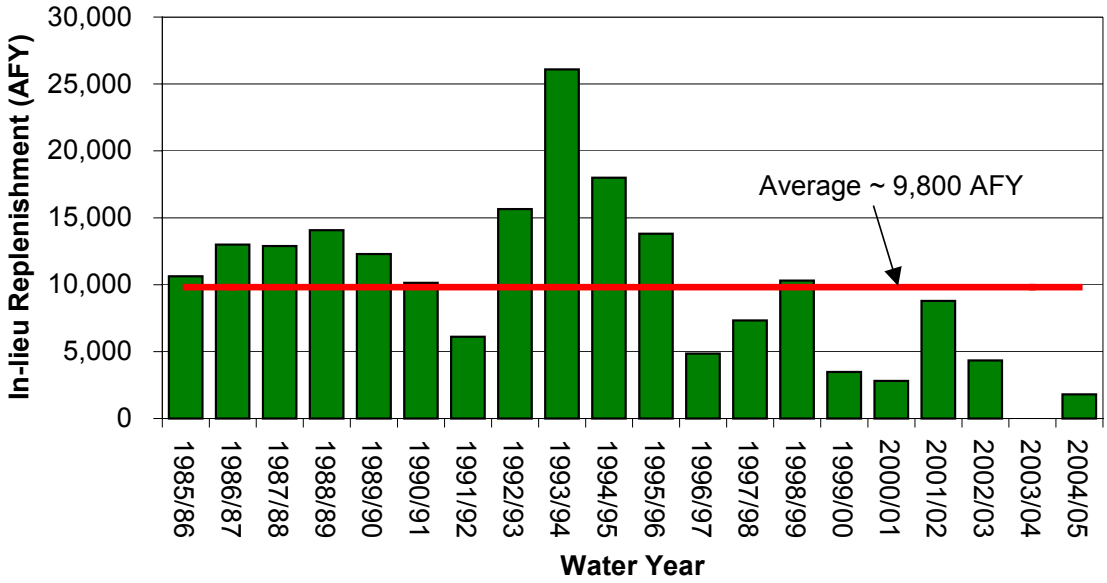
Groundwater Treatment

As discussed above, about 2,500 AFY has been treated by the Brewer and Goldsworthy desalters since 2000. In addition, oil recovery and cleanup programs operated by the oil refineries in the West Coast Basin have treated an average of about 900 AFY since 2000. About 7 percent of the total water produced in 2004/05 in the West Coast Basin was treated. Costs for treatment are not available at this time.

EXISTING GROUNDWATER STORAGE PROGRAMS

WRD operates an in-lieu replenishment program. An average of about 9,800 AFY of in-lieu storage has been generated in the West Coast Basin through this program since 1985. These data are summarized in **Figure 4-8**. No other formal groundwater storage programs are operational in the West Coast Basin.

Figure 4-8
Historical In-lieu Storage for West Coast Basin



BASIN MANAGEMENT CONSIDERATIONS

Management considerations in the West Coast Basin include:

- Extraction is limited by the Judgment to 64,468 AFY.
- The Regional Board regulates injection of recycled water and limits the amount of recycled water that can be injected.
- Brackish water inland of the West Coast Basin Barrier may limit the ability to store and extract water in some parts of the basin. The Brewer and Goldsworthy Desalters have increased the ability to use this part of the basin.
- Because most of the West Coast Basin is confined, there are no identified locations for spreading.
- Disagreements related to the Interim Rules for Conjunctive Use Storage and In-Lieu Exchange and Recovery in the Central and West Coast Basins may limit the ability to store water in the West Coast Basin. At this time, the approval of storage projects is administered by WRD using the framework defined in the Interim Rules for Conjunctive Use Storage and In-Lieu Exchange and Recovery in the Central and West Coast Basins.

References:

California Department of Water Resources (DWR), 1961. Bulletin 104 Planned Utilization of the Ground Water Basins of Coastal Plain of Los Angeles County. Appendix A, Ground Water Geology.

California Department of Water Resources (DWR), 2004. California's Groundwater Bulletin 118 – Los Angeles County Coastal Plain West Coast Basin. Updated 2/27/04. Website: http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/4-11.03.pdf Accessed 6/12/07.

California Department of Water Resources (DWR), 2005. Watermaster Service in the West Coast Basin, Los Angeles County, July 1, 2004 – June 30, 2005. September 2005.

Los Angles County Department of Public Works, 2006. Website: http://ladpw.org/wrd/Barriers/Facility.cfm. Accessed September 18, 2006.

United States Geological Survey (USGS), 2003. Water Resources Investigations Report 03-4065. Geohydrology, Geochemistry, and Ground-Water Simulation – Optimization of the Central and West Coast Basins, Los Angeles County, California.

Water Replenishment District of Southern California (WRD),2004. Technical Bulletin – An Introduction to the Central and West Coast Groundwater Basins.

Water Replenishment District of Southern California (WRD), 2006a. Website: http://www.wrd.org/articles/Century%20of%20Groundwater.htm Accessed August 24, 2006.

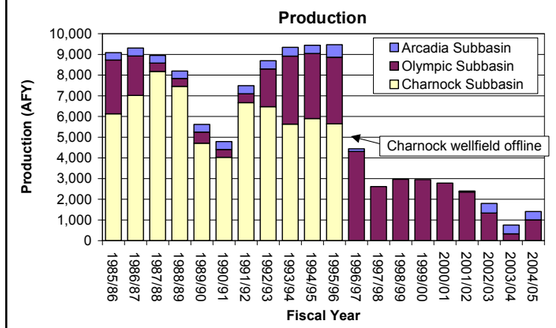
Water Replenishment District of Southern California (WRD), 2006b. Regional Groundwater Monitoring Report – Water Year 2004-2005, Central and West Coast Basins Los Angeles County, California, March 2006.

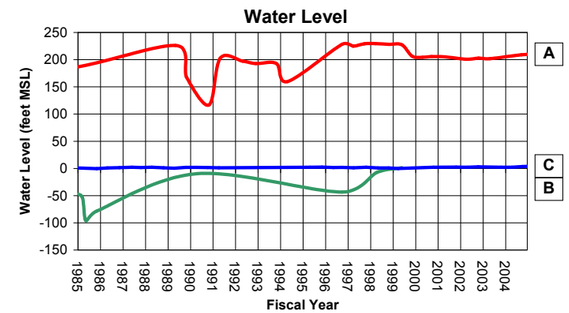
Water Replenishment District of Southern California (WRD), 2006c. Engineering Survey and Report, Updated June 21, 2006.

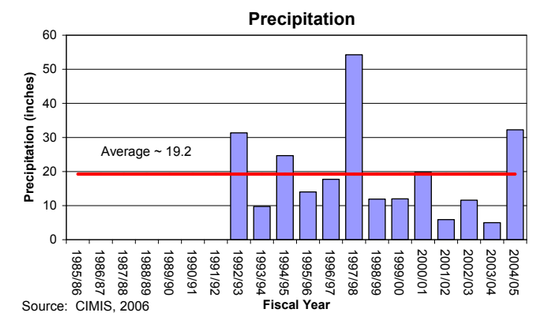
Water Replenishment District of Southern California (WRD), 2006d. Groundwater Study Questionnaire.

Water Replenishment District of Southern California (WRD), 2006e. Personal communication with Ted Johnson, September 21, 2006.

Santa Monica Basin







Source: CIMIS, 2006

Direct Recharge
No direct groundwater recharge for this basin

BASIN FACTS

Santa Monica Basin

Description
Location: Los Angeles County
Watershed Surface Area: 50 square miles
MWD Member Agency(s):
City of Santa Monica
City of Los Angeles
City of Beverly Hills
West Basin MWD
Management: Unadjudicated
Basin is not formally managed. Cleanup operations are coordinated by Regional Board

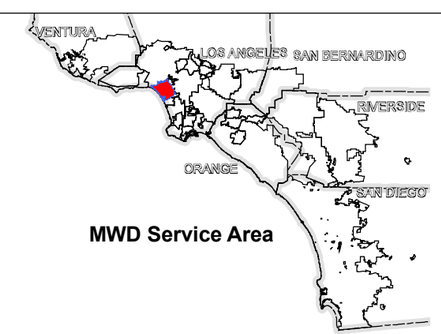
	Santa Monica
Natural Safe Yield	~7,500 AFY
Total Storage	1.1 million AF
Unused Storage Space	Unknown
Portion of Unused Storage Space Available for Storage	Unknown

Storage and Extraction Facilities

	Santa Monica
Production Wells	
Production Capacity	16,150 AFY
Average 2000-2004	1,838 AFY
Injection Wells	
Injection Capacity	None
Average 1985-2004	None
Spreading Basins	
Spreading Capacity	None
Average 1985-2004	None

Basin Management Considerations

- Several wells are offline because of MTBE and TCE contamination, which limits the ability to store and extract in this basin
- Potential for seawater intrusion may limit ability to store and extract water in this basin



MWD Service Area

Key Well
Freeways
Water Body
MWD Pipeline
Adjacent Basin
Basin
MWD Member Agency Boundary (color varies)

N
W E
S

0.7 0.35 0 0.7 Miles

Note: This map was prepared by the Metropolitan Water District of Southern California for its own use. No warranty is expressed or implied as to the correctness, timeliness, or content of the information shown herein.

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Additional Data Sourse(s): Santa Ana Watershed Project Authority (SAWPA); California Spatial Information Library (CaSIL).

Plate 5-1
Overview of Santa Monica Basin

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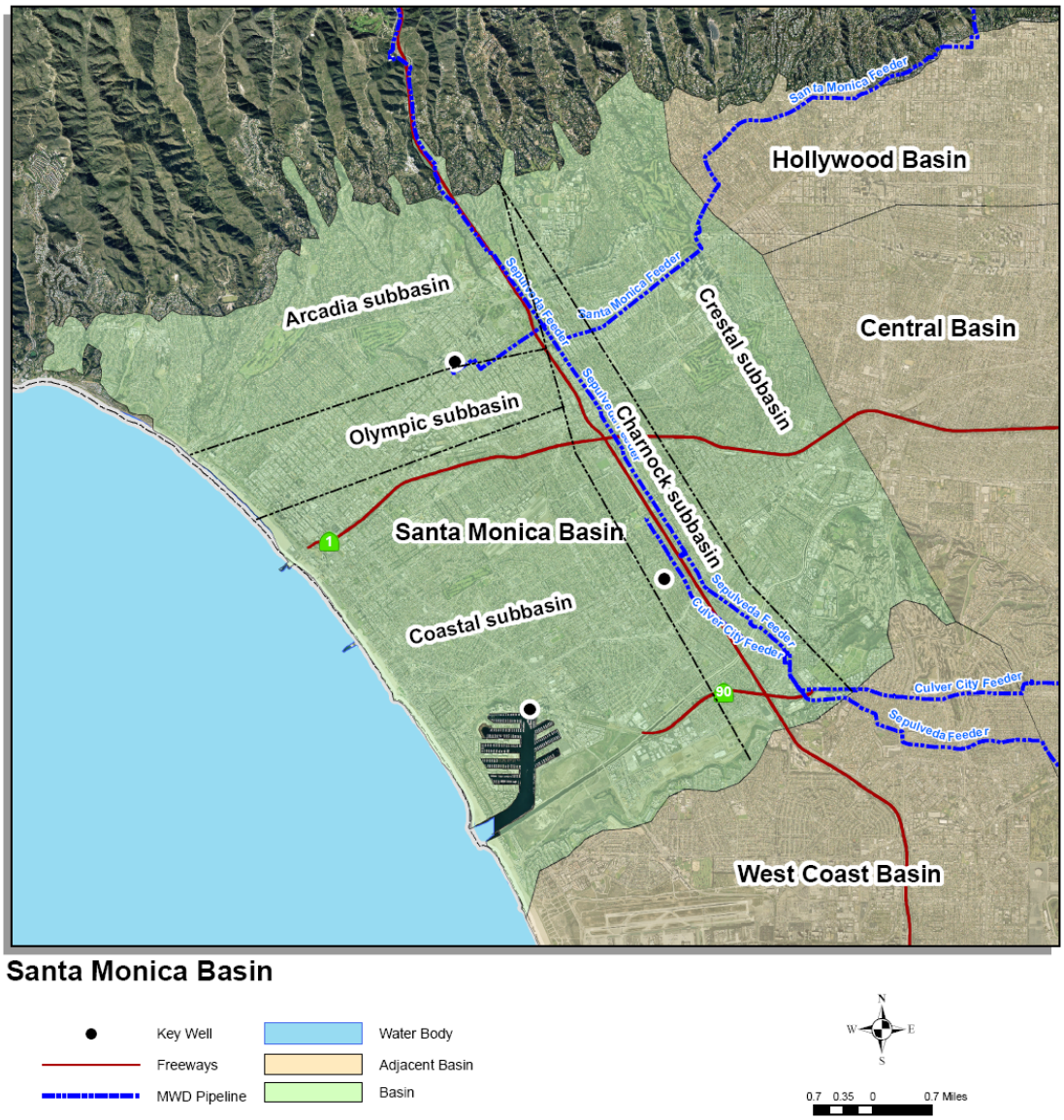
The Santa Monica Basin is located in the northwestern portion of the coastal plain of Los Angeles County. The Santa Monica Basin is within the service areas of the Metropolitan member agencies of the cities of Santa Monica, Los Angeles, Beverly Hills and West Basin Municipal Water District (West Basin MWD) and underlies the cities of Santa Monica, Culver City, and Beverly Hills and the communities of Pacific Palisades, Brentwood, Venice, Marina del Rey, West Los Angeles, Century City and Mar Vista. The Santa Monica Basin is divided into five subbasins: Arcadia, Olympic, Coastal, Charnock, and Crestal. A map of the basin is provided in **Figure 5-1**.

Figure 5-1
Map of the Santa Monica Basin



BASIN CHARACTERIZATION

The following section provides a physical description of the Santa Monica Basin including its geographic location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

The basin is bounded by the Santa Monica Mountains to the northwest, the Pacific Ocean to the west and southwest, the Newport-Inglewood fault to the northeast, and the Ballona escarpment and Baldwin Hills to the south and southeast. The Santa Monica Basin is separated from the West Coast Basin by the Ballona Gap. As described above, faults subdivide the Santa Monica Basin into five sub-basins: Arcadia, Olympic, Coastal, Charnock and Crestal. Hydrogeologic data are provided in **Table 5-1**.

Table 5-1
Summary of Hydrogeologic Parameters of Santa Monica Basin

Parameter	Description
Structure	
Aquifer(s)	Alluvium (Ballona aquifer) Lakewood Formation San Pedro Formation (Silverado aquifer)
Depth of groundwater basin	Up to 550 feet
Thickness of water-bearing units	Ballona aquifer: 30 to 50 feet Lakewood Formation: 100 feet Silverado aquifer: Up to 280 feet
Yield and Storage	
Natural Safe Yield	~7,500 AFY
Total Storage	1.1 million AF
Unused Storage Space	Unknown
Portion of Unused Storage Space Available for Storage	Unknown

Total depth of the Santa Monica Basin is as much as 500 feet. Groundwater occurrence in the Santa Monica Basin is generally confined with some areas of unconfined or perched groundwater. The primary groundwater-producing zones within the Santa Monica Basin include aquifers within the recent alluvium and the underlying San Pedro Formation of the Los Angeles Coastal Plain. The Recent alluvium reaches a maximum thickness of about 90 feet and includes the clays of the Bellflower aquiclude and the underlying Ballona aquifer, which is also referred

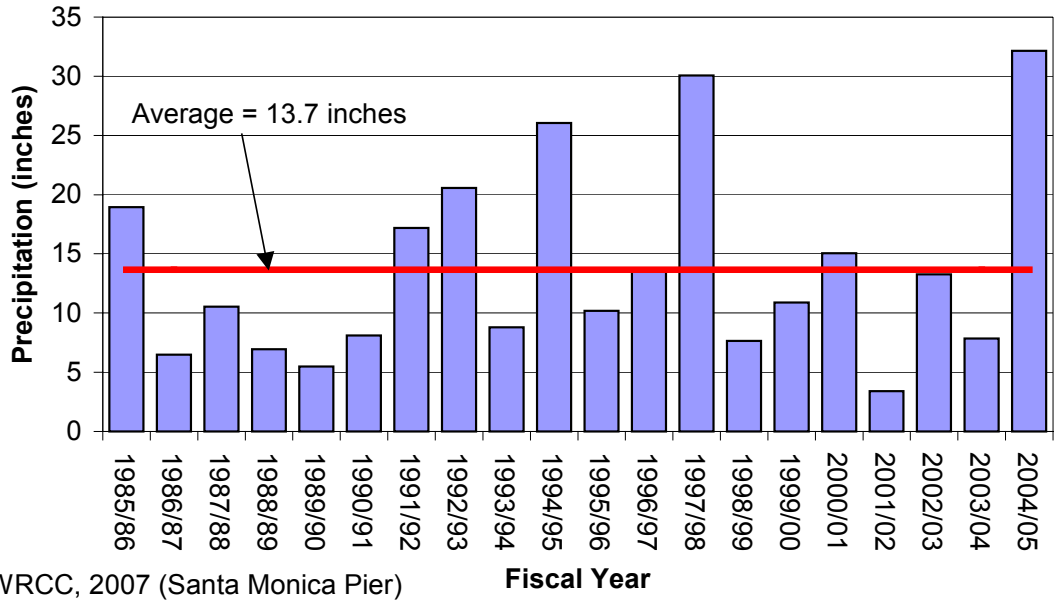
to as the "50-foot gravel." Perched groundwater may occur in this unit. The Lakewood Formation, a significant aquifer within other areas of Los Angeles County appears to be present only in the northern half of the basin; wells in the Arcadia and Olympic subbasins utilize this aquifer. Other unnamed sand units also occur. The main potable production aquifer in the Santa Monica Basin is the Silverado aquifer of the San Pedro Formation. This aquifer is up to 280 feet in thickness in the Santa Monica Basin. Additional fresh-water units lie below the San Pedro Formation, but are not widely produced (DWR 1961).

Total storage in the Santa Monica Basin has been estimated to be approximately 1.1 million AF (DWR, 1961). Current storage space is unknown.

Safe Yield/Long-Term Balance of Recharge and Discharge

The primary source of groundwater recharge into the Santa Monica Basin is percolation of precipitation and surface runoff from the Santa Monica Mountains. Water is discharged from the basin via surface runoff and subsurface outflow to the south. Natural recharge from precipitation and runoff is the largest inflow to the basin. **Figure 5-2** provides the historical precipitation data from 1985 to 2004. Average precipitation during this time period was approximately 13.7 inches. Although no formal safe yield determination has been made for the Santa Monica Basin, based upon studies performed by the USGS, the average yield based upon estimated inflows and outflows between 1971 and 2000 was about 7,500 AFY (USGS, 2003).

Figure 5-2
Historical Precipitation in the Santa Monica Basin



WRCC, 2007 (Santa Monica Pier)

GROUNDWATER MANAGEMENT

The following section describes how the Santa Monica Basin is currently managed including a discussion of the governing structure and relationship to adjoining basins.

Basin Governance

The Santa Monica Basin is an unadjudicated basin. The primary producer in the basin is the city of Santa Monica. As discussed below, the groundwater management in the Santa Monica Basin has centered primarily around the cleanup of groundwater contaminated by MTBE, most notably in the Arcadia and Charnock subbasins. The cleanup operations are coordinated/overseen by the Los Angeles Regional Water Quality Control Board.

Table 5-2
Summary of Management Agencies in the Santa Monica Basin

Agency	Role
City of Santa Monica	Primary producer in basin Operation of treatment facilities
California Department of Health Services	Oversight of cleanup of Arcadia and Charnock Wellfields
California Regional Water Quality Control Board – Los Angeles Region	Coordination and oversight of cleanup of Charnock and Arcadia Wellfields.

Interactions with Adjoining Basins

The Santa Monica Basin is adjacent to the Hollywood Basin to the north and east, the West Coast Basin to the south and the Central Basin to the east. The flow into the Hollywood and Central Basins is restricted by the Newport-Inglewood Uplift. Average outflows (1971 to 2000) are estimated to be about 1,000 AFY into the West Coast Basin (USGS, 2003). There are no formal agreements governing this flow.

WATER SUPPLY FACILITIES AND OPERATIONS

The following provides a summary of the facilities within the Santa Monica Basin. Facilities include 12 groundwater production wells and treatment facilities associated with the MTBE and volatile organic compound cleanups in the Arcadia and Charnock subbasins.

Active Production Wells

There are currently 19 production wells (13 drinking water, 6 irrigation) within the Santa Monica Basin. Only five drinking water wells and four irrigation wells are currently in production. Prior to 1996, about 50 percent of the supply within the city of Santa Monica came from groundwater produced from the Arcadia, Charnock and Olympic subbasins. Since 1996, when

Santa Monica's Arcadia and Charnock wellfields were shut down due to MTBE and VOC contamination, about 95 percent of the city's water has been from imported water supplied by Metropolitan. The remainder of city's water comes from the Olympic subbasin wells, which have not been impacted by MTBE contamination (USEPA, 2006). Total existing capacity of active wells is approximately 3,300 gpm (Santa Monica, 2005).

Historical production within the Santa Monica Basin is summarized in **Figure 5-3**. Average production between 2000 and 2004 was approximately 1,800 AFY compared to a high of about 10,300 AFY in 1995 when contamination was discovered. Between 1985 and 1996, about 6,100 AFY was produced from the Charnock subbasin. Since 1996, production from this basin has been limited.

Table 5-3
Summary of Production Wells in the Santa Monica Basin

Subbasin	Number of Wells	Estimated Production Capacity [1] (AFY)	Average Production 1999/00 - 2004/05 (AFY)	Well Operation Cost ($/AF)
Arcadia	5 wells: 3 drinking (active) 2 irrigation (inactive)	450	261	Data not available
Charnock	7 drinking wells (inactive)	12,800	0	
Coastal	0	0	0	
Crestal	4 irrigation wells (active)	0	0	
Olympic	3 drinking wells 2 active 1 inactive	2,900	1,577	
Total	**19 wells** **9 active** **10 inactive**	**Active Wells 3,350 AFY** **Inactive Wells 12,800 AFY**	**1,838**	

Source: Santa Monica, 2000b, 2005, 2006
[1]Maximum annual production in past 5 years or rated pump capacity in Charnock subbasin

Other Production

All production in the Santa Monica Basin is designated for municipal use.

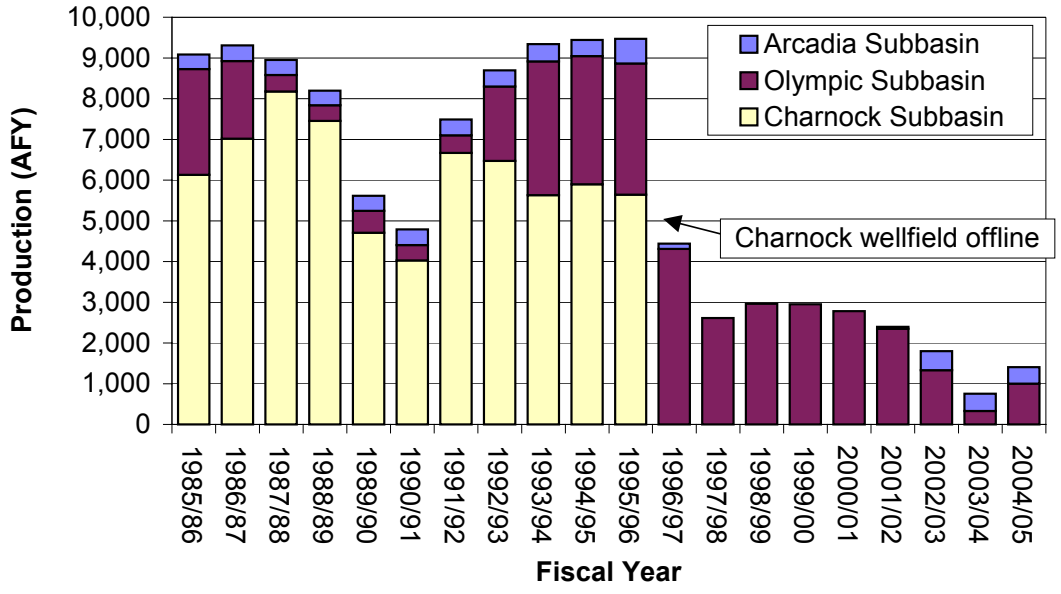
ASR Wells

There are no currently active ASR wells in the Santa Monica Basin. During the 1980s, the city of Santa Monica injected up to 2,148 AFY of imported water from Metropolitan into the Charnock subbasin (DBS & A, 1999). This injection was stopped in 1990.

Spreading Basins

There are no spreading basins in the Santa Monica Basin.

Figure 5-3
Historical Groundwater Production in the Santa Monica Basin



Source: City of Santa Monica, December 2006

Seawater Intrusion Barriers

There are no seawater intrusion barriers in the Santa Monica Basin.

Desalters

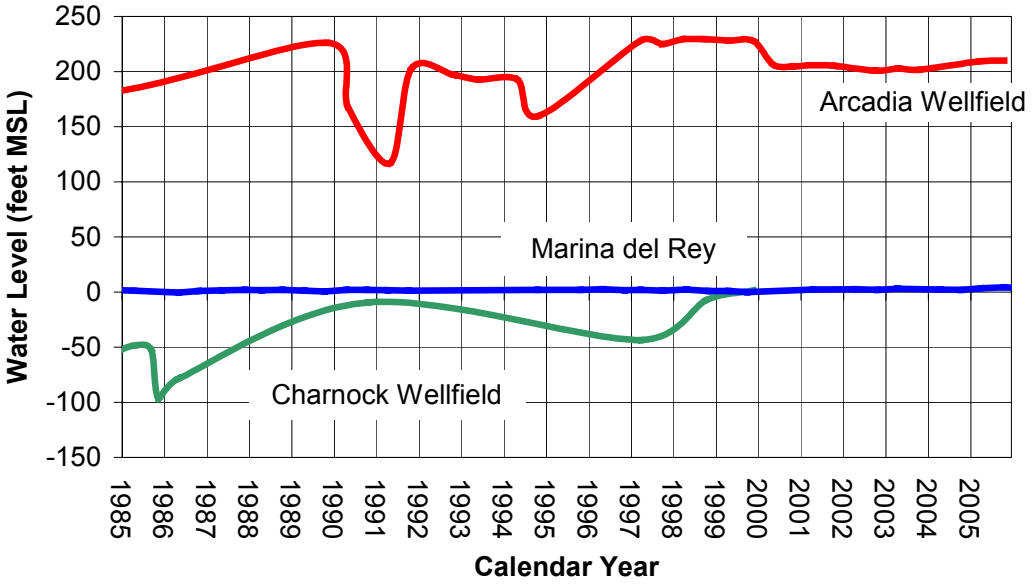
There are no desalters in the Santa Monica Basin.

GROUNDWATER LEVELS

Groundwater flow is generally from the Santa Monica Mountains in the north toward the West Coast Basin to the south. **Figure 5-4** shows representative hydrographs for key wells throughout the basin. In general, water levels in the Arcadia subbasin ranged from about

100 feet above MSL to 230 feet above MSL between 1985 and 2005. Well production in the Coastal subbasin is limited, in part, because water levels in this area are at or below sea level. The risk for seawater intrusion in this area is high. Water levels in the Charnock subbasin were as low as 100 feet below MSL prior to 1996 when the wells in this area were turned off because of MTBE contamination. Water levels in this area are currently at or near sea level.

Figure 5-4
Historical Water Levels in the Santa Monica Basin



GROUNDWATER QUALITY

The following section describes the groundwater quality issues within the Santa Monica Basin. Groundwater quality in the Santa Monica Basin is generally fair to poor with total dissolved solids (TDS) concentrations ranging from 729 to 1,156 mg/L (DWR, 2004). MTBE contamination in production wells has been a primary concern for the Santa Monica Basin.

Groundwater Quality Monitoring

Groundwater quality samples are collected from active production wells within the Santa Monica Basin in accordance with California DHS requirements as specified in Title 22 of the California Code of Regulations. In addition, groundwater quality has been evaluated as part of the cleanup operations in the Charnock subbasin. No basin-wide monitoring program has been established.

Groundwater Contaminants

Groundwater constituents of concerns for the Santa Monica Basin include: TDS, nitrate, VOCs, and MTBE. Perchlorate has not been detected in the Santa Monica Basin. A summary of the range and extent of these constituents is provided in **Table 5-4**.

Table 5-4
Summary of Constituents of Concern in Santa Monica Basin

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	Arcadia:664 to 738 Olympic:800 to 960 Charnock: 650 to 1,251	TDS ranges from 664 to 1,251 mg/L.
Nitrate (as N) MCL = 10	mg/L	Arcadia: 1.1 to 6.8 Olympic: ND to 9.1 Charnock: ND to 5	Nitrate concentrations meet drinking water standards.
VOCs **(TCE and PCE)** TCE MCL = 5 PCE MCL = 5	µg/L	Arcadia: TCE: ND to 7.8 PCE: ND Olympic: TCE: ND to 100 PCE: ND to 23.9 Charnock: TCE: ND to 17.7 PCE: ND	PCE only detected in 1 well in Olympic subbasin TCE has ranged from non-detect to 100 µg/L
Perchlorate Notification level =6	µg/L	Arcadia: ND Olympic: ND Charnock: ND	Perchlorate not detected
MTBE Secondary MCL = 5	µg/L	Arcadia: ND to 86.5 Olympic: ND Charnock: ND to 610	Cleanup in underway in Arcadia and Charnock subbasins. Wells in Charnock subbasin remain offline.
1,4-dioxane Notification level = 3	µg/L	Olympic: ND to 20	The City of Santa Monica has detected 1,4-dioxane in its Olympic production wells.

Source: Regional Board, 2006 (data from 1990-2002); Santa Monica, 2006

TDS concentrations in the Santa Monica Basin exceed the secondary standard of 500 mg/L for TDS. Blending or treatment is required to meet drinking water standards.

Trichloroethylene (TCE) was detected in the Olympic subbasin in 1979 with maximum detections up to 190 µg/L. Air strippers were installed in the wells in this subbasin in the mid 1980s (Santa Monica, 2000b). More recently, the City of Santa Monica has detected 1,4-dioxane in its Olympic production wells.

MTBE, a chemical in reformulated gasoline was first detected in groundwater extracted from production wells at the Charnock and Arcadia subbasins in 1995. In 1996, all water supply wells in the Charnock well field were shut down due to persistent and increasing levels of volatile organic contaminants and MTBE.

Blending Needs

While the City of Santa Monica blends various source waters prior to disinfection and distribution, the City is not permitted to utilize blending as a treatment option for contaminated groundwater.

Groundwater Treatment

A summary of the groundwater treatment activities is provided in **Table 5-5**.

Table 5-5
Summary of Groundwater Treatment in the Santa Monica Basin

Subbasin	Constituent Treated	Treatment Type	Average Amount Treated (AFY)
Arcadia	None	None	Not applicable
Charnock	MTBE	To be determined	To be determined
Olympic	TCE	Mechanical surface aeration	1,450
Total	**--**	**--**	**1,450**

Source: Santa Monica, 2006

A shallow aquifer and vadose remediation system (SAVRS) and lower aquifer remediation system (LARS) were installed at the Arcadia wells to remediate the MTBE-affected zones (Santa Monica, 2005).

In November 1999, Shell Oil Company began operating a groundwater extraction and treatment system on Tuller Avenue south of Venice Boulevard. This system is extracting and treating shallow and deep groundwater from wells on both the west side and east side of the 405 freeway

along with wells on and adjacent to an operating Shell gas station. This system, which has a treatment capacity of approximately 300 gallons per minute, increased its operations to approximately 450 gallons per minute as of January 2002. USEPA and the Regional Board have required periodic adjustments in the operation of this system in order to clean up the area around the Venice and Sepulveda intersection (USEPA, 2006).

In December 2003, the city of Santa Monica and some of the companies responsible for the MTBE contamination of the Charnock subbasin received court approval for a settlement under which the companies will fund construction and operation of a treatment plant at the City's Charnock Wellfield. This treatment plant will clean up residual regional MTBE contamination. Because the treatment plant will provide a protective remedy, EPA does not plan to undertake additional remedy selection at the site. The Regional Board will remain the lead agency to insure that all individual source site cleanups are properly completed. DHS in consultation with the Regional Board will oversee the permitting, construction and operation of the treatment plant provided for in the settlement. (USEPA).

To date, over 100 million gallons of contaminated groundwater has been treated in the Charnock subbasin, over 17,000 pounds of hydrocarbons have been removed using soil vapor extraction (SVE), and over 4100 cubic yards of contaminated soil has been excavated and removed (USEPA, 2006).

CURRENT GROUNDWATER STORAGE PROGRAMS

There are no current groundwater storage programs in the Santa Monica Basin.

BASIN MANAGEMENT CONSIDERATIONS

Considerations that could limit the ability to store and extract water in the Santa Monica Basin are based upon water quality concerns. They include:

- Several wells are offline because of MTBE and TCE contamination, which limits the ability to store and extract in this basin
- Potential for seawater intrusion may limit ability to store and extract water in this basin

References:

California Department of Water Resources (DWR). 1961. Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County. Bulletin No. 104.

California Department of Water Resources (DWR), 2004. California's Groundwater Bulletin 118 – Los Angeles County Coastal Plain Santa Monica Basin. Updated 2/27/04. Website: http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/4-11.01.pdf Accessed 6/12/07.

California Regional Water Quality Control Board. 2006. Geotracker database. Accessed at: http://www.geotracker.swrcb.ca.gov/reports/well_search.asp November 6, 2006.
City of Santa Monica (Santa Monica). November 2006. Comments on Draft Groundwater Assessment Study.
City of Santa Monica (Santa Monica). December 2005. 2005 Urban Water Management Plan.

City of Santa Monica (Santa Monica). 2000a. 2000 Urban Water Management Plan.

City of Santa Monica (Santa Monica), 2000b. Southern California Groundwater Agency Technical Working Group. March 22, 2000. Powerpoint presentation.

City of Santa Monica. Santa Monica Civic Center Specific Plan EIR, Section 4.7 Hydrology and Water Quality.

City of Santa Monica. Production data. December 2006.

Daniel B Stevens and Associates (DBS&A), 1999. Preliminary Evaluation of Groundwater Contamination in the Charnock Subbasin, August 9, 1999.

United States Environmental Protection Agency (USEPA), 2006. http://www.epa.gov/region9/cross_pr/mtbe/charnock/ Accessed November 15, 2006

United States Geological Survey (USGS). 2003. Water Resource Investigation Report 03-4065. Geohydrology, geochemistry, and ground-water simulation – Optimization of the Central and West Coast Basins, Los Angeles County, California.

Western Regional Climate Center, 2007. Santa Monica Pier Station 47953. Website: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7953 Accessed 6/27/07

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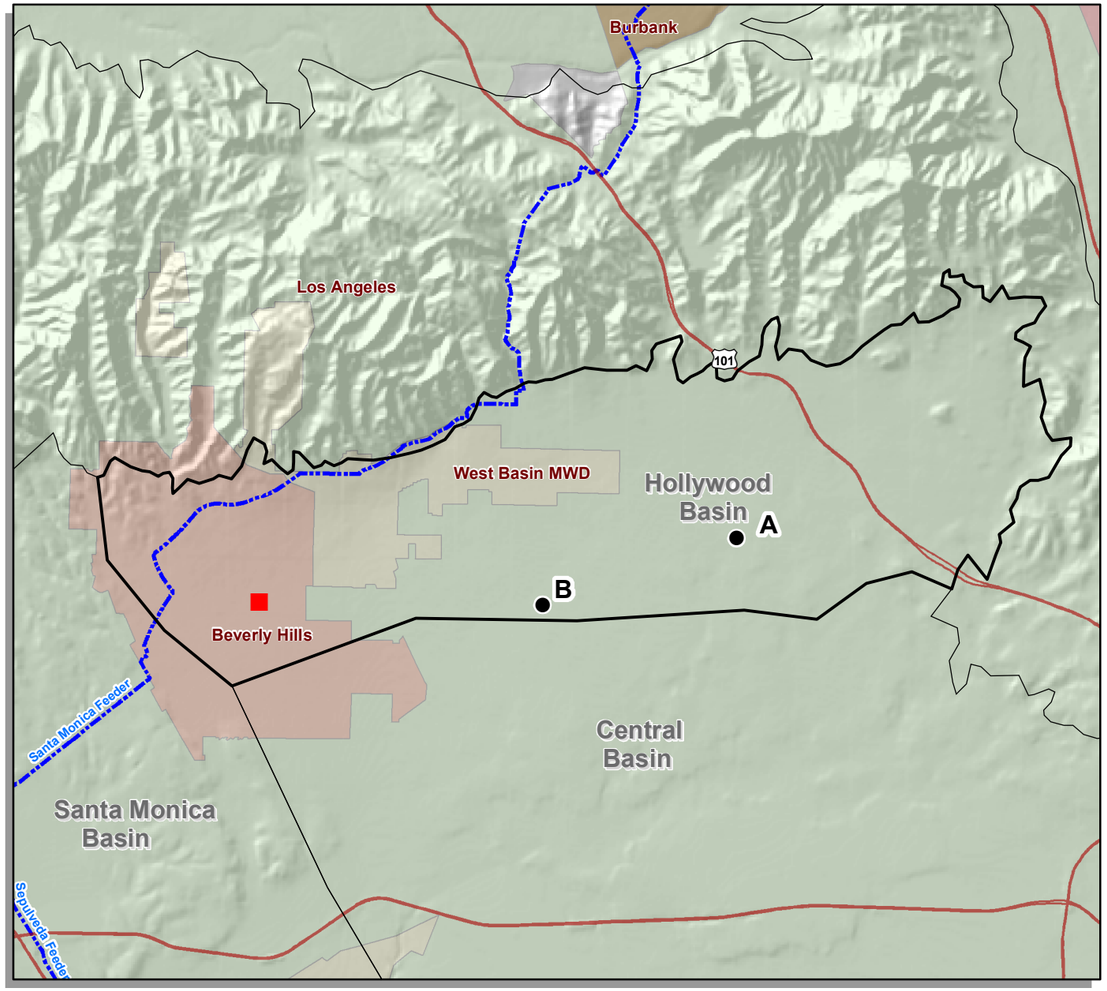

Hollywood Basin

A ● Key Wells — MWD Pipeline
■ Desalter — MWD Member Agency Boundary (color varies)
Freeways — Basin

N W E S

1 0.5 0 1 Miles

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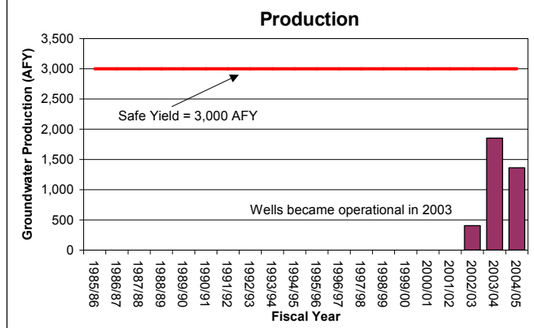
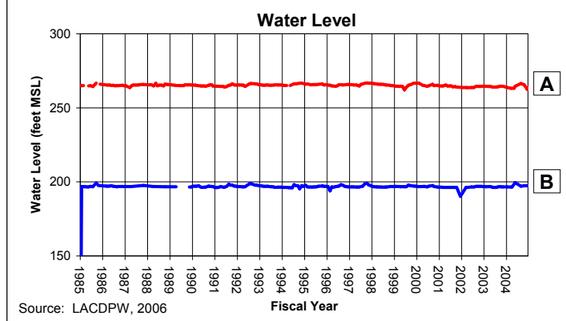
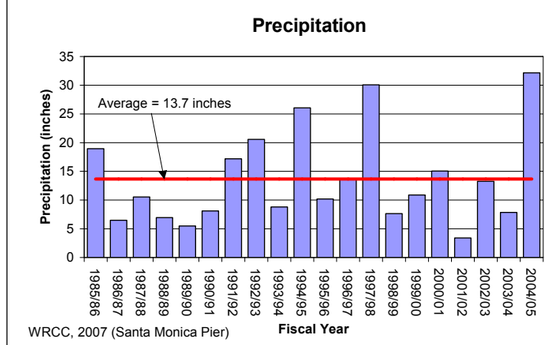
Additional Data Sourse(s): Santa Ana Watershed Project Authority (SAWPA); California Spatial Information Library (CaSIL).





Source: LACDPW, 2006



WRCC, 2007 (Santa Monica Pier)

Direct Recharge

No direct recharge data are available for this basin.

BASIN FACTS

Hollywood Basin

Description
Location: Los Angeles County
Watershed Surface Area: 16.4 square miles
Management: Unadjudicated
Only producer is City of Beverly Hills.
MWD Member Agencies:
City of Beverly Hills
West Basin MWD
City of Los Angeles

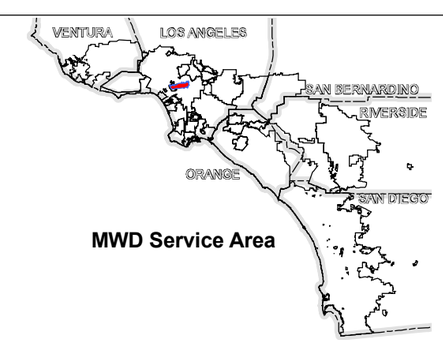
	Hollywood
Natural Safe Yield	3,000 AFY
Total Storage	400,000 AF
Unused Storage Space	Unknown
Portion of Unused Storage Space Available for Storage	Unknown

Storage and Extraction Facilities

	Hollywood
Production Wells	
Production Capacity	~1,850 AFY
Average 2002/03-2004/04	~1,200 AFY
Injection Wells	
Injection Capacity	None
Average 1985/06-2004/05	None
Spreading Basins	
Spreading Capacity	None
Average 1985/86-2004/05	None

Basin Management Considerations

- Shallow groundwater may limit ability to store water
- Groundwater must be treated to meet drinking water standards
- Basin receives limited natural recharge



MWD Service Area

Plate 6-1
Overview of Hollywood Basin

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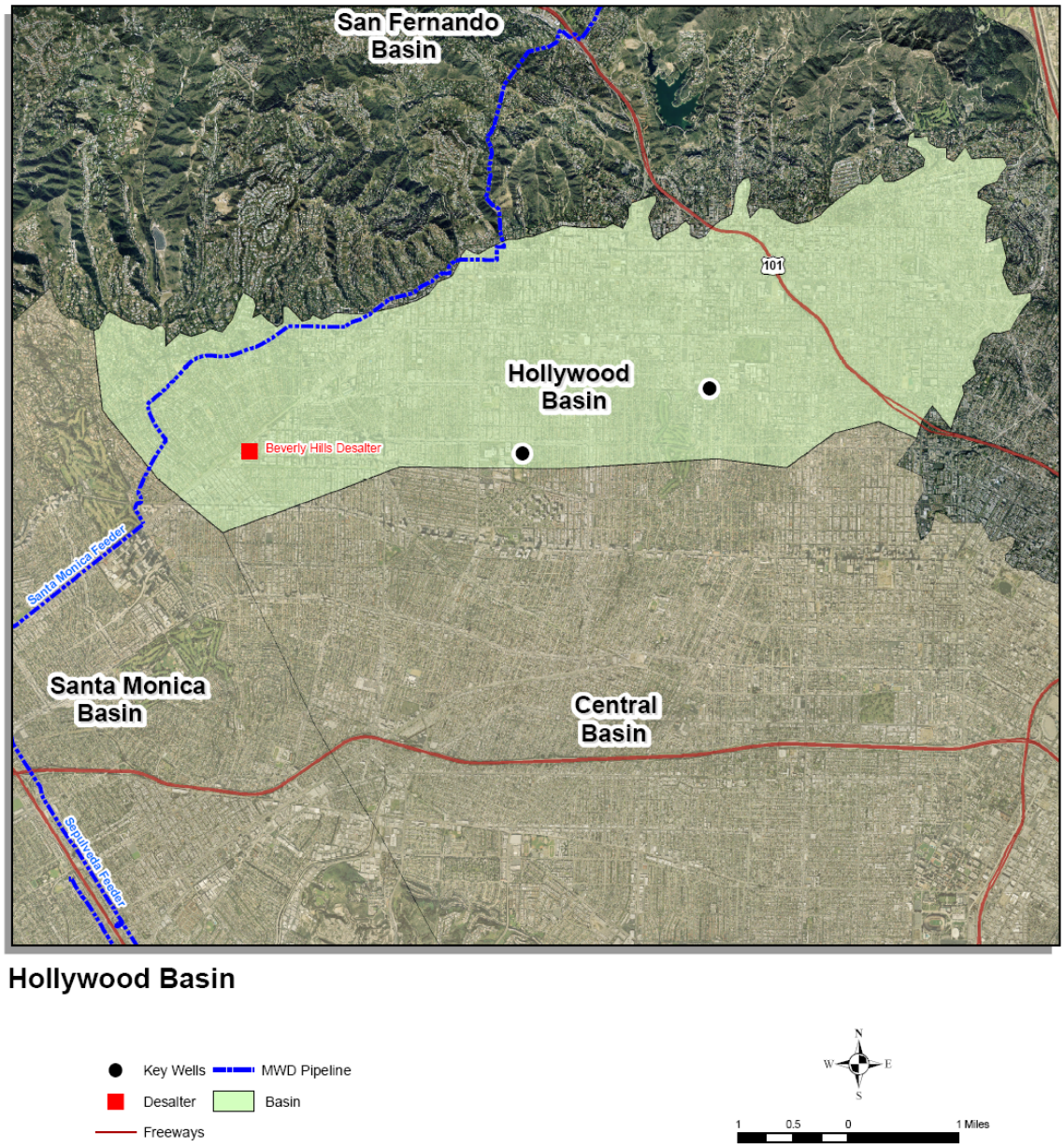
The Hollywood Basin is located within Los Angeles County adjacent to the Santa Monica Mountains. It underlies the service areas of Metropolitan member agencies the City of Beverly Hills, West Basin Municipal Water District (West Basin MWD) and the City of Los Angeles. Overlying cities include Beverly Hills, West Hollywood and Los Angeles. The location of the Hollywood Basin is shown in **Figure 6-1**.

Figure 6-1
Map of the Hollywood Basin



BASIN CHARACTERIZATION

The following section provides a physical description of the Hollywood Basin and its hydrogeologic character.

Basin Producing Zones and Storage Capacity

The Hollywood Basin underlies the northeastern portion of the Los Angeles Coastal Plain. The basin is bounded on the north by the Santa Monica Mountains and the Hollywood fault, on the east by the Elysian Hills, the west by the Newport-Inglewood Uplift and the south by the La Brea high, an area of shallow bedrock (DWR, 2004). A summary of the general hydrogeologic characteristics of the basins is provided in **Table 6-1**.

Table 6-1
Summary of Hydrogeologic Parameters of Hollywood Basin

Parameter	Description
Structure	
Aquifer(s)	• Alluvium • Lakewood Formation (Exposition and Gage aquifers) • San Pedro Formation (Jefferson, Lynwood, Silverado, and Sunnyside aquifers)
Depth of groundwater basin	Up to 660 feet
Thickness of water-bearing units	Alluvium (up to 60 feet) Lakewood Formation (up to 175 feet) San Pedro Formation (up to 100 feet)
Yield and Storage	
Natural Safe Yield	3,000 AFY
Total Storage	400,000 AF
Unused Storage Space	Unknown
Portion of Unused Storage Available for Storage	Unknown

Source: DWR, 2004; DWR 1961; Beverly Hills 2006.

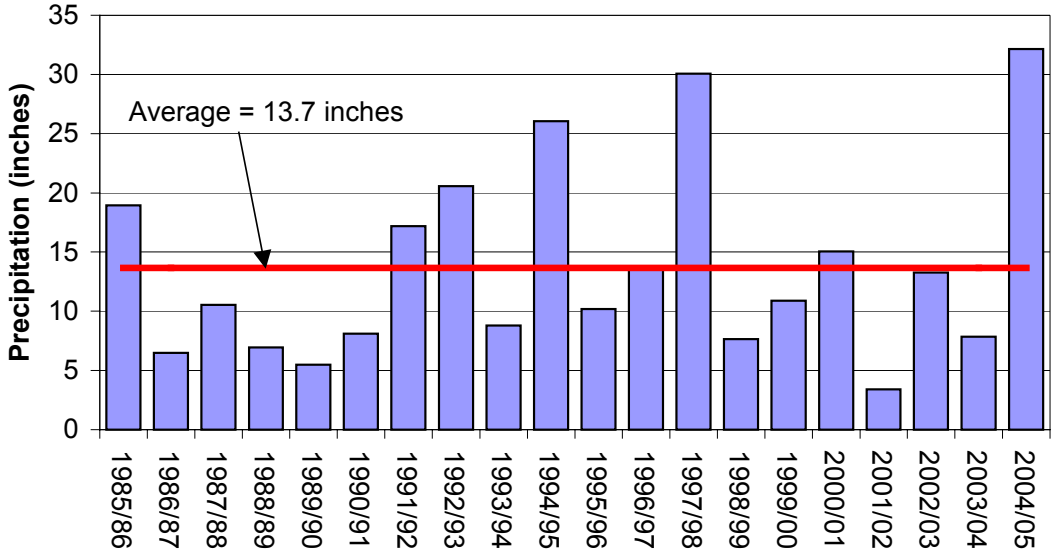
The depth of the Hollywood Basin is as much as 660 feet (DWR, 1961). Semi-perched groundwater may occur in the alluvium, which ranges in thickness from five to 35 feet and covers about half of the basin. Limited groundwater is produced from this zone but it is still an important component of basin management as water from this zone can percolate into the underlying aquifers. The main potable production aquifers include the deeper aquifers of the San Pedro Formation (including from top to bottom, the Jefferson, Lynwood, Silverado and

Sunnyside aquifers) and the shallower aquifers of the Lakewood Formation (including aquifers Exposition and Gage). The San Pedro Formation is only found in the westernmost portion of the basin in the Beverly Hills area. The Gage aquifer of the Lakewood Formation is the major water-bearing member of the Hollywood Basin (DWR, 1961). However, in general, aquifers in the Hollywood Basin are not highly transmissive and do not yield significant groundwater except in the western portion where the basin is deeper.

Safe Yield/Long-Term Balance of Recharge and Discharge

Groundwater in the Hollywood Basin is replenished by percolation of precipitation and stream flow from the Santa Monica Mountains to the north. Historical precipitation at the nearby Santa Monica Pier is summarized in **Figure 6-2**. Urbanization in this area has decreased the surface area open to direct percolation. Therefore, natural recharge is somewhat limited. The natural safe yield of the basin is estimated to be approximately 3,000 AFY (Beverly Hills, 2006).

Figure 6-2
Historical Precipitation near the Hollywood Basin



WRCC, 2007 (Santa Monica Pier)

Total storage in the Hollywood Basin has been estimated to be approximately 400,000 AF. The usable storage in the basin is unknown. However, current depths to water are generally less than 20 feet in the central and eastern portions of the basin, which suggests limited storage space available in these areas. The depth of the static water level in wells in the City of Beverly Hills in the western portion of the basin ranges from 227 feet to 313 feet from the top of the well head to the water table, indicating potential for more storage in this portion of the basin.

GROUNDWATER MANAGEMENT

The following section provides a brief description of the groundwater management activities and governing structure for the Hollywood Basin.

Basin Governance

The Hollywood Basin is unadjudicated. It is presently managed by the city of Beverly Hills through municipal ordinances. These municipal ordinances regulate the production of groundwater, prohibit waste, protect water quality and require dewatering activities to mitigate adverse impacts on the Hollywood Basin. **Table 6-2** summarizes the groundwater management structure in the Hollywood Basin.

The primary producer from the basin is the city of Beverly Hills. The city has historically produced significant quantities of groundwater from the Hollywood Basin, and in some years produced more than 7,000 AF. In 1976, the city of Beverly Hills discontinued producing groundwater from the Hollywood Basin for a variety of reasons, reserving its rights to return to groundwater as necessary to satisfy its water supply requirements. In the 1990s, the city chose to reevaluate the use of groundwater in the Hollywood Basin and elected to resume groundwater production. Since that time, four groundwater wells and a groundwater treatment facility have been activated (SA Associates, 2005).

Table 6-2
Summary of Management Agencies in the Hollywood Basin

Agency	Role
City of Beverly Hills	Manager of production, use and discharge of groundwater through a series of municipal ordinances. Primary producer in basin and operation of reverse osmosis treatment facility

Interactions with Adjoining Basins

The Hollywood Basin is adjacent to the Central Basin and the Santa Monica Basin. The USGS (USGS, 2003) has estimated that the flow from the Hollywood Basin into the Central Basin is approximately 5,900 AFY (based upon 1971 to 2000). There are no formal agreements regarding this flow. The flow into the Santa Monica Basin is restricted by the Newport-Inglewood Uplift.

WATER SUPPLY FACILITIES AND OPERATIONS

Facilities in the Hollywood Basin include four active production wells and a desalter facility. Each of these is discussed below.

Active Production Wells

The city of Beverly Hills currently owns and operates four groundwater production wells in the Hollywood Basin. These wells have a combined capacity of 2,025 gpm and are treated by the city's reverse osmosis desalter discussed below. Details of the treated well production are summarized in **Table 6-3**. Historical treated production since the wells and treatment facility came online in 2003 is shown in **Figure 6-3**. An average of about 1,200 AFY of groundwater was used to meet local demands between 2003 and the end of fiscal year 2004/05.

Figure 6-3
Historical Groundwater Production in the Hollywood Basin

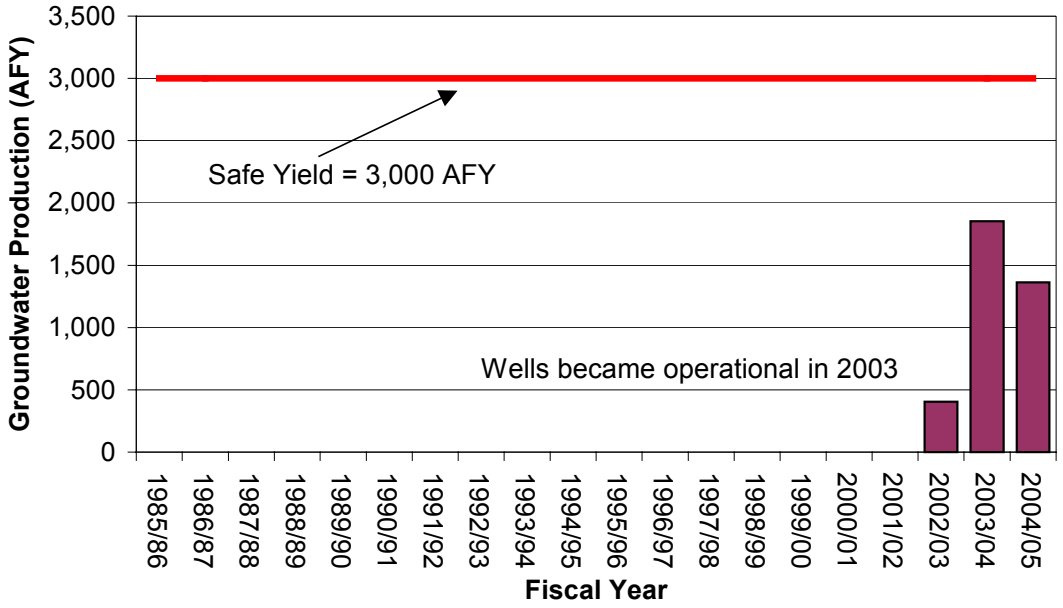


Table 6-3
Summary of Production Wells in the Hollywood Basin

Category	Number of Active Wells	Estimated Production Capacity [1] (AFY)	Average Production 2002/3-2004/5 (AFY)	Well Operation Cost ($/AF)
Municipal	4	1,850	1,207	Data not available

Note: 1. Production capacity is based upon maximum annual production since 2003.
Source: SA Associates, 2005.

Other Production

There is no other documented production in the Hollywood Basin.

ASR Wells

There are no ASR wells in the Hollywood Basin.

Spreading Basins

There are no spreading basins in the Hollywood Basin.

Seawater Intrusion Barriers

There are no seawater intrusion barriers in the Hollywood Basin.

Desalters

The City of Beverly Hills currently treats up to 3 mgd of groundwater via reverse osmosis from the Hollywood Basin at the Beverly Hills Desalter. The project pumps and treats brackish water from the City of Beverly Hills. The desalter facilities include extraction wells, a collector pipeline, a treatment plant and a brine line to deliver waste to the Hyperion Wastewater Treatment Plant. This facility is designed to produce about 2,600 AFY of treated water and discharge about 336 AFY to the brine line (Metropolitan, 2006).

GROUNDWATER LEVELS

Groundwater generally flows from east to west across the Hollywood Basin. Representative hydrographs are shown for inactive wells in **Figure 6-4**. These data suggest that the inflows and outflows in the Hollywood Basin are generally balanced and there is limited effect from natural recharge (i.e. annual variations are only a few feet). Limited production has occurred in the basin during this 20-year period.

GROUNDWATER QUALITY

The following section describes the water quality issues in the Hollywood Basin. Water quality is generally fair with TDS concentrations ranging from 519 to 788 mg/L.

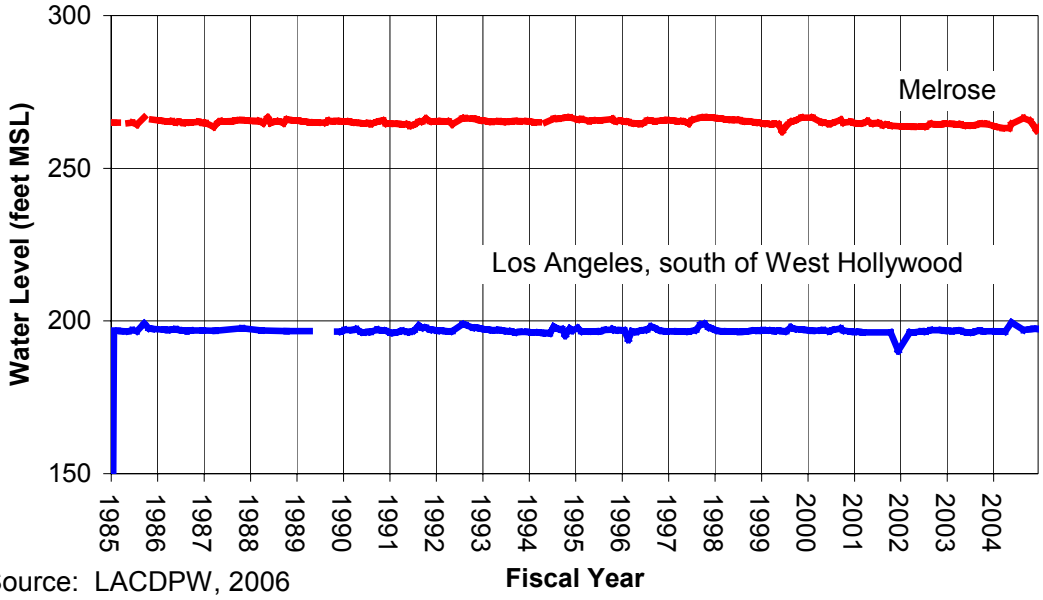
Groundwater Quality Monitoring

Water quality not been measured on a regular basis because the production wells have been inactive since the 1970s. Current production wells are sampled in accordance with Title 22.

Groundwater Contaminants

Constituents of concern for the Hollywood Basin include total dissolved solids (TDS). These constituents are summarized in **Table 6-4**. In addition, constituents of regional concern (nitrate, volatile organic compounds, or VOCs, and perchlorate) are also included for reference.

Figure 6-4
Historical Water Levels in the Hollywood Basin



Source: LACDPW, 2006

Limited historical data are available because wells have not been active. TDS concentrations in the Hollywood Basin generally ranged from 357 to 970 mg/L between 2002 and 2006 (Regional Board, 2007). Based upon data from the four active wells between 2002 and 2006, about 85 percent of the samples collected exceeded the secondary standard of 500 mg/L for TDS.

Blending Needs

There is no information related to blending needs in the Hollywood Basin.

Groundwater Treatment

As discussed above, wells are treated by reverse osmosis at the Beverly Hills Desalter. All groundwater pumped in the Hollywood Basin is treated.

CURRENT GROUNDWATER STORAGE PROGRAMS

There are no current groundwater storage programs in the Hollywood Basin.

Table 6-4
Summary of Constituents of Concern in Hollywood Basin

Constituent	Units	Range 2002/03-2005/06	Description
TDS Secondary MCL = 500	mg/L	357 to 970	Based upon data collected between 2002 and 2006, 85 percent of all samples collected had TDS concentrations above 500 mg/L.
Nitrate (as N) Primary MCL = 10	mg/L	ND	Nitrate has not been detected in the Hollywood Basin
VOCS (TCE and PCE) Primary MCL for TCE = 5 Primary MCL for PCE = 5	µg/L	ND	TCE and PCE have not been detected in the Hollywood Basin
Perchlorate Notification level = 6	µg/L	ND	Perchlorate has not been detected in the Hollywood Basin.

Source: Regional Board, 2007

BASIN MANAGEMENT CONSIDERATIONS

Management considerations in the Hollywood Basin include:

- Shallow groundwater may limit ability to store water. As discussed above, depth to groundwater is less than 20 feet in central and eastern portions of the basin, which would limit the ability to store water.

- Groundwater must be treated to meet drinking water standards. As discussed above, TDS concentrations exceed the secondary standard of 500 mg/L.

- Basin receives limited natural recharge because of urbanization. The safe yield is only about 3,000 AFY.

References:

California Department of Water Resources (DWR), 1961. Bulletin 104 - Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County. Appendix A, Ground Water Geology.

California Department of Water Resources (DWR), 2004. Bulletin 118 – Coastal Plain of Los Angeles Groundwater Basin, Hollywood Subbasin. Updated 2/27/04. Website: http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/4-11.02.pdf Accessed 6/27/07.

California Regional Water Quality Control Board. 2007. Geotracker database. Website: http://www.geotracker.swrcb.ca.gov/reports/well_search.asp Accessed June 27, 2007.

Los Angeles County Department of Public Works (LACDPW). Water level data for wells 2671A and 2642M. Accessed at: http://ladpw.org/wrd/wellinfo/well.cfm. November 6, 2006.

Metropolitan Water District of Southern California (Metropolitan), 2006. Local Resource Program, Recycled Water and Groundwater Recovery Projects, Summary Report August 2006.

SA Associates, 2005. City of Beverly Hills 2005 Urban Water Management Plan – December 2005. Prepared for the City of Beverly Hills.

United States Geological Survey (USGS). 2003. Water Resource Investigation Report 03-4065. Geohydrology, geochemistry, and ground-water simulation – Optimization of the Central and West Coast Basins, Los Angeles County, California.

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CHAPTER IV

GROUNDWATER BASIN REPORTS

SAN GABRIEL VALLEY BASINS

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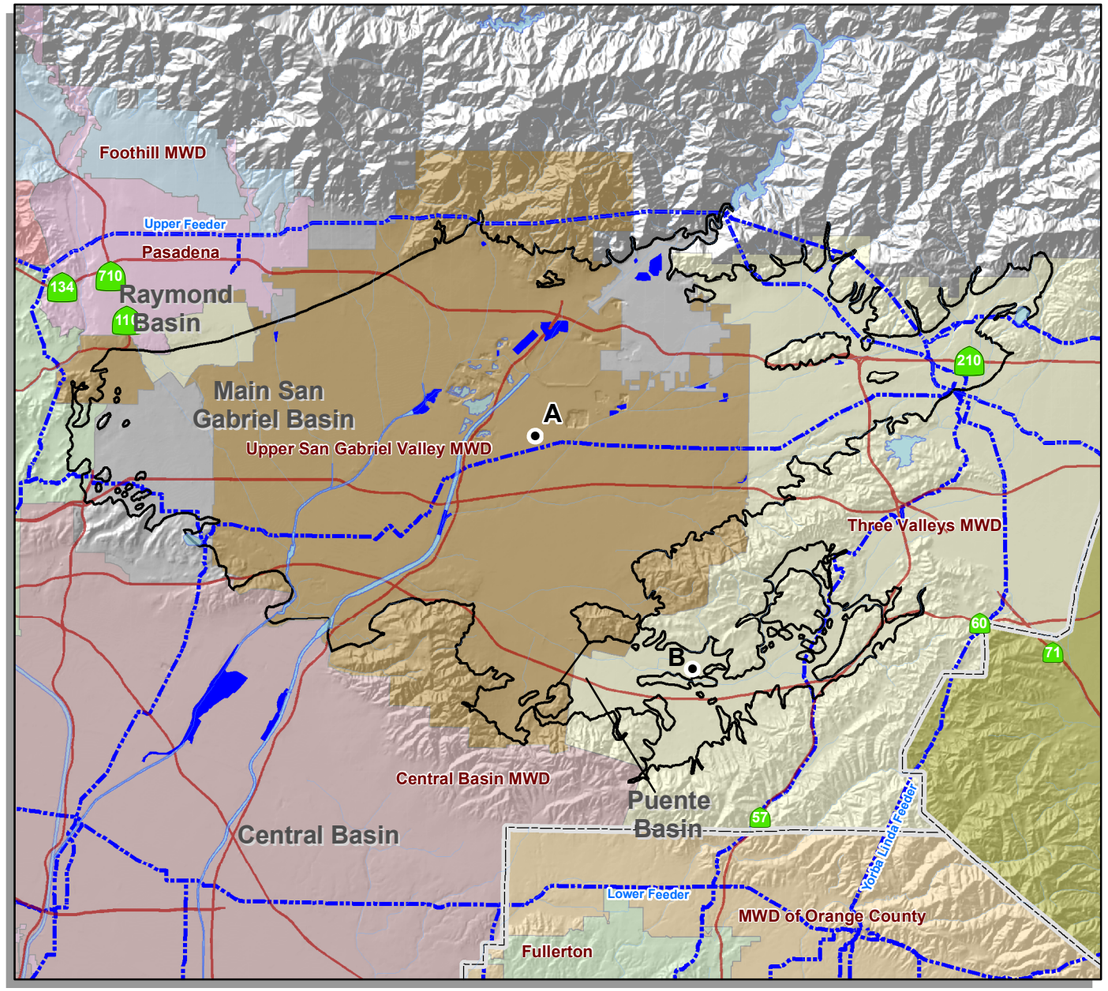

Main San Gabriel and Puente Basins

A ● Key Well
Freeways
Stream
MWD Pipeline
County
MWD Member Agency Boundaries (colors vary)
Recharge Basins
Water Body
Groundwater Basin

N W E S

4 2 0 4 Miles

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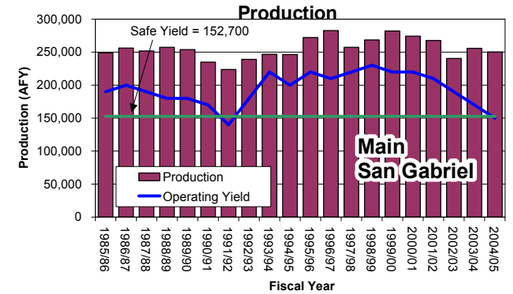
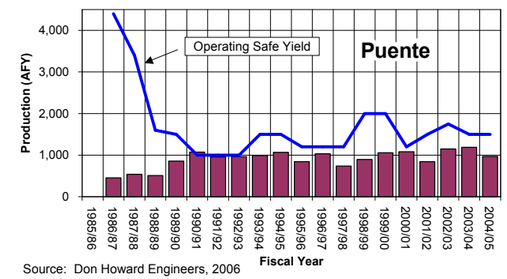
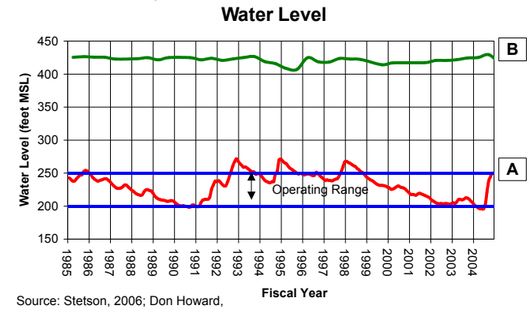
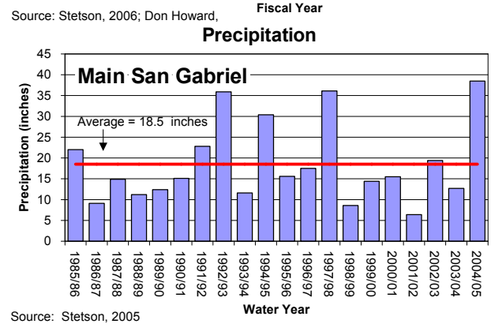




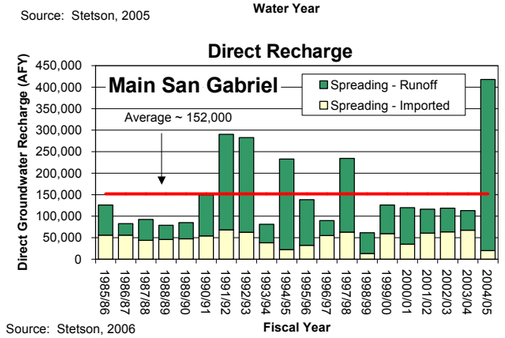
Source: Don Howard Engineers, 2006



Source: Stetson, 2006; Don Howard,



Source: Stetson, 2005



Source: Stetson, 2006

BASIN FACTS

Main San Gabriel and Puente Basins

Description
Location: Los Angeles County
Watershed Surface Area: 167 square miles
Subbasins:
Main Basin
Puente Basin
Management: Adjudicated
Main Basin adjudicated in 1973. Puente Basin adjudicated in 1986.
MWD Member Agencies:
San Marino
Three Valleys MWD
Upper San Gabriel Valley MWD

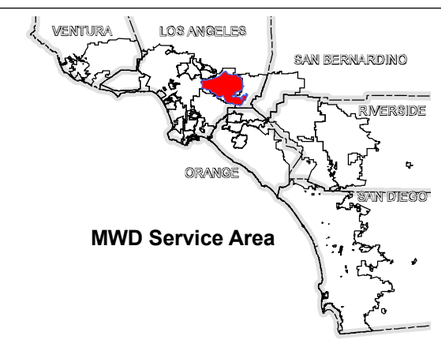
	Main	Puente
Natural Safe Yield	152,700 AFY	4,400 AFY
Operating Safe Yield (2005/06)	240,000 AFY	1,530 AFY
Total Storage	8.6 million AF	979,650 AF
Usable Storage	800,000 AFY	Unknown
Storage Space Available	None	Unknown

Storage and Extraction Facilities

	Main	Puente
Production Wells		
Production Capacity	~500,000 AFY	300-600 gpm
Average 1985-2004	~256,000 AFY	905 AFY
Injection Wells		
Injection Capacity	None	None
Average 1985-2004	None	None
Spreading Basins		
Spreading Capacity	~620,000 AFY	None
Average 1985-2004	~152,000 AFY	None

Basin Management Considerations

- Pumping subject to adjudication in Main and Puente Basins
- Cannot store supplemental imported water in Main Basin when the key well groundwater elevation exceeds 250 feet MSL
- Must have a Cyclic Storage Agreement with Main Basin Watermaster to store imported water in Main Basin
- Puente Basin Judgment has no provisions for storage
- Perchlorate and various chlorinated solvent contaminants associated with the USEPA Operable Units could limit ability to store and extract water
- Nitrate concentrations in eastern portion of the Main Basin could limit ability to store and extract water



MWD Service Area

Plate 7-1
Overview of Main San Gabriel and Puente Basins

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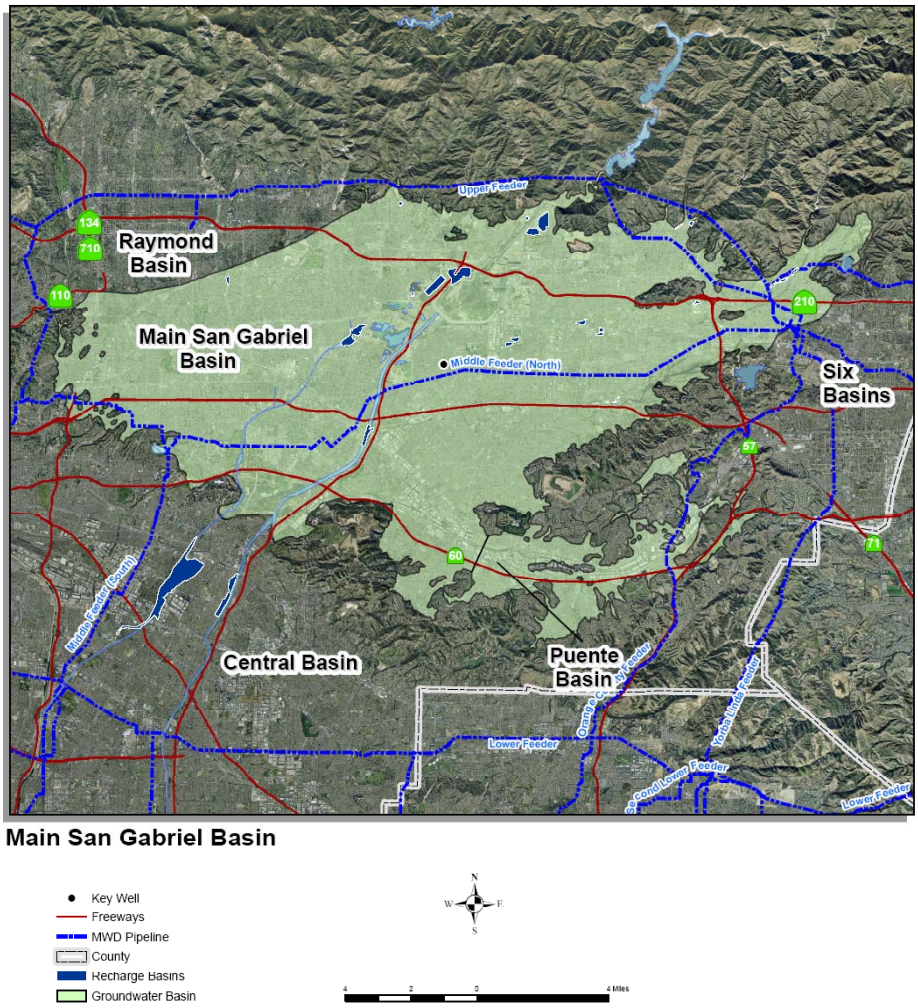
The Main San Gabriel and Puente Basins lie in eastern Los Angeles County, California. The hydrologic basin or watershed coincides with a portion of the upper San Gabriel River watershed, and the aquifer or groundwater basin underlies most of the San Gabriel Valley. Metropolitan member agencies overlying the Main San Gabriel Basin (or Main Basin) include: Upper San Gabriel Municipal Water District (Upper District), Three Valleys Municipal Water District (Three Valleys) and the City of San Marino. The service areas of three member agencies (cities of Azusa, Alhambra and Monterey Park) of the State Water Project contractor, San Gabriel Valley Municipal Water District (SGVMWD), also overlie the Main San Gabriel Basin. The Metropolitan member agency overlying the Puente Basin is Three Valleys. Overlying communities include: Arcadia, Azusa, Baldwin Park, Bradbury, Covina, Duarte, El Monte, Glendora, Industry, Irwindale, La Puente, Monrovia, Rosemead, San Gabriel, San Marino, South El Monte, South Pasadena, Temple City, Walnut, and West Covina. A map of the Main San Gabriel and Puente Basins is provided in **Figure 7-1**.

Figure 7-1
Map of the Main San Gabriel and Puente Basins



BASIN CHARACTERIZATION

The following section provides a physical description of the Main San Gabriel and Puente Basins including geographic location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

The Main San Gabriel and Puente Basins are bounded by the San Gabriel Mountains to the north, San Jose Hills to the east, Puente Hills to the south, and by a series of hills and the Raymond Fault to the west. The watershed is drained by the San Gabriel River and Rio Hondo, a tributary of the Los Angeles River.

The physical groundwater basin is divided into two main parts, the Main Basin and the Puente Basin. The Puente Basin, lying in the southeast portion of the map above, is tributary to the Main Basin and hydraulically connected to it, with no barriers to groundwater movement. Each basin is separately adjudicated and managed by a watermaster. **Table 7-1** provides a summary of the hydrogeologic parameters of the Main San Gabriel and Puente Basins. Each basin is discussed separately in the following section.

Table 7-1
Summary of Hydrogeologic Parameters of Main San Gabriel and Puente Basins

Parameter	Main San Gabriel Basin	Puente Basin
Structure		
Aquifer(s)	Unconfined	Unconfined
Depth of groundwater basin	800 to 1,600 feet MSL	25 to 1,300 feet
Thickness of water-bearing units	300 to 2,000 feet	70 to 200 feet
Yield and Storage		
Natural Safe Yield	152,700 AFY	4,400 AFY
Operating Yield	FY 2005/06: 240,000 AFY	FY 2006/07: 1,530 AFY
Total Storage	8.6 million AF	979,650 AF
Unused Storage Space	~500,000 AF	Unknown
Portion of Unused Storage Available for Storage (in 2005/06)	None	Unknown

Sources: Stetson, 2006 and Main San Gabriel Basin Watermaster, 2006
Puente Basin Watermaster, 2006; Ecological Systems Corporation, 1975; Geotechnical Consultants, Inc, 1979; CH2MHill, 1997. Main San Gabriel Basin

Main San Gabriel Basin

The Main San Gabriel Basin occupies most of the San Gabriel Valley and encompasses a surface area of more than 73,000 acres. Principal water-bearing formations of the Main Basin are unconsolidated and semi-consolidated unconfined alluvial sediments that range in size from coarse gravel to fine-grained sands. Total thickness of water-bearing sediments ranges from about 300 feet to more than 2,000 feet (Stetson, 2006).

The total amount of water in storage for the Main San Gabriel Basin is approximately 8.6 million AF (Main San Gabriel Watermaster, 2006b). Usable storage within the operating range is approximately 800,000 AF while the unused storage space is about 500,000 AF (Stetson, 2006). Supplemental imported water cannot be stored in the Main San Gabriel Basin when the groundwater elevation at the key well exceeds 250 feet MSL. Water levels at this time are near or above the target level. Therefore, available storage space for supplemental water is currently limited.

Puente Basin

The Puente Basin occupies the western end of the San Jose Valley and contains nearly 8,870 acres. For the most part, the basin is relatively shallow, and in several locations, bedrock is found at the surface. Boundaries of the Puente Basin are formed on the north and south by the nonwater-bearing rocks of the San Jose and Puente Hills. The eastern boundary is contiguous with the western boundary of the Spadra Basin and is defined by a bedrock ridge and groundwater divide. As discussed above, the Puente Basin is bounded by the Main San Gabriel Basin to the west. Groundwater freely flows from the Puente Basin into the Main San Gabriel Basin. (Engineering Science, Inc, 1979).

Primary water-bearing sediments include weathered alluvium from the adjacent hills and recent deposits within San Jose Creek. The alluvial fill in the Puente Basin tends to be finer-grained and has higher clay content than the sediments in the Main Basin and ranges in depth from 25 feet to 1,300 feet (CH2MHill, 1997). Water-bearing sediments range in thickness between 70 and 120 feet throughout most of the basin but increase in thickness toward the west (maximum thickness of about 500 feet near the boundary with the Main Basin (Engineering Science, Inc, 1979; Ecological Systems Corporation, 1975). Well depths range from about 75 feet to 300 feet in the Puente Basin (Engineering Science, Inc, 1979). Total storage within the Puente Basin has been estimated to be approximately 979,650 AF (Engineering Science Inc, 1979).

Safe Yield/Long-Term Balance of Recharge and Discharge

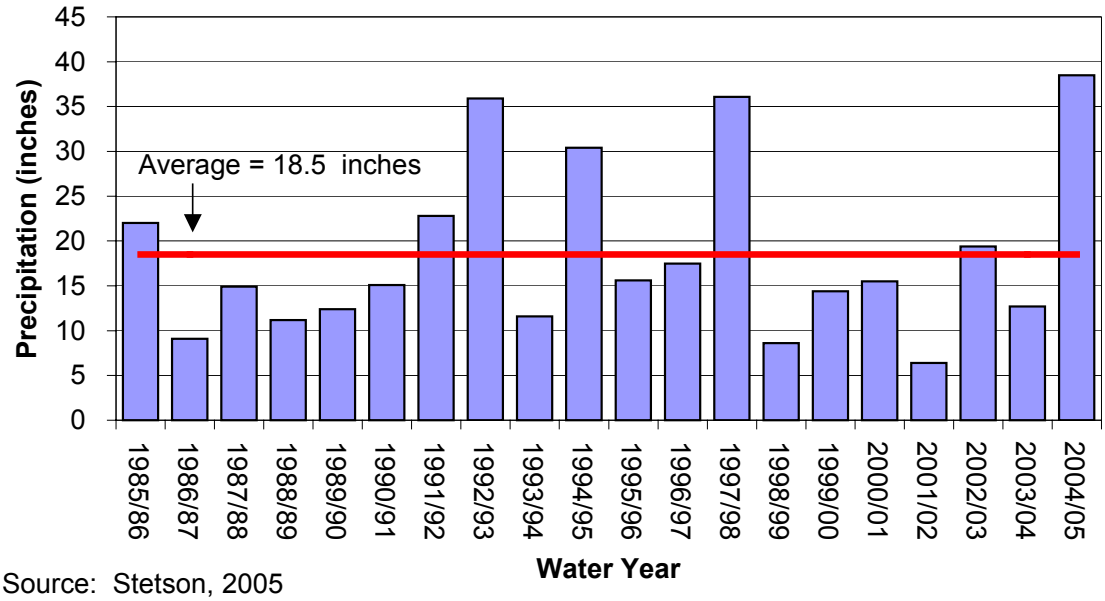
The natural sources of recharge and long-term balance for the Main San Gabriel and Puente Basins are discussed separately in the following section.

Main San Gabriel Basin

The major sources of natural recharge to the Main San Gabriel Basin are infiltration of rainfall on the valley floor and percolation of runoff from the adjacent mountains. Historical precipitation in the Main San Gabriel Basin is summarized in **Figure 7-2**. The average precipitation over the past 20 years is approximately 18.5 inches. The basin also receives imported water and return flow from applied water.

According to the Main San Gabriel Basin Judgment (discussed below), the natural safe yield of the Main San Gabriel Basin is defined as 152,700 AFY (Main San Gabriel Basin Judgment, 1989).

Figure 7-2
Historical Precipitation in the Main San Gabriel Basin



Source: Stetson, 2005

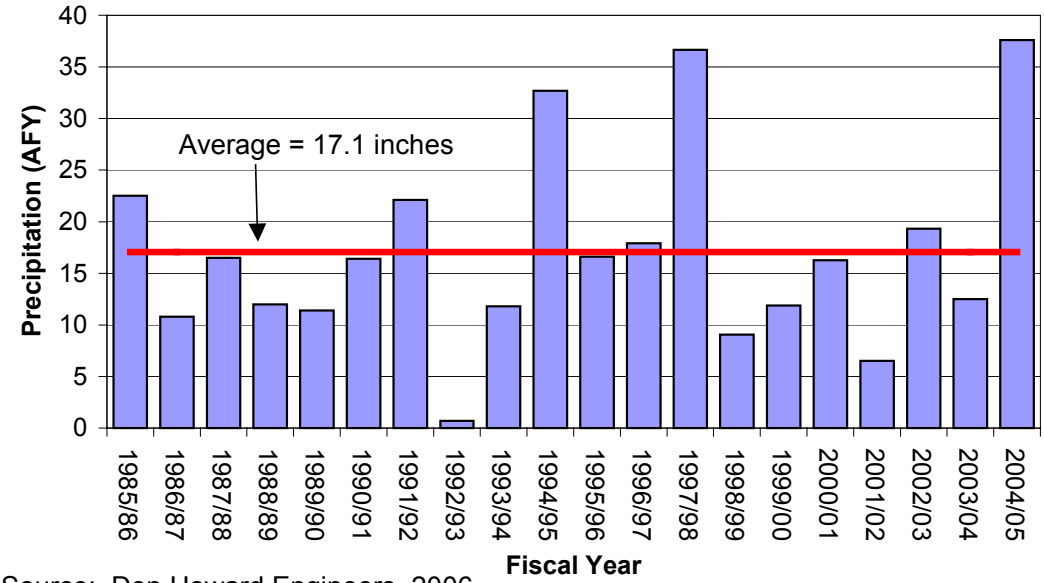
The Operating Safe Yield (OSY) is the quantity of water that the Main San Gabriel Basin Watermaster (Watermaster) determines may be pumped from the Basin in a fiscal year, without Replacement Water assessments. Watermaster considers a wide range of data in setting the OSY, including provisions of the Main San Gabriel Basin Judgment, key well water level, current hydrologic conditions in the basin such as precipitation, storage of local runoff in surface reservoirs, conservation of local runoff, amount of water in cyclic storage accounts, carryover rights and others. In accordance with the Main San Gabriel Basin Judgment, Watermaster at its regular meeting in May of each year determines the OSY applicable to the succeeding fiscal year (July 1 through June 30) and estimates the OSY for the next succeeding four fiscal years. On May 11, 2005, Watermaster adopted an OSY of 240,000 AF for fiscal year 2005-06 and an estimated OSY of 210,000 AF for fiscal year 2006-07.

Since 1975, Watermaster has used cyclic storage accounts to store imported water against future replenishment requirement. Three current cyclic storage accounts (Metropolitan Water District on behalf of its member agencies (140,000 AF) and San Gabriel Valley Municipal Water District (40,000 AF), totaling 180,000 AF of potential water storage capacity are maintained for providing supplemental water to the basin. These accounts allow delivery of imported water when it is available and the water is stored in the basin for sale to Watermaster at a later date.

Puente Basin

The major sources of natural recharge to the Puente Basin are infiltration of rainfall on the valley floor and percolation of runoff from the adjacent mountains. In addition, water is imported into the basin from the Pomona Water Reclamation Plant (recycled water) and from Metropolitan via the Rowland and Walnut water districts (CH2MHill, 1997). Historical precipitation in the Puente Basin is summarized in **Figure 7-3**. The average precipitation over the past 20 years has been approximately 17.1 inches, lower than the long-term average of about 18 inches per year. The basin also receives imported water and return flows from applied water.

Figure 7-3
Historical Precipitation in the Puente Basin



Source: Don Howard Engineers, 2006

According to the Puente Basin Judgment (discussed below), the declared safe yield of the Puente Basin is 4,400 AFY (Puente Basin Judgment, 1986). However, the basin is managed on the basis of Operating Safe Yield determined annually by the Watermaster and has averaged 1,666 AFY since 1988.

The Operating Safe Yield (OSY) is the quantity of water that the Puente Basin Watermaster (Watermaster) determines may be pumped from the basin in a fiscal year. Watermaster

determines the OSY in consideration of five factors specified in the Judgment: water levels, Puente Narrows Agreement, subsurface flows, cost of availability of alternate sources of water, and groundwater pumping. In accordance with the Puente Basin Judgment, Watermaster makes the preliminary determination of OSY by the first Monday in April for upcoming fiscal year and estimates the OSY for the next succeeding four fiscal years. On April 27, 2006, Watermaster adopted an OSY of 1,530 AF for fiscal year 2006-07 and an estimated OSY of 1,500 AF for the subsequent four years.

GROUNDWATER MANAGEMENT

The following section describes how the Main San Gabriel and Puente Basins are currently managed. This includes a discussion of the governing structure and relationship with adjoining basins.

Basin Governance

The following section describes the governing structure and adjudication of the Main San Gabriel and Puente Basins. A summary of the agencies contributing to the management of each basin is provided in **Table 7-2.**

Main San Gabriel Basin

The Main San Gabriel Basin is an adjudicated basin. On January 4, 1973, after extensive negotiations, a stipulated Judgment in this case was entered (Main San Gabriel Basin Judgment) that created Watermaster, governing body and specified a program for management of water in the Main Basin. Since the Main San Gabriel Basin Judgment was originally entered, there have been subsequent amendments to it that extend and clarify Watermaster's role.

The Watermaster is a nine-person board appointed by the Los Angeles County Superior Court that administers and enforces the provisions of the Main San Gabriel Basin Judgment, which established water rights and responsibility for efficient management of the quantity and quality of the Basin's groundwater. The Watermaster manages and controls the withdrawal of groundwater/surface water and replenishment of imported water supplies in the basin and determines the amount that can be safely extracted. The Watermaster coordinates imported water deliveries and recharge. Watermaster coordinates local involvement in efforts to preserve and restore the quality of groundwater in the basin. The Watermaster assists and encourages regulatory agencies to enforce water quality regulations affecting the basin; collects production, water quality, and other relevant data from producers; prepares an annual report of pumping and diversions; and a Five Year Plan to address water quality management.

The Main San Gabriel Basin Judgment allows a producer to pump or divert more water than its share, but the producer must pay for replenishment water for any amount produced above its water rights. Producers can carryover up to 100 percent of their water rights for only one year.

Any entity, public or private, desiring to spread and store supplemental water within the basin for subsequent recovery and use for Watermaster credit must have a cyclic storage agreement

pursuant to Watermaster's Rules and Regulations. Cyclic storage agreements are for a term of five years and may extend for additional terms, not to exceed five years. The cyclic storage agreement notes the maximum amount of supplemental water that may be stored at any point in time by a particular storing entity.

Table 7-2
Summary of Management Agencies in the Main San Gabriel and Puente Basins

Agency	Role
Main San Gabriel Basin	
Main San Gabriel Basin Watermaster	Court appointed Watermaster to manage water quantity/quality; coordinate U.S. EPA Operable Unit cleanup.
Upper San Gabriel Valley Municipal Water District	Delivery of Supplemental Water
Three Valleys Municipal Water District	Delivery of Supplemental Water
San Gabriel Valley Municipal Water District	Delivery of Supplemental Water
County of Los Angeles, Department of Public Works (LACDPW)	Recharge local runoff/supplemental water
San Gabriel Basin Water Quality Authority	Obtain funding for Basin clean up activities
San Gabriel River Watermaster	Calculates credits/debits between Main San Gabriel Basin and Central Basin
Puente Basin	
Puente Basin Watermaster	Appointed by the Principal Parties to the Judgment to determine the annual Operating Safe Yield and Annual Pumping Rights and components.
Puente Narrows Watermaster	Calculates credits/debits between Puente Basin and Main Basin.
Los Angeles County Department of Public Works	Monitors water levels in Puente Basin
Los Angeles Regional Water Quality Control Board	Oversees clean-up in Puente Basin of groundwater contamination
U.S. Environmental Protection Agency	Oversees remediation of Puente Valley Operable Unit component of the San Gabriel Valley Superfund Site.
Three Valleys Municipal Water District	Delivery of supplemental imported water
County Sanitation Districts of Los Angeles County	Provider of recycled water for landscape irrigation.
Walnut Valley Water District Rowland Water District	Puente Basin water quality sampling since 1992

Puente Basin

The Puente Basin was adjudicated in 1986. Under the Judgment, a management plan was executed by the Principal Parties to the Judgment and is administered by a three-person Watermaster. The three Watermasters are nominated and appointed by the Principal Parties according to directives of the Judgment. The Judgment specifies the duties of the Watermaster to include determining Operating Safe Yield and notifying the Court and Principal Parties of Annual Pumping Rights and components thereof. Import return flow credits are calculated separately from Operating Safe Yield. The Judgment provides for up to 100 percent carryover of unpumped water rights for one year, up to 10 percent excess pumping, restricts exportation of groundwater, and makes no provisions for storage of surplus supplies within the groundwater basin.

Interactions with Adjoining Basins

The Long Beach Judgment (City of Long Beach v. San Gabriel Valley Water Company) guarantees the Lower Area (Central and West Coast Basin) an average annual water supply of approximately 98,000 AFY through Whittier Narrows and is administered by the three-person court appointed San Gabriel River Watermaster. As part of that Judgment, subsurface flow from the Main San Gabriel Basin into Central Basin is calculated and is included in the determination of usable water provided to Lower Area.

Subsurface outflow from the Puente Basin into the Main San Gabriel Basin is governed and calculated pursuant to the provisions of the Puente Narrows Agreement between Puente Basin Water Agency (comprised of Walnut Valley Water District and Rowland Water District) and Upper San Gabriel Valley Municipal Water District. The Puente Narrows Agreement is Exhibit F to the Puente Basin Judgment. The Agreement calls for an average Base Underflow of 580 acre-feet per year from Puente Basin to the Main San Gabriel Basin, with credits and debits accumulating. Credit is also given to the Puente Basin Water Agency for pumping associated with some water quality clean-up operations pursuant to the Clean-Up Production Agreement that discharge treated water to the concrete-lined San Jose Creek.

WATER SUPPLY FACILITIES AND OPERATIONS

The following provides a summary of the facilities within the Main San Gabriel and Puente basins. Key storage and extraction facilities include more than 300 production wells and associated facilities and 17 spreading basins for groundwater recharge.

Municipal Production Wells

Table 7-3 provides a summary of the production wells in the Main San Gabriel and Puente basins.

Main San Gabriel Basin

In the Main San Gabriel Basin, there are 305 wells in the basin (250 active wells and 55 inactive wells). About 10 of these wells (less than 3 percent) are projected to be replaced or rehabilitated in the next 5 years (Stetson, 2006). Historical production in the Main San Gabriel Basin is summarized in **Figure 7-4**. Between fiscal years 1985/86 and 2004/05, production ranged from about 224,000 AFY to 283,000 AFY with an average of 255,525 AFY. The groundwater production exceeded the operating yield, which has ranged from 140,000 AFY to 240,000 AFY during the same period. Therefore, producers must provide for replacement water.

Table 7-3
Summary of Production Wells in the Main San Gabriel and Puente Basins

Category	Number of Wells	Estimated Production Capacity (AFY)	Average Production 1985-2004 (AFY)	Well Operation Cost ($/AF)
Main San Gabriel Basin		~500,000 AFY (active wells) [1] ~80,000 AFY (inactive wells)	255,525	$85 Power $1.74 Disinfection $2.50 O&M **Total** [2] **$89.24**
Municipal	250			
Other	55			
Total Main San Gabriel Basin	**305**			
Puente Basin Non-potable-supply	**5**	300 to 600 gpm	905	

Notes: 1 Stetson, 2006
2 Does not include treatment costs

Puente Basin

There are five production wells in the Puente Basin. (Don Howard Engineers, December 2006). Due to the poor quality of the Puente Basin groundwater, groundwater is used for non-potable purposes including blending with reclaimed water, construction water, and irrigation (Puente Watermaster, April 2006). Historical production in the Puente Basin is shown in **Figure 7-5**.

Figure 7-4
Historical Groundwater Production in the Main San Gabriel Basin

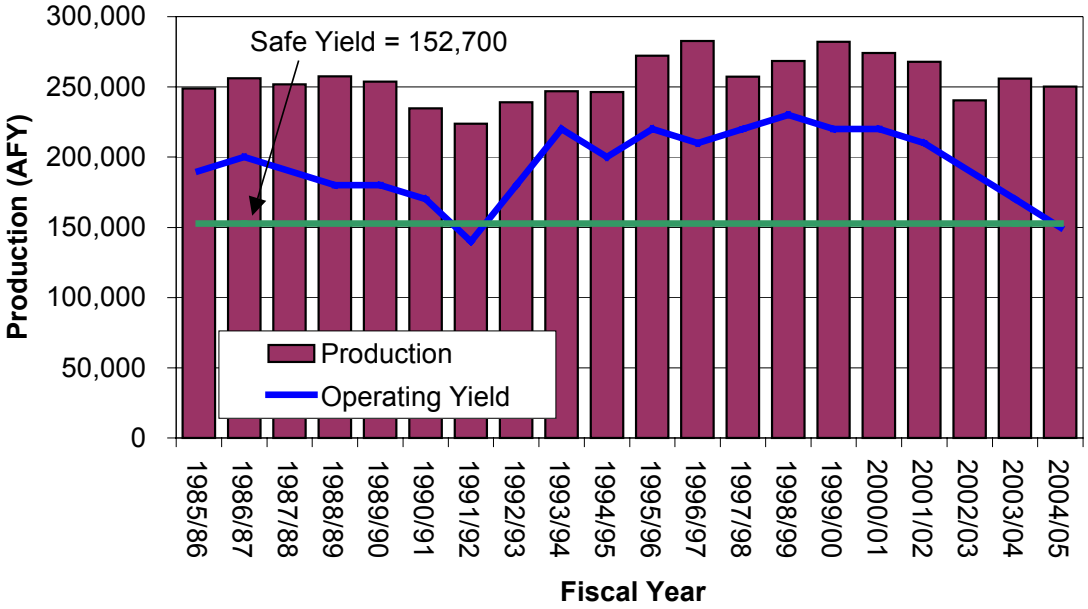
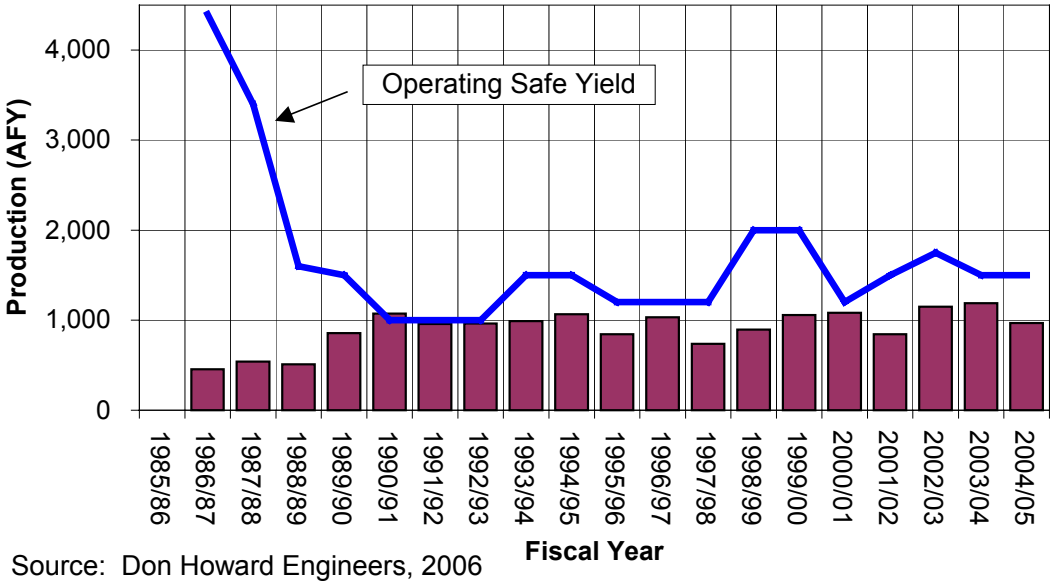


Figure 7-5
Historical Groundwater Production in the Puente Basin



Source: Don Howard Engineers, 2006

Other Production

There are approximately 55 non-municipal wells in the Main San Gabriel Basin. Approximately 50 percent of the non-municipal production is for agricultural purposes and nearly 50 percent is for either industrial or domestic purposes (Stetson, 2006).

ASR Wells

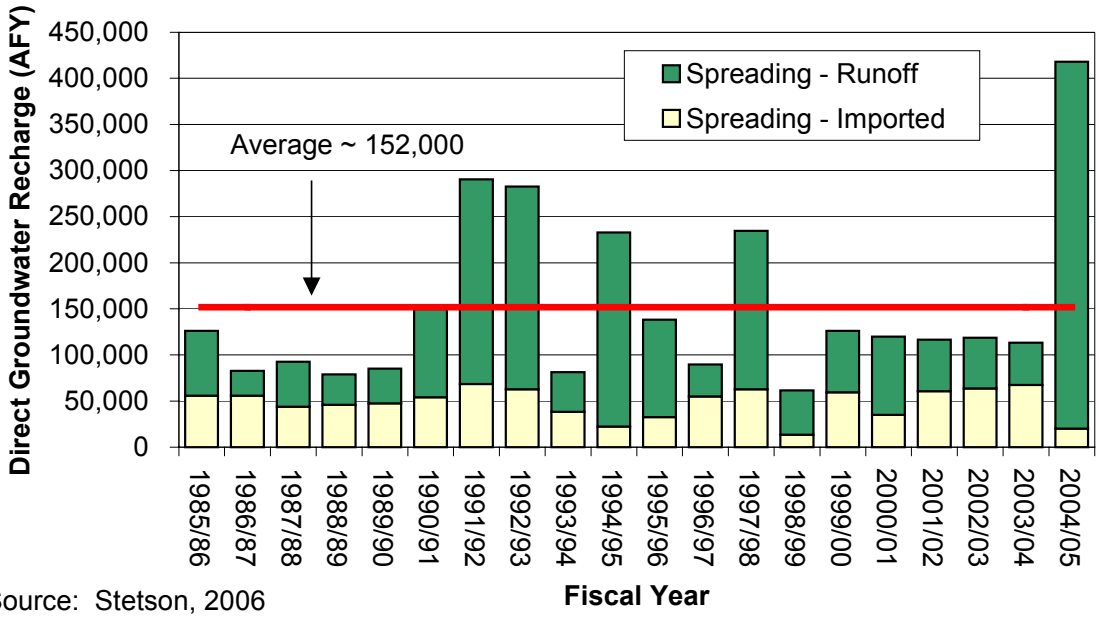
There are no ASR wells in the Main San Gabriel and Puente Basins.

Spreading Basins

Main San Gabriel Basin

There are currently 17 spreading basins, covering more than 1,100 acres, either operated by LACDPW or other agencies that are capable of capturing stormwater runoff from the adjacent canyons or imported water. The details of these facilities are summarized in **Table 7-4**. The historical recharge data are presented in **Figure 7-6**.

Figure 7-6
Historical Groundwater Recharge in the Main San Gabriel Basin



Source: Stetson, 2006

LACDPW spreads imported water from Metropolitan and SGVMWD in the San Gabriel Valley on behalf of the SGVMWD, Upper San Gabriel Valley Municipal Water District, and the Three Valleys Municipal Water District. The spreading capacity of the existing facilities is more than 600,000 AFY. However, the amount of imported water that can be spread is limited because space in the basins must be reserved for the capture of runoff during storm events. Between fiscal years 1985/86 and 2004/05, from 62,000 and

417,000 AFY, with an average of approximately 152,000 AFY was recharged in the Main San Gabriel Basin.

Table 7-4
Summary of Spreading Basins in the Main San Gabriel Basin

Spreading Basin	Area (acres)	Wetted Area (acres)	Recharge Capacity (cfs)	Recharge Capacity (AFY)	Source Water	Owner
Ben Lomond	24	17	30	21,681	Runoff	LACDPW
Big Dalton	24	8	12	8,672	Runoff	LACDPW
Buena Vista	10	6	6	4,336	Runoff	LACDPW
Citrus	19	15	28	20,236	Runoff	LACDPW
Eaton Basin	16	10	10	7,227	Runoff	LACDPW
Fish Canyon	6	4	7	5,059	Runoff	California-American Water Company
Forbes	21	10	5	3,614	Runoff Imported	LACDPW
Irwindale/Manning	62	30	60	43,362	Runoff Imported	LACDPW
Little Dalton	14	5	15	10,841	Runoff Imported	LACDPW
Peck Road	157	105	25	18,068	Runoff	LACDPW
San Dimas Canyon	22	11	12	8,672	Runoff	LACDPW
San Gabriel Canyon	165	140	50	36,135	Runoff Imported	LACDPW
San Gabriel River	196	196	180	130,086	Runoff Imported	LACDPW
Santa Fe	338	168	400	289,080	Runoff Imported	LACDPW
Sawpit	12	4	12	8,672	Runoff	LACDPW
Valley Rubber Dam	60	60	0	0	Runoff Imported	LACDPW
Walnut	16	8	5	3,614	Runoff	LACDPW
Total	**1162**	**797**	**857**	**619,355**		

Source: LACDPW, 2006

Puente Basin

There are no spreading basins in Puente Basin.

Seawater Intrusion Barriers

There are no seawater intrusion barriers in the Main San Gabriel and Puente Basins.

Desalters

There are no desalters in the Main San Gabriel and Puente Basins.

GROUNDWATER LEVELS

The following section provides a description of groundwater levels in the Main San Gabriel and Puente Basins.

Main San Gabriel Basin

As shown in **Figure 7-7**, groundwater flow in the Main San Gabriel Basin is generally from the east to the west across the basin and southward into the Central Basin. In addition, groundwater typically flows northward from the Puente Basin into the Main San Gabriel Basin. Current groundwater levels range from about 1,200 feet MSL in the east portion of the basin along the San Gabriel Mountains to 110 feet MSL in the Alhambra area (referred to as the Alhambra pumping hole).

A key well located in Baldwin Park is used as an indicator of the amount of water in storage. As shown in **Figure 7-8**, the typical basin operating range is for basin water levels between 200 and 250 feet MSL. As discussed above, imported water cannot be spread when the key well groundwater level is above 250 feet. After reaching a historic low water level of 195.5 feet MSL in December 2004, water levels increased in the Baldwin Park key well to 251 feet MSL in June 2005. Water level in April 2006 was approximately 246 feet MSL.

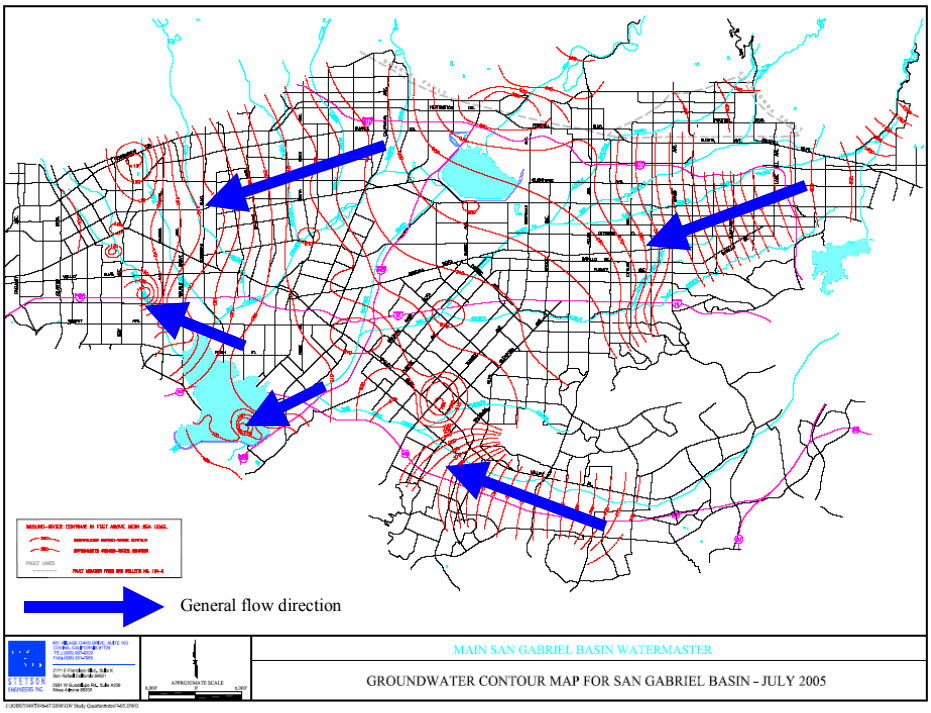
Puente Basin

Groundwater movement within the Puente Basin is generally controlled by topographic highs (i.e. The surrounding hills). Faults that may potentially affect groundwater movement have not been identified within the Puente Basin (CH2MHill, 1997). Because the Puente Basin is constrained on the north and south by bedrock, groundwater generally flows toward the west and northwest. As shown in **Figure 7-9**, water levels have been relatively stable-in the Puente Basin since 1985 with an overall fluctuation of less than 25 feet.

GROUNDWATER QUALITY

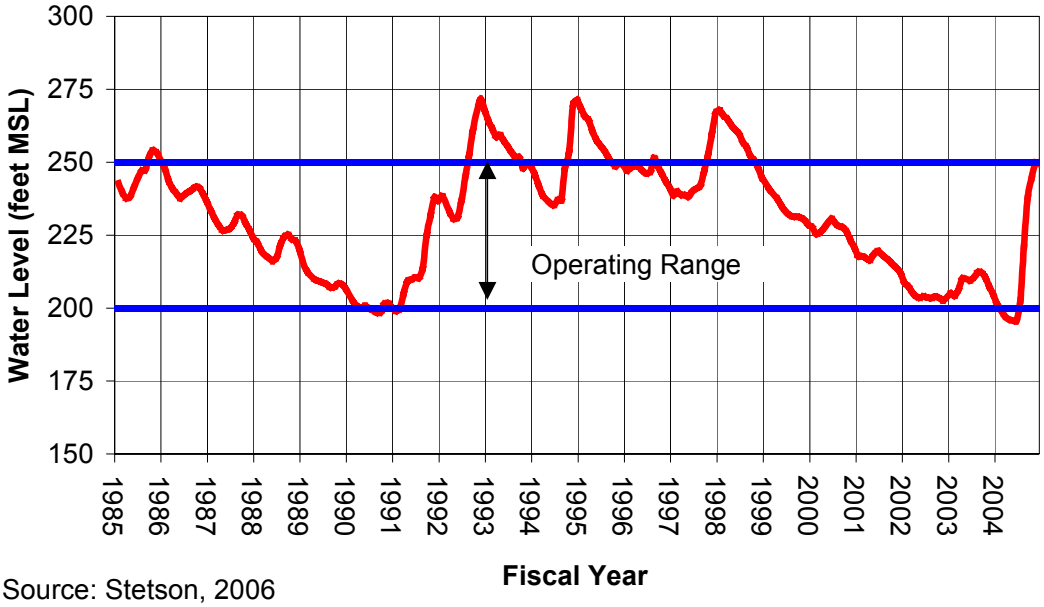
The following section provides a brief description of the groundwater quality issues in the Main San Gabriel and Puente Basins.

Figure 7-7
Groundwater Contour Map of the Main San Gabriel and Puente Basins – Summer 2005



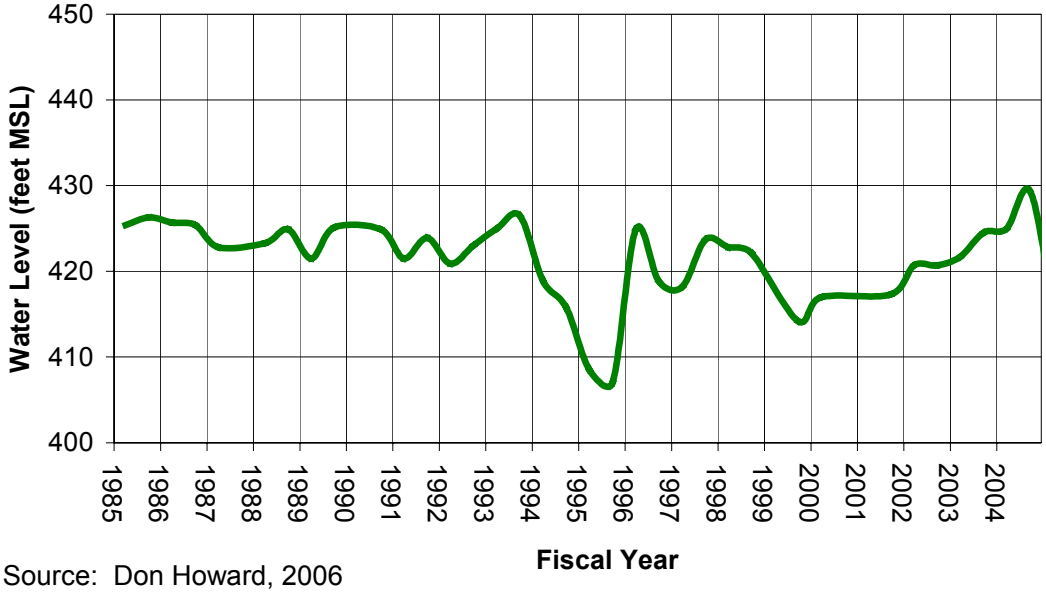
Source: Stetson, 2006

Figure 7-8
Historical Water Levels in the Main San Gabriel Basin



Source: Stetson, 2006

Figure 7-9
Historical Water Levels in the Puente Basin



Source: Don Howard, 2006

Groundwater Quality Monitoring

The Main San Gabriel Basin Watermaster currently coordinates the Title 22 sampling of approximately 200 active wells in the basin. In addition, groundwater quality is monitored by Watermaster at least once per year for nitrate and volatile organic compounds (VOCs) as part of the Basinwide Ground Water Quality Monitoring Program. The project is designed to facilitate the coordination of existing monitoring done by other agencies under one comprehensive program.

In the Puente Basin, general water quality was monitored by the Los Angeles County Department of Public Works for 1986 and ending in 1992. Since then, water quality monitoring has been performed by Walnut Valley Water District and Rowland Water District. Walnut Valley Water District quarterly monitors and reports total dissolved solids (TDS) concentrations, and Rowland Water District analyzes for a wider range of water quality constituents. The data are reported in the Puente Basin Watermaster's annual report.

Groundwater Contaminants

Table 7-5 provides a summary of groundwater constituents of concern for Main San Gabriel and Puente Basins.

Table 7-5
Summary of Constituents of Concern in the Main San Gabriel and Puente Basins

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	Main Basin: 90 to 4,288 Average ~ 367	Main Basin: Data from municipal production wells indicate a range of 172 to 914 mg/L with an average of 318 mg/L.
		Puente Basin: 1,100	Puente Basin: as measured at Rowland Water District well.
Nitrate (as N) MCL = 10	mg/L	Main Basin: ND to 27.8	Main Basin: Exceed nitrate MCL in eastern portion of basin.
		Puente Basin: 8.44	Puente Basin: as sampled by Rowland Water District
VOCs **(TCE and PCE)** TCE MCL = 5 PCE MCL = 5	µg/L	Main Basin: ND to 499 for TCE ND to 330 for PCE	Main Basin: 64 wells are currently treated for a variety of VOCs associated with prior land use in the basin. Much of the basin is unaffected.
		Puente Basin: TCE: ND to 28 PCE: ND to 4.7	Puente Basin: To be addressed by Superfund cleanup of Puente Valley Operable Unit overseen by USEPA. Concentrations reported in remedial design progress report Aug 2006.
Perchlorate Notification level = 6	µg/L	Main Basin: ND to 183	Main Basin: In January 2002, 22 wells were removed from service due to unacceptable levels of perchlorate. Perchlorate treatment facilities are currently online.
		Puente Basin: ND	Puente Basin: as measured at Rowland WD well

Table 7-5 (continued)
Summary of Constituents of Concern in the Main San Gabriel and Puente Basins

Constituent	Units	Range	Description
NDMA Notification level = 2	ppt	Main Basin: ND to > 2 ppt	Main Basin: During 1998, eight local wells were found to contain levels of NDMA above the action level of 2 ppt. Three facilities are currently in operation to treat NDMA.
		Puente Basin: ND	Puente Basin: as measured at Rowland WD well

Sources: Main San Gabriel BasinWatermaster, 2004 and DWR, 2004
Puente Basin Watermaster, September, 2006.
GeoTrans, Inc., August 10, 2006

Main San Gabriel Basin

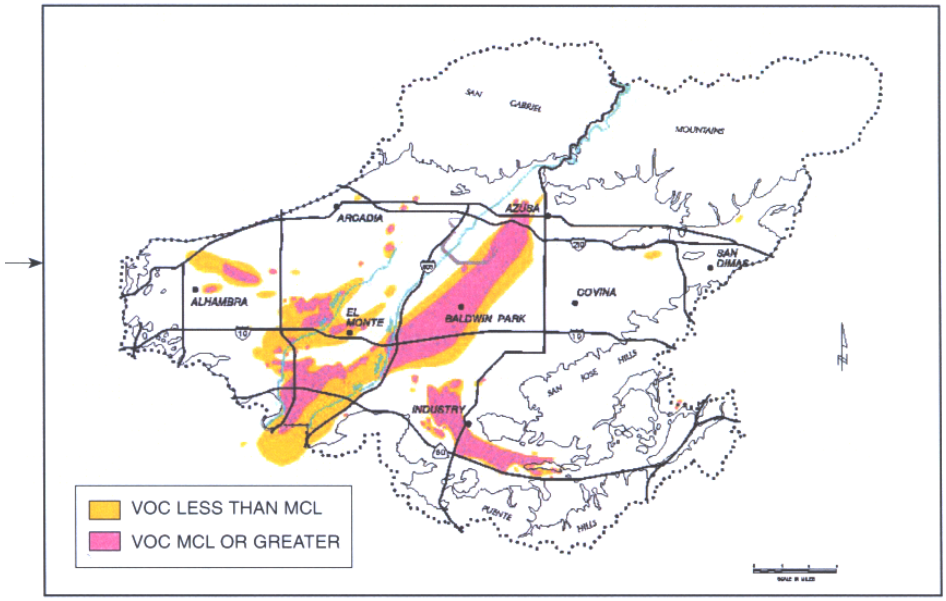
Water quality within the Main San Gabriel Basin is good in most areas. TDS concentrations range from 90 to 4,288 mg/L and average about 367 mg/L in the Main San Gabriel Basin (DWR, 2004). Concentrations in the Puente Basin average above 1,200 mg/L (DWR, 2004). Key constituents of concern for the Main San Gabriel Basin are summarized in **Table 7-5**. These constituents include: TDS, nitrate, VOCs, perchlorate and NDMA.

During the late 1970s and early 1980s, significant groundwater contamination associated with various VOCs was discovered in the Main San Gabriel Basin. The USEPA established Operable Units for areas within the basin that have been contaminated by VOCs and require groundwater cleanup (defined as Area 3, Whittier Narrows, Puente, Baldwin Park, El Monte and South El Monte Operable Units). Cleanup operations are currently underway in Whittier Narrows, Puente, Baldwin Park, El Monte and South El Monte Operable Units. A remedial investigation to identify the extent of contamination is currently underway in the Area 3 Operable Unit. VOC concentrations are shown in **Figure 7-10**.

Nitrate is also an issue for the Main San Gabriel Basin. As shown in **Figure 7-11**, nitrate concentrations exceed the nitrate MCL in eastern portion of basin. Water contaminated with nitrates is either blended with other sources or not used (Watermaster, 2004).

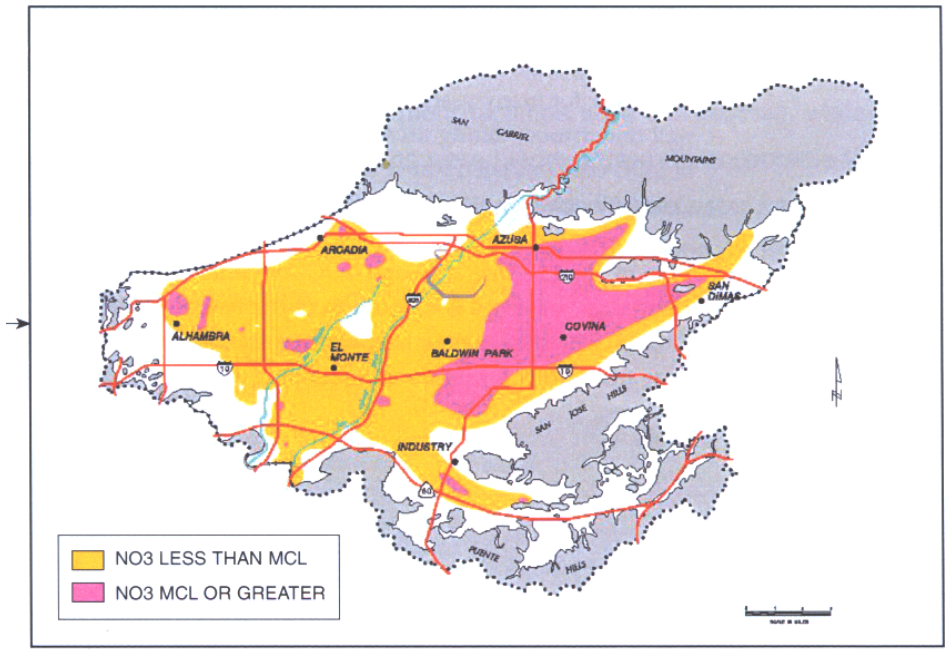
In addition to VOCs and nitrate, perchlorate and NDMA have been detected in concentrations above applicable notification levels in wells from the Main San Gabriel Basin. In January 2002, 22 wells were removed from service due to unacceptable levels of perchlorate. Perchlorate treatment facilities are currently online. During 1998, eight local wells were found to contain levels of NDMA above the action level of 2 ppt. Three facilities are currently in operation to treat NDMA.

Figure 7-10
Location of VOC Plumes in the Main San Gabriel and Puente Basins



Source: Main San Gabriel Basin Watermaster, 2004

Figure 7-11
Location of Nitrate Plumes in the Main San Gabriel and Puente Basins



Source: Main San Gabriel Basin Watermaster, 2004

Puente Basin

The western portion of the Puente Basin in the vicinity of the Puente Narrows lies within the U.S. Environmental Protection Agency's Puente Valley Operable Unit of the San Gabriel Valley Superfund Site. The cleanup of the Puente Valley Operable Unit will involve cleanup of VOCs including TCE and PCE within the shallow groundwater. As of August 2006, remediation wells had been drilled and design of the remedial action was underway. Remediation of other VOC leaks in the Puente Basin are overseen by the Los Angeles Regional Water Quality Control Board.

Blending Needs

As discussed above, many wells in the Main San Gabriel Basin are blended to meet nitrate standards. Due to the high TDS of Puente Basin groundwater, Puente Basin groundwater is blended with recycled water to allow its use for landscape irrigation.

Groundwater Treatment

The following section describes groundwater treatment activities in the Main San Gabriel basin. As shown in Table 7-6, about 93 wells are currently treated for VOCs, perchlorate or NDMA with a total treatment volume of about 79,000 AFY (about 30 percent of the total produced groundwater). Nearly 490,000 AF has been treated for VOCs as part of the USEPA cleanup since 1984 (Watermaster, 2005a).

EXISTING GROUNDWATER STORAGE PROGRAMS

In the Main San Gabriel Basin, three current cyclic storage accounts (Metropolitan Water District on behalf of its member agencies and San Gabriel Valley Municipal Water District), totaling 180,000 AF of potential water storage capacity are maintained for providing supplemental water to the basin. These accounts allow delivery of imported water when it is available and the water is stored in the basin for sale to Watermaster at a later date. Metropolitan pre-delivers replenishment water to Main San Gabriel Basin. Metropolitan later sells stored water to Three Valleys Municipal Water District and Upper District at replenishment rate. The cyclic storage balance at the end of fiscal year 2004/05 was approximately 91,000 AF (Watermaster, 2005a).

There are no existing storage programs in the Puente Basin.

BASIN MANAGEMENT CONSIDERATIONS

The following section identifies issues or considerations that are important for groundwater management in the Main San Gabriel and Puente Basins.

Table 7-6
Summary of Groundwater Treatment in Main San Gabriel Basin

Treatment Type	Number of Wells	Constituents(s) of Concern	Treatment Target	Treatment Cost ($/AF)	Amount Treated (AFY)
Air Stripping	39	VOCs	ND	$25	47,000
Liquid Phase GAC	16	VOCs	ND	Varies	14,000
Ultra-Violet/Oxidation	9	1,4-Dioxane	ND	$100	6,000
Ion Exchange	17	Perchlorate	ND	$200	6,000
Ultra-Violet	12	NDMA	ND	$100	6,000
Total	**93**	**--**	**ND**	**--**	**79,000**

Source, Stetson, 2006.

Main San Gabriel Basin

Storage and extraction in the Main San Gabriel Basin are limited by the following factors.

- Pumping subject to adjudication and limits the amount of water that could be produced.
- Cannot store supplemental imported water when the key well groundwater elevation exceeds 250 feet MSL. Water levels at this time are near or above the target level. Therefore, storage of supplemental water is currently limited.
- Must have a cyclic storage agreement with Watermaster to store supplemental imported water
- Perchlorate and various chlorinated solvent contaminants associated with the USEPA operable units may limit ability to store and extract water.
- Nitrate concentrations in eastern portion of the Basin may limit ability to store and extract water.

Puente Basin

Storage and extraction in the Puente Basin are limited by the following factors.

- Pumping subject to adjudication and limits the amount of water that could be produced
- The Puente Basin Judgment does not provide for storage of surplus water supplies for later extraction.

References:

Main San Gabriel Basin

California State Superior Court for the County of Los Angeles (Long Beach Judgment), 1964. Case No. 722647, Board of Water Commissioners for the City of Long Beach et al. vs. San Gabriel Valley Water Company et al.

California State Superior Court for the County of Los Angeles (Main San Gabriel Judgment), 1989. Case No. 924127, Upper San Gabriel Valley Municipal Water District vs. City of Alhambra, et al.

Main San Gabriel Basin Watermaster, November 2004. Five-Year Water Quality and Supply Plan 2004-05 to 2008-09.
Main San Gabriel Basin Watermaster,2005a. Annual Report 2004-05.

Main San Gabriel Basin Watermaster, 2005b. Determination of Operating Safe Yield for Fiscal Years 2005-06 through 2009-2010, May 24, 2005.

Main San Gabriel Watermaster, 2006a Website: http://www.watermaster.org. Accessed August 24, 2006.

Main San Gabriel Watermaster, 2006b Website: http://www.watermaster.org/basinmap.html Accessed August 24, 2006. (basin description and storage capacity).

State of California Department of Water Resources (DWR), 2004. Bulletin 118 – Main San Gabriel Valley Basin. Updated 2/27/04. Accessed at: http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/4-13.pdf#search=%22main%20san%20gabriel%20basin%2Cbulletin%20118%22

Stetson Engineers, 2005. Upper San Gabriel Valley Municipal Water District Urban Water Management Plan. December 2005. Prepared for the Upper San Gabriel Valley Municipal Water District.

Stetson Engineers, 2006. Groundwater Study Questionnaire, groundwater production and groundwater level data.

Puente Basin

CH2MHill, 1997. Puente Valley Operable Unit Interim RI/FS Feasibility Study. Prepared for U.S. EPA. May 1997.

Ecological Systems Corporation, 1975. Pomona Valley Water Quality Management Study – Hydrogeology, Nitrates and Dissolved Solids. Prepared for Pomona Valley Municipal Water District.

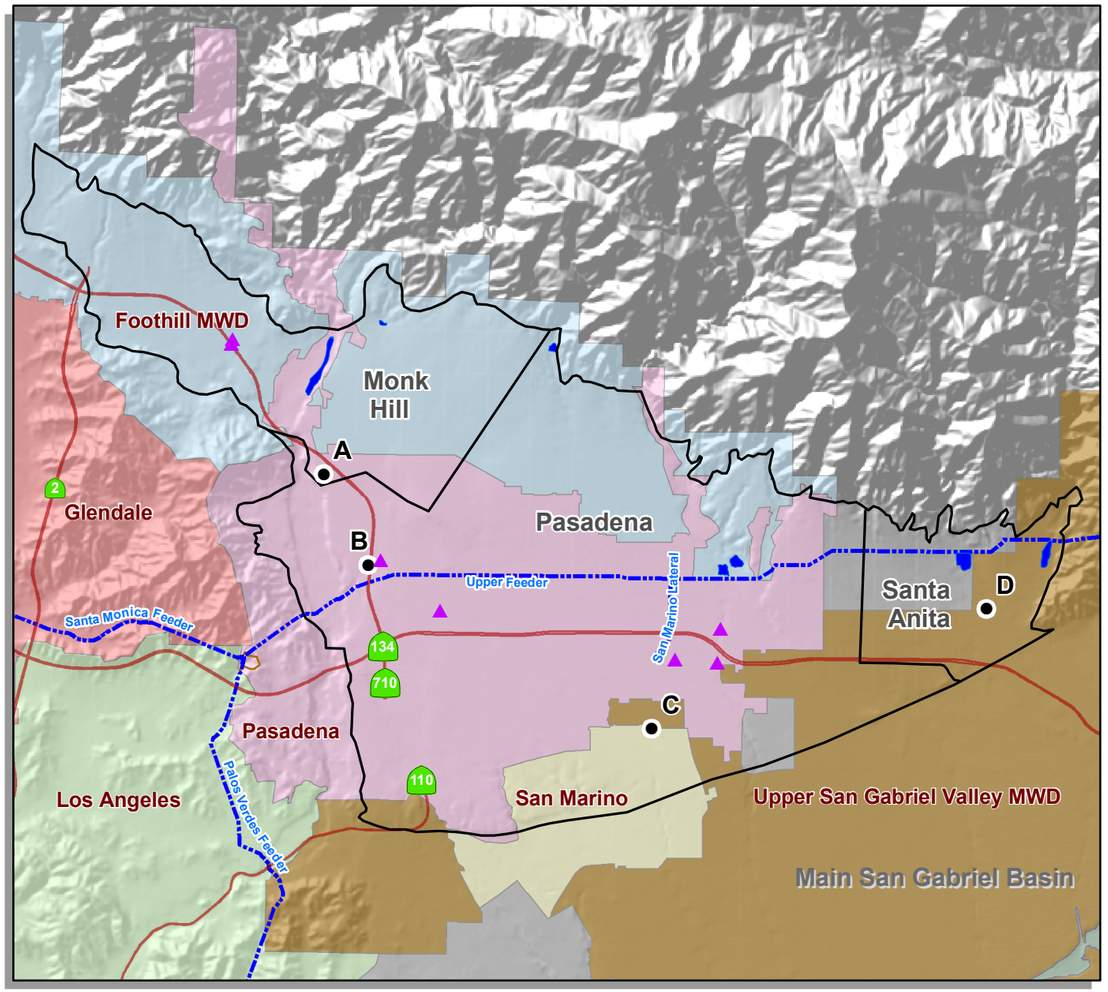
Geotechnical Consultants, Inc., 1979. Hydrogeologic Evaluation. Spadra and Puente Basins. Step I – Facilities Plan Water Reclamation Project for Pomona Valley Municipal Water District.

GeoTrans, Inc. Bimonthly Progress Report, Shallow Zone Interim Remedial Design/Remedial Action, Puente Valley Operable Unit, Los Angeles County, California. August 10, 2006.

Puente Basin Judgment, 1986.

Puente Basin Watermaster, April 2006. 2006-2007 Final Operating Safe Yield Determination.

Puente Basin Watermaster, September, 2006. Twentieth Annual Report Fiscal Year 2005-2006.



Raymond Basin

A ● Key Wells
▲ Injection-ASR Wells
Recharge Basins
Freeways (TBM)
Water Body
MWD Pipeline
▲ MWD Facility
Basin
MWD Member Agency Boundary (color varies)

N W E S

2.5 1.25 0 2.5 Miles

Note: This map was prepared by the Metropolitan Water District of Southern California for its own use. No warranty is expressed or implied as to the correctness, timeliness, or content of the information shown herein.

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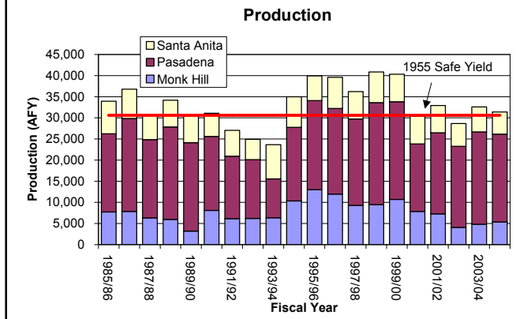
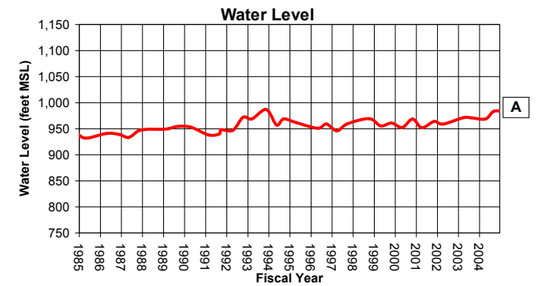
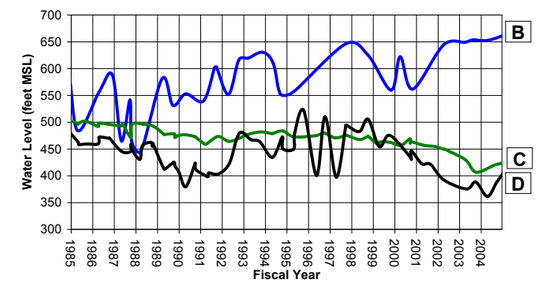
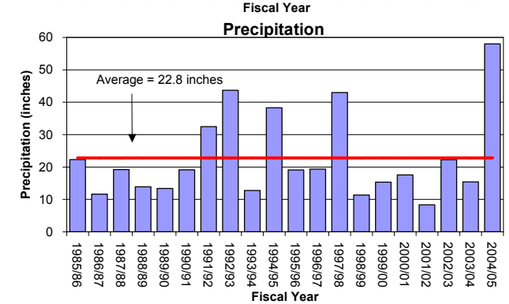
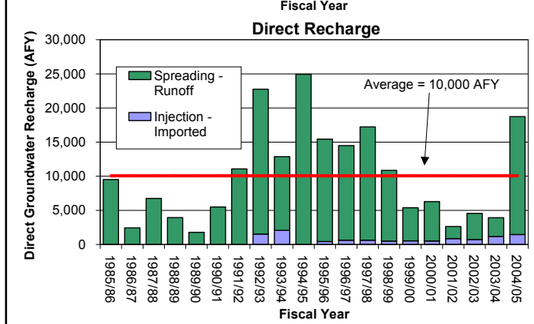
Additional Data Sourse(s): Santa Ana Watershed Project Authority (SAWPA); California Spatial Information Library (CaSIL).











BASIN FACTS

Raymond Basin

Description
Location: Los Angeles County
Watershed Surface Area: 40 square miles
Subbasins:
Monk Hill
Pasadena
Santa Anita
Management: Adjudicated
Adjudicated in 1955 and managed by the Raymond Basin Management Board
MWD Member Agencies:
Foothill MWD
City of San Marino
City of Pasadena
Upper San Gabriel Valley MWD

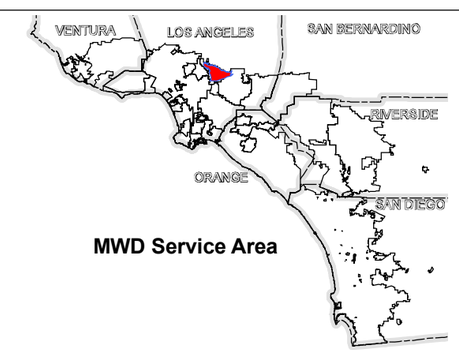
	Monk Hill	Pasadena	Santa Anita
Safe Yield	7,489 AFY	17,843 AFY	5,290 AFY
Total Storage		1.37 million AF	
Unused Storage Space (2003)		570,000 AF	
Portion of Unused Storage Space Available (2003)		At least 250,000 AF	

Storage and Extraction Facilities

	Monk Hill	Pasadena	Santa Anita
Production Wells			
Production Capacity	17,500 AFY	72,500 AFY	7,600 AFY
Average 1985-2004	8,065 AFY	18,588 AFY	6,315 AFY
Injection Wells			
Injection Capacity	2,500 AFY	8,000 AFY	None
Average 1985-2004	263 AFY	181 AFY	None
Spreading Basins			
Spreading Capacity	13,000 AFY	10,100 AFY	14,400 AFY
Average 1985-2004	4,654AFY	3,570 AFY	1,279 AFY

Basin Management Considerations

- The Judgment limits the amount of groundwater that a party may extract from the Basin each year.
- Storage space is allocated by producer and must be approved by Raymond Basin Management Board.
- Perchlorate, VOC and nitrate cotamination could limit ability to store and extract water.



MWD Service Area

Plate 8-1
Overview of Raymond Basin

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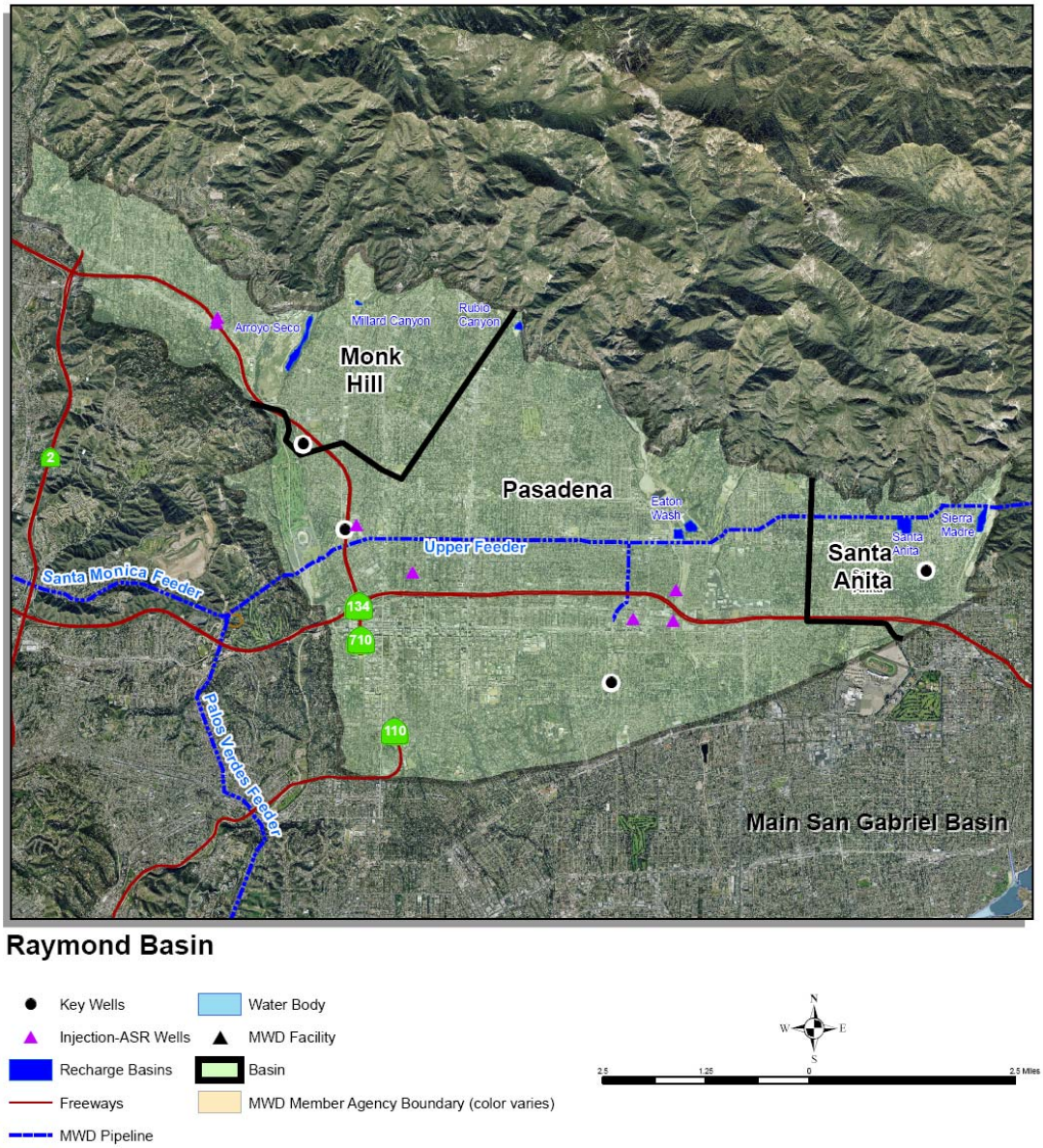
The Raymond Basin is located in the northwestern portion of the San Gabriel Valley in Los Angeles County. The Raymond Basin includes the communities of Sierra Madre, Arcadia, Pasadena, La Cañada Flintridge and unincorporated areas of Los Angeles County, and includes 16 separate water purveyors. The Raymond Basin underlies the service areas of the Metropolitan member agencies of Foothill Municipal Water District (Foothill MWD), Upper San Gabriel Valley Municipal Water District (Upper District), City of Pasadena and City of San Marino. The City of Sierra Madre is a member agency of San Gabriel Valley Municipal Water District, a State Water Project Contractor. A map of the basin is provided in **Figure 8-1**.

Figure 8-1
Map of the Raymond Basin



BASIN CHARACTERIZATION

The following section provides a physical description of the Raymond Basin including its geographic location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

The Raymond Basin is bounded by the San Gabriel Mountains to the north, the San Rafael Hills to the west and the Raymond fault to the south and southeast. The Raymond Basin is divided into three subareas because of differences in elevation and groundwater flow directions (Monk Hill in the northwest, Pasadena in the central portion, and Santa Anita in the eastern portion).

Hydrogeologic data are provided in **Table 8-1**. The Raymond Basin is generally classified as an unconfined to semi-confined aquifer system. The base of the water bearing zones is considered bedrock with elevations ranging from approximately 500 feet below sea level to 2,000 feet above mean sea level. Depth to bedrock ranges from 450 to 750 feet below ground surface (bgs) in the Monk Hill and Santa Anita subareas to more than 1,200 feet bgs in the Pasadena subarea/central portion of the Raymond Basin. The total storage capacity of the Raymond Basin is estimated to be approximately 1.37 million AF (Geoscience, 2004). Amount of water in storage in 2003 was approximately 800,000 AF, with an unused storage space of about 570,000 (Geoscience, 2004).

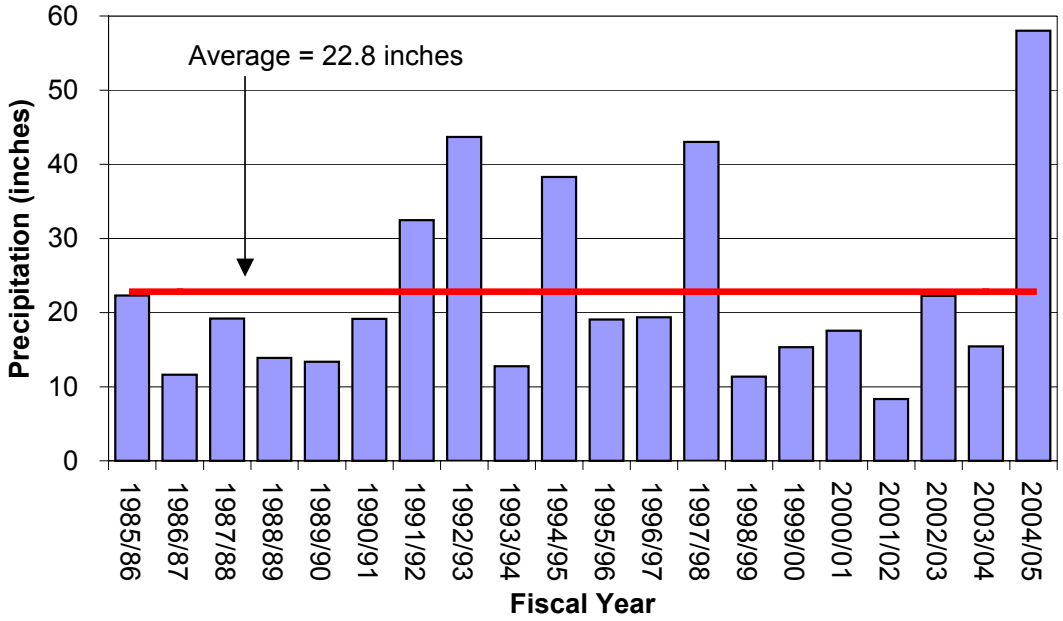
Table 8-1
Summary of Hydrogeologic Parameters of Raymond Basin

Parameter	Description
Structure	
Aquifer(s)	Unconfined to semi-confined
Depth of groundwater basin	450 to 750 feet in Santa Anita and Monk Hill More than 1,200 feet in Pasadena
Thickness of water-bearing units	
Yield and Storage	
Natural Safe Yield	Monk Hill: 7,489 AFY Pasadena: 17,843 AFY Santa Anita: 5,290 AFY Total 30,622 AFY
Total Storage	1.37 million AF
Unused Storage Space	570,000 AF
Portion of Unused Storage Space Available for Storage	At least 250,000 AF

Safe Yield/Long-Term Balance of Recharge and Discharge

Natural groundwater recharge to the Raymond Basin occurs through infiltration and percolation of rainfall and surface runoff from the San Gabriel Mountains. Groundwater discharge occurs through pumping and subsurface outflow into the Main San Gabriel Basin across the Raymond fault. Natural recharge from precipitation and runoff is the largest inflow to the basin. **Figure 8-2** provides the historical precipitation data from 1985 to 2004 based upon the average of several precipitation stations within the basin (RBMB, 2005). Average precipitation in the basin during this 20-year period was approximately 22.8 inches.

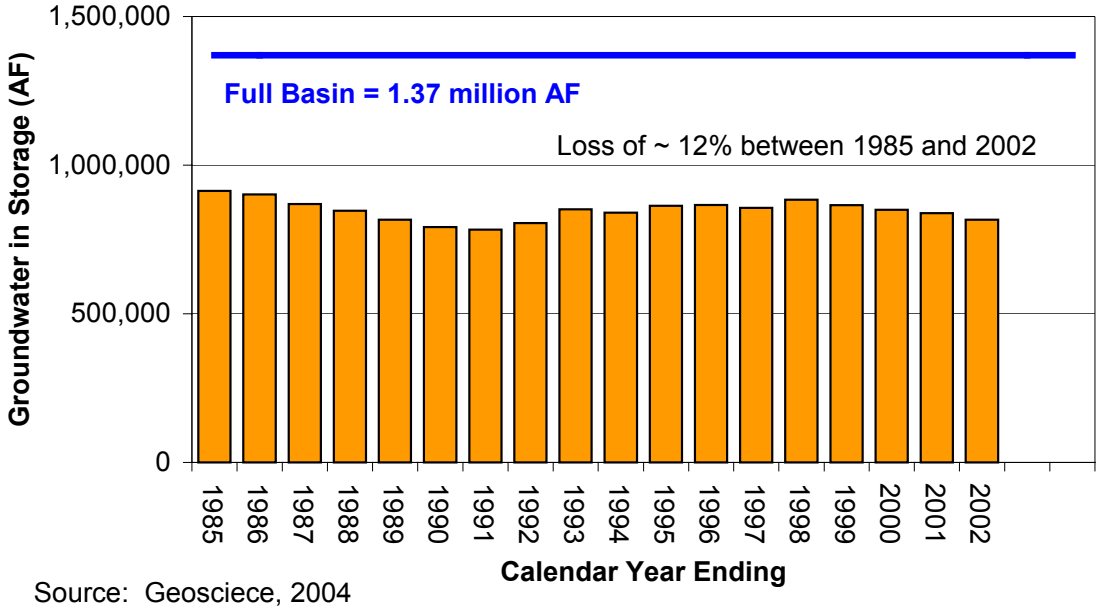
Figure 8-2
Historical Precipitation in Raymond Basin



The Raymond Basin safe yield, which is based upon native recharge and returns from use alone, was defined as 30,622 AFY in 1955. The distribution of the safe yield by subarea is provided in **Table 8-1**. As described below, this natural safe yield can be increased by groundwater recharge operations.

Figure 8-3 shows the estimated amount of groundwater in storage between 1985 and 2002 based upon estimates made by Geoscience (2004). In this time period groundwater in storage decreased from about 913,000 AF at the end of 1985 to 816,000 AF at the end of 2002. Despite a moderate recovery between 1992 and 1998, the net decrease in storage was about 100,000 AF, or about 12 percent. Data are not available beyond 2002. However, based upon water levels discussed below, the storage would be expected to continue to decline through 2005. The basin producers are aware of the decline and are currently in the process of addressing the issue.

Figure 8-3
Historical Groundwater in Storage Estimates for the Raymond Basin



Source: Geosciece, 2004

GROUNDWATER MANAGEMENT

The following section describes how the Raymond Basin is currently managed.

Basin Governance

The Raymond Basin is adjudicated. The Raymond Basin was adjudicated in 1944 by the Los Angeles County Superior Court. The Raymond Basin Management Board (RBMB) administers and enforces the provisions of the Judgment (Pasadena v. City of Alhambra), which established water rights and responsibility for management of the quantity of the basin's groundwater. RBMB coordinates local involvement in efforts to preserve and restore the quality of groundwater in the basin. RBMB also assists and encourages regulatory agencies to enforce water quality regulations affecting the basin, collects production, water quality, and other relevant data from producers and prepares an annual report of pumping and diversions. **Table 8-2** provides a list of management agencies in the Raymond Basin.

The Judgment limits the amount of groundwater that a party may extract from the basin each year. Each party's extraction is restricted to a specific hydrologic unit (Western Unit: Pasadena and Monk Hill Subareas; Eastern Unit; Santa Anita Subarea), and its Decreed Rights. Exceptions are that a party may extract ten percent of any unused Decreed Right in any year (not cumulative), and the RBMB may allow more to be carried over in an emergency or another reasonable cause. Parties may also enter into a Long Term Storage Account to add or extract groundwater during the year subject to the RBMB adopted Groundwater Storage Policies.

Imported water is provided by Foothill Municipal Water District to several parties in-lieu of pumping to meet demand.

The Judgment provisions also allow parties to increase their annual extractions by performing groundwater recharge operations. A more detailed discussion of groundwater recharge is described below.

Table 8-2
Summary of Management Agencies in the Raymond Basin

Agency	Role
Raymond Basin Management Board	Watermaster for 1944 Judgment to manage water quantity/quality
Los Angeles County Department of Public Works	Operation of Eaton Wash, Santa Anita, and Arroyo Seco Spreading Grounds
City of Pasadena	Owns Arroyo Seco Spreading Grounds
City of Sierra Madre	Operation of Sierra Madre Spreading Grounds
NASA/Jet Propulsion Laboratory(JPL)	Coordination and implementation of EPA cleanup in Monk Hill

Interactions with Adjoining Basins

The Raymond Basin is hydraulically connected to the Main San Gabriel Basin to the south and east along the Raymond fault. Approximately one percent of the total water in storage in the Raymond Basin is lost across the Raymond fault (Geoscience, 2004). Parties who store water in the Raymond Basin are assessed this 1 percent loss. No other formal agreements govern this flow.

WATER SUPPLY FACILITIES AND OPERATIONS

The following provides a summary of the facilities within the Raymond Basin.

Active Production Wells

There are about 45 active groundwater extraction wells (RBMB, 2005) in the Raymond Basin with an estimated total well capacity of approximately 97,600 AFY based upon maximum month extractions during fiscal year 2004/05 or production capacity data available from individual producers. Average extractions have been approximately 33,000 AFY for municipal use between fiscal years 1985/86 and 2004/05. Historical production data by subbasin are provided in **Figure 8-4**.

Twelve wells within the basin have had detections of perchlorate (> 4 ug/L). These wells are located downstream of the Jet Propulsion Laboratory (JPL) Superfund site within the

Arroyo Seco (Geoscience, 2004). Most of these wells are inactive or are blended with other wells to decrease the concentration of perchlorate.

Other Production

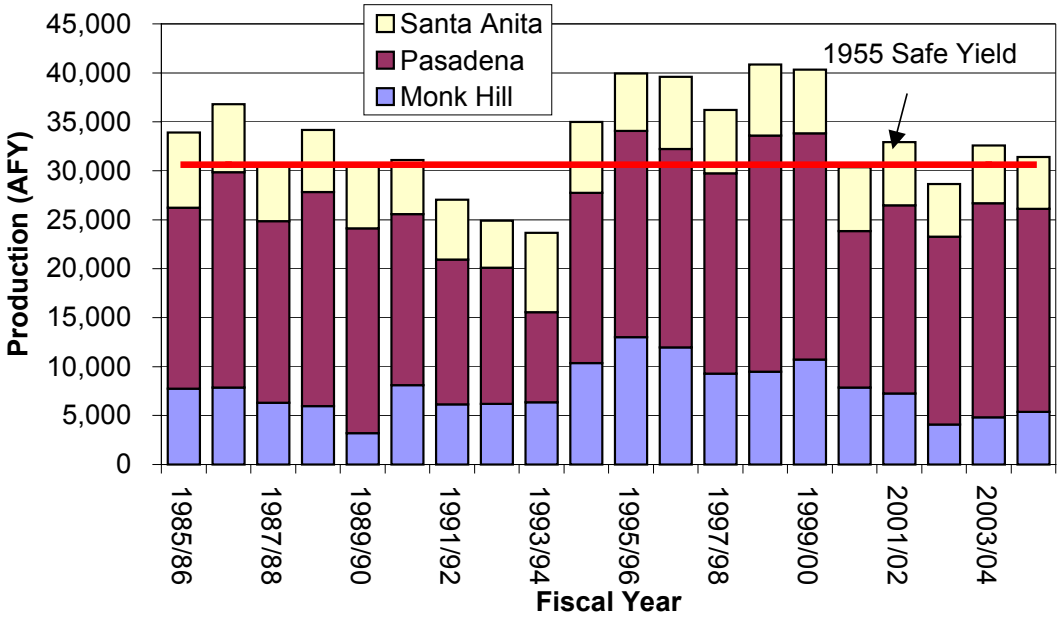
All production in the Raymond Basin is designated for municipal use.

Table 8-3
Summary of Production Wells in the Raymond Basin

Basin	Number of Active Wells	Estimated Production Capacity [1] (AFY)	Average Production 1985-2004 (AFY)	Well Operation Cost ($/AF)
Monk Hill	11 [2]	17,500	8,065	Not available
Pasadena	25	72,500	18,588	
Santa Anita	9	7,600	6,315	
Total	**45**	**97,600**	**32,969**	

Source: Number of wells based upon RBMB, 2005
1. Estimated based upon maximum monthly production in 2004/05 or known capacities
2. Does not include City of Pasadena wells

Figure 8-4
Historical Groundwater Production in the Raymond Basin



ASR Wells

There are currently seven ASR wells in the Raymond Basin. The details of the wells are provided in **Table 8-4**. Total groundwater recharge is summarized in **Figure 8-5**. Valley Water Company currently has two wells capable of injecting water in the Monk Hill subarea. Valley Water Company has recharged approximately 5,300 AF of water using these wells since 1994. The City of Pasadena currently has five wells capable of injecting water. The City of Pasadena has recharged approximately 3,600 AF of water in the Pasadena subarea using three of the injection wells between late 1992 and 1996. The City of Pasadena wells have not been used for injection since 1996.

Table 8-4
Summary of ASR Wells in the Raymond Basin

Basin	Number of ASR Wells	Estimated Injection Capacity [1] (AFY)	Average Injection 1985-2004 (AFY)	Well Operation Cost ($/AF)
Monk Hill	2	2,500	263	Data not available
Pasadena	5	8,000	181	
Santa Anita	0	0	0	
Total	**7**	**10,500**	**444**	

Source: Number of wells based upon RBMB, 2005
1. Estimated based upon maximum monthly production or known capacities

Foothill MWD is currently in the process of converting an additional three wells in the Monk Hill subarea to ASR. The City of Pasadena is currently considering construction of three additional ASR wells in the Pasadena subarea.

Spreading Basins

More than 90 percent of the annual spreading in the Raymond Basin has taken place at the Arroyo Seco, Eaton Wash, Santa Anita and Sierra Madre spreading basins. The remainder occurs at the Millard Canyon, Pasadena Glen, Pasadena Sludge Ponds and Rubio Canyon spreading basins. The total recharge capacity of the four major recharge basins is approximately 37,500 AFY as shown in **Table 8-5**. The combined smaller recharge basins have an estimated annual capacity of approximately 3,000 AFY. Historical groundwater recharge (including both spreading and injection) is shown in **Figure 8-5**.

Seawater Intrusion Barriers

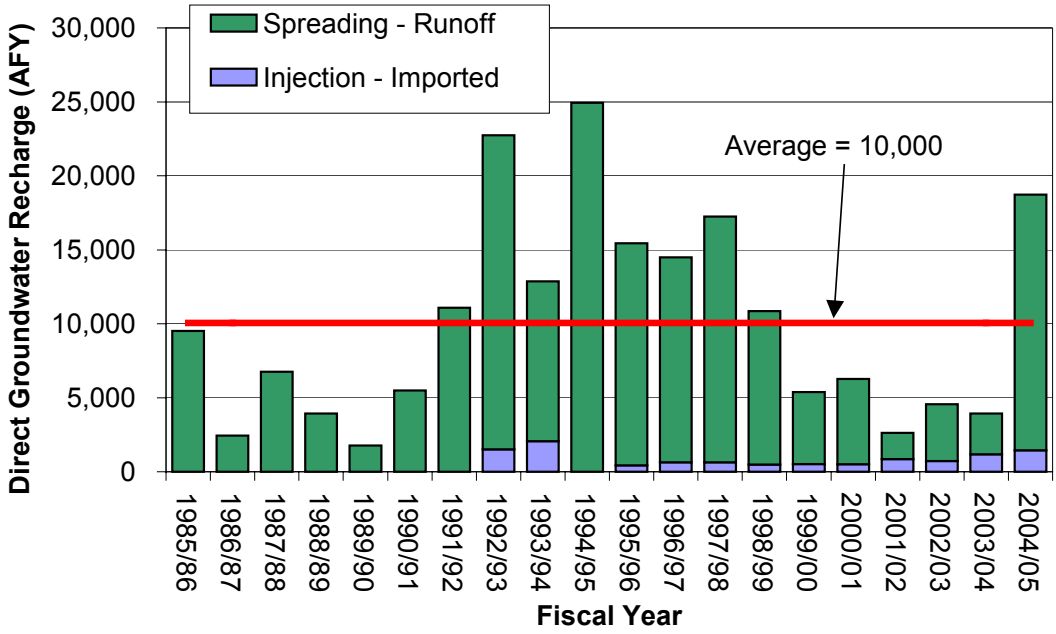
There are no seawater intrusion barriers in the Raymond Basin.

Table 8-5
Summary of Spreading Basins in the Raymond Basin

Basin	Area (acres)	Wetted Area (acres)	Recharge Capacity (cfs)	Recharge Capacity (AFY)	Source Water	Owner
Arroyo Seco	24	15.1	18	13,000	Runoff	City of Pasadena
Eaton Wash	28	25.4	14	10,100	Runoff	LACDPW
Sierra Madre	22	9	15	10,800	Runoff	City of Sierra Madre
Santa Anita	28	8.5	5	3,600	Runoff	LACDPW
Total	**102**	**58**	**52**	**37,500**	--	--

Source: LACDPW, 2006, Geoscience, 2004 and Stetson, 2006

Figure 8-5
Historical Groundwater Recharge in the Raymond Basin



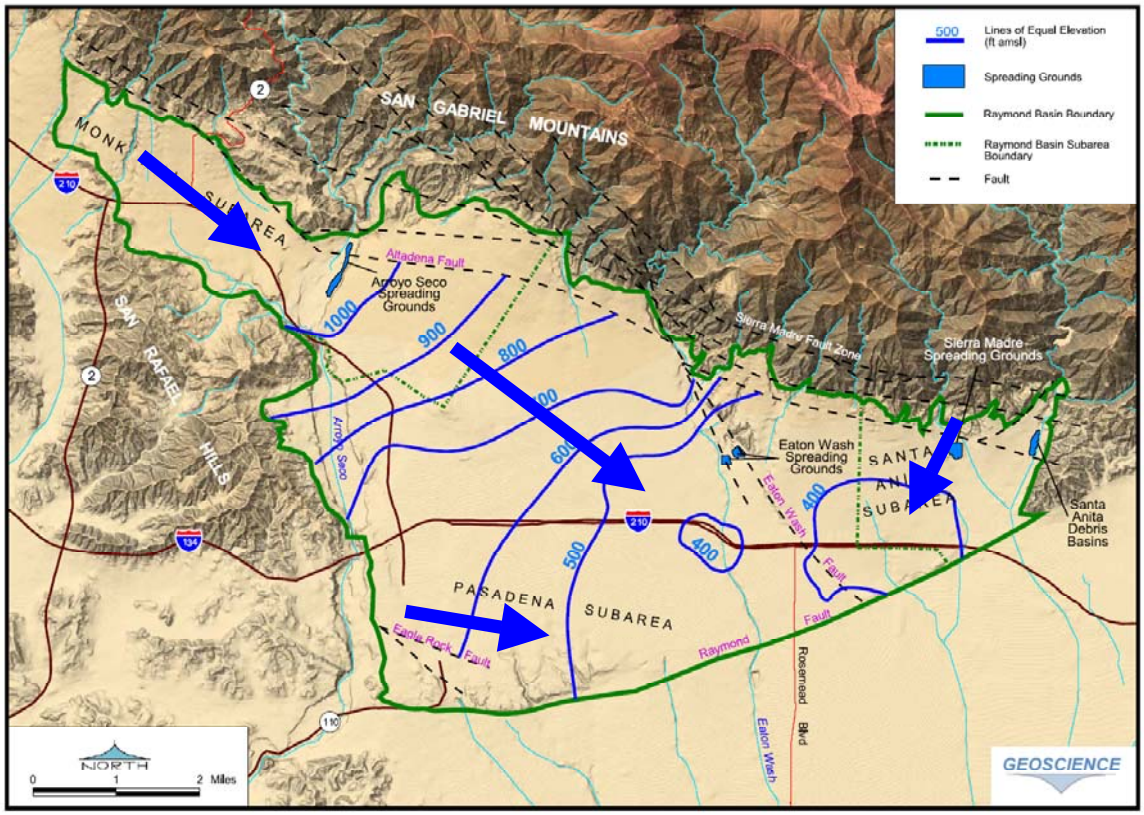
Desalters

There are no desalters in the Raymond Basin.

GROUNDWATER LEVELS

As shown in **Figure 8-6**, groundwater generally flows southeast from the Monk Hill subarea in the northwest to Raymond fault in the southeast. Historical groundwater levels from key wells in the Raymond Basin are summarized in **Figure 8-7.** Key well locations are shown on **Figure 8-1.** Groundwater levels in the Raymond Basin range from about 350 feet above MSL in Santa Anita subarea to more than 1,100 feet above MSL in the Monk Hill subarea.

Figure 8-6
Raymond Basin Groundwater Elevation Contours – Fall 2005

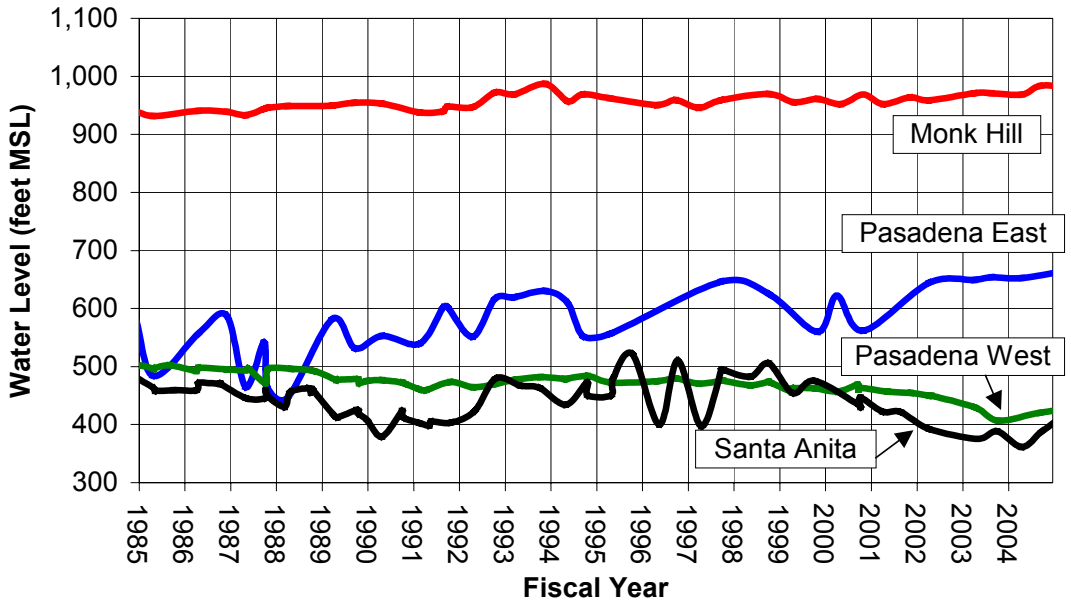


Source: RBMB, 2006

As shown in **Figure 8-7**, water levels in the Monk Hill area of the groundwater basin have increased about 50 feet in the key well between fiscal years 1985/86 and 2004/05, largely due to decreased production because of perchlorate. Similarly, groundwater levels in the western portion of the Pasadena subarea have increased more than 150 feet between 1985/86 and 2004/05 because of inactive wells in this area.

As shown in **Figure 8-7**, groundwater levels in the southeastern portion of the Pasadena subarea and the Santa Anita subarea have decreased substantially in the past 10 years. Water levels have decreased as much as 14 feet per year in these portions of the basin. Some wells in the Santa Anita subbasin have lost production because of low water levels. Thee data are consistent with the decline in storage estimates discussed previously.

Figure 8-7
Historical Water Levels in the Raymond Basin



GROUNDWATER QUALITY

Groundwater quality in the Raymond Basin is generally good to fair in most areas. Groundwater concentrations of total dissolved solids (TDS) typically range from 350 to 700 mg/L in the central and southern portions of the Pasadena subarea and in the Monk Hill subarea (Geoscience, 2004). Along the mountains in Sierra Madre in the Santa Anita subbasin, concentrations of TDS are generally below 300 mg/L. Further south in the Santa Anita subbasin, TDS concentrations are above 300 mg/L (Geoscience, 2004).

Groundwater Quality Monitoring

Groundwater quality samples are collected from active production wells within the Raymond Basin in accordance with California DHS requirements as specified in Title 22 of the California Code of Regulations. No basin-wide monitoring program has been established.

Groundwater Contaminants

As summarized in **Table 8-6**, the primary contaminants of concern in the Raymond Basin include: nitrate, perchlorate, and VOCs (specifically chlorinated solvents PCE and TCE). The wells impacted by these constituents are provided in **Figure 8-8**.

Table 8-6
Summary of Constituents of Concern in the Raymond Basin

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	Less than 300 to 730	Concentrations 350 to 730 mg/L in the central and southern portions of the Pasadena subarea and in the Monk Hill subarea. Along the mountains in the Santa Anita subarea, concentrations are generally less than 300 mg/L.
Nitrate (as N) MCL = 10	mg/L	ND to 16	Nitrate concentrations are highest in the shallow areas below former agricultural areas in Monk Hill and in the southeastern portion of the Pasadena unit. Twelve wells have had concentrations above the MCL of 10 mg/L.
VOCs **(TCE and PCE)** TCE MCL = 5 PCE MCL = 5	µg/L	ND to 9 for TCE ND to 17 for PCE	PCE and TCE have been detected above the MCL in 7 wells in Monk Hill, southeastern Pasadena and in Santa Anita. Treatment for PCE and TCE is online in Monk Hill.
Perchlorate Notification level = 6	µg/L	ND to 26	Seven wells along the Arroyo Seco are currently offline or limited in production because of perchlorate. Treatment for perchlorate is online in Monk Hill.

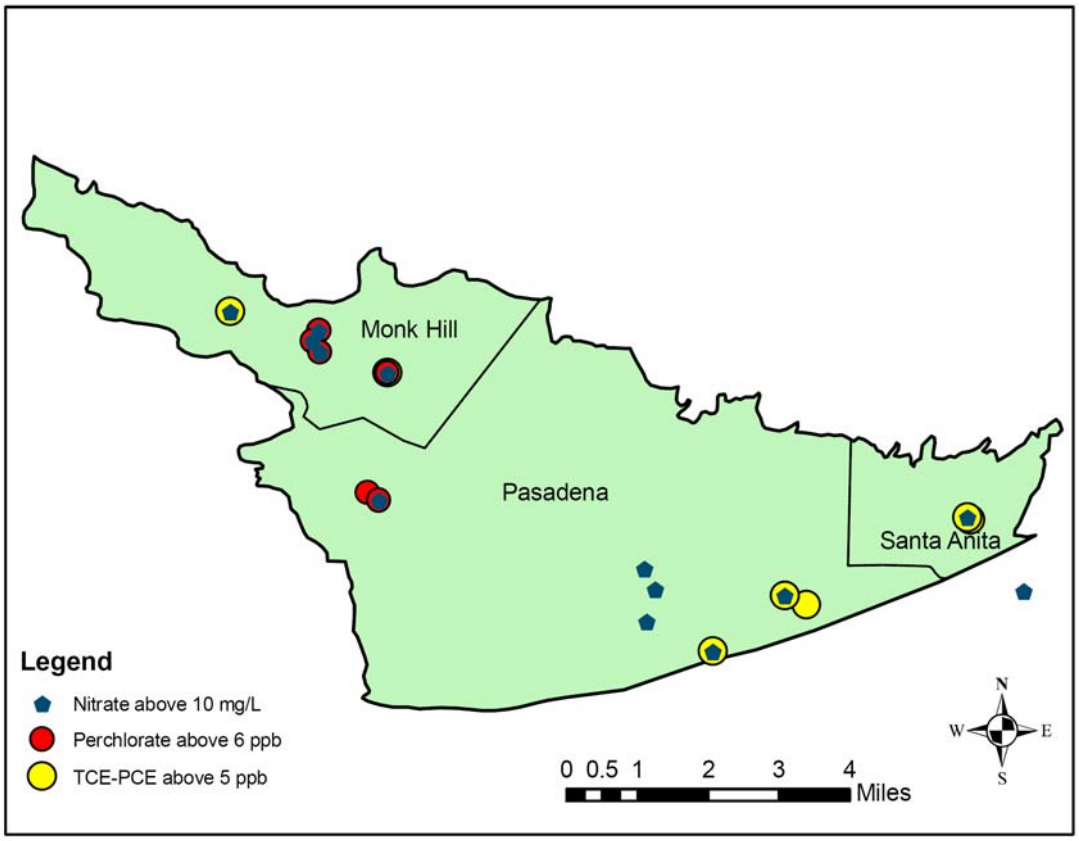
Source: Geoscience, 2004

Various wells throughout the basin have been impacted by nitrate, a result of historical agricultural practices and septic tank effluent. Most of the higher concentrations of nitrate are found in the shallower portions of the Raymond Basin. Nitrate concentrations are highest in the shallow areas below former agricultural areas in Monk Hill and in the southeastern portion of the Pasadena unit. Twelve wells have had nitrate (as N) concentrations above the MCL of 10 mg/L (Geoscience, 2004).

In the 1940s and 1950s, liquid wastes from materials used at JPL were disposed of into seepage pits, a practice common at that time. While these disposal practices were discontinued by the early 1960s, some chemicals, such as perchlorate and volatile organic compounds, have been found in groundwater beneath JPL and in areas adjacent to JPL, to the east and southeast. In

1992, the JPL site was characterized as a Superfund site. Cleanup of VOCs and perchlorate have been ongoing. PCE and TCE have been detected above the MCL for TCE and PCE in seven wells in Monk Hill, southeastern Pasadena and in Santa Anita. Treatment for PCE and TCE is online in Monk Hill. Seven wells within the Monk Hill and Pasadena subareas along the Arroyo Seco are currently inactive because of perchlorate.

Figure 8-8
Locations of Water Quality Issues in the Raymond Basin



Source: Geoscience, 2006

Blending Needs

Some wells in the Monk Hill subarea must be blended with imported water from Metropolitan to meet the nitrate MCL. The historical injection program has decreased the nitrate concentrations in the groundwater produced, allowing for less blending.

Groundwater Treatment

The City of Pasadena, Lincoln Avenue Water Company and Valley Water Company have installed wellhead treatment for VOC and perchlorate removal in Monk Hill (RBMB, 2005). In July 2004, Lincoln Avenue Water Company completed construction of a 2,000 gpm treatment plant for VOCs and perchlorate. About 1,940 AF has been treated to date (RBMB, 2005). JPL

and the City of Pasadena are currently planning to construct another 10 MGD capacity treatment facility to treat the City of Pasadena's wells in the Arroyo Seco area. The current groundwater treatment facilities are listed in **Table 8-7**.

Table 8-7
Summary of Groundwater Treatment in the Raymond Basin

Number of Wells	Treatment Type	Constituents of Concern	Treatment Target	Treatment Cost ($/AF)	Amount Treated (AFY)
2	Liquid phase GAC Ion-Exchange	VOCs, Perchlorate	ND	Data not available	2,000 gpm 1,940 (2004/05)
2	GAC	VOCs	ND	Data not available	Data not available
4 (proposed)	Liquid phase GAC Ion-Exchange	VOCs, Perchlorate	ND	$517	6,000

Source:JPL, 2006 and RBMB, 2005

CURRENT GROUNDWATER STORAGE PROGRAMS

In 2003, the RBMB approved a 9,000 AF conjunctive use program between Foothill MWD and Metropolitan. Under this program, up to 9,000 AF of imported water from Metropolitan would be stored by Foothill MWD agencies in the Monk Hill subarea via injection or in-lieu methods. Upon Metropolitan's call in the future, up to 3,000 AFY could be extracted. To date, approximately 2,940 AF has been stored under this program.

Metropolitan, Foothill MWD and the City of Pasadena are currently considering a similar conjunctive use program of up to 66,000 AF in the Pasadena subarea. In January 2006, the RBMB adopted a resolution of support for this program.

BASIN MANAGEMENT CONSIDERATIONS

Basin management considerations include the following:

- The Raymond Basin is adjudicated and annual production is restricted to the adjudicated rights. In addition, since 1992 use of long-term storage space in the basin is subject to approval by the RBMB.

- Perchlorate, VOC and nitrate contamination could limit the ability to store and extract water.

- Treated imported water from Metropolitan is available for storage from Metropolitan's Upper Feeder (a blend of Colorado River and State Water Project sources from Metropolitan's Weymouth plant). The Regional Board has established specific water quality objectives for the Raymond Basin for TDS, chloride, sulfate and boron. Imported water via the Upper Feeder does not always meet these water quality objectives. Therefore, direct recharge via spreading and/or injection could be limited.

- There has been a significant loss in storage in the Raymond Basin since 1985. The RBMB is currently investigating options to address this issue.

References:

Geoscience Support Services, Inc (Geoscience)., 2004. Baseline Ground Water Assessment of the Raymond Basin – Final Report. February 2, 2004. Prepared for the Raymond Basin Management Board.

Geoscience Support Services, Inc. (Geoscience), 2005. Technical Memorandum Raymond Basin Ground Water Flow Model Predictive Simulations. September 23, 2005. Prepared for the Raymond Basin Management Board.

Geoscience Support Services, Inc. (Geoscience), 2006. GIS files.

Raymond Basin Management Board.(RBMB) 1989-2006. Annual Reports.

Stetson Engineers (Stetson), 2006. Electronic transmission of Groundwater Study Questionnaire.

JPL, 2006. Technical Memorandum Alternatives Evaluation for the City of Pasadena Treatment Plant National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California Accessed at: http://jplwater.nasa.gov/NMOWeb/AdminRecord/docs_nonadmin/Final-Alternatives-Memorandum.pdf on September 8, 2006

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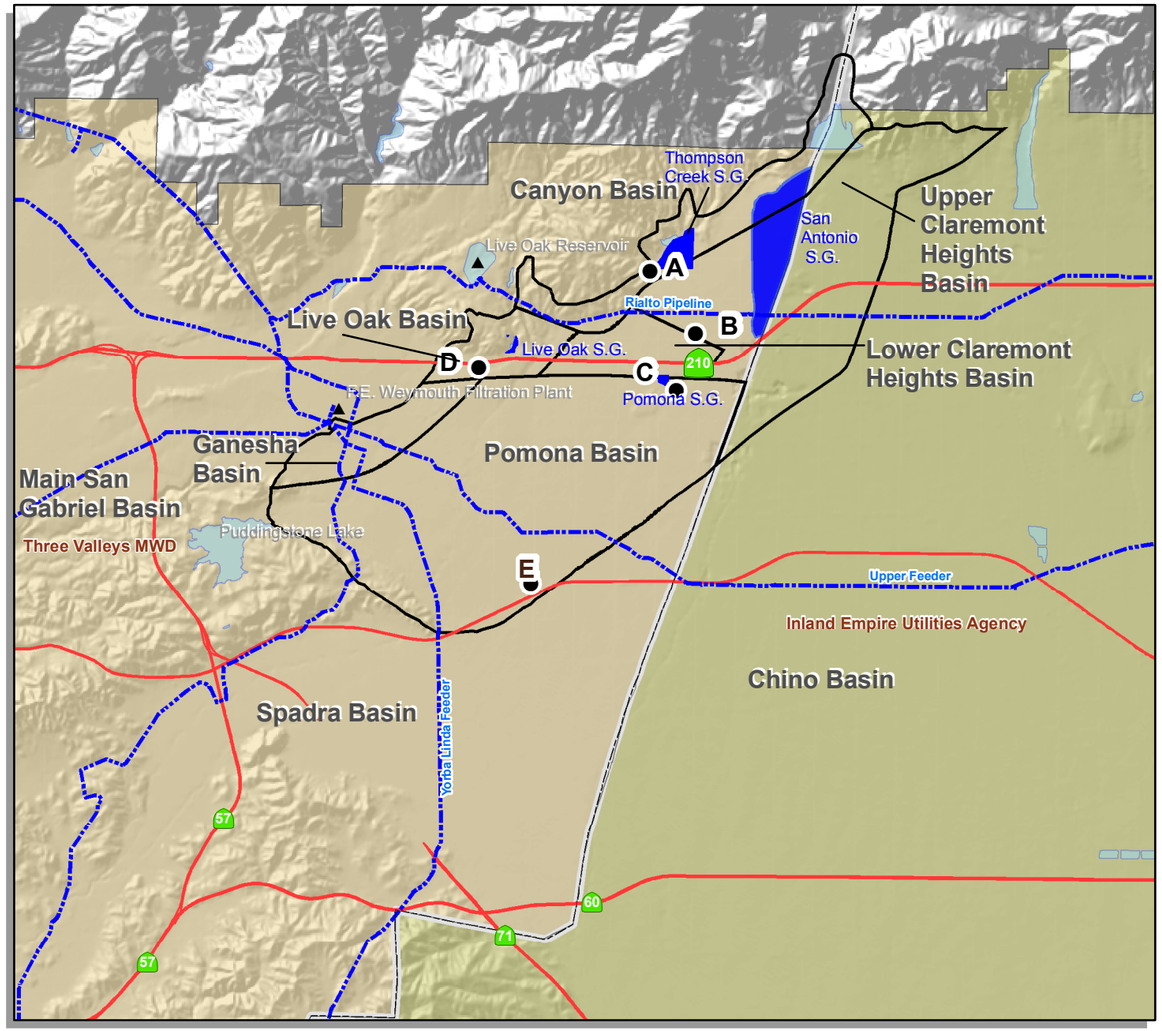

Six Basins

A ● Key Well
Recharge Basin
County
Freeways
Water Body
MWD Pipeline
MWD Facility
MWD Member Agency Boundary (color varies)

N W E S

1 0.5 0 1 Miles

Note: This map was prepared by the Metropolitan Water District of Southern California for its own use. No warranty is expressed or implied as to the correctness, timeliness, or content of the information shown herein.

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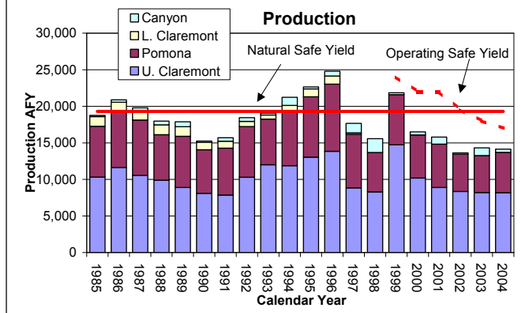
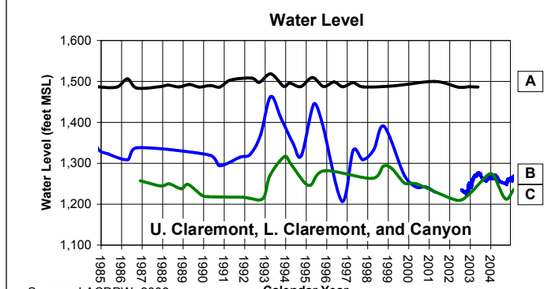
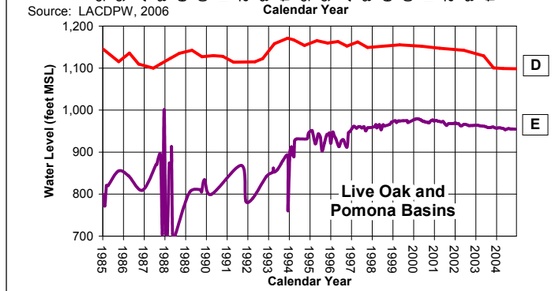
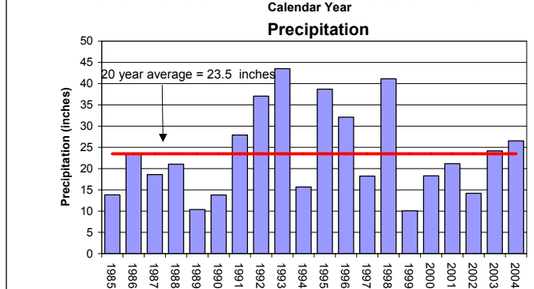
Additional Data Sourse(s): Santa Ana Watershed Project Authority (SAWPA); California Spatial Information Library (CaSIL).

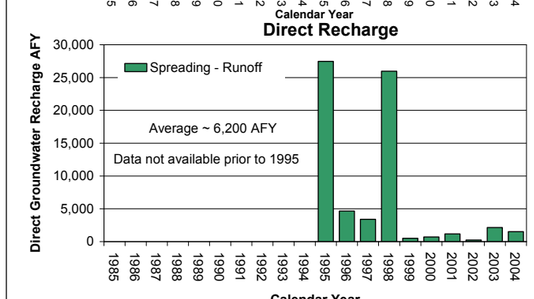




Source: LACDPW, 2006







Source: Three Valleys MWD,

BASIN FACTS

Six Basins

Description
Location: Los Angeles and San Bernardino Counties
Surface Area: ~16 square miles
Subbasins:
Upper Claremont Heights
Lower Claremont Heights
Canyon
Live Oak
Ganesha
Pomona
Management: Adjudicated
Adjudicated in 1999. Court-appointed Watermaster manages water quantity and quality, defines annual operating yield for four of the six basins (Live Oak and Ganesha not included)
MWD Member Agencies:
Three Valleys MWD
IEUA

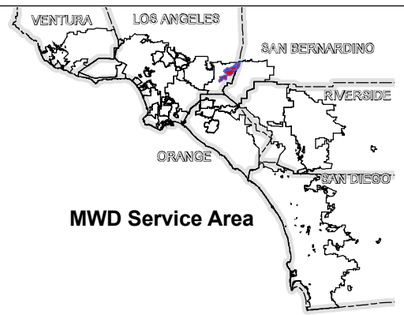
	Six Basins
Natural Safe Yield	19,300 AFY
Operating Safe Yield (2005)	18,000 AFY
Total Storage	335,000 AF
Unused Storage Space	Unknown
Portion of Unused Storage Space Available for Storage (2005)	20,000 AF

Storage and Extraction Facilities

	Six Basins
Production Wells	
Production Capacity	Data not available
Average 1985-2004	18,164 AFY
Injection Wells	
Injection Capacity	None
Average 1985-2004	None
Spreading Basins	
Spreading Capacity	>18,000 AFY
Average 1985-2004	~1,200 AFY

Basin Management Considerations

- Pumping subject to adjudication
- Nitrate and VOC concentrations in various areas of the basins could limit ability to store and extract water
- Rising groundwater in Pomona Basin could limit ability to store water upstream



MWD Service Area

Plate 9-1
Overview of Six Basins

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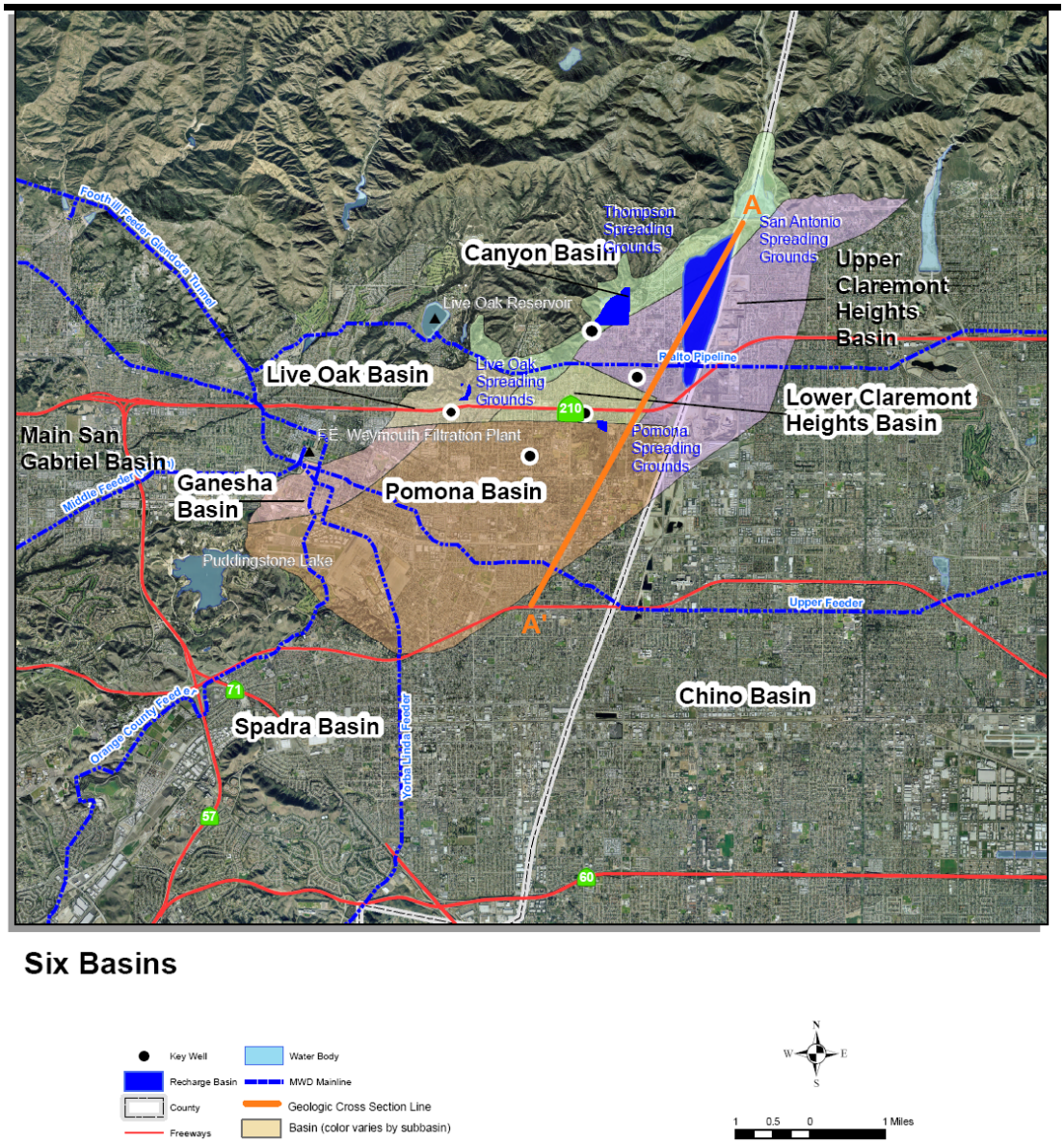
The Six Basins are located in the eastern Los Angeles County and western San Bernardino County, bounded on the southwest by the San Jose Hills, on the north by the San Gabriel Mountains, on the south and east by the Chino Basin and on the west by the Main San Gabriel Basin. The Six Basins are comprised of the Canyon, Upper and Lower Claremont Heights, Pomona, Live Oak, and Ganesha Basins. They underlie the service areas of Three Valleys Municipal Water District (Three Valleys) and Inland Empire Utilities Agency (IEUA). These Six Basins underlie the cities of Claremont, La Verne, Pomona and northern Upland. A map of the basin is provided in **Figure 9-1**.

Figure 9-1
Map of the Six Basins



BASIN CHARACTERIZATION

The following section describes the physical properties of the Six Basins, including its hydrogeologic characteristics and analysis of inflows and outflows.

Basin Producing Zones and Storage Capacity

Individual subbasins within the Six Basins are defined by faults and physical boundaries. The Indian Hills fault separates the Live Oak, Upper and Lower Claremont Heights, and Canyon basins (herein referred to as upper basins) to the north from the Pomona and Ganesha Basins (herein referred to as lower basins) to the south (Three Valleys, 2004). The Canyon Basin is separated from the other basins by the Sierra Madre-Cucamonga fault. The Ganesha and Pomona Basins are separated by the San Antonio fault. These faults do not appear to be barriers to flow. The San Jose fault separates the Six Basins from the Chino Basin. This boundary is not a complete barrier to flow and groundwater appears to flow at least to some extent between the basins.

Table 9-1 summarizes the hydrogeologic characteristics of the Six Basins. Studies are currently underway to reevaluate the basin geology. Changes to the basin structure as part of these studies were not available at the time of this report. In addition, limited data are available for the Ganesha and Live Oak Basins so data are provided for the four basins: Canyon, Upper Claremont Heights, Lower Claremont Heights and Pomona Basins (herein referred to as Four Basins Area). A geologic cross section through the Six Basins area from north to south is provided in **Figure 9-2**. Maximum basin depths range from about 200 feet in Canyon Basin to about 1,200 feet in the Pomona Basin. As shown in **Figure 9-2**, bedrock is offset by faulting, thereby increasing the basin depth toward the south.

Groundwater in Six Basins occurs under both unconfined and confined conditions. In the upper basins where material is generally coarser and mostly younger alluvium, the groundwater is unconfined. In the lower basins, fine-grained silts and clays overlie more permeable materials and groundwater can be confined. For example, the Pomona Basin consists of at least two aquifers. Most of the production from the Pomona Basin is from the underlying confined aquifers. Issues related to rising groundwater occur in the upper unconfined aquifer in the Pomona Basin. These issues are discussed in more detail below.

Total storage estimates range from about 15,000 AF of storage in the Canyon Basin to more than 200,000 AF of storage in the Pomona Basin. Total storage in the Four Basins Area is estimated to be about 335,000 AF (Three Valleys, 2004). Available storage space is estimated to be approximately 20,000 AF in 2005/06 (Three Valleys, 2006). Groundwater in storage in the upper basins has decreased from a high of about 74,500 AF in 1999 to about 65,200 AF in early 2004, a decrease of about 9,300 AF. Groundwater in storage increased by over 20,000 AF as a result of the near record rainfall in 2005.

Safe Yield/Long-Term Balance of Recharge and Discharge

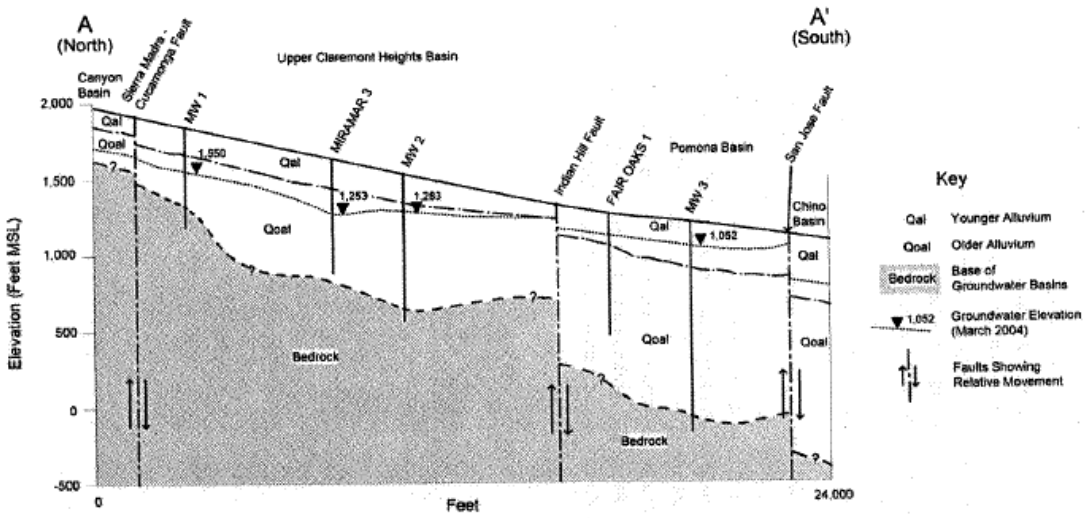
Water supply to Six Basins is greatly affected by precipitation in the area and in the watershed of San Antonio Canyon. **Figure 9-3** shows the historical annual average rainfall in the Six Basins area measured at San Antonio Dam. (Six Basins, 2005) The historical annual rainfall average for the period between 1985 and 2004 at this location is approximately 23.5 inches. The long-term precipitation averages range from about 40 inches in the upper reaches of San Antonio Canyon to 24 inches at the mouth of the canyon, and 17 inches at the southerly edge of the Pomona Basin. Much of the precipitation in the higher elevation falls as snow with the beneficial effect of delayed runoff. This creates a base flow of surface water, which is available for direct diversion or for surface spreading. (Six Basins, 2005)

Table 9-1
Summary of Hydrogeologic Parameters of the Six Basins

Parameter	Description
Structure	
Aquifer(s)	Unconfined alluvium in upper basins Confined to semi-confined in lower basins
Depth of groundwater basin	0 to 1,200 feet
Thickness of water-bearing units	Canyon: Up to 200 feet Upper Claremont Heights: Up to 1,000 feet Lower Claremont Heights: Up to 700 feet Pomona: Up to 1,200 feet
Yield and Storage	
Natural Safe Yield	19,300 AFY
Operating Safe Yield (Calendar Year 2005)	18,000 AFY
Total Storage	Canyon: 15,000 AF Upper Claremont Heights: 100,000 AF Lower Claremont Heights: 20,000 AF Pomona: 200,000 AF **Total: 335,000 AF**
Unused Storage Space	Unknown
Portion of Unused Storage Space Available for Storage (in 2005/06)	~20,000 AF

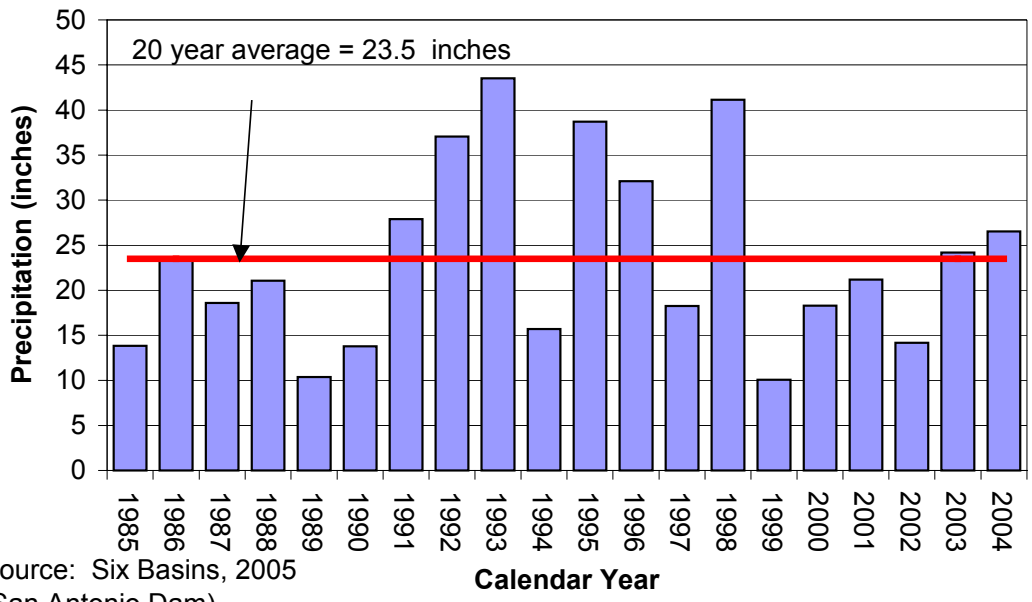
Source: Three Valleys, 2004; 2006

Figure 9-2
Generalized Hydrogeologic Cross Section in the Six Basins



Source: Three Valleys, 2004

Figure 9-3
Historical Precipitation in Six Basins Area



Source: Six Basins, 2005
(San Antonio Dam)

Groundwater generally flows from the upper basins to the lower basins. Therefore, the primary source of recharge to the lower basins is subsurface flow from the upper basins. The long term natural safe yield for all groundwater supplies within the Six Basins area, including the benefits of historical augmentation is estimated to be approximately 19,300 AFY. The operating safe yield for the Four Basins Area, which is updated annually, is dependent on rainfall and

groundwater recharge of surface water runoff from the local mountains. Since 1999, when the basins were adjudicated, the operating safe yield has ranged from 17,000 AFY to 24,000 AFY. In 2005, the operating safe yield was established at 18,000 AFY.

GROUNDWATER MANAGEMENT

The following section describes how the Six Basins area is currently managed.

Basin Governance

The Six Basins are adjudicated. The Six Basins were adjudicated in 1999 and administrated by Three Valleys MWD, through a contract with the Six Basins Watermaster Board of Directors. The Board is comprised of nine parties representing producers and interests in the basins. The Board of Directors rotates board positions on a yearly basis. Each party is represented on the governing Watermaster Board of Directors. A summary of the management agencies in the Six Basins is provided in **Table 9-2**.

Table 9-2
Summary of Management Agencies in the Six Basins

Agency	Role
Six Basins Watermaster Board of Directors	Governance and Oversight of Adjudicated Basins
Golden State Water Company	Major Party and Producer
City of Pomona	Major Party and Producer Operates Pomona Spreading Grounds pursuant to storage and recovery agreement with Watermaster
City of Upland	Major Party and Producer
City of La Verne	Major Party and Producer
Pomona College	Minor Party and Producer
City of Claremont	Minor Party and Producer (Sells rights to Golden State Water Company)
San Antonio Water Company	Major Party and Producer
Three Valleys MWD	Minor Party and Administrator (Storage & Recovery only)
Pomona Valley Protective Association (PVPA)	Operates San Antonio and Thompson Creek Spreading Grounds
Los Angeles County Department of Public Works (LACDPW)	Operates Live Oak Spreading Grounds

In accordance with the adjudication, pumping is limited to the annual operating safe yield within the Four Basins Area. Pumping is not limited in the Ganesha or Live Oak Basins. According to the adjudication, annual over-pumping in the Four Basins Area is allowed with no specified upper limit but incurs replenishment obligation of equal amount. Carryover of 25 percent of the original annual allocation or unused balance, whichever is less, is allowed. Additional storage is allowed with no specified upper limit but only pursuant to a storage and recovery agreement between Watermaster and a single party. Imported water deliveries are allowed for replenishment obligation or Storage/Recovery account (Six Basins, 2005). However, facilities to spread and store imported water are not yet available in the Six Basins area.

Criteria for monitoring of the basin include monthly monitoring and groundwater modeling of water levels and monthly reporting and groundwater modeling of production. Pumping rights are allocated to each producer in the Four Basins Area based on the percentages in the Judgment. The Base Annual Production percentage owned by each producer is applied to the current Operating Safe Yield, and the resulting allocation is the pumping allowance available to each party without incurring a replacement water obligation (Six Basins, 2005)

Interactions with Adjoining Basins

Subsurface outflow to the Chino Basin across the San Jose fault has not been estimated but is considered to be very low (Three Valleys, 2004). The quantity of flow is not currently known with enough certainty for a formal exchange agreement to be made. Future studies have been proposed to better quantify this outflow.

Under the adjudication, Six Basins producers are allowed to export water upon approval by the Watermaster. For example, production from the western edge of the Pomona Basin is exported to the Main San Gabriel Basin. In addition, production by the City of La Verne is exported outside the boundaries of the Live Oak and Ganesha Basins (Three Valleys, 2004).

WATER SUPPLY FACILITIES AND OPERATIONS

The following provides a summary of the facilities within the Six Basins. Facilities for groundwater supply and storage include approximately 68 production wells and nearly 700 acres of recharge basins.

Municipal Production Wells

Table 9-3 provides details of the production wells within the Six Basins area. There are approximately 68 municipal production wells in the Six Basins area. Fourteen municipal wells are inactive. The total production capacity of active municipal wells is at least 35,000 AFY (Three Valleys, 2007). It is important to note that groundwater demand is only about 24,000 AFY. Approximately seven wells are anticipated to be replaced in the next five years (Six Basins, 2006).

Figure 9-4 summarizes the historical production data in the Four Basins Area. Data from the Live Oak and Ganesha Basins were not available at the time of this report. However, because of

water quality issues in these two basins, production is limited but still significant. Most of the groundwater production in the Six Basins area is from the Upper Claremont Heights Basin and the Pomona Basin. Between 1985 and 2004, pumping in the Upper Claremont Heights Basin ranged from 7,857 AFY to 14,732 AFY with an average of 9,890 AFY. Production in this basin generally correlates with precipitation. There has been limited pumping in the Lower Claremont Heights Basin after 1998, and extractions from the Canyon Basin are a result of precipitation because it responds quickly to runoff from San Antonio Canyon. Production from the Pomona Basin ranged from 5,028 AFY to 9,195 AFY between 1985 and 2004. Production from the Pomona Basin has been less than the adjudicated allowance because of water quality issues in this basin. However, in recent years, production from the Pomona Basin has increased as facilities to remove contaminants from the groundwater are constructed.

Table 9-3
Summary of Production Wells in the Six Basins

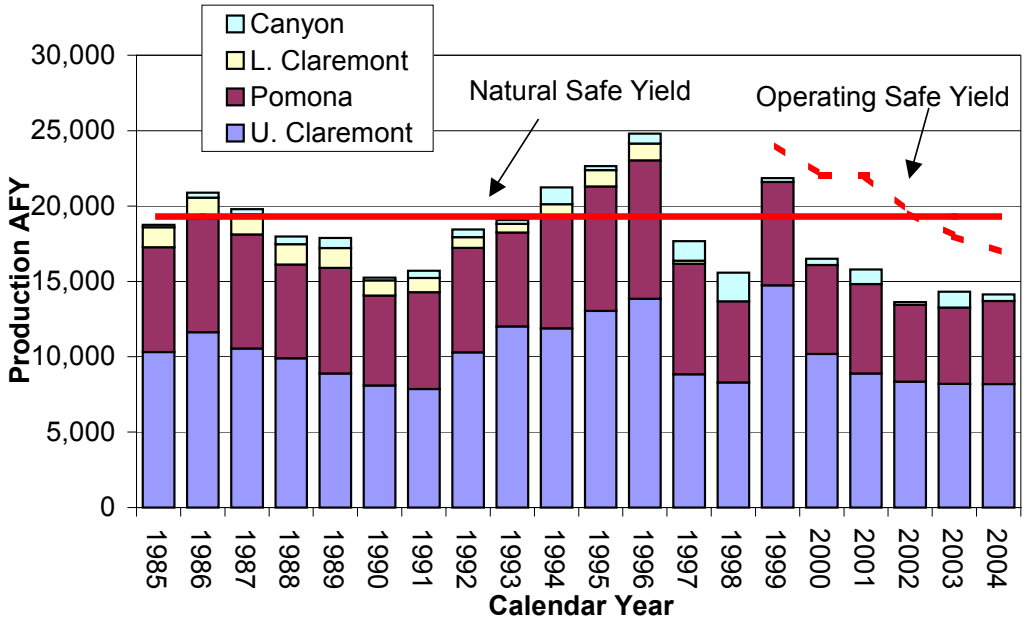
Basin	Number of Wells	Estimated Production Capacity (AFY)	Average Production 1985-2004 (AFY)	Well Operation Cost ($/AF)
Canyon	54 Active 14 Inactive	At least 35,000	595	$60-175 (average of $125) Power only
Upper Claremont Heights			10,199	
Lower Claremont Heights			723	
Pomona			6,649	
Ganesha			Data not available	
Live Oak			Data not available	
Total	**68**	35,000	18,164	

Source: Three Valleys, 2006

Other Production

Other non-municipal production has not been reported for the Six Basins. Non-municipal production is included in production data discussed above.

Figure 9-4
Historical Groundwater Production in the Six Basins



ASR Wells

There are no ASR wells in the Six Basins.

Spreading Basins

There are four spreading basin areas in the Six Basins area. These include: San Antonio, Thompson Creek, Live Oak and Pomona. Each of these is discussed below and summarized in **Table 9-4**. **Figure 9-5** summarizes the historical groundwater recharge spreading operations in the Six Basins. An average of about 6,200 AFY has been recharged in the Six Basins area between 1995 and 2004. During the wet years of 1995 and 1998 more than 25,000 AFY was recharged.

The San Antonio Spreading Grounds consist of about 600 acres of spreading grounds in the Upper Claremont Heights Basin. This facility is owned and operated by the Pomona Valley Protective Agency (PVPA). The primary source of water for this facility is runoff from San Antonio Creek by way of controlled releases from San Antonio Dam by the Army Corps of Engineers. Imported water from Metropolitan will also spread at this facility as part of the Upper Claremont Heights Conjunctive Use Program discussed below. Facilities to spread imported water have not been constructed yet. Although larger volumes of water have been spread in the San Antonio Spreading Grounds historically, the recharge capacity of the San Antonio Spreading Grounds has been estimated by Bookman-Edmonston to range from about 13,000 to 18,000 AFY taking into consideration adjustments to avoid impacts of high groundwater (Three Valleys, 2004).

The Live Oak Spreading Grounds consist of about five acres of spreading facilities in the Live Oak Basin. This facility is owned an operated by LACDPW. The primary source of water is runoff from the Live Oak Dam. Imported from Metropolitan is also recharged at this facility as part of the Live Oak Conjunctive Use Program discussed below.

Table 9-4
Summary of Recharge Basins in Six Basins

Basin	Area (acres)	Wetted Area (acres)	Recharge Capacity (cfs)	Recharge Capacity (AFY)	Source Water	Owner
San Antonio	600	Data not available	Data not available	13,000 to 18,000 [1]	Runoff	Pomona Valley Protection Agency
Thompson Creek	53	5	15	Data not available	Runoff	Pomona Valley Protection Agency
Live Oak	5	3	13	Data not available	Runoff Imported	LACDPW
Pomona	8	Data not available	Data not available	Data not available	Runoff	City of Pomona

Source: Three Valleys, 2004; LACDPW, 2006
1. Spreading capacity as determined by Bookman Edmonston (Three Valleys, 2004)

The Pomona spreading groundwater facilities are owned by the City of Pomona adjacent to its Pedley Water Treatment Plant pursuant to a storage and recovery agreement with Watermaster.

The Thompson Creek Spreading Grounds consist of about 53 acres of spreading facilities in the Canyon Basin. The primary source of recharge is runoff from the adjacent drainages upstream of the facilities.

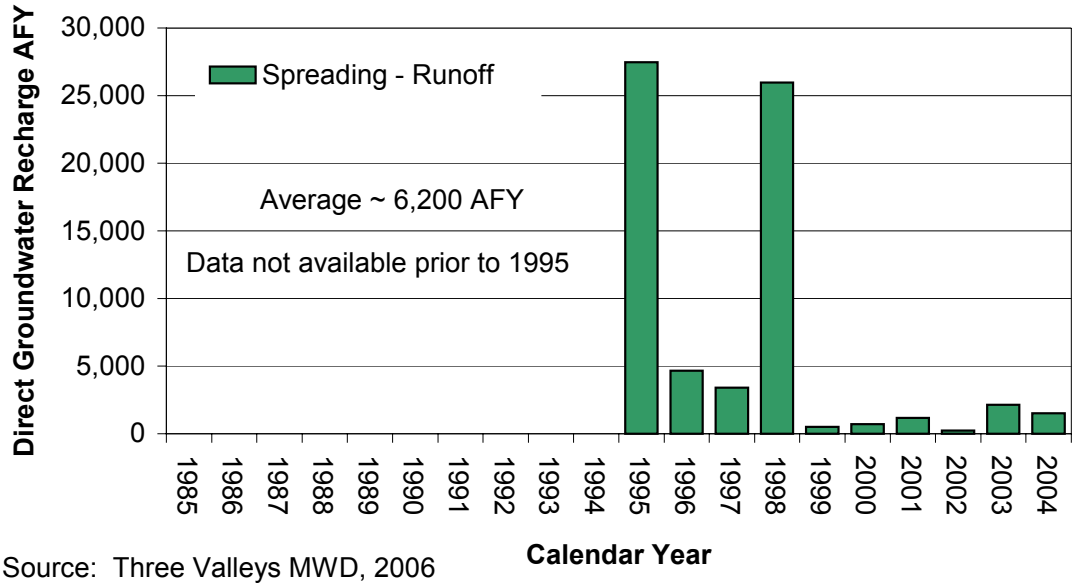
Seawater Intrusion Barriers

There are no seawater intrusion barriers in the Six Basins area.

Desalters

There are no desalters in the Six Basins area.

Figure 9-5
Historical Groundwater Recharge in Six Basins Area



Source: Three Valleys MWD, 2006

GROUNDWATER LEVELS

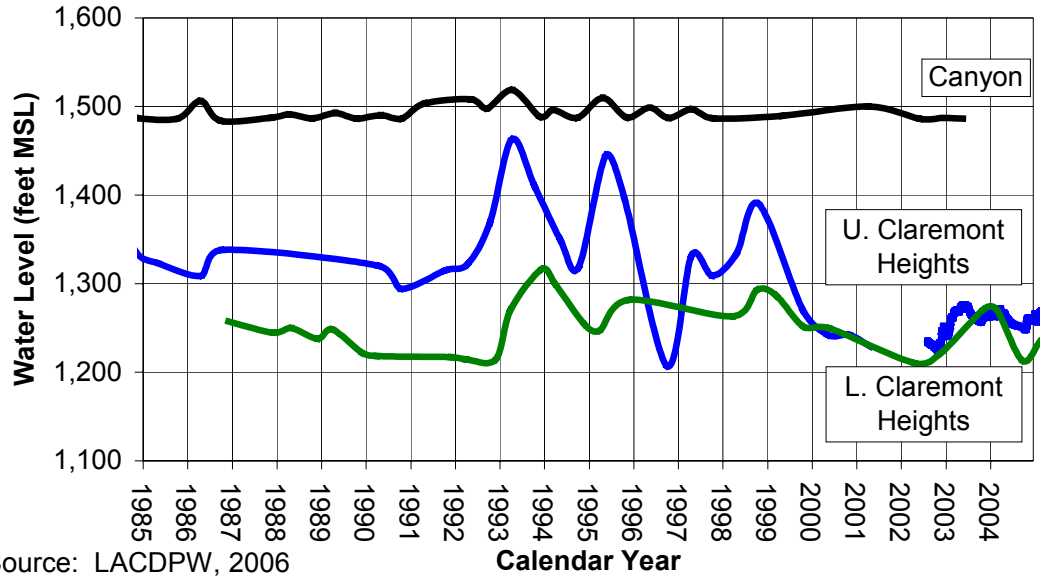
The general direction of groundwater flow is south to southwest from the upper basins to the lower basins. Historical water levels for the Six Basins area are shown in **Figure 9-6**. Water levels generally decreased in each basin between1985 and 2004. Decreases have ranged from slight decreases in the Canyon Basin to more than 80 feet (between 1985 and 2004) in the Upper Claremont Heights Basin. However, since the heavy rains of early 2005, water levels have recovered and, during 2005 and 2006 are near historical highs.

Despite the overall decrease after 1985, water levels in the Pomona Basin increased between 1990 and 1994 because wells were shutdown due to water quality issues in this basin. Water levels have remained higher since that time. Unlike the three upper basins, water levels in the Pomona Basin are above desired levels (Six Basins, 2005). Areas of rising groundwater (cienegas) are present in various locations in the Pomona Basin and are a concern for management of the basin. The approximate locations of known cienegas are provided in **Figure 9-7.**

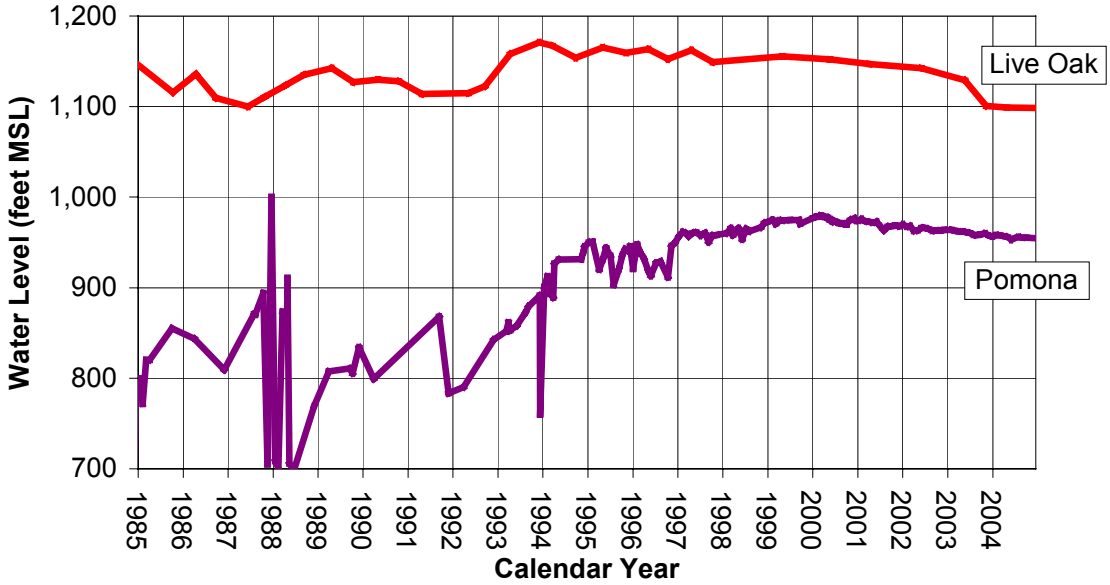
Basin water levels must be closely managed to avoid rising water and property damage. Canyon Basin and Upper Claremont Heights Basin both experienced rising groundwater conditions in early 2005. In 1993, James M. Montgomery Consulting Engineers (JMM) developed a spreadsheet model to evaluate spreading conditions. Based upon the model assumptions, water is not to be spread when the Index Water Level (weighted average of 5 wells in Upper Claremont Heights Basin) approaches or reaches an elevation of 1,455 feet MSL. Since 1993, the index water level has ranged from 1262.3 feet MSL to 1,342.4 feet MSL. The

index water level in March 2004 was 1,296.1 feet MSL (Six Basins, 2005). In 2006, CDM developed a new spreadsheet model, which utilizes data from nine dedicated monitoring wells in the Six Basins. The new threshold index for this model is 1,475 feet MSL.

Figure 9-6
Historical Water Levels in the Six Basins

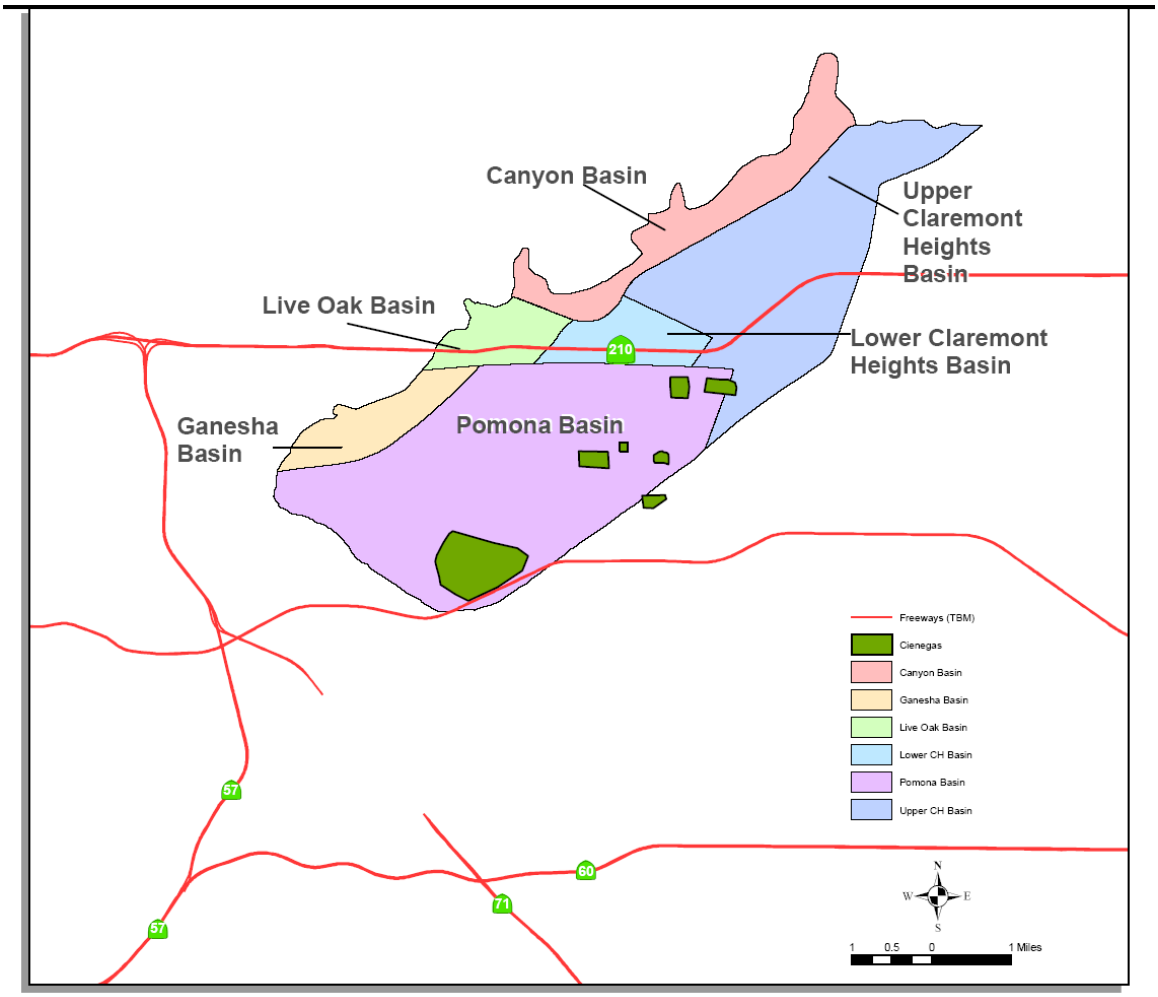


Source: LACDPW, 2006



Source: LACDPW, 2006

Figure 9-7
Locations of Cienegas in the Six Basins Area



GROUNDWATER QUALITY

The following section describes the overall water quality considerations for the Six Basins. Fourteen wells, particularly in the Live Oak and Pomona Basins are offline because of water quality issues.

Groundwater Quality Monitoring

Basin water quality assessments utilize Title 22 reporting for production wells. There is no formal groundwater quality-monitoring program established for the Six Basins.

Groundwater Contaminants

General water quality information was collected from the various water agencies in the Six Basins Area to conduct an assessment of water quality conditions in the area. The water quality analysis was collected for 2005/06. **Table 9-5** provides summary of the primary constituents of concern in the Six Basins areas. Constituents of concern include: total dissolved solids (TDS), nitrate, volatile organic compounds, or VOCs (trichloroethylene, or TCE, tetrachloroethylene, or PCE), and perchlorate. A brief discussion of water quality conditions for each of the compounds of potential concern is presented below.

Nitrate is a main water quality concern in the Live Oak Basin and the westerly portion of the Pomona Basin, where most of the wells currently exceeding the MCL (13 of the 44 wells reported). Nitrate concentrations in some of the city of La Verne wells are 20 to 22 mg/L as N, over twice the current MCL. The eastern half of the Pomona Basin and the Upper Claremont Basin experience lower nitrate concentrations with most of the wells below 50 percent MCL. **Figure 9-8** illustrates nitrate concentrations for the reporting wells in the Six Basins area.

TDS information was obtained for only 14 of the producing wells in the area. TDS is currently not an issue of concern as none of the wells exceed the secondary MCL of 500 mg/L; further, 11 of the 14 wells showed concentrations below 50 percent MCL. **Figure 9-8** illustrates TDS concentrations for the reporting wells in the Six Basins area.

The Pomona Basin also contains VOCs at four wells above the appropriate MCL. As described below, the City of Pomona has constructed VOC treatment/removal facilities in the Pomona Basin. TCE is an issue of concern at two primary locations in the Pomona Basin. In the vicinity of the historical Del Monte Cienega there are 2 wells with TCE concentrations exceeding MCL. Similarly, the there are 2 wells located east of the Palomares Cienega with elevated concentrations of TCE. These four wells are treated or blended to meet drinking water standards. **Figure 9-9** illustrates PCE and TCE concentrations for the reporting wells in the Six Basins area. Some levels of perchlorate have also been observed, but below notification levels.

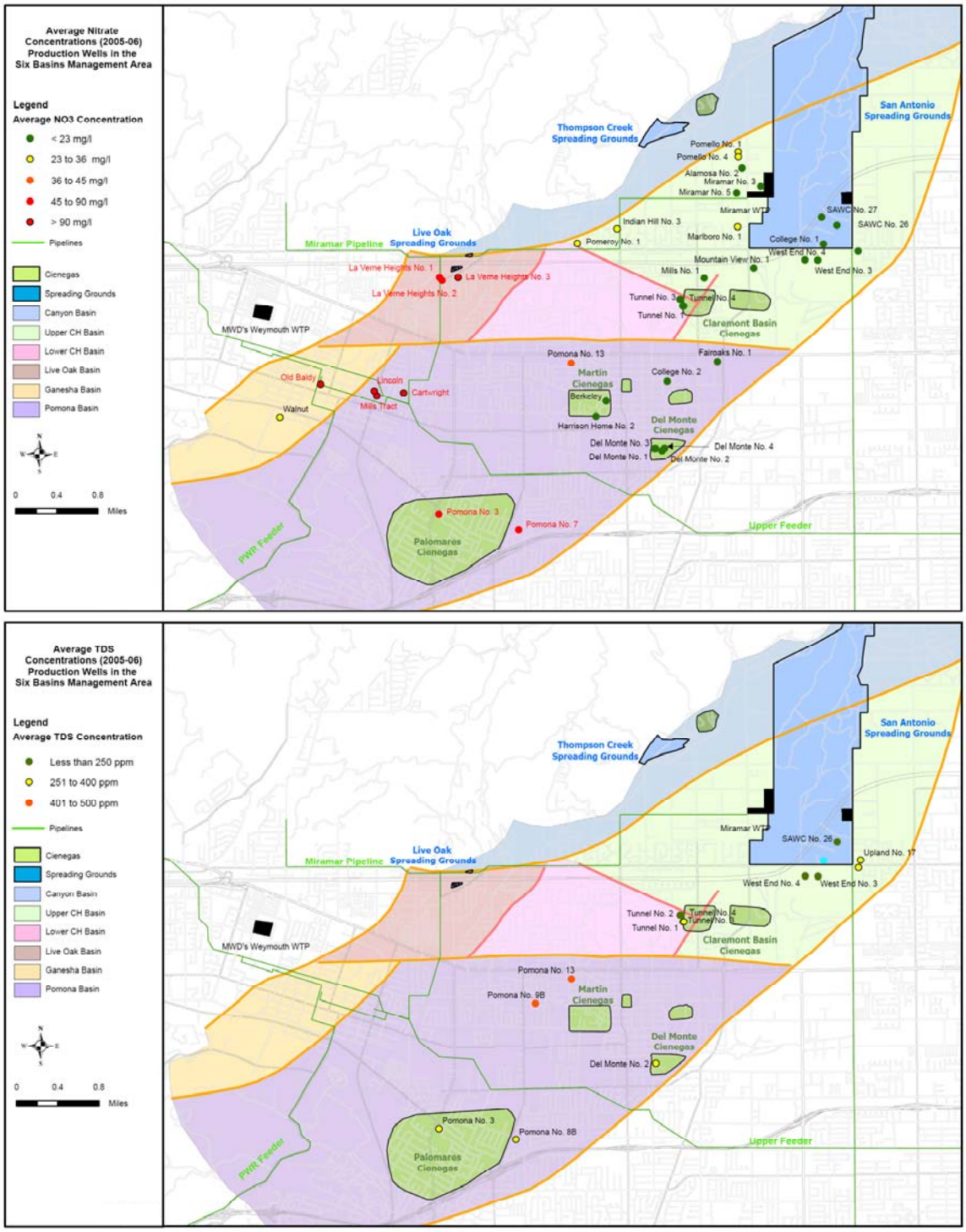
Blending Needs

The City of Pomona blends 60 percent of imported SWP water with treated groundwater to improve nitrate concentrations. The Golden State Water Company also blends with imported SWP water to improve nitrate concentrations. Blending needs are summarized in **Table 9-6**.

Groundwater Treatment

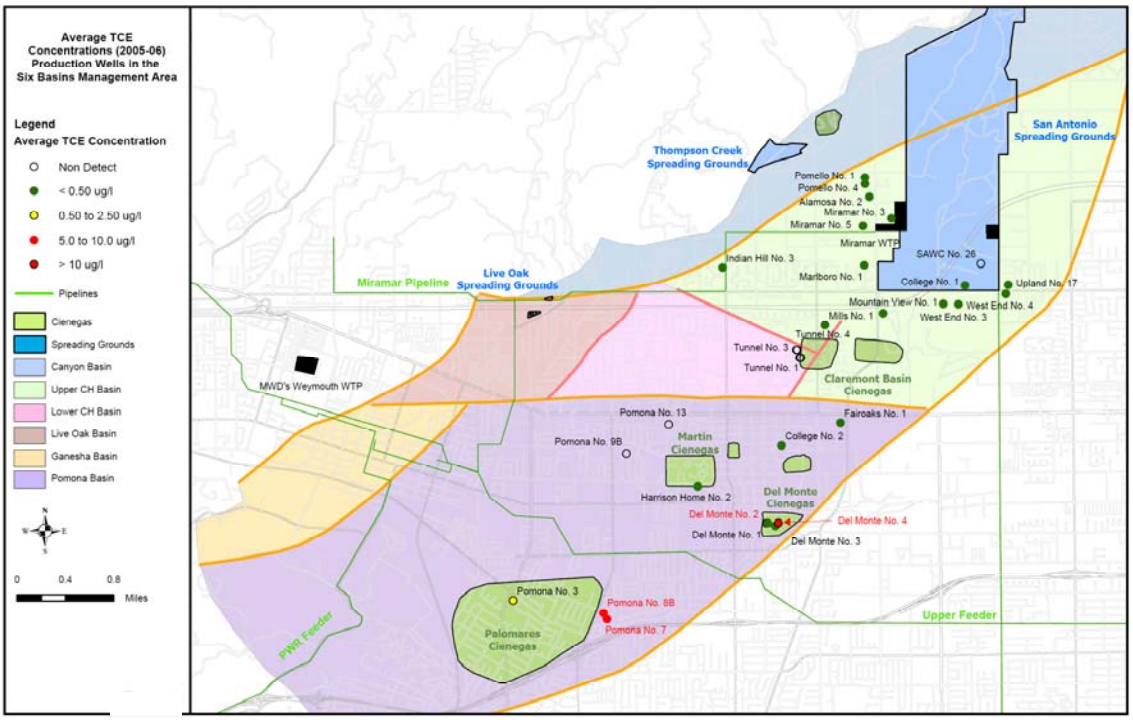
Table 9-7 summarizes the treatment type and constituents of concern for Six Basins. In addition, the city of La Verne is currently constructing ion exchange facilities for removal of nitrates in Live Oak Basin. It is estimated that up to 5,000 AFY additional production capacity can be achieved with groundwater treatment facilities over and above those mentioned here. (Three Valleys, 2006).

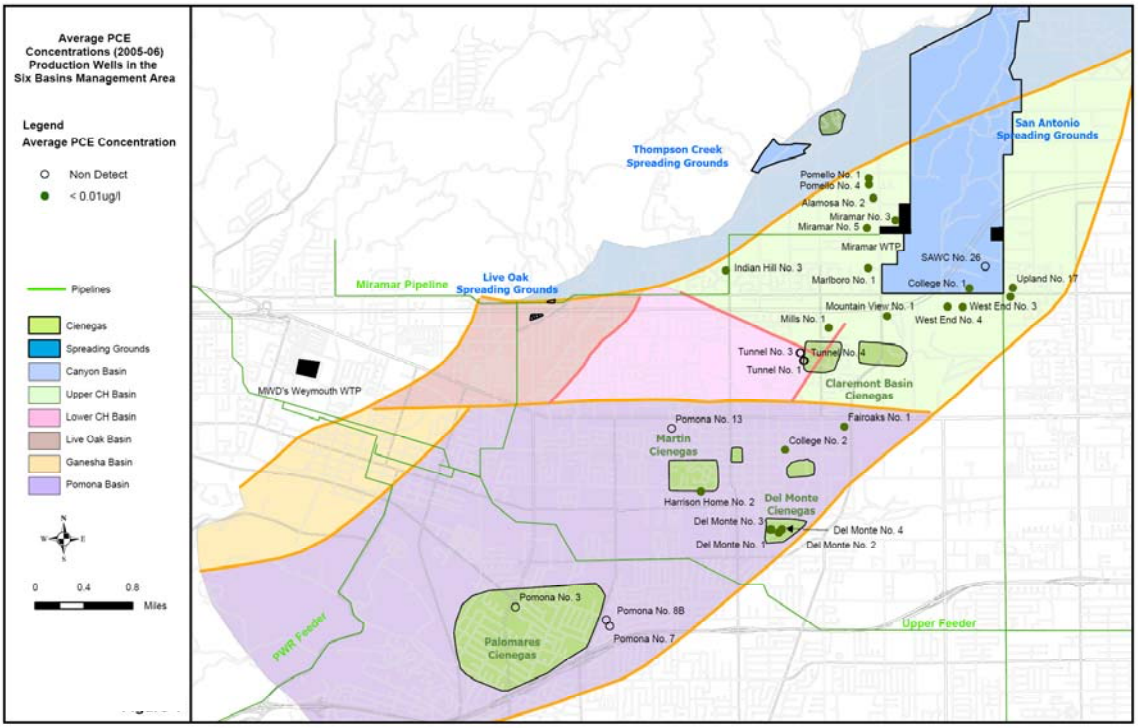
Figure 9-8
Nitrate and TDS Concentrations in the Six Basins



Source: Three Valleys, 2007

Figure 9-9
Volatile Organic Compound Concentrations in the Six Basins





Source: Three Valleys, 2007

Table 9-5
Summary of Constituents of Concern in Six Basins

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	190 to 480	Below MCL of 500 in all basins (14 of 14 wells)
Nitrate (as N) Primary MCL = 10	mg/L	ND to 22	Above MCL in some portions of Pomona, Lower Claremont Heights and Live Oak Basins (13 of 44 wells exceed MCL and 24 of 44 wells are less than 50 percent of MCL)
VOCs (TCE and PCE) Primary MCL for TCE = 5 Primary MCL for PCE = 5	µg/L	ND to > 10 for TCE ND to < 0.01 for PCE	Above MCL in some portions of Pomona Basin. VOC treatment occurs in Pomona Basin (4 of 32 wells exceed MCL for TCE and no wells exceed MCL for PCE – 28 of 32 well had TCE concentrations less than 50 percent of MCL and all wells had PCE concentration less than 50 percent of MCL)
Perchlorate Notification level = 6	µg/L	< 6	No reported exceedances of notification level found in Six Basins

Source: Three Valleys, 2007

CURRENT GROUNDWATER STORAGE PROGRAMS

Metropolitan has recently implemented two conjunctive programs under the Proposition 13 program in the Six Basins. These include programs in the Live Oak and Upper Claremont Heights Basins. Each of these programs is described in **Table 9-8**. Total storage from these programs is 6,000 AF. As of June 30, 2006, about 610 AF was in storage under these combined programs.

Table 9-6
Summary of Blending Needs in the Six Basins

Purveyor	Constituent Blended	Average Groundwater Blended (AFY)
City of Pomona	Nitrate (blended with imported water)	1,363
Golden State Water Company	Nitrate (blended with imported water)	648
Total		**2,011**

Source: Three Valleys, 2006

Table 9-7
Summary of Groundwater Treatment in the Six Basins

# Wells	Treatment Type	Constituents of Concern	Treatment Target	Treatment Cost	Amount Treated (AFY)
3	Air-Stripping	1,1-DCE PCE TCE	ND	$70/AF	1,363
2	GAC	VOC	ND	$81/AF	460

Source: Three Valleys, 2006

Live Oak Basin Conjunctive Use Project

Metropolitan, Three Valleys, and the City of La Verne executed the Live Oak Basin Conjunctive Use Project agreement on October 21, 2002. The Live Oak Conjunctive Use Project will allow the storage of up to 3,000 AF of water. Surplus water will be stored when available and during dry, drought, or emergency periods. Metropolitan will be able to recover 1,000 AF of water per year.

Table 9-8
Summary of Conjunctive Use Programs in the Six Basins

Program	Member Agencies	Year Began	Total Storage (AF)	Amount in storage [1] (AF)
Live Oak Conjunctive Use Program	Three Valleys	2002	3,000	610
Upper Claremont Heights Conjunctive Use Program	Three Valleys	2005	3,000	0

[1]As of June 30, 2006

Upper Claremont Heights Conjunctive Use Program (San Antonio Spreading Grounds Conjunctive Use Project)

In October 2005, Three Valleys entered into an agreement with Metropolitan to store up to 3,000 AF in the Upper Claremont Heights Basin. Three Valleys plans to construct a production well to take advantage of the available storage capacity in the Upper Claremont Heights Basin. Three Valleys has available storage within this basin as a part of an agreement with the Six Basins Watermaster. The Watermaster agreement provides Three Valleys with an annual storage account of up to 1,000 AF and an extraction limit of up to 3,500 AF that would be used for the program. Facilities to store water have not yet been completed for this program. Facility construction is expected to be completed by the end of 2007.

BASIN MANAGEMENT CONSIDERATIONS

Potential constraints to groundwater storage and extraction include:

- Because the shallower upstream basins production ability is largely dependent upon natural recharge, during dry years, these basins produce very little.
- Production limits as a result of the adjudication may limit ability to extract water from the Four Basins Area.
- Spreading may be limited in the Upper Claremont Heights Basin if water level index exceeds 1,475 feet MSL. New CDM model calculates amount of storage available for recharge based upon the 1,475 index. Additional monitoring wells wills be needed to monitor water levels.
- Rising groundwater conditions in the Pomona Basin may limit the ability to store water in the upstream basins.

- Groundwater quality, particularly nitrate and VOCs in the Live Oak, Pomona and Lower Claremont Basins may limit ability to store and extract water.

- In the event that there is imported water in storage that prohibits the spreading of local runoff, provisions in the Judgment would reduce the amount of imported water spreading by an equivalent amount of local surface water that could not be spread. Imported water would be the first stored water lost in the event that surface water could not be spread. As such, groundwater accounting would be affected.

References:

California Department of Water Resources (DWR), 2004. California's Groundwater Bulletin 118 – San Gabriel Valley Groundwater Basin.

Six Basins Watermaster (Six Basins), 2004. Preliminary Determination of Operating Safe Yield for calendar year 2005.

Six Basins Watermaster (Six Basins). 2005. Annual Report.

Three Valleys Municipal Water District (Three Valleys), 2004. Initial Study/Mitigated Negative Declaration - Imported Water Spreading at San Antonio Spreading Grounds.

Three Valley Municipal Water District (Three Valleys), 2006 Groundwater Study Questionnaire.

Three Valley Municipal Water District (Three Valleys), 2007. Comments from Mike Sovich on Draft Groundwater Assessment Study, March 2007 dated June 12, 2007.

CHAPTER IV

GROUNDWATER BASIN REPORTS

ORANGE COUNTY BASINS

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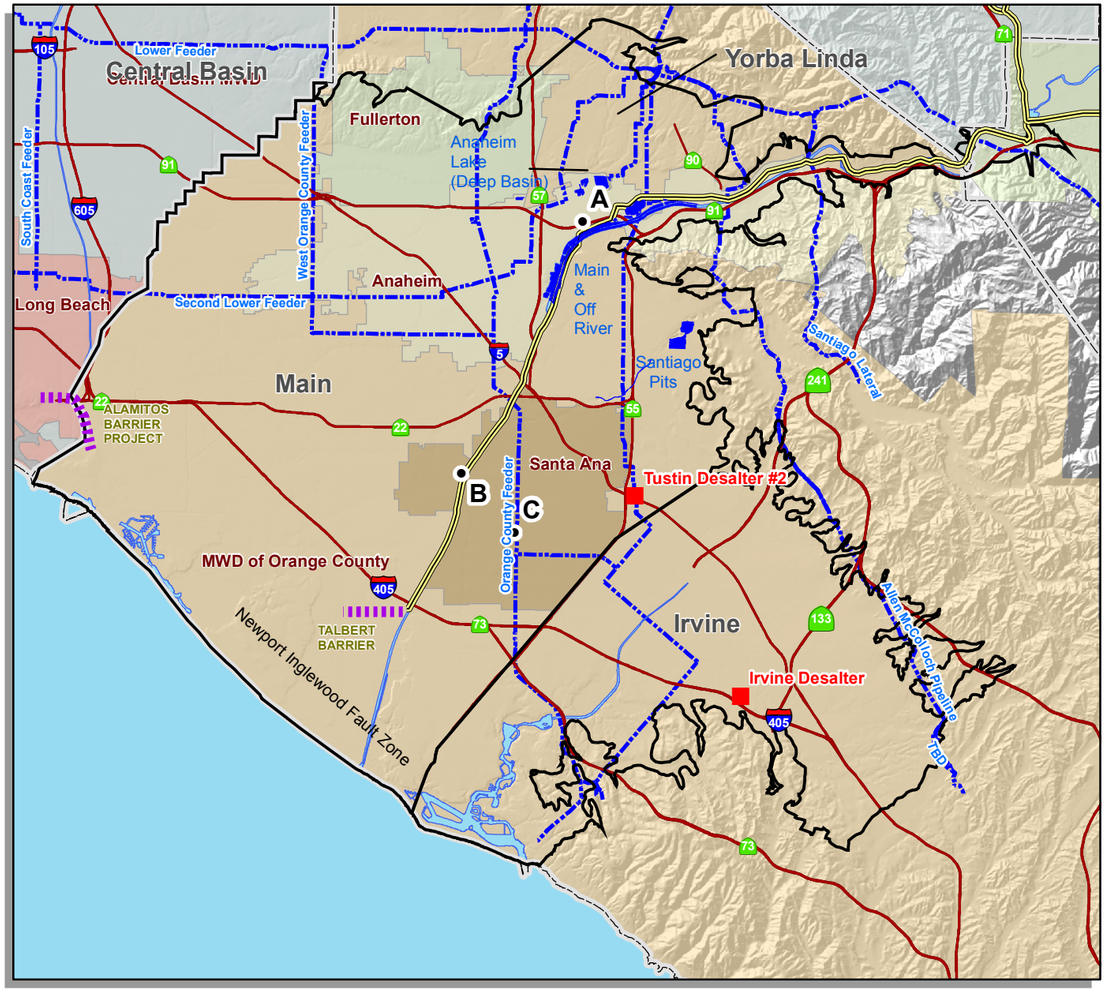

Orange County Basin

A Key Well
Desalter
Recharge Basin
Seawater Barrier
County
Freeways
Water Body
MWD Pipeline
Santa Ana Regional Interceptor Line
Basin
MWD Member Agency Boundary (color varies)

N W E S

4 2 0 4 Miles

Note: This map was prepared by the Metropolitan Water District of Southern California for its own use. No warranty is expressed or implied as to the correctness, timeliness, or content of the information shown herein.

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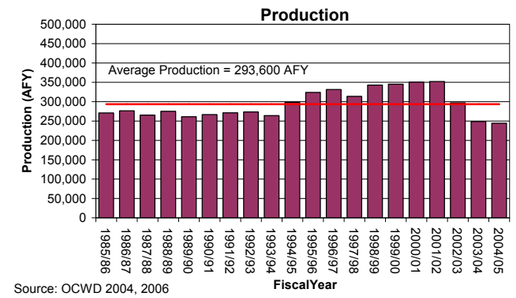
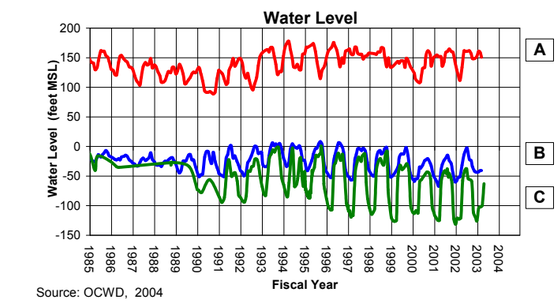
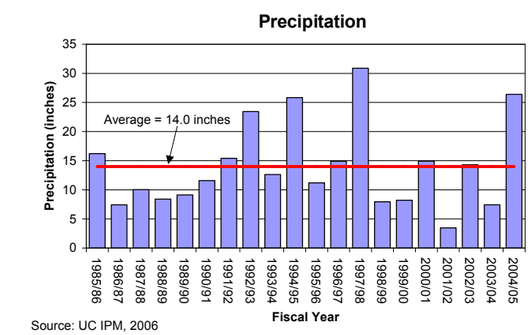
Additional Data Sourse(s): Santa Ana Watershed Project Authority (SAWPA); California Spatial Information Library (CaSIL).



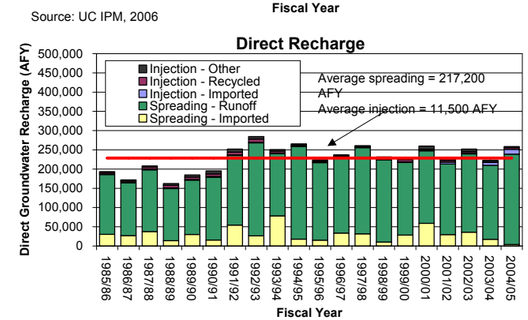
Source: OCWD 2004, 2006



Source: OCWD, 2004



Source: UC IPM, 2006



BASIN FACTS

Orange County Basin

Description
Location: Orange County
Watershed Surface Area: 350 square miles
Subbasins:
Main
Irvine
Yorba Linda
MWD Member Agencies:
Municipal Water District of Orange County
Management: Managed
Since 1933, OCWD has managed basin. OCWD manages production, water quality, spreading operations, and seawater intrusion barrier operations.

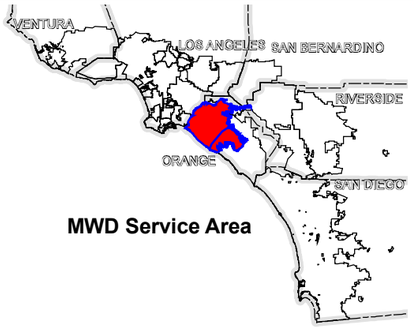
	Orange County
Natural Safe Yield	70,500 AFY
Basin Production Percentage (BPP) for 2005/06	64 percent
Total Storage	66 million AF
Unused Storage Space	Data not available
Portion of Unused Storage Space Available for Storage (2006)	135,000 AF (100,000 AF reserved wet-year storms)

Storage and Extraction Facilities

	Orange County
Production Wells	
Production Capacity	420,000 to 440,000 AFY
Average 1985/86-2004/05	293,645 AFY
Seawater Intrusion Barriers	
Injection Capacity	53,000 AFY
Average 1985/86-2004/05	11,495 AFY
Non-barrier Injection Wells	
Injection Capacity	None
Average 1985/06-2004/05	None
Spreading Basins	
Spreading Capacity	250,000 AFY
Average 1985/86-2004/05	217,225 AFY

Basin Management Considerations

- Artificial recharge is a key management strategy for the Orange County Basin.
- Pumping in the basin is limited by the BPP, which is established annually by OCWD.
- The potential for seawater intrusion could limit the utilization of the basin unless additional seawater barrier facilities are constructed
- Water quality issues such as high TDS and nitrate in Irvine subbasin and colored water in the Lower aquifer system could limit ability to store and extract water from some portions of the aquifer.



MWD Service Area

Plate 10-1
Overview of Orange County Basin

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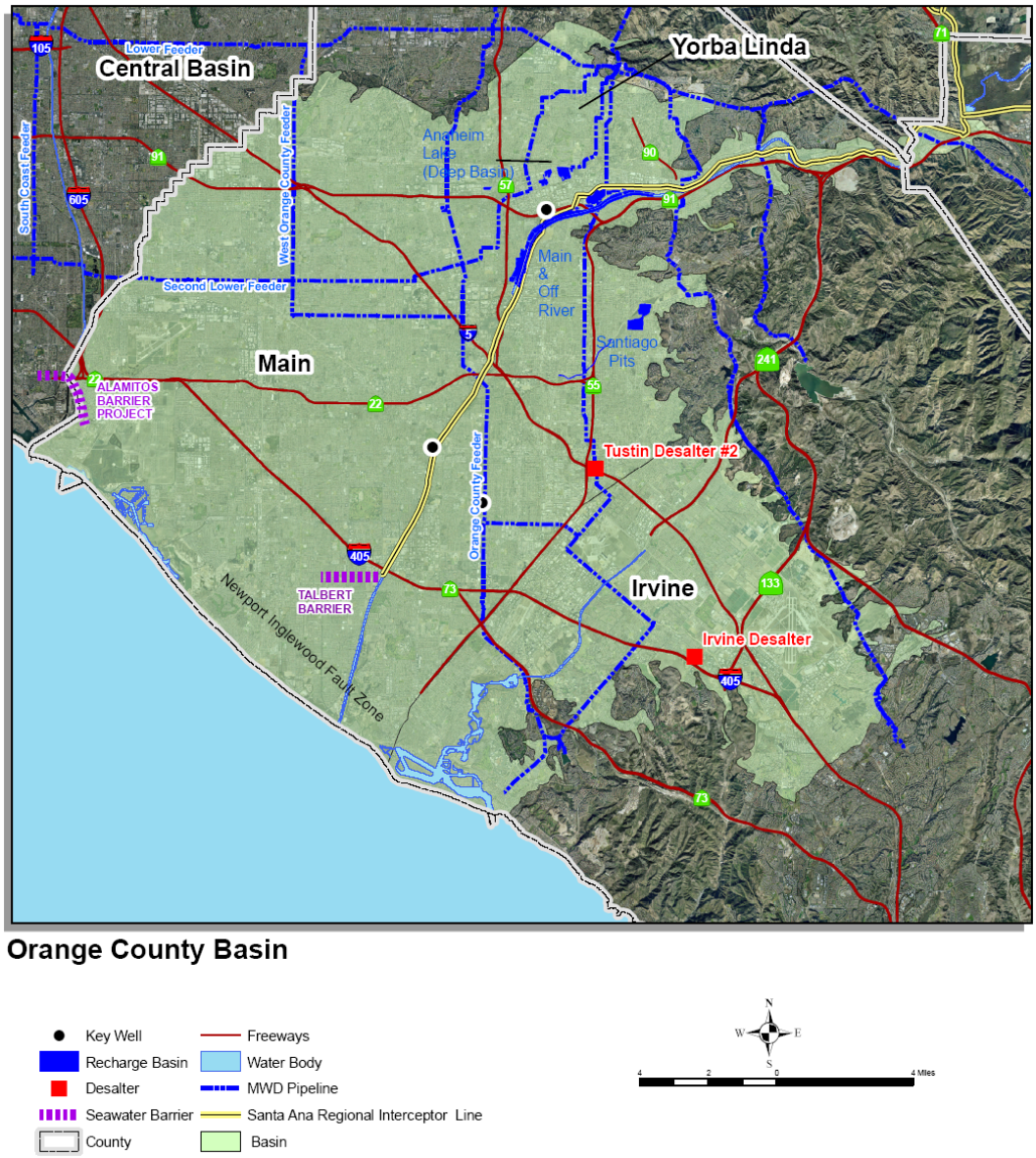
The Orange County Basin is located in north and central Orange County within the lower Santa Ana River watershed. Member agencies within the Orange County Basin include Anaheim, Fullerton, Santa Ana and the Municipal Water District of Orange County. It includes the communities of Anaheim, Buena Park, Costa Mesa, Cypress, Fountain Valley, Fullerton, Garden Grove, Huntington Beach, Irvine, La Palma, Los Alamitos, Newport Beach, Orange, Placentia, Santa Ana, Seal Beach, Stanton, Tustin, Villa Park, Westminster and Yorba Linda. The Orange County Basin has been divided into three subbasins: Yorba Linda, Main and Irvine. A map of the basin is provided in **Figure 10-1**.

Figure 10-1
Map of Orange County Basin



BASIN CHARACTERIZATION

The following section provides a physical description of the Orange County Basin including its geographic location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

The Orange County Basin is bounded by the Coyote and Chino Hills on the north, the Santa Ana Mountains on the northeast, the San Joaquin Hills on the south, and the Pacific Ocean and the Newport-Inglewood fault zone on the southwest (OCWD, 2004). The Orange County Basin is separated from the Central Basin along Coyote Creek and the County line, although there is no physical barrier between the two basins. The Newport-Inglewood fault zone acts as a complete barrier to flow from the ocean along most of its length in Orange County except at ancient river-crossing gaps, most notably the Alamitos Gap along the Los Angeles County line and the Talbert Gap in Huntington Beach and Costa Mesa. At these two locations, permeable river deposits cross the fault barrier providing the opportunity for seawater to flow into the Orange County Basin. As discussed in more detail below, a series of injection wells are utilized to halt the seawater intrusion at these locations.

As discussed above, the Orange County Basin includes three subbasins: Yorba Linda, Main and Irvine. These subbasins are managed by OCWD as a whole and are described herein for informational purposes.

The Yorba Linda subbasin is located north of the Anaheim Forebay recharge area, within the cities of Yorba Linda and Placentia. It is part of the basin, but currently has little groundwater pumping due to its low transmissivity and high TDS concentrations (Mills, 1987). 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 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 and Newport Boulevard approximate the subbasin's boundary with the Main Basin. Irvine-area aquifers are thinner and contain more clay and silt deposits than aquifers in the main portion of the basin. Groundwater typically flows out of the Irvine subbasin westerly into the Main Basin.

The hydrogeology of the Orange County Basin is characterized by a deep structural alluvial basin containing a thick accumulation of interbedded sand, silt and clay. **Table 10-1** provides a summary of hydrogeologic parameters for the Orange County Basin. The Orange County Basin contains three defined aquifer units: the Upper, Principal (or Middle) and Lower aquifers. In the northern portions of the Orange County Basin, referred to as the Forebay area, many of these aquifers are merged and allow for direct recharge into the deeper aquifers. In the area referred to as the Pressure Area, these aquifers are less hydraulically connected and create confined aquifer conditions. A conceptual geologic cross section across the Orange County Basin is provided in **Figure 10-2**.

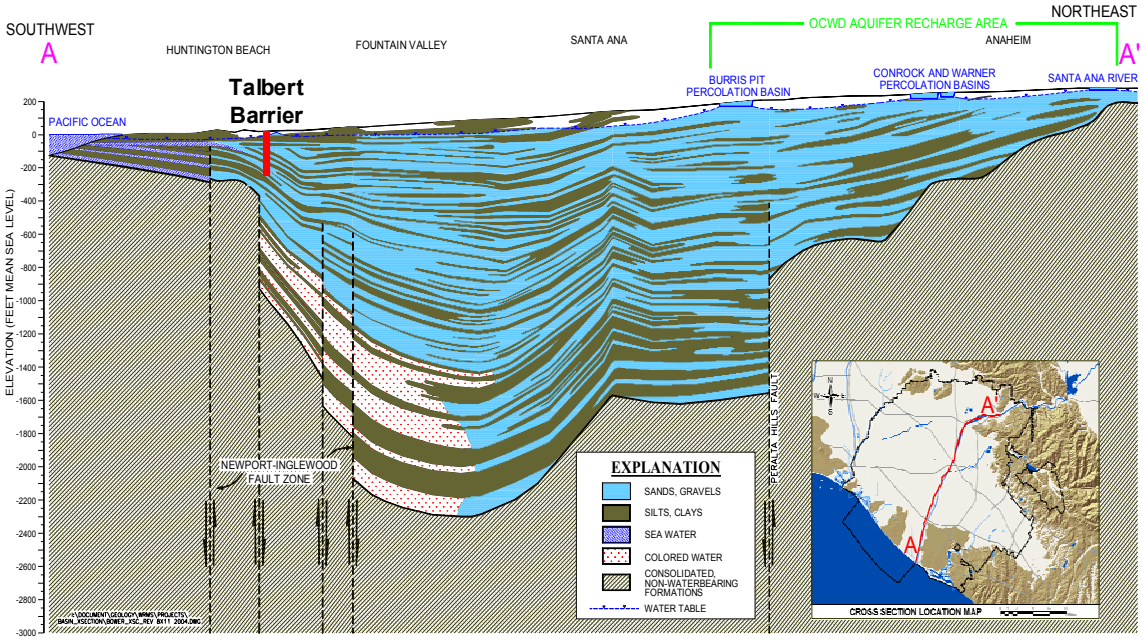
Table 10-1
Summary of Hydrogeologic Parameters of Orange County Basin

Parameter	Description
Structure	
Aquifer(s)	Forebay areas (unconfined) Pressure areas (confined) • Upper aquifer system • Principal aquifer system • Lower aquifer system
Depth of groundwater basin	> 2,000 feet
Depth of producing zones or screen intervals	200 to ~2,000 feet
Thickness of water-bearing units	Upper aquifer: Up to 300 feet (average ~200 feet) Principal aquifer: 500 to > 1,600 feet (average ~ 1,000 feet) Lower aquifer: ~300 to 1,000 feet
Yield and Storage	
Natural Safe Yield (Natural Incidental Recharge) [1]	70,500 AFY
Basin Production Percentage (2005/06) [2]	64 percent
Total Storage	Upper aquifer: 5 million AF Principal aquifer: 32.9 million AF Lower aquifer: 25.1 million AF Aquitards: 3 million AF 66 million AF
Unused Storage Space	Data not available
Portion of Unused Storage Space Available for Storage (June 2006) [3]	100,000 AF (reserved for wet year stormwater) 35,000 AF 135,000 AF total available

Source: DWR, 2004; OCWD, 2004

1. Natural safe yield includes infiltrated precipitation, irrigation, and other incidental recharge. Referred incidental recharge by OCWD.
2. Basin Production Percentage (BPP) is percentage of groundwater production out of the total water demand. BPP is set annually by OCWD. Historically, BPP has ranged from 64 to 80 percent.
3. Use of storage space is subject to approval by OCWD consistent with objectives for basin management

Figure 10-2
Hydrogeologic Cross Section of the Orange County Basin



The Upper aquifer system, which averages approximately 200 feet in thickness, consists of alluvial sediments and includes the Talbert aquifer and recent alluvium. The total storage of this aquifer system is estimated to be approximately five million AF (OCWD, 2004). However, only about five percent of the total basin production comes from this aquifer because of lower production rates and poorer water quality than the underlying aquifers.

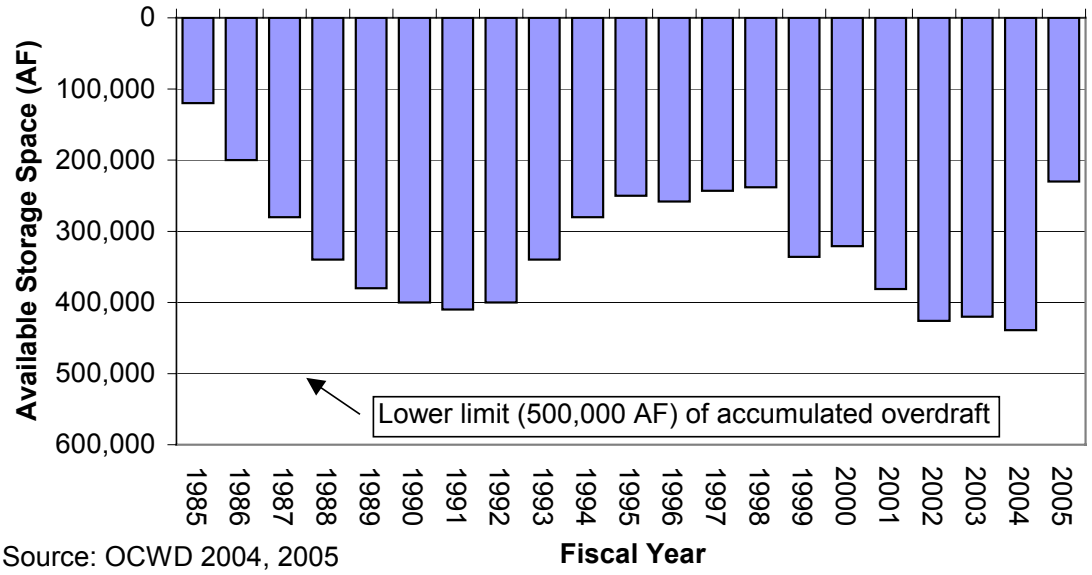
The Principal aquifer system averages approximately 1,000 feet in thickness and is the primary source of production in the Orange County Basin. The principal aquifers are located approximately 200 to 1,200 feet below ground surface (fbgs). This aquifer is correlative with portions of the Lakewood Formation and the San Pedro Formation of the Central and West Coast Basins in Los Angeles County. Orange County Water District (OCWD) estimates the total storage in this aquifer system is approximately 32.9 million AF (OCWD, 2004).

Deeper aquifers below the principal aquifer system comprise the Lower aquifer system (DWR, 2004), with a thickness of about 300 to 1,000 feet. Few wells produce from this aquifer because of the increased depth and the potential presence of colored water.

The total estimated volume of fresh groundwater capable of being stored in the Orange County Basin when it is completely full is estimated to be approximately 66 MAF by OCWD (2004). Based upon review of historical data, OCWD has established basin water contour levels, which represent a full basin. Volume in storage indicates how much storage space is available for use (defined as accumulated overdraft) within the Orange County Basin. OCWD estimates that between 400,000 and 500,000 AF of the total basin storage is actually usable (OCWD, 2004) in terms of emptying and filling operations. If groundwater levels are allowed to drop below the

lower limit (i.e. >400,000 AF of accumulated overdraft) there is an increased potential for seawater intrusion, increased potential for colored water upwelling, and increased potential for subsidence. However, the basin can be operated on a short-term emergency basis with an accumulated overdraft up to approximately 500,000 AF without causing irreversible seawater intrusion or land subsidence (OCWD, 2004 and 2006). If groundwater levels are allowed to rise to near-full conditions, outflow to the Central Basin can increase, local near-surface groundwater levels may occur, and there would be a decreased potential for capturing large amounts of recharge if it were to become available. Historical data are shown in **Figure 10-3**. As shown in **Figure 10-3**, the accumulated overdraft increased more than 100,000 AF between 2000 and 2004 to more than 400,000 AF as a result of a six-year drought on the Santa Ana River. Due to recent heavy rains and basin management activities, as of June 2006, the accumulated overdraft or available storage space was 135,000 AF. Of this amount, 100,000 AF is kept in reserve for capture of stormwater runoff during a potentially wet year and 35,000 AF would be available for other storage purposes. It is also important to note that storage varies substantially from year to year in the Orange County Basin.

Figure 10-3
Historical Available Storage Space in Orange County Basin



Source: OCWD 2004, 2005

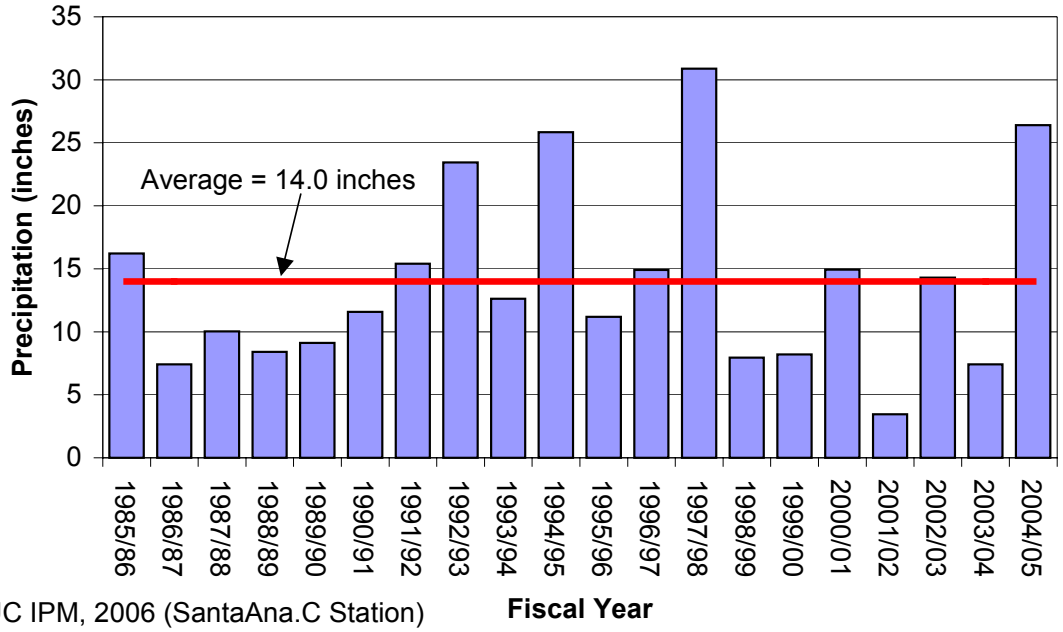
Safe Yield/Long-Term Balance of Recharge and Discharge

Recharge to the Orange County Basin is primarily by direct percolation of Santa Ana River water through highly permeable sands and gravels within the forebay areas. Recharge also occurs as a result of injection through wells at the Talbert and Alamitos seawater barriers, use of imported water for groundwater replenishment, wastewater reclamation and other water conservation practices. The natural yield of the Orange County Basin, which includes infiltrated precipitation, irrigation, and other native incidental recharge, has been estimated to be

approximately 70,500 AFY (OCWD, 2004). Active recharge in the Orange County Basin significantly increases the yield of the basin. For example, total recharge amounts (inclusive of natural incidental recharge and all active recharge) to the basin can vary between 300,000 AFY to 400,000 AFY and change annually depending upon the hydrology of the Santa Ana River, the amount of imported Metropolitan replenishment water that is purchased, the amount of water injected into the seawater barriers, and other incidental recharge. It is important to note that the Orange County Basin is not managed on a safe yield basis every year, but rather, as discussed below, is managed to maintain basin balance over the long-term.

Precipitation falling on the watershed contributing recharge to the Orange County Basin varies between the low lands and the flanking mountains depending on elevation. As measured at the Santa Ana Fire Station, approximately in the center of the basin, the average yearly precipitation over the 1985 through 2005 period is about 14 inches. **Figure 10-4** provides the historical precipitation data from the Santa Ana Fire Station over that period.

Figure 10-4
Historical Precipitation in the Orange County Basin



UC IPM, 2006 (SantaAna.C Station)

Groundwater pumping is the primary outflow from the basin. Groundwater production from the basin is managed by OCWD. As described below, the amount of groundwater producers can use is set annually and changes depending upon the management goals at that time. In fiscal year 2006/07, pumping is expected to be about 330,000 AFY. Annual pumping is expected to increase with the development of the Groundwater Replenishment System to 380,000 to 400,000 AFY.

GROUNDWATER MANAGEMENT

The following section describes how the Orange County Basin is currently managed. It includes a discussion of the governing structure within the basin and relationships with other adjoining basins.

Basin Management

The Orange County Basin is a managed basin. OCWD has managed the Orange County Basin since 1933 pursuant to a special act of the State legislature (West's Annotated California Codes, Water Code Appendix Chapter 50 as amended and Deering's California Codes Annotated Water Uncodified Acts.Act 5683). OCWD has managed the basin based upon the principle of seeking to increase supply rather than restricting access and to provide for uniformity of cost. **Table 10-2** provides a list of other agencies that OCWD may interact with in carrying out its mission.

The basin groundwater pumping is not operated on a safe-yield basis each year. Rather, the goal is to maintain an approximate balance over a period of several years. The amount of production from the basin is governed through financial incentives based on establishing an annual Basin Production Percentage (BPP), which is the percentage of groundwater production out of the total water demand for the Orange County Basin. Pumping up to the BPP is charged a fee on a per AF basis, i.e., the Replenishment Assessment (RA). Groundwater production above the BPP is charged the RA plus the Basin Equity Assessment (BEA). The BEA is typically set so that the cost of groundwater production above the BPP is similar to the cost of purchasing alternative supplies. Pumping agencies do not accrue individual storage rights if they pump less than the BPP, which is a major difference compared to most adjudicated basins. Additionally, agencies cannot transfer groundwater-pumping rights.

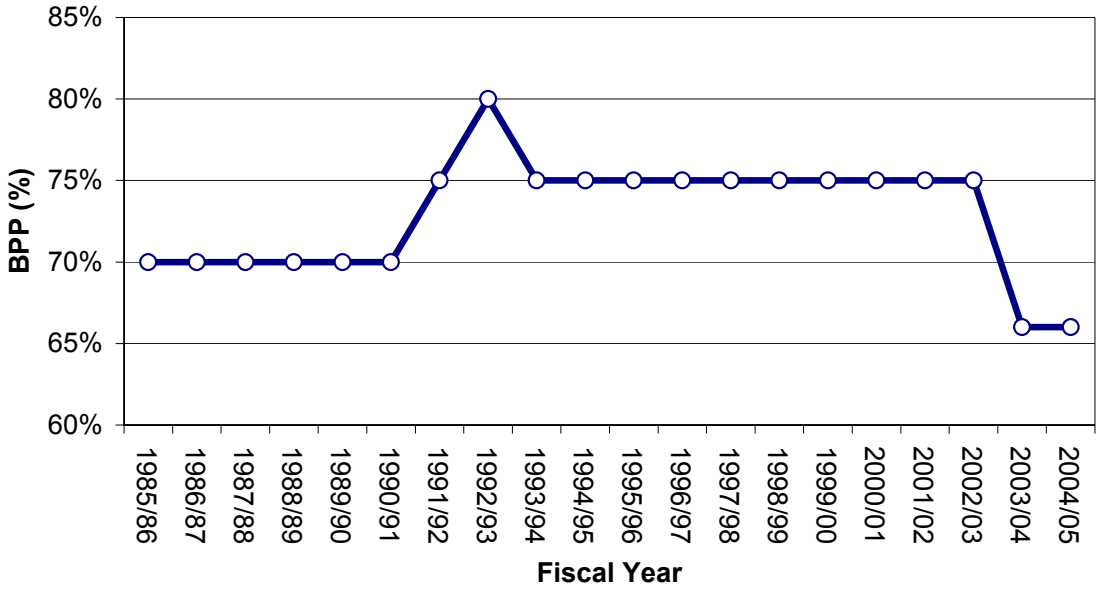
The basin is managed to provide approximately three years of drought supplies for the region. The accumulated overdraft target of 100,000 AF was in part set to meet this goal. If Santa Ana River supplies decline and/or Metropolitan replenishment water is not available, OCWD can generally sustain high pumping rates by overdrafting the groundwater basin for a three-year period down to an accumulated overdraft of 400,000 to 500,000 AF. The 100,000 AF target also provides sufficient storage space to capture excess water supplies that become available during very wet winters.

Figure 10-5 shows the historical BPP between 1985/86 and 2004/05. During this period, the BPP ranged from 66 percent to 80 percent. For the last 6 years of this period, Santa Ana River flows were significantly less than average. For the first four years of the drought (1998/99 through 2002/03) the BPP was maintained at 75 percent, which allowed for normal pumping levels. However, groundwater storage was reduced by approximately 230,000 AF during this period. Due to the continued drought conditions and seawater intrusion concerns, the BPP was reduced in fiscal year 2003/04 to 66 percent for two years and then lowered to 64 percent in fiscal year 2005/06. This lower BPP and heavy rainfall over the past few years has refilled the basin. As such, the BPP was raised to 69 percent for fiscal year 2006/07 and will be raised to 74 percent in fiscal year 2007/08.

Table 10-2
Summary of Water-Related Agencies in the Orange County Basin

Agency	Role
Orange County Water District	Basin Manager. Establishes and assesses production fees Monitors water levels and quality. Oversees recharge and seawater barriers operations.
Santa Ana Water Project Authority (SAWPA)	Joint Powers Authority established to plan and build facilities to protect the water quality of the Santa Ana River Watershed.
Municipal Water District of Orange County (MWDOC)	Provides imported water for direct recharge. Regional planning agency.
Orange County Sanitation District	Provides recycled water for injection at Talbert Barrier and spreading at the forebay
Santa Ana River Watermaster	Court-appointed oversight of 1969 Judgment governing Santa Ana River flows
Orange County Resources Development and Management Department	Operation of Placentia and Raymond recharge basins Coordinates operation of Santa Ana River
Los Angeles County Department of Public Works (LACDPW)	Operation of Alamitos Barrier Project
United States Army Corps of Engineers	Operation of Prado Dam
California Regional Water Quality Control Board – Santa Ana Region (Regional Board)	Sets and enforces Basin Water Quality Objectives. Issues permits for discharges to Santa Ana River. Oversees injection operations using recycled water.

Figure 10-5
Historical Basin Production Percentage in Orange County Basin



Interactions with Adjoining Basins

The Orange County Basin is downstream of Prado Dam in the Lower Santa Ana River area. On April 17, 1969, the Orange County Superior Court entered a Stipulated Judgment in Case No. 117628 involving the Orange County Water District vs. City of City of Chino et al.

The Judgment, which became effective October 1, 1970, contains a declaration of rights of the entities in the lower Santa Ana River area (i.e. OCWD) versus those in the upper Santa Ana River area (i.e. San Bernardino Valley Municipal Water District, or SBVMWD, Chino Basin MWD, now called IEUA, and Western MWD). The Judgment is administered by the Santa Ana River Watermaster, a committee of five members (one each from SBVMWD, IEUA and Western MWD and two from OCWD). Under this Judgment, purveyors upstream of Prado Dam have the right to use all surface and groundwater supplies originating above Prado Dam without interference from water purveyors downstream of Prado Dam, provided that the average adjusted base flow at Prado Dam is at least 42,000 AFY. Baseflows have ranged from approximately 38,000 AFY in 1970 to approximately 170,000 AFY in 2002. (Santa Ana River Watermaster, 2003). SBVMWD has an obligation to ensure an average annual adjusted base flow of 15,250 AFY at Riverside Narrows. IEUA and Western MWD have a joint obligation to ensure average annual adjusted base flow of 42,000 AFY at Prado Dam. OCWD is allocated all other flows reaching Prado Dam in addition to the average annual adjusted base flow of 42,000 AFY. Further, SBVMWD, IEUA and Western MWD are prohibited from exporting water from the lower area to the upper area while OCWD is prohibited from exporting water or causing water to flow from the upper area to the lower area (Santa Ana River Watermaster, 2003).

Approximately 1,000 to 14,000 AFY underflow or outflow from the Orange County Basin can occur northwestward across political boundaries into the Central Basin in Los Angeles County depending on the groundwater elevations on either side of the political 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 storage in the Orange County Basin.

OCWD has purchased water from the area of high groundwater in Bunker Hill Basin from San Bernardino Valley Municipal Water District. This water is spread in the recharge facilities along the Santa Ana River. A total of 7,084 AF of this water has been recharged since 2000.

OCWD also purchases water from the Arlington Desalter in the Arlington Basin for groundwater recharge in the Orange County Basin. This water is spread in the recharge facilities along the Santa Ana River. An average of approximately 3,800 AFY has been recharged since the Arlington Desalter came online in 1990. As demands increase in the Riverside and Norco areas, this supply source is likely to decline in the future. Brine from the Arlington Desalter is also delivered to the Orange County Sanitation District treatment facilities via the Santa Ana Regional Interceptor (SARI) line for treatment and discharge to the ocean.

OCWD has worked extensively with the United States Army Corps of Engineers (USACE) regarding the operations of Prado Dam to conserve Santa Ana River storm flows. During the winter storm season, the USACE will store water up to elevation 498 feet MSL, which creates a pool of approximately 13,000 AF. Beginning on March 15th of every year the USACE will store water up to elevation 505 feet MSL, which creates a pool of approximately 26,000 AF. The OCWD coordinates its recharge operations to empty these pools as quickly as possible without losing water to the Pacific Ocean to create storage space for future storms.

WATER SUPPLY FACILITIES AND OPERATIONS

The following section describes the water supply facilities within the Orange County Basin. Facilities include nearly 500 production wells, 800 monitoring wells, more than 1,000 acres of recharge ponds in the Forebay areas, two seawater intrusion barriers, three desalters, the Groundwater Replenishment System, the Prado wetlands and Prado Dam. OCWD has constructed numerous projects to support increases in basin pumping. These investments have resulted in a doubling of the basin's yield over the past 30 years.

Active Production Wells

Groundwater extraction from the Orange County Basin occurs from nearly 500 production wells. Average production in the Orange County Basin for the past 20 years was nearly 294,000 AFY. Approximately 97 percent of the production is municipal water supplied through approximately 200 large capacity wells. For example, groundwater production (excluding Metropolitan in-lieu supplies received) totaled 244,370 AF for the 2004/05 water year; of that amount 240,978 AF was for non-irrigation use. These data are summarized in **Table 10-3**.

Table 10-3
Summary of Production Wells in the Orange County Basin

Category	Number of Active Wells	Estimated Production Capacity[1] (AFY)	Average Production 1985/86-2004/05[2] (AFY)	Well Operation Cost ($/AF)
Non-Irrigation Wells (large and small capacity)	~300	420,000 to 440,000	293,645	O&M $65 Energy $56 **Total $111**
Irrigation Wells	~200			
Total	**~500**			

Source: OCWD, 2005 and Herndon, 2006
1. Based on analysis and estimates by MWDOC
2. Excludes Metropolitan long-term in-lieu replenishment water deliveries

Figure 10-6 shows historical production in the Orange County Basin. In the five-year period between 2000/01 and 2004/05, groundwater production declined from about 350,000 AFY in fiscal year 2000/01 to less than 245,000 AFY because, as discussed above, the BPP was adjusted to increase the amount of water stored in the basin (see **Figure 10-5**).

Orange County Basin producers participate in a variety of in-lieu groundwater storage programs whereby they receive imported water from Metropolitan in lieu of pumping groundwater. Historically, these programs have included Metropolitan's, short-term shift (seasonal), cyclic water, replenishment water and conjunctive use programs. The long-term in-lieu storage (cyclic, replenishment or conjunctive use programs) amounts are included in **Figure 10-5**. Short-term shift totals, since they are seasonal in nature, are not shown in this figure. Between fiscal years 1985/86 and 2004/05, on average, about 28,000 AFY was stored via long-term in-lieu. These and other storage programs are discussed in more detail below.

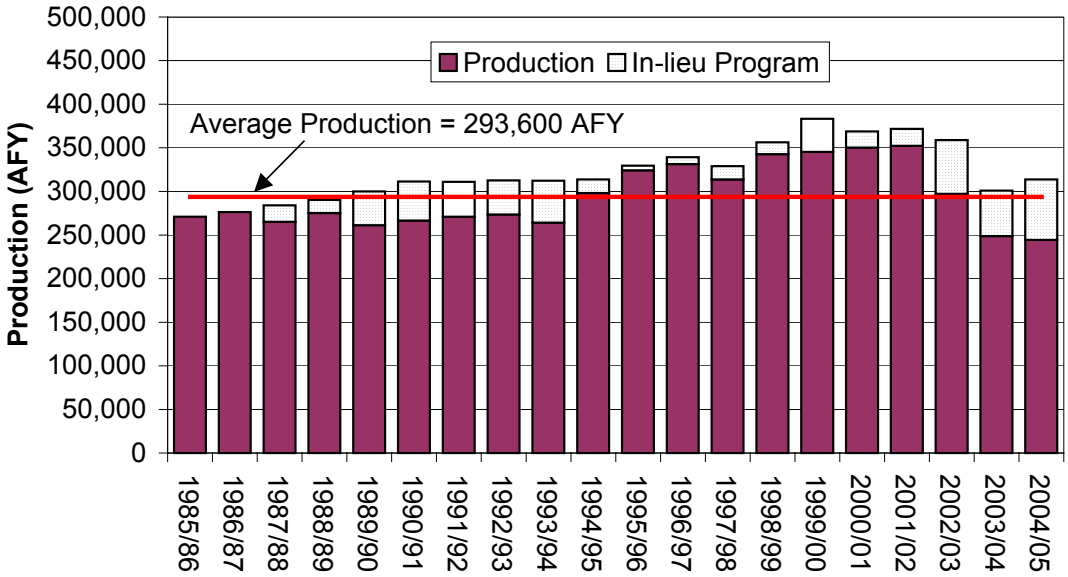
Other Production

The primary groundwater production in the Orange County Basin, other than municipal usage, is for agricultural irrigation as summarized in **Table 10-3**. The volume of agricultural production has been steadily declining with increasing urban development of agricultural lands.

ASR Wells

There currently are no ASR wells in the Orange County Basin.

Figure 10-6
Historical Groundwater Production in the Orange County Basin



Source: OCWD 2004, 2006

Spreading Basins

The OCWD currently owns and operates more than 1,000 acres of ponds in and adjacent to the Santa Ana River and Santiago Creek, as shown on **Figure 10-1**. **Table 10-4** provides details of the recharge basins size and spreading capacity, which can vary significantly depending upon their cleanliness. Over a few months, the bottom of the recharge basins can become clogged with fine silts, which greatly diminishes their spreading capacity. These facilities currently provide for the infiltration of approximately 250,000 AFY (OCWD, 2004). Water sources used for recharge include Santa Ana River baseflow and stormflow, Santiago Creek flows, imported water from Metropolitan and from the upper Santa Ana River Watershed, and previously treated water from OCWD's Water Factory 21 and now the Groundwater Replenishment (GWR) System. **Figure 10-7** shows historical groundwater recharge in the Orange County Basin. OCWD spread an average of approximately 217,000 AFY between fiscal years 1985/86 and 2004/05.

Wetlands

OCWD owns 1,400 acres of land behind Prado Dam. Approximately 400 acres have been developed into wetlands. About 50 percent of the Santa Ana River base flows (up to 120 cfs) are diverted through the wetlands where they receive natural treatment that significantly reduces

nitrate concentrations. These wetlands provide a significant water quality benefit to the Orange County Basin.

Table 10-4
Summary of Spreading Basins in the Orange County Basin

Recharge Basin/System	Area (acres)	Recharge Capacity (cfs)[1]	Source water	Owner
Main Santa Ana River	245	80 to 130	Runoff[2] Imported	OCWD
Off-River	126	15 to 40	Runoff[2] Imported	OCWD
Deep Basin	285	90 to 390	Runoff[2] Imported	OCWD and OC Resources Development and Management Department
Burris Pits/ Santiago Basin	378	110 to 220	Runoff[2] Imported	OCWD
Total	**1,034**	**313 average[3]**	**--**	**--**

Source: OCWD, 2004
[1]Percolation rate range represents clogged and clean capacities
[2]The primary source of recharge water enters the facilities from the Santa Ana River downstream of Prado Dam.
[3]Average for period 1989 to 2005

Seawater Barriers

The portion of the basin within 5 miles of the coast, particularly in the geologic gaps previously discussed, is sensitive to seawater intrusion due to lower groundwater levels. To protect the fresh groundwater in the basin from seawater intrusion, OCWD injects water into the Talbert and Alamitos barriers, which are shown on **Figure 10-1**. Details of the barriers are provided in **Table 10-5.** The total annual volume of water injected into the barriers is included in **Figure 10-7**. During the 2004/05 fiscal year about 19,800 AF of water was injected into the barriers (OCWD, 2006). An average of approximately 11,500 AFY was injected into the barriers between fiscal years 1985/86 and 2004/05.

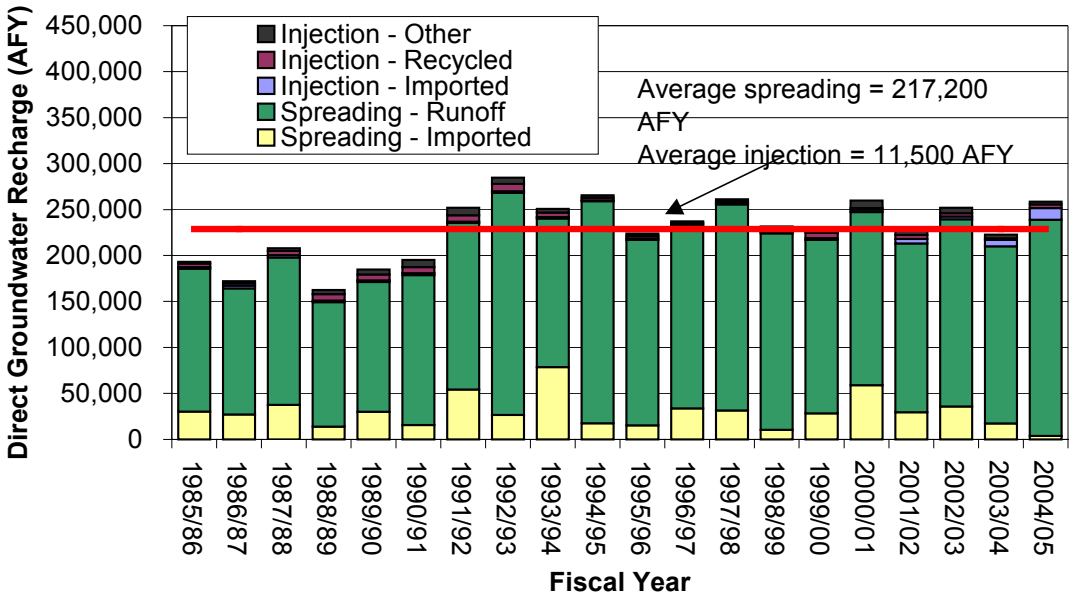
The Talbert Barrier, in operation since 1975, is composed of a series of 26 injection wells that span the 2.5 mile wide Talbert Gap in Fountain Valley. Historically, a mixture of wastewater treated at Water Factory 21 and deep well water was pumped to the wells and injected into the shallow aquifer systems. Since 2003, imported water from Metropolitan has also been injected.

Water Factory 21 was decommissioned in 2004 and is being replaced with the GWR System, which will include 12 new wells and increase the injection capacity to 40 MGD. The GWR System will produce a total of 72,000 AFY of new water supplies. Up to half of the water will be annually injected into the Talbert Barrier. The remaining supplies will be pumped to OCWD's spreading facilities in Anaheim for recharge in the Forebay area (OCWD, 2004). The GWR System is expected to be constructed and fully on line by September 2007.

Table 10-5
Summary of Seawater Intrusion Barriers in the Orange County Basin

Seawater Barrier	Number of wells	Injection capacity (AFY)	Source water	Owner
Talbert Barrier	38	40,000	Recycled Groundwater Imported	OCWD
Alamitos Barrier Project	43	11,000	Recycled Imported	LACDPW OCWD
Total	**69**	**53,000**	**--**	**--**

Figure 10-7
Historical Groundwater Recharge in the Orange County Basin



The Alamitos Barrier Project consists of 43 wells with a combined injection capacity of 15 cfs and 4 extraction wells in the Alamitos Gap in Long Beach and Seal Beach (DWR, 2005;WRD, 2006d). The barrier straddles the political boundary between the Central and Orange County basins and is operated by LACDPW in cooperation with OCWD and Water Replenishment District of Southern California (WRD). Up to 11,000 AFY could be injected. The barrier utilizes imported water purchased from the City of Long Beach or recycled water from WRD's Leo J. Vander Lans Advanced Water Treatment Facility. Prior to 2005, recycled water was not injected in the Alamitos Barrier Project. WRD began delivering recycled water for injection in water year 2005/06.

Desalters

The Irvine Desalter is a joint groundwater quality restoration project by the Irvine Ranch Water District (IRWD), OCWD, MWDOC, Metropolitan, and the United States Navy to employ two water purification plants to address a shallow plume of VOCs that exists beneath the former El Toro Marine Corp Air Station, which is moving toward the Main Orange County Basin. One plant removes TDS and VOCs from the contaminated groundwater and the treated water is used for irrigation and recycled water purposes (OCWD, 2004). The second plant removes TDS and nitrate from the shallow groundwater aquifer outside the former El Toro Marine Corps Air Station plume to provide a new drinking water source (OCWD, 2004).

The Tustin Seventeenth Street Desalter is operated to reduce primarily shallow groundwater with high nitrate and TDS levels produced from the Seventeenth Street Wells Nos. 2, 4 and Tustin's Newport Well. The treated water is blended back with produced native water producing up to 3,000 AFY of potable water (OCWD, 2004).

GROUNDWATER LEVELS

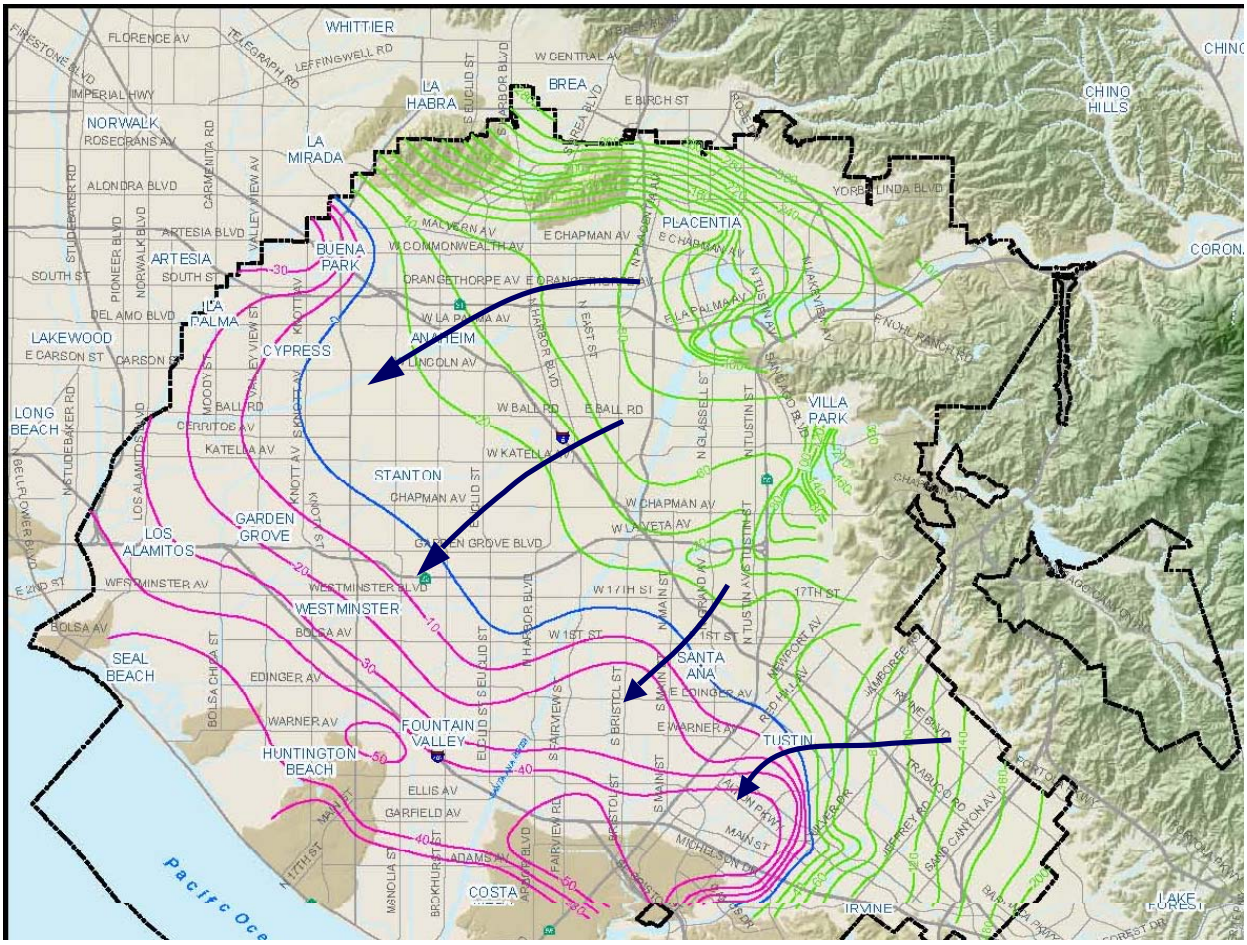
Historically, groundwater flow in the Orange County Basin has been from the recharge areas in the north toward the Pacific Ocean. As shown in **Figure 10-8**, in November 2005, Orange County Basin water levels ranged from a high of about 300 feet above mean sea level (MSL) in the north portion of the basin upgradient of the spreading grounds to a low of about 80 feet below MSL in the coastal areas.

Historical water levels in key wells in various locations in the basin are summarized in **Figures 10-9 and 10-10**. The locations of the wells plotted are shown in **Figure 10-1**. These data show that water levels in the Forebay area where the aquifers are merged generally experience higher water levels and are relatively stable with annual variations on the order of 50 feet. In the Pressure area, water levels in the underlying aquifers are generally below sea level. Water levels generally correlate with the change in storage discussed above. Seasonal variations in water level in the Pressure area are as much as 100 feet. Water levels in the key well in south-central pressure area decreased up to 70 feet between 1985 and 2004. Water levels in other key wells are essentially unchanged in this same period.

Land subsidence due to groundwater withdrawal is common in groundwater basins. Slight subsidence has been observed in Santa Ana, which may be due to groundwater withdrawal, and

in the Huntington Beach area, likely due to oil withdrawal (OCWD, 2004). In the period between 1993 and 1999, land surface elevations declined about 0.5 inches per year in Santa Ana (OCWD, 2004). Despite the indications of land subsidence in the Orange County Basin, there has been no indication that these decreases have resulted in damage. By managing groundwater levels and storage, the potential for land subsidence can be reduced (OCWD, 2004).

Figure 10-8
Groundwater Elevation Contours – November 2005

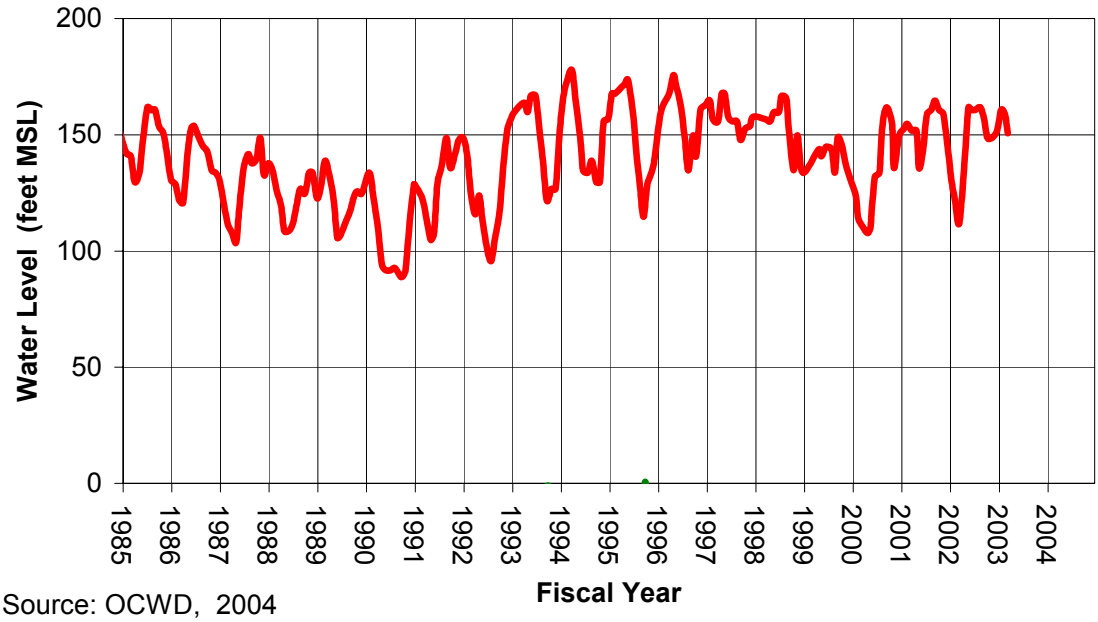


Source: Herndon, 2006

GROUNDWATER QUALITY

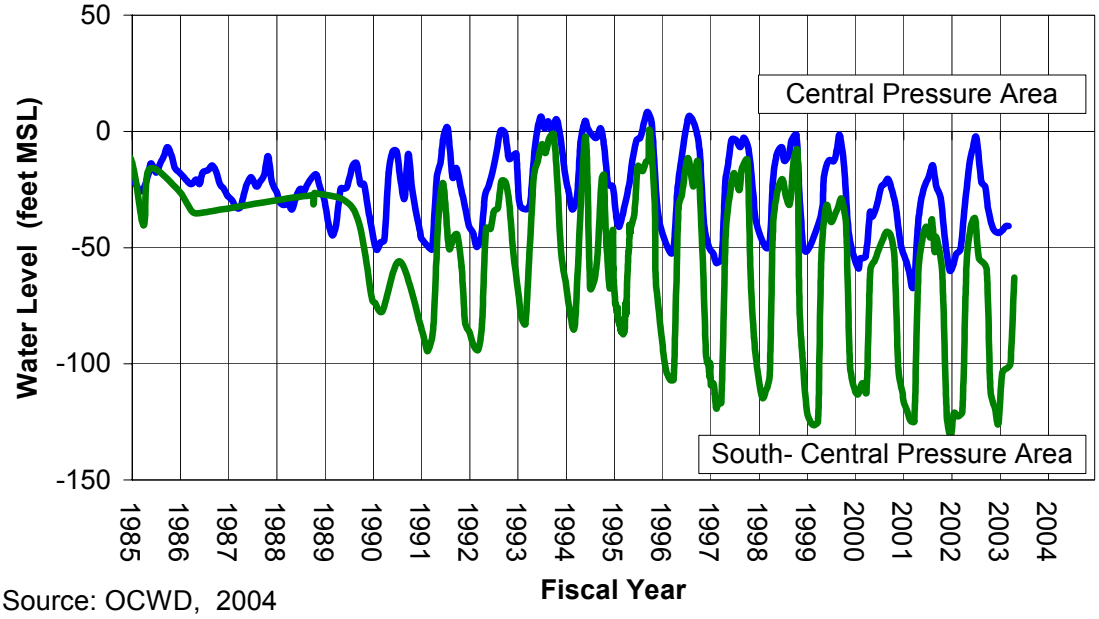
In general, groundwater in the main producing aquifers of the basins is of good quality with an average concentration of total dissolved solids (TDS) in the basin of 441 mg/L (OCWD, 2006). Ninety to 95 percent of basin pumping is from the main aquifers. A few localized areas of shallow contamination exist in the basin, however, very little water is pumped from the shallow aquifers. Additionally, OCWD has implemented active projects and programs to remove contaminants from the shallow aquifers before they can migrate into the main producing aquifers.

Figure 10-9
Historical Water Levels in the Forebay Area



Source: OCWD, 2004

Figure 10-10
Historical Water Levels in the Pressure Area



Source: OCWD, 2004

The following section provides a brief description of groundwater quality issues in the Orange County Basin. The discussion includes a description of current monitoring program, constituents of concern, and treatment operations in the basin.

Groundwater Contaminants

Key constituents of concern for the Orange County Basin include: total dissolved solids, nitrate, volatile organic compounds (VOCs), perchlorate, colored water, and NDMA. The nitrate and VOC contaminants are located in the shallow aquifers and none of these contaminants have significantly impacted the groundwater basin's operation. In many portions of the groundwater basin, shallow water is prevented from migrating into deeper aquifers due to aquitards (impervious formations). Additionally, OCWD has aggressively initiated programs to address contaminants of concern before they become larger issues. A summary of these constituents is provided in **Table 10-6**.

TDS concentrations range from 221 mg/L in Seal Beach area to more than 1,000 mg/L in portions of the Irvine subbasin (OCWD, 2006). Increasing concentrations in forebay areas of the Main basin are shown in **Figure 10-11**, which have led to management approaches such as using low TDS groundwater replenishments and desalters. Areas of high TDS (>1,000 mg/L) in the Irvine subbasin areas are shown in **Figure 10-12**.

Nitrate concentrations generally range from 4 to 7 mg/L in Forebay and 1 to 4 mg/L in the Pressure area with an average of about 2.2 mg/L (OCWD, 2004; OCWD, 2006). Areas with concentrations above 10 mg/L are located in inland areas. Nitrate concentrations that exceed the MCL occur only in a small number of areas in the Orange County Basin (OCWD, 2004). Nitrate plumes that are generally located in the shallow aquifers in the basin are shown in **Figure 10-12**.

Localized shallow aquifer areas, as shown in **Figure 10-12**, are also affected by high concentrations of volatile organic compounds (VOCs), most notably trichloroethylene (TCE) and tetrachloroethylene (PCE). OCWD has active remediation projects to remove these VOC and nitrate contaminants before they reach the Principal aquifer system.

Perchlorate has primarily been detected in the Forebay area and in only one well in the Orange County Basin at concentrations at or below the current State notification level of 6 μg/L.

As discussed above, the presence of colored water is significant in the Orange County Basin. However, colored groundwater is limited to the Lower aquifer system primarily near the coast and ranges from 25 color units to 230 color units. The area of colored groundwater is shown in **Figure 10-13**. Most production wells along the coast pump from the Principal aquifer, which is above the colored water.

Blending Needs

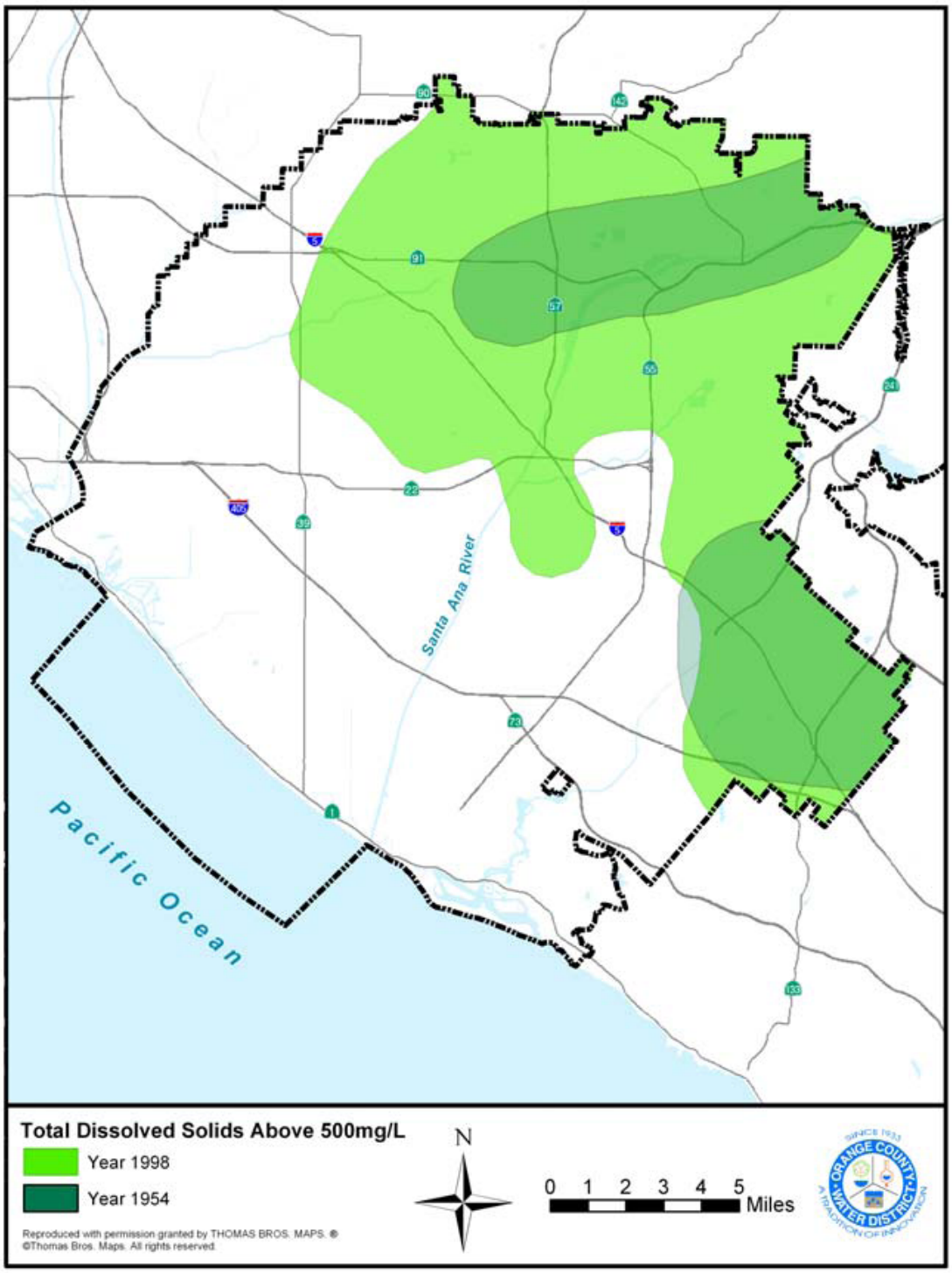
The local retail producers serve a blend of groundwater and MWD imported water supplies. The blend percentage primarily depends upon the BPP. The average TDS of blended water in agency systems ranges from 315 mg/L to 560 mg/L with an average of 450 mg/L. Nitrate concentrations of blended water range from 0.1 to 3.5 mg/L with an average of 1.4 mg/L (OCWD, 2006).

Table 10-6
Summary of Constituents of Concern in the Orange County Basin

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	221 to > 1,000 Average ~ 441	Range from 221 mg/L in Seal Beach area to more than 1,000 mg/L in portions of Irvine subbasin. Increasing concentrations in Forebay areas.
Nitrate (as N) MCL = 10	mg/L	ND to >10 Average ~ 2.2	Associated with former agricultural activities. Concentrations range from 4 to 7 mg/L in Forebay and 1 to 4 mg/L in the pressure areas. Localized shallow aquifer areas with concentrations above 10 mg/L are located in inland areas. No production wells are impacted by nitrate.
VOCs **(TCE and PCE)** TCE MCL = 5 PCE MCL = 5	µg/L	ND to >5 for TCE ND to 5.5 for PCE	VOCs found beneath El Toro Marine Corps Air Station and central Irvine in 1985. Found in Forebay areas in 1989. Limited to shallow zones in Forebay. PCE found in well in Santa Ana.
Perchlorate Notification level =6	µg/L	ND to 6	Occurs primarily in Forebay area and one well in Santa Ana. No production wells are impacted by perchlorate.
Color Secondary MCL =3	Units	ND to 230	Colored groundwater is limited to Lower aquifer system near the coast. Range in colored water zone ranges from 25 color units to 230 color units.
NDMA Notification level = 10	ng/L	ND to >10	One well along the coast is treated for NDMA

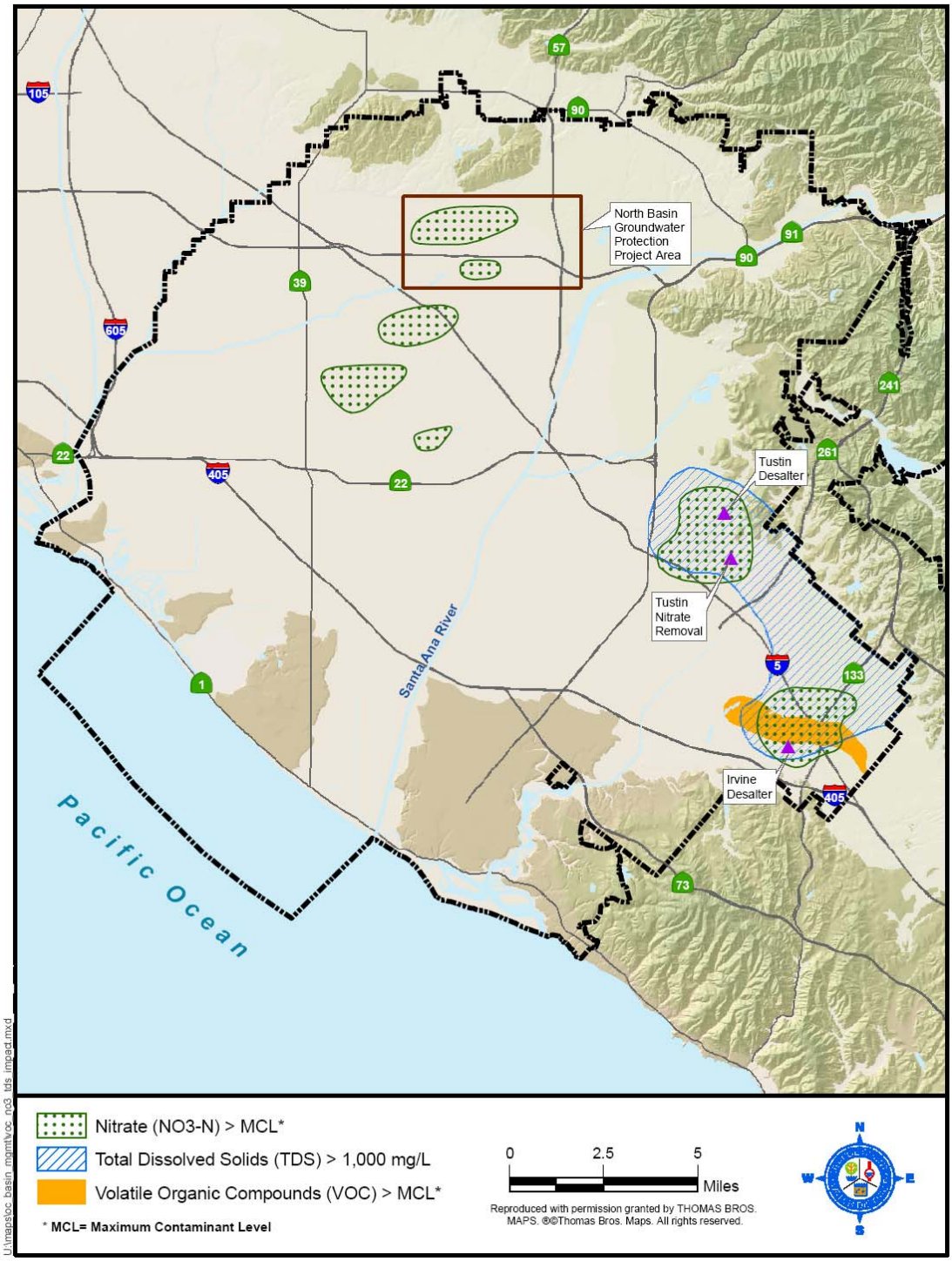
Source: OCWD, 2004, 2006

Figure 10-11
Areas Containing TDS above 500 mg/L in Orange County Basin



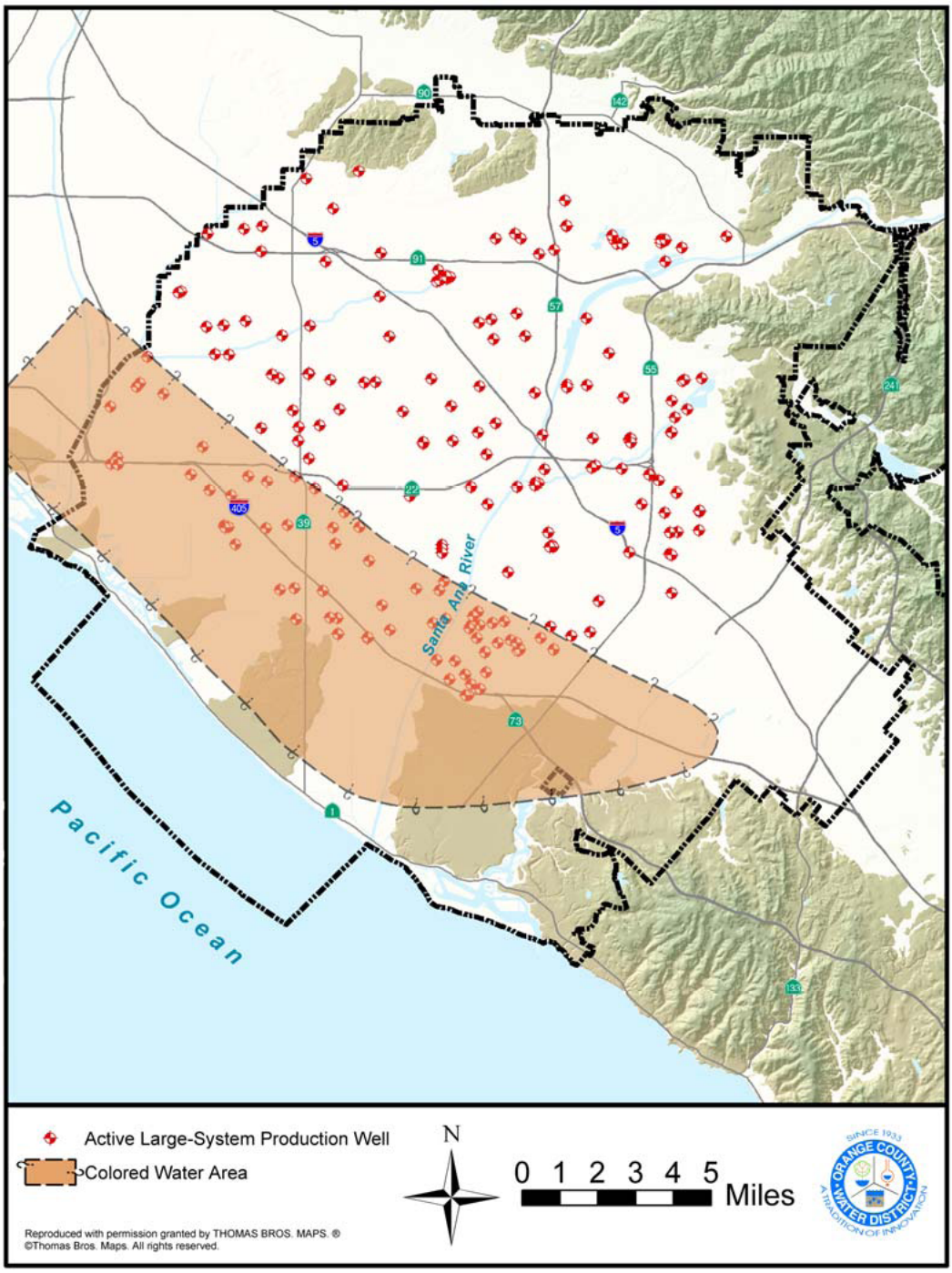
Source: OCWD, 2004

Figure 10-12
Areas Impacted by Nitrates, Salts, and VOCs in Orange County Basin



Source: OCWD, 2007

Figure 10-13
Areas of Colored Water in the Orange County Basin



Source: OCWD, 2004

Groundwater Treatment

Six treatment projects are in effect to lower nitrate, TDS, VOC, iron and manganese, NDMA and color to acceptable levels in groundwater produced from several wells totaling approximately 20,000 AF in 2006. The locations of the treatment facilities are shown in **Figure 10-14**.

CURRENT GROUNDWATER STORAGE PROGRAMS

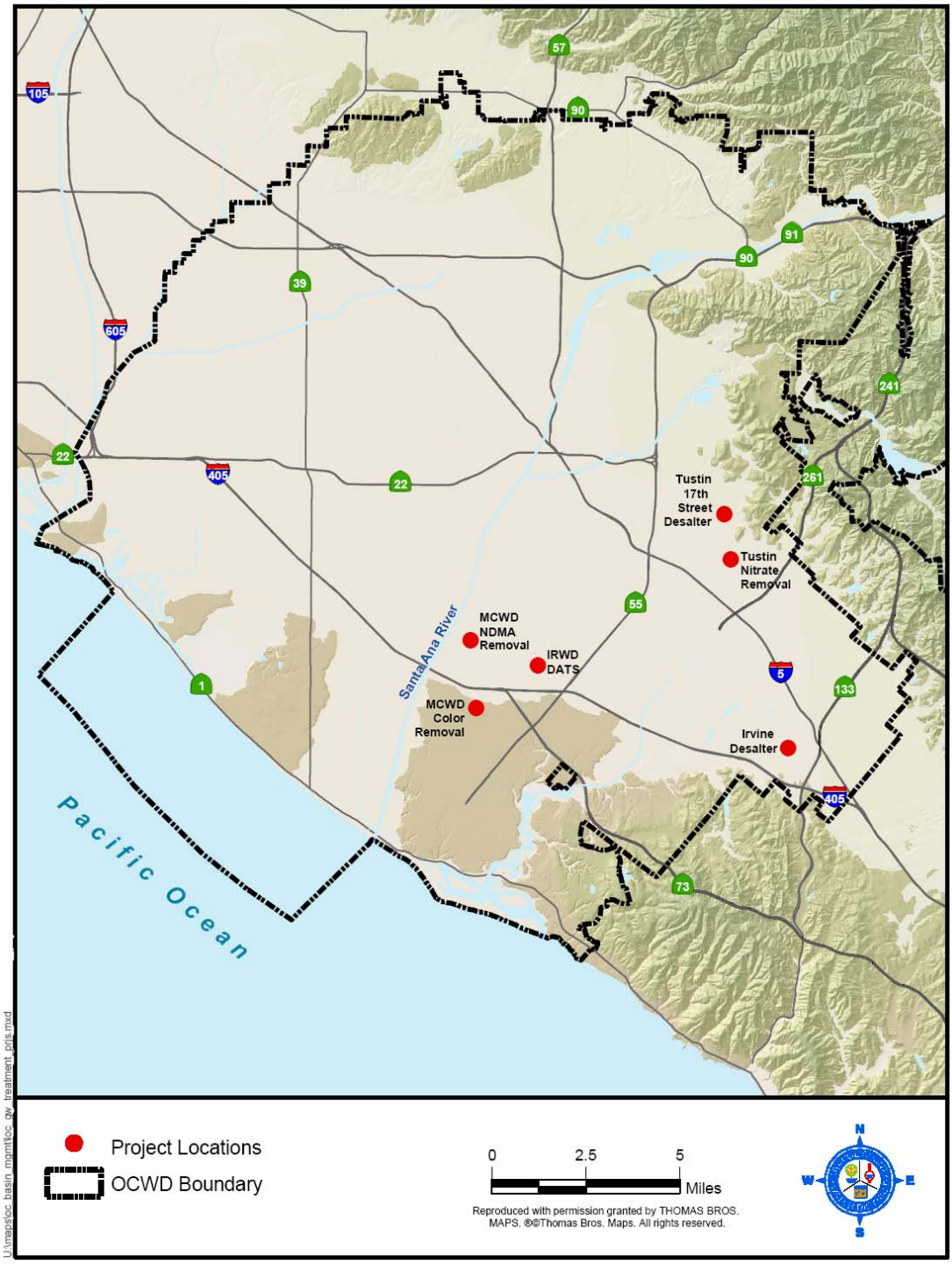
Orange County Basin producers have participated in a variety of groundwater storage programs with Metropolitan since 1985. These include Metropolitan's short-term shift, cyclic water, and replenishment water programs for purchase of imported water for recharge and in-lieu. Direct recharge volumes are discussed above.

In-lieu deliveries are summarized in **Figure 10-15**. An average of approximately 27,800 AFY was stored in-lieu in the Orange County Basin between fiscal years 1985/86 and 2004/05. On average about 15,500 AFY of short-term seasonal shift water (i.e. stored and extracted in same year) was also delivered.

In June 2003, OCWD and Metropolitan entered into an agreement for the Orange County Conjunctive Use Program (Orange County CUP). The Orange County CUP allows Metropolitan to store up to 66,000 AF in the basin to be taken later by Metropolitan in-lieu of providing imported supplies during water shortage events. The balance at the end of fiscal year 2005/06 was approximately 35,500 AF.

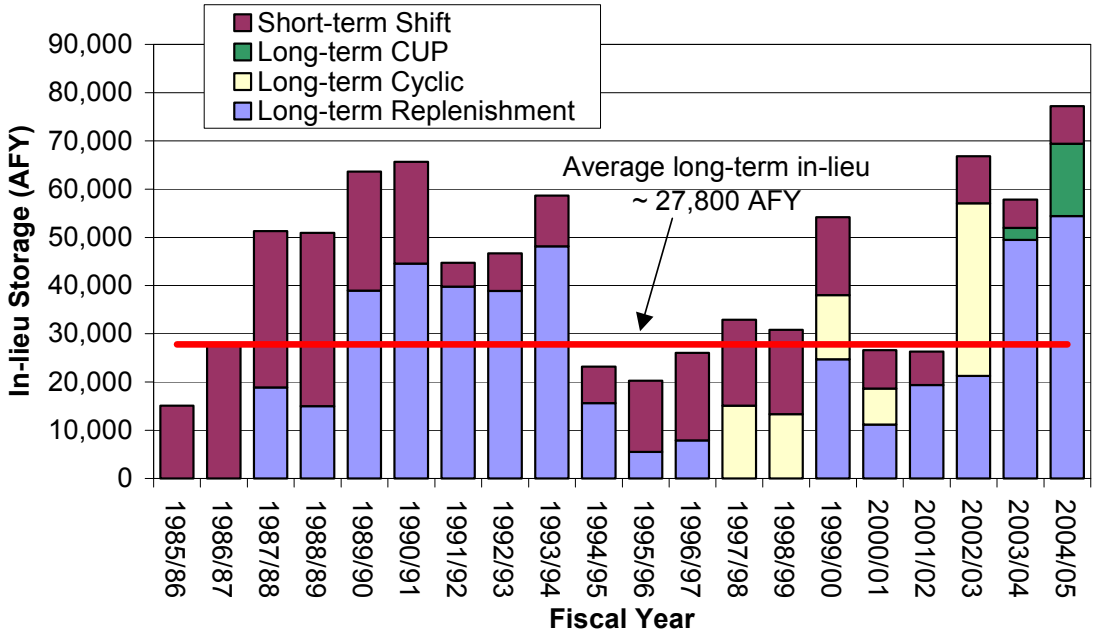
In addition to replenishment and CUP storage, Metropolitan and MWDOC entered into an agreement in late 2005 for delivery of supplemental storage water. After a combined 80,000 AF had been taken via the replenishment and CUP programs, MWDOC could purchase additional imported water for storage in the Orange County Basin at a discounted rate before June 30, 2006. This water would be stored in the Orange County Basin for five years. Metropolitan could call the water during this time period. After five years, this water would revert to the Orange County Basin. 16,000 AF of water was placed into this account.

Figure 10-14
Locations of Groundwater Treatment Projects in the Orange County Basin



Source: OCWD, 2007

Figure 10-15
Historical In-Lieu Storage in the Orange County Basin



Source, MWD 2006

BASIN MANAGEMENT CONSIDERATIONS

The following describes the basin management considerations in the Orange County Basin. Considerations include:

- The basin is managed to provide a sustainable yield of groundwater to the OCWD region.
- Recharge via spreading or injection is a key management strategy for the Orange County Basin. An average of about 229,000 AFY was recharged between 1985 and 2004.
- Groundwater production in the basin is limited by the BPP. OCWD sets the BPP each year to manage the groundwater basin. The BPP has ranged from 64 percent to 80 percent of total water demand.
- The potential for seawater intrusion primarily limits the utilization of the basin unless additional seawater barrier facilities are constructed. Current groundwater improvement projects and the construction of the GWR System at the Talbert Barrier have increased the groundwater utilization.

References:

Banks, Harvey O, Consulting Engineer, 1984. Groundwater Management, Irvine Area, Orange County. Prepared for Orange County Water District.

California Department of Water Resources (DWR), 1967. Progress Report on Ground Water Geology of the Coastal Plain of Orange County.

California Department of Water Resources (DWR), 2004. California's Groundwater, Bulletin 118 Coastal Plain of Orange County Basin. Updated 2/27/04. Website: http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/8-1.pdf Accessed 6/27/07.

Herndon, Roy. 2006. Managing the Orange County Groundwater Basin. Powerpoint presentation dated June 29, 2006.

Mills, William, R. and Associates, 1987. Hydrogeology of the Yorba Linda Subarea and Impacts from Proposed Class III Landfills. Prepared for Orange County Water District.

Orange County Water District (OCWD), 2004. Groundwater Management Plan.

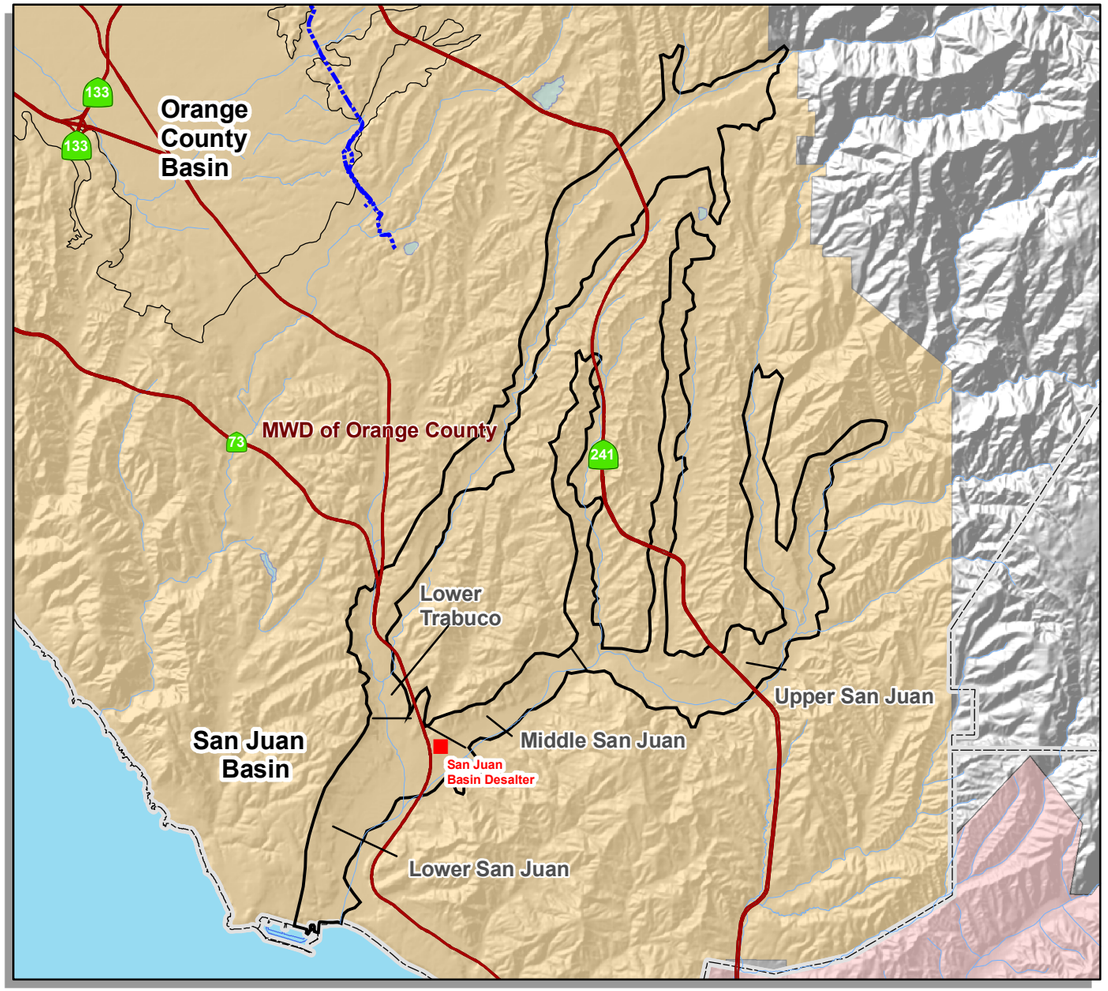
Orange County Water District (OCWD), 2006, 2004-2005 Engineer's Report on Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District.

Orange County Water District (OCWD), 2007. Electronic transmission of graphics files from John Kennedy, January 26, 2007.

Singer, John A., 1973. Geohydrology and Artificial Recharge Potential of the Irvine Area, Orange County California, USGS Open File Report 73-264.

Superior Court of Orange County. 1969. Stipulated Judgment in Case No. 117628 Orange County Water District vs. City of City of Chino et al.

University of California Statewide Integrated Pest Management Program (UC IPM), 2006. Precipitation Data.



San Juan Basin

Freeways
County
Stream
Water Body
MWD Pipeline
MWD Member Agency Boundary (color varies)
Basin
Desalter

Note: This map was prepared by the Metropolitan Water District of Southern California for its own use. No warranty is expressed or implied as to the correctness, timeliness, or content of the information shown herein.

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Additional Data Sourse(s): Santa Ana Watershed Project Authority (SAWPA); California Spatial Information Library (CaSIL).

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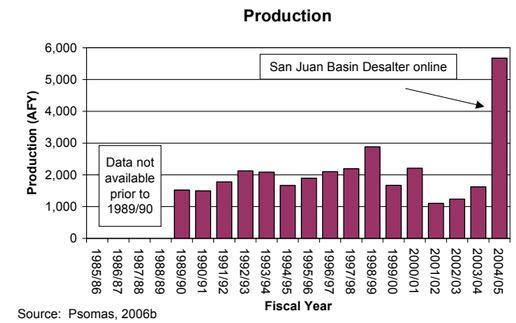
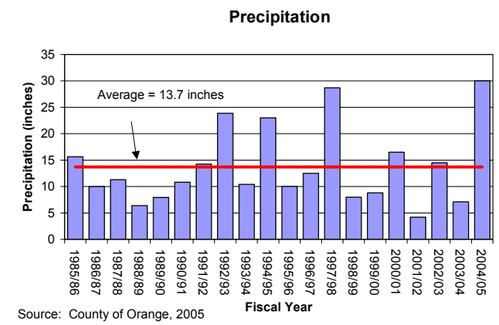


Source: Psomas, 2006b



Source: County of Orange, 2005

Direct Recharge
No direct groundwater recharge for this basin

BASIN FACTS

San Juan Basin

Description
Location: Southern Orange County
Watershed Surface Area: 26 square miles
MWD Member Agency(s):
Municipal Water District of Orange County
Management: Unadjudicated
Groundwater managed by the San Juan Basin Authority since 1971.

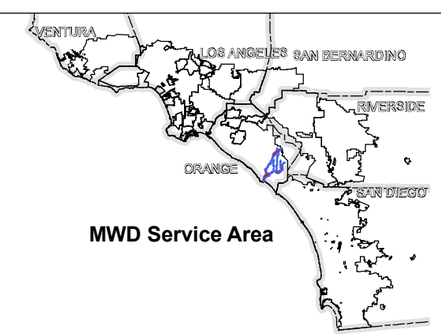
	San Juan
Safe Yield	7,300 to 7,800 AFY
Total Storage	90,000 AF
Unused Storage Space	Unknown
Portion of Unused Storage Space Available for Storage	Unknown

Storage and Extraction Facilities

	San Juan
Production Wells	
Production Capacity	~14,800 AFY
Average 1989/90-2004/05	2,079 AFY
Injection Wells	
Injection Capacity	None
Average 1985/86-2004/05	None
Spreading Basins	
Spreading Capacity	None
Average 1985/86-2004/05	None

Basin Management Considerations

- Allowable quantities of water that may be diverted and pumped are specified in the water rights permits administered by the State Water Resources Control Board.
- Except for the Upper San Juan, the TDS of most of the groundwater in storage in the main part of the groundwater basin is too high for domestic water use. Groundwater is treated by the San Juan Basin Desalter, which increases the usability of the basin in the future.
- Shallow groundwater limits the ability to store significant supplies.



MWD Service Area

Plate 11-1
Overview of San Juan Basin

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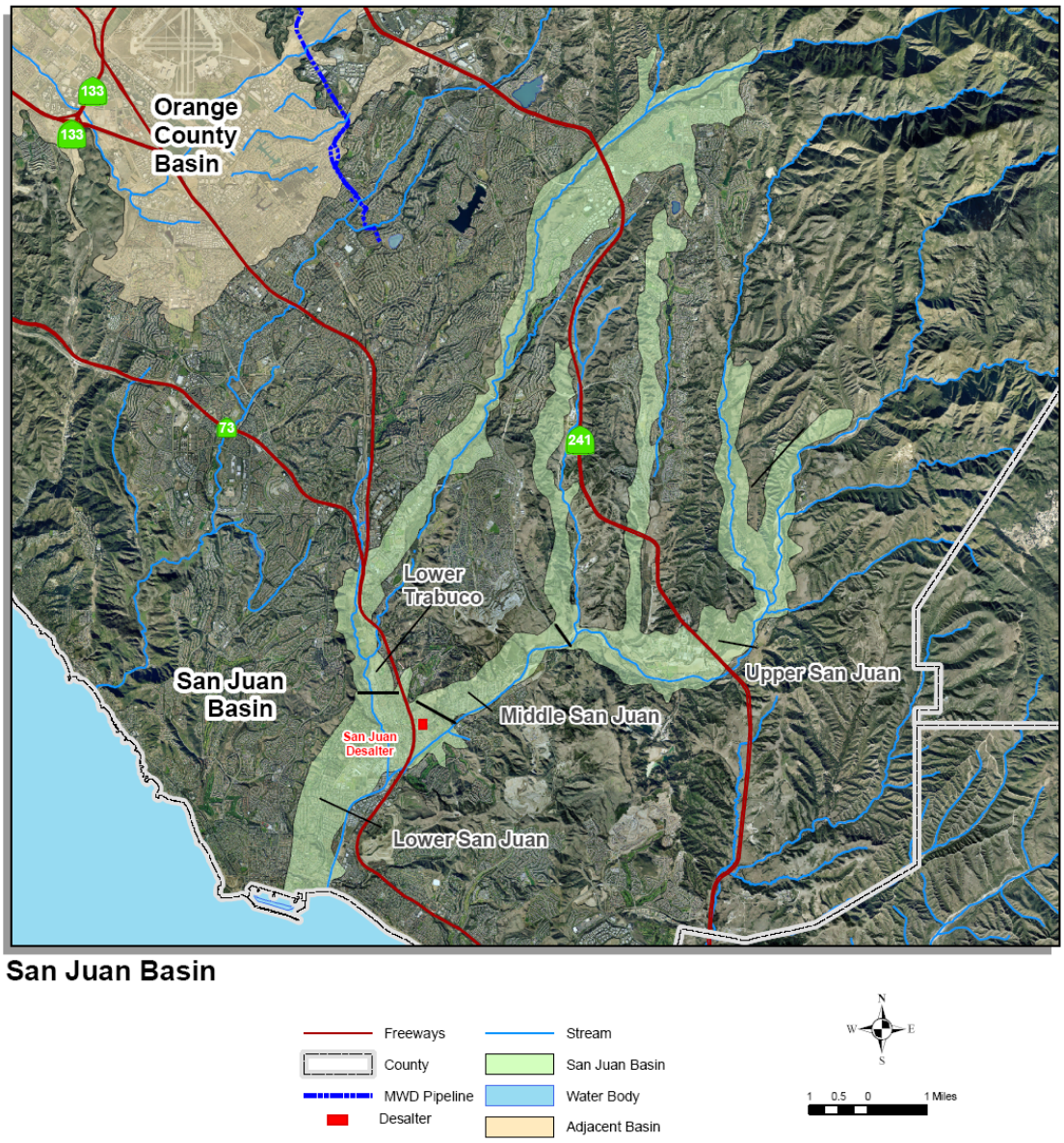
The San Juan Basin is located in southern Orange County within the San Juan Creek Watershed. The basin is comprised of four subbasins: Upper San Juan, Middle San Juan, Lower San Juan and Lower Trabuco. The San Juan Basin is within the service area of Metropolitan member agency Municipal Water District of Orange County (MWDOC) and underlies portions of the communities of Mission Viejo, San Juan Capistrano, Dana Point, and unincorporated areas of southern Orange County. A map of the basin is provided in **Figure 11-1**.

Figure 11-1
Map of the San Juan Basin



BASIN CHARACTERIZATION

The following section provides a physical description of the San Juan Basin including its geographic location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

Groundwater exists in generally narrow, shallow unconfined alluvium that has been deposited in the San Juan Canyon area and its tributaries: Arroyo Trabuco, Oso, and other smaller canyons. The basin is bounded on the southwest by the Pacific Ocean and otherwise by Tertiary marine sedimentary rocks, which underlie the surrounding hills and the alluvium. The alluvium consists of a heterogeneous mixture of sand, silt, and gravel in the eastern portion of the basin, to coarse sand near the center, to silts, clays, coarse sand, fine gravel and sediments in the southern portion of the basin (DWR, 2004, MWDOC, 2006a). The alluvium ranges in depth from about 200 feet at the coast to essentially zero at the upper ends of the small alluvial tributaries to the main canyons (NBS Lowry, 1994). A summary of the basin characteristics is provided in **Table 11-1**.

Table 11-1
Summary of Hydrogeologic Parameters of San Juan Basin

Parameter	Description
Structure	
Aquifer(s)	Unconfined alluvium; confined zones near the coast.
Depth of groundwater basin	< 20 feet to >200 feet
Yield and Storage	
Safe Yield	7,300 to 7,800 AFY
Total Storage	63,220 to 90,000 AF
Unused Storage Space	Unknown
Portion of Unused Storage Available for Storage	Unknown

Sources: County of Orange, 2006; DWR, 1972; NBS Lowry, 1994

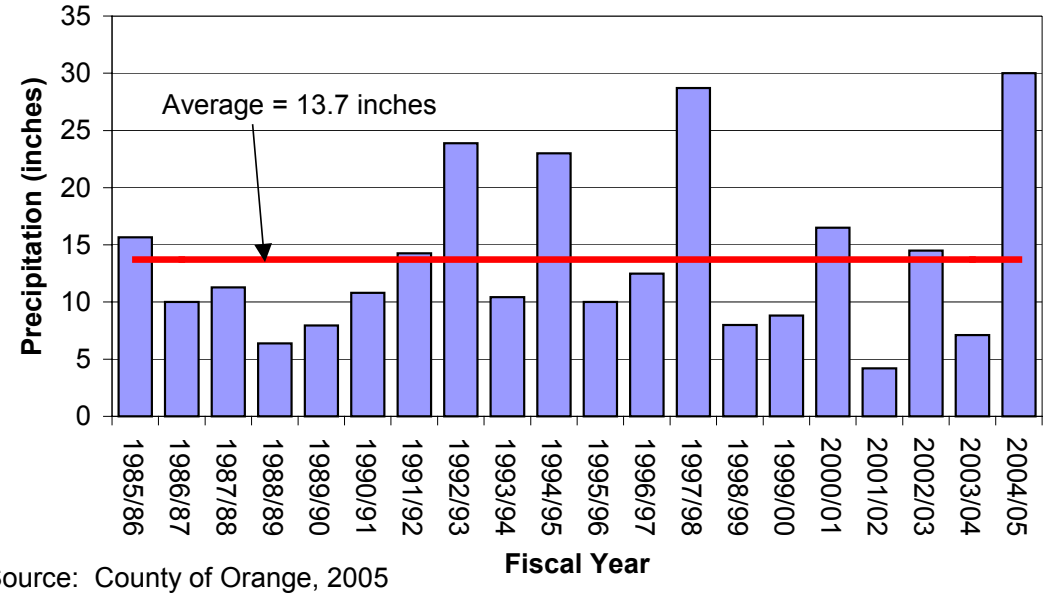
The main structural feature influencing groundwater movement is the Cristianitos Fault, which crosses San Juan Canyon in a north-south direction where it forms a narrow section at the confluence of San Juan Creek and Canada Chiquita. At the fault and canyon narrows, groundwater is forced to the surface, and the Upper Basin is separated from the Lower Basins. As shown on **Figure 11-1**, the Lower Basins include the Lower Trabuco, Middle San Juan, and the Lower San Juan subbasins.

Total storage capacity estimates range from 63,220 AFY to 90,000 AF (NBS Lowry, 1994; DWR, 1972). Useable groundwater storage is approximately 60,000 AF (MNWD, 2006). Unused storage capacity is unknown. However, following the heavy rains of the 1997/98 winter season, the basin was essentially full (USACE, 2002). Water levels in various locations in the basin since 2004 are less than 50 feet below ground surface. As a result, available storage space is limited in most areas (Psomas, 2006).

Safe Yield/Long-Term Balance of Recharge and Discharge

Recharge consists of streambed percolation from the mainstream San Juan and Arroyo Trabuco Creeks, rainfall infiltration and subsequent deep percolation to the water table, deep percolation of applied water from landscape and agricultural irrigation, and subsurface inflow from the tributary alluvial stream areas. The average annual precipitation in the lower portion of the basin ranges from 11 to 15 inches (DWR, 2004). **Figure 11-2** provides the historical precipitation data in the lower portion of the basin for the fiscal years from 1985/86 to 2004/05. Average precipitation during this time period was about 13.7 inches. It is important to note that precipitation is highly variable in this basin with lower rainfall in the lower basins and higher rainfall in the upper basins. For example, the 40-year average precipitation (1965 to 2004) in the upper portions of the basin is as much as 20 inches (County of Orange, 2005).

Figure 11-2
Historical Precipitation in the San Juan Basin



Source: County of Orange, 2005
Station 186

Discharge from the basin includes well extractions, losses to transpiration by phreatophytes, rising groundwater resulting in surface discharge to the ocean and subsurface outflow to the

Pacific Ocean. Extractions of water from the lower reaches of the basin were limited due to poor water quality until the San Juan Desalter came online in 2004.

In 1993, the sustained yield for the basin was estimated to be 7,800 AFY (NBS Lowry, 1994; USACE, 2002). More recently, the County of Orange has used a 2005 estimate of 7,300 AFY of safe yield in their planning (County of Orange, 2006).

GROUNDWATER MANAGEMENT

The following describes how the San Juan Basin is currently managed. This section includes a discussion of the governing structure and agreements with adjacent basins.

Basin Governance

The San Juan Basin is managed by the San Juan Basin Authority (SJBA), which was created in 1971 as a joint powers authority for the purpose of carrying out water resources development of the San Juan Basin. The members of the SJBA are the Santa Margarita Water District (SMWD), the Moulton Niguel Water District (MNWD), South Coast Water District, and the City of San Juan Capistrano.

Table 11-2 provides a list of management agencies in the San Juan Basin.

Table 11-2
Summary of Management Agencies for the San Juan Basin

Agency	Role
San Juan Basin Authority (SJBA)	Joint Powers Authority established to plan and build facilities to protect the water quality of the San Juan Basin. Operates San Juan Basin Desalter
City of San Juan Capistrano (SJC)	Retail Water Provider and SJBA Member
Santa Margarita Water District (SMWD)	Retail Water District and SJBA Member
Moulton Niguel Water District (MNWD)	Retail Water District and SJBA Member
South Coast Water District (SCWD)	Retail Water District and SJBA Member
Municipal Water District of Orange County (MWDOC)	Wholesale imported water supplier and regional planning agency
California Regional Water Quality Control Board – San Diego Region (RWQCB)	Issuance of permits for discharges
State Water Resources Control Board	Issuance of water rights permits for diversion/extraction of water from the San Juan Basin.

The San Juan Basin has been categorized as subterranean flowing stream, and therefore groundwater extractions are within the scope of water rights regulations of the State Water Resources Control Board. Permits require the monitoring of groundwater quality and quantity in storage within the groundwater basin and other factors, including potential seawater intrusion and environmental issues. The SJBA conducts the monitoring activities that are needed to comply with its permits and also actively pursues the development of projects within the basin (MNWD, 2006).

Interactions with Adjoining Basins

No subsurface flow has been quantified between the San Juan Basin and adjoining basins. Water not captured by production wells or lost to evapotranspiration flows out of the basin into the ocean.

WATER SUPPLY FACILITIES AND OPERATIONS

The following provides a summary of the facilities within the San Juan Basin. Facilities include 13 groundwater production wells and a desalter.

Active Production Wells

A summary of the municipal production wells within the San Juan Basin is provided in **Table 11-3**. Private wells are not included on this table. Wells in the San Juan Basin typically produce from 450 to 1,000 gpm (DWR, 2004). Historical production for the period between fiscal years 1989/90 and 2004/05 is shown in **Figure 11-3**. The average production during this time period was approximately 2,079 AFY. It is important to note that production increased in 2004/05 as a result of the operation of the San Juan Desalter discussed below.

Groundwater is used principally for agricultural, horticultural, glass sand mining, golf course irrigation and for domestic uses. There are only three agencies within the SJBA actively pumping groundwater for municipal use (City of San Juan Capistrano, TCWD, and Santa Margarita Water District). More than 90 percent of the municipal groundwater production is for domestic use with less than 10 percent for non-domestic use.

Other Production

Data related to the private wells in the basin are not available.

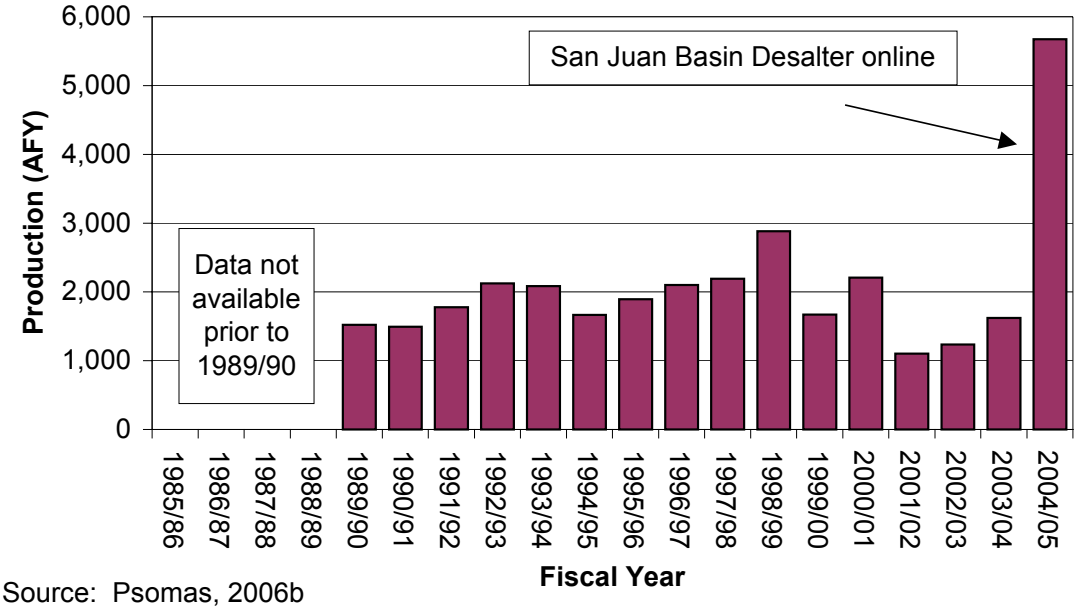
ASR Wells

Currently there are no ASR wells operating within the basin.

Spreading Basins

There are no spreading basins in the San Juan Basin. Recharge occurs mainly in natural streambeds and flood control channels (MNWD, 2006). SJBA plans to develop recharge basins to enhance capture of surface runoff.

Figure 11-3
Historical Groundwater Production in the San Juan Basin



Source: Psomas, 2006b

Table 11-3
Summary of Production Wells in the San Juan Basin

Category	Number of Active Wells	Estimated Production Capacity (AFY)	Average Production 1989/90-2004/05 (AFY)	Well Operation Cost ($/AF)
Municipal	7	10,000	1,949	Data not available
Desalter [1]	6	4,800	130	
Total	**13**	**14,800**	**2,079**	--

Source: Psomas, 2006b
[1]Desalter came online in 2004.

Seawater Barriers

There are no seawater barriers in the San Juan Basin.

Desalters

There is one existing desalter in the San Juan Basin. The San Juan Basin Desalter was constructed by the City of San Juan Capistrano pursuant to the terms of the 1998 San Juan Basin Desalter Project Groundwater Recovery Program Agreement between Metropolitan, MWDOC, and the SJBA, and as modified by First Amendment dated October 15, 2002. The San Juan Basin Desalter was completed in December 2004 and has capacity of about 5 MGD and can currently treat about 4,800 AFY. The plant is currently supplied by six wells located in the Lower San Juan subbasin. The brackish water from these wells is conveyed to the plant where it is treated by reverse osmosis (County of Orange, 2006). Approximately 4,800 AF was produced from the six operating wells during the period December 2004 through December 2005 (Psomas, 2006).

A second desalter, referred to as the Capistrano Beach Desalter Project, is currently under construction in the City of Dana Point by South Coast Water District. This desalter would treat up to 1,300 AFY from the San Juan Basin. Construction is estimated to be completed by March 2007.

GROUNDWATER LEVELS

Groundwater generally flows in a southwesterly direction to the ocean. The SJBA measures the water level in monitoring wells on a regular basis. Groundwater levels within the lower San Juan Creek are relatively close to the ground surface. Depth to water levels measured during 2004 and 2005 were typically less than 20 feet in the Lower and Middle San Juan subbasins. Drops in water levels of about 20 feet were observed in the vicinity of the San Juan Basin Desalter since it began operation. Water levels in the Lower Trabuco subbasin were deeper with an average depth to water of about 50 feet.

Monitoring wells recently installed in the basin are used to measure both water level and electric conductivity. The goal of the SJBA is to produce enough data to determine how the basin can be more effectively used as a water storage facility to increase the use of the groundwater for domestic uses. Water levels in basin wells show seasonal cycles with average declines related to drought cycles that recover during more plentiful seasons (DWR, 2004).

GROUNDWATER QUALITY

The following section describes the existing groundwater quality issues in the San Juan Basin. In general, the groundwater quality of the San Juan Basin ranges from good to poor. For example, although the Upper San Juan subbasin is shallower, it is has lower total dissolved solids (TDS) concentrations (less than 500 mg/L) than the lower basins. The lower basins are generally deeper with more abundant supply, but they are brackish and require treatment for use.

Groundwater Quality Monitoring

Active groundwater production wells within the San Juan Basin are sampled in accordance with Title 22. In addition, as described above, monitoring wells installed in the basin are used to measure both water level and electric conductivity in the field and various inorganic constituents in the laboratory on a semi-annual basis.

Groundwater Contaminants

The following section describes the concentrations of key constituents of concern (TDS, iron, manganese, and sulfate) in the San Juan Basin. Concentrations are summarized in **Table 11-4**. In general, TDS content in groundwater increases from below 500 mg/L in the upper stream channels valleys to above 2,000 mg/L near the coast (NBS Lowry, 1994; Psomas 2006a).

Table 11-4
Summary of Constituents of Concern in the San Juan Basin

Constituent	Units	Range (1999-2005)	Description
TDS Secondary MCL = 500	mg/L	390 to 2,200	TDS in production wells ranges from 390 to 1,250 mg/L. Average is 657 mg/L.
Nitrate (as N) Primary MCL = 10	mg/L	ND to 2	Average in production wells is approximately 0.6 mg/L.
VOCs **(TCE and PCE)** Primary MCL for TCE = 5 Primary MCL for PCE = 5	µg/L	ND	VOCs are not detected in the San Juan Basin.
Perchlorate Notification level = 6	µg/L	ND	Perchlorate is not detected in the San Juan Basin.
Iron and manganese Secondary MCL for iron = 300 Secondary MCL for manganese = 50	µg/L	Iron ND to 700 Manganese ND to 200	Only 2 groundwater production wells have detections of iron and manganese.
Sulfate Secondary MCL = 250	mg/L	71 to 840	Sulfate in production wells ranges from 71 to 225 mg/L with an average of 150 mg/L.

Source: Regional Board, 2006; Psomas, 2006a

Seawater intrusion could also be a potential problem in the coastal portions of the basin. It is believed that much of the salt content in the groundwater comes from the marine sediments that underlie much of the basin principally from Trabuco Creek (USACE, 2002).

Blending Needs

Blending is not applicable to the San Juan Basin (MNWD, 2006).

Groundwater Treatment

Groundwater is treated by the San Juan Basin Desalter as discussed above. Approximately 2,075 AF was treated in 2004/05, about 58 percent of the total groundwater production.

CURRENT GROUNDWATER STORAGE PROGRAMS

There are currently no groundwater storage programs in the San Juan Basin.

BASIN MANAGEMENT CONSIDERATIONS

Basin management considerations:

- Allowable quantities of water that may be diverted and pumped are specified in the water rights permits administered by the State Water Resources Control Board.
- Except for the Upper San Juan, the TDS of most of the groundwater in storage in the main part of the groundwater basin is too high for domestic water use. Groundwater is treated by the San Juan Basin Desalter, which increases the usability of the basin in the future.
- Shallow groundwater limits the ability to store significant supplies.

References:

California Department of Water Resources (DWR), 1972, Bulletin No. 104-7, Planned Utilization of Water Resources in the San Juan Creek Basin Area.

California Department of Water Resources (DWR), 2004. California's Groundwater Bulletin 118 – San Juan Valley Groundwater Basin. Updated 2/27/04. Website: http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/9-1.pdf Accessed 7/9/07.

California Regional Water Quality Control Board, 2007. Geotracker database. Accessed at: http://www.geotracker.swrcb.ca.gov/

County of Orange Resources and Development Management Department (County of Orange), 2005. Hydrologic Data Report. 2003-2004 Season.

County of Orange Resources and Development Management Department (County of Orange), 2006. South Orange County Integrated Regional Water Management Plan – May 2006.

County of Orange Resources and Development Management Department (County of Orange), 2005. Hydrologic Data Report. 2003-2004 Season. Station 186 Data.

Metropolitan Water District of Southern California (Metropolitan), 2006. Local Resource Program, Summary Report, August 2006.

Moulton Niguel Water District (MNWD), 2005. Urban Water Management Plan Update, December.

Moulton Niguel Water District (MNWD), 2006. Groundwater Study Questionnaire.

Municipal Water District of Orange County (MWDOC), 2006a. Phase 1 and 2 Hydrogeologic Investigation, Dana Point Ocean Desalination Project.

Municipal Water District of Orange County (MWDOC), 2006b. Urban Water Management Plan.

NBS Lowry Engineers and Planners (NBS Lowry). 1994. San Juan Basin Groundwater Management and Facility Plan.

Psomas, 2006b. Annual Integrated Environmental Monitoring Report. Prepared for San Juan Basin Authority.

Psomas, 2006b. Groundwater production data.

South Orange County Integrated Regional Water Management Plan (County of Orange), May 2006.

United States Army Corps of Engineers (USACE). August 2002. San Juan Creek Watershed Management Study, Orange County, California, Feasibility Phase. Hydrology Appendix.

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