1959 - 2009
50
YEARS OF EXCELLENCE
Water Replenishment District

Water Replenishment District of Southern California



Engineering Survey and Report

2009

March 20, 2009

Updated:
May 1, 2009

WRD

Water Replenishment District of Southern California
Engineering Survey and Report 2009

WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

MEMORANDUM

DATE: MAY 1, 2009

TO: INTERESTED PARTIES

FROM: ROBB WHITAKER, GENERAL MANAGER

SUBJECT: UPDATED ENGINEERING SURVEY AND REPORT 2009

The Water Replenishment District of Southern California (WRD) is pleased to present this updated Engineering Survey and Report (ESR) for 2009. For 50 years, the WRD has been a regional groundwater management agency responsible for the replenishment, protection, and preservation of groundwater supplies and groundwater quality in the Central and West Coast Basins of southern Los Angeles County. Groundwater constitutes approximately 40% of the total water demand for the businesses and nearly 4 million residents of the 43 cities in our service area.

WRD prepares an ESR each year as required by the California Water Code section 60300. This report contains information on the past, present, and predicted future groundwater conditions in the two basins. It anticipates the amount, cost, and sources of replenishment water needed to make up the ensuing year annual overdraft and describes the replenishment and water quality projects and programs necessary to ensure sustainable groundwater supplies for the future.

This ESR supersedes the earlier March 20, 2009 report to provide new and updated information received after releasing the earlier version. The most significant difference is that a new price for replenishment water was established after the Metropolitan Water District of Southern California (MWD) set their rates on April 14, 2009. Their new rates combined with surcharges by the MWD-member agencies will increase our imported replenishment water costs by 33%.

This and other new information was presented at District Committee meetings, Public Hearings, and Board of Directors' meetings leading up to the Board's adoption of the 2009/2010 Replenishment Assessment (RA) on May 1, 2009. The new replenishment assessment is $181.85 per acre foot (af) of groundwater pumped effective July 1, 2009 through June 30, 2010. This is an 18.9% increase in the previous RA of $153.00 per acre foot. This increase is due mainly to the rising cost of imported replenishment water. WRD will continue to work aggressively to reduce our dependence on imported water for replenishment by building projects for alternative water sources such as increased recycled water and storm water under our Water Independence Now (WIN) program.

WRD appreciates the input received from the water producers, water agencies, basin stakeholders, and the general public over the past few months leading to the adoption of the RA to ensure sufficient supplies of groundwater. My staff and I welcome any comments or questions you may have regarding the updated report. Additional copies are available by calling the District at (562) 921-5521 or by downloading it from our web site at http://www.wrd.org. Thank you for your interest and input on the groundwater conditions in the Central and West Coast Basins.

Water Replenishment District
Of Southern California

ENGINEERING SURVEY AND REPORT, 2009
Updated May 1, 2009

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Professional Certification

This Engineering Survey and Report has been prepared under the direct supervision of the California Professional Geologist whose signature appears below. This individual certifies that the information contained in the report has been prepared in accordance with the generally accepted principles and practices of his profession.

Theodore A. Johnson, PG 6142, CHG 240



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GLOSSARY OF ACRONYMS

ABP	Alamitos Barrier Project
AF	Acre-Feet (equivalent to 325,851 gallons)
AFY	Acre-Feet per Year
APA	Allowed Pumping Allocation
CB	Central Basin
CBMWD	Central Basin Municipal Water District
CDPH	California Department of Public Health (formerly California Department of Health Services)
CHG	Certified Hydrogeologist
CIP	Capital Improvement Program
CPI	Consumer Price Index
CSDLAC	County Sanitation Districts of Los Angeles County
CWCB	Central and West Coast Basins
DGBP	Dominguez Gap Barrier Project
DPH	California Department of Public Health
DTSC	California Department of Toxic Substances Control
DWR	State Department of Water Resources
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
ESR	Engineering Survey and Report
FY	Fiscal Year (July 1 – June 30)
GAC	Granular Activated Carbon
GIS	Geographic Information System
IRWMP	Integrated Regional Water Management Plan
LACDHS	Los Angeles County Department of Health Services
LACDPW	Los Angeles County Department of Public Works (Flood Control)
LADWP	Los Angeles Department of Water and Power
LBWD	Long Beach Water Department
Met	Metropolitan Water District of Southern California
MCL	Maximum Contaminant Level
MF	Microfiltration
MFI	Modified Fouling Index
mgd	Million Gallons per Day
MOU	Memorandum of Understanding
msl	Mean Sea Level
MWD	Metropolitan Water District of Southern California

GLOSSARY OF ACRONYMS (continued)

NDMA	N-Nitrosodimethylamine
O&M	Operations and Maintenance
ppb	Parts Per Billion
PG	Professional Geologist
PRC	Program Review Committee
PWRP	Pomona Water Reclamation Plant
RA	Replenishment Assessment
RO	Reverse Osmosis
RTS	Readiness-to-Serve
RWQCB	Regional Water Quality Control Board (Los Angeles Region)
SAT	Soil Aquifer Treatment
SDWP	Safe Drinking Water Program
SGVMWD	San Gabriel Valley Municipal Water District
SJCWRP	San Jose Creek Water Reclamation Plant
TAC	Technical Advisory Committee
TITP	Terminal Island Treatment Plant
USGS	United States Geological Survey
USGVMWD	Upper San Gabriel Valley Municipal Water District
UV	Ultraviolet Light Treatment
VOC	Volatile Organic Compound
WAS	Water Augmentation Study
WBMWD	West Basin Municipal Water District
WCB	West Coast Basin
WCBBP	West Coast Basin Barrier Project
WIN	Water Independence Network
WNWRP	Whittier Narrows Water Reclamation Plant
WRD	Water Replenishment District of Southern California
WRP	Water Reclamation Plant
WY	Water Year (October 1 – September 30)

BOARD SUMMARY

WRD: 50 YEARS OF EXCELLENCE 1959 - 2009

District Staff is pleased to present the 2009 Engineering Survey and Report (ESR) to the Board of Directors on the 50th Anniversary of WRD. So much has been accomplished over the past 50 years to restore the Central and West Coast Groundwater Basins to a usable, reliable, clean, and inexpensive source of water for the 4 million residents and businesses in the 43 cities that overlie the basins. The District should be proud of the accomplishments made to date, including the following:

- WRD has added over 5-½ million acre feet of replenishment water to the groundwater aquifers of the Central and West Coast Basins since 1959 to keep them usable and protected from drought and seawater intrusion.

- WRD has cleaned up and improved the quality of the groundwater in the Central and West Coast Basin aquifers. Well head treatment projects have been constructed to remove volatile organic contamination, iron, manganese, and arsenic from well water and made potable to serve to the public. WRD has also constructed the Robert Goldsworthy brackish groundwater desalination plant to remove salt from water and serve it as a potable supply.

- WRD has installed a series of over 250 groundwater observation wells that record water levels four times daily and collect over 50,000 water quality records annually to monitor the health of the basins and ensure groundwater supply. The results are published on the web and hard copy for the public and other interested parties.

- WRD has constructed many projects to capture more storm water or to use more recycled water for recharge, thus lessening the region's dependence on imported water which is currently of limited supply. Projects such as rubber dams along river channels to enhance percolation of storm water, improvements to an area behind the Whittier Narrows Dam known as the conservation pool to capture more storm water, extensive research to prove recycled water continues to be a safe and valuable recharge source, and the construction of the Leo J. Vander Lans water treatment facility to perform advanced treatment to recycled water for use in seawater barrier injection wells.

- WRD has protected the coastal aquifers from seawater intrusion by working closely with Los Angeles County Department of Public Works to maintain a 16-mile network of injection wells along the coast known as seawater barrier injection wells. LA County owns and operates the wells since the 1950s and WRD purchases all of the water that goes into the wells (both imported and recycled water). These injection wells operate 365 days a year, 24 hours a day to inject fresh water to build an underground water dam to stop the seawater from intruding.

- WRD provided groundwater education to the citizens, water managers and elected officials in the local, state, and Federal arena through tours, presentations, sit down meetings, and conferences.

- WRD is also pleased to have worked so closely with our partners in groundwater resources concerns in the Central and West Coast Basins, including the County of Los Angeles Dept. of Public Works, the County Sanitation Districts of Los Angeles County, the Central Basin Watermaster, the West Coast Basin Watermaster, the Metropolitan Water District of Southern California and their member agencies (Central Basin MWD, West Basin MWD, Long Beach, Torrance, Los Angeles, and Compton), the San Gabriel River Watermaster, the groundwater pumpers in the District, and the 43 cities in our service area. WRD is also proud to work successfully with the water quality agencies that oversee protection of the groundwater resources, including the Environmental Protection Agency, Los Angeles Regional Water Quality Control Board, California Department of Public Health, and the California Department of Toxic Substances Control.



WRD Groundwater Festival

But the District can not rest on its laurels. The Central and West Coast Basins, and the rest of the State, are in the midst of an unprecedented water crisis. As the State Water Resources Control Board recently proclaimed "*The collapse of the Bay-Delta ecosystem, climate change, and continuing population growth have combined with a severe drought on the Colorado River and failing levees in the Delta to create a new reality that challenges California's ability to provide the clean water needed for a healthy environment, a healthy population and a healthy economy, both now and in the future.*"

Great challenges lie ahead of us to continue to replenish and protect the Central and West Coast Basins in the manner we are accustomed to in the face of dwindling imported water supplies and climate change impacts. Increased recycled water reuse, increased storm water capture, creative ways to obtain imported water when available, alternative water sources such as brackish groundwater or seawater or contaminated groundwater, and water education and conservation will all be explored to ensure safe, reliable and affordable groundwater for the next 50 years. WRD Staff and Board welcome this challenge.

Engineering Survey and Report (ESR)

The ESR is a required annual report that helps determine the District's groundwater replenishment needs, costs, and overall health of the basins. It was prepared pursuant to Chapter I, Part 6, Division 18 of the California Water Code, and determines the past, current, and ensuing year groundwater conditions in the Central and West Coast Basins (CWCB). The report contains information on

groundwater production, annual and accumulated overdraft, water levels, quantity, source, and cost of replenishment water, and a discussion of necessary projects and programs to protect and preserve the groundwater resources of the basins.

The ESR provides the Board of Directors with the necessary information to justify the setting of a replenishment assessment (RA) for the ensuing fiscal year (July 1 – June 30) to purchase replenishment water and to fund projects and programs related to groundwater replenishment and groundwater quality over the water year (October 1 – September 30).

The following is a summary of information presented in the 2009 ESR:

1. Groundwater Production

- Adjudicated Amount: 281,835 AF
- Previous Water Year: 244.732 AF
- Current Water Year: 240,000 AF (est)
- Ensuing Water Year: 240,200 AF (est)

2. Annual Overdraft

- Previous Water Year: 104,740 AF
- Current Water Year: 94,800 AF (est)
- Ensuing Water Year: 95,000 AF (est)

3. Accumulated Overdraft

- Previous Water Year: 701,800 AF
- Current Water Year: 700,200 AF (est)



New WRD Monitoring Well LA#2

4. Groundwater Levels

Groundwater levels are an indication of the amount of water in the basins. They indicate areas of recharge and discharge and reveal which way the groundwater is moving. Groundwater levels are used to determine when additional replenishment water is required and are used to calculate storage changes. The groundwater levels can also indicate possible source areas for saltwater intrusion and can show the effectiveness of the seawater barrier injection wells along the coast.

WRD staff tracks groundwater levels throughout the year by measuring the depth to water in production wells and monitoring wells. In the previous WY 2007/2008, water levels fell up to 15 feet in the Central Basin due to the lack of imported water for replenishment and increased pumping. In the West Coast Basin, water levels rose in some areas, fell in others, but remained generally flat over most of the basin. Overall, there was a loss of groundwater storage of 41,600 AF. In the current water year, below normal precipitation and lack of MWD replenishment water will likely cause a decrease in water levels.

5. Quantity Required for Replenishment

Chapter IV details the quantity of water that WRD must purchase in the ensuing water year to help offset the annual overdraft. A summary is listed below:

- Spreading Water: 69,000 AF (48,000 recycled; 21,000 imported)
- Seawater Barrier Water: 27,400 AF (17,500 recycled; 9,900 imported)
- In-Lieu Program Water: 10,303 AF
- Total Water: 106,703 AF

6. Source of Replenishment Water

The sources of replenishment water to the District for the ensuing water year are expected to include the following. Although it is uncertain if spreading and in-lieu water will be available due to drought, WRD is planning on this water and if not purchased in the ensuing year will be carried over for purchase in a subsequent year:

- Recycled Water: Spreading water from the County Sanitation Districts of Los Angeles County. West Coast Basin Barrier Project (WCBBP) water from the West Basin Municipal Water District. Dominguez Gap Barrier Project (DGBP) water from the City of Los Angeles. Alamitos Barrier Project (ABP) water from WRD's Leo J. Vander Lans Facility.

- Imported Water: Spreading water from Central Basin Municipal Water District. WCBBP water and DGBP water from West Basin Municipal Water District. ABP water from the City of Long Beach. In-Lieu program water from MWD and various MWD-member agencies.

7. Cost of Replenishment Water

WRD has estimated it will need 106,703 acre feet of replenishment water in the ensuing year. The Metropolitan Water District of Southern California (MWD) and their member agencies set the price for the imported water WRD buys for the replenishment at the spreading grounds, barrier wells, and In-Lieu, and are a direct pass-through on WRD's replenishment assessment.

At their April 14, 2009 Board meeting, MWD set their new rates which, in addition to the surcharges added by the MWD-member agencies, will cause an overall increase on WRD's imported replenishment water cost of 33%. This large increase is due to the State's water crisis including drought, environmental concerns, energy concerns, and reductions in water purchases through conservation. With the known and estimated costs for replenishment water in mind, WRD has estimated that it will cost $28,815,746 to purchase the 106,703 acre feet of replenishment water in the ensuing year. **Tables 1 and 2** present the details of these anticipated costs.

The estimated cost for replenishment water has been detailed in this report. However, this is just the District's water costs and does not include the costs for projects and programs necessary to replenish the basins and to protect and preserve the groundwater quality. The entirety of the District costs were presented during the annual budgeting and rate setting process that culminated in the Board's adoption of the Replenishment Assessment for FY 2009/2010 on May 1, 2009 at $181.85 per acre foot of groundwater pumped. This represents an 18.9% increase from the previous year.

8. Projects and Programs

A list of the WRD projects and programs related to groundwater replenishment and the protection and preservation of water quality is shown on **Table 3**. Funds are required to finance these projects and programs. Sections 60221 and 60230 of the Water Replenishment Districts Act authorize the WRD to undertake a wide range of capital projects and other programs aimed at enhancing groundwater replenishment. Section 60224 of the Water Replenishment Districts Act states that WRD may establish projects or programs that will directly or indirectly preserve and protect the groundwater supplies within its boundaries.

These projects and programs address any existing or potential problems related to the basin's groundwater, and may extend beyond the District's boundaries if the threat of contamination is outside those boundaries. The programs span all phases of planning, design, and construction and are financed by the collection of a replenishment assessment. A more detailed description of each project and program is presented in Chapter V of the report.

9. Conclusions

Based upon the information presented in the ESR, a replenishment assessment is necessary in the ensuring year to purchase replenishment water to help make up the overdraft and to finance projects and programs to perform replenishment and water quality activities. These actions will ensure sufficient supplies of high quality groundwater within the District for the benefit of the residents and businesses in the Central and West Coast Basins.



Summer 2008 Releases from Morris Dam Captured at Rio Hondo Spreading Grounds

CHAPTER I
INTRODUCTION

Purpose of the Engineering Survey & Report

To facilitate the Board of Directors' decisions and actions, the Water Replenishment Districts Act requires that an engineering survey and report (ESR) be prepared each year. This *Engineering Survey and Report 2009* is in conformity with the requirements of the Water Replenishment Districts Act and presents the necessary information on which the Board of Directors can declare whether funds shall be raised to purchase water for replenishment during the ensuing year, as well as to finance projects and programs aimed at accomplishing groundwater replenishment. With the information in this ESR, the Board can also declare whether funds shall be collected to remove contaminants from the groundwater supplies or to exercise any other power under Section 60224 of the California Water Code. The information presented in this report along with the District's strategic planning and budget preparation presents the necessary information on which the Board of Directors can base the establishment of a replenishment assessment for the ensuing year 2009/20010.

Scope of Engineering Survey & Report

This report contains specific information outlined in Chapter I, Part 6 of Division 18 of the Water Code (the Water Replenishment Districts Act, § 60300 and § 60301). The following is a brief description of the contents of this report:

1) *a discussion of groundwater production within the District (Chapter II);*
2) *an evaluation of groundwater conditions within the District, including estimates of the annual overdraft, the accumulated overdraft, changes in water levels, and the effects of water level fluctuations on the groundwater resources (Chapter III);*
3) *an appraisal of the quantity, availability, and cost of replenishment water required for the ensuing water year (Chapter IV); and*
4) *a description of current and proposed programs and projects to accomplish replenishment goals and to protect and preserve high quality groundwater supplies within the District (Chapter V).*

Schedule for Setting the Replenishment Assessment

The following actions are required by the Water Code to set the Replenishment Assessment:

1) *The Board shall order the preparation of the ESR by the second Tuesday in February.*
2) *The Board shall declare by resolution whether funds shall be collected to purchase replenishment water and to fund projects and programs related to replenishment and/or water quality activities by the second Tuesday in March and after the ESR has been completed.*
3) *A Public Hearing will be held for the purpose of determining whether District costs will be paid for by a replenishment assessment. The Public Hearing will be opened on or before the second Tuesday in April and may be continued from time to time to subsequent Board meetings but will be completed by the first Tuesday in May.*
4) *The Board by resolution shall levy a replenishment assessment for the ensuing fiscal year by the second Tuesday in May.*

Although dates specified in the code refer generally to 'on or before certain Tuesdays', the Water Code (Section 60043) also states that "*Whenever any act is required to be done or proceeding taken on or set for a particular day or day of the week in any month, the act may be done or proceeding set for and acted upon a day of the month otherwise specified for a regular meeting of the board"*. Therefore, there is flexibility as to the actual dates when Board actions are taken regarding the ESR, adopting resolutions, conducting public hearings, and the setting the replenishment assessment.

The ESR is completed in March of each year to provide the Board with the necessary information to determine whether a replenishment assessment will be needed in the ensuing year to purchase replenishment water and to fund projects and programs related to water quality and replenishment activities. However, in the subsequent months leading up to the adoption of the replenishment assessment in April or May, new information is normally received that affects the findings presented in the March ESR. This new information is typically related to the price WRD has to pay for replenishment water since the rates set by the Metropolitan Water District of Southern California (MWD or Met) and the Met-member agencies are not typically finalized until after the March ESR is adopted. The final information used by the Board to adopt the replenishment assessment in April or May is reflected in an updated ESR published following the adoption of the replenishment assessment.

The 2009/2010 Replenishment Assessment was adopted by the Board on May 1, 2009 and was set at a rate of $181.85 per acre foot of groundwater pumped within the District. The new rate takes effect on July 1, 2009 through June 30, 2010. This represents an 18.9% increase from the previous year's rate of $153.00 per acre foot. The increase was mostly due to the sharp rise in the cost of imported water that WRD's purchases from MWD and its member agencies for groundwater replenishment.

This updated ESR replaces the earlier March 20 report.

CHAPTER II
GROUNDWATER PRODUCTION

Adjudication and Demand

Prior to the adjudication of groundwater rights in the early 1960s, annual production (pumping) reached levels as high as 292,000 AF in the Central Basin (CB) and 94,000 AF in the West Coast Basin (WCB). This was more than double the natural safe yield of the basins as determined by the California Department of Water Resources in 1962 (173,400 AF). Due to this serious overdraft, water levels declined, groundwater was lost from storage, and seawater intruded into the coastal aquifers. To remedy this problem, the courts adjudicated the two basins to put a limit on pumping. The West Coast Basin adjudication was set at 64,468.25 acre feet/year (AFY). The Central Basin adjudication was set at 271,650 AFY, although the Judgment set a lower "Allowed Pumping Allocation" (APA) of 217,367 AFY to impose stricter control. Therefore, the current amount allowed to be pumped from both basins is 281,835 AFY (rounded).

The adjudicated pumping amounts are greater than the natural replenishment of the groundwater aquifers, creating an annual deficit or annual overdraft. WRD is enabled under the California Water Code to purchase and recharge additional water to make up the overdraft, which is known as artificial replenishment. WRD has the authority to levy a replenishment assessment on all pumping within the District to raise the monies necessary to purchase the artificial replenishment water and to fund projects and programs necessary for replenishment and groundwater quality activities.

Production

Under the terms of the Water Replenishment Districts Act, each groundwater producer must submit a report to the District summarizing their monthly production activities (quarterly for smaller producers). The information from these reports is the basis by which each producer pays the replenishment assessment. WRD then provides these production data to the State Department of Water Resources (DWR), which acts as the court-appointed Watermaster in connection with the adjudication of the Central and West Coast Basins (CWCB).

Previous Water Year:

Per the Water Code, WRD tracks and reports groundwater basin information (pumping, replenishment, water purchases) on a Water Year (WY) basis which covers the time frame from October 1 - September 30 each year. Over the past 5 water years including an estimate for the current water year (2004/05 – 2008/09), groundwater production in the CWCB has averaged 235,600 AFY (196,800 AF in CB and 38,800 AF in WCB). For the previous WY 2007/2008, groundwater production totaled 244,732 AF, of which 206,260 AF was from the CB (including 4,333 of stored water pumped by Long Beach) and 38,472 AF was from the WB. The previous year's pumpage is a 4% increase from the five year average (5% increase in CB, 1% decrease in WCB). There were multiple causes for the increases and decreases in pumping. Rising costs of imported water, repair of well infrastructure, call of groundwater from storage, and installation of well head treatment facilities caused an increase in pumpage, whereas drought / water conservation, well problems, and water quality problems caused a reduction in pumping for other purveyors.

Groundwater Production

Plate 1 illustrates the groundwater production in the CWCB during the previous water year and **Table A-5** presents historical pumping amounts in the CWCB.

Current Water Year:

For the first three months of the current WY (October – December), production was 47,204 AF in the CB compared to 52,530 AF the previous year, a 10% decrease. In the WCB, the first three months of the current water year saw 10,638 AF of production versus 8,889 AF from the previous year (a 20% increase). It is very difficult to predict what the final current year production amounts will be since only three months of actual data are in to date. According to several pumpers, the mix between desiring more groundwater to offset their increasing imported MWD water rates (for those pumpers who take MWD water in addition to groundwater), and those pumpers who predict reduced water demands due to drought and conservation this summer may balance out.

Therefore, Staff estimated current year pumping by taking actual pumping for the first three months of the current water year and the final 9 months of the previous water year. This produced a total production of 240,000 AF (200,000 AF in CB and 40,000 AF in WCB).

Ensuing Water Year:

To estimate production for the ensuing year, the 3-year average pumping was used. In previous ESRs, the 5-year average was used and is normally a good indicator of longer term pumping. However, 2004/05 and 2005/06 (the first two years of the 5-year average) were anomalously low values and more recent pumping reflects improvements to wells and increased overall basin pumping. The 3-year average included the current water year estimate and the previous 2-years of actual pumping. Actual pumping amounts will vary year to year based on a pumper's individual operational needs, water demands, and hydrology. The ensuing year groundwater production estimate based on the 3-year average is 240,200 AF (201,500 AF in CB and 38,700 AF in the WCB). **Table 1** shows the groundwater production for the previous, current, and ensuing years.

Measurement of Production

With few exceptions, meters installed and maintained by the individual producers measure the groundwater production from their wells. Through periodic testing, both WRD and Watermaster verify the accuracy of individual meters and orders corrective measures when necessary. The production of the few wells that are not metered is estimated on the basis of electrical energy consumed by individual pump motors, duty of water, or other reasonable means.

Carryover and Drought Provisions

The "carryover" of unused rights influences the actual amount of production for any given year. The "carryover" for any single year is 20% of the allotted pumping right in both the Central and West Coast Basins. This provision extends the flexibility with which the pumpers can operate. Conversely, the use of rights beyond the annual allotted quantity affects the annual production amount in the opposite manner. The original court adjudication in both basins allows for each individual pumper to extract up to 10% beyond their allowable pumping rights within a given year.

During emergency or drought conditions, WRD can allow under certain conditions an additional 27,000 AF of extractions for a four-month period (17,000 for Central Basin and 10,000 for West Coast Basin). This provision has yet to be exercised but offers the potential use of an additional 7.8% for Central Basin and 15% for West Coast Basin pumpers.

CHAPTER III
GROUNDWATER CONDITIONS

Introduction

The California Water Code Section 60300 requires WRD to determine annually in the Engineering Survey and Report (ESR) the following items related to groundwater conditions in the Central and West Coast Basins (CWCB):

1) Total groundwater production for the previous water year and estimates for the current and ensuing water years;

2) The Annual Overdraft for the previous water year and estimates for the current and ensuing water years;

3) The Accumulated Overdraft for previous water year and an estimate for the current water year;

4) Changes in groundwater levels (pressure levels or piezometric heights) within the District and the effects these changes have on groundwater supplies within the District; and

5) An estimate of the quantity, source, and cost of water available for replenishment during the ensuing water year;

To meet these requirements, WRD's hydrogeologists and engineers closely monitor and collect data to manage the groundwater resources of the District throughout the year. They track groundwater levels from WRD's network of specialized monitoring wells and from groundwater producers' production wells. They update and run computer models developed by the United States Geological Survey (USGS) and others to simulate groundwater conditions and to predict future conditions. They use their geographic information system (GIS) and database management system to store, analyze, map, and report on the information required for the ESR. They work closely with the Los Angeles County Department of Public Works on spreading grounds and seawater barrier wells to determine current and future operational impacts to groundwater supplies. They work closely with the Metropolitan Water District of Southern California (MWD or Met), the local MWD member agencies, and the County Sanitation Districts of Los Angeles County (CSDLAC) on the current and future availability of supplemental replenishment water. They also work with regulators on replenishment criteria for water quality and recycled water use, and with the groundwater pumpers, the pumpers' Technical Advisory Committee (TAC), and other stakeholders to discuss the current and future groundwater conditions within the District and in neighboring basins.

The information on Annual Overdraft, Accumulated Overdraft, water levels, and change in storage are discussed in the remainder of this chapter. Groundwater production was previously discussed in Chapter II. The estimated quantity, source, and cost of replenishment water will be discussed in Chapter IV.

Annual Overdraft

The Water Replenishment Districts Act defines Annual Overdraft as "*...the amount...by which the quantity of groundwater removed by any natural or artificial means from the groundwater supplies*

within such replenishment district during the water year exceeds the quantity of non-saline water replaced therein by the replenishment of such groundwater supplies in such water year by any natural or artificial means other than replenishment under the provisions of Part 6 of this act or by any other governmental agency or entity." (Part 6 of the Act pertains to water that WRD purchases for replenishment). Therefore, the Annual Overdraft equals the natural inflows to basins (not including WRD purchased water) minus all of the outflows (mostly pumping). There is an Annual Overdraft almost every year for the simple fact that the groundwater extractions typically exceed the natural groundwater replenishment. It has been one of the District's main responsibilities since 1959 to help make up this Annual Overdraft by purchasing artificial replenishment water to recharge the aquifers and supplement the natural recharge.

To determine the Annual Overdraft for the previous water year, WRD determines the inflows and outflows of the CWCB. In Water Year 2007/08, natural inflows (storm water capture, areal recharge, underflow) totaled 140,563 AF and WRD or others purchased 63,140 AF of recharge water (at barrier wells and spreading grounds). The total net outflows from the basins were 245,303 AF from pumping. The difference between the inflows and outflows was -41,600 AF, which is a loss from storage. The Annual Overdraft is the outflows minus natural inflows, or 104,740 AF.

For the current and ensuing WY estimates for Annual Overdraft, the concept of "Average Annual Groundwater Deficiency" is utilized. The Average Annual Groundwater Deficiency is the long-term average of natural inflows minus total outflows and represents the long term average deficit (Annual Overdraft) in the basins. The development of the USGS/WRD computer model derived these long term average inflow and outflow terms. **Table 4** presents this information, which concluded that the Average Annual Groundwater Deficiency is 105,385 AFY. Values of the average deficiency are based on the long term (30 year average) inflows and outflows as calculated by the computer model. Long-term average inflows are influenced by the amount of precipitation falling on the District as well as for storm water capture at the spreading grounds. **Table 5** shows the historical precipitation at LACDPW Station #107D, located in Downey near the Montebello Forebay.

The calculation of the Average Annual Groundwater Deficiency represents in general that WRD needs to replenish about 105,385 AFY assuming long-term average conditions for the water balance to reach equilibrium, the overall change in storage to equal zero, and groundwater levels to remain relatively constant. As shown in **Table 6**, adjustments have been made to the long term average inflows and outflows for the current and ensuing WY to reflect determine estimates of the Annual Overdraft for those years. Based on these adjustments, the current year Annual Overdraft is estimated at 94,800 AF and 90,400 AF for the ensuing year. The determination of an anticipated Annual Overdraft in the ensuing WY gives the District justification under the Water Code to levy a replenishment assessment on groundwater production in the ensuing year to purchase artificial replenishment water to help make up the annual overdraft.

Accumulated Overdraft

The Water Replenishment Districts Act defines *"Accumulated Overdraft"* as "*...the aggregate amount…by which the quantity of ground water removed by any natural or artificial means from the groundwater supplies…during all preceding water years shall have exceeded the quantity of nonsaline water replaced therein by the replenishment of such ground water supplies in such water years by any natural or artificial means…"*

In connection with the preparation of Bulletin No. 104-Appendix A (1961), the DWR estimated that the historically utilized storage (Accumulated Overdraft) between the high water year of 1904 and 1957[1] was 1,080,000 AF (780,000 in CB, 300,000 in WCB). Much of this storage removal was from the forebay areas (Montebello Forebay and Los Angeles Forebay), where aquifers are merged, unconfined and serve as the "headwaters" to the confined pressure aquifers. Storage loss from the confined and completely full, deeper aquifers was minimal in comparison or was replaced by seawater intrusion, which can not be accounted for under the language of the Water Code since it is considered saline water.

The goal of groundwater basin management by WRD is to ensure a sufficient supply of high quality groundwater in the basins for annual use by the pumpers, to keep a sufficient supply in storage for times of drought when imported water supplies may be curtailed for several consecutive years as well as to keep suitable room available in the basins to receive natural water replenishment in very wet years, such as an El Niño type year. Groundwater storage discussions currently underway in the region may also lead to projects that bank water in some of the available storage space in the basins.

To compute the Accumulated Overdraft since this initial amount, WRD takes each consecutive year's Annual Overdraft and replenishment activities and determines the change in storage. It adds to or subtracts the corresponding value from the Accumulated Overdraft. Since the base level, the aggregate excess of extractions over recharge from the basins has been reduced due to the replenishment by WRD, the reduction of pumping from the adjudications, and the replenishment from seawater barrier injection. Because of the loss from storage last year of 41,600 AF, the Accumulated Overdraft at the end of the previous WY was determined to be 701,800 AF. For the current year, the Accumulated Overdraft is expected to remain relatively level at an estimated amount of 700,200 AF. This could change if hydrology or pumping patterns or planned artificial replenishment supplies vary considerably.

Table 7 presents information for the previous and current Accumulated Overdraft estimate. The annual changes in storage since 1961 are presented on **Table 8**.

Groundwater Levels

A groundwater elevation contour map representing water levels within the District in fall 2008 (end of the water year) was prepared for this report and is presented as **Plate 2**. The data for the map were collected from wells that are screened in the deeper basin aquifers where the majority of groundwater pumping occurs. These deeper aquifers include the Upper San Pedro Formation aquifers, including the Lynwood, Silverado, and Sunnyside. Water level data was obtained from WRD's network of monitoring wells and from groundwater production wells that are screened in the deeper aquifers.

As can be seen on **Plate 2**, groundwater elevations range from a high of about 170 feet above mean sea level (msl) in the northeast portion of the basin above the spreading grounds in the Whittier Narrows to a low of about 110 feet below msl in both the Long Beach area and the Gardena area. With the exception of the Montebello Forebay and along the West Coast Basin Barrier Project, the

[1] DWR Bulletin 104-A did not refer to the ending year for the storage determination. WRD has assumed it to be the year 1957, as this is the end year for their detailed storage analysis presented in Bulletin 104-B – Safe Yield Determination.

majority of groundwater levels in the District are below sea level, which is why continued injection at the seawater barriers is needed to prevent saltwater intrusion.

Plate 2 also shows the location of the key wells used for long-term water level data. These long-term hydrographs have been presented in the ESR for years, and provide a consistent basis from which to compare changing water levels. A discussion of water levels observed in the key wells is presented below.

Los Angeles Forebay

The Los Angeles Forebay occupies the westerly portion of the Central Basin Non-Pressure Area. Historically a recharge area for the Los Angeles River, this forebay's recharge capability has been substantially reduced since the river channel was lined. Recharge is now limited to deep percolation of precipitation, in-lieu when available, subsurface inflow from the Montebello Forebay, the northern portion of the Central Basin outside of WRD's boundary, and relatively small amounts from the San Fernando Valley through the Los Angeles Narrows.

Key well **2S/13W-10A01** represents the overall water level conditions of the Los Angeles Forebay (see **Figure B**). The water level high was observed in 1938 and by 1962 water levels had fallen nearly 180 feet due to basin over-pumping and lack of sufficient natural recharge. Since then, basin adjudication and artificial replenishment by WRD have improved water levels in this area by over 80 feet. Over the past 7 years, groundwater levels in this well have remained relatively constant with only minor fluctuations, although this past year saw a drop of about 3 feet.

For the current water year, rainfall is currently 77% of normal and imported water for recharge is not expected to be available. Therefore, water levels in the Los Angeles Forebay are expected to decline.

Montebello Forebay

The Montebello Forebay lies in the northeastern portion of the Central Basin and connects with the San Gabriel Basin to the north to 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. Three key wells help describe the water level conditions in the Montebello Forebay, a northern well, middle well, and southeastern well (**Plate 2**):

- **Well 2S/11W-18C07** (WRD Monitoring Well Pico#1, Zone 4) is in the northern part of the Montebello Forebay. It replaces the earlier production well 2S/11W-18K02 that had been used for over 50 years but has been destroyed. The upper chart on **Figure C** shows the water levels for this well. At the end of water year 2007/2008, groundwater levels in this well were 5 feet lower than the previous year likely due to lack of imported water for replenishment.
- **Well 2S/12W-24M08** (LACDPW Well No. 1601T) is centrally located between the two spreading grounds. This well is monitored weekly by WRD to assess water levels in the forebay and as an indicator for the need to purchase replenishment water. The middle chart on **Figure C** shows the water levels for this well. The historic water level high was observed in 1942, but by 1957 had fallen 117 feet to an all-time low due to basin over-pumping and insufficient natural recharge. As described above for the Los Angeles Forebay, adjudication of pumping rights and artificial replenishment water by WRD helped restore water levels in the Montebello Forebay.

At the end of WY 2007/2008, groundwater levels in this well were 10 feet lower than the previous year, likely due to the below normal recharge from lack of imported spreading water.

- **Well 3S/12W-01A06** (LACDPW Well No. 1615P) is located downgradient and southeast of the spreading grounds near the southern end of the Montebello Forebay and the water level responses in this well are less pronounced than the other two wells because it is further from the spreading grounds and the recharge that occurs there. The lower chart on **Figure C** shows the water levels for this well. At the end of water year 2007/08, groundwater levels in this well were 9 feet lower than the previous year.

For the current water year, rainfall is currently 77% of normal and imported water for recharge is not expected to be available. Therefore, water levels in the Montebello Forebay are expected to decline.

Central Basin Pressure Area

The District monitors key wells **4S/13W-12K01** (LACDPW No. 906D) and **4S/12W-28H09** (LACDPW No. 460K) which represent the conditions of the pressurized groundwater levels in the Central Basin Pressure Area. The hydrographs for these two wells are shown on **Figure D**.

Groundwater highs were observed in these wells in 1935 when they began to continually drop over 110 feet until their lows in 1961 due to the over-pumping and insufficient natural recharge. Groundwater levels recovered substantially during the early 1960s as a result of replenishment operations and reduced pumping. Since 1995, there have been 100-foot swings in water levels each year from winter to summer. These swings are due to pumping pattern changes by some of the Central Basin producers who operate with more groundwater in the summer months and less groundwater in the winter months.

For example, in WY 2007/08 average monthly Central Basin pumping in May through September was about 18,400 AF, whereas in October through April was 16,300 AF. This 2,100 AF/month difference, combined with the confined and pressurized Central Basin aquifers, result in the wide water level swings. However, the monthly differences and water level swings used to be higher than in years prior to 2007/2008. This is because MWD had their In-Lieu program, and some participating pumpers would take Met water in-lieu of pumping in the winter months (water levels rise) and pump more groundwater in the summer months (water levels drop). However, in 2007/08 Met did not offer their In-Lieu program, so the producers pumped groundwater all year round and the swings were not as pronounced.

At the end of WY 2007/08, water levels in well 4S/13W-12K01 was a foot higher than the previous year, and well 4S/12W-28H09 was 14 feet higher than the previous year. WRD attributes this rise to the smoothing out of pumping as described above, and also water conservation efforts by some of the cities in this area due to the current drought. As conditions in the Pressure Area remain the same this year as last year, water levels should remain steady if not somewhat rise.

West Coast Basin

The West Coast Basin is separated from the Central Basin by the Newport-Inglewood Uplift which is a series of discontinuous, subparallel hills and faults that act as a partial barrier to groundwater flow. Groundwater moves across the uplift from one basin to the other based on water levels on either side of the uplift.

Figure E shows the hydrographs of key wells **3S/14W-22L01** (LACDPW No. 760C) and **4S/13W-21H05** (LACDWP No. 869). These two wells represent the general conditions of the water levels in the West Coast Basin. In 1955, the control of groundwater extractions in the West Coast Basin resulted in stabilizing and reversal of the declining water levels in the center of the basin (well 3S/14W-22L01), whereas at the eastern end near the Dominguez Gap Barrier water levels continued to decline until about 1971, when a recovery began due mostly to the startup of the Dominguez Gap Barrier Project. For the previous year 2007/2008, water levels in both wells were a generally stable to a couple feet lower than the previous year, possibly due to the increased pumping in the West Coast Basin. In other District monitoring wells, water levels were a few feet higher than the previous year, especially near the Dominguez Gap Barrier and in Gardena. The complexity of water level rises and falls is reflective of localized pumping patterns and barrier wells, but in general the water levels in the current year are expected to remain stead to slightly lower.

Plate 3 shows the water level changes over the entire CWCB over the previous water year. Because of the driest year on record and increased pumping, the Central Basin experienced water level declines up to 15 feet. The average water level change in the Central Basin was a drop of nearly 7 feet. The West Coast Basin was less impacted because the inflows generally matched the outflows. Much of the basin remained relatively flat with only the eastern portion experiencing minor water level decreases. The average water level change in the West Coast Basin was less than a foot. For the combined CWCB, average water levels fell 4.5 feet.

Based on the groundwater levels observed over various areas of the Central and West Coast Basins and the projections for the current and ensuing year, the District anticipates no problems in having adequate groundwater supplies to meet the demands of the groundwater pumpers in the immediate future. However, if MWD imported spreading water and in-lieu water continue to remain unavailable, replenishment will be reduced, overdraft will increase, and water levels will drop further.

Change in Storage

The District determines the change in storage by comparing water levels from one year to the next. Rising water levels means an increase in groundwater storage and a drop in water levels means a decrease in storage. Using water level elevation data collected from WRD's monitoring well network and selected production wells, the District constructs a water level change map from one year to the next (**Plate 3**). The data from this map are multiplied by the storage coefficient values for the aquifers as obtained from the USGS calibrated model of the District to produce the change in storage.

As reported in the Annual Overdraft discussion, the change in storage in WY 2007/2008 was approximately 41,600 AF. Over the past 10 years, there have been two years of gaining storage and 8 years of losing storage, with the average loss from storage at 20,000 AFY, or 200,000 AF loss over 10 years. This is a considerable amount of storage loss and is attributable to dry years and lack of replenishment water. But, the groundwater basins can act as a reservoir, draining in times of drought and rising in times of surplus. The District monitors these changes and compares it to its defined Optimum Groundwater Quantity, as described below.

For the current water year, due to the precipitation amounts being below normal so far and the lack of imported water for replenishment, it is expected that there will be a loss from storage again. **Table 8** provides the historical tracking of storage changes in the CWCB.

Optimum Groundwater Quantity

In response to a 2002 State audit of the District's activities, the Board of Directors adopted an Optimum Quantity for groundwater amounts in the Central and West Coast Basins. The Optimum Quantity is based on the Accumulated Overdraft (AOD) concept described in the Water Code and in this ESR. The historic maximum groundwater drawdown due to over pumping reported in the CWCB between 1904 and 1957 was 1,080,000 AF. This is defined as the historic maximum AOD. As pumping eased and artificial replenishment occurred, more water was put back into the basins and the AOD was reduced resulting in rising water levels.

After considerable analysis and discussion, on June 18, 2003 the Board of Directors adopted the Optimum Quantity for the CWCB at an AOD of 400,000 AF, or 680,000 AF on top of the historic maximum AOD. The adopted value was based on the amount of groundwater necessary to meet the pumpers' demands in a worst case scenario of a major 3-year major where pumping would be maximized due to a lack of MWD water and replenishment at the spreading grounds and other means is at a minimum.

In 2003 through 2006, however, new discussions were being held by the local water community on groundwater storage opportunities within the District. The original derivation of the Optimum Quantity of AOD = 400,000 AF did not take into full account storage projects. If this Optimum Quantity were fully realized, there would not be enough storage space in the aquifers for large storage projects. Therefore, to utilize the groundwater basins for both endeavors, the Board of Directors on April 19, 2006 established a new Optimum Quantity at an AOD of 612,000 AF. This value was based on an extensive review of over 70 years of water level fluctuations in the District and recognizing that in the year 2000, groundwater amounts were at a healthy quantity to sustain the adjudicated pumping rights in the basins. The AOD in the year 2000 was 612,000, and therefore was set by the Board of Directors as the new Optimum Quantity.

The Board of Directors at that April 19, 2006 meeting also adopted a policy to make up the Optimum Quantity should it fall too low. The policy is as follows:

> *An Accumulated Overdraft greater than the Optimum Quantity is a deficit. WRD will make up the deficit within a 20 year period as decided by the Board on an annual basis. If the deficit is within 5 percent of the Optimum Quantity, then no action needs to be taken to allow for natural replenishment to makeup the deficit.*

Since the end of WY 1999/2000, a total of approximately 89,800 AF have been lost from storage, brining the AOD down to 701,800. Based on the adopted policy, the Board will be considering options to make up the AOD and return the basin to the Optimum Quantity over a period of time.

CHAPTER IV
GROUNDWATER REPLENISHMENT: QUANTITIES, AVAILABILITY, AND COSTS

As discussed in the previous chapter, the Central and West Coast Basins have an annual overdraft because more groundwater is pumped out than is replaced naturally. The District purchases supplemental water (artificial replenishment water) each year to help offset this overdraft. The purchased water enters the groundwater basins at the Montebello Forebay spreading grounds, at the seawater barrier injection wells, and through the District's In-Lieu Program. The purpose of this Chapter is to determine the quantities of water needed for purchase in the ensuing year and to determine the availability and cost of that water.

The District currently has available to it recycled and imported water sources for use as artificial replenishment water. These two sources are described below:

- ***Recycled Water****: Recycled water is wastewater from the sewer systems that is reclaimed through extensive treatment at water reclamation plants (WRPs). The water is treated to high quality standards so that it can be reused safely. Some agencies and businesses use recycled water for non-potable purposes, such as for irrigation of parks, golf courses, and street medians, or for industrial purposes. WRD uses recycled water for groundwater recharge since 1962. In semi-arid areas such as Southern California where groundwater and imported water are in short supply, recycled water has proven to be a safe and reliable additional resource to supplement the water supply. Recycled water is used at the spreading grounds and the seawater barrier wells. Although recycled water is high quality, relatively low cost, and a reliable supply all year long, the District is limited by regulatory agencies in the amount it can use for replenishment. Therefore, imported water is also used for recharge.*
- ***Imported Water****: This source originates from northern California (State Water Project) and the Colorado River and is brought to the District by the Metropolitan Water District of Southern California (MWD or Met). Raw (untreated), surplus imported water is used at the spreading grounds whereas potable imported water is used at the seawater intrusion barriers and for the in-lieu program. Because of treatment and transportation costs, it is the most expensive source for recharge water. The supply is under full upstream control, and its availability at the spreading grounds is limited and variable, especially during drought years. In fact, since May 2007 MWD has stopped delivery of this water for replenishment and the availability for 2009/2010 is questionable due to continued drought and Bay Delta issues.*

Recommended Quantities of Replenishment Water

With information presented in the preceding chapters regarding the basins' pumping demands and the overall condition of the groundwater basins, WRD can estimate its projected need for replenishment water in the ensuing year.

Spreading

Groundwater recharge through surface spreading occurs in the Montebello Forebay Spreading Grounds adjacent to the Rio Hondo and the San Gabriel River, within the unlined portion of the San Gabriel River, and behind the Whittier Narrows Dam in the Whittier Narrows Reservoir. Owned and operated by the Los Angeles County Department of Public Works (LACDPW), they were

originally constructed in 1938 for flood control and conservation of local storm water, but have been used since the 1950s to replenish the basins with imported water and since 1962 with recycled water.

Since recycled water is a high quality, less expensive, and available year-round source of replenishment water, the District maximizes its use within established regulatory limits. These limits are discussed below under "Expected Availability of Replenishment Water". In general, the District plans on purchasing 48,000 AF in the ensuing year to maximize the amount under regulatory limits. However, this amount may change on April 2, 2009, when the Los Angeles Regional Water Quality Control Board considers amending WRD's permit to allow about 5,000 AFY more.

However, additional replenishment water is needed beyond the 48,000 AFY of recycled and will come from the purchase of imported water from MWD. In 2003, the WRD Board adopted the long term average of 27,600 AFY of imported water to purchase for spreading. This value was based on long-term (30 year) averages of the overall water budget of the basins using the USGS computer model. The 2003 ESR discusses the derivation of this value in more detail.

Since that time, the District has invested in cooperative projects with the LACDPW to capture more storm water and to lessen the need for imported water as part of WRD's Water Independence Now program, or WIN. Improvements to the Whittier Narrows Conservation Pool are expected to conserve an additional 3,000 AFY of storm water on average. Two new rubber dams were built in the San Gabriel River near Valley Boulevard and are expected to conserve an additional 3,600 AFY on average. Therefore, the new Long Term Average for imported spreading demands is 21,000 AFY and the total WRD spreading needs for the ensuing year is 69,000 AF. **Table 9** presents the imported water replenishment needs. In the near future, additional storm water conservation projects such as the interconnection pipeline will conserve more storm water.

Injection

Another way of replenishing the groundwater supply is to inject water at the three seawater intrusion barriers owned and operated by LA County Department of Public Works (LADPW), including the West Coast Basin Barrier, Dominguez Gap Barrier, and Alamitos Barrier. Although the primary purpose of the barriers is for seawater intrusion control, groundwater replenishment also occurs as the freshwater is injected into the CWCB aquifers and then moves inland towards pumping wells.

To determine the amount of barrier water estimated for the ensuing year, WRD under an Agreement with LADPW gets estimates from the expected demand at the barriers. WRD reviews these estimates and makes adjustments as necessary. For 2009/2010, no adjustments to the LADPW estimates were made.

For the West Coast Basin Barrier Project 15,200 AF are estimated of which 11,400 AF will be recycled water (75%) and 3,800 AF will be imported water. For the Dominguez Gap Barrier Project 8,000 AF are estimated, with 4,000 AF recycled and 4,000 AF imported. For the Alamitos Barrier 4,200 AF are estimated with 2,100 AF recycled and 2,100 AF imported.

The total barrier demand forecast for the ensuing year is 27,400 AF (**Table 9)**, or 17,500 AF recycled and 9,900 AF imported.

In-Lieu Replenishment Water

The basic premise of the In-Lieu Program is to offset the pumping in the basin to lower the annual overdraft and reduce the artificial replenishment needs by WRD. It helps provide an alternate means of replenishing the groundwater supply by encouraging basin pumpers to purchase surplus imported water when available instead of pumping groundwater. This can help raise water levels in areas that are otherwise more difficult to address. For the current year, the Board approved an In-Lieu Program of 10,303 AF (6,000 AF in CB and 4,303 AF in WCB). To this date, the water has not been made available by MWD due to water shortages. However, the length of this shortage is unknown, so WRD assumes that the water will be available in the ensuing year. Although the Board has not yet adopted the In-Lieu Program for the ensuing year, it is assumed that the current year program will continue into the ensuing year in the amount of 10,303 AF (6,000 in Central Basin and 4,303 in the West Coast Basin).

Based on this information, it has been determined that the District will need to purchase 106,703 AF of replenishment water in the ensuing year. **Table 9** summarizes these quantities.

Expected Availability of Replenishment Water

The availability of water supplies for the ensuing water year has been taken into account when determining how funds should be raised. If a particular resource is expected to be unavailable during a given year, money can still be raised to fund the purchase of that quantity of water in a succeeding year. That situation happened in WY 2008/09 when MWD spreading water and In-Lieu water were not made available due to surface water shortages. This is also expected to be the case in the ensuing year 2009/2010 at the time of this writing. However, the District intends to raise money for the water necessary for replenishment in case the MWD water does become available, and if not, will carry it over into subsequent years for a later purchase.

Recycled Water

Recycled water is reliable all year round compared to imported replenishment water. The current recycled water spreading requirements for the Montebello Forebay established by the California Regional Water Quality Control Board (RWQCB) are detailed in Order No. 91-100 adopted on September 9, 1991. WRD plans on maximizing its allowable use of recycled water because it is a reliable and cost-effective replenishment source of good quality water. The District is limited to spreading 60,000 AF of recycled water per year or an amount not to exceed 50% of the total inflow into the Montebello Forebay for that year, whichever is less. Furthermore, the Order stipulates that recycled water shall not exceed 150,000 AF in any three-year period or 35% of the total inflow into the Forebay. However, these permit conditions are being reviewed on April 2, 2009, when the Los Angeles Regional Water Quality Control Board will consider amending WRD's permit to limit recycled water use to just the 35% criteria and over 5 years instead of 3. The net result of this change, if approved, would be to allow up to 5,000 AFY more recycled water on average, assuming that dilution waters (storm water and imported water) remain available and in sufficient amounts.

The County Sanitation Districts of Los Angeles County (CSDLAC) provides the recycled water to WRD for spreading. This water comes from the Whittier Narrows Water Reclamation Plant (WNWRP), San Jose Creek Water Reclamation Plant (SJCWRP), and Pomona Water Reclamation Plant (PWRP). WRD purchases water from the WNWRP and SJCWRP, whereas the water from the PWRP is considered incidental recharge and is not purchased by WRD. For planning purposes, the

Groundwater Replenishment

District assumes that a total of 50,000 AFY will be used for spreading of recycled water to meet the 3-year cap of 150,000 AF. Since the PWRP discharges about 2,000 AFY, this leaves 48,000 AFY of recycled water to be purchased by WRD from the WNWRP and SJCWRP. **Table 2** shows the breakdown amounts for these purchases.

Recycled water for injection into the barrier wells at the WCBBP is available from WBMWD's West Basin Recycling Plant. Per regulatory limits, this resource can provide up to 75% of the water injected into the West Coast Basin Barrier with an increase up to 100% being explored. WRD has entered into an agreement with WBMWD to purchase up to 12,500 AFY of their recycled water for the WCBBP.

Recycled water for the DGBP is available from the City of Los Angeles' Terminal Island Treatment Plant (Harbor Recycled Water Project). The plant is expected to provide up to 5 million gallons per day (mgd), equivalent to 5,600 AFY of the barrier water demand in the ensuing year, or 50% of the total barrier water, which is the maximum permitted amount.

Recycled water for the ABP is available from WRD's Leo J. Vander Lans Water Treatment Facility. This treatment plant is expected to provide up to 50% of the source water to the barrier, with imported water comprising the other half.

Imported Water

For spreading and In-Lieu (considered interruptible water), WRD is assuming that MWD water will be available next year, but this is not guaranteed and is not looking likely at the time of this writing. As import deliveries are cut back during dry years or with climate change or extended periods of drought, WRD may need to look at other sources for replenishment water, such as increased used of recycled water and storm water. For the current year, imported water from MWD for spreading and In-Lieu have been unavailable due to drought and environmental issues (Delta smelt protection, dry conditions, and court rulings causing State Water Project cutbacks). The availability of replenishment water for the rest of 2009 and into 2010 will depend on this year's snow pack and reservoir levels. To date, precipitation is below normal and there will likely not be any imported spreading water available in 2009. WRD intends to raise money for replenishment water in the ensuing year assuming that is will be available. But if not, the money will be kept in reserves to be used for water purchases in the future when it does become available.

For the imported water used for injection at the seawater barrier wells, the District pays the premium price for "non-interruptible" water meaning that it will be available all year long with the possible exception that MWD could invoke a Water Allocation Plan to ration available supplies to all users if there is a severe drought. Because of the increasing water costs at the barriers, the District is looking at ways to minimize costs such as reduction of pumping near the barriers, increased recycled water to offset imported water, or banking water at lower seasonal rates. At the ABP, the City of Long Beach and WRD have entered into an agreement to bank seasonal treated water through inland injection wells and then extract the water for injection at the barriers, thus saving considerable costs on barrier water. However, because MWD has halted the availability of seasonal water, the amount remaining in the bank has been put on hold and Tier 1 water is being purchased. When seasonal water becomes available again, the storage bank will be refilled.

Projected Cost of Replenishment Water

WRD has estimated it will need 106,703 acre feet of replenishment water in the ensuing year. The Metropolitan Water District of Southern California (MWD) and their member agencies set the price for the imported water WRD buys for the replenishment at the spreading grounds, barrier wells, and In-Lieu, and are a direct pass-through on WRD's replenishment assessment.

At their April 14, 2009 Board meeting, MWD set their new rates which, in addition to the surcharges added by the MWD-member agencies, will cause an overall increase on WRD's imported replenishment water cost of 33%. This large increase is due to the State's water crisis including drought, environmental concerns, energy concerns, and reductions in water purchases through conservation. With the known and estimated costs for replenishment water in mind, WRD has estimated that it will cost $28,815,746 to purchase the 106,703 acre feet of replenishment water in the ensuing year. **Tables 1 and 2** present the details of these anticipated costs. Specifics of the unit costs for water are presented in the next three sections.

Recycled Water Rates

Under an interim contract, the current price for recycled water from the WNWRP is $7.00/AF. The unit cost of recycled water from the SJCWRP is adjusted every three-years based on an agreement between WRD and the Sanitation Districts. In January 2007, the new three year period commenced with the price going down from $21.31/AF to $20.66/AF.

At the WCBBP, the cost of recycled water from WBMWD is expected to increase from $458/AF to $497/AF based on a new agreement between WBMWD and WRD for long term reliability of the water. This price will be in effect from July 1, 2009 – June 30, 2010, when it is expected to go up by $20/AF. For this ESR, a melded rate of $504/AF was applied for the period between January and September 2010 to account for this July 2010 price increase.

At the DGBP, the rate for recycled water from the Terminal Island Treatment Plant will cost $431/AF from the City of Los Angeles. This is a guaranteed rate for the first 5 years of the project, and is good until 2011.

For recycled water at the ABP from the Leo J. Vander Lans Water Treatment Facility, WRD has determined that the cost of water to the District will be $286/AF, which represents the operations and maintenance costs of the treatment plant less the MWD rebate. However, this cost is incorporated into the District's budgeting for the operations and maintenance costs for the facility (WRD Project #001), and therefore is included in the project's budget instead of the water budget.

Imported Water Rates

WRD cannot buy directly from MWD because it is not a member agency. The District, therefore, purchases water from MWD member agencies such as the CBMWD, WBMWD, and the City of Long Beach for the spreading grounds, barrier wells, and In-Lieu. The cost of replenishment water to WRD is the MWD rate plus any surcharges added by the MWD member agencies.

Recently, MWD made a substantial increase in their water rates due to the State's water crisis including drought, environmental concerns, energy concerns, and reductions in water purchases through conservation.. The base commodity rate (without member surcharges) for replenishment water will increase from $294/AF to $366/AF for spreading water (25% increase); from $579/AF to

$701/AF for seawater barrier water (21% increase), and $436/AF to $558/AF for In-Lieu Water (28% increase).

Met-member agencies also add surcharges on top of the MWD rates. WBMWD has water service and capacity fees. CBMWD has administrative surcharges and meter connection fees. LBWD has administrative fees. As of this writing the agencies have not yet adopted their rates. Therefore, WRD has made assumptions based on projections and workshops. The total rates are presented in **Table 1**. The table breaks out two time frames, October through December 2009 and January through September 2010. This accounts for expected price increases starting the beginning of the next calendar year.

In-Lieu Rates

The WRD Board of Directors sets the In-Lieu rates. For 2009/2010, the rates reflect the cost of MWD seasonal storage water plus any surcharges by the MWD member agencies less the cost to pump groundwater and less WRD's 2009/10 replenishment assessment. The unit costs are shown on **Table 1**.

Summary

Based on the pricing structures discussed earlier in this Chapter and on the quantities of water forecast for purchase in the ensuing year, WRD estimates that the cost for 106,703 AF of replenishment water will be $28,815,746. **Table 2** presents the detailed breakdown of these costs.

These estimated costs are for water purchases only. They do not include the additional costs for the projects and programs needed to replenish the basins and to protect groundwater quality. Those projects and programs are discussed in the next chapter and their costs will be presented in the District's separate annual budget document presented during the rate setting process. The entirety of the District costs were presented during the annual budgeting and rate setting process that culminated in the Board's adoption of the Replenishment Assessment for FY 2009/2010 on May 1, 2009 at $181.85 per acre foot of groundwater pumped. This represents an 18.9% increase from the previous year's assessment of $153/AF and takes effect from July 1, 2009 through June 30, 2010.

CHAPTER V
PROJECTS AND PROGRAMS

California Water Code Sections 60220 through 60226 describe the broad purposes and powers of the District to perform any acts necessary to replenish, protect, and preserve the groundwater supplies of the District. In order to meet its statutory responsibilities, WRD has instituted numerous projects and programs in a continuing effort to effectively manage groundwater replenishment and groundwater quality in the Central and West Coast Basins (CWCB). These projects and programs include activities that enhance the replenishment program, increase the reliability of the groundwater resources, improve and protect groundwater quality, and ensure that the groundwater supplies are suitable for beneficial uses.

These projects and programs have had a positive influence on the basins, and WRD anticipates continuing these activities into the ensuing year. The following is a discussion of the projects and programs that WRD intends to continue or initiate during the ensuing year.

001 – Leo J. Vander Lans Water Treatment Facility Project

The Leo J. Vander Lans Water Treatment Facility provides advanced treated recycled water to the Alamitos Seawater Intrusion Barrier. The facility receives tertiary-treated water from the Sanitation Districts and provides the advanced treatment through a process train that includes microfiltration, reverse-osmosis, and ultraviolet light. The facility's operations permit was approved by the Los Angeles Regional Water Quality Control Board on September 1, 2005, and the replenishment operations of this facility started in October 2005. The product water has since been discharging to the barrier to replace up to 50% of the potable imported water currently used, thereby improving the reliability and quality of the water supply to the barrier. The plant is designed to produce approximately 3,000 AFY for delivery to the barrier. A study was conducted within the last year to improve the production efficiency of the facility. Measures are being implemented to improve the performance of the facility.

The Long Beach Water Department (LBWD) is responsible for operation and maintenance of the treatment plant under contract with WRD. Expected costs for the coming year will primarily involve operating and maintaining the plant through the LBWD contract as well as meeting groundwater monitoring requirements from the permit to inject recycled water at the barrier. Because the primary purpose of this project is to provide a more reliable means of replenishing the basin through injection, 100% of the costs are considered to be drawn from the Replenishment Fund.

002 – Robert W. Goldsworthy Desalter Project

The Robert W. Goldsworthy Desalter has been operating since 2002 to remove brackish groundwater from a saline plume in the Torrance area that was stranded inland of the West Coast Basin Barrier after the barrier was put into operation in the 1950s and 1960s. The production well and desalting facility are located within the city of Torrance, and the product water is delivered for potable use to the City's distribution system. The project currently extracts about 2,200 AFY.

As with the Vander Lans facility, future costs for this project will involve O&M activities and replacement costs. The purpose of the desalter is directly related to remediating degraded groundwater quality, and costs are thus attributed 100% to the Clean Water Fund.

Additional measures may be necessary in the future to fully contain and remediate the saline plume, which extends outside of the Torrance area. WRD is actively pursuing long-term solutions to this problem and continues to work with the City of Torrance Municipal Water Department, the pumpers' Technical Advisory Committee, and other stakeholders on the future of the saline plume removal in the West Coast Basin.

004 – Recycled Water Program

Recycled water (reclaimed municipal wastewater) has been used for groundwater recharge by WRD since 1962. Using recycled water to replenish the groundwater basins provides a reliable source of high quality water for surface spreading in the Montebello Forebay and injection at the seawater intrusion barriers. In view of the drought conditions that periodically occur in California and uncertainty in the future availability of imported supplies, this resource has become increasingly vital and essential as a replenishment source.

WRD participates in various activities to ensure that the use of recycled water continues to be safe and reliable for groundwater recharge. WRD, along with other stakeholders, is working closely with the California Department of Public Health (CDPH) to revise regulations on groundwater recharge using recycled water. Through this dialogue, WRD and CDPH exchange information and develop a mutual understanding of each agency's perspectives.

From an operational standpoint, the District continues to coordinate with the Sanitation Districts of Los Angeles County with permit compliance activities, including groundwater monitoring and reporting, to ensure that the current practice and operation of replenishing with recycled water continues to be safe. Many monitoring wells and production wells are sampled frequently by WRD staff, and the results are reported as required to the regulatory agencies.

In addition to regular monitoring and sampling around the spreading grounds, WRD is partnering with others to more fully investigate the effectiveness of soil aquifer treatment (SAT) during percolation. Research is being conducted by specialists and experts and includes specific tests to characterize the percolation process and quantify the filtering and purifying properties of the underlying soil on constituents of concern such as nitrogen, total organic carbon, and emerging contaminants. More recently, the District is participating in a study through the WateReuse Foundation to compare the relative risks of water supplies that contain a portion of recycled water after SAT with water supplies that do not and found that there are no significant differences. In addition, the Colorado School of Mines completed an investigation that studied the effectiveness of SAT in removing organic carbon after recycled water percolates through the soil, which serves as a surrogate for potentially harmful contaminants, and compared it with percolation of drinking water and characterized similarities and differences. The District continues to be vigilant in monitoring research on the detection, significance, and treatment of emerging contaminants, such as pharmaceuticals and personal care products.

Tracer studies to verify travel time estimates from the spreading facilities to neighboring production wells were completed in mid-2006. It was shown that the depth to the screens of these wells was a more significant factor than horizontal distances between the spreading facilities and the wells. Also, travel time increased in one well after its well screen was sealed at shallow depths, thereby restricting flow into the well only from deeper aquifers. These efforts, in addition to periodic studies assessing health effects and toxicological issues, are necessary to provide continued assurances that

recycled water for groundwater recharge remains safe and compliant with regulatory standards in the local basins.

Recycled water is also injected into the three seawater intrusion barriers in Los Angeles County (Alamitos, West Coast Basin, and Dominguez Gap). Work associated with the use of recycled water at those facilities is maintained under the specific project (e.g., Leo J. Vander Lans Water Treatment Facility) that delivers that resource to the barriers or under the program related to recycled water use at the specified barrier.

Projects under this program help to improve the reliability and utilization of an available local resource. This resource is used to improve replenishment capabilities and is thus funded 100% from the Replenishment Fund.

005 – Groundwater Resources Planning Program

The Groundwater Resources Planning Program was instituted to evaluate basin management issues and to provide a means of assessing project impacts over the Central and West Coast Groundwater Basins. Prior to moving forward with a new project, an extensive evaluation is undertaken. Within the Groundwater Resources Planning Program, new projects and programs are analyzed based on benefits to overall basin management. This analysis includes performing an extensive economic evaluation to compare estimated costs with anticipated benefits. As part of this evaluation process, all new capital projects are brought to the District's Technical Advisory Committee for review and recommendation. District staff will perform an update to the CIP in the upcoming year, upon resolution of outstanding issues related to basin management.

The past several years have focused on the potential groundwater storage capabilities of the two basins. This year, the District will continue to work closely with basin stakeholders to finalize the framework for the implementation of storage projects.

Under this program, District staff will continue to monitor State and Federal grant programs to determine applicability to the District's list of potential projects. In the coming year, staff resources will be allocated to the District's continued participation in the review refinement of the Integrated Regional Water Management Plan for Greater Los Angeles County (IRWMP). The development of this plan is a requirement for entities to secure grant funding under Proposition 84 and Proposition 1E which were passed in November 2006. It is expected that this plan will play a significant role in future grant funding opportunities at the Local, State and Federal levels. District staff will also monitor the ongoing AB303 grant funding program.

Projects under the Groundwater Resources Planning Program serve to improve replenishment operations and general basin management. Accordingly, this program is also wholly funded through the Replenishment Fund.

006 – Groundwater Quality Program

This comprehensive program constitutes an ongoing effort to address water quality issues that affect WRD projects and the pumpers' facilities. The District monitors and evaluates the impacts of proposed, pending and recently promulgated drinking water regulations and proposed legislation. If warranted, the District assesses the justification and reasoning used to draft these proposals and, if

warranted, joins in coordinated efforts with other interested agencies to resolve concerns during the early phases of the regulatory and/or legislative process.

The District continually evaluates current and proposed water quality compliance in production wells, monitoring wells, and spreading/injection waters of the basins. If noncompliance is identified, WRD staff develops a recommended course of action and associated cost estimates to address the problem and achieve compliance.

Effective January 1, 2007, the District assumed responsibility for the Central Basin Title 22 Groundwater Monitoring Program that had been administered by the Central Basin Municipal Water District. This program provides services for monitoring of drinking water wells as required by state statutes to ensure that they continue to be safe for domestic use. Nineteen pumpers with 78 wells have elected to continue participation in this program. In addition, a new contract for sample collection and laboratory analysis was issued for this work. This program is paid for by the participants, and therefore, does not impact the District's replenishment assessment.

In recent years, new emerging contaminants have been identified as impacting local groundwater not only in the Central and West Coast Basins, but also in neighboring regions such as the Main San Gabriel Basin, Orange County Basin, Chino Basin, etc. Constituents such as perchlorate, n-nitroso dimethylamine (NDMA), hexavalent chromium, and 1,4-dioxane have emerged as contaminants of concern and pose a potential threat to the local resources. In addition, due to advancements in and greater sensitivity of new laboratory analytical methods, trace amounts of pharmaceutical drugs have also been found. Existing drinking water regulations are being revisited and may be revised in the near future, which would impact the use of some existing wells. New regulations may be established as well. Monitoring for potential contaminants began on January 1, 2008 to comply with the federal Unregulated Contaminated Monitoring Rule 2.

WRD's service area contains a large and diverse industrial and commercial base. Consequently, many potential groundwater contamination sources exist within District boundaries. Examples of contamination sources range from leaking underground storage tanks, to petroleum pipeline leaks at refineries and petrochemical plants, to discharges from dry cleaning facilities, auto repair shops, metal works facilities, and others. Such contamination sources may pose a threat to the drinking water aquifers. Accordingly, WRD established its Groundwater Contamination Prevention Program as a key component of the Groundwater Quality Program, in an effort to minimize or eliminate threats to groundwater supplies.

The Groundwater Contamination Prevention Program includes several ongoing efforts:

- Central and West Coast Basin (CWCB) Groundwater Contamination Forum: Several years ago, WRD established this data-sharing and discussion forum with key stakeholders including the U.S. Environmental Protection Agency (USEPA), the California Department of Toxic Substances Control (DTSC), the California Regional Water Quality Control Board – Los Angeles (RWQCB-LA), the California Department of Public Health (CDPH), the U.S. Geological Survey (USGS), and various cities and pumpers. Stakeholders drafted and signed a Memorandum of Understanding (MOU) agreeing to meet regularly (meetings are held 3 to 4 times per year at WRD) and share data on contaminated groundwater sites within the District. WRD has acted as the meeting coordinator and data repository/distributor, helping stakeholders to characterize the extent of contamination to identify pathways for shallow

contaminants to reach deeper drinking water aquifers, and develop optimal methods for remediating contaminated groundwater.

- With the cooperation and support of all stakeholders in this Forum, WRD developed a list of high-priority contaminated groundwater sites within the District. This list is a living document, subject to cleanup and "closure" of sites as well as discovery of new sites warranting further attention. Currently, the list includes over 40 sites across the CWCB. WRD works with the lead regulatory agencies for each of these sites to keep abreast of their status, offer data collection, review and recommendations as needed, and facilitate progress in site characterization and cleanup.

- In 2003, WRD developed a scope of work with the Los Angeles County Department of Health Services (LACDHS) to clarify the status of 217 potentially abandoned (a.k.a., "unknown status") wells located within District boundaries, as identified through researching WRD's groundwater production database. WRD completed numerous tasks to determine the status of these wells, including: distributing, collecting and tallying a survey questionnaire to all well owners associated with the potentially abandoned wells; searching through thousands of hard-copy well construction and destruction permits at the DWR, LACDHS, and City of Long Beach; conducting field reconnaissance trips to locate and photograph wells. These efforts were successful: WRD was able to reduce the number of "unknown status" wells from 217 to 20, and most of the remaining 20 are suspected to have been paved over during development of industrial and residential neighborhoods. At this time, it is WRD's intention to revisit its groundwater production database every few years, to identify any new "unknown status" wells, and to repeat the tasks listed above to clarify their status.

WRD is also participating in the Water Augmentation Study (WAS) of the Los Angeles and San Gabriel River Watershed Council. This is a multi-year investigation to evaluate the feasibility of capturing more storm runoff at localized sites in lieu of discharge into ~~the~~ storm drains, channels, and ultimately to the ocean. It is a potential source of new replenishment water, and would be in addition to stormwater currently captured and retained for percolation at ~~in~~ the existing spreading grounds within the District. The underlying concept for the WAS is to retain more stormwater rather than allow it to be lost to the ocean; however, precautions must be taken to ensure that this new water does not degrade groundwater quality if allowed to percolate at local sites. More stormwater could be saved by utilizing Best Management Practices (BMP's), e.g., bioswales, infiltration basins, and porous pavements. Much of the WAS is focused on evaluating the technical feasibility of this project and the potential impacts on groundwater quality. Other aspects of the WAS include modeling to estimate the amount of water that can be percolated in the local watershed and the economic value of this additional source of water. In 2009, a neighborhood demonstration project is being constructed with BMP's to evaluate the effectiveness and potential of a large-scale project.

Much of the work for the coming year will involve additional investigations at well sites known to have contaminated water, continued monitoring of water quality regulations and proposals affecting production and replenishment operations, further characterization of contaminant migration into the deeper aquifers, and monitoring and expediting cleanup activities at contaminated sites. All work under this program is related to water quality and cleanup efforts; therefore, 100% of it is funded from the Clean Water Fund.

010 – Geographic Information System (GIS)

The District maintains an extensive database and Geographic Information System (GIS) in-house. The database includes water level and water quality data throughout the entire WRD service area with information drawn not only from the District's Regional Groundwater Monitoring Program and permit compliance monitoring, but also from water quality data downloaded from DHS. The system requires continuous update and maintenance but serves as a powerful tool for understanding basin characteristics and overall basin health.

The GIS is used to provide better planning and basin management. The system is used to organize and store an extensive database of spatial information, including well locations, water level data, water quality information, well construction data, production data, aquifer locations, and computer model files. Staff uses the system daily for project support and database management. Specific information is available to any District pumper or stakeholder upon request and can be delivered through the preparation of maps, tables, reports, or other compatible format. Additionally, the District has made its web-based Interactive Well Search tool available to selected users. This web site provides these users with limited access to WRD's water quality and production database.

District staff will continue to streamline and refine the existing data management system and website as well as satisfy both internal and external data requests. As part of the streamlining of the data, staff will develop an map library of commonly requested information based on input from all District staff. Additionally, District staff will continue efforts to integrate its regional groundwater flow model with the GIS in order to more clearly convey model results. Continued use, upkeep, and maintenance of the GIS are planned for the coming year. The use of the system supports both replenishment activities and groundwater quality efforts. Accordingly, the cost for this program is equally split between the Replenishment and Clean Water Funds.

011 – Regional Groundwater Monitoring Program

The Regional Groundwater Monitoring Program provides for the collection of basic information used for groundwater basin management including groundwater level data and water quality data. It currently consists of a network of about 250 WRD and USGS-installed monitoring wells at over 50 locations throughout the District, supplemented by the existing groundwater production wells. The information generated by this program is stored in the District's GIS and provides the basis to better understand the dynamic changes in the Central and West Coast Basins. WRD staff, comprised of hydrogeologists and engineers, provides the in-house capability to collect, analyze and report groundwater data.

Water quality samples from the monitoring wells are collected twice a year. Water levels are measured in most monitoring wells with automatic data loggers daily, while water levels in all monitoring wells are measured by WRD field staff a minimum of four times per year. On an annual basis, staff prepares a report that documents groundwater production, groundwater level, and groundwater quality conditions throughout the District.

Most of the work during the coming year will involve continuous field activities including quarterly and semi-annual data collection, continuous well and equipment maintenance, and annual reporting activities. In addition, three new monitoring wells will be constructed. Work associated with the Regional Groundwater Monitoring Program also supports activities relating to both replenishment

and water quality projects. The program, therefore, is funded 50% each from the Replenishment and Clean Water Funds.

012 – Safe Drinking Water Program

WRD's Safe Drinking Water Program (SDWP) has operated since 1991 and is intended to promote the cleanup of groundwater resources at specific well locations. Through the installation of wellhead treatment facilities at existing production wells, the District hopes to remove contaminants from the underground supply and deliver the extracted water for potable purposes. Projects implemented through this program are accomplished through direct input and coordination with well owners. In May 2007, the latest treatment plant went online which was a removal system for iron, manganese, and arsenic. The removal mechanism is a pressurized filtration system.

The current program focuses on the removal of VOCs and offers financial assistance for the design and equipment of the selected treatment facility. Another component of the program offers no-interest loans for other constituents of concern that affect a specific production well. The capital costs of wellhead treatment facilities range from $500,000 to over $1,000,000. Due to financial constraints, this initial cost is generally prohibitive to most pumpers. Financial assistance through the District's SDWP makes project implementation much more feasible.

There are several current projects in various stages of completion and new candidates for participation are on the rise. A total of fifteen (15) facilities are already completed and online and one facility has successfully completed removal of the contamination and no longer needs treatment. While continued funding of this program is anticipated for next year, the District has revised the guidelines of the SDWP to place a greater priority on projects involving VOC contamination or other anthropogenic (man-made) constituents, now classified as Priority A Projects. Further, any treatment projects for naturally-occurring constituents would be classified as Priority B Projects and funded on a secondary priority, on a case-by-case basis, and only if program monies are still available during the fiscal year. While such projects are of interest to WRD, availability of funding for them will not be determined until after the budget process.

Projects under the SDWP involve the treatment of contaminated groundwater for subsequent beneficial use. This water quality improvement assists in meeting the District's groundwater cleanup objectives. Thus, funding for the costs of the program is drawn wholly from the Clean Water Fund.

018 – Dominguez Gap Barrier Recycled Water Injection

This Project involves the delivery of recycled water from the City of Los Angeles Department of Water and Power's (LADWP) Terminal Island Treatment Plant (TITP) Advanced Water Treatment Facility (AWTF) to the Dominguez Gap Barrier (DGB). Deliveries of recycled water to the barrier commenced in late February 2006 and have continued into 2009.

This water is being treated with microfiltration, reverse osmosis, and chlorination before being injected into the DGB. The project is permitted to maintain an overall ratio of 50% recycled water and 50% potable water to the entire barrier to satisfy regulatory requirements. Additional water quality requirements, which includes turbidity and modified fouling index (MFI), must also be met to minimize potential fouling of injection wells in the DGB, which is owned and operated by the County of Los Angeles Department of Public Works.

While LADWP is responsible for the treatment and delivery of the recycled water and all the water quality sampling associated with those activities, WRD has responsibility over groundwater monitoring compliance. As part of the permit, groundwater monitoring is required to observe water quality conditions and to anticipate potential problems before recycled water travels to down gradient drinking water wells. In addition, a tracer study continues to be investigated to determine the extent of travel and movement of the recycled water blend. This is necessary to determine if adequate mixing and further blending in the ground is occurring and to ascertain if samples being collected are representative of the recycled water blend.

Recycled water use at the barriers improves the reliability of a supply that is needed on a continuous basis. Traditionally, water purchases for the barriers have been viewed as a replenishment function. Therefore, this program is funded 100% through the Replenishment Fund.

023 – Replenishment Operations

WRD actively monitors the operation and maintenance practices at the LACDPW-owned and operated spreading grounds and seawater barriers within the District. Optimizing replenishment opportunities is fundamentally important to WRD, in part because imported and recycled water deliveries directly affect the District's annual budget. Consequently, the District seeks to ensure that the conservation of stormwater is maximized, and that imported and recycled water replenishment are optimized.

Due to the reduction and unreliability of imported water for replenishment, WRD is working on its Water Independence Now (WIN) program to eventually become independent from imported water for groundwater recharge. Currently, the District needs about 31,000 AF of imported water for recharge; 21,000 AF for spreading and 10,000 AF for injection at the seawater barriers. By maximizing the use of recycled water and stormwater, the amount of imported water can eventually be reduced or eliminated, thereby providing the groundwater basins with full replenishment needs through locally-derived water.

WRD coordinates regular meetings with LACDPW, MWD, CSDLAC, and other water interests to discuss replenishment water availability, spreading grounds operations, scheduling of replenishment deliveries, seawater barrier improvements, upcoming maintenance activities, and facility outages or shutdowns. The District tracks groundwater levels in the Montebello Forebay weekly to assess general basin conditions and determine the level of artificial replenishment needed. WRD also monitors the amount of recycled water used at the spreading grounds and seawater barriers to maximize use while complying with pertinent regulatory limits.

A major District goal for the coming year is to continue working with LACDPW to complete construction of the Interconnection Pipeline. This jointly-funded project is a new, dedicated pipeline and pumping station that will be constructed between the Rio Hondo and San Gabriel River Spreading Grounds to transfer replenishment water in either direction via gravity flow from the Rio Hondo to San Gabriel or pumping in the reverse direction. When completed, this project is expected to conserve approximately 1,300 AF/year of additional stormwater on average, help maximize the amount of recycled water conserved by approximately 5,700 AF/year, and provide operational flexibility to mitigate obstacles to performing replenishment at these spreading grounds. The Interconnection Pipeline project is a key component of the District's WIN.

As its name implies, this program deals primarily with replenishment issues and its costs are borne completely by the Replenishment Fund.

025 – Hydrogeology Program

This program accounts for the projects that occur regularly each year, related to the hydrogeology of the Central and West Coast Basins and surrounding groundwater basins. Staff work performed under this program includes the preparation of the annual Engineering Survey and Report, which incorporates the calculation and determination of annual overdraft, accumulated overdraft, change in storage, pumping amounts, and replenishment needs and costs. Extensive amounts of data are compiled and analyzed by Staff to determine these values. Maps are created showing water levels in the basins and production patterns and amounts. The updates, maintenance, and use of the Regional Groundwater Flow Model developed by the USGS and WRD are part of this program. This model is a significant analytical tool utilized by WRD to determine basin benefits and impacts of changes proposed in the management of the Central and West Coast Basins. It will be utilized for conjunctive use and water banking programs discussed earlier under Project 005.

An ongoing effort at the District to better characterize the hydrogeologic conditions across the Central and West Coast Basins is called the "Hydrogeologic Conceptual Model". This long-term project involves compiling and interpreting the extensive amounts of data generated during drilling and logging of the WRD/USGS monitoring wells, and collected from historical information for production wells and oil wells within the District. The ultimate goal of this project is to incorporate these data in WRD's database/GIS and apply the system to generate aquifer surfaces and cross-sections for comparison with historical interpretations of basin hydrogeology. The final conceptual model will significantly improve the understanding of the aquifer depths, extents, and thicknesses throughout the District, and will assist Staff, pumpers and stakeholders with planning for groundwater resource projects such as new well drilling, storage opportunities, or modeling. The data will also be made available on WRD's website to be used as a reference source for hydrogeologic interpretations and fulfilling project-related data requests.

Hydrogeologic analysis is also needed for projects associated with groundwater quality concerns and specific cleanup projects. Staff work may include investigative surveys, data research, and oversight of specific project studies. Such efforts are used to relate water quality concerns with potential impact to basin resources. An example of this type of Staff work is the District's Well Testing Program. The District assists pumpers in evaluating drinking water supply well contamination. Services may include existing data collection and review, and field tasks such as spinner logging and depth-discrete sampling. WRD's evaluation helps pumpers to determine the best course of action; e.g., sealing off a particular screened interval of a well, wellhead treatment, or well destruction.

Another project performed this year under this program was the Saline Plume Geophysical Survey, which used new methods in an attempt to better map the extent of the saline plume in the West Coast Basin. This work is leading to the adoption of a saline plume policy to recommend to the Board of Directors later in 2009.

For the ensuing year, it is expected that additional investigative research projects into the saline plume, well testing, and recycled water travel time using tracers will be performed. In 2009/2010, a major update to the regional groundwater flow model will continue to be performed by the USGS to incorporate 7 years of new information since the model was last updated. The Hydrogeology

Program also includes a meter testing program to assist the DWR in checking the flow meters at production wells.

The Hydrogeology Program addresses both groundwater replenishment objectives and groundwater quality matters. This dual service warrants that the cost of the program be split evenly between the Replenishment and Clean Water Funds.

033 – Groundwater Reliability Improvement Program (GRIP)

The WRD continues to pursue projects through its Water Independence Now (WIN) program that develop local, sustainable sources of water for use in groundwater replenishment. This has become increasingly important in light of the environmental and political issues limiting delivery of imported water to Los Angeles area together with the potential for a drought to hit California.

To address these issues WRD is seeking alternative sources of water to offset the imported water used for replenishment in the Montebello Forebay. This program is referred to as the Groundwater Reliability Improvement Program (GRIP). The effort of this program is to evaluate all feasible alternatives for replacing or offsetting the current quantity of imported water used for replenishment. One alternative being considered is the use of advanced treated recycled municipal wastewater (microfiltration, reverse osmosis, ultra-violet light with hydrogen peroxide.) from the Los Angeles County Sanitation Districts' (LACSD) San Jose Creek Water Reclamation Plant.

To determine the viability of this project WRD entered into a partnership with the Upper San Gabriel Valley Municipal Water District (USGVMWD) and the LACSD to share in the cost for a consultant to perform a conceptual design of the facility on the proposed site for the purpose of developing preliminary cost estimates. The project will deliver advanced treated water to the San Gabriel River spreading basins to meet a portion of WRD's replenishment requirements along with delivery to proposed spreading basins near the Santa Fe Dam to help satisfy the needs of the USGVMWD.

This project will begin to move ahead rapidly in the coming year. Most of the work will involve preliminary studies needed for the preparation of environmental documents and an outreach program to educate and solicit input from the pumping community, elected officials, non-governmental organizations, as well as the general public. Projects associated with the GRIP help to improve the reliability and utilization of an available local resource. This resource is used to improve replenishment capabilities and is thus funded 100% from the Replenishment Fund.

TABLES

Table 1

GROUNDWATER CONDITIONS AND REPLENISHMENT SUMMARY

ITEM	WATER YEAR Oct 1 - Sep 30		
	2007-2008	*2008-2009 (a)*	*2009-10 (a)*
Total Groundwater Production	244,732 AF	240,000 AF	240,200 AF*
Annual Overdraft	(104,740) AF	(94,800) AF	(95,000) AF
Accumulated Overdraft	(701,800) AF	(700,200) AF	

Quantity Required for Artificial Replenishment for the Ensuing Year

Spreading		
Imported for Spreading in Montebello Forebay		21,000 AF
Recycled for Spreading in Montebello Forebay		48,000
	Subtotal Spreading	69,000
Injection		
West Coast Basin Barrier		15,200
Dominguez Gap Barrier		8,000
Alamitos Barrier		4,200
	Subtotal Injection	27,400
In-lieu[(b)]	Subtotal In-lieu	10,303
	Total	**106,703** AF

Source and Unit Cost of Replenishment Water for the Ensuing Year

Recycled Water	**Oct-Dec**	**Jan-Sep**
Spreading (CSDLAC - San Jose Creek)	$ 20.66 /AF	$ 20.66 /AF
Spreading (CSDLAC - Whittier Narrows)	$ 7.00 /AF	$ 7.00 /AF
Injection (WBMWD - West Coast Barrier)	$ 496.76 /AF	$ 504.00 /AF
Injection (LA-Terminal Island - Dominguez Barrier)	$ 431.00 /AF	$ 431.00 /AF
Injection (WRD-Alamitos Barrier)	$ 286.00 /AF	$ 286.00 /AF
Imported Water		
Spreading from CBMWD (MWD Commodity Rate plus CBMWD surcharge)	$ 419.00 /AF	$ 419.00 /AF
Injection - Alamitos (seasonal rate w/ Long Beach banking)	$ 706.00 /AF	$ 706.00 /AF
Injection - Dominguez Gap & West Coast (includes RTS surcharge and WBMWD surcharges)	$ 819.00 /AF	$ 836.00 /AF
CBMWD Annual Contract Rate for Spreading	$0	
CBMWD Total Meter Capacity Charge	$30,000	$90,000
WBMWD Water Service & Capacity Reservation Charges	$ 60,000	$ 180,000
Long Beach Capacity Reservation Charge	$ 6,000	$ 18,000

In-lieu[(b)]	
Central Basin Met Member Agency (Long Beach, Compton, Los Angeles)	$ 310 /AF
CBMWD Customer	$ 363 /AF
West Basin Met Member Agency (Torrance, Los Angeles)	$ 310 /AF
WBMWD Customer	$ 359 /AF

(a) Estimated values

(b) Amounts and rates for In-lieu are estimated and have not yet been established by the Board for ensuing year

Table 2

QUANTITY AND COST OF REPLENISHMENT WATER FOR WY 2009-2010

ITEMS	October - December			January - September			TOTAL	TOTAL
	acre feet	unit cost	subtotal	acre feet	unit cost	subtotal	WATER (af)	COST
Spreading Imported	5,250	$419	$2,199,750	15,750	$419	$6,599,250	21,000	$8,799,000
Spreading Recycled (San Jose Creek Plant)	10,000	$20.66	$206,600	30,000	$20.66	$619,800	40,000	$826,400
Spreading Recycled (Whittier Narrows Plant)	2,000	$7	$14,000	6,000	$7	$42,000	8,000	$56,000
West Coast Barrier imported	950	$819	$778,050	2,850	$836	$2,382,600	3,800	$3,160,650
West Coast Barrier recycled	2,850	$497	$1,415,766	8,550	$504	$4,309,200	11,400	$5,724,966
Dominguez Gap Barrier imported	1,000	$819	$819,000	3,000	$836	$2,508,000	4,000	$3,327,000
Dominguez Gap Barrier recycled	1,000	$431	$431,000	3,000	$431	$1,293,000	4,000	$1,724,000
Alamitos Barrier imported	525	$706	$370,650	1,575	$706	$1,111,950	2,100	$1,482,600
Alamitos Barrier recycled	525	$286	$150,150	1,575	$286	$450,450	2,100	$600,600
In-Lieu Central Basin Met Member	1,500	$310	$465,000	4,500	$310	$1,395,000	6,000	$1,860,000
In-Lieu CBMWD Customer	0	$363	$0	0	$363	$0	0	$0
In-Lieu West Basin Met Member	376	$310	$116,483	1,127	$310	$349,448	1,503	$465,930
In-Lieu WBMWD Customer	700	$359	$251,300	2,100	$359	$753,900	2,800	$1,005,200
CBMWD Spreading Contract Rate	-	-	-	-	-	-	-	$0
CBMWD Meter Connection Fee	-	-	$30,000	-	-	$90,000	-	$120,000
WBMWD Water Service & Capacity Fees	-	-	$60,000	-	-	$180,000	-	$240,000
Long Beach Capacity Reservation Charge	-	-	$6,000	-	-	$18,000	-	$24,000
Subtotal							106,703	$29,416,346
less Alamitos Barrier Recycled*								($600,600)
TOTAL							**106,703**	**$28,815,746**

Met - Metropolitan Water District of Southern California, WBMWD = West Basin Municipal Water District, CBMWD = Central Basin Municipal Water District

* The Alamitos recycled water cost is based on O&M less MWD rebate. It is shown as a water cost, but is deducted at the end since it is part of the Vander Lans (Water Supply) project

Table 3

WRD PROJECTS AND PROGRAMS

PROJECT / PROGRAM	DISTRICT FUNCTION	
	Replenishment	Clean Water
001 Leo J. Vander Lans Water Treatment Facility Project	100%	
002 Robert W. Goldsworthy Desalter Project		100%
004 Recycled Water Program	100%	
005 Groundwater Resources Planning Program	100%	
006 Groundwater Quality Program		100%
010 Geographic Information System	50%	50%
011 Regional Groundwater Monitoring Program	50%	50%
012 Safe Drinking Water Program		100%
018 Dominguez Gap Barrier Recycled Water Injection	100%	
023 Replenishment Operations (Spreading & Barriers)	100%	
025 Hydrogeology Program	50%	50%
033 Groundwater Resources Improvement Program (GRIP)	100%	0%

Table 4

30-YEAR AVERAGE GROUNDWATER BALANCE
FROM USGS & WRD REGIONAL MODEL

INFLOWS	Average AFY	OUTFLOWS	Average AFY
Natural Inflows:		**Artificial Outflows:**	
Local water conserved at spreading grounds [1]	48,825	Pumping	250,590
Interior and mountain front recharge	47,900		
Net underflow from adjacent basins [2]	48,480		
Subtotal Natural Inflows:	145,205		
Artificial Inflows:			
Imported and recycled spreading [3]	74,075		
Barrier injection water [4]	34,600		
Subtotal Artificial Inflows:	108,675		
Total Inflows:	**253,880**	**Total Outflows:**	**250,590**

Average Annual Groundwater Deficiency (afy) = Natural Inflows - Total Outflows = (105,385)

[1] includes stormwater and base flow water captured and recharged at the spreading grounds

[2] does not include average of 7,100 afy of seawater intrusion, which can not be considered as replenishment per the water code

[3] includes all imported purchased, all recycled purchased, and Pomona Plant (free) recycled water.

[4] includes all injected water at the three barrier systems, including all of Alamitos Barrier. Model value may differ slightly from actual purchas

Description of the model can be found in USGS, 2003, Geohydrology, Geochemistry, and Ground-Water Simulation - Optimiation of the Central and West Coast Basins, Los Angeles County, California; Water Resources Investigation Report 03-4065 by Reichard, E.G., Land, M., Crawford, S.M., Johnson, T., Everett, R.R., Kulshan, T.V., Ponti, D.J., Halford, K.J., Johnson, T.A., Paybins, K.S., and Nishikawa, T.

Table 5

HISTORICAL RAINFALL

Station #107D, Downey Fire Department

Water Year	Inches	Water Year	Inches	Water Year	Inches	Water Year	Inches
1925-26	12.63	1950-51	8.27	1975-76	9.55	2000-01	14.98
1926-27	16.92	1951-52	24.68	1976-77	11.23	2001-02	2.52
1927-28	11.97	1952-53	10.53	1977-78	33.85	2002-03*	19.89
1928-29	11.52	1953-54	12.33	1978-79	18.68	2003-04	7.73
1929-30	10.84	1954-55	11.84	1979-80	28.29	2004-05	23.43
1930-31	10.45	1955-56	13.97	1980-81	8.74	2005-06	11.36
1931-32	14.52	1956-57	9.89	1981-82	13.41	2006-07	1.95
1932-33	10.02	1957-58	24.65	1982-83	30.3	2007-08	17.11
1933-34	11.1	1958-59	6.68	1983-84	11.96		
1934-35	21.94	1959-60	9.84	1984-85	12.44		
1935-36	9.65	1960-61	4.3	1985-86	19.47		
1936-37	22.11	1961-62	18.46	1986-87	6.49		
1937-38	21.75	1962-63	10.9	1987-88	11.47		
1938-39	18.69	1963-64	6.86	1988-89	7.82		
1939-40	12.81	1964-65	13.27	1989-90	7.87		
1940-41	34.21	1965-66	17.02	1990-91	12.22		
1941-42	14.66	1966-67	17.78	1991-92	16.07		
1942-43	17.91	1967-68	11.46	1992-93	26.55		
1943-44	17.89	1968-69	22.33	1993-94	9.26		
1944-45	11.25	1969-70	7.52	1994-95	26.82		
1945-46	10.31	1970-71	11.45	1995-96	10.68		
1946-47	15.24	1971-72	6.4	1996-97	13.95		
1947-48	8.62	1972-73	18.57	1997-98	32.47		
1948-49	9.04	1973-74	14.51	1998-99	7.29		
1949-50	10.14	1974-75	15.01	1999-00	9.21		
			Period of Record	**83 years**			
			Running 83 Year Average	**14.3 inches**			
			Standard Deviation	**6.9 inches**			
			Minimum	**2.0 inches**			
			Maximum	**34.2 inches**			

* 2002/03 from station 388D (City of Paramount Fire Station), since 107D data are incomplete

Table 6

ANNUAL OVERDRAFT CALCULATION

for Current and Ensuing Water Years (in acre-feet)

Item	WATER YEAR	
	2008-2009	2009-10
Average Annual Groundwater Deficiency (from Table 4)	(105,385)	(105,385)
Adjustments/Variances to AAGD		
(1) Local Water at Spreading Grounds[a]	0 [d]	0 [d]
(2) Precipitation, mountain front recharge, applied water[a]	0 [d]	0 [d]
(3) Subsurface inflow[b]	0 [d]	0 [d]
(4) Groundwater Extractions[c]	(10,600) [d]	(10,400) [d]
ANNUAL OVERDRAFT [AAGD+(1)+(2)+(3)-(4)]	(94,800)	(95,000)

Note: Numbers in parentheses represent negative values.

(a) Difference between actual and model average. Positive value indicates increased recharge.

(b) Difference between annual model value and average model value. Positive value indicates increased inflow. Does not include seawater intrusion inflow

(c) Difference between actual and model average. Positive value indicates increased pumpage.

(d) Estimated Values. A value of zero indicates average year was assumed.

Table 7

ACCUMULATED OVERDRAFT CALCULATION (in acre-feet)

ITEM	AMOUNT
Accumulated Overdraft at end of Previous Water Year	(701,800)
Estimated Annual Overdraft for Current Year	(94,800)
Subtotal without artificial replenishment	(796,600)
Planned Artificial Replenishment for Current Year	
Imported Water Purchased for Spreading	21,000
Recycled Water Purchased for Spreading	48,000
Imported and Recycled Water Purchased for Barrier Wells	27,400
Replenishment Subtotal	96,400
PROJECTED ACCUMULATED OVERDRAFT FOR CURRENT YEAR	**(700,200)**

Note: Numbers in parentheses represent negative values.

Table 8

CHANGES IN GROUNDWATER STORAGE

WATER YEAR	CHANGE IN AMT OF WATER IN STORAGE (AF)	CUMULATIVE CHANGE IN STORAGE (AF)
1961-62	88,500	88,500
1962-63	(11,100)	77,400
1963-64	10,300	87,700
1964-65	35,200	122,900
1965-66	21,100	144,000
1966-67	21,400	165,400
1967-68	11,400	176,800
1968-69	(7,500)	169,300
1969-70	(800)	168,500
1970-71	(3,400)	165,100
1971-72	(50,600)	114,500
1972-73	34,800	149,300
1973-74	(2,400)	146,900
1974-75	(14,100)	132,800
1975-76	(40,200)	92,600
1976-77	(32,900)	59,700
1977-78	88,600	148,300
1978-79	30,100	178,400
1979-80	(1,100)	177,300
1980-81	17,100	194,400
1981-82	18,400	212,800
1982-83	46,800	259,600
1983-84	(22,400)	237,200
1984-85	(9,600)	227,600
1985-86	10,600	238,200
1986-87	4,000	242,200
1987-88	(11,700)	230,500
1988-89	10,400	240,900
1989-90	13,600	254,500
1990-91	28,400	282,900
1991-92	1,600	284,500
1992-93	45,800	330,300
1993-94	(28,500)	301,800
1994-95	19,400	321,200
1995-96	12,500	333,700
1996-97	15,700	349,400
1997-98	16,700	366,100
1998-99	(80,200)	285,900
1999-00	(30,000)	255,900
2000-01	(400)	255,500
2001-02	(36,500)	219,000
2002-03	(10,500)	208,500
2003-04	(43,000)	165,500
2004-05	89,100	254,600
2005-06	12,000	266,600
2006-07	(59,000)	207,600
2007-08	(41,600)	166,000
2008-09	-	-

Note: Numbers in parentheses represent negative values.

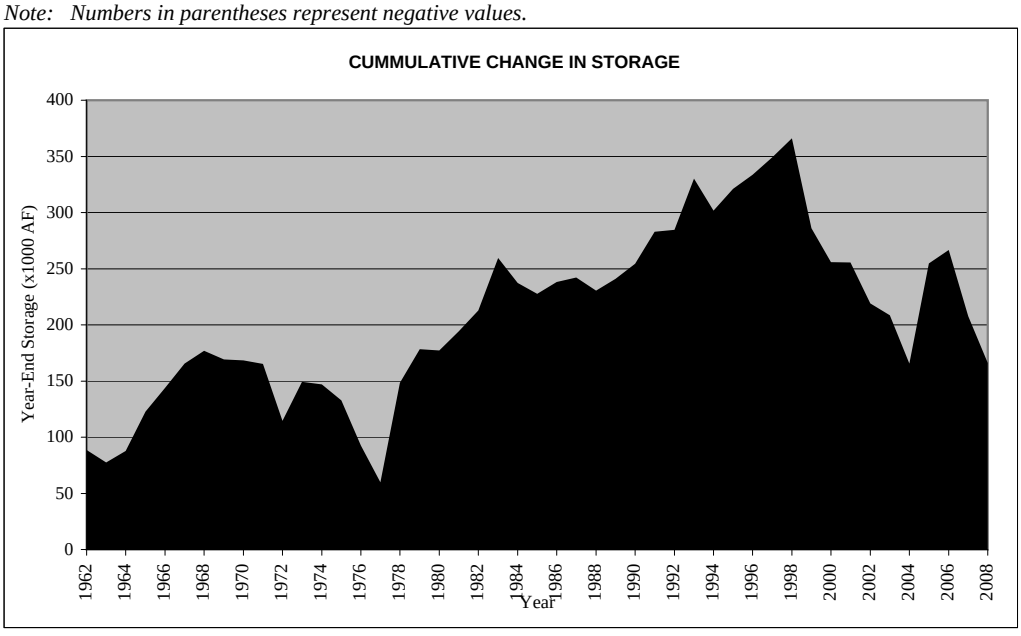


Table 9

QUANTITY OF WATER REQUIRED FOR ARTIFICIAL REPLENISHMENT

WATER TYPE	AMOUNT (AF)
Long Term Average for Imported Spreading (updated, see below)*	21,000
Recycled Water for Spreading (WRD Purchases - avg permitted limit)	48,000
Total Spreading	**69,000**
West Coast Barrier - Imported	3,800
West Coast Barrier - Recycled	11,400
Dominguez Gap - Imported	4,000
Dominguez Gap - Recycled	4,000
Alamitos Barrier - Imported - WRD portion only	2,100
Alamitos Barrier - Recycled - WRD portion only	2,100
Total Barriers	**27,400**
In-Lieu Central Basin	6,000
In-Lieu West Coast Basin	4,303
Total In-Lieu	**10,303**
Total Water Purchase Estimate for Ensuing Year	**106,703**

* - Derivation of new Long Term Imported Spreading Requirement is possible due to new projects that will capture more stormwater for conservation, and thus less imported needs:

1. Long Term Average of 27,600 af defined in 2003 ESR
2. minus 3,000 afy for increasing Whittier Narrows Conservation Pool
3. minus 3,600 afy for two new rubber dams on San Gabriel River
4. equals new Long Term Average of **21,000** afy imported spreading

HISTORICAL AMOUNTS OF WATER PURCHASED FOR SPREADING IN THE MONTEBELLO FOREBAY [a]

(In Acre-feet)

WATER YEAR	Imported Water		Reclaimed Water		Make-up Water		TOTAL
	LACFCD	WRD	WHITTIER NARROWS WRP	SAN JOSE CREEK WRP	USGVMWD & SGVMWD	CBMWD	
1953-54	30,000						30,000
1954-55	24,800						24,800
1955-56	54,500						54,500
1956-57	50,000						50,000
1957-58	105,100						105,100
1958-59	54,400						54,400
1959-60	80,900						80,900
1960-61	80,800	66,400					147,200
1961-62	39,500	168,600	1,178				209,278
1962-63	4,800	75,800	12,405				93,005
1963-64		104,900	13,258				118,158
1964-65	75,500	84,600	14,528				174,628
1965-66	67,800	53,900	15,056		6,500		143,256
1966-67	74,100	10,200	16,223		-		100,523
1967-68	66,600	28,800	18,275		-		113,675
1968-69	12,500	5,300	13,877		-		31,677
1969-70	25,800	43,100	17,158		-		86,058
1970-71	46,700	25,400	19,494		-		91,594
1971-72		34,400	17,543		-	-	51,943
1972-73		71,900	13,622	8,327	-	20,000	113,849
1973-74		68,200	13,385	7,064	-	23,900	112,549
1974-75		71,900	14,650	6,549	-	-	93,099
1975-76		50,800	12,394	9,062	-	-	72,256
1976-77		9,300	10,158	12,705	14,500	6,900	53,563
1977-78		39,900	13,104	5,997	-	-	59,001
1978-79		65,300	10,716	11,741	-	-	87,757
1979-80		10,200	14,568	9,815	10,900	-	45,483
1980-81	3,300	28,700	11,464	14,645	31,500	-	89,609
1981-82		4,600	14,133	15,285	30,900 [c]	-	64,918
1982-83		2,000	12,818	4,217	8,900 [c]	-	27,935
1983-84		1,500	13,194	14,590	20,800 [c]	-	50,084
1984-85		40,600	12,905	14,093	-	-	67,598
1985-86		21,500	13,827	11,487	-	-	46,814
1986-87		49,200	15,280	20,041	-	6,500	91,021
1987-88		23,300	14,585	27,182 [b]	5,800 [c]	-	70,867
1988-89		50,300	13,830	33,327	6,500 [c]	-	103,957
1989-90		52,700	15,043	33,498	13,600 [c]	-	114,841
1990-91		56,287	13,841	38,603	100 [c]	-	108,831
1991-92		43,103	12,620	31,326	-	-	87,049
1992-93		16,561	11,026	29,811	-	-	57,397
1993-94		20,411	10,249	40,768	-	-	71,427
1994-95		21,837	10,642	18,431	-	-	50,909
1995-96		18,012	9,971	40,922	-	-	68,906
1996-97		22,738	9,850	36,977	-	-	69,566
1997-98		952	8,378	26,483	-	-	35,813
1998-99		-	10,968	34,782	-	-	45,750
1999-00		45,037	8,950	30,481	-	-	84,468
2000-01		23,451	8,253	35,165	-	-	66,869
2001-02		42,875 [d]	8,474	50,194	-	-	101,543
2002-03		22,366 [e]	5,156	35,320	-	-	62,842
2003-04		27,520 [f]	8,195	34,033	-	-	69,748
2004-05		25,296 [f]	6,741	20,547	-	-	52,584
2005-06		33,229	8,868	30,180	-	-	72,278
2006-07		40,214	7,334	34,823	-	-	82,371
2007-08	1,510	- [g]	6,212	29,131	-	-	36,853
TOTAL	898,610	1,823,188	564,399	857,602	150,000	57,300	**4,351,099**
	Import:	2,721,798	Reclaimed:	1,422,001	Make-up:	207,300	

(a) Does not include stormwater or reclaimed water from Pomona WRP. See WRD's Regional Groundwater Monitoring Report.
(b) Of which 2,501 AF was delivered in October 1988.
(c) Includes State Project water imported by the San Gabriel Valley Municipal Water District.
(d) Includes 1,607 af of EPA extracted groundwater from Whittier Narrows considered imported water to WRD. Paid for in 2003.
(e) Includes 5,069 af of EPA extracted groundwater from W.N. considered imported water to WRD. Paid for in June 2005.
(f) includes 13,000 af of water banked by Long Beach under a storage agreement with WRD (792 af 02/03, 12,210 af 3/04).
(g) CBMWD purchased 1,510 af of imported water for spreading as a storage project for Downey, Lakewood, and Cerritos. but the categorizatoin of this water as stored versus replenishment water has not been determined.yet by Watermaster

HISTORICAL AMOUNTS OF WATER PURCHASED FOR INJECTION

(In Acre-feet)

WATER YEAR	WEST COAST BASIN BARRIER[a]			DOMINGUEZ GAP BARRIER[b]			ALAMITOS BARRIER[c]			TOTAL
	Imported	Recycled	Total	Imported	Recycled	Total	Imported	Recycled	Total	
1952-53	1,140		1,140							1,140
1953-54	3,290		3,290							3,290
1954-55	2,740		2,740							2,740
1955-56	2,840		2,840							2,840
1956-57	3,590		3,590							3,590
1957-58	4,330		4,330							4,330
1958-59	3,700		3,700							3,700
1959-60	3,800		3,800							3,800
1960-61	4,480		4,480							4,480
1961-62	4,510		4,510							4,510
1962-63	4,200		4,200							4,200
1963-64	10,450		10,450							10,450
1964-65	33,020		33,020				2,760		2,760	35,780
1965-66	44,390		44,390				3,370		3,370	47,760
1966-67	43,060		43,060				3,390		3,390	46,450
1967-68	39,580		39,580				4,210		4,210	43,790
1968-69	36,420		36,420				4,310		4,310	40,730
1969-70	29,460		29,460				3,760		3,760	33,220
1970-71	29,870		29,870	2,200		2,200	3,310		3,310	35,380
1971-72	26,490		26,490	9,550		9,550	4,060		4,060	40,100
1972-73	28,150		28,150	8,470		8,470	4,300		4,300	40,920
1973-74	27,540		27,540	7,830		7,830	6,140		6,140	41,510
1974-75	26,430		26,430	5,160		5,160	4,440		4,440	36,030
1975-76	35,220		35,220	4,940		4,940	4,090		4,090	44,250
1976-77	34,260		34,260	9,280		9,280	4,890		4,890	48,430
1977-78	29,640		29,640	5,740		5,740	4,020		4,020	39,400
1978-79	23,720		23,720	5,660		5,660	4,220		4,220	33,600
1979-80	28,630		28,630	4,470		4,470	3,560		3,560	36,660
1980-81	26,350		26,350	3,550		3,550	3,940		3,940	33,840
1981-82	24,640		24,640	4,720		4,720	4,540		4,540	33,900
1982-83	33,950		33,950	6,020		6,020	3,270		3,270	43,240
1983-84	28,000		28,000	7,640		7,640	2,440		2,440	38,080
1984-85	25,210		25,210	7,470		7,470	3,400		3,400	36,080
1985-86	20,260		20,260	6,160		6,160	3,410		3,410	29,830
1986-87	26,030		26,030	6,230		6,230	4,170		4,170	36,430
1987-88	24,270		24,270	7,050		7,050	3,990		3,990	35,310
1988-89	22,740		22,740	5,220		5,220	3,900		3,900	31,860
1989-90	20,279		20,279	5,736		5,736	4,110		4,110	30,125
1990-91	16,039		16,039	7,756		7,756	4,096		4,096	27,891
1991-92	22,180		22,180	6,894		6,894	4,172		4,172	33,246
1992-93	21,516		21,516	4,910		4,910	3,350		3,350	29,776
1993-94	15,482		15,482	5,524		5,524	2,794		2,794	23,800
1994-95	14,237	1,480	15,717	4,989		4,989	2,883		2,883	23,589
1995-96	12,426	4,170	16,596	5,107		5,107	3,760		3,760	25,463
1996-97	11,388	6,241	17,629	5,886		5,886	4,015		4,015	27,530
1997-98	8,173	8,308	16,481	3,771		3,771	3,677		3,677	23,929
1998-99	10,125	6,973	17,097	4,483		4,483	4,012		4,012	25,591
1999-00	11,172	7,460	18,632	6,010		6,010	4,028		4,028	28,670
2000-01	13,988	6,838	20,826	3,923		3,923	3,710		3,710	28,459
2001-02	12,724	7,276	20,000	5,459		5,459	3,961		3,961	29,420
2002-03	10,419	6,192	16,611	8,056		8,056	3,445		3,445	28,112
2003-04	9,304	3,669	12,973	6,089		6,089	3,876		3,876	22,938
2004-05	4,548	3,920	8,468	8,557		8,557	2,870		2,870	19,895
2005-06	5,997	4,249	10,246	7,259	1,450	8,709	1,042	921	1,963	20,918
2006-07	4,373	10,960	15,333	5,510	1,733	7,243	1,568	219	1,787	24,363
2007-08	3,662	10,954	14,616	4,468	2,452	6,920	3,467	1,284	4,751	26,287
TOTAL	1,024,432	88,689	1,113,121	227,747	5,635	233,382	162,726	2,424	165,150	1,511,652

(a) Prior to 10/1/71, water was purchased by the State, West Basin Water Association, local water interests, Zone II of the LA County Flood Control District and WRD. After 10/1/71, all purchases have been by WRD

(b) In 1970-71, purchases were shared by WRD and Zone II. After 10/1/71, all purchases have been by WRD

(c) Excludes water purchases by Orange County Water District. Refer to Regional Groundwater Monitoring Report for Total Water.

HISTORICAL AMOUNTS OF THE IN-LIEU PROGRAM

(In Acre-Feet)

WATER YEAR	CENTRAL BASIN	WEST COAST BASIN	TOTAL
1965-66	-	745	745
1966-67	-	851	851
1967-68	-	850	850
1968-69	-	850	850
1969-70	-	900	900
1970-71	-	881	881
1971-72	-	756	756
1972-73	-	901	901
1973-74	-	901	901
1974-75	-	400	400
1975-76	-	400	400
1976-77	-	400	400
1977-78	11,316	4,815	16,131
1978-79	9,723	8,655	18,378
1979-80	10,628	4,333	14,961
FISCAL YEAR			
1980-81	17,617	6,206	23,823
1981-82	14,050	4,833	18,883
1982-83	13,813	5,939	19,752
1983-84	29,216	12,524	41,740
1984-85	23,246	13,594	36,840
1985-86	15,505	10,627	26,132
1986-87	16,205	12,997	29,202
1987-88	15,518	12,893	28,411
1988-89	11,356	14,069	25,425
1989-90	16,858	12,293	29,151
1990-91	11,886	10,153	22,039
1991-92	13,000	6,104	19,104
1992-93	37,652	15,654	53,306
1993-94	83,488	26,093	109,581
1994-95	32,904	17,994	50,898
1995-96	37,517	13,816	51,333
1996-97	34,547	4,847	39,394
1997-98	22,995	7,335	30,330
1998-99	13,213	10,303	23,516
1999-00	18,799	3,479	22,278
2000-01	18,364	2,817	21,181
2001-02	11,931	8,789	20,720
2002-03	6,866	4,339	11,205
2003-04	-	-	-
2004-05	6,000	1,804	7,804
2005-06	7,475	2,414	9,889
2006-07	5,779	3,480	9,259
2007-08	-	-	-
TOTAL	567,468	272,035	839,503

HISTORICAL AMOUNTS OF
WATER PURCHASED FOR REPLENISHMENT

(In Acre-feet)

WATER YEAR	SPREADING				INJECTION	IN-LIEU	TOTAL
	IMPORTED WATER	RECLAIMED WATER	MAKEUP WATER	SUBTOTAL			
1952-53					1,140		1,140
1953-54	30,000		-	30,000	3,290		33,290
1954-55	24,800		-	24,800	2,740		27,540
1955-56	54,500		-	54,500	2,840		57,340
1956-57	50,000		-	50,000	3,590		53,590
1957-58	105,100		-	105,100	4,330		109,430
1958-59	54,400		-	54,400	3,700		58,100
1959-60	80,900		-	80,900	3,800		84,700
1960-61	147,200		-	147,200	4,480		151,680
1961-62	208,100	1,178	-	209,278	4,510		213,788
1962-63	80,600	12,405	-	93,005	4,200		97,205
1963-64	104,900	13,258	-	118,158	10,450		128,608
1964-65	160,100	14,528	-	174,628	35,780		210,408
1965-66	121,700	15,056	6,500	143,256	47,760	745	191,761
1966-67	84,300	16,223	-	100,523	46,450	851	147,824
1967-68	95,400	18,275	-	113,675	43,790	850	158,315
1968-69	17,800	13,877	-	31,677	40,730	850	73,257
1969-70	68,900	17,158	-	86,058	33,220	900	120,178
1970-71	72,100	19,494	-	91,594	35,380	881	127,855
1971-72	34,400	17,543	-	51,943	40,100	756	92,799
1972-73	71,900	21,949	20,000	113,849	40,920	901	155,670
1973-74	68,200	20,449	23,900	112,549	41,510	901	154,960
1974-75	71,900	21,199	-	93,099	36,030	400	129,529
1975-76	50,800	21,456	-	72,256	44,250	400	116,906
1976-77	9,300	22,863	21,400	53,563	48,430	400	102,393
1977-78	39,900	19,101	-	59,001	39,400	16,131	114,532
1978-79	65,300	22,457	-	87,757	33,600	18,378	139,735
1979-80	10,200	24,383	10,900	45,483	36,660	14,961	97,104
1980-81	32,000	26,109	31,500	89,609	33,840	23,823	147,272
1981-82	4,600	29,418	30,900	64,918	33,900	18,883	117,701
1982-83	2,000	17,035	8,900	27,935	43,240	19,752	90,927
1983-84	1,500	27,784	20,800	50,084	38,080	41,740	129,904
1984-85	40,600	26,998	-	67,598	36,080	36,840	140,518
1985-86	21,500	25,314	-	46,814	29,830	26,132	102,776
1986-87	49,200	35,321	6,500	91,021	36,430	29,202	156,653
1987-88	23,300	41,767	5,800	70,867	35,310	28,411	134,588
1988-89	50,300	47,157	6,500	103,957	31,860	25,425	161,242
1989-90	52,700	48,541	13,600	114,841	30,125	29,151	174,117
1990-91	56,287	52,444	100	108,831	27,891	22,039	158,761
1991-92	43,103	43,946	-	87,049	33,246	19,104	139,399
1992-93	16,561	40,837	-	57,397	29,776	53,306	140,479
1993-94	20,411	51,016	-	71,427	23,800	109,581	204,808
1994-95	21,837	29,073	-	50,909	23,589	50,898	125,396
1995-96	18,012	50,893	-	68,906	25,463	51,333	145,702
1996-97	22,738	46,827	-	69,566	27,530	39,394	136,490
1997-98	952	34,861	-	35,813	23,929	30,330	90,072
1998-99	-	45,750	-	45,750	25,591	23,516	94,857
1999-00	45,037	39,431	-	84,468	28,670	22,278	135,416
2000-01	23,451	43,418	-	66,869	28,459	21,181	116,509
2001-02	42,875	58,668	-	101,543	29,420	20,720	151,684
2002-03	22,366	40,476	-	62,842	28,112	11,205	102,159
2003-04	27,520	42,228	-	69,748	22,938	-	92,686
2004-05	25,296	27,288	-	52,584	19,895	7,804	80,283
2005-06	33,229	39,049	-	72,278	20,918	9,889	103,085
2006-07	40,214	42,158	-	82,372	24,363	9,259	115,994
2007-08	-	35,343	-	35,343	26,287	-	61,630
TOTAL	2,720,289	1,422,002	207,300	4,349,590	1,511,652	839,503	6,700,745

HISTORICAL AMOUNTS OF GROUNDWATER PRODUCTION

(In Acre-feet)

YEAR	CENTRAL BASIN	WEST COAST BASIN	TOTAL
WATER YEAR			
1960-61	292,500	61,900	354,400
1961-62	275,800	59,100	334,900
1962-63	225,400	59,100	284,500
1963-64	219,100	61,300	280,400
1964-65	211,600	59,800	271,400
1965-66	222,800	60,800	283,600
1966-67	206,700	62,300	269,000
1967-68	220,100	61,600	281,700
1968-69	213,800	61,600	275,400
1969-70	222,200	62,600	284,800
1970-71	211,600	60,900	272,500
1971-72	216,100	64,800	280,900
1972-73	205,600	60,300	265,900
1973-74	211,300	55,000	266,300
1974-75	213,100	56,700	269,800
1975-76	215,300	59,400	274,700
1976-77	211,500	59,800	271,300
1977-78	196,600	58,300	254,900
1978-79	207,000	58,000	265,000
1979-80	209,500	57,100	266,600
1980-81	211,915	57,711	269,626
1981-82	202,587	61,874	264,461
1982-83	194,548	57,542	252,090
1983-84	196,660	51,930	248,590
1984-85	193,085	52,746	245,831
1985-86	195,972	53,362	249,334
1986-87	196,660	48,026	244,686
1987-88	194,704	43,837	238,541
1988-89	200,207	44,323	244,530
1989-90	197,621	48,047	245,668
1990-91	187,040	53,660	240,700
1991-92	196,400	56,318	252,718
1992-93	150,495	40,241	190,736
1993-94	156,565	41,826	198,391
1994-95	180,269	41,729	221,998
1995-96	182,414	52,222	234,636
1996-97	187,561	52,576	240,137
1997-98	188,305	51,859	240,164
1998-99	204,418	51,926	256,344
1999-00	198,483	53,599	252,082
2000-01	195,361	53,870	249,231
2001-02	200,168	50,063	250,231
2002-03	190,268	51,946	242,214
2003-04	200,365	48,013	248,378
2004-05	188,707	41,297	230,004
2005-06	191,030	36,809	227,839
2006-07	198,115	37,655	235,770
2007-08	206,260	38,472	244,732
2008-09 est	200,000	40,000	240,000
TOTAL	9,993,783	2,613,879	12,607,661

HISTORICAL AMOUNTS OF TOTAL WATER USE IN THE WATER REPLENISHMENT DISTRICT*

(In Acre-feet)

YEAR	GROUNDWATER PRODUCTION	IMPORTED WATER FOR DIRECT USE*	RECLAIMED WATER FOR DIRECT USE*	TOTAL
WATER YEAR				
1960-61	354,400	196,800		551,200
1961-62	334,900	178,784		513,684
1962-63	284,500	222,131		506,631
1963-64	280,400	257,725		538,125
1964-65	271,400	313,766		585,166
1965-66	283,600	308,043		591,643
1966-67	269,000	352,787		621,787
1967-68	281,700	374,526		656,226
1968-69	275,400	365,528		640,928
1969-70	284,800	398,149		682,949
1970-71	272,500	397,122		669,622
1971-72	280,900	428,713		709,613
1972-73	265,900	400,785		666,685
1973-74	266,300	410,546		676,846
1974-75	269,800	380,228		650,028
1975-76	274,700	404,958		679,658
1976-77	271,300	355,896		627,196
1977-78	254,900	373,116		628,016
1978-79	265,000	380,101	100 [(a)]	645,201
1979-80	266,600	397,213	200	664,013
1980-81	269,626	294,730	300	564,656
1981-82	264,461	391,734	300	656,495
1982-83	252,090	408,543	400	661,033
1983-84	248,590	441,151	1,800	691,541
1984-85	245,831	451,549	2,000	699,380
1985-86	249,334	427,860	2,400	679,594
1986-87	244,686	478,744	2,300	725,730
1987-88	238,541	479,318	3,500	721,359
1988-89	244,530	466,166	5,300	715,996
1989-90	245,668	448,285	5,900	699,853
1990-91	240,700	485,109	5,000	730,809
1991-92	252,718	395,191	4,900	652,809
1992-93	190,736	388,949	824	580,509
1993-94	198,391	483,287	3,413	685,091
1994-95	221,998	437,191	6,143	665,332
1995-96	234,636	426,699	19,804	681,139
1996-97	240,137	436,569	25,046	701,752
1997-98	240,164	375,738	27,075	642,977
1998-99	256,344	396,655	30,510	683,509
1999-00	252,082	395,681	33,589	681,352
2000-01	249,231	395,024	32,589	676,844
2001-02	250,231	395,799	38,694	684,724
2002-03	242,214	381,148	38,839	662,201
2003-04	248,378	389,233	36,626	674,237
2004-05	230,004	402,660	33,988	666,652
2005-06	227,839	366,815	35,301	629,955
2006-07	235,770	376,492	41,899	654,161
2007-08	244,732	346,035	45,120	635,887
TOTAL	12,367,661	18,459,272	483,860	31,310,794

(a) Los Coyotes on-line in 1979; Long Beach on-line in 1980

** - Includes imported & recycled at seawater barriers, but not spreading grounds.*

WRD GROUNDWATER BANKING PROGRAM

(In Acre-feet)

WATER YEAR	CITY OF LONG BEACH			LONG BEACH/ALAMITOS BARRIER			TOTAL		
	Banked	Called	Balance	Banked	Called	Balance	Banked	Called	Balance
2002-03	4,864	-	4,864	-	-	-	4,864	-	4,864
2003-04	8,136	-	13,000	-	-	-	8,136	-	13,000
2004-05	-	-	13,000	3,652	-	3,652	3,652	-	16,652
2005-06	-	-	13,000	1,324	56	4,919	1,324	56	17,919
2006-07	-	-	13,000	300	1,561	3,658	300	1,561	16,658
2007-08	-	4,333	8,667	-	1,498	2,160	-	5,831	10,827
TOTAL	13,000	4,333		5,275	3,115		18,275	7,448	

FIGURES

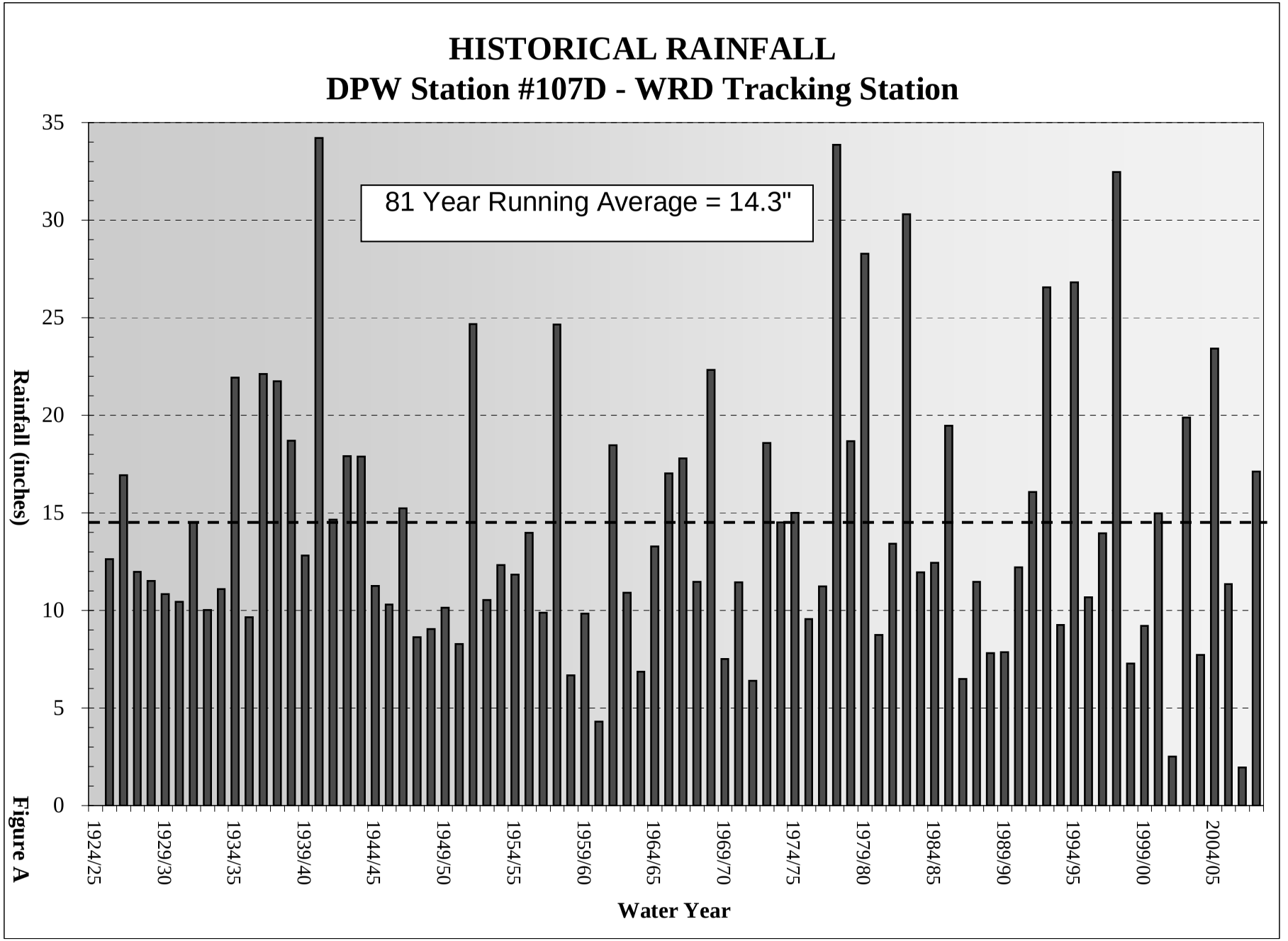
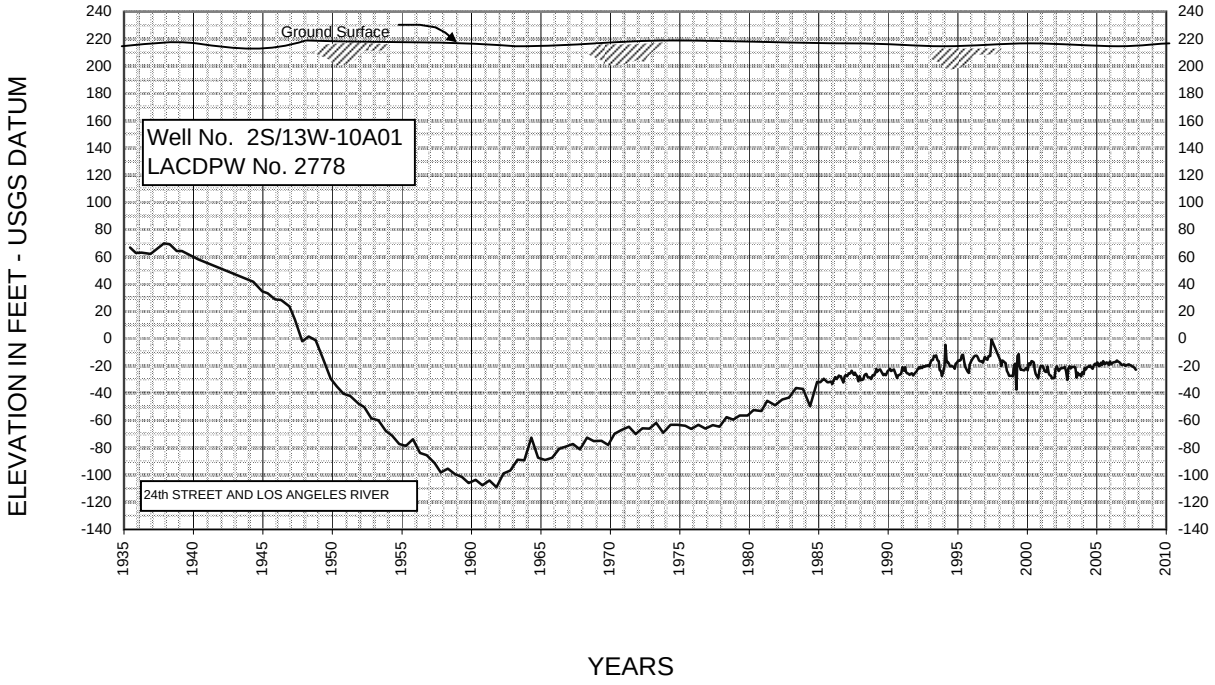

HISTORICAL RAINFALL
DPW Station #107D - WRD Tracking Station
81 Year Running Average = 14.3"
Rainfall (inches)
0
5
10
15
20
25
30
35
1924/25
1929/30
1934/35
1939/40
1944/45
1949/50
1954/55
1959/60
1964/65
1969/70
1974/75
1979/80
1984/85
1989/90
1994/95
1999/00
2004/05
Water Year

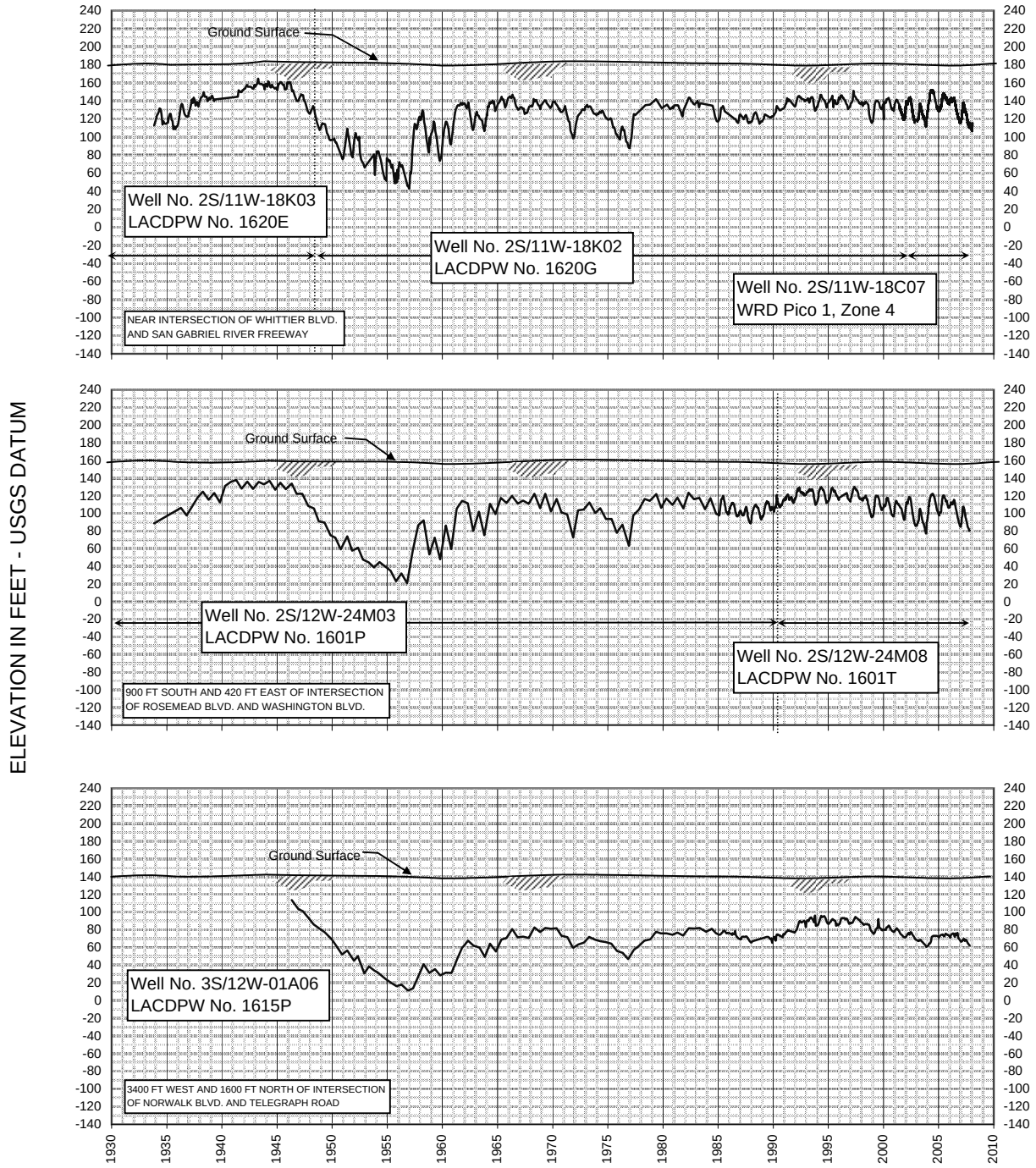
Figure A



FLUCTUATIONS OF WATER LEVEL AT WELLS

LOS ANGELES FOREBAY

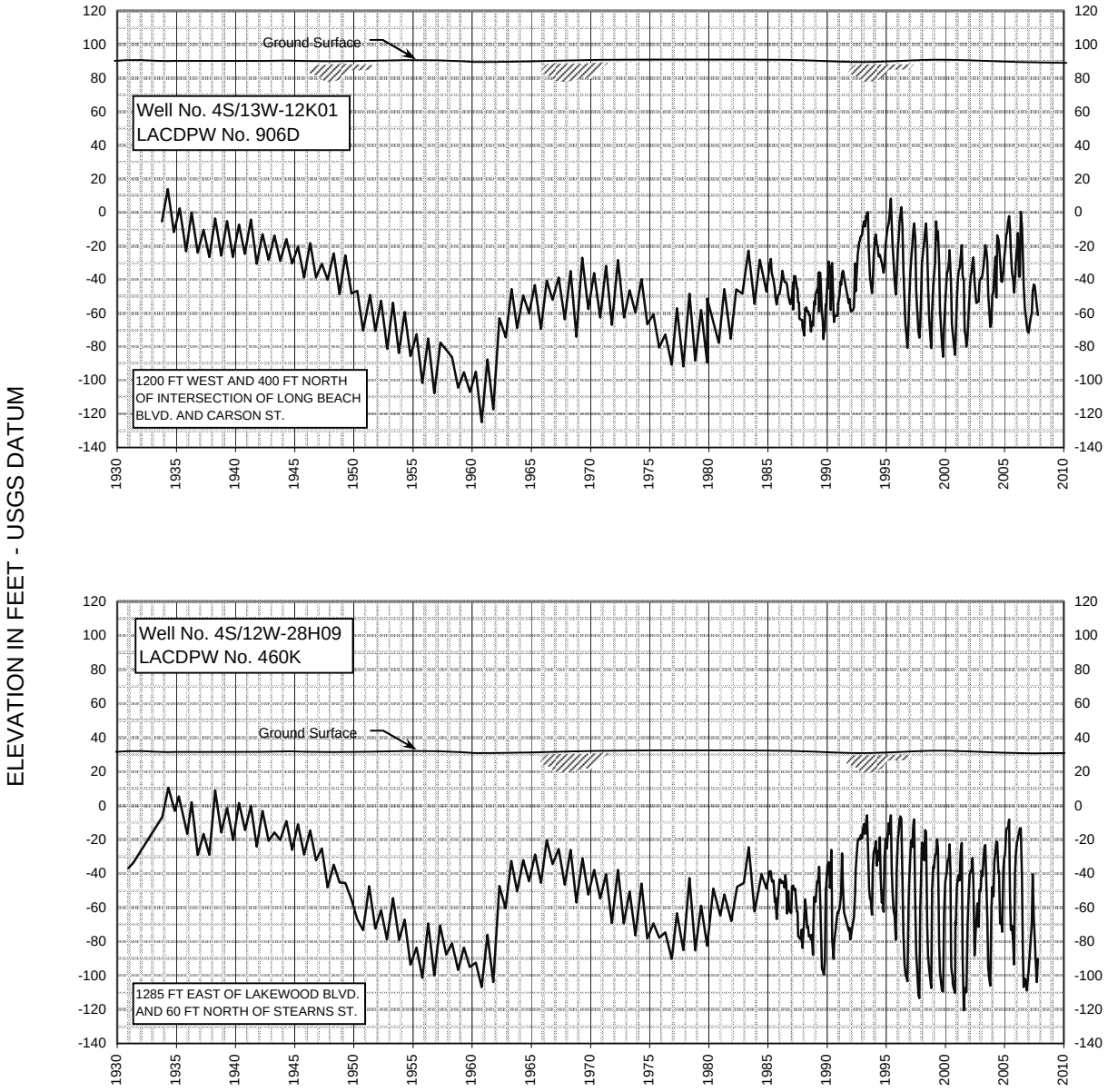
Figure B



FLUCTUATIONS OF WATER LEVEL AT WELLS

MONTEBELLO FOREBAY

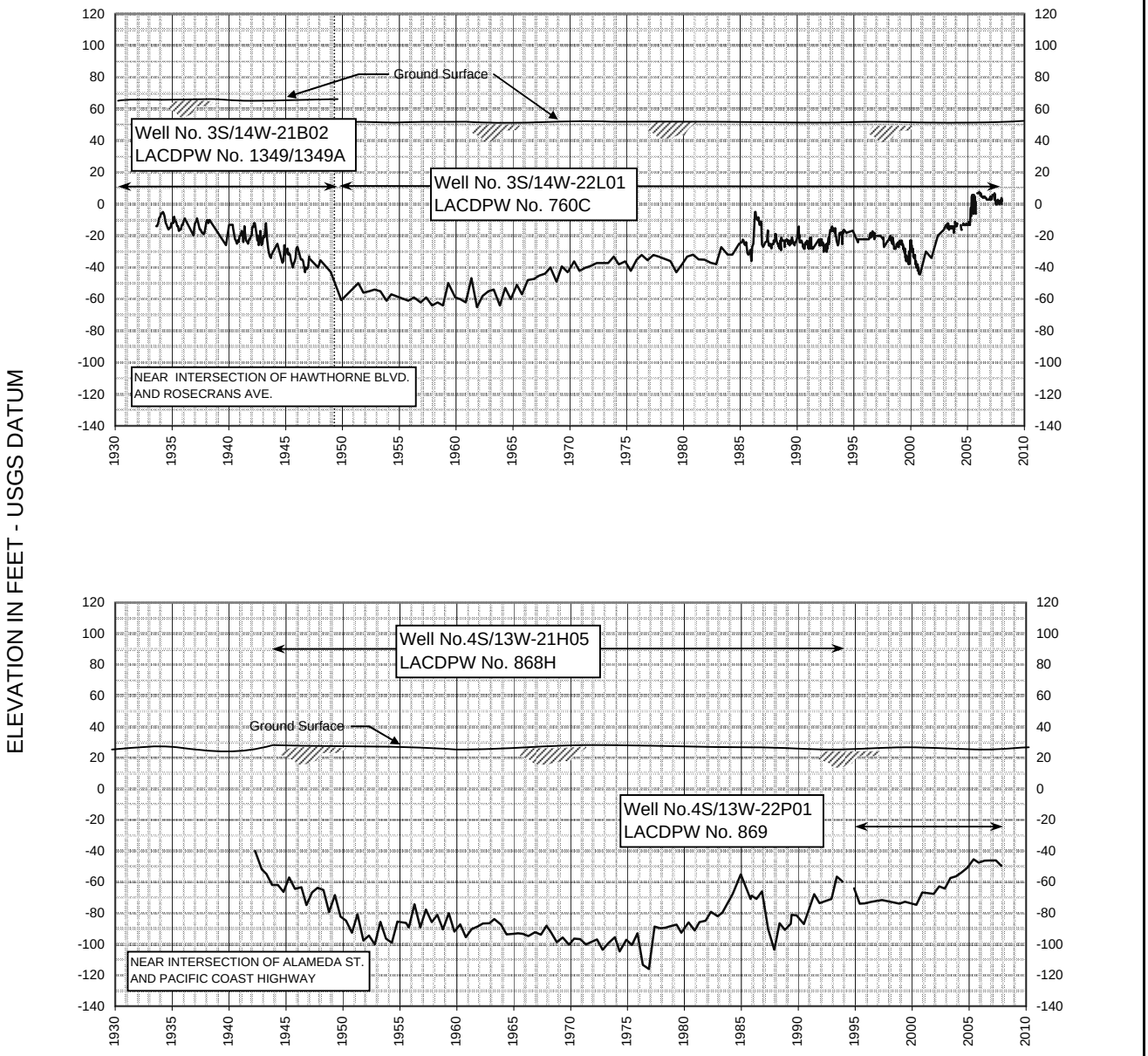
Figure C



FLUCTUATIONS OF WATER LEVEL AT WELLS

CENTRAL BASIN PRESSURE AREA

Figure D



FLUCTUATIONS OF WATER LEVEL AT WELLS

WEST BASIN

Figure E

PLATES

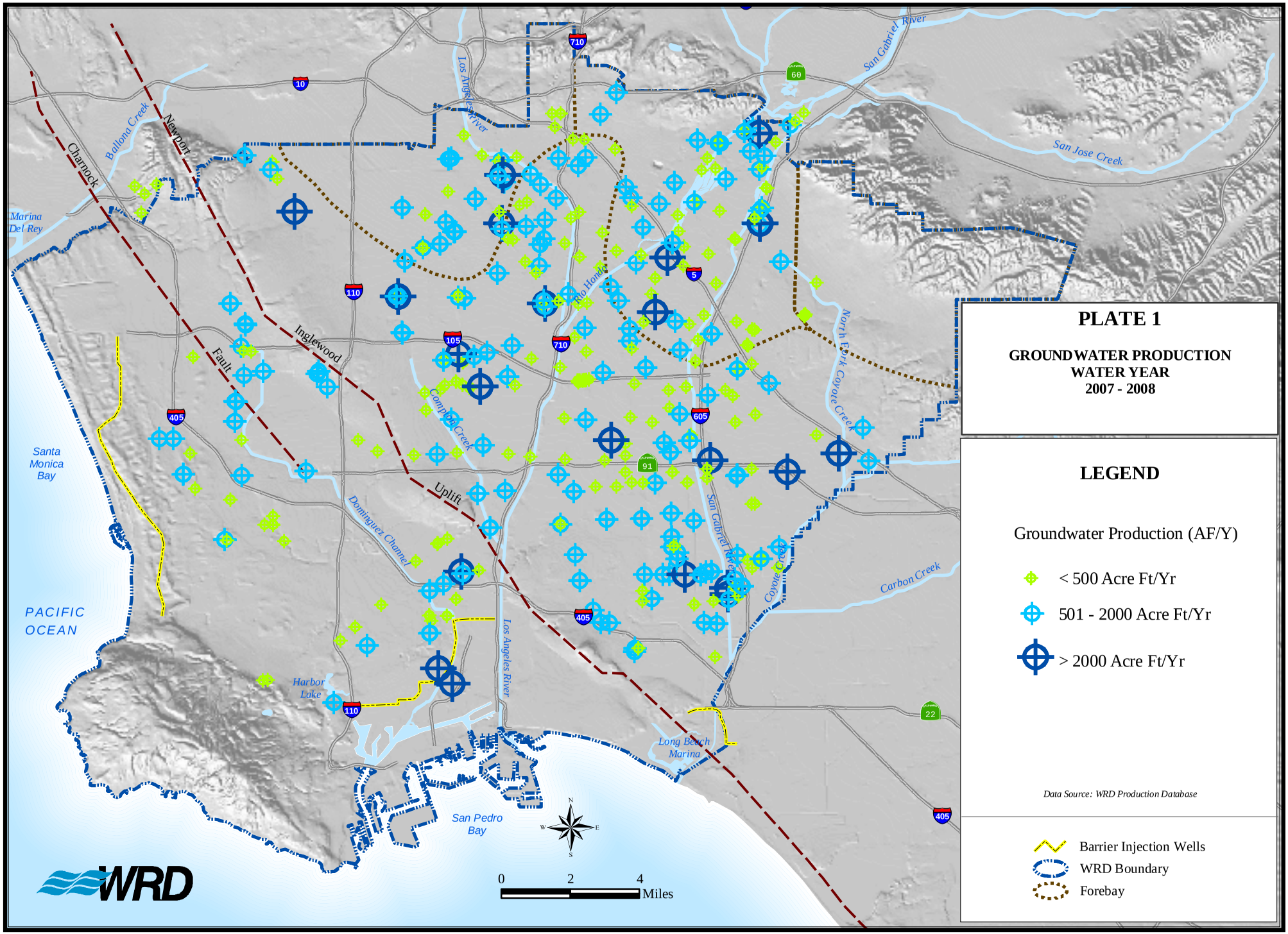


PLATE 1
GROUNDWATER PRODUCTION
WATER YEAR
2007 - 2008
LEGEND
Groundwater Production (AF/Y)
< 500 Acre Ft/Yr
501 - 2000 Acre Ft/Yr
> 2000 Acre Ft/Yr
Data Source: WRD Production Database
Barrier Injection Wells
WRD Boundary
Forebay
0
2
4
Miles
WRD
Charnock
Newport
Inglewood
Fault
Uplift
Ballona Creek
Marina Del Rey
Santa Monica Bay
PACIFIC OCEAN
Harbor Lake
San Pedro Bay
Long Beach Marina
Los Angeles River
Compton Creek
Dominguez Channel
Rio Hondo
San Gabriel River
Coyote Creek
North Fork Coyote Creek
Carbon Creek
San Jose Creek
10
110
105
710
405
605
91
5
60
22

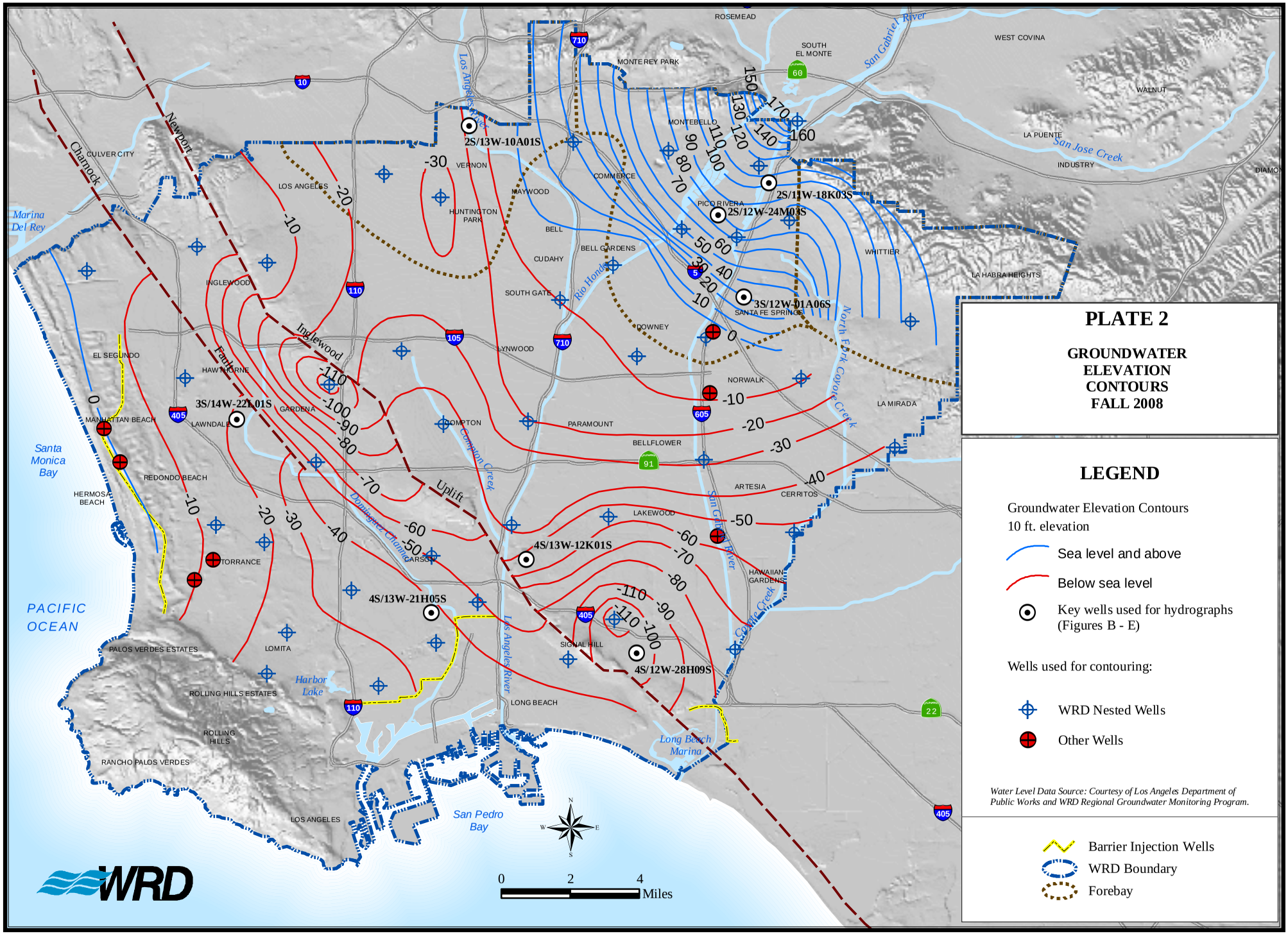


PLATE 2
GROUNDWATER ELEVATION CONTOURS FALL 2008
LEGEND
Groundwater Elevation Contours
10 ft. elevation
Sea level and above
Below sea level
Key wells used for hydrographs (Figures B - E)
Wells used for contouring:
WRD Nested Wells
Other Wells
Water Level Data Source: Courtesy of Los Angeles Department of Public Works and WRD Regional Groundwater Monitoring Program.
Barrier Injection Wells
WRD Boundary
Forebay
2S/13W-10A01S
2S/11W-18K03S
2S/12W-24M03S
3S/12W-01A06S
3S/14W-22L01S
4S/13W-12K01S
4S/13W-21H05S
4S/12W-28H09S
Inglewood
Newport
Charnock
Uplift
Dominguez Channel
Compton Creek
Rio Hondo
North Fork Coyote Creek
San Gabriel River
Los Angeles River
Coyote Creek
San Jose Creek
Harbor Lake
Long Beach Marina
San Pedro Bay
Marina Del Rey
Santa Monica Bay
PACIFIC OCEAN
ROSEMEAD
SOUTH EL MONTE
WEST COVINA
MONTEREY PARK
MONTEBELLO
WALNUT
LA PUENTE
INDUSTRY
COMMERCE
VERNON
MAYWOOD
HUNTINGTON PARK
BELL
BELL GARDENS
PICO RIVERA
WHITTIER
LA HABRA HEIGHTS
CUDAHY
SOUTH GATE
SANTA FE SPRINGS
DOWNEY
LYNWOOD
NORWALK
LA MIRADA
PARAMOUNT
BELLFLOWER
ARTESIA
CERRITOS
LAKEWOOD
HAWAIIAN GARDENS
SIGNAL HILL
LONG BEACH
CARSON
COMPTON
LAWNDALE
GARDENA
HAWTHORNE
EL SEGUNDO
MANHATTAN BEACH
REDONDO BEACH
HERMOSA BEACH
TORRANCE
PALOS VERDES ESTATES
ROLLING HILLS ESTATES
ROLLING HILLS
RANCHO PALOS VERDES
LOMITA
LOS ANGELES
INGLEWOOD
CULVER CITY
0 2 4 Miles
WRD

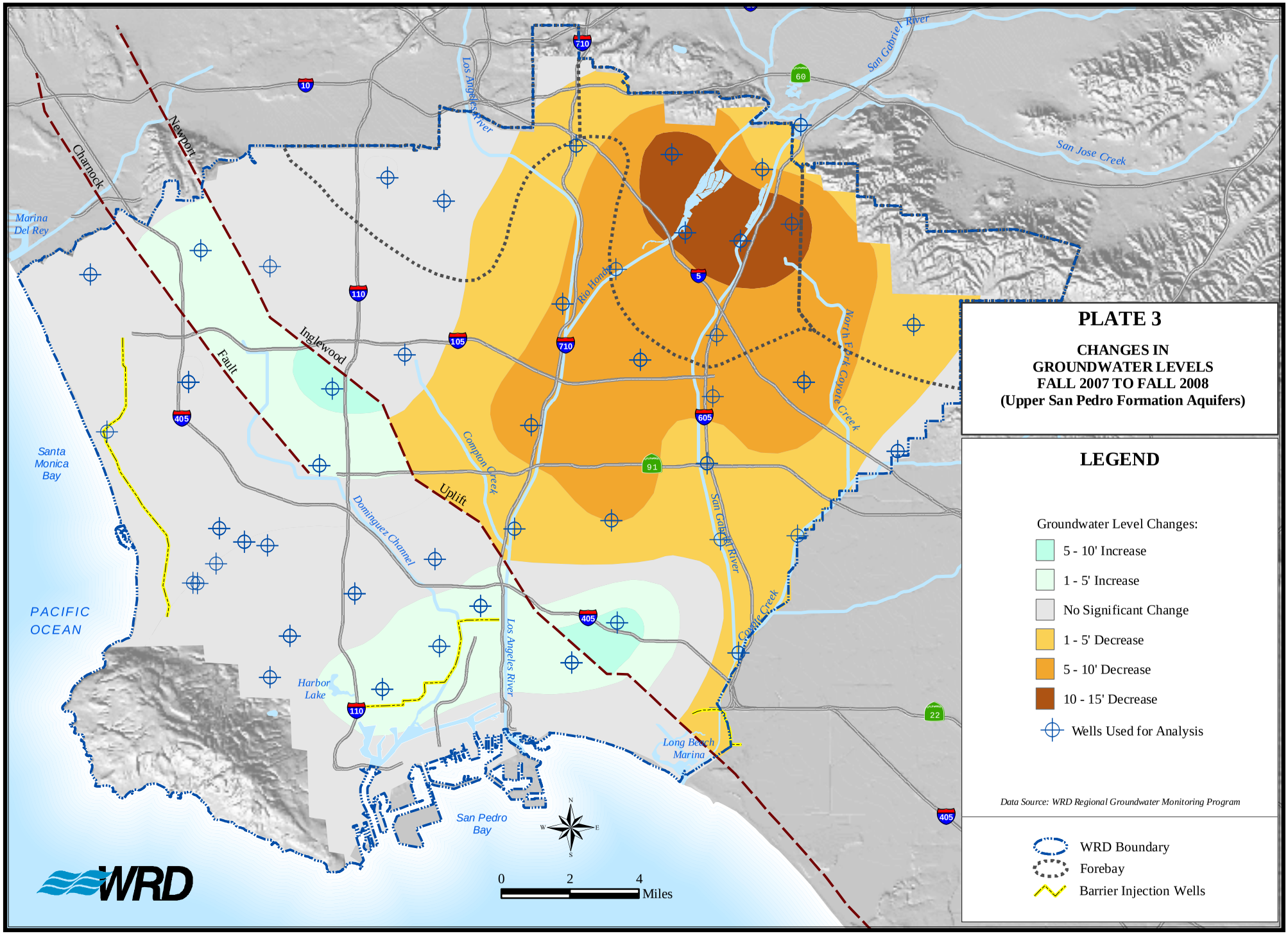


PLATE 3
CHANGES IN
GROUNDWATER LEVELS
FALL 2007 TO FALL 2008
(Upper San Pedro Formation Aquifers)
LEGEND
Groundwater Level Changes:
5 - 10' Increase
1 - 5' Increase
No Significant Change
1 - 5' Decrease
5 - 10' Decrease
10 - 15' Decrease
Wells Used for Analysis
Data Source: WRD Regional Groundwater Monitoring Program
WRD Boundary
Forebay
Barrier Injection Wells
Chamock
Newport
Fault
Inglewood
Uplift
Los Angeles River
San Gabriel River
San Jose Creek
Rio Hondo
North Fork Coyote Creek
Compton Creek
Dominguez Channel
Coyote Creek
Marina Del Rey
Santa Monica Bay
PACIFIC OCEAN
Harbor Lake
Long Beach Marina
San Pedro Bay
0 2 4
Miles
WRD