# Appendix 7-G: Pacoima Spreading Grounds Improvements Supporting Documents

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April 6, 2011

Approved Diego Cadena 4/8/11
Diego Cadena

TO: Diego Cadena

FROM: Christopher Stone C. Stone
Water Resources Division

**PACOIMA SPREADING GROUNDS**
**PROJECT CONCEPT REPORT**

Recommendations

1. Approve the attached project concept report for the Pacoima Spreading Grounds Improvements Project.

2. Authorize Water Resources Division (WRD) to pursue project funding opportunities with interested stakeholders.

3. Authorize Design Division to complete final design plans and specifications in Fiscal Year (FY) 2011-12.

4. Authorize Watershed Management Division (WMD) (Flood Programs) to allocate:

   a. $200,000 for the project's environmental contract.
   ~~b. $28,000,000 in the FY 2012-13 Flood Construction Program~~.
   PROGRAM IN FUTURE YEARS

5. Authorize WRD to pursue the environmental document required for the project.

Discussion

Pacoima Spreading Grounds has insufficient storage capacity, low percolation rates, and intake restrictions during high flow conditions. The proposed spreading grounds improvements will reconfigure the basins to provide increased storage capacity, while removing clay to increase percolation rates.

The project consists of improving the existing intake structure by replacing the intake canal with four 54-inch diameter reinforced concrete pipes. The area will be backfilled to create an area for future recreational or habitat enhancement opportunities. The radial gate will be replaced with a rubber dam. The improved intake will convey an intake flow rate of 600 cubic feet per second (cfs) even under high flow conditions and eliminate flooding problems at Arleta Avenue.

The recharge basins will be reconfigured and deepened. The shallow clay layer in the upper 12 to 24 feet of the subsurface will be removed to improve percolation and increase storage capacity. Estimated removal depths for each basin are based on recommendations reported in the January 2009 Geological Investigation Report completed by Geotechnical and Materials Engineering Division, but field conditions will be used to determine the final removal limits. Approximately 1,370,000 cubic yards of excavated material will be removed from the site. The material will be sent to the nearby Vulcan Materials Co. processing site or trucked to an alternative location.

The proposed improvements will increase the storage capacity of the grounds from 530 to 1,197 acre-feet (AF) by deepening and combining basins. Operational efficiency will be enhanced with the proposed interbasin structures and facility layout. The percolation is expected to increase from 65 to 142 cfs as a result of the clay removal. The improvements are estimated to conserve an additional 10,500 AF of water per wet year.

Department of Water and Power (DWP) has expressed an interest in improvements to Pacoima Spreading Grounds. Upon approval of this concept we will meet with DWP to discuss the approved concept and to explore cost sharing opportunities.

WMD and Flood Maintenance Division have reviewed the concept and we have incorporated their comments.

If you have any questions, please contact Ken Zimmer at Extension 6188.

KZ:vt
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Attach.

cc: Design
Flood Maintenance (Vander Vis)
Watershed Management

March 28, 2011

Approved [signature]
Christopher Stone

TO: Christopher Stone

FROM: Ken Zimmer [signature]
Water Conservation Planning Section

**PACOIMA SPREADING GROUNDS**
**PROJECT CONCEPT REPORT**

Background

Pacoima Spreading Grounds is located in the City of Los Angeles near the intersection of Paxton and Arleta Streets on the west side of Pacoima Diversion Channel. The facility consists of 12 large shallow basins and has a storage capacity of 530 acre-feet (AF). The facility is one of the major water conservation facilities that recharge the San Fernando Basin.

The water conserved at Pacoima Spreading Grounds is supplied by storm flows and controlled releases from Pacoima Dam, partially controlled flow from Lopez Basin, and uncontrolled flows from East Canyon and Pacoima Wash. Water is diverted from Pacoima Wash into the spreading grounds utilizing a radial gate, and then the water flows through the intake canal to the spreading basins.

The facility's percolation is limited due to clay-rich lenses with low permeability that underlie the recharge area. The intake to the spreading grounds is limited to 600 cubic feet per second (cfs) since higher flows cause the intake canal to overflow, which causes flooding on Arleta Street. Channel flows in Pacoima Wash frequently exceed the radial gate's limited operating capacity of 1,700 cfs. When this occurs, diversion to the spreading grounds is suspended since the radial gate must be removed from the channel invert, allowing water to be wasted to the ocean.

Additional maintenance and operational difficulties exist at the facility. A Department of Water and Power (DWP) 72-inch diameter water main, runs across the lower basins and has been previously damaged during spreading grounds maintenance activities. Also, flow is limited to the western basins south of Devonshire Street because the culverts cannot convey the design intake flow.

Proposed Spreading Grounds Improvements

The proposed improvements will increase the storage capacity and simplify operations by combining basins and constructing new interbasin structures. The radial gate will be replaced with a rubber dam that can operate during higher flows. Different options to upgrade the intake structure have resulted in the following three alternatives for this project:

Alternative A - Modify Existing Intake and Remove Clay

Alternative B - Build New Intake at Different Location and Remove Clay

Alternative C – No Change to Existing Intake, Remove Clay

Intake Upgrade

Modify Existing Intake – Alternative A

Alternative A consists of improving the existing intake structure by replacing the intake canal with four 54-inch diameter reinforced concrete pipes (RCP). The area will be backfilled to create an area for future recreational or habitat enhancement opportunities. The radial gate will be replaced with a rubber dam. The improved intake will convey an intake flow rate of 600 cfs and eliminate flooding at Arleta Avenue. The recharge basins will be reconfigured and deepened.

Build New Intake at Different Location – Alternative B

Alternative B consists of constructing a new intake structure located at the southeast corner of Arleta Avenue and Paxton Street. An air-inflatable rubber dam will be installed in Pacoima Diversion Channel at the new location, the radial gate and old Headworks Structure will be removed, the settling basin will be reconstructed, and recharge basins will be reconfigured and deepened. The parcel that is proposed for the new Headworks location is privately owned and an easement will need to be acquired, or the parcel will need to be purchased outright.

No Change to Existing Intake – Alternative C

Alternative C consists of leaving the existing intake operational. This option would save $1,400,000 of the capital costs but would reduce the water conservation benefit.

Percolation Improvement

Clay Removal

For both alternatives the shallow clay layer in the upper 12 to 24 feet of the subsurface will be removed to improve percolation and increase storage capacity. Estimated removal depths for each basin are based on recommendations reported in the January 2009 Geological Investigation Report completed by Geotechnical and Materials Engineering Division, but field conditions will determine the final removal depths. Approximately 1,370,000 cubic yards (CY) of excavated material will be removed from the site. The material will be sent to the nearby Vulcan Materials Co. processing site or trucked to an alternative location.

Storage Improvement

Alternative A – Storage capacity will increase by approximately 667 AF.

Alternative B – Storage capacity will increase by approximately 692 AF.

Alternative C – Storage capacity will increase by approximately 667 AF.

Alternatives

The alternatives along with their respective estimated costs and benefits during a high rainfall year are listed in the following table.

| Alternative | Description | Estimated Cost | Wet Year Benefit |
|---|---|---|---|
| A | Modify existing intake, remove clay layers. | $28,068,000 | $5,160,300 |
| B | Build new intake, remove clay layers. | $28,282,600* | $5,124,700 |
| C | No change to existing intake, remove clay layers. | $26,600,000 | $5,039,000 |

* plus cost to acquire land.

Recommendation

The proposed alternative A will increase the storage capacity of the grounds from 530 to 1,197 AF by deepening and combining basins. Operational efficiency will be enhanced with the new interbasin structures and facility layout. The percolation is expected to increase from 65 to 142 cfs as a result of the clay removal. The improvements are estimated to conserve an additional 10,500 AF of water per wet year.

DWP has expressed an interest in improvements to Pacoima Spreading Grounds. We will meet with DWP to discuss the approved concept and to explore cost sharing opportunities.

MG:vt
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Attach.

# Pacoima Spreading Grounds Improvement Project
# New Open Space

MPM-GIS Services


Data contained in this map is produced in whole or part from the Los Angeles County Department of Public Work's precise database.

Los Angeles Department of Water & Power

# URBAN WATER
## MANAGEMENT PLAN

2010

RESOLUTION NO. 011 268

WHEREAS, the California Urban Water Management Planning Act requires California water suppliers to prepare and adopt an Urban Water Management Plan every five years that describes their historical and future efforts in the area of water resources; and

WHEREAS, the Los Angeles Department of Water and Power (LADWP) has prepared a five-year update to the City of Los Angeles ' Urban Water Management Plan (UWMP) pursuant to applicable provisions of Sections 10610 through 10656 of the California Water Code; and

WHEREAS, the UWMP is required as a condition of application for various water system grant and loan funding opportunities administered by the State of California; and

WHEREAS, LADWP has selected Method 3 of the four methods developed by the California Department of Water Resources for calculating the 2020 water use target and 2015 interim target in the UWMP as required in the California Water Conservation Act of 2009, SBX7-7; and

WHEREAS, LADWP's current water rate structure includes funding for water conservation, water recycling, and stormwater capture programs; and

WHEREAS, the development of the UWMP involved public meeting notices, public involvement, and incorporated oral and written public comments prior to final adoption; and

WHEREAS, the final UWMP must be adopted by LADWP's Board of Water and Power Commissioners and submitted to the California Department of Water Resources by July 1, 2011.

NOW, THEREFORE, BE IT RESOLVED, that the City of Los Angeles Department of Water and Power 2010 Urban Water Management Plan is hereby adopted; and

BE IT FURTHER RESOLVED that the President or Vice President of the Board, or the General Manager or such person as he shall designate in writing as his designee, and the Secretary, Assistant Secretary, or the Acting Secretary of the Board be and they are hereby authorized, empowered, and directed to approve said UWMP for and on behalf of LADWP.

I HEREBY CERTIFY that the foregoing is a full, true, and correct copy of a Resolution adopted by the Board of Water and Power Commissioners of the City of Los Angeles at its meeting held MAY 03 2011

APPROVED AS TO FORM AND LEGALITY
CARMEN A. TRUTANICH, CITY ATTORNEY

APR 11 2011

BY [signature]
JANNA SIDLEY
DEPUTY CITY ATTORNEY

Barbara E. Moschos
Secretary

Urban Water Management Plan

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Note: The 2010 Urban Water Management Plan for the Los Angeles Department of Water and Power is available to the public at Los Angeles City Public Library, County of Los Angeles Public Library, West Hollywood Library, Culver City Julian Dixon Library, California State Library, and LADWP website at www.ladwp.com.

## Executive Summary



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## Chapter Three – Water Conservation

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Urban Water Management Plan

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## Urban Water Management Plan
## List of Case Studies

Urban Water Management Plan

# Glossary of Abbreviations and Terms

## Agencies

| | |
|---|---|
| AVEK | Antelope Valley-East Kern Water Agency |
| BOE | City of Los Angeles Department of Public Works, Bureau of Engineering |
| BOS | City of Los Angeles Department of Public Works, Bureau of Sanitation |
| Caltrans | California Department of Transportation |
| CDPH | California Department of Public Health |
| CDTSC | California Department of Toxic Substance Control |
| CITY | City of Los Angeles |
| CUWCC | California Urban Water Conservation Council |
| CVWD | Coachella Valley Water District |
| DWR | California Department of Water Resources |
| IAPMO | International Association of Plumbing and Mechanical Officials |
| IID | Imperial Irrigation District |
| KERN-DELTA | Kern Delta Water District |
| LACDPH | Los Angeles County Department of Public Health |
| LACDPW | Los Angeles County Department of Public Works |
| LACFCD | Los Angeles County Flood Control District |
| LADBS | Los Angeles Department of Building and Safety |
| LADWP | Los Angeles Department of Water and Power |
| LARWQCB | Los Angeles Regional Water Quality Control Board |
| LASGRWC | Los Angeles and San Gabriel Rivers Watershed Council |
| LBWD | Long Beach Water Department |
| MWD | Metropolitan Water District of Southern California |
| NWRI | National Water Research Institute |
| PVID | Palo Verde Irrigation District |
| RWAG | Recycled Water Advisory Group |
| RWQCB | Regional Water Quality Control Board |
| SBMWD | San Bernardino Municipal Water District |
| SCAG | Southern California Association of Governments |
| SWRCB | State Water Resources Control Board |
| USBR | United States Bureau of Reclamation |
| USEPA | United States Environmental Protection Agency |
| WBMWD | West Basin Municipal Water District |
| WRD | Water Replenishment District |

### Facilities and Locations

| | |
|---|---|
| AWTF | Advanced Water Treatment Facility |
| BAY-DELTA | San Francisco Bay and Sacramento-San Joaquin River Delta |
| CRA | Colorado River Aqueduct |
| DCT | Donald C. Tillman Water Reclamation Plant |
| ECLWRF | Edward C. Little Water Recycling Facility |
| EOC | Emergency Operations Center |
| HTP | Hyperion Treatment Plant |
| JWPCP | Joint Water Pollution Control Plant |
| LAA | Los Angeles Aqueducts (First and Second) |
| LAAFP | Los Angeles Aqueduct Filtration Plant |
| LAG | Los Angeles/Glendale Water Reclamation Plant |
| LVMWD | Las Virgenes Municipal Water District |
| NTPS | Neenach Temporary Pumping Station |
| RWMP | Recycled Water Master Plan |
| SFB | San Fernando Basin |
| SWP | State Water Project |
| TIWRP | Terminal Island Water Reclamation Plant |
| ULARA | Upper Los Angeles River Area |

### Measurements and Miscellaneous

| | |
|---|---|
| ACT | Urban Water Management Planning Act |
| AF | Acre-Feet |
| AFY | Acre-Feet Per Year |
| BACM | Best Available Control Measures |
| BDCP | Bay Delta Conservation Plan |
| BMP | Best Management Practices |
| CBO | Community-Based Organizations |
| CEQA | California Environmental Quality Act |
| CFS | Cubic Feet Per Second |
| CII | Commercial/Industrial/Institutional |
| CIP | Capital Improvement Program |
| CVP | Central Valley Project |
| EIR | Environmental Impact Report |
| ERP | Emergency Response Plan |
| FY | Fiscal Year |
| FYE | Fiscal Year Ending |
| GAC | Granular Activated Carbon |
| GCM | Global Climate Models |
| GHG | Greenhouse Gases |
| GPCD | Gallons Per Capita Per Day |
| GPD | Gallons Per Day |
| GPF | Gallons Per Flush |
| GPM | Gallons Per Minute |
| GSIS | Groundwater System Improvement Study |
| GWR | Groundwater Replenishment |
| HET | High Efficiency Toilets |
| IAP | Independent Advisory Panel |
| IRP | Integrated Resources Plan |
| IAWP | Interim Agricultural Water Program |

| | |
|---|---|
| IRWMP | Integrated Regional Water Management Plan |
| KWh/AF | Kilowatt-Hour per Acre-Foot |
| LID | Low Impact Development |
| LRP | Long-Range Finance Plan |
| M&I | Municipal and Industrial |
| MAF | Million Acre-Feet |
| MCL | Maximum Contaminant Level |
| MF/RO | Microfiltration/Reverse Osmosis |
| MGD | Million Gallons Per Day |
| MOA | Memorandum of Agreement |
| MOU | Memorandum of Understanding |
| NDMA | N-nitrosodimethlamine |
| NdN | Nitrification/Denitrification |
| NPR | Non-Potable Water Reuse |
| PCE | Perchloroethylene |
| PPB | Parts Per Billion |
| PPCPs | Pharmaceuticals and Personal Care Products |
| PPM | Parts Per Million |
| QSA | Quantification Settlement Agreement |
| RI | Remedial Investigation |
| ROD | Record of Decision |
| RTP | Southern California Association of Governments Regional Transportation Plan |
| RWMP | Recycled Water Master Plan |
| RUWMP | Regional Urban Water Management Plan (Prepared by MWD) |
| SB | Senate Bills |
| SOC | Synthetic Organic Compounds |
| SUSMP | Standard Urban Stormwater Mitigation Plan |
| STORMWATER PLAN | Stormwater Capture Master Plan |
| SWAT | Irrigation Association Smart Water Application Technologies |
| SWE | Snow Water Equivalent |
| TAF | Thousand Acre-Feet |
| TAP | Technical Assistance Program |
| TCE | Trichloroethylene |
| TDMLs | Total Maximum Daily Loads |
| TOC | Total Organic Carbon |
| ULF | Ultra-Low Flush |
| UWMP | Urban Water Management Plan |
| VOCs | Volatile Organic Compounds |
| WAS | Los Angeles Basin Water Augmentation Study |
| WBICs | Weather-Based Irrigation Controllers |
| WQCMPUR | Water Quality Compliance Master Plan for Urban Runoff |
| WRR | Water Recycling Requirements |
| WSA | Water Supply Assessment |
| WSAP | Metropolitan Water District's Water Supply Allocation Plan |
| WSDM Plan | Water Surplus and Drought Management Plan |
| 20x2020 | Reduce Per Capita Water Use by 20 Percent by 2020; Senate Bill x7-7 |

# Executive Summary

## ES-1 Overview and Purpose of Plan

In 1902, the City created a municipal water system by acquiring title to all properties of a private water company. In 1925, the Los Angeles Department of Water and Power (LADWP) was established by a new city charter. The availability of water has significantly contributed towards the economic development of the City of Los Angeles (City). It has supported the City's need for water resources as it has developed from a town with a population of approximately 146,000 residents in 1902, into the nation's second largest city with over 4 million residents, encompassing a 473 square mile area. As the largest municipal utility in the nation, LADWP delivers safe and reliable water and electricity supplies at an affordable price to the residents and businesses of Los Angeles.

### Overview of Water Issues

LADWP, along with all other water agencies in Southern California, is faced with the challenge of providing a reliable and high quality water supply to meet current and future needs. In the past five years, water supplies in California and locally have become scarcer due to multi-year dry weather and regulatory restrictions affecting water supplies originating in the Sacramento-San Joaquin Delta (Bay Delta) and Colorado River Basin. It is projected that imported and local water supplies will be adversely affected by global climate change. Finally, contamination of local groundwater has resulted in reduced groundwater supplies for the City.

To address these issues, LADWP will take the following water management actions in order to meet the City's water needs while maximizing local resources and minimizing the need to import water:

- Significantly enhance water conservation, stormwater capture and recycling projects to increase supply reliability.
- Implement treatment for San Fernando Basin groundwater supplies.
- Ensure continued reliability of the water supplies from the Metropolitan Water District of Southern California (MWD) through active representation of City interests on the MWD Board.
- Maintain the operational integrity of the Los Angeles Aqueduct (LAA) and in-City water distribution systems.
- Meet or exceed all Federal and State standards for drinking water quality.

### Purpose of Plan

The California Urban Water Management Planning Act (first effective on January 1, 1984) requires that every urban water supplier prepare and adopt an Urban Water Management Plan (UWMP) every five years. Since its original enactment, there have been several amendments added to the Act. The main goal of the UWMP is to forecast future water demands and water supplies under average and dry year conditions, identify future water supply projects such as recycled water, provide a summary of water conservation best management practices (BMPs), and provide a single and multi-dry year management strategy.

LADWP's 2010 UWMP serves two purposes: (1) achieve full compliance with requirements of California's Urban Water Management Planning Act; and (2) serve as a master plan for water supply and resources management consistent with the City's goals and policy objectives.

## Changes Since 2005 UWMP

A number of important changes have occurred since LADWP prepared its 2005 UWMP. First, LADWP released its Water Supply Action Plan (Action Plan) in 2008 to address the water reliability issues associated with the lowest snowpack on record in the Sierra Nevada (in 2007), the driest year on record for the Los Angeles Basin (in 2007), increased water for environmental mitigation and enhancement in the Owens Valley, San Fernando Groundwater Basin contamination, and reduced imported water from the Bay-Delta due to a prolonged water shortage and environmental restrictions on Delta exports. Second, a number of new requirements were added to the Urban Water Management Planning Act, such as addressing California's new mandate of reducing per capita water use by 20 percent by the year 2020. And third, LADWP developed a new water demand forecast based on a more rigorous analysis of water use trends and measurement of achieved water conservation.

As a result of these changes, the implementation plan and schedule in the 2005 UWMP have been revised as follows:

- The Water Supply Action Plan provided more focused strategies as described in Section 1.1.2 with more conservation and recycled water than the amounts planned in the 2005 UWMP.
- Owens Lake Dust Mitigation water use exceeded the 55,000 AFY estimated in 2005 UWMP and resulted in reduced LAA deliveries.
- Groundwater production decreased due to expanded San Fernando Groundwater Basin contamination impacts.

- Seawater desalination was removed from planned water supplies due to concerns over high cost and environmental impacts.

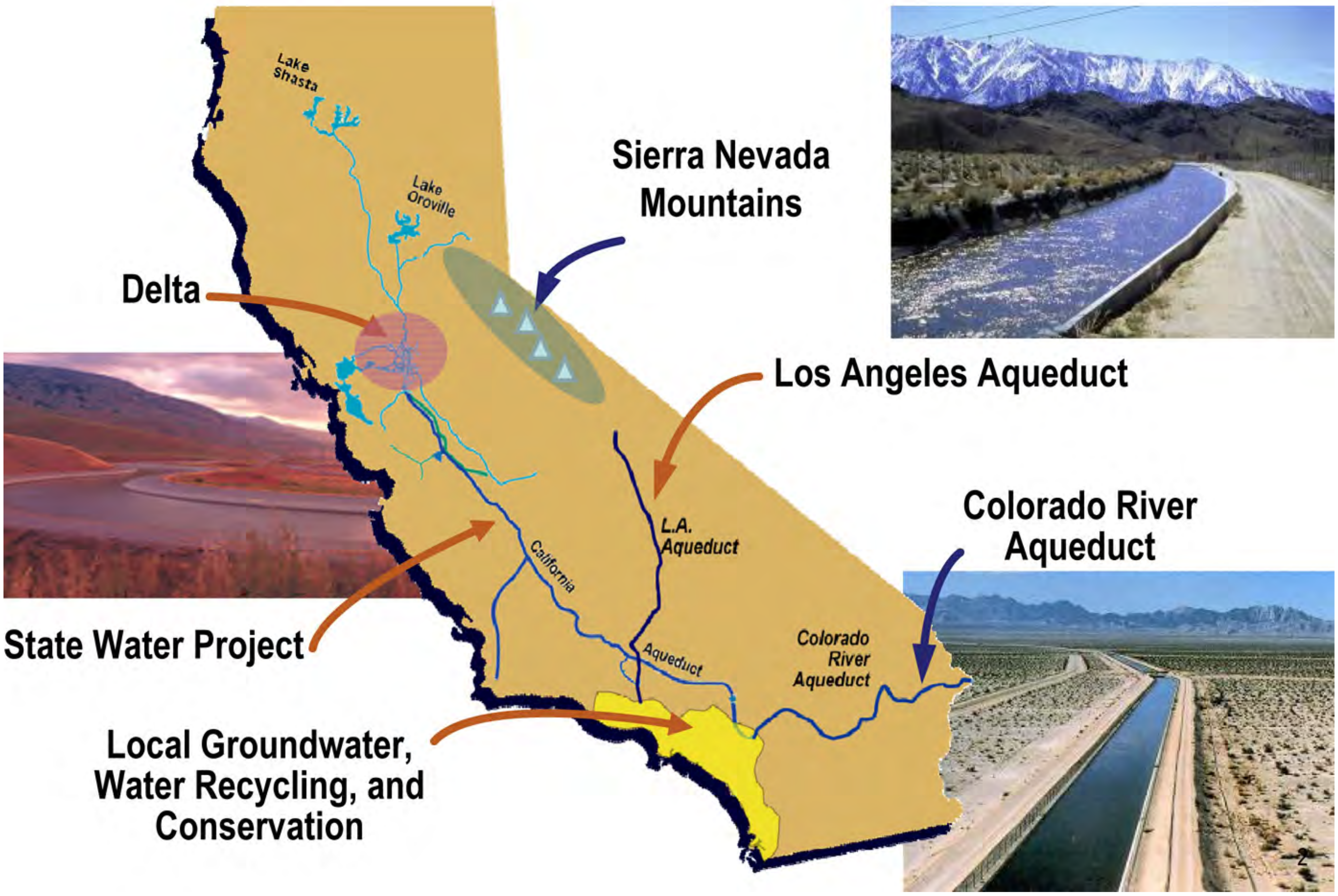
- The schedule for water transfers was postponed because the California Aqueduct interconnection with the Los Angeles Aqueduct has not yet been constructed.

## ES-2 Existing Water Supplies

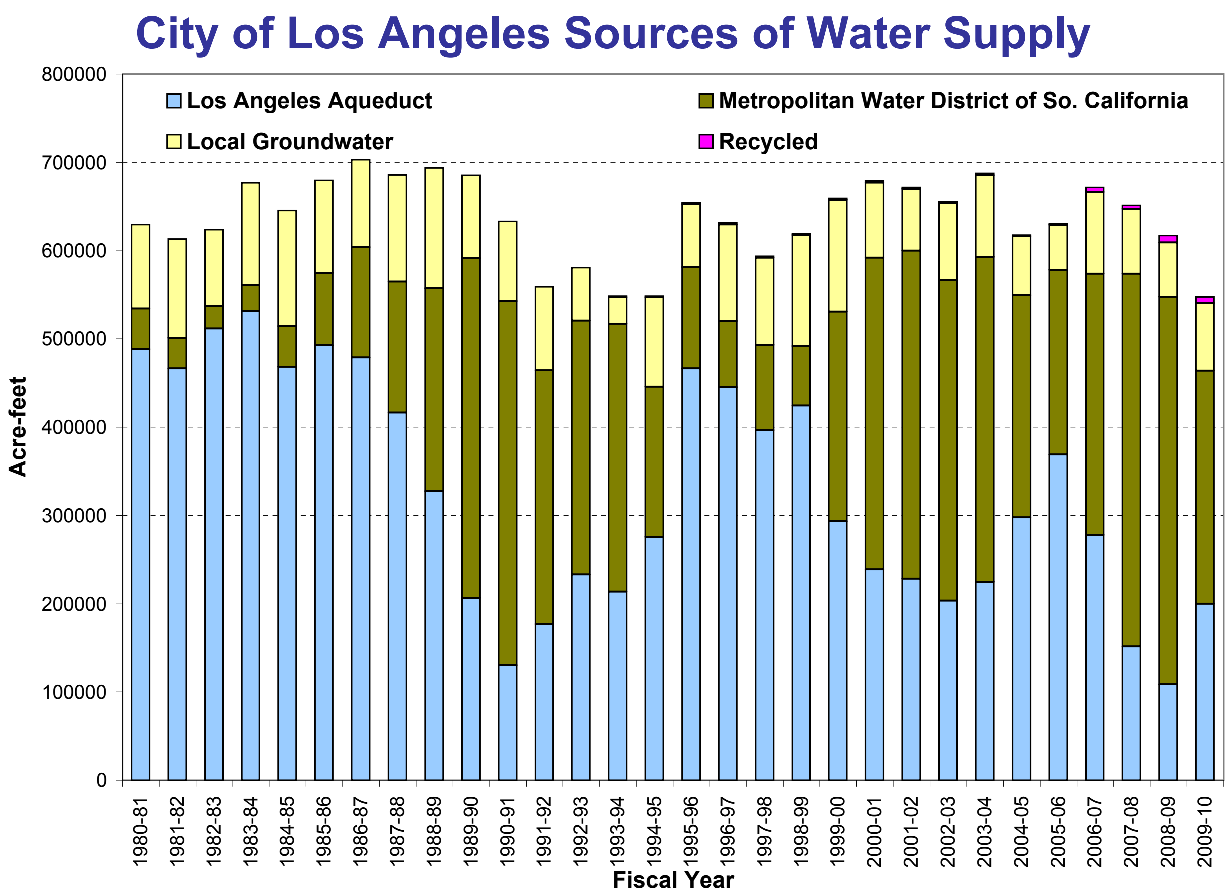
Primary sources of water for the LADWP service area are the Los Angeles Aqueducts (LAA), local groundwater, and purchased imported water from MWD (see Exhibit ES-A). An additional fourth source, recycled water, is increasingly becoming a larger source in the overall supply portfolio. Two of the supply sources, LAA and water purchased from MWD, are classified as imported as they are obtained from outside LADWP's service area. MWD is the regional wholesale water agency, importing water from the Bay-Delta via the State Water Project (SWP) and from the Colorado River via the Colorado River Aqueduct (CRA). Groundwater is local and is obtained within the service area. Historical supply sources are increasingly under multiple constraints including potential impacts of climate change, groundwater contamination, and reallocation of water for environmental concerns. To mitigate these impacts on supply sources, LADWP is modifying its water supply portfolio through increased water use efficiency programs, water recycling, and stormwater capture.

The challenge of water management in California is the year-to-year variability in availability of surface water due to hydrologic conditions from wet and dry years. Also, environmental regulations can result in temporary or permanent restrictions in certain water supplies. For example, recent pumping restrictions in the Bay-Delta resulted in MWD restricting the availability of imported water to LADWP. The LAA supply has also seen reductions in availability due to dry years and environmental mitigation and enhancement needs. Exhibit ES-B shows LADWP's historical water supplies from fiscal year (FY) 1980/81 to 2009/10. The supplies in FY 2009/10 are much lower due to the mandatory water use restrictions LADWP imposed on its customers in response to the prolonged statewide supply shortage and environmental regulations reducing pumping from the Bay-Delta.

*ES-A L.A. Water Supplies*



## *Exhibit ES-B*
## *LADWP Historical Water Supply Sources 1980-2010*




## Recycled Water

In 1979, LADWP began delivering recycled water to the Department of Recreation and Parks for irrigation of areas in Griffith Park. This service was later expanded to include Griffith Park's golf courses. In 1984, freeway landscaping adjacent to the park was also irrigated with recycled water. In addition, the Japanese Garden, Balboa Lake and Wildlife Lake in the Sepulveda Basin now utilize recycled water for environmentally beneficial reuse purposes. The Greenbelt Project, which carries recycled water from the Los Angeles-Glendale Water Reclamation Plant to Forest Lawn Memorial Park, Mount Sinai Memorial Park, Lakeside Golf Club of Hollywood and Universal Studios, began operating in 1992, and represents LADWP's first project to supply recycled water to non-governmental customers. In 2009 phase 1 of the Playa Vista development began receiving recycled water. Playa Vista is the first planned development in the City that uses recycled water to meet all landscape needs. Future recycled water projects will continue to build on the success of these prior projects making recycled water a more prominent component of the City's water supply portfolio. LADWP expects to increase the use of recycled water to 59,000 AFY by 2035.

## Los Angeles Aqueduct

Since its construction in the early 1900's, the Los Angeles Aqueduct historically provided the vast majority of water for the City. It remains as a significant water supply source, providing an average of 36 percent of total water supplies from FY 2005/06 to 2009/10. In the last decade environmental considerations have required that the City reallocate approximately one-half of the Los Angeles Aqueduct (LAA) water supply to environmental mitigation and enhancement projects. As a result, approximately 205,800 AF of water supplies for environmental mitigation and enhancement in the Owens Valley and Mono Basin regions were used in 2010, which is in addition to the almost 107,300 acre-ft per year (AFY) supplied for agricultural, stockwater, and Native American Reservations. Reducing water deliveries to the City from the LAA has led to increased dependence on imported water supply from MWD. This need for purchased water has reinforced LADWP's plans to focus on developing local supplies.

### Local Groundwater

A key resource that the City has relied upon as the major component of its local supply portfolio is local groundwater. Over the last ten years local groundwater has provided approximately 12 percent of the total water supply for Los Angeles, and historically has provided nearly 30 percent of the City's total supply during droughts when imported supplies become unreliable. In recent years, contamination issues have impacted LADWP's ability to fully utilize its local groundwater entitlements. Additionally, reduction of natural infiltration due to expanding urban hardscape and channelization of stormwater runoff has resulted in declining groundwater elevations. In response to contamination issues and declining groundwater levels, LADWP is working to clean up the San Fernando Basin's groundwater, and is making investments to recharge local groundwater basins through stormwater recharge projects, while at the same time collaborating on rehabilitation of aging stormwater capture and spreading facilities. The San Fernando Basin is a fully adjudicated basin with an active Watermaster and Administrative Committee.

### MWD Supply

As a wholesaler, MWD sells water to all of its 26 member agencies. LADWP is exclusively a retailer and has historically purchased MWD water to make up the deficit between demand and other City supplies. As a percentage of the City's total water supply, purchases of MWD water have historically varied from 4 percent in FY 1983/84 to 71 percent in FY 2008/09, with a 5-year average of 52 percent between FY 2005/06 and FY 2009/10. The City relies on MWD water even more in dry years and has increased its dependence in recent years as LAA supply has been reduced. Although the City plans to reduce its reliance on MWD supply, it has made significant investments in MWD anticipating that the City will continue to rely on the wholesaler to meet its current and future supplemental water needs.

## ES-3 Water Demands

Water demands are driven by a number of factors: demographics (population, housing and employment); implementation of water conservation programs; behavioral practices of water users; and weather. For the development of LADWP's 2010 UWMP, a new water demand forecast was prepared using: (1) the latest trends in water use; (2) econometric-derived elasticities for estimating the impacts of weather, price of water, income, and family size on per household and per employee water use; and (3) more accurate estimates of the effectiveness of water conservation in the City.

### Demographics and Climate

Over 4 million people reside in the LADWP service area which is slightly larger than the legal boundary of the City of Los Angeles. LADWP provides water service outside the City's boundary to portions of West Hollywood, Culver City, Universal City, and small parts of the County of Los Angeles. The population within LADWP's service area increased from 2.97 million in 1980 to 4.1 million in 2009, representing an average annual growth rate of 1.3 percent. The total number of housing units increased from 1.10 million in 1980 to 1.38 million in 2009, representing an average annual growth rate of 0.9 percent.

During this time, average household size increased from 2.7 persons in 1980 to 2.9 persons in 2009. Employment grew by about 1.0 percent annually from 1980 to 1990, but declined from 1990 to 2000 as a result of an economic recession that started in 1991. Another decline in employment began in 2008 reflecting the recent economic recession. Overall, employment increased by about 0.3 percent annually from 1990 to 2009.

Demographic projections for LADWP's service area are based on the 2008 forecast generated by the Southern California Association of Governments (SCAG). Exhibit ES-C summarizes these demographic projections for the LADWP service area. Service area population is expected to increase at a rate of 0.4 annually over the next 25 years. While this growth is substantially less than the historical 1.3 percent annual growth rate from 1980 to 2009, it will still lead to approximately 367,300 new residents over the next 25 years.

Weather in Los Angeles is considered mild with blue skies, and sunshine throughout most of the year. Favorable weather is a popular attribute that attracts businesses, residents, and tourists to the City. Because of its relative dryness, Los Angeles' climate has been characterized as Mediterranean. Exhibit ES-D provides a summary of average monthly rainfall, maximum temperatures, and evapotranspiration readings.

## Exhibit ES-C Demographic Projections for LADWP Service Area

| Demographic | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|
| **Population** | 4,100,260 | 4,172,760 | 4,250,861 | 4,326,012 | 4,398,408 | 4,467,560 |
| **Housing** | | | | | | |
| Single-Family | 627,395 | 646,067 | 665,261 | 678,956 | 691,703 | 701,101 |
| Multi-Family | 764,402 | 804,013 | 846,257 | 880,580 | 914,125 | 942,846 |
| Total Housing | 1,391,797 | 1,450,080 | 1,511,518 | 1,559,536 | 1,605,828 | 1,643,947 |
| Persons per Household | 2.88 | 2.81 | 2.75 | 2.71 | 2.67 | 2.65 |
| **Employment** | | | | | | |
| Commercial | 1,674,032 | 1,724,106 | 1,754,998 | 1,790,798 | 1,828,765 | 1,865,156 |
| Industrial | 163,382 | 157,652 | 155,012 | 152,426 | 150,009 | 147,508 |
| Total Employment | 1,837,415 | 1,881,758 | 1,910,010 | 1,943,224 | 1,978,773 | 2,012,664 |

Source: SCAG Regional Transportation Plan (2008), modified using MWD's land use planning to represent LADWP's service area.

## Exhibit ES-D Average Climate Data for Los Angeles 1990-2010

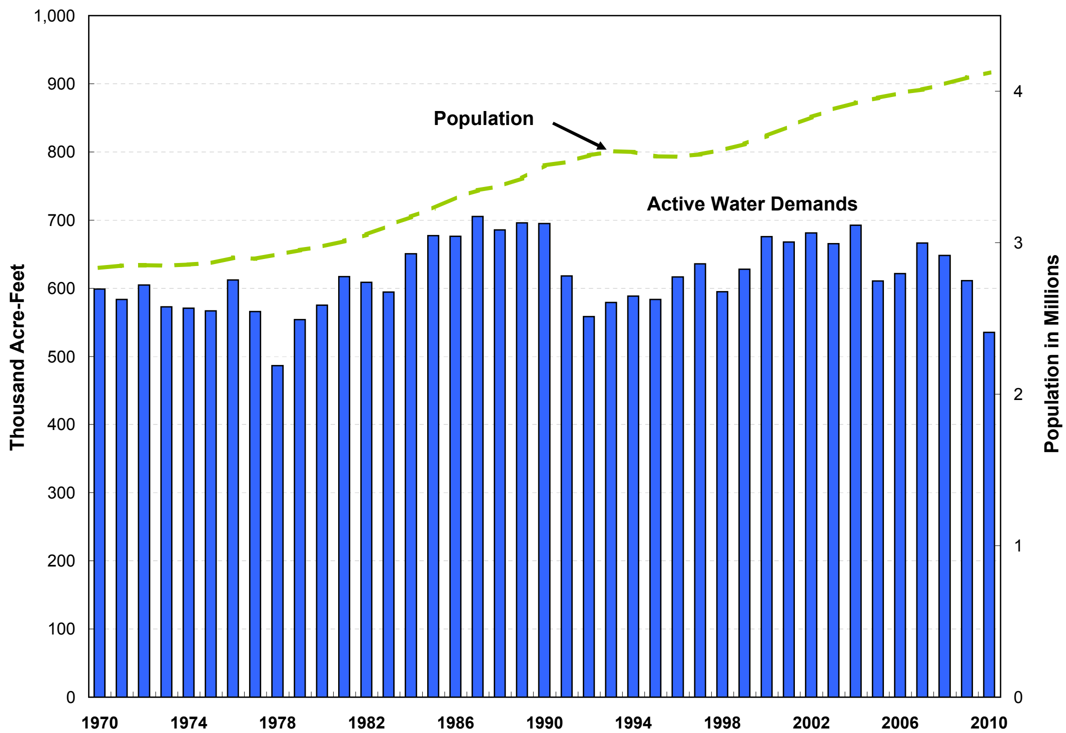
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Maximum Temperature (°F)[1] | 68 | 68 | 70 | 73 | 75 | 78 | 83 | 85 | 83 | 79 | 73 | 68 | 75 |
| Average Precipitation (inches)[1] | 3.62 | 4.46 | 2.28 | 0.75 | 0.34 | 0.12 | 0.01 | 0 | 0.07 | 0.68 | 0.72 | 2.53 | 15.58 |
| Average Eto (inches)[2,3] | 1.98 | 2.26 | 3.66 | 4.96 | 5.46 | 6.08 | 6.46 | 6.31 | 4.87 | 3.63 | 2.56 | 2.03 | 50.26 |

1. 1990-2010, Los Angeles Downtown USC Weather Station ID 5115

2. Average of Hollywood Hills (Station Id. 73), Glendale (Station Id. 133), and Long Beach (Station Id. 174)

3. www.cimis.water.ca.gov

### *Exhibit ES-E*
### *Historical Total Water Demand in LADWP's Service Area*




### *Exhibit ES-F*
### *Breakdown in Historical Water Demand for LADWP's Service Area*

| Fiscal Year | Single-Family | | Multifamily | | Commercial | | Industrial | | Government | | Non-Revenue | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ending | AF | % | AF | % | AF | % | AF | % | AF | % | AF | % | AF |
| 1986-90 Avg | 238,248 | 35% | 197,312 | 29% | 123,324 | 18% | 30,502 | 4% | 43,378 | 6% | 52,830 | 8% | 685,594 |
| 1991-95 Avg | 197,322 | 35% | 177,104 | 31% | 110,724 | 19% | 21,313 | 4% | 38,600 | 7% | 24,100 | 4% | 569,164 |
| 1996-00 Avg | 222,748 | 35% | 191,819 | 30% | 111,051 | 18% | 23,560 | 4% | 39,830 | 6% | 43,617 | 7% | 632,626 |
| 2001-05 Avg | 239,754 | 36% | 190,646 | 29% | 109,685 | 17% | 21,931 | 3% | 41,888 | 6% | 58,299 | 9% | 662,203 |
| 2005-10 Avg | 236,154 | 38% | 180,279 | 29% | 106,955 | 17% | 23,201 | 4% | 42,940 | 7% | 31,929 | 5% | 621,458 |
| 25-yr Avg | 226,845 | 36% | 187,432 | 29% | 112,348 | 18% | 24,101 | 4% | 41,327 | 6% | 42,155 | 7% | 634,209 |

## Historical Water Use

Exhibit ES-E presents the historical water demand for LADWP. In 2009, an economic recession and a water supply shortage required LADWP to impose mandatory conservation. In 2010 mandatory conservation continued as the economic recession became more severe, resulting in a 19 percent decrease in water use.

Prior to 1990, population growth in Los Angeles was a good indicator of total demands. From 1980 to 1990, population in the City grew at 1.7 percent annually. Water demands during this same ten year period also grew at 1.7 percent annually. However, after 1991, LADWP began implementing water conservation measures and water use efficiency programs which prevented water demands from returning to pre-1990 levels. Average water demands in the last five years from FY 2004/05 to 2009/10 are about the same as they were in FY1980/81 despite the fact that over 1.1 million additional people now live in Los Angeles.

Exhibit ES-F shows the breakdown in average total water use between LADWP's major billing categories and non-revenue water in five-year intervals for the past

25 years. Non-revenue water, which is the difference between total water use and billed water use, includes water for fire fighting, reservoir evaporation, mainline flushing, leakage from pipelines, meter error, and theft. Single-family residential water use comprises the largest category of demand in LADWP's service area, representing about 36 percent of the total. Multifamily residential water use is the next largest category of demand, representing about 29 percent of the total. Industrial use is the smallest category, representing only 4 percent of the total demand. Although total water use has varied substantially from year to year, the breakdown between the major billing categories of use has not.

In order to assess the potential for water use efficiency and target conservation programs, LADWP conducted an analysis to determine indoor and outdoor water uses for its major billing categories. The analysis concluded that the City's total outdoor water use was approximately 39 percent of the total water use during the study period from 2004 to 2007. (see Exhibit ES-G).

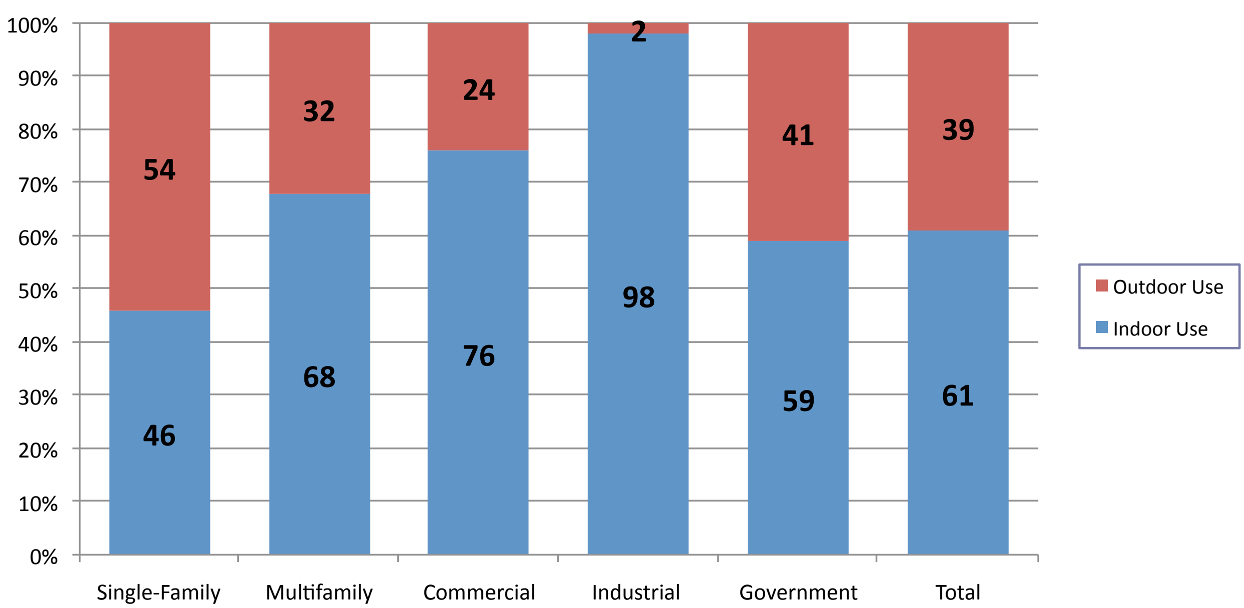
## Water Demand Forecast

Using an econometric water demand forecasting approach, LADWP projected water demands by major category and under different weather conditions. Exhibit ES-H presents the water demand forecast with and without future active water conservation programs.

Categorically, conservation can be grouped into two main types; active and passive conservation. Passive conservation accounts for the improved water use efficiency of retrofitted and new residential homes and commercial buildings due to plumbing code changes. The passive conservation due to the 1991 and 2010 plumbing code changes is hardwired into the 2010 water demand forecast model. Therefore, both cases of demand forecast on Exhibit ES-H are presented with the built-in passive conservation.

Examples of active conservation include installation of low-flush toilets and low flow plumbing fixtures, replacing turf with drought resistant landscaping, and programs which promote water use efficiency in industrial processes. The demand forecast model can present the

***Exhibit ES-G***
***Indoor and Outdoor Water Use in LADWP's Service Area***



## Exhibit ES-H Water Demand Forecast and Conservation Savings Under Average Weather Fiscal Year Ending June 30 (Acre-Feet)

| Demand Forecast with Passive Water Conservation | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|---|
| Single-Family | | 198,444 | 229,115 | 241,976 | 249,528 | 257,693 | 259,904 |
| Multifamily | | 167,299 | 179,653 | 194,724 | 205,136 | 216,054 | 221,912 |
| Commercial/Gov | | 135,000 | 143,081 | 149,597 | 153,791 | 158,628 | 160,049 |
| Industrial | | 20,298 | 20,524 | 20,726 | 20,532 | 20,408 | 19,852 |
| Non-Revenue | | 33,515 | 42,421 | 44,989 | 46,617 | 48,380 | 49,042 |
| Total | | 554,556 | 614,794 | 652,012 | 675,604 | 701,164 | 710,760 |
| **Demand Forecast with Passive & Active Water Conservation** | **2005 Actual** | **2010 Actual** | **2015** | **2020** | **2025** | **2030** | **2035** |
| Single-Family | 233,192 | 196,500 | 225,699 | 236,094 | 241,180 | 246,879 | 247,655 |
| Multifamily | 185,536 | 166,810 | 178,782 | 193,220 | 202,999 | 213,284 | 218,762 |
| Commercial/Gov | 107,414 | 130,386 | 135,112 | 133,597 | 129,761 | 126,567 | 120,420 |
| Industrial | 62,418 | 19,166 | 18,600 | 16,852 | 14,708 | 12,634 | 10,513 |
| Non-Revenue | 26,786 | 32,909 | 41,370 | 42,969 | 43,627 | 44,421 | 44,272 |
| Total | 615,346 | 545,771 | 599,563 | 622,732 | 632,275 | 643,785 | 641,622 |
| **Aggregate Active Water Conservation Savings From** | **2005** | **2010** | **2015** | **2020** | **2025** | **2030** | **2035** |
| Single-Family | | 1,944 | 3,416 | 5,882 | 8,349 | 10,815 | 12,249 |
| Multifamily | | 489 | 871 | 1,504 | 2,137 | 2,770 | 3,150 |
| Commercial/Gov | | 4,614 | 7,969 | 16,000 | 24,030 | 32,061 | 39,629 |
| Industrial | | 1,132 | 1,924 | 3,874 | 5,824 | 7,774 | 9,339 |
| Non-Revenue | | 606 | 1,051 | 2,020 | 2,990 | 3,959 | 4,771 |
| Total | | 8,785 | 15,231 | 29,280 | 43,329 | 57,379 | 69,138 |

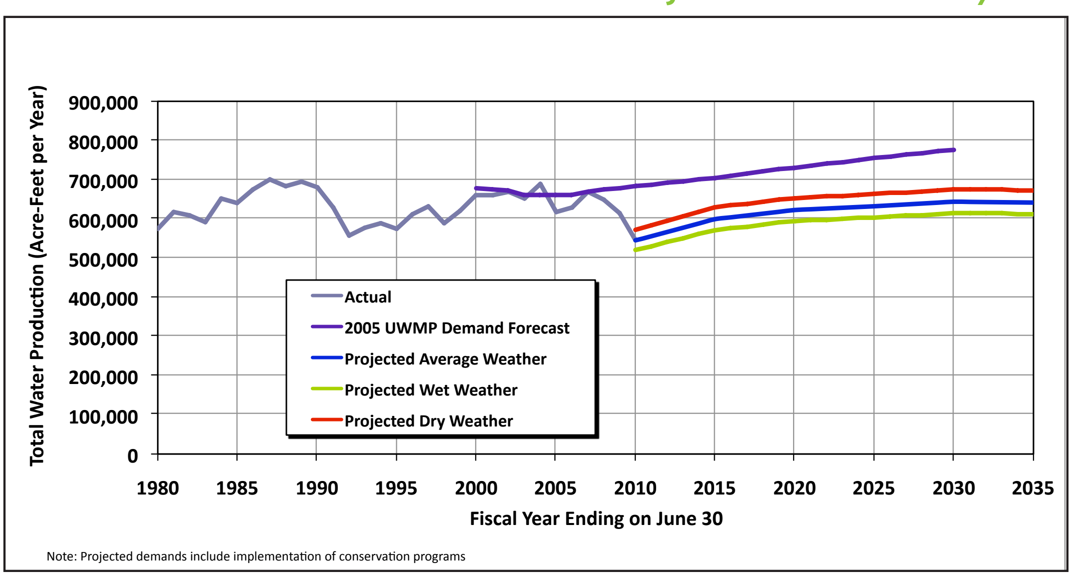
* Non-revenue is the combination of unaccounted water and accounted non-revenue water. Unaccounted water is defined as system losses. In recent years, the City experienced no accounted non-revenue water. Thus, non-revenue water is considered system loss.

results with or without the additional active conservation planned after 2008. The active conservation prior to 2008 is considered a permanent part of the newly established water demand factors for the 2010 water demand forecast model and is accounted for in the forecast.

The calculated active conservation savings include the planned active conservation savings and the additional savings as a result of the decrease in non-revenue water, which is proportional to the decrease of the total water demand.

Exhibit ES-I shows the projected water demands can vary by approximately ± 5 percent in any given year due to average historical weather variability. Historical water use from 1980 to 2010 is illustrated as actual water use. When comparing with the demands forecasted in the 2005 UWMP, the 2010 demand forecasts are about 15 percent lower.

## Exhibit ES-I
## LADWP Water Demand Forecast with Average Weather Variability



## ES-4 Water Conservation

Los Angeles is a national leader in water use efficiency. This accomplishment has resulted from the City's sustained implementation of effective water conservation programs since the 1990s. One of LADWP's most effective conservation tools is its customer's water use efficiency ethic. During past water shortages, residents and businesses have aggressively implemented conservation to achieve demand reductions. During FY 2009/10, water use was below 1979 water use levels thanks to extraordinary conservation efforts by LADWP customers.

To measure conservation effectiveness, LADWP developed a statistical regression model that correlates total water use against population, weather, economic recession, and conservation. The model can predict what water use would be based on actual population, weather and economy in a given year, but without the conservation. The predicted water use is then compared to actual water use and the difference between the two is the annual total water conservation/savings as shown in Exhibit ES-J. The exhibit summarizes LADWP's historical water conservation since FY 1990. The table shows water savings from hardware programs, such as ultra-low-flow and high-efficiency toilet retrofits, cooling tower recirculation, high efficiency clothes washer machines, and other plumbing and efficiency measures. The table also shows water savings that occur from non-hardware programs that result from changes in water customer behavior, such as reduced watering, and taking shorter showers. These behavioral conservation savings occur as a result of public education and information programs, and increases in the price of water. As shown in the exhibit, hardware water savings have been steadily increasing since 1990 while non-hardware water savings peaked in FY 1991/92 and again in FY 2009/10. The peaks in non-hardware savings were due to City of Los Angeles' mandatory water use restrictions implemented in response to multi-year water shortages.

### *Exhibit ES-J*
### *Historical Water Conservation in LADWP's Service Area*

| Fiscal Year | Additional Annual Hardware Installed Savings (AF) | Cumulative Annual Hardware Savings (AF) | Annual Non-Hardware Savings (AF) | Annual Total Savings (AF) |
|---|---|---|---|---|
| Prior to 1990/1991 | 31,825 | 31,825 | | |
| 1990/1991 | 4,091 | 35,916 | 76,350 | 112,267 |
| 1991/1992 | 8,670 | 44,586 | 105,593 | 150,179 |
| 1992/1993 | 3,286 | 47,872 | 58,546 | 106,417 |
| 1993/1994 | 4,961 | 52,832 | 60,928 | 113,761 |
| 1994/1995 | 4,041 | 56,873 | 62,084 | 118,958 |
| 1995/1996 | 4,642 | 61,516 | 52,648 | 114,164 |
| 1996/1997 | 2,376 | 63,892 | 33,720 | 97,612 |
| 1997/1998 | 2,637 | 66,529 | 30,434 | 96,964 |
| 1998/1999 | 2,781 | 69,310 | 38,305 | 107,614 |
| 1999/2000 | 3,532 | 72,842 | -6,262 | 66,580 |
| 2000/2001 | 3,078 | 75,920 | -3,407 | 72,513 |
| 2001/2002 | 2,452 | 78,371 | 15,131 | 93,502 |
| 2002/2003 | 2,630 | 81,002 | 8,725 | 89,726 |
| 2003/2004 | 3,257 | 84,259 | 13,107 | 97,366 |
| 2004/2005 | 3,299 | 87,558 | 46,865 | 134,423 |
| 2005/2006 | 2,404 | 89,963 | 62,223 | 152,186 |
| 2006/2007 | 2,095 | 92,058 | 76,643 | 168,701 |
| 2007/2008 | 782 | 92,840 | 64,472 | 157,312 |
| 2008/2009 | 3,127 | 95,967 | 106,151 | 202,118 |
| 2009/2010 | 4,269 | 100,236 | 126,466 | 226,702 |

1. Negative non-hardware savings are due to overestimation in hardware savings due to years with extreme wet weather conditions.

## Exhibit ES-K
## Active Water Conservation Projections

| Sector | Acre-feet per Fiscal Year | | | | |
|---|---|---|---|---|---|
| | 2014/2015 | 2019/2020 | 2024/2025 | 2029/2030 | 2034/2035 |
| Single-Family Residential | 3,416 | 5,882 | 8,349 | 10,815 | 12,249 |
| Multi-Family Residential | 871 | 1,504 | 2,137 | 2,770 | 3,150 |
| Commercial/Government | 7,969 | 16,000 | 24,030 | 32,061 | 39,629 |
| Industrial | 1,924 | 3,847 | 5,824 | 7,774 | 9,339 |
| Total Active Conservation Projections | 14,180 | 27,260 | 40,340 | 53,420 | 64,368 |

### Water Conservation Goals

LADWP has set a water conservation goal to further reduce potable water demands an additional 64,000 AFY by 2035. This aggressive approach includes multiple strategies: investments in state-of-the-art technology; rebates and incentives promoting installation of weather-based irrigation controllers (WBICs), efficient clothes washers and urinals; expansion and enforcement of prohibited water use; reductions in outdoor water uses; and extending education and outreach efforts. Exhibit ES-K shows the projected water conservation by sector of use. Note that these projected savings are in addition to what has already occurred in the City since the 1990s.

The California Water Conservation Act of 2009, Senate Bill x7-7, requires water agencies to reduce per capita water use by 20 percent by the year 2020 (20x2020). This includes increasing recycled water use to offset potable water use. Water suppliers are required to set a water use target for 2020 and an interim target for 2015 using one of four methods. The 2020 urban water use target may be updated in a supplier's 2015 UWMP. The California Department of Water Resources (DWR) has developed four methods for measuring compliance with 20x2020.

LADWP has selected Method 3 to set its 2015 interim and 2020 water use targets. Method 3 requires setting the 2020 water use target to 95 percent of the applicable State hydrologic region target as provided in the State's Draft 20x2020 Water Conservation Plan. LADWP is within State hydrologic region 4, the South Coast region. LADWP was required to further adjust the calculated 2020 target to achieve a minimum reduction in water use. The per capita water use at 95 percent of the hydrologic region was 142 gallons per capita per day (gpcd), and using 95 percent of the five-year average base daily per capita water use was equal to 138 gpcd. Therefore, LADWP was required to set its 2020 target at the smaller of the two resultant values. LADWP's interim 2015 target is 145 gpcd and the 2020 target is 138 gpcd. Exhibit ES-L presents the calculations for LADWP's 20x2020 target. Also shown in this exhibit for reference is LADWP's 10-year and 5-year historical average per capita water use.

## Exhibit ES-L
## 20x2020 Base and Target

| 20x2020 Required Data | Gallons Per Capita Per Day (GPCD) |
|---|---|
| **Base Per Capita Daily Water Use** | |
| 10-Year Average[1] | 152 |
| 5-Year Average[2] | 145 |
| **2020 Target Using Method 3[3]** | |
| 95% of Hydrologic Region Target (149 gpcd) | 142 |
| 95% OF Base Daily Capita Water Use 5-Year Average (145 gpcd) | 138 |
| **Actual 2020 Target** | **138** |
| **2015 Interim Target** | 145 |

1. Ten-year average based on fiscal year 1995/96 to 2004/05

2. Five-year average based on fiscal year 2003/04 to 2007/08

3. Methodology requires smaller of two results to be actual water use target to satisfy minimum water use target.

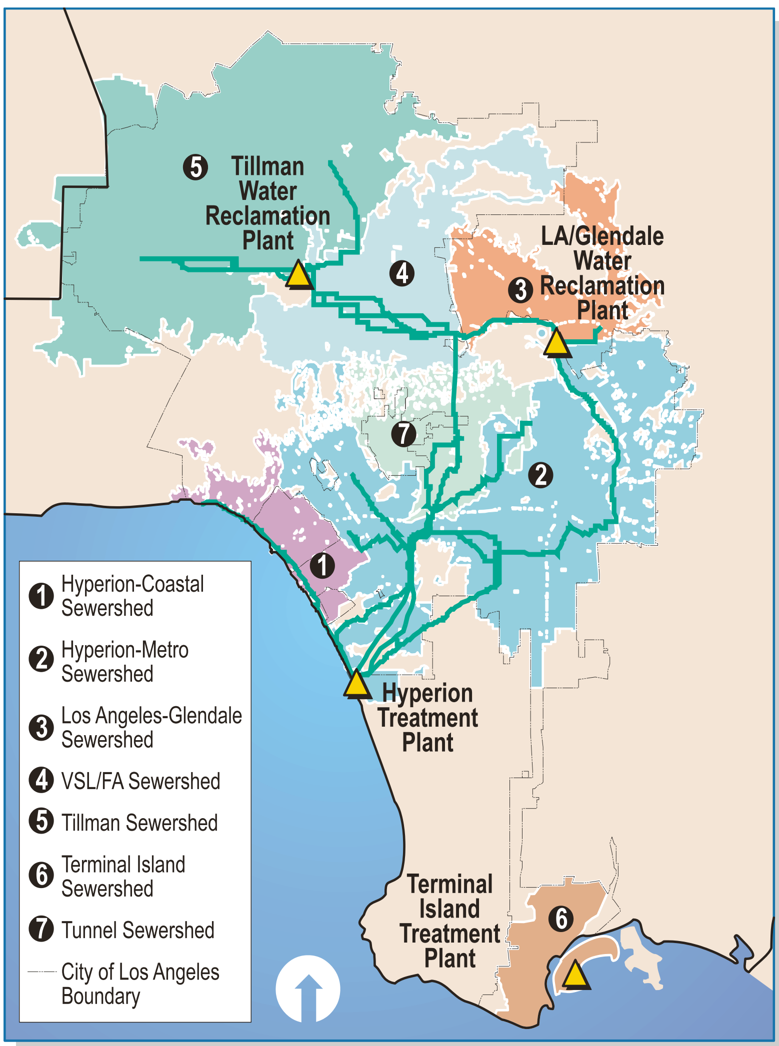
## *Exhibit ES-M*
## *Water Conservation BMPs and Implementation Status*

| Category | Sub-category | Practices | Status |
|---|---|---|---|
| **Foundational** | | | |
| Utility Operations | Operations Practices | Maintain the position of a trained conservation coordinator | Implemented |
| | | Prevent water waste – enact, enforce or support legislation, regulations, and ordinances | Implemented |
| | | Wholesale agency assistance programs | Not applicable |
| | Water Loss Control | Conduct Standard Water Audit and Water Balance | Implemented |
| | | Measure performance using AWWA software | Implemented |
| | | Locate and Repair all leaks and breaks | Implemented |
| | Metering with Commodity Rates | 100% of existing unmetered accounts to be metered and billed by volume of use | Implemented |
| | Conservation Pricing | Maintain a water conserving retail rate structure | Implemented |
| Education | Public Information Programs | Maintain active public information program to promote and educate customers about water conservation | Implemented |
| | School Education Programs | Maintain active program to educate students about water conservation and efficient water use | Implemented |
| **Programmatic** | | | |
| Residential | | Residential Assistance – provide leak detection assistance | Implemented |
| | | Landscape Water Surveys for residential accounts | Implemented |
| | | High efficiency clothes washer incentive program | Implemented |
| | | WaterSense Specification (WSS) for toilets | Implemented |
| Commercial/ Industrial/ Institutional (CII) | | Implement unique conservation programs to meet annual water savings goals for CII customers | Implemented |
| Landscape | | Implement Large Landscape custom programs | Implemented |
| | | Offer technical assistance and surveys upon request | Implemented |
| | | Implement and maintain incentive program(s) for irrigation equipment retrofits | Implemented |

### Water Conservation Best Management Practices (BMPs)

LADWP is one of the original signatories to the California Urban Water Conservation Council Memorandum of Understanding (MOU), and as such has to report its progress on achieving water conservation BMPs. Exhibit ES-M presents the checklist of BMPs that LADWP has implemented. LADWP is currently in compliance with all the BMP's contained in the MOU.

***Exhibit ES-N***
***City Wastewater Plants and Sewersheds***




## ES-5 Future Water Supplies

As stated previously, the water management goal of LADWP is to implement cost-effective conservation, recycled water, and stormwater capture programs. In addition, LADWP is also pursuing water transfers in order to make up for its LAA water losses.

### Water Recycling

LADWP is committed to significant expansion of recycled water in the City's water supply portfolio. Realizing multiple factors are decreasing the reliability of imported water supplies, LADWP released the City of Los Angeles Water Supply Action Plan (Plan), "Securing L.A.'s Water Supply" in May of 2008. The Plan established the goal of using 50,000 AFY of recycled water to offset demands on potable supplies. In order to meet this goal, LADWP, in conjunction with the Department of Public Works Bureau of Sanitation (BOS), are working together to develop a Recycled Water Master Plan (RWMP). Opportunities to expand the water recycling program are being studied through development of the RWMP. These include expanding the recycled water distribution system for Non-Potable Reuse (NPR) such as for irrigation and industrial use, along with replenishment of groundwater basins with highly purified recycled water. Beyond 50,000 AFY, LADWP expects to increase recycled water use by approximately 1,500 AFY annually, bringing the total to 59,000 AFY by 2035.

LADWP's water recycling program is dependent on the City's wastewater treatment infrastructure. Wastewater in the City of Los Angeles is collected and transported through some 6,500 miles of major interceptors and mainline sewers, more than 11,000 miles of house-sewer connections, 46 pumping plants, and four treatment plants. BOS is responsible for the planning and operation of the wastewater program. The City's wastewater system serves 515 square miles, of which 420 square miles are within the City. In addition to the City, service is provided to 29 non-City agencies through contract services. Exhibit ES-N shows the City's four wastewater treatment plants and seven sewersheds that feed those plants. A portion of the treated effluent from the wastewater plants is utilized by LADWP to meet recycled water demands.

In FY 2009/10, LADWP provided 31,872 AFY of recycled water for municipal & industrial purposes and environmental benefits.

The use of recycled water must meet California's regulatory requirements for safety. Non-potable water reuse (NPR) regulations in the City of Los Angeles are governed by the California Department of Public Health (CDPH), State Water Resources Control Board (SWRCB), Los Angeles Regional Water Quality Control Board (LARWQCB) and the Los Angeles County Department of Public Health (LACDPH). Criteria and guidelines for the production and use of recycled water were established by the CDPH in the California Code of Regulations, Title 22, Division 4, and Chapter 3 (Title 22). Title 22, also known as Water Recycling Criteria, establishes required wastewater treatment levels and recycled water quality levels dependent upon the end use of the recycled water. Title 22 additionally establishes recycled water reliability criteria to protect public health.

The regulations governing recharge of groundwater or groundwater replenishment (GWR) with recycled water are established by the CDPH and LARWQCB. For groundwater replenishment, LADWP will implement advanced treatment that includes reverse osmosis, microfiltration, and advanced oxidation. This level of treatment will address water quality concerns for the health of the basin along with emerging contaminants of concern.

Exhibit ES-O presents LADWP's projected recycled water use based on preliminary findings from the RWMP.

## Stormwater Capture

The 2010 UWMP projects that the stormwater capture can potentially provide increased groundwater pumping rights in the San Fernando Basin of 15,000 AFY from groundwater recharge using captured stormwater, and 10,000 AFY of additional water conservation from

### *Exhibit ES-O*
### *Recycled Water Use Projections*

| Category | Projected Use (AFY)[1] | | | | |
|---|---|---|---|---|---|
| | **2015** | **2020** | **2025** | **2030** | **2035** |
| Municipal and Industrial Non-Potable Reuse | 20,000 | 20,400 | 27,000 | 29,000 | 29,000 |
| Indirect Potable Reuse (Groundwater Recharge) | 0 | 0 | 15,000 | 22,500 | 30,000 |
| **Subtotal[2]** | **20,000** | **20,400** | **42,000** | **51,500** | **59,000** |
| Environmental[3] | 26,990 | 26,990 | 26,990 | 26,990 | 26,990 |
| Seawater Intrusion Barrier (Dominguez Gap Barrier) | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| **Total** | **49,990** | **50,390** | **71,990** | **81,490** | **88,990** |

1. Projected use by category is subject to change per completion of Recycled Water Master Plan, but overall total will not change. Does not include deliveries of 34,000 AFY of secondary treated water to WBMWD for further treatment to recycled water standards.

2. To offset potable use and included in supply reliability tables in Chapter 11.

3. Environmental use includes Wildlife Lake, Balboa Lake, and the Japanese Garden. Additional environmental benefits associated with recycled water discharges to the Los Angeles River are not included.

## *Exhibit ES-P Planned Centralized Stormwater Capture Programs*

| Project | Current Annual Recharge (AFY) | Increased Annual Capture/ Recharge (AFY) | Expected Annual Recharge (AFY) | Estimated Project Completion | Total Project Cost (millions) | LADWP Share (millions) |
|---|---|---|---|---|---|---|
| Sheldon-Arleta Gas Collection System | - | 4,000 [1] | - | Completed Nov 2009 | $8.2 | $6.3 |
| Big Tujunga Dam Rehabilitation [3] | - | 4,500 | - | July 2011 | $105.7 | $9.0 |
| Hansen Spreading Grounds Upgrade | 13,834 | 1,200 | 17,284 [2] | Dec 2011 | $9.3 | $4.8 |
| Tujunga Spreading Grounds Upgrade | 4,419 | 8,000 | 18,669 [4] | 2015 | $24.0 | $24.0 |
| Pacoima Spreading Grounds Upgrade | 6,453 | 2,000 | 8,453 | 2015 | $32.0 | $16.0 |
| Lopez Spreading Grounds Upgrade | 527 | 750 | 1,277 | 2016 | $8.0 | $4.0 |
| Strathern Wetlands Park | - | 900 | 900 [5] | 2016 | $46.0 | $4.0 |
| Hansen Dam Water Conservation | - | 3,400 | 3,400 | 2017 | $5.0 | $2.5 |
| Valley Generating Station Stormwater Capture | - | 700 | 700 | 2018 | $9.7 | $9.7 |
| Branford Spreading Basin Upgrade | 549 | 500 | 1,049 | 2018 | $4.0 | $2.0 |
| **Total Estimated Yield** | **25,782** | **25,950** | **51,732** | | **$251.9** | **$82.3** |

1. This will allow increased collection of 4,000 AFY at Tujunga Spreading Grounds.
2. Includes 1/2 benefits from Big Tujunga Dam Rehabilitation Project.
3. No recharge occurs at the facility. All additional capture has been divided between Hansen & Tujunga Spreading Grounds.
4. Including benefits from Sheldon-Arleta Project and 1/2 benefits from Big Tujunga Dam Rehabilitation Project.
5. To be recharged at Sun Valley Park.

capture and reuse solutions such as rain barrels and cisterns, for a total of 25,000 AFY by FY 2034/35. A Stormwater Capture Master Plan is being prepared and will comprehensively evaluate stormwater capture potential within the City.

In January 2008, LADWP created the Watershed Management Group which is responsible for developing and managing the water system's involvement in emerging issues associated with local and regional stormwater capture. The Watershed Management Group coordinates activities with other agencies, departments, stakeholders and community groups for the purpose of planning and developing projects and initiatives to improve stormwater management within the City. The Group's primary goal is to increase stormwater capture by enhancing existing centralized stormwater capture facilities and promoting distributed stormwater infiltration systems to achieve the City's long-term strategy of enhancing local stormwater capture.

Watershed management provides additional important benefits to the City of Los Angeles, including surface water quality improvements, water conservation, open space enhancements, and flood control. Water quality improvements are necessary because stormwater runoff is a conveyance mechanism that transports pollutants from the watershed into waterways and ultimately the Pacific Ocean. Pollutants include, but are not limited to, bacteria, oils, grease, trash, and heavy metals. The City must comply with adopted Total Maximum Daily Loads (TMDLs) for pollutants. TMDLs set maximum limits for a specific pollutant that can be discharged to a water body without causing the water body to become impaired or limiting certain uses.

LADWP has already been implementing several watershed projects and has identified others for planned implementation. Exhibit ES-P summarizes the currently planned watershed projects.

The Stormwater Capture Master Plan (Stormwater Plan) is being prepared to investigate potential strategies for stormwater and watershed management in the City. The Stormwater Plan will be used to guide decision makers in the City when making decisions affecting how the City will develop both centralized and distributed stormwater capture goals. The Stormwater Plan will evaluate existing stormwater capture facilities and projects, quantify the maximum stormwater capture potential, develop feasible stormwater capture alternatives (i.e., projects, programs, potential policies, etc.), and provide strategies to increase stormwater capture. It will also evaluate the multi-beneficial aspects of increasing stormwater capture, including potential open space alternatives, improved downstream water quality, and peak flow attenuation in downstream channels, creeks, and streams such as the Los Angeles River.

## Water Transfers

Water transfers involve the lease or sale of water or water rights between consenting parties. Water Code Section 470 (The Costa-Isenberg Water Transfer Act of 1986) states that voluntary water transfers between water users can result in a more efficient use of water, benefiting both the buyer and the seller. The State Legislature further declared that transfers of surplus water on an intermittent basis can help alleviate water shortages, save capital outlay development costs, and conserve water and energy. This section of the Water Code also obligates the California Department of Water Resources (DWR) to facilitate voluntary exchanges and transfers of water.

LADWP plans on acquiring water through transfers to replace a portion of LAA water used for environmental enhancements in the eastern Sierra Nevada. The City would purchase water when available and economically beneficial for storage or delivery to LADWP's transmission and distribution system. The City is seeking non-State Water Project water to replace the reallocation of LAA water supply for environmental enhancements. MWD holds an exclusive contractual right to deliver State Water Project entitlement water into its service territory, which includes the City of Los Angeles. Purchasing only non-State Water Project supplies will ensure the City's compliance with MWD's State Water Project contract.

To facilitate water transfers, LADWP is constructing an interconnection between the LAA and the State Water Project's California Aqueduct, located where the two aqueducts intersect in the Antelope Valley (Neenach, California). This interconnection, the Neenach Pumping Station will allow for water transfers from the East Branch of the State Water Project to the LAA System, as well as provide operational flexibility in the event of a disruption of flows along the LAA System. Construction of the Neenach Pumping Station required a four-way agreement between DWR, MWD, LADWP, and the Antelope Valley-East Kern Water Agency (AVEK). When completed, the Neenach Pumping Station facility will be owned by DWR but will be designated as an AVEK interconnection. The Neenach Pumping Station will be operated on behalf of the LADWP. MWD is involved in the agreement to provide consent for the transfer of water into its service territory.

LADWP's current goal is to transfer up to 40,000 AF per year once the Neenach Pumping Station facilities are in place. This will provide LADWP with the ability to replace some Los Angeles Aqueduct supplies reallocated to environmental enhancement projects.  This will also provide increased operational flexibility and the ability to yield cost savings.

## Other Water Supply Opportunities

### Seawater Desalination

LADWP initiated efforts in 2002 to evaluate seawater desalination as a potential water supply source with the goals of improving reliability and increasing diversity in its water supply portfolio. These efforts led to the selection of the Scattergood Generating Station's unused tank farm as a potential site for a seawater desalination plant. For the City, seawater desalination is a potential resource that could also offset supplies that had been committed from the LAA for environmental restoration in the eastern Sierra Nevada. As an identified project in MWD's Seawater Desalination Program, the proposed full-scale project would have qualified for MWD's grant of $250 per acre-foot of water produced. However, in May 2008, LADWP decided to focus on water conservation and water recycling as primary strategies for creating a sustainable water supply due to concerns with cost and the environmental impacts associated with the implementation of desalination. While desalination may be explored further in the future, it currently represents only a supply alternative.

### Graywater Systems

As defined by State regulations, graywater is untreated household wastewater which has not come into contact with toilet waste or unhealthy bodily wastes. It includes water sources from bathtubs, showers, bathroom wash basins, and water from clothes washing machines and laundry tubs. It specifically excludes water from kitchen sinks and dishwashers. Graywater is a drought-proof source of supply for subsurface landscape irrigation. Graywater regulations do not allow its application using spray irrigation. Graywater is also not allowed to pond or runoff, enter a storm drain system or surface water body, or irrigate root crops or edible food crops that are directly in contact with the surrounding soil.

The Graywater Systems for Single Family Residences Act of 1992 legally incorporated the use of graywater as part of the California Plumbing Code. In September 1994, the City approved an ordinance that permitted the installation of graywater systems in residential homes. However, installing graywater systems under the Act was costly in terms of both installation and maintenance. To address the current water shortage and reduce water demands, emergency graywater regulations added Chapter 16A (Part I) "Non-potable Water Reuse Systems" to the 2007 California Plumbing Code. These regulations were approved by California Building Standards Commission in 2009 and became effective on August 4, 2009. Further revisions were made to the regulations and the regulations became permanent on January 12, 2010 with an effective date of January 20, 2010. These new code changes allow the use of certain types of untreated graywater systems as long as specific health requirements are met as defined by the authority having jurisdiction.

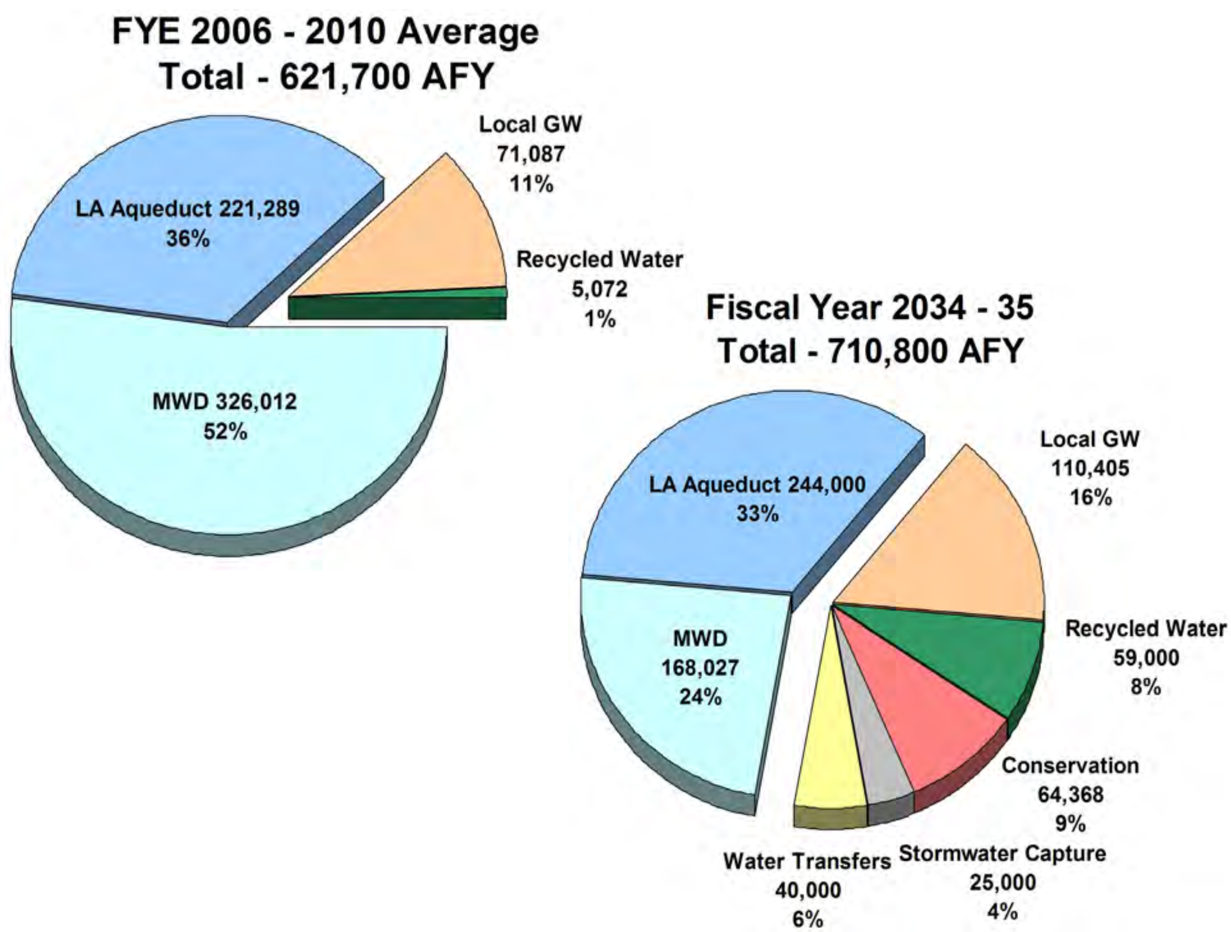
## ES-6 Water Supply Reliability

With its current water supplies, planned future water conservation, and planned future water supplies, LADWP will be able to reliably provide water to its customers through the 25-year planning period covered by this UWMP. While there may be times in which severe water shortages require MWD to allocate its imported water in the future, LADWP's customers have shown that they can adapt and reduce consumption in those years. However, MWD's 2010 Regional UWMP currently shows that with its investments in storage, water transfers and improving the reliability of the Delta, water shortages are not expected to occur within the next 25 years.

Exhibit ES-Q shows the current and future mix of LADWP's water supply. As shown in this exhibit, local water supplies and new water conservation are projected to increase from the current 12 percent to 43 percent by 2035. This increased local supply mix will allow LADWP to reduce by half its MWD water supply purchases, effectively making LADWP less subject to cost increases on purchased water. The focus on local supplies also increases flexibility and overall reliability, particularly during periods of water shortage.

***Exhibit ES-Q***
***Current and Projected Mix of LADWP's Water Supplies***

Note: Charts do not reflect approximately 100,000 AF of existing conservation



## Supply Reliability Assessment

To demonstrate LADWP's water supply reliability, Exhibit ES-R summarizes the water demands and supplies for an average weather year through 2035.

Exhibit ES-S presents the supply reliability for the driest three-year sequence from 2010 to 2013, as required by the UWMP guidelines.

## Water Quality Issues

Water quality is an important and necessary consideration in all impact water management strategies and supply reliability. For example as shown in Footnote 2 of the Exhibit ES-R, the sustainability of the groundwater production is contingent on completing two groundwater treatment facilities for the San Fernando Basin groundwater. Similarly, the effectiveness of expanding

### *Exhibit ES-R Service Area Reliability Assessment for Average Weather Year*

| **Demand and Supply Projections (in acre-feet)** | FY2009-10 Actual | **Average Weather Conditions (FY 1956/57 to 2005/06) Fiscal Year Ending on June 30** | | | | |
|---|---|---|---|---|---|---|
| | | 2015 | 2020 | 2025 | 2030 | 2035 |
| **Total Demand** | **555,477** | **614,800** | **652,000** | **675,600** | **701,200** | **710,800** |
| **Existing / Planned Supplies** | | | | | | |
| Los Angeles Aqueduct[1] | 199,739 | 252,000 | 250,000 | 248,000 | 246,000 | 244,000 |
| Groundwater[2] | 76,982 | 40,500 | 96,300 | 111,500 | 111,500 | 110,405 |
| Conservation | 8,178 | 14,180 | 27,260 | 40,340 | 53,419 | 64,368 |
| Recycled Water | | | | | | |
| - Irrigation and Industrial Use | 6,703 | 20,000 | 20,400 | 27,000 | 29,000 | 29,000 |
| - Groundwater Replenishment | 0 | 0 | 0 | 15,000 | 22,500 | 30,000 |
| Water Transfers | 0 | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| Subtotal | 291,602 | 366,680 | 433,960 | 481,840 | 502,419 | 517,773 |
| **MWD Water Purchases** With Existing/Planned Supplies | 263,875 | 248,120 | 218,040 | 193,760 | 198,781 | 193,027 |
| **Total Supplies** | **555,477** | **614,800** | **652,000** | **675,600** | **701,200** | **710,800** |
| **Potential Supplies** | | | | | | |
| Stormwater Capture | | | | | | |
| - Capture and Reuse (Harvesting) | 0 | 2,000 | 4,000 | 6,000 | 8,000 | 10,000 |
| - Increased Groundwater Production (Recharge) | 0 | 0 | 2,000 | 4,000 | 8,000 | 15,000 |
| Subtotal | 0 | 2,000 | 6,000 | 10,000 | 16,000 | 25,000 |
| MWD Water Purchases With Existing/Planned/Potential Supplies | 263,875 | 246,120 | 212,040 | 183,760 | 182,781 | 168,027 |
| **Total Supplies** | **555,477** | **614,800** | **652,000** | **675,600** | **701,200** | **710,800** |

[1] Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impact.

[2] North Hollywood/Rinaldi-Toluca Treatment Complex is expected in operation in 2019-20. Tujunga Groundwater Treatment Plant is expected in operation in 2020-21. Storage credit of 5,000 afy will be used to maximize the pumping in 2020-21 and thereafter. Sylmar Basin production was increased to 4,500 AFY from 2014-15 to 2029-30 to avoid the expiration of stored water credits, then go back to its entitlement of 3,405 AFY in 2030-31.

## *Exhibit ES-S*
## *Driest Three-Year Water Supply Sequence*

| Demand and Supply Projections (in acre-feet) | FY2009-10 Actual | Followed by Repeat of Driest Three Consecutive Years FY 1958/59 to 1960/61 Hydrology Fiscal Year Ending on June 30 | | |
|---|---|---|---|---|
| | | 2011 | 2012 | 2013 |
| **Total Demand** | **555,477** | **590,000** | **608,200** | **626,500** |
| | | | | |
| **Existing / Planned Supplies** | | | | |
| Los Angeles Aqueduct[1] | 199,739 | 104,530 | 50,849 | 59,382 |
| Groundwater[2] | 76,982 | 61,090 | 53,660 | 46,260 |
| Conservation | 8,178 | 9,380 | 10,580 | 11,780 |
| Recycled Water | | | | |
| - Irrigation and Industrial Use | 6,703 | 7,500 | 8,300 | 9,000 |
| - Groundwater Replenishment | 0 | 0 | 0 | 0 |
| Water Transfers | 0 | 0 | 0 | 0 |
| Subtotal | 291,602 | 182,500 | 123,389 | 126,422 |
| | | | | |
| **MWD Water Purchases** With Existing/Planned Supplies | 263,875 | 407,500 | 484,811 | 500,078 |
| **Total Supplies** | **555,477** | **590,000** | **608,200** | **626,500** |

1. Driest three consecutive years on record in LAA watershed (FY1958-59 to FY1960-61) averaged 28 percent of normal runoff.
2. LAA deliveries reflect increased releases for environmental restoration in the Owens Valley and Mono Basin.
3. Dry year demands are 5 percent greater than normal year demands
4. MWD's Water Surplus and Drought Management Plan actions sufficient to meet LADWP demands.

the use of the San Fernando Basin groundwater from recycled water and captured stormwater also depends on implementation of treatment.

In the portions of the eastern San Fernando Basin, we have detected several industrial contaminants. These include trichloroethylene (TCE), perchloroethylene (PCE), hexavalent chromium, perchlorate and other volatile organic compounds (VOCs). These contaminants are a result of historical improper chemical disposal in the San Fernando Valley. Nitrates in the San Fernando Basin is an additional contaminant of concern which is the result of decades of agricultural activities. These contaminants threaten the overall reliability and sustainability of the City's groundwater supply. LADWP is determined to address the contamination in order to continue to provide high quality water.  In this effort, LADWP is working with local, state and federal agencies such as the U.S. Environmental Protection Agency, the California Department of Public Health, the Los Angeles Regional Water Quality Control Board, and the California Department of Toxic Substances Control.  LADWP has an ongoing extensive groundwater monitoring program to ensure that groundwater pumping occurs from the safer areas of the basin. LADWP has shutdown groundwater pumping from highly contaminated regions. This has resulted in a 40 percent reduction in pumping from the San Fernando Basin. LADWP has embarked on an ambitions and comprehensive undertaking to address this groundwater contamination. It has begun with a $19 million Groundwater System Improvement Study (GSIS) that will provide vital information to assist with developing both short and long-term projects to maximize the restore the City's historical groundwater usage from the San Fernando Basin. This includes installing additional monitoring wells to help identify contaminants and the best technologies to treat them. The pace of implementation of treatment will be subject to necessary approvals and availability of funding. Already some wellfield treatment projects are underway in partnership with the U.S. Environmental Protection Agency, Metropolitan Water District of Southern California and others.

LADWP closely monitors water quality issues regarding source water challenges and proposed regulations at the local, state and federal levels. LADWP also proactively researches and invests in advanced and emerging technologies to ensure continued safety and reliability of the City's water supplies. A recent example of LADWP's regulatory diligence is addressing the Stage 2 Disinfectants and Disinfection Byproduct Rule with the conversion from chlorine to chloramine as the City's secondary disinfectant. Studies have shown that chlorine tends to increase levels of disinfection byproducts such as trihalomethanes (THMs) and haloacetic acids (HAAs). While still protective, chloramine is significantly less reactive and forms lesser levels of THMs and HAAs. LADWP is planning to complete the conversion from chlorine to chloramine by April 2014.

Similarly, LADWP is closely monitoring level of naturally occurring arsenic in the LAA supply. Although the levels of arsenic in the water served is on average 3.3 parts per billion (ppb) and is well below the current federal and state drinking water standard of 50 ppb. LADWP is committed to continuing research to develop strategies to further reduce the levels of arsenic in its water supply.

LADWP continuously strives to surpass the water quality standards and requirements and do so in an effective and affordable way for our customers. By managing state-of-the-art water treatment process, maintaining and operating treatment facilities, and vigilantly monitoring and testing the water we serve, LADWP has been meeting or exceeding all health-based drinking water standards. The drinking water standards are set by the U.S. Environmental Protection Agency and the California Department of Public Health.

## Global Climate Change

LADWP is considering impacts of climate change during development of its long-term water supply plan. Climate change is a global-scale concern, but is particularly important in the western United States where potential impacts on water resources can be significant to supplies for water agencies. Climate change can impact surface supplies from the LAA, imported supplies from MWD, and local demands. As a result, LADWP completed a study to analyze the operational and water supply impacts of potential shifts in the timing and quantity of runoff along the LAA system due to climate change in the 21st Century. Such potential shifts may require LADWP to develop, enhance, and modify management of local water resources. Projected changes in climate are expected to alter hydrologic patterns in the Eastern Sierra through changes in precipitation, snowmelt, relative ratios of rain and snow, and runoff.

To understand some of the key issues surrounding climate change impacts, it is important to put it into the context of LADWP's water supplies. California lies within multiple climate zones. Therefore, each region will experience unique impacts to climate change. Because LADWP relies on both local and imported water sources, it is necessary to consider the potential impacts climate change could have on the local watershed as well as the western and eastern Sierra Nevada watersheds where a portion of MWD's imported water originates and LADWP's imported LAA supplies originate, respectively, and the Colorado River Basin where the remainder of MWD's imported supplies originate. Generally speaking, any water supplies that are dependent on natural hydrology are vulnerable to climate change, especially if the water source originates from mountain snow pack. For LADWP, the most vulnerable water sources subject to climate change impacts are imported water supplies from MWD and the LAA. In addition to water supply impacts, changes in local temperature and precipitation are expected to alter water demand patterns.

The LAA is one of the major imported water sources delivering a reliable water supply to the City of Los Angeles. The LAA originates approximately 340 miles away from snowmelt runoff in the eastern Sierra Nevada; hence LAA is subject to hydrologic variability associated with climate change. Since the majority of precipitation occurs during winter in the eastern Sierra Nevada watershed, water is stored in natural reservoirs in the form of snowpacks, and is gradually released into streams that feed into the LAA during spring and summer. Higher concentrations of greenhouse gases in the atmosphere are often indications of pending climate change. These changes threaten the hydrologic stability of the eastern Sierra Nevada watershed through alterations in precipitation, snowmelt, relative ratios of rain and snow, winter storm patterns, and evapotranspiration, all of which have major potential impacts on the LAA water supply and deliveries.

LADWP's climate change study evaluated the potential impacts of climate change on the eastern Sierra Nevada watershed and the LAA water supply and deliveries. In this study, future climate conditions were predicted using a set of sixteen global climate models and two greenhouse gas emission scenarios. Results of the study show steady temperature increases throughout the 21st century and are consistent with other prior studies performed in the scientific community. Temperature is the main climate variable that is projected to rise significantly in the coming years and this rise in temperature directly affects several variables including:

- Whether precipitation falls as snow or rain.
- The ground-level temperature determines the timing and rate of snowmelt.
- The temperature profile that determines the rate of evapotranspiration.

Results have shown that future predictions for the early-21st century suggested a warming trend of 0.9 to 2.7 ˚F and almost no change in average precipitation. Mid-21st century projections suggested a warming trend of 3.6 to 5.4 ˚F and a small average decrease in precipitation, approximately 5 percent. This warming trend is expected to increase significantly by the end of 21st century, as the results suggest further warming of 4.5 to 8.1 ˚F and a decrease in precipitation of approximately 10 percent. Projected changes in temperature (warmer winters) will change precipitation patterns to rain with larger fractions than historically encountered. Consequently, peak Snow Water Equivalent (SWE) and runoff are projected to undergo a shift in timing to earlier dates.

***Exhibit ES-T***
***Projected Runoff, Snow-Water Equivalent, and Rain-to-Snow Ratio for Eastern Sierra Nevada Watershed***

| | Runoff (MAF) | April 1 SWE (Inches) | Rain/Snow Ratio |
|---|---|---|---|
| **Baseline (Second Half of 20th Century)** | **0.6** | **15.0** | **0.2** |
| **Early 21st-century (2010-2039)** | 0.5 - 0.85 | 10.6 - 19.0 | 0.24 - 0.33 |
| **Mid-century (2040-2069)** | 0.34 - 0.9 | 7.0 - 19.7 | 0.25 - 0.43 |
| **End-of-century (2070-2099)** | 0.35 – 1.1 | 5.0 - 16.0 | 0.28 - 0.54 |

Exhibit ES-T summarizes the projections for runoff, SWE, and rain-to-snow ratio for the 21st century. The projected temperature and precipitation dataset form the basis of the hydrologic model projections for runoff, snow-water equivalent (SWE), and rain-to-snow ratio. To compare the future projections of these variables, the trends that dominated the second half of the 20th century are considered baselines for future trends. The baseline values for runoff, SWE, and rain-to-snow ratio are 0.6 million acre-feet (MAF), 15 inches, and 0.2, respectively. By Early 21st century (2010 – 2039), results illustrate runoff is projected to undergo increases and decreases averaging between 0.5 to 0.85 MAF; SWE is projected to undergo decreases and increases ranging between 10.6 to 19.0 inches, and the rain-to-snow ratio is projected to increase between 0.24 to 0.33. By mid-century (2040 – 2069), the same trends are expected to dominate, with runoff ranging between 0.34 to 0.9 MAF, SWE ranging between 7.0 to 19.7 inches, and the rain-to-snow ratio increasing between 0.25 to 0.43. These trends are expected to govern until the end-of-century (2070 -2099) with runoff ranging between 0.35 to 1.1 MAF, SWE ranging between 5.0 to 16.0 inches, and rain-to-snow ratio increasing between 0.28 to 0.54.

It is important to acknowledge that the predictions of global climate models lack the desired precision due to the presence of uncertainties inherent in the analyses. The uncertainty to future emissions of greenhouse gases and the chaotic nature of the climate system leads to uncertain response of the global climate system to the increases in greenhouse gases. In addition, the science of climate change still lacks the complete understanding of regional manifestations that will result from global changes, thus restraining the projecting capacity of these models. However, these projections are consistent with the state of science today, and they help predict the manner of which hydrologic variables are likely to respond to a range of possible future climate conditions, and thus help to guide water managers in their planning and development efforts to ensure the reliability and sustainability of adequate water supply and delivery.

## ES-7 Financing

The UWMP also addresses financing issues associated with providing a reliable water supply. To fund future water conservation, recycled water, and stormwater programs, LADWP will utilize the following funding sources:

- Water Rates – An existing component of water rates currently provide approximately $100 million annually for water conservation, water recycling, and stormwater capture programs. It is anticipated that the water conservation, water recycling, and stormwater capture goals of the UWMP can be met with current levels of expenditures. State and/or federal funding will offset LADWP revenues, or allow goals to be achieved sooner than projected. In order to accomplish the UWMP goals related to treatment of contaminated groundwater supplies it will be necessary to increase current levels of expenditure, which will require an increase in water rates.

- MWD – Currently provides funding up to $250 per AF for water recycling through their Local Resources Program. MWD also provides some water conservation incentive funding through rebates equal to $195 per AF of water saved or half the product cost whichever is less.

- State Funds – Funds for recycling, conservation, and stormwater capture have been available on a competitive basis though voter approved initiatives, such as Propositions 50 and 84. The proposed 2012 Water Bond also includes potential funding for groundwater cleanup. Occasionally low or zero-interest loans are also available though State Revolving Fund programs.

- Federal Funds – Federal funding for recycling is available through the U.S. Army Corps of Engineers, via periodic Water Resource Development Act legislation, and the U.S. Bureau of Reclamation's Title XVI program.

To fund its future water quality programs, including groundwater cleanup, LADWP will seek reimbursement from potential responsible parties to assist with cleanup program costs. However, it is anticipated that water rates will need to be increased to pay for these much needed capital projects in order to ensure our groundwater supply is maximized.

## ES-8 Conclusion

LADWP's 2010 Urban Water Management Plan is not only designed to meet the current requirements of the UWMP Act, but also serves as the City's master plan for water supply and resource management. The UWMP provides the basic policy principles that guide LADWP's decision-making process to secure a sustainable water supply for Los Angeles in the next 25 years.

The 2010 UWMP projects a 15 percent lower water demand trend than what was projected in the 2005 UWMP. It lays out a detailed plan to develop a sustainable water supply portfolio that includes the increase of local water supplies and water conservation from the current 12 percent to 43 percent by 2035. This increased local supply mix will allow the City to reduce its reliance on the purchased MWD water supply by one-half. The focus on local supplies increases flexibility and overall water supply reliability.

# Chapter One
# Introduction


## 1.0 Overview

In 1902, the City of Los Angeles (City) had a population of approximately 146,000 residents and created a municipal water system by acquiring title to a private water company. In 1925, the Los Angeles Department of Water and Power (LADWP) was established by a new city charter. The availability of water has significantly contributed to the economic development of the City. LADWP met the City's need for water resources as Los Angeles developed into the nation's second largest city with over 4 million residents, encompassing a 473-square-mile area. As the largest municipal utility in the nation, LADWP delivers safe and reliable water and electricity services at an affordable price to the residents and businesses of Los Angeles.

With increasing demands for additional water supplies, LADWP and other water agencies in Southern California are faced with the challenge of providing a reliable water supply for a growing population.

LADWP plans to meet the City's water needs through the following actions:

- Significantly enhance water conservation, stormwater capture, and recycling projects to increase supply reliability.
- Implement treatment for San Fernando Basin groundwater supplies.
- Ensure continued reliability of the water supplies from the Metropolitan Water District of Southern California (MWD) through active representation of City interests on the MWD Board.
- Maintain the operational integrity of the Los Angeles Aqueduct and in-City water distribution systems.
- Meet or exceed all Federal and State standards for drinking water quality.

## 1.1 Purpose

The LADWP's 2010 Urban Water Management Plan (UWMP) serves two purposes: (1) compliance with the requirements of California's Urban Water Management Planning Act (Act), and (2) as a master plan for water supply and resources management consistent with the City's goals and policy objectives.

### 1.1.1 UWMP Requirements and Checklist

This 2010 UWMP complies with Sections 10610 and 10656 of the California Water Code, the Urban Water Management Planning Act (Act), and details how LADWP plans to meet all of the City's customer water needs. The Act became effective on January 1, 1984 and requires that every urban water supplier that provides municipal and industrial water to more than 3,000 customers (or supplies more than 3,000 acre-feet per year) prepare and adopt a UWMP every five years in accordance with prescribed requirements.

The Act was originally developed due to concerns about potential water supply shortages throughout California. Therefore, it required information that focused primarily on water supply reliability and water use efficiency measures. Since its original passage in 1983, there have been several amendments, the most recent adopted in 2009. Some of the recent amendments include: requirements to assess present and proposed future demands to achieve per capita water use reductions of 20 percent by 2020, project water use for low-income single family and multi-family residential housing, and add "indirect potable reuse" to the list of recycled water uses. A copy of the Act is provided in Appendix A. A checklist cross-referencing Act requirements to applicable pages in this UWMP is provided in Appendix B.

With the passage of Senate Bills (SB) 610 and 221 in 2001, UWMPs took on even more importance. SB 610 and 221 require counties and cities to consider the availability of adequate water supplies for certain new large developments and to have written verification of sufficient water supply to serve them. UWMPs are identified as key source documents for this verification. Based on these statutes the LADWP prepares individual Water Supply Assessments for these new large developments.

LADWP's 2010 UWMP not only meets the current requirements of the Act, but also serves as the City's master plan for water supply and resource management. The UWMP helps guide policy makers in the City and the Metropolitan Water District of Southern California (MWD) and provides information to the citizens of Los Angeles. The UWMP presents the basic policy principles that guide LADWP's decision-making process to secure a sustainable water supply for Los Angeles.

### 1.1.2 Water Supply Action Plan

LADWP has a long history of working to ensure that its customers have enough water. These efforts go back to the early 20th century with the building of the Los Angeles Aqueduct. Investments in water rights, aqueducts, reservoirs, conservation, and, more recently, recycled water and stormwater capture have allowed City residents to enjoy a reliable water supply. Sound planning and timely investments in water have played a critical role in meeting the water needs of the City despite the fact that Southern California is a semi-arid region.

In May of 2008, LADWP's Water Supply Action Plan (Plan), "Securing L.A.'s Water Supply", was released. It addressed a number of critical water supply reliability issues including: (1) the 2007 occurrence of the lowest snowpack on record in the

Eastern Sierras, which has historically provided Los Angeles with the greatest share of its water supply; (2) the 2007 occurrence of the driest year on record for the Los Angeles basin; (3) anticipated regional water allocations by MWD in response to dry year and regulatory reductions in imported water available from the San Francisco Bay Delta; (4) local groundwater contamination in the San Fernando Basin, restricting LADWP's ability to fully utilize this local resource; (5) Los Angeles Aqueduct delivery reductions due to environmental mitigation and enhancements in the Owens Valley and Mono Lake Basins, totaling nearly one-half of historic water supplies from the Eastern Sierra watershed; and (6) uncertain climate change impacts which threaten traditional water supply sources.

The convergence of these critical issues has far-reaching implications for the City of Los Angeles' water supply that require long-range planning to ensure a reliable supply of water to meet current and future demand. The Plan was a blueprint for creating sustainable water resources to serve the future needs of the City, and outlined responsible water management and long-term planning. By 2028, the Plan envisioned a six-fold increase in recycled water supplies to a total of 50,000 Acre-Feet per Year (AFY). Similarly, by 2030 an increase of 50,000 AFY was planned for conservation. As described in the Plan, this aggressive approach included investments in state-of-the-art technology; a combination of rebates and incentives; efficient clothes washers and urinals; and long-term measures such as expansion of water recycling and treatment of contaminated groundwater supplies. A multi-faceted approach to developing a locally sustainable water supply was developed incorporating the following key short-term and long-term strategies:

Short-Term Conservation Strategies

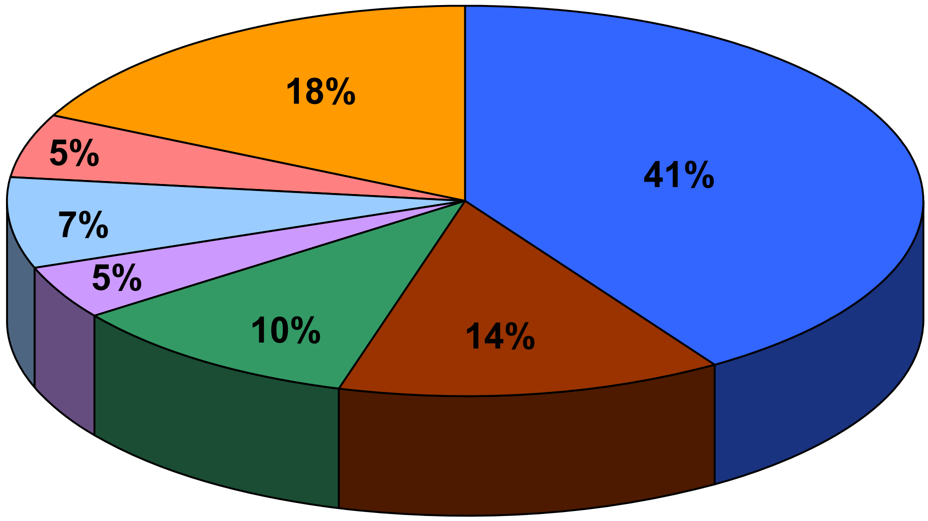
- Enforcing prohibited uses of water
- Expanding prohibited uses of water
- Extending outreach efforts
- Encouraging regional conservation measures

Long-Term Strategies

- Increasing water conservation through reduction of outdoor water use and new technology
- Maximizing water recycling
- Enhancing stormwater capture
- Accelerating groundwater basin treatment
- Expanding groundwater storage
- Green Building Initiatives (added subsequent to the release of the Plan)

The Water Supply Action Plan is an integral part of the UWMP, and is incorporated into the associated chapters. The UWMP outlines how the strategies contained in the Water Supply Action Plan will be implemented and how these strategies will increase the reliability of LADWP's water supplies through 2035.

*Exhibit 1A*
*City of Los Angeles Land Uses*




| Land Use Type | Acres |
|---|---|
| Single-family Residential[1] | 123,365 |
| Open Space/Parks | 41,317 |
| Multi-family Residential | 31,718 |
| Commercial | 13,632 |
| Manufacturing | 22,567 |
| Public Facilities | 16,314 |
| Other[2] | 53,731 |
| **Total** | 302,644 |

Source: Data aggregated from City of Los Angeles, Department of City Planning, November, 2009

Notes:

1. Includes agricultural use as defined by LA City Planning Department
2. Includes parking, hillside area, and other miscellaneous area

## 1.2 Service Area

In order to properly plan for water supply, it is important to understand the factors that influence water demands over time. These factors include land use, demographics, and climate.

### 1.2.1 Land Use

The City of Los Angeles is comprised of approximately 302,644 acres. Residential development constitutes over 51 percent of the total land use within the City. Within the residential land use category, single-family residential is the largest at approximately 123,000 acres or 41 percent of the total land use within the City. Multi-family residential is at approximately 32,000 acres or 10 percent of the total land use within the City. Open space/parks is the second largest land use within the City at approximately 14 percent. Commercial, public facilities and manufacturing land uses combined account for approximately 17 percent of the total. Public facilities include land uses such as libraries, public schools, and other government facilities. Exhibit 1A provides a breakdown of the land uses within the City of Los Angeles. The "Other" category includes specific plans, transportation, freeways, rights of way, hillsides, and other miscellaneous uses that are not zoned.

## 1.2.2 Demographics

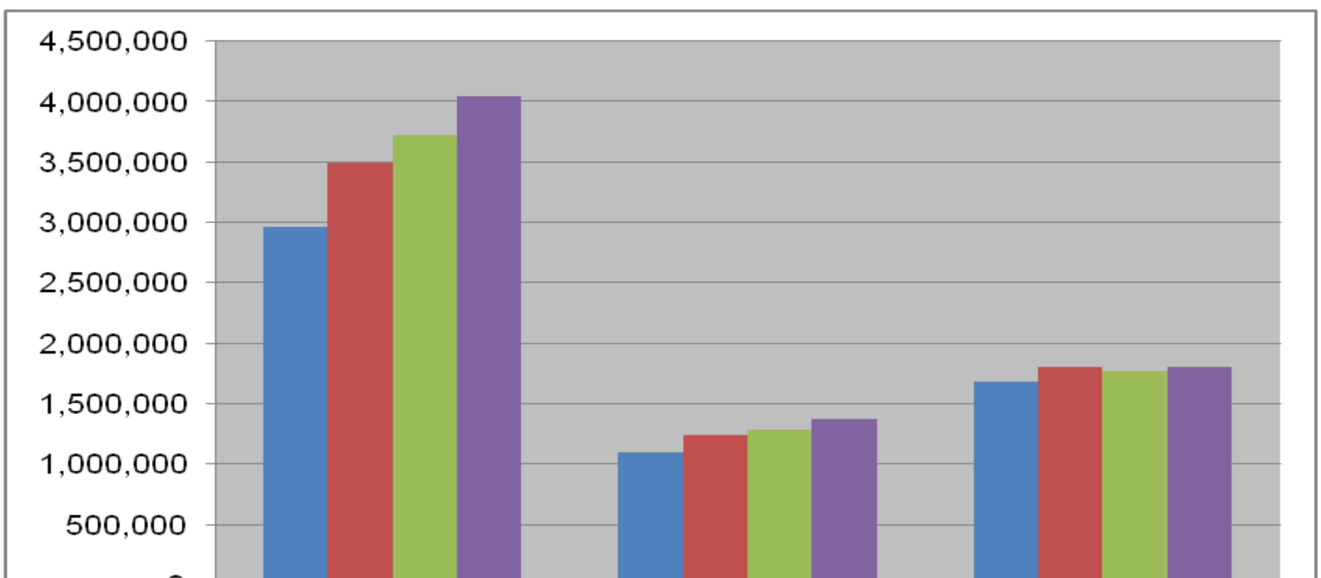
Over 4 million people reside in the LADWP service area, which is slightly larger than the legal boundary of the City of Los Angeles. In addition to the City, LADWP also provides water service to portions of West Hollywood, Culver City, Universal City, and small parts of the County of Los Angeles.

The population within LADWP's service area increased from 2.97 million in 1980 to 4.1 million in 2009, representing an average annual growth rate of 1.3 percent. The total number of housing units increased from 1.10 million in 1980 to 1.38 million in 2009, representing an average annual growth rate of 0.9 percent. During this time, average household size increased from 2.7 persons in 1980 to 2.9 persons in 2009. Employment grew by about 1.0 percent annually from 1980 to 1990, but declined from 1990 to 2000 as a result of an economic recession that started in 1991. Another decline began in 2008 reflecting the recent economic recession. Overall, employment increased by about 0.3 percent annually from 1990 to 2009. Exhibit 1B summarizes the historical demographics for the LADWP service area.

Demographic projections were obtained for the LADWP service area from the MWD. The MWD utilizes a land-use based planning tool that allocates projected demographic data from the Southern California Association of Governments (SCAG) into water service areas for each of MWD's member agencies. MWD's demographic projections use data reported in SCAG's 2008 Regional Transportation Plan (RTP). Exhibit 1C summarizes these demographic projections for the LADWP service area.

LADWP's service area population is expected to continue to grow over the next 25 years at a rate of 0.4 percent annually. While this is substantially less than the historical 1.3 percent annual growth rate from 1980 to 2009, it will still lead to approximately 367,300 new residents over the next 25 years. According to SCAG's 2008 RTP, housing is expected to grow faster than population over the next 25 years at 0.7 percent annual growth versus 0.4 percent annual growth for population,

**Exhibit 1B Historical Demographics for LADWP Service Area**




| | Population | Housing | Employment |
|---|---|---|---|
| 1980 | 2,970,000 | 1,100,000 | 1,692,000 |
| 1990 | 3,501,602 | 1,243,022 | 1,813,615 |
| 2000 | 3,732,579 | 1,290,440 | 1,773,895 |
| 2009 | 4,051,438 | 1,376,013 | 1,812,926 |

### *Exhibit 1C*
### *Demographic Projections for LADWP Service Area*

| Demographic | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|
| **Population** | 4,100,260 | 4,172,760 | 4,250,861 | 4,326,012 | 4,398,408 | 4,467,560 |
| **Housing** | | | | | | |
| Single-Family | 627,395 | 646,067 | 665,261 | 678,956 | 691,703 | 701,101 |
| Multi-Family | 764,402 | 804,013 | 846,257 | 880,580 | 914,125 | 942,846 |
| Total Housing | 1,391,797 | 1,450,080 | 1,511,518 | 1,559,536 | 1,605,828 | 1,643,947 |
| Persons per Household | 2.88 | 2.81 | 2.75 | 2.71 | 2.67 | 2.65 |
| **Employment** | | | | | | |
| Commercial | 1,674,032 | 1,724,106 | 1,754,998 | 1,790,798 | 1,828,765 | 1,865,156 |
| Industrial | 163,382 | 157,652 | 155,012 | 152,426 | 150,009 | 147,508 |
| Total Employment | 1,837,415 | 1,881,758 | 1,910,010 | 1,943,224 | 1,978,773 | 2,012,664 |

Source: SCAG Regional Transportation Plan (2008), modified using MWD's land use planning to represent LADWP's service area.

and it is anticipated that household size will continue to decline over the projection period.

The 2008 RTP projects that by 2035 the average household size will decrease to 2.65 persons per household. Throughout the projection period, multi-family housing units are expected to increase at slightly less than twice the rate of single-family housing units (0.93 percent annual growth vs. 0.47 percent annual growth).

Employment is expected to increase by 0.4 percent annually throughout the projection period. This growth is primarily driven by the current and long-term opportunities available from the economic base within the five-county metropolitan region of Southern California. The economic base is wide-ranging and includes services, wholesale and retail trade, manufacturing, government, financial service industries, transportation, utilities, construction, education, and tourism. Over the 25-year forecast period, industrial growth is expected to decline and experience a subtle annual negative growth of -0.4 percent, while commercial employment is expected to increase by about 0.5 percent annually.

The SCAG demographic projections for population, households, and employment included in their 2008 RTP and presented in LADWP's 2010 UWMP vary from what was presented in LADWP's 2005 UWMP. The demographic projections in the 2005 UWMP were based on SCAG's 2004 RTP. The current 2008 projections incorporate the latest population, households, and employment data from multiple local, state, and federal agencies. Projected 2008 RTP data reflect adjustments in future population growth related to declining fertility, mortality, labor force participation, and household headship rates; leveling in net migration; fluctuating net domestic migration in response to economic cycles; and an employment shift from the manufacturing

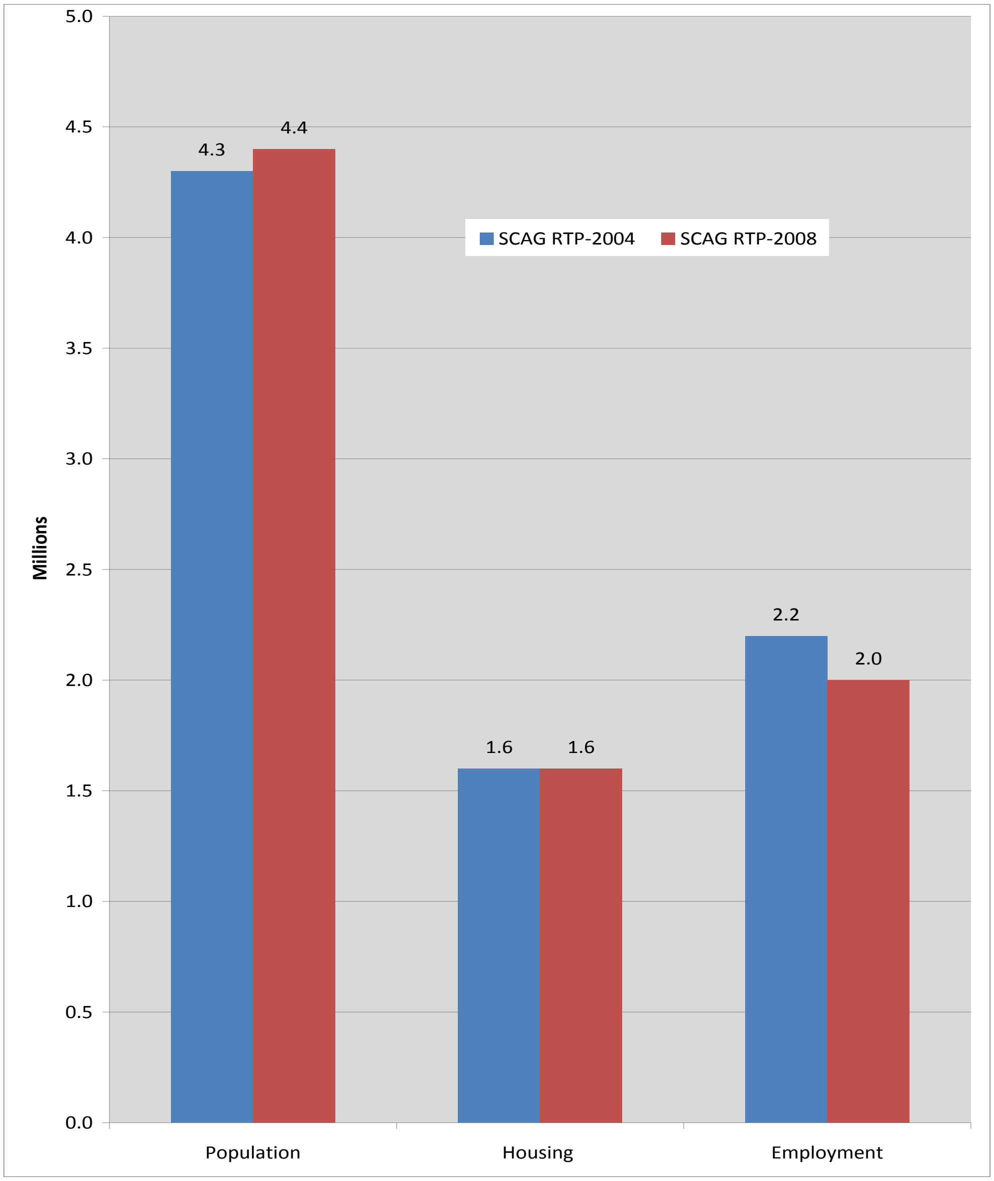



***Exhibit 1D Comparison of SCAG Demographic Projections for LADWP Service Area Between 2004 and 2008 RTP Forecasts for Year 2030***

sector to the service sector. The SCAG 2008 RTP was adopted in May 2008 prior to the recent recession beginning in 2008. Additionally, MWD has further adjusted the service area boundaries based on LADWP input. Exhibit 1D shows the differences between the SCAG demographic projections for the RTP in 2004 and 2008.

For the forecast year 2030, population was projected to be 4.30 million under the SCAG 2004 RTP and 4.40 million under the 2008 RTP, a difference of 100,000. Housing was projected to be 1.60 million in 2030 under SCAG 2004 RTP and slightly more under the SCAG 2008 RTP at 1.61 million.

Employment was forecast to be less in 2030 under the newest RTP. It is projected to be 2.20 million under the SCAG 2004 RTP versus 1.98 million with the 2008 RTP. It is important to recognize that projected total employment under both the 2004 RTP and 2008 RTP continue to increase from 2010 to 2035. The 2008 RTP simply projects a lower rate of increase compared to the 2004 RTP. Conversely, the rate at which the population increases is expected to be higher with the 2008 RTP as compared with the 2004 RTP.

## 1.2.3 Climate

Weather in Los Angeles is considered mild, which is a major attribute that attracts businesses, residents, and tourists to the City. Because of its relative dryness, Los Angeles' climate has been characterized as Mediterranean. Exhibit 1E provides a summary of average monthly rainfall, maximum temperatures, and evapotranspiration readings.

The City's average monthly maximum temperature is 75 degrees Fahrenheit based on the period of 1990-2010. This is based on data from the Los Angeles Downtown weather station. The standard annual average evapotranspiration rate (ETo) for the Los Angeles area is 50.26 inches per year. ETo measures the loss of water to the atmosphere by evaporation from soil and plant surfaces and transpiration from plants. ETo serves as an indicator of how much water plants need for healthy growth. Total precipitation averages 15.58 inches per year, with over 90 percent of this total amount typically falling during the period of November through April.

## 1.2.4 Water Demand and Supply Overview

LADWP maintains historical water use data separated into the following categories: single-family residential, multi-family residential, commercial, industrial, government, and non-revenue water. Single-family residential water use is the largest category of demand in LADWP's service area, representing about 36 percent of the total. Multifamily residential water use is the next largest category of demand, representing about 29 percent of the total. Industrial use is the smallest category, representing only 4 percent of the total demand. Non-revenue water is the difference between total water delivered to the city and total water sales and has averaged 7 percent in recent years. Chapter 2 – Water Demands provides an in-depth look at water demand trends and projections for the next 25 years.

Primary sources of water for the LADWP service area are the Los Angeles Aqueducts (LAA), local groundwater, and imported supplemental water purchased from MWD. An additional fourth source, recycled water, is becoming a larger part of the overall supply portfolio. Water from two of the supply sources, the LAA and MWD, is classified as imported because it

***Exhibit 1E***
***Average Climate Data for Los Angeles***

Average Climate Data for Los Angeles 1990-2010

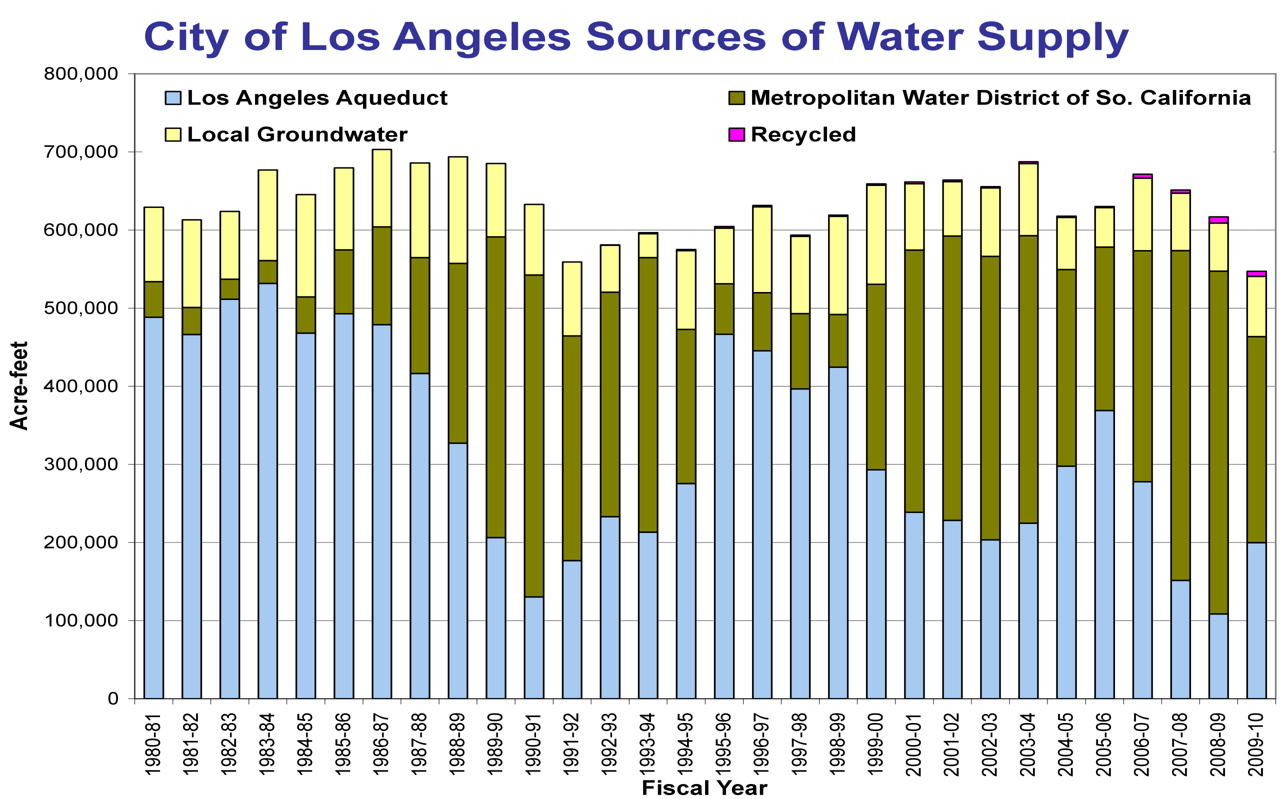
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Maximum Temperature (°F)[1] | 68 | 68 | 70 | 73 | 75 | 78 | 83 | 85 | 83 | 79 | 73 | 68 | 75 |
| Average Precipitation (inches)[1] | 3.62 | 4.46 | 2.28 | 0.75 | 0.34 | 0.12 | 0.01 | 0 | 0.07 | 0.68 | 0.72 | 2.53 | 15.58 |
| Average Eto (inches)[2,3] | 1.98 | 2.26 | 3.66 | 4.96 | 5.46 | 6.08 | 6.46 | 6.31 | 4.87 | 3.63 | 2.56 | 2.03 | 50.26 |

1. 1990-2010, Los Angeles Downtown USC Weather Station ID 5115
2. Average of Hollywood Hills (Station Id. 73), Glendale (Station Id. 133), and Long Beach (Station Id. 174)
3. www.cimis.water.ca.gov

is obtained from outside LADWP's service area. Groundwater is local and is obtained within the service area. Historical supply sources are increasingly under multiple constraints including potential impacts of climate change, groundwater contamination, and reallocation of water for environmental concerns. To mitigate these impacts on supply sources, LADWP is modifying its water supply portfolio through conservation, water recycling, and stormwater capture.

The primary water supply sources are vital to maintaining LADWP's water system reliability. Pressure on one resource, such as little snowfall in the eastern Sierra Nevada Mountains, will result in an increased reliance on another resource, such as MWD. Supplies available from each source are determined using computer models in an attempt to balance total projected supplies with projected demands. Exhibit 1F illustrates historical water supplies from 1980 to 2010. As a result of supply shortages, overall demands decreased by over 124,000 AFY in Fiscal Year (FY) 2009/10 as compared to FY 2006/07. In FY 2009/10, approximately 36 percent of the water supply was from the LAA, 14 percent from local groundwater, 48 percent from MWD, and 1 percent from recycled water. The five-year water supply averages (FY 2005/06 to FY 2009/10) were as follows: 36 percent from the LAA, 11 percent from local groundwater, 52 percent from MWD, and less than 1 percent from recycled water. The imported water (LAA water plus MWD water) supplied on average approximately 88 percent of the City's demands.

### *Exhibit 1F*
### *LADWP Historical Water Supply Sources 1980-2010*



Chapter Two
# Water Demand

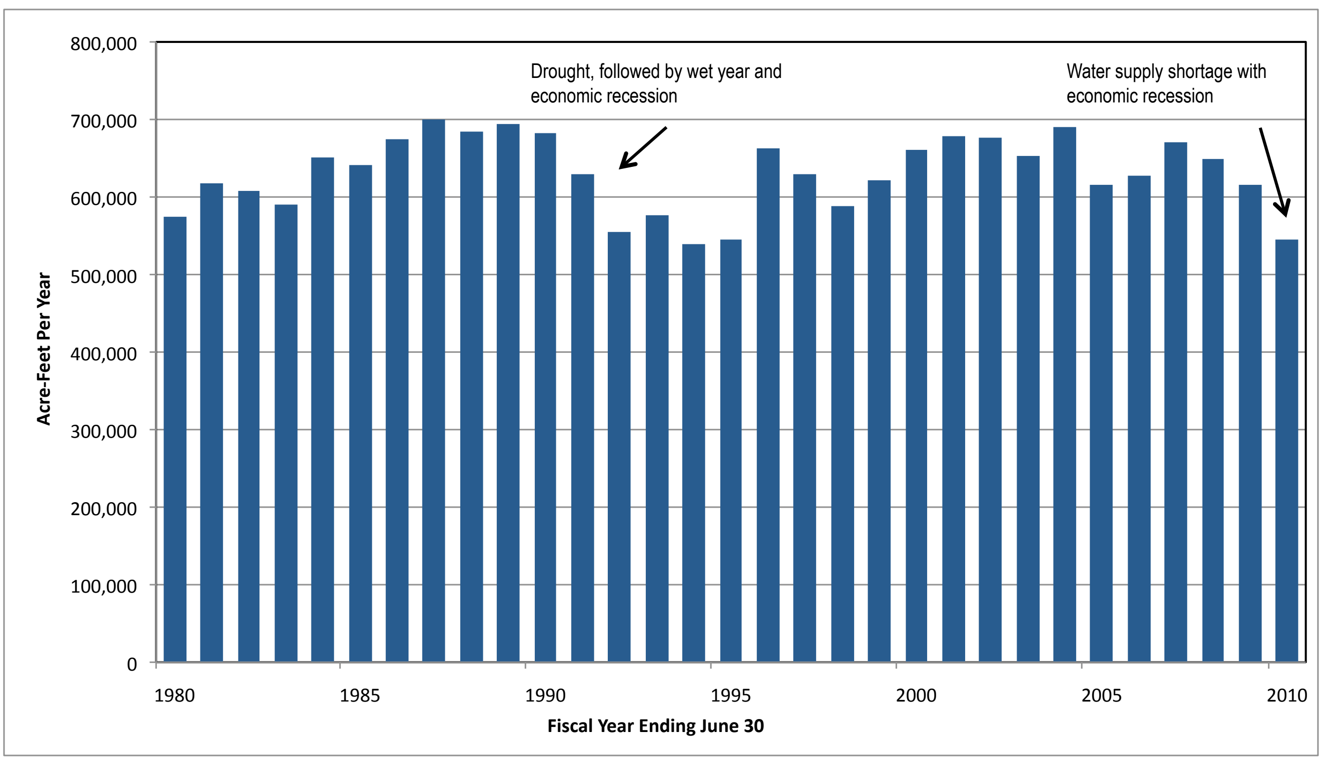
## 2.0 Overview

In order to properly plan for water supply, it is important to understand water demands and the factors that influence demands over time. LADWP maintains historical water use data separated into the following categories: single-family residential, multifamily residential, commercial, industrial, government, and non-revenue water. This categorization of demands allows better evaluation of trends in water use over time and more precise targeting of water conservation measures.

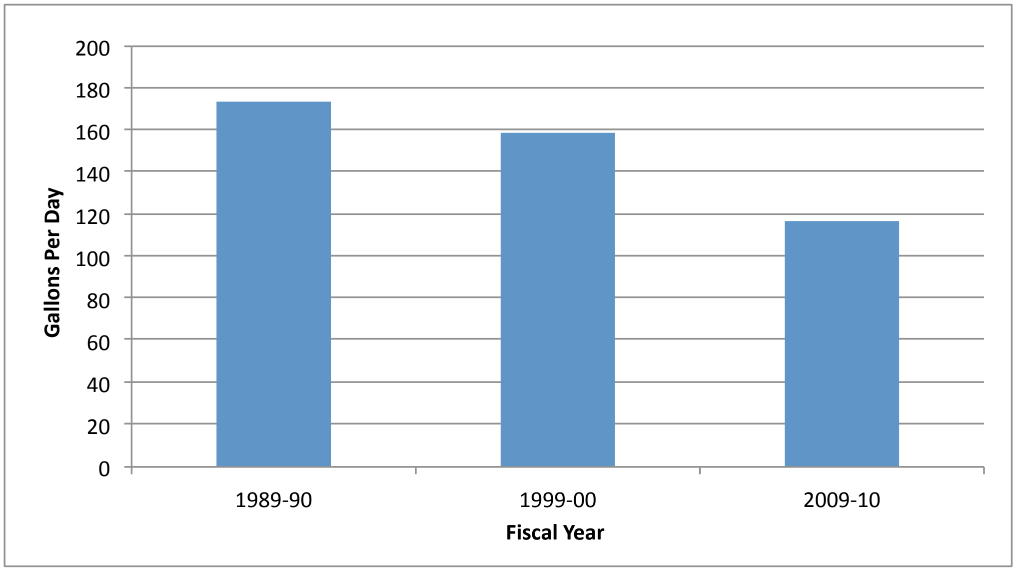
## 2.1 Historical Water Use

Exhibit 2A presents the historical water demand for LADWP. As seen in this exhibit, total water demand varies from year to year and is influenced by a number of factors such as population growth, weather, water conservation, drought, and economic activity. In 2009, a 3-year water supply shortage coinciding with an economic recession required LADWP to impose mandatory conservation. In 2010 mandatory conservation continued and the economic recession became more severe. This resulted in Fiscal Year (FY) 2009/10 water use decreasing by 19 percent from FY 2006/07 levels.

***Exhibit 2A***
***Historical Total Water Demand in LADWP's Service Area***



## *Exhibit 2B*
## *Historical Per Capita Water Use in LADWP's Service Area*




Prior to 1990, population growth in Los Angeles was a good indicator of total demands. From 1980 to 1990, population in the City grew at 1.7 percent annually. Water demands during this same ten year period also grew at 1.7 percent annually. However, after 1991, LADWP began implementing water conservation measures which prevented water demands from returning to pre-1990 levels. Average water demands in the last five years from FY 2005/06 to FY 2009/10 are about the same as they were in FY 1980/81 despite the fact that over 1.1 million additional people now live in Los Angeles. This is evidenced by examining per person (or per capita) water use since 1980 (see Exhibit 2B). In FY 1989/90, per capita water use was 173 gallons per day (gpd). By FY 1999/00, per capita water use fell to 159 gpd (or a 10 percent reduction from 1990). In FY 2009/10, per capita water use was estimated to be 117 gpd, but it is important to note that mandatory conservation and a severe economic recession were occurring at this time.

## Water Use by Sector

Exhibit 2C shows the breakdown in average total water use between LADWP's major billing categories and non-revenue water in five-year intervals for the past 25 years. Non-revenue water consists of unaccounted water and accounted non-revenue water. Accounted non-revenue water usually refers to mainline flushing at dead-end water mains to improve water quality and is less than 0.005 percent of the total demand. Unaccounted water is the system loss which includes water for fire fighting, reservoir evaporation, leakage from pipelines, meter error, and theft. Single-family residential water use comprises the largest category of demand in LADWP's service area, representing about 36 percent of the total. Multifamily residential water use is the next largest category of demand, representing about 29 percent of the total. Industrial use is the smallest category, representing only 4 percent of the total demand. Although total water use has varied substantially from year to year, the breakdown in percentage of total demand between the major billing categories has not.

Non-revenue water has significantly decreased in recent years. Historically, non-revenue water has averaged 7 percent of total water demand. Since 2005, non-revenue water levels have averaged 5 percent. This may be attributed to a number of steps that LADWP has taken to improve its water system. In 2001, LADWP began replacing its large and intermediate meters, focusing on improving accuracy of the meters as well as their strategic placement. In addition, work to replace smaller customer meters was finally completed in FY 2009/10 which also contributed to water loss control. In FY 2007/08, an accelerated mainline replacement program was launched to repair and replace deteriorating pipelines. Furthermore, LADWP's ongoing program to remove or cover large open-air reservoirs reduces water loss due to evaporation and infiltration

## Indoor and Outdoor Water Use

In order to assess the potential for water use efficiency and target conservation programs, it is important to characterize water use in terms of indoor and outdoor demands. As with most water utilities, LADWP does not have separate irrigation meters for most of its customers. Only a small fraction of LADWP's customers, mostly parks and golf courses, have designated irrigation meters. Therefore, measuring indoor vs. outdoor water demands involves the use of other data and assumptions.

There are two methods that LADWP uses to estimate total outdoor water use: (1) estimation of supplemental water needed for landscape irrigation in accordance with the California Model Water Efficient Landscape Ordinance; and (2) comparison of wastewater flows to total water consumption. The first method uses the following formula to estimate the water needed to supplement outdoor landscape irrigation beyond the effect of natural precipitation:

**LW = (Eto –Eppt) x 0.62 x A x ETAF**

Where:
LW = Estimated total supplemental water needed for landscape irrigation;
Eto = Reference evapotranspiration for the City of Los Angeles;
Eppt = Effective precipitation (25% of monthly precipitation);
0.62 = Conversion factor to gallons;
A = Total greenscape area; and
ETAF = Evapotranspiration (Et) adjustment factor

In 2007, an infrared analysis of the City was conducted as part of the City's Million Trees Program to determine tree canopy and landscape coverage. The infrared analysis methodology used two types of remotely sensed data, infrared imagery and aerial imagery to determine

### *Exhibit 2C*
### *Breakdown in Historical Water Demand for LADWP's Service Area*

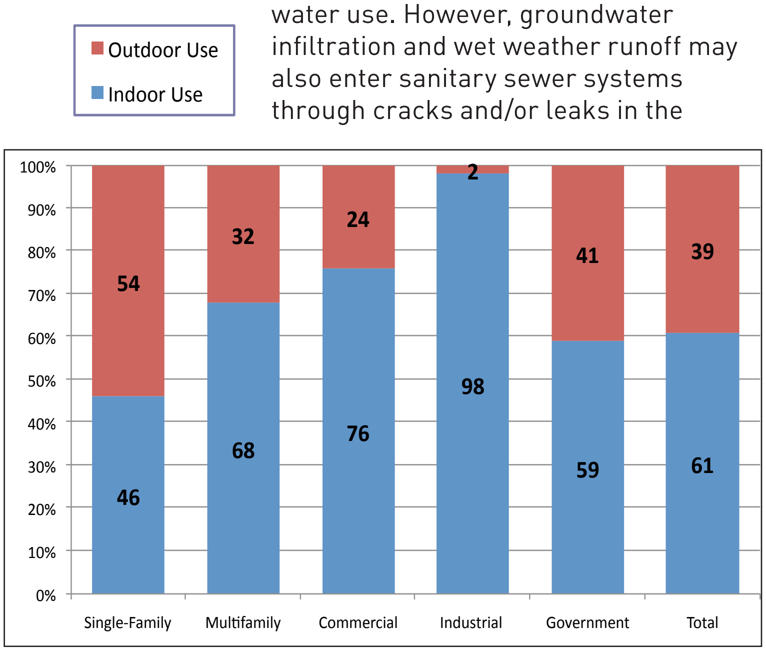
| Fiscal Year Ending | Single-Family | | Multifamily | | Commercial | | Industrial | | Government | | Non-Revenue | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AF | % | AF | % | AF | % | AF | % | AF | % | AF | % | AF |
| 1986-90 Avg | 238,248 | 35% | 197,312 | 29% | 123,324 | 18% | 30,502 | 4% | 43,378 | 6% | 52,830 | 8% | 685,594 |
| 1991-95 Avg | 197,322 | 35% | 177,104 | 31% | 110,724 | 19% | 21,313 | 4% | 38,600 | 7% | 24,100 | 4% | 569,164 |
| 1996-00 Avg | 222,748 | 35% | 191,819 | 30% | 111,051 | 18% | 23,560 | 4% | 39,830 | 6% | 43,617 | 7% | 632,626 |
| 2001-05 Avg | 239,754 | 36% | 190,646 | 29% | 109,685 | 17% | 21,931 | 3% | 41,888 | 6% | 58,299 | 9% | 662,203 |
| 2005-10 Avg | 236,154 | 38% | 180,279 | 29% | 106,955 | 17% | 23,201 | 4% | 42,940 | 7% | 31,929 | 5% | 621,458 |
| 25-yr Avg | 226,845 | 36% | 187,432 | 29% | 112,348 | 18% | 24,101 | 4% | 41,327 | 6% | 42,155 | 7% | 634,209 |

the total greenscape areas within the City. Results of this effort indicated that there is approximately 83,699 acres of greenscape in Los Angeles. The ETAF (or Et adjustment factor) of 0.8 for the City was derived from the types of plants to be irrigated and an assumed irrigation efficiency. It is consistent with the ETAF for non-rehabilitated landscapes as defined in the California Model Water Efficient Landscape Ordinance. The 2004-2007 average total water demand was selected as the basis for calculating outdoor water use percentage. This period was considered to be about average in terms of weather for Los Angeles and there were no irrigation restrictions in effect. Using the formula described previously, the supplemental water for outdoor landscaping in the City was estimated to be 249,000 AFY. During this same period, total water demand averaged 647,000 AFY. Therefore, it is estimated that the City's total outdoor water use represents approximately 39 percent of the total demand.

Comparing wastewater flows to total water consumption is another useful method to assess overall outdoor water use. Since wastewater flow represents indoor water use that flows into the sanitary sewer system, the difference between total water consumption and wastewater flows represents outdoor water use. However, groundwater infiltration and wet weather runoff may also enter sanitary sewer systems through cracks and/or leaks in the sanitary sewer pipes or manholes and results in overestimation of indoor water use. To minimize overestimation, only data from summer months were used to estimate average monthly wastewater attributable to indoor water use. In Los Angeles, the summer months typically have little or no measurable rainfall. Using the same pre-water restriction period of 2004-2007 selected in the first method, the average monthly wastewater flow (only the months of June through September) yields approximately 365 million gallons per day (MGD) or 403,000 AFY of estimated indoor water use. Subtracting this estimated indoor water use from the total water consumption of 647,000 AFY results in an estimated total outdoor demand of 244,000 AFY or 38 percent, which is similar to the 39 percent obtained with the landscape irrigation method. Therefore, two entirely different methods produced very similar results in estimating the total outdoor water use for the City.

To obtain an estimate of indoor vs. outdoor water use for each major billing category, a minimum-month method was used. Monthly water use for single-family, multifamily, commercial, industrial, and government was obtained for 2004-2007. The water use in the minimum month, usually one of the cool/wet winter months, is assumed to be mostly indoor use. The difference between any month and the minimum month is all attributed to outdoor water use. However, based on the two prior methods, a certain amount of outdoor water use occurs even in the minimum month. Therefore, estimates of the outdoor water use that occurs in the minimum month were developed for each major billing category. Then the outdoor use of each major billing category was summed up to compare with the total outdoor water use obtained from the previous two methods. Exhibit 2D presents the estimated indoor and outdoor water use for the City using all three methods.

**Exhibit 2D Indoor vs. Outdoor Water Use in LADWP's Service Area**



## 2.2 Quantification of Historical Water Conservation

LADWP has invested hundreds of millions of dollars in water conservation since 1990. These conservation investments include various active programs such as high efficiency toilet rebates, commercial/industrial water audits, education and public outreach, and much more. During periods of water shortage, public education and outreach are especially important and has contributed to significant reductions in water use. In an effort to quantify its water conservation efforts, LADWP developed a statistical Conservation Model that correlates total monthly water use in the City with population, weather, the presence of mandatory water conservation, and economic recessions. The model can be used to predict what the water demand would be under actual weather conditions, population growth and economy, but without active or drought water conservation in place. This modeled water consumption without conservation is then compared to actual water consumption—with the difference being attributed to water conservation. In order to assess the model's accuracy, the model was used to "back cast" the period from 1980 to 1990 when conservation was not implemented. In this case, the modeled water consumption was very close to the actual water consumption. After 1990, it was expected that the modeled water consumption will be greater than actual water consumption as LADWP has implemented increasing levels of water conservation measures. Exhibit 2E presents modeled and actual monthly water consumption from 1980 to 2009. As seen, the Conservation Model is performing as expected. The modeled water consumption (red line) is nearly identical to the actual water consumption (blue line) up until 1990. After 1990, the modeled water consumption is greater than actual water consumption.

Exhibit 2F summarizes the annual estimated water conservation using the Conservation Model. During periods of

### *Exhibit 2E*
### *Modeled vs. Actual Monthly Water Consumption for LADWP*

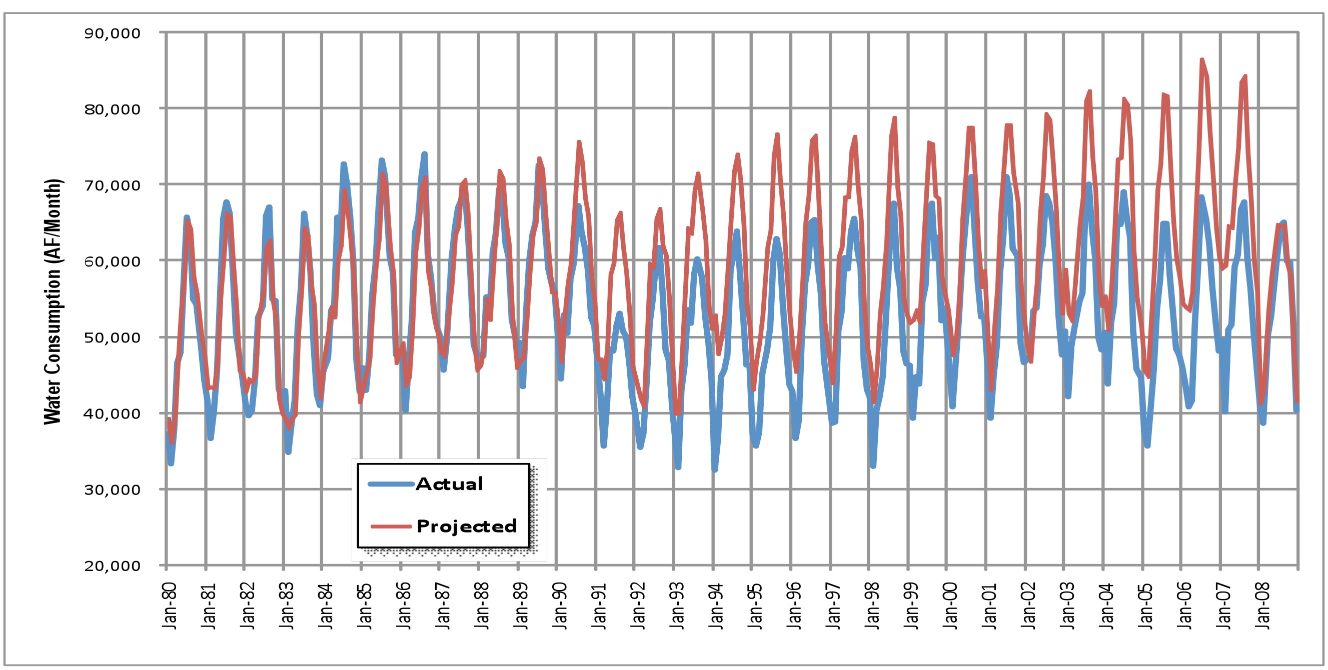
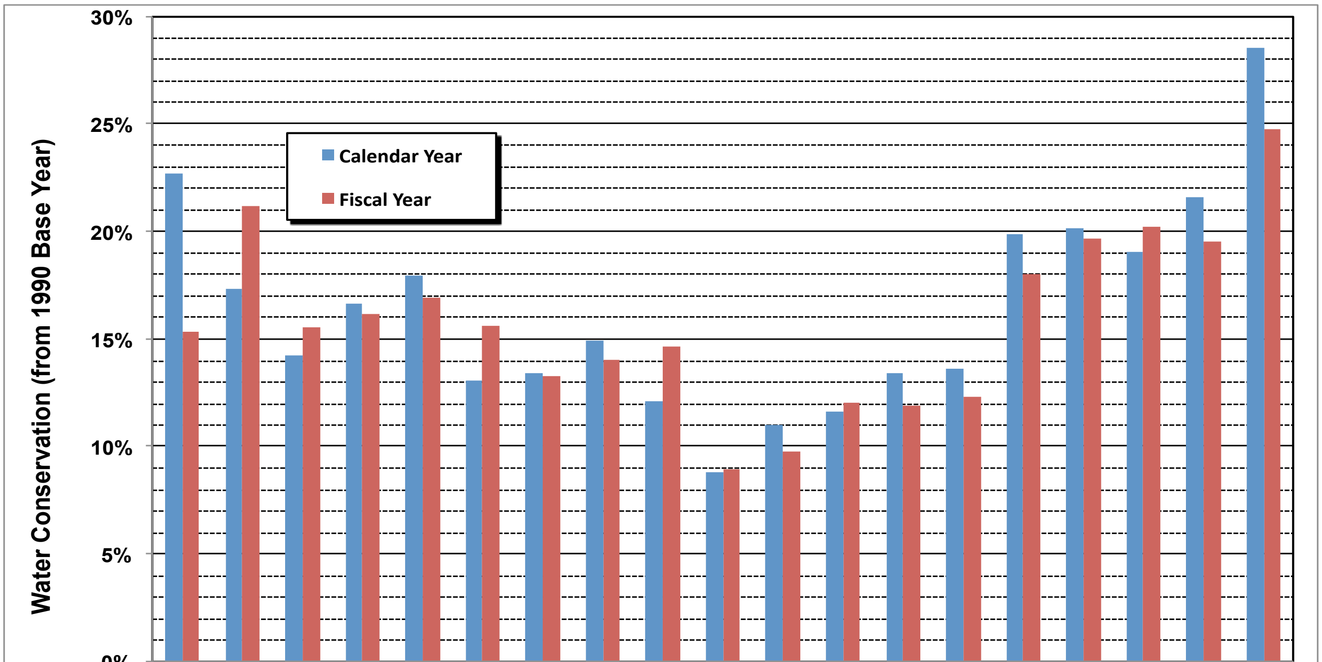


*Exhibit 2F*
*Estimates of Total Water Conservation in LADWP's Service Area*




| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calendar Year | 23% | 17% | 14% | 17% | 18% | 13% | 13% | 15% | 12% | 9% | 11% | 12% | 13% | 14% | 20% | 20% | 19% | 22% | 29% |
| Fiscal Year | 15% | 21% | 16% | 16% | 17% | 16% | 13% | 14% | 15% | 9% | 10% | 12% | 12% | 12% | 18% | 20% | 20% | 20% | 25% |

water shortage, even when mandatory water conservation is not in place, there is more conservation occurring due to extensive public education and outreach. Water conservation in 2009 represents the highest levels of conservation so far, which reflects a combination of active conservation programs, heightened public education and outreach, and mandatory conservation measures.

## 2.3 Water Demand Forecast

### Demand Forecast Methodology

LADWP has developed a water demand forecast for each of its major categories of demand. This allows the City to better understand trends in water use and target conservation programs. The methodology used for the demand forecast is called a modified unit use approach. The following steps are used in this approach:

Step 1: Estimate baseline per unit water use – take each billed category of water demand (e.g., single-family, industrial, etc.) for a base (or starting) period and divide by associated demographic driver (e.g., number of single-family homes or number of industrial employees). This yields for instance, a baseline of 359 gallons used each day in a single-family residence.

Step 2: Modify the estimated baseline per unit water use to account for future changes in the following socioeconomic variables: price of water, personal income, family size, economy, drought conservation effect, and passive water conservation (which accounts for efficiencies in water use from state and local plumbing codes and ordinances).

Step 3: Multiply modified per unit water use for each category in Step 2 by the associated projected

## Exhibit 2G
## Projected Demographic Drivers
### (Based on MWD allocated 2008 SCAG forecast data with corrected service area boundary, 5-17-2010)

| Fiscal Year Ending | Single-Family (# Homes) | Multi-Family (# Homes) | Commercial/ Government (# Employees) | Industrial (# Employees) | Landscaping (# of MF Homes) | Non-Revenue Water* (%) |
|---|---|---|---|---|---|---|
| 2010 | 627,395 | 764,402 | 1,674,032 | 163,382 | 764,402 | 6.9% |
| 2015 | 646,067 | 804,013 | 1,724,106 | 157,652 | 804,013 | 6.9% |
| 2020 | 665,261 | 846,257 | 1,754,998 | 155,012 | 846,257 | 6.9% |
| 2025 | 678,956 | 880,580 | 1,790,798 | 152,426 | 880,580 | 6.9% |
| 2030 | 691,703 | 914,125 | 1,828,765 | 150,009 | 914,125 | 6.9% |
| 2035 | 701,101 | 942,846 | 1,865,156 | 147,508 | 942,846 | 6.9% |

* Calculated from difference between historical production and billing data

demographic drivers (see Exhibit 2G) in order to obtain projected water demands by billed category that does not include active water conservation (which is defined as conservation achieved through LADWP incentives such as rebates and programs).

Step 4: Estimate non-revenue water (the difference between total water consumption and billed water use) by applying a non-revenue water use factor, and add non-revenue water to the billed category water demands in Step 3 in order to get a forecast of total water consumption without active water conservation.

Step 5: Subtract future projections of active water conservation from the total water consumption in Step 4 in order to determine the water demand forecast that is fully inclusive of both passive and active water conservation.

## Applying the Methodology

In Step 1 of this method, historical water demands for single-family, multifamily, commercial/government, and industrial were averaged from 2005 to 2008 to determine the baseline. This period was used because on average, it represented normal weather conditions, and it was before mandatory outdoor water use restrictions were in effect. For each of these categories, the water demand was divided by a demographic driver that could be projected into the future. The result of this calculation is a water demand expressed as a unit water use rate. Exhibit 2H presents this unit use calculation for the baseline.

Step 2 in the methodology involves modifying these baseline unit use rates to account for changes in the following socioeconomic variables: price of water, personal income, family size, economy, drought conservation effect, and passive water conservation. MWD has developed an Econometric Water Demand Model as part of its 2010 Integrated Water Resources Plan that is able to account for the impact that personal income, family

## Exhibit 2H
## Baseline Unit Water Use Rates (2005-2008)
### Source: California Department of Finance and Employment Development Department

| Demand Category | Average Water Demand (AFY) | Average Demographic Driver * | Average Unit Use Rate (gallons/day/driver) |
|---|---|---|---|
| Single-Family | 244,407 | 607,301 (homes) | 359 |
| Multifamily | 184,428 | 734,461 (homes) | 224 |
| Commercial/Gov | 153,199 | 1,631,896 (employees) | 84 |
| Industrial | 23,613 | 160,328 (employees) | 132 |

size, and price of water have on water demands. For each of these factors, a statistical coefficient or elasticity was estimated from MWD's Econometric Water Demand. The elasticity is generally interpreted as a percent change in water use resulting from a percent change in a specific socioeconomic variable. For example, a price elasticity of -0.131 would imply that a 10 percent increase in the real price of water would result in a 1.24 percent decrease in water demand (e.g. $1.24\% = 1-(1+10\%)^{-0.131}$). The following elasticities used in MWD's Econometric Water Demand Model were also used for LADWP's water demand forecast:

| | Price of Water | Income | Family Size |
|---|---|---|---|
| Single-Family | -0.131 | +0.270 | +0.550 |
| Multifamily | -0.109 | +0.310 | +0.450 |
| Commercial/ Government | -0.107 | | |
| Industrial | -0.107 | | |

Source: MWD 2010 Integrated Water Resources Plan Update Appendix A.2 Demand Projections

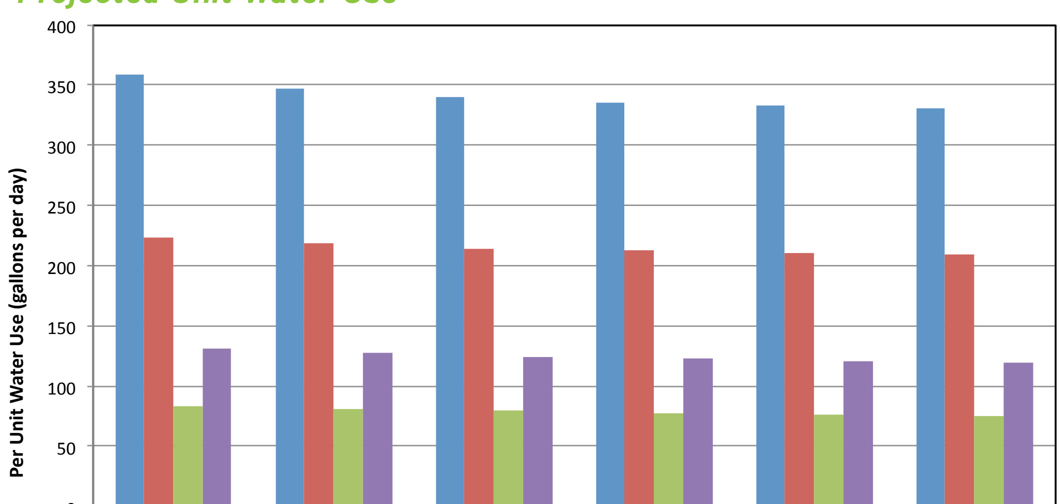
The price elasticities reflect a reduction of approximately 1/3 from those tabulated in MWD's 2010 IRP. However, MWD's 2010 IRP Appendix A.1 states that consumers respond to price increase by installing water-conserving fixtures and appliances. As more water efficient fixtures are installed, the impact of changing water-using behavior through rates is reduced. This is known as "demand hardening". Reducing price elasticity is done to avoid double-counting conservation savings and to account for demand hardening.

Exhibit 2I presents the modified per unit water use over time that incorporates future real increases in the price of water, personal income, and projected changes in family size. Also incorporated are the residual drought conservation effect from the significant public education and mandatory water use restrictions that occurred during the drought period of 2009 through 2010, and the effect of passive conservation due to mandated efficiencies from plumbing codes and ordinances.

## Water Demand Forecast Results

Steps 3, 4, and 5 involve applying the modified per unit water use factors shown in Exhibit 2J to the projected demographics for LADWP (see Chapter 1), then adding non-revenue water, and subtracting projected active water conservation (that is summarized in Chapter 3). The result of these steps is the water demand forecast for each of the major categories of demand.

### *Exhibit 2I*
### *Projected Unit Water Use*




| | Baseline | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|
| Single-Family (per home) | 359 | 348 | 340 | 336 | 333 | 331 |
| Multifamily (per home) | 224 | 219 | 215 | 213 | 211 | 210 |
| Commercial (per employee) | 84 | 81 | 80 | 78 | 77 | 76 |
| Industrial (per employee) | 132 | 128 | 125 | 123 | 121 | 120 |

## *Exhibit 2J*
## *Water Demand Forecast and Conservation Savings Under Average Weather Fiscal Year Ending June 30 (Acre-Feet)*

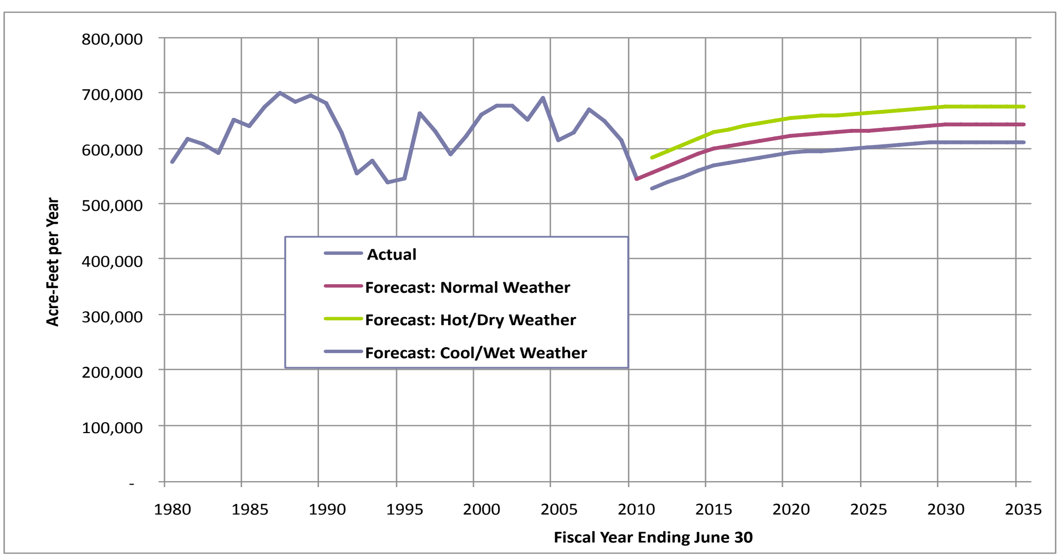
| Demand Forecast with Passive Water Conservation | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|---|
| Single-Family | | 198,444 | 229,115 | 241,976 | 249,528 | 257,693 | 259,904 |
| Multifamily | | 167,299 | 179,653 | 194,724 | 205,136 | 216,054 | 221,912 |
| Commercial/Gov | | 135,000 | 143,081 | 149,597 | 153,791 | 158,628 | 160,049 |
| Industrial | | 20,298 | 20,524 | 20,726 | 20,532 | 20,408 | 19,852 |
| Non-Revenue | | 33,515 | 42,421 | 44,989 | 46,617 | 48,380 | 49,042 |
| Total | | 554,556 | 614,794 | 652,012 | 675,604 | 701,164 | 710,760 |
| **Demand Forecast with Passive & Active Water Conservation** | **2005 Actual** | **2010 Actual** | **2015** | **2020** | **2025** | **2030** | **2035** |
| Single-Family | 233,192 | 196,500 | 225,699 | 236,094 | 241,180 | 246,879 | 247,655 |
| Multifamily | 185,536 | 166,810 | 178,782 | 193,220 | 202,999 | 213,284 | 218,762 |
| Commercial/Gov | 107,414 | 130,386 | 135,112 | 133,597 | 129,761 | 126,567 | 120,420 |
| Industrial | 62,418 | 19,166 | 18,600 | 16,852 | 14,708 | 12,634 | 10,513 |
| Non-Revenue | 26,786 | 32,909 | 41,370 | 42,969 | 43,627 | 44,421 | 44,272 |
| Total | 615,346 | 545,771 | 599,563 | 622,732 | 632,275 | 643,785 | 641,622 |
| **Aggregate Active Water Conservation Savings From Jul 07** | **2005** | **2010** | **2015** | **2020** | **2025** | **2030** | **2035** |
| Single-Family | | 1,944 | 3,416 | 5,882 | 8,349 | 10,815 | 12,249 |
| Multifamily | | 489 | 871 | 1,504 | 2,137 | 2,770 | 3,150 |
| Commercial/Gov | | 4,614 | 7,969 | 16,000 | 24,030 | 32,061 | 39,629 |
| Industrial | | 1,132 | 1,924 | 3,874 | 5,824 | 7,774 | 9,339 |
| Non-Revenue | | 606 | 1,051 | 2,020 | 2,990 | 3,959 | 4,771 |
| Total | | **8,785** | **15,231** | **29,280** | **43,329** | **57,379** | **69,138** |

* Non-revenue is the combination of unaccounted water and accounted non-revenue water. Unaccounted water is defined as system losses. In recent years, the City experienced no accounted non-revenue water. Thus, non-revenue water is considered system loss.

## Water Demand Forecast with Average Weather Variability

Using the weather coefficients from the statistical water conservation model (see Exhibit 2E), annual weather adjustment factors can be derived to determine the range in forecasted water demands due to historical weather variability. This is accomplished by projecting water demands assuming long-term normal weather, and then comparing this normal-weather demand to actual demands. After adjusting for economy and drought conditions, projected water demands can vary by approximately ± 5 percent in any given year due to average historical weather variability. This means that water demands under cool/wet weather conditions could be as much as 5 percent lower than normal demands on average; while water demands under hot/dry

## *Exhibit 2K*
## *Water Demand Forecast with Average Weather Variability*



### *Exhibit 2L*
### *Water Demand Forecast for Low-Income Residential Customers*
### *Fiscal Year Ending June 30*

| **Low-Income Single-Family Customers** | **2015** | **2020** | **2025** | **2030** | **2035** |
|---|---|---|---|---|---|
| Number of Homes | 42,640 | 43,907 | 44,811 | 45,652 | 46,273 |
| Household Water Use (Gallons/Day)* | 250 | 253 | 254 | 255 | 252 |
| Demand Forecast (Acre-Feet/Year) | 11,917 | 12,466 | 12,734 | 13,035 | 13,076 |
| **Low-Income Multifamily Customers** | **2015** | **2020** | **2025** | **2030** | **2035** |
| Number of Homes | 131,054 | 137,940 | 143,535 | 149,002 | 153,684 |
| Household Water Use (Gallons/Day)* | 159 | 163 | 165 | 167 | 166 |
| Demand Forecast (Acre-Feet/Year) | 23,313 | 25,196 | 26,471 | 27,812 | 28,527 |
| **Total Low-Income Residential Customers** | **2015** | **2020** | **2025** | **2030** | **2035** |
| Demand Forecast (Acre-Feet/Year) | 35,230 | 37,662 | 39,205 | 40,847 | 41,603 |

* Assumes same percent conservation as system for single-family and multifamily homes.

weather conditions could be as much as 5 percent higher than normal demands on average. Exhibit 2K presents LADWP's historical and forecasted total water demands with both passive and active conservation, under the full range of historical weather variability.

## Low-Income Water Demand Projections

The requirements for the 2010 UWMP call for projections of water demands for low-income customers. For rate relief purposes, LADWP maintains records of low-income water customers. For the FY 2009/10, approximately 6.6 percent of the total number of single-family homes in the City was classified as low-income. On average, these customers used about 20 percent less water per household than overall single-family customers. To forecast low-income single-family water demand, the 6.6 percent ratio of low-income to total single-family homes was applied to determine the total number of low-income single family homes. The system wide per unit water use for single-family homes was reduced by 20 percent and multiplied by the total number of low-income single-family homes to determine low-income single-family water demand.

Because the water services of multifamily residential customers are typically not individually metered, a multifamily water account can represent upwards of 100 homes. Therefore, a different approach was used. LADWP's power system does individually meter multifamily homes and also classifies homes as low-income for rate relief purposes. Therefore, the ratio of current low-income to total multifamily homes in the City was applied to the total projection of multifamily homes in order to project the total number of low-income multifamily homes. For the FY 2009 /10, approximately 16.3 percent of the total number of multifamily homes in the City were classified as low-income. Assuming that low-income multifamily homes also use 20 percent less water than overall multifamily homes, an adjusted per unit water use for multifamily homes was multiplied by the projected number of low-income multifamily homes to determine low-income multifamily water demand. Exhibit 2L presents the water demand forecast for low-income residential water customers.

# Chapter Three
# Water Conservation

## 3.0 Overview

Multiple factors are increasingly restricting LADWP's traditional water supply sources. The City of Los Angeles has long recognized water conservation as the core of multiple strategies to improve overall water supply reliability. In May of 2008, LADWP's Water Supply Action Plan, "Securing L.A.'s Water Supply", was released in response to factors impacting LADWP's major water supply sources beginning in 2007. The Water Supply Action Plan calls for reducing potable water demands by an additional 50,000 AFY by 2030 through conservation, incorporating multiple conservation strategies to increase the sustainability of LADWP's water supply. Additional conservation efforts will increase this total to 64,368 AFY by 2035.

Los Angeles has historically taken a leadership role in managing its demand for water. Los Angeles consistently ranks among the lowest in per person water consumption when compared to California's largest cities. This significant accomplishment has resulted from the City's sustained implementation of effective water conservation programs since the 1980s.

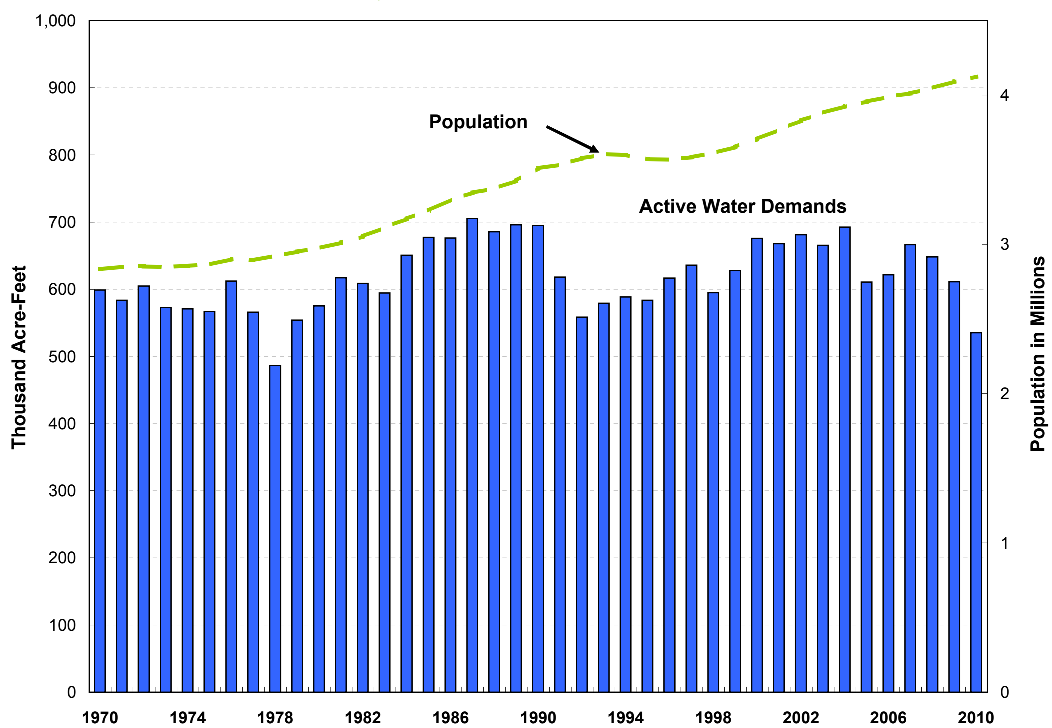
One of LADWP's most effective conservation tools is the sustained conservation ethic of its customers. During past droughts and water shortages, residents and businesses have aggressively implemented additional conservation to achieve demand reductions. During FY 09/10, water use was below 1979 water use levels thanks to extraordinary conservation efforts by LADWP customers. Specifically, water use in FY 09/10 was almost 20 percent lower than water use in FY 06/07 with single-family residential water use 25 percent lower, multi-family water use 11 percent lower, commercial water use 16 percent lower, industrial water use 15 percent lower, and governmental water use 33 percent lower.

LADWP has continually invested in water conservation programs and measures targeting cost-effective reductions in water use. Looking forward, LADWP plans to continue to make investments in conservation programs and expand its focus on landscape water use efficiency and conservation opportunities in the commercial/industrial/institutional (CII) customer sectors. LADWP's conservation planning process includes working with other City departments to ensure that mutual needs are addressed and goals are achieved (e.g., landscape water use efficiency and dry weather runoff reduction).

The civic cultural ethic of water conservation in Los Angeles began with the installation of water meters on all services in the early 1900's. At that time, this foundational conservation measure resulted in a 30 percent reduction in water use. During the recurrence of periodic water shortages, LADWP customers have demonstrated concern and responsiveness to the need for additional conservation. When faced with significant supply shortages, City residents have responded with unprecedented reductions in their water use. Los Angeles was one of the first cities in southern California to invoke mandatory water rationing during the 1976 through 1977 drought. While severe, this two-year dry period resulted in only a temporary reduction in water use, as a subsequent series of wet years erased memories of the water shortage experienced during the brief dry period. However, it was the multiple dry years that followed the 1978 through 1986 wet cycle that would prove to be the turning point in Los Angeles' water use efficiency.

The dry years of 1987-1992 left a permanent imprint on Los Angeles water customers. In response to this water shortage, LADWP expanded its voluntary water conservation program. Prompted by an extensive public awareness program and education campaign, LADWP customers responded not only with water saving practices but also by installing conservation measures in their homes and businesses. Devices such as low-flow showerheads and ultra-low-flush (ULF) toilets replaced existing high water use devices. These hardware changes, coupled with more efficient use habits, have significantly reduced the amount of imported water that the City would need to buy as its population and commerce

***Exhibit 3A***
***Historical City of Los Angeles Water Use***



## *Exhibit 3B*
## *Historical City of Los Angeles Conservation*

| Fiscal Year | Additional Annual Hardware Installed Savings (AF) | Cumulative Annual Hardware Savings (AF) | Annual Non-Hardware Savings (AF)[1] | Annual Total Savings (AF) |
|---|---|---|---|---|
| Prior to 1990/1991 | 31,825 | 31,825 | | |
| 1990/1991 | 4,091 | 35,916 | 76,350 | 112,267 |
| 1991/1992 | 8,670 | 44,586 | 105,593 | 150,179 |
| 1992/1993 | 3,286 | 47,872 | 58,546 | 106,417 |
| 1993/1994 | 4,961 | 52,832 | 60,928 | 113,761 |
| 1994/1995 | 4,041 | 56,873 | 62,084 | 118,958 |
| 1995/1996 | 4,642 | 61,516 | 52,648 | 114,164 |
| 1996/1997 | 2,376 | 63,892 | 33,720 | 97,612 |
| 1997/1998 | 2,637 | 66,529 | 30,434 | 96,964 |
| 1998/1999 | 2,781 | 69,310 | 38,305 | 107,614 |
| 1999/2000 | 3,532 | 72,842 | -6,262 | 66,580 |
| 2000/2001 | 3,078 | 75,920 | -3,407 | 72,513 |
| 2001/2002 | 2,452 | 78,371 | 15,131 | 93,502 |
| 2002/2003 | 2,630 | 81,002 | 8,725 | 89,726 |
| 2003/2004 | 3,257 | 84,259 | 13,107 | 97,366 |
| 2004/2005 | 3,299 | 87,558 | 46,865 | 134,423 |
| 2005/2006 | 2,404 | 89,963 | 62,223 | 152,186 |
| 2006/2007 | 2,095 | 92,058 | 76,643 | 168,701 |
| 2007/2008 | 782 | 92,840 | 64,472 | 157,312 |
| 2008/2009 | 3,127 | 95,967 | 106,151 | 202,118 |
| 2009/2010 | 4,269 | 100,236 | 126,466 | 226,702 |

1. Negative non-hardware savings are due to overestimation in hardware savings due to years with extreme wet weather conditions.

continued to grow. In response to current water shortage conditions the City reinitiated its extensive public awareness campaigns, in addition to campaigns launched by MWD, to encourage water saving practices and installation of conservation devices in homes and businesses.

As a result of mandatory conservation and reduced deliveries of imported water from MWD, residential customers have attained conservation levels exceeding 20 percent during the period between 2007 and 2010. In response to the current water supply shortage, the City has updated its Emergency Water Conservation Plan Ordinance's enforceable water waste provisions and mandatory outdoor watering restrictions. In addition, the City has implemented water shortage year rates reducing Tier 1 water allotments for customers by 15 percent. As a direct result of conservation, imported water purchases from MWD are 23 percent below baseline allocations for FY 2009/10. In response to recently enacted State laws, LADWP has developed new water conservation goals which aim to reach approximately 64,000 AFY in hardware conservation savings by 2035.

Conservation has had a tremendous impact on Los Angeles' water use patterns and has become a permanent part of LADWP's water management philosophy. The City's water usage in 2010 was less than 1979 despite an increase in population of over 1,000,000 people (see Exhibit 3A). Exhibit 3B shows historical conservation savings from FY 1990/91 through FY 2009/10 based on installation of conservation devices subsidized through rebates and incentives. Cumulative annual hardware savings since the inception of LADWP's conservation program totals 100,236 AFY. Additional conservation was achieved through changes in customer behavior and lifestyle changes.

Conservation benefits the City by improving water supply reliability and reducing embedded energy use for water treatment and pumping. Conserving customers see a tangible benefit as well through monetary savings on their water bill. Another ancillary benefit of conserving water is that the need for costly sewer facility expansions is deferred as wastewater discharge into the sewer collection and treatment systems is reduced, thus increasing the lifespan of current sewer infrastructure. Water conservation also has the added benefits of reducing greenhouse gas emissions and energy use. Delivering water supplies to and within the LADWP service area and heating water for showers, dishwashing, etc. all require large amounts of energy. In the end, the primary beneficiaries of conservation are the water customers and the environment where the supplies originate. Furthermore, increased conservation results in decreased dry weather runoff which decreases the amount of pollutants flowing into local rivers and the Pacific Ocean.

Los Angeles has been implementing permanent conservation since the 1980's. In 1988, the City adopted a plumbing retrofit ordinance to mandate the installation of conservation devices in all properties and to require water-efficient landscaping in all new construction. The ordinance was amended in 1998, requiring the installation of ULF toilets and water saving showerheads in single-family and multi-family residences prior to resale. A new ordinance adopted in 2009, the Water Efficiency Requirements ordinance, establishes water efficiency requirements for new developments and renovations of existing buildings by requiring installation of high efficiency plumbing fixtures in all residential and commercial buildings. LADWP's past water conservation programs have assisted customers affected by the ordinances by offering free ULF toilets and showerheads, free installation of ULF toilets, showerheads and faucet aerators, as well as rebates for ULF toilets purchased and installed. Current water conservation programs co-sponsored by MWD through the SoCal Water$mart Program for residential customers and the Save Water Save a Buck Program for CII customers continue to assist customers in complying with ordinances and reducing overall water demands.

## 3.1 Water Conservation Goals

Water conservation reduces demand that typically rises over time with growth in population and commerce. By mitigating those increases in demand, water supply reliability is improved while costs are reduced. In the early 1990s, City residents responded with conservation levels exceeding 20 percent due to increasingly drier conditions and mandatory conservation. As normal water supply conditions returned and with continuation of LADWP's conservation program, conservation levels stabilized at approximately 15 percent. With the recent water shortage and reduced deliveries of imported water from MWD, residential customers have repeated conservation levels exceeding 20 percent in the period between 2007 and 2010 as a result of mandatory conservation. From July 2007 through February 2011, 90.6 billion gallons of water were saved through conservation. As a direct result of conservation, imported water purchases from MWD are 23 percent below baseline allocations for FY 2009/10. In response to the goals provided in the Plan and recently enacted State laws, LADWP has developed numerous water conservation programs.

### 3.1.1 Water Supply Action Plan Conservation Goal

To continue increased conservation levels once mandatory outdoor watering restrictions are lifted, LADWP has set a water conservation goal in the Water Supply Action Plan of reducing potable water demands by an additional 50,000 AFY by 2030. This conservation level will further lessen the City's reliance on imported water while providing a drought-proof resource that is not subject to weather conditions. This aggressive approach includes multiple strategies: investments in state-of-the-art technology; a combination of rebates and incentives promoting installation of weather-based irrigation controllers (WBICs), efficient clothes washers and urinals; expansion and enforcement of prohibited water uses; reductions in outdoor water use; extending education and outreach efforts; and encouraging regional conservation.

LADWP's commitment to conservation is a successful multi-faceted approach that includes tiered water pricing, education and awareness, financial incentives for the installation of a variety of conservation measures, free water saving showerheads, Technical Assistance Program (TAP) incentives for business and industry, and large landscape irrigation efficiency programs. Conservation is a foundational component of LADWP's water resource planning efforts and will continue to be over the long term.

### 3.1.2 Water Conservation Act of 2009

The Water Conservation Act of 2009, Senate Bill x7-7, requires water agencies to reduce per capita water use by 20 percent by 2020 (20x2020). This includes increasing recycled water use to offset potable water use. Water suppliers are required to set a water use target for 2020 and an interim target for 2015 using one of four methods. The 2020 urban water use target may be updated in a supplier's 2015 UWMP. Failure to meet adopted targets will result in the ineligibility of a water supplier to receive water grants or loans administered by the State unless one of two exceptions is met. Exception one states a water supplier may be eligible if they have submitted a schedule, financing plan, and budget to Department of Water Resources (DWR) for approval to achieve the per capita water use reductions. Exception two states a water supplier may be eligible if an entire water service area qualifies as a disadvantaged community.

Four methodologies are stipulated for calculating the water use target. Three of the methods are listed in Water Code § 10608.20(a)(1). The fourth method was developed by DWR. The four methodologies are:

- Method 1 – Eighty percent of the water supplier's baseline per capita water use.

- Method 2 – Per capita daily water use estimated using the sum of performance standards applied to indoor residential water use, landscape area water use, and commercial, industrial, and institutional water uses.

- Method 3 – Ninety-five percent of the applicable State hydrologic region target as stated in the State's *draft 20x2020 Water Conservation Plan*.

- Method 4 – Developed through public process. This method allows flexibility in its calculation to account for the highly diverse conditions of each agency's landscape, commercial, industrial, and institutional water needs and to give credit for past conservation efforts. For more information please go to: http://www.water.ca.gov/wateruseefficiency/sb7/committees/urban/u4/

**Exhibit 3C 20x2020 Base and Target Data**

| 20x2020 Required Data | Gallons Per Capita Per Day (GPCD) |
|---|---|
| **Base Per Capita Daily Water Use** | |
| 10-Year Average[1] | 152 |
| 5-Year Average[2] | 145 |
| **2020 Target Using Method 3[3]** | |
| 95% of Hydrologic Region Target (149 gpcd) | 142 |
| 95% Of Base Daily Capita Water Use 5-Year Average (145 gpcd) | 138 |
| **Actual 2020 Target** | 138 |
| **2015 Interim Target** | 145 |

1. Ten-year average based on fiscal year 1995/96 to 2004/05
2. Five-year average based on fiscal year 2003/04 to 2007/08
3. Methodology requires smaller of two results to be actual water use target to satisfy minimum water use target.

In 2015, urban retail water suppliers will be required to report interim compliance followed by actual compliance in 2020. Interim compliance is halfway between the baseline water use and 2020 target. Baseline, target, and compliance-year water use estimates are required to be reported in gallons per capita per day (gpcd).

For consistent application of the Act, DWR produced Methodologies for Calculating Baseline and Compliance Urban Water Per Capita Use in October 2010. By following requirements provided in this document, LADWP has calculated its baseline per capita water use, its urban use target for 2020, and its interim water use target for 2015. Reporting compliance with daily per capita water use targets is not required until the 2015 UWMP cycle as it compares the interim target to actual water use in 2015. Exhibit 3C presents results of the calculations. Calculations and the technical bases for each calculation are presented in Appendix G. LADWP's baseline per capita water use is 152 gpcd using a ten-year average ending between December 31, 2004 and December 31, 2009 and 145 gpcd using a five-year average ending between December 31, 2007 and December 31, 2009.

LADWP has selected Method 3 to set its 2015 interim and 2020 water use targets. LADWP investigated all four methods and selected Method 3 because it is the most straightforward and reliable calculation method that adequately accounts for the City's past conservation investments.

Method 3 requires setting the 2020 water use target to 95 percent of the applicable State hydrologic region target as provided in the State's Draft 20x2020 Water Conservation Plan. LADWP is within State hydrologic region 4, the South Coast region. LADWP was required to further adjust the calculated 2020 target to achieve a minimum reduction in water use. The gpcd at 95 percent of the hydrologic region was 142 gpcd and using 95 percent of the five-year average base daily per capita water use was equal to 138 gpcd. Therefore, LADWP was required to set its 2020 target at the smaller of the two resultant values. LADWP's interim 2015 target is 145 gpcd and LADWP's 2020 target is 138 gpcd.

## 3.2 Existing Programs, Practices, and Technology to Achieve Water Conservation

LADWP has developed a number of progressive water conservation programs to address recently enacted State laws and to meet its goal of achieving an additional 50,000 AFY conservation by 2030. LADWP uses multiple programs, practices, and technologies in conjunction with enactment of State and local conservation ordinances and plumbing code modifications to achieve its current water conservation levels throughout its service area and customer classes.

## 3.2.1 State Laws and City Ordinances

### State Laws

In addition to the Water Conservation Act of 2009 multiple legislative bills have been enacted in the past few years requiring water agencies to enact measures to increase water conservation, establishing new plumbing standards, and linking grants and loans to implementation of best management practices (BMPs).

The Water Conservation in Landscaping Act of 2006, Assembly Bill 1881, reduces outdoor water waste through improvements in irrigation efficiency and selection of plants requiring less water. The Act required an update to the existing Model Water Efficient Landscape Ordinance and adoption of this ordinance or an equivalent ordinance by local agencies no later than January 1, 2010. If any agency failed to adopt the ordinance or its equivalent, then the Model Water Efficient Landscape Ordinance was automatically mandated by statute. The ordinance requires development of water budgets for landscaping, reduction of erosion and irrigation related runoff, utilization of recycled water if available, irrigation audits, development of requirements for landscape and irrigation design, and scheduling of irrigation based on localized climate for new construction and redevelopment projects.

In 2009, Assembly Bill 1465, Urban Water Management Planning, was approved to include language in the UWMP Act requiring water suppliers that are members of the California Urban Water Conservation Council (CUWCC) and comply with its "Memorandum of Understanding Regarding Urban Water Conservation in California (MOU)" to describe their water demand management measures in their respective UWMPs. A more detailed discussion of the CUWCC and BMP compliance is provided in Section 3.2.3.

Assembly Bill 1420 links state funding for water management by urban water suppliers to implementation of water conservation measures. Urban water suppliers are required to be in compliance with the CUWCC MOU to be eligible for water management grants or loans. Senate Bill X7-7 further clarifies that the grant funding conditions required by AB 1420 will be repealed as of July 1, 2016 and replaced with eligibility determined by compliance with 20x2020 targets.

In the recent years, there have been numerous regulations approved that increase the water use efficiency requirements of plumbing devices, specifically, Assembly Bill 715 (2007), Senate Bill 407 (2009), and the CALGreen Building Standards.  AB 716 requires that all toilet and urinal fixtures sold through retail or installed in existing and new residential and commercial building meet the high efficiency standards by January 1, 2014. SB 407 does not address the sale of plumbing fixtures but adds a requirement that beginning in January 1, 2017 all residential and commercial property sales must disclose all non-efficient plumbing fixtures. CALGreen has an effective date of January 1, 2011 and requires use of water efficient plumbing fixtures for all new construction and renovations of residential and commercial properties.

### City Ordinances

Los Angeles has utilized ordinances as a tool to reduce water waste since 1988, beginning with the adoption of its first version of a plumbing retrofit ordinance. The ordinance mandated installation of conservation devices in all existing residential and commercial properties and installation of water-efficient landscaping in all new construction. Toilets were required to use less than 3.5 gallons per flush (gpf), urinals less than 1.5 gpf, and showerheads less than 2.5 gallons per minute (gpm). Customers with three acres or more of turf were required to reduce water consumption by 10 percent from 1986 levels or face a 100 percent surcharge on their water bills.

**Exhibit 3D Water Efficiency Requirements Ordinance Summary**

| Device | Requirement |
|---|---|
| High Efficiency Toilets | 1.28 gallons per flush |
| Urinals | 0.125 gallons per flush |
| Faucets | |
| Indoor Faucets (Maximum) | 2.2 gallons per minute |
| Private Lavatory Faucets | 1.5 gallons per minute |
| Public Use Lavatory Faucets[1] | 0.5 gallons per minute |
| Pre-rinse Spray Valve | 1.6 gallons per minute |
| Showerheads | 2.0 gallons per minute |
| Dishwashers | |
| Commercial Dishwashers | varies by type between 0.62 and 1.16 maximum gallons per rack |
| Domestic Dishwashers | 5.8 gallons per cycle |
| Cooling Towers | 5.5 cycles of concentration |
| Single-Pass Cooling Systems | Prohibited[2] |

1. Metering faucets shall not deliver more than 0.25 gallons per cycle.
2. Single pass cooling systems are prohibited unless installed for health and safety purposes that cannot otherwise safely operate.

In 1998 the ordinance was amended, requiring the installation of ULF toilets and water saving showerheads in single-family and multi-family residences prior to the close of escrow. This progressive requirement is implemented with the help of local real estate professionals. LADWP has explored the expansion of the City's Retrofit on Resale Ordinance to include nonresidential properties.

Los Angeles further increased its water efficiency mandates in 2009 with adoption of the Water Efficiency Requirements Ordinance. This ordinance establishes water efficiency requirements for new developments and renovations of existing buildings by requiring installation of high efficiency plumbing fixtures in all residential and commercial buildings. Exhibit 3D summarizes the minimum requirements for new construction and replacement of fixtures in existing buildings.

In an effort to lead by example, LADWP has been retrofitting all its facilities with high efficiency plumbing fixtures since before the effective dates of the ordinance. As of early June 2010, LADWP is 57 percent complete in upgrading its 600 buildings to high efficiency faucets, toilets, urinals, showers, flexible hose connectors, angle valves, as well as correcting leaks and removing existing water damage.

In May 1996, the City's Landscape Ordinance (No. 170,978) became effective with an overarching goal to improve the efficient use of outdoor water. This ordinance was recently amended in 2009 to comply with the previously discussed Water Conservation in Landscaping Act of 2006 and the Model Water Efficient Landscape Ordinance.

LADWP first adopted an Emergency Water Conservation Plan Ordinance in the early 1990's in response to drought conditions. Subsequently in the current water shortage LADWP has adopted two amendments expanding prohibited uses, increasing penalties for violating the ordinance, and modifying water conservation requirements. Five phases of water conservation are incorporated into the plan with prohibitions and water conservation measures steadily increasing by phase. Regardless of water supply availability Phase I conservation requirements are in effect permanently unless a more stringent phase is in effect. In response to the ongoing water shortage conditions, LADWP implemented Phase III restrictions on June 1, 2009, restricting outdoor irrigation to two days per week. Following an ordinance amendment, Phase II implementation began on August 25, 2010 which allows outdoor watering three days per week. Exhibit 3E summarizes the five phases as defined in the latest amendment approved August 25, 2010.

## *Exhibit 3E*
## *Emergency Water Conservation Plan Ordinance Restrictions by Phase*

| Phase | Restrictions |
|---|---|
| I | No use of a water hose to wash paved surfaces |
| | No use of water to clean, fill, or maintain levels in decorative fountains, ponds, lakes or similar structures used for aesthetic purposes unless a recirculating system is used |
| | No drinking water shall be served unless expressly requested in restaurants, hotels, cafes, cafeterias, or other public places where food is sold, served, or offered for sale |
| | No leaks from any pipes or fixtures on a customer's premises; failure or refusal to fix leak in a timely manner shall subject the customer penalties for a prohibited use of water |
| | No washing vehicles with a hose if the hose does not have a self-closing water shut-off device attached or the hose is allowed to run continuously while washing a vehicle |
| | No irrigation during rain |
| | No irrigation between 9am and 4pm, except for public and private golf courses and professional sports fields to maintain play areas and event schedules. System testing and repair is allowed if signage is displayed. |
| | All irrigation of landscape with potable water using spray head and bubblers shall be limited to no more than ten minutes per water day per station. All irrigation of landscape with potable water using standard rotors and multi-stream rotary heads shall be limited to no more than 15 minutes per cycle and up to 2 cycles per water day per station. Exempt from these restrictions are irrigation systems using very low-flow drip-type irrigation when no emitter produces more than 4 gallons of water per hour and micro-sprinklers using less than 14 gallons per hour. This restriction does not apply to Schedule F water customers or water service that has been granted the General Provision M rate adjustment under the City's Water Rate Ordinance, subject to the customer having complied with best management practices for irrigation approved by LADWP. |
| | No watering or irrigation of any lawn, landscape, or other vegetated area shall occur in a manner that causes or allows excess or continuous water flow or runoff onto an adjoining sidewalk, driveway, street, gutter, or ditch. |
| | No installation of single-pass cooling systems shall be permitted in buildings requesting new water service. |
| | No installation of non-recirculating systems shall be permitted in new conveyor car wash and new commercial laundry systems. |
| | Operators of hotels and motels shall provide guests with the option of choosing not to have towels and linens laundered daily. |
| | No large landscape areas shall have irrigation systems without rain sensors that shut off the irrigation systems. |
| II | All prohibited uses in Phase 1 shall apply, except as provided. |
| | No landscape irrigation shall be permitted on any day other than Monday, Wednesday, or Friday for odd-numbered street address and Tuesday, Thursday, or Sunday for even-numbered street addresses. If a street address ends in 1/2 or any fraction it shall conform to the permitted uses for the last whole number in the address. For non-conserving nozzles (spray head sprinklers and bubblers) watering times shall be limited to no more than 8 minutes per watering day per station for a total of 24 minutes per week. For conserving nozzles (standard rotors and multi-stream rotary heads watering times shall be limited to no more than 15 minutes per cycle and up to two cycles per watering day per station for a total of 90 minutes per week. |
| | Irrigation of sports fields may deviate from non-watering days to maintain play areas and accommodate event schedules with written notice from LADWP. However, a customer must reduce overall monthly water use by LADWP's Board of Water and Power Commissioners adopted degree of shortage plus an additional 5% from the customer baseline water usage within 30 days. |
| | If written notice is received from LADWP, large landscape areas may deviate from the non-watering days if the following requirements are met: 1) approved weather-based irrigation controllers registered with LADWP; 2) Must reduce overall monthly water use by LADWP's Board adopted degree of shortage plus and additional 5% from the customer baseline within 30 days; 3) Must use recycled water if available |
| | These restrictions do not apply to drip irrigation supplying water to a food source or to hand-held hose watering of vegetation, if the hose is equipped with a self-closing water shut-off device, which is allowed everyday during Phase II, except between the hours of 9am and 4pm. |
| III | All prohibited uses in Phases I and II shall apply, except as provided. |
| | No landscape irrigation shall be permitted on any day other than Monday for odd-numbered street address and Tuesday for even-numbered street addresses. If a street address ends in 1/2 or any fraction it shall conform to the permitted use for the last whole number in the address. |
| | No washing of vehicles allowed except at commercial car washes. |
| | No filling of residential swimming pools and spas with potable water. |
| | Irrigation of sports fields may deviate from non-watering days and be granted one additional watering days for a total of two watering days with written notice from LADWP. However, a customer reduce overall monthly water use by LADWP's Board of Water and Power Commissioners adopted degree of shortage plus an additional 10% from the customer baseline water usage within 30 days. |
| | If written notice is received from LADWP, large landscape areas may deviate from the non-watering days and be granted one extra day of watering for a total of 2 watering days if the following requirements are met: 1) approved weather-based irrigation controllers registered with LADWP; 2) Must reduce overall monthly water use by LADWP's Board adopted degree of shortage plus and additional 10% from the customer baseline within 30 days; 3) Must use recycled water if available |
| | These restrictions do not apply to drip irrigation supplying water to a food source or to hand-held hose watering of vegetation, if the hose is equipped with a self-closing water shut-off device, which is allowed everyday during Phase III, except between the hours of 9am and 4pm. |
| IV | All prohibited uses in Phases I, II, and III shall apply, except as provided. |
| | No landscape irrigation is allowed. |
| V | All prohibited uses in Phases I, II, III, and IV shall apply, except as provided. |
| | The LADWP Board of Water and Power Commissioners is authorized to implement additional water prohibitions based on the water supply situation. |

Specific procedures for determining the initiation of a phase and termination of a phase are provided in the Emergency Water Conservation Plan Ordinance. Phases are initiated through recommendations provided by LADWP to the Mayor and City Council (Council).

## 3.2.2 Conservation Pricing

In 1993, Los Angeles restructured its water rates to provide customers with a clear financial signal to use water more efficiently. It was the first time in LADWP's history that an ascending tiered rate structure was used. This conservation-based rate structure remains in use and applies a lower first tier rate for water used within a specified allocation, and a higher second tier rate for every billing unit (748 gallons) that exceeds the first tier allocation. A unique feature of the rate structure is that the first tier allocation considers factors that influence individual residential customer's water use patterns (i.e. lot size, climate zone, and family size).

The goals of LADWP's two-tiered water rate structure are to:

- Use price as a signal to encourage the efficient use of water
- Provide basic water needs at an affordable price
- Provide equity among customers
- Use price to stabilize water use during a shortage
- Generate adequate revenue for maintaining and upgrading the water system

In a period where increasing demands and reductions in water supply are becoming more commonplace, a rate structure that provides appropriate signals to encourage efficient water use has become a necessity for many areas, including Los Angeles.

The substantial investments required for water quality improvements, security, and supply development have significantly raised the cost of delivering water. As rates increase, water agencies have noticed a change in use patterns. Because there is a known correlation between price and use, agencies use rates to encourage conservation activities and to postpone the need to construct new facilities or purchase even larger quantities of imported water.

LADWP's tiered rate structure, first implemented in 1993 with assistance from a broad-based group of stakeholders, applies a lower tier block rate for responsible water use within an allocated block of water, and a much higher rate for every billing unit above this block. The higher block rate reflects the "marginal cost," or the projected cost for additional water that would be required to meet these needs.

To further emphasize the conservation message, water charges are based solely on water used. This eliminates the inclusion of all fixed charges thereby allowing customers who use no water during a during a billing cycle to receive a bill that includes no charge for water service. There are automatic adjustments triggered when a water shortage exists. In June 2009, shortage year rates went into effect reducing first tier allocations for all customers by 15 percent (see Appendix C). These adjustments are based on the actual water use patterns that occurred during the 1991 period of mandatory water rationing. The purpose of these adjustments is to use price to encourage additional conservation and to provide LADWP with the revenue necessary to operate the system efficiently during a shortage.

## 3.2.3 CUWCC Best Management Practices

The CUWCC is the voice of urban water conservation in California, and LADWP has been active in the CUWCC since its inception in 1991. Instrumental in the development of the CUWCC MOU, LADWP was also one of the original signatories to this MOU. The MOU identifies BMPs as proven conservation measures as determined by the CUWCC. The most recent amendment to the MOU was adopted on June 9, 2010 updating compliance alternatives with the adopted BMPs. A water agency can now comply with the MOU through one of three methodologies: BMP compliance, accomplishing water conservation through a set of measures equal or greater than the water savings provided by the BMPs (Flex Track Menu), or accomplishing water conservation goals as measured in gpcd. All Group One (water suppliers) signatories to the MOU are committed to implement the BMPs.

Over the last 19 years, LADWP has played a significant role in the governance and policy making at the CUWCC, holding a seat on the Board of Directors, Strategic Planning Committee, By-Laws Committee, Research and Evaluation Committee, CII Committee, co-chair of the Membership Committee, and chair of the Group 1 Representation Selection Committee. LADWP also has been actively involved in all of the revisions that the MOU has undergone to date.

One of the obligations as a signatory to the MOU is to submit a Best Management Practices Retail Water Agency Report to the CUWCC. Previously submitted annually, this report is now submitted biennially and details progress in implementing the foundational and programmatic BMPs as currently specified in the MOU. LADWP actively implements the BMPs and the CUWCC BMP reports are available for review through the internet by accessing CUWCC's website at www.cuwcc.org.

In the early 1990s, the State Water Resources Control Board identified urban water conservation as a major means for resolving problems in the Bay-Delta. Large water agencies, including LADWP, actively participated in work groups to develop conservation strategies. The result of this effort is in the aforementioned MOU.

The MOU commits signatory water suppliers to develop comprehensive conservation programs using sound economic criteria and to consider water conservation on an equal footing with other water management options. The MOU established the CUWCC to monitor implementation of the BMPs and to maintain the list of BMPs.

A BMP is defined as:

(a) An established and generally accepted practice among water suppliers resulting in more efficient use or conservation of water.

(b) A practice for which sufficient data are available from existing water conservation projects to indicate that significant conservation or conservation-related benefits can be achieved; that the practice is technically and economically reasonable and not environmentally or socially unacceptable; and that the practice is not otherwise unreasonable for most water suppliers to carry out.

LADWP implements all of the BMP requirements in the MOU that are applicable to retail water agencies like LADWP. Foundational BMPs are considered as essential BMPs for any water utility and are ongoing practices not subject to time limitations. Programmatic BMPs are minimal activities required to be completed by each utility within the timeframe of the implementation schedules provide in the MOU. A listing of the BMPs is shown in Exhibit 3F.

### *Exhibit 3F*
### *CUWCC BMPs and Implementation Status*

| Category | Sub-category | Practices | Status |
|---|---|---|---|
| ***Foundational*** | | | |
| Utility Operations | Operations Practices | Maintain the position of a trained conservation coordinator | Implemented |
| | | Prevent water waste – enact, enforce or support legislation, regulations, and ordinances | Implemented |
| | | Wholesale agency assistance programs | Not applicable |
| | Water Loss Control Metering with Commodity Rates | Conduct Standard Water Audit and Water Balance | Implemented |
| | | Measure performance using AWWA software | Implemented |
| | | Locate and Repair all leaks and breaks | Implemented |
| | | 100% of existing unmetered accounts to be metered and billed by volume of use | Implemented |
| | Conservation Pricing | Maintain a water conserving retail rate structure | Implemented |
| Education | Public Information Programs | Maintain active public information program to promote and educate customers about water conservation | Implemented |
| | School Education Programs | Maintain active program to educate students about water conservation and efficient water use | Implemented |
| ***Programmatic*** | | | |
| Residential | | Residential Assistance – provide leak detection assistance | Implemented |
| | | Landscape Water Surveys for residential accounts | Implemented |
| | | High efficiency clothes washer incentive program | Implemented |
| | | WaterSense Specification (WSS) for toilets | Implemented |
| Commercial/ Industrial/ Institutional (CII) | | Implement unique conservation programs to meet annual water savings goals for CII customers | Implemented |
| Landscape | | Implement Large Landscape custom programs | Implemented |
| | | Offer technical assistance and surveys upon request | Implemented |
| | | Implement and maintain incentive program(s) for irrigation equipment retrofits | Implemented |

## 3.2.4 LADWP Conservation Programs

LADWP develops cost effective programs to achieve multiple goals of cost-effective demand reduction, customer service, environmental responsibility, and compliance with CUWCC BMPs. Conservation potential is considered in determining program approach and duration. Some types of conservation programs result in savings that are more easily measured than others. LADWP's programs include traditional demand-side management measures, as well as infrastructure improvement programs that contribute to water waste reductions. Demand-side management programs, like the rebate programs for water-saving toilets and high-efficiency washing machines, produce results that are measurable. Public information, education, and other general conservation awareness programs are intended to alter customers' behavioral patterns on water use and thus, are more difficult to quantify. It is such behavioral change in water use, however, that the City can point to as the primary reason for significant reduction in water consumption during water shortage periods. Combined with LADWP's conservation pricing structure discussed in Section 3.2.2, these programs increase system reliability and efficiency and will provide a secondary benefit of reducing runoff.

LADWP dedicates numerous staff in support of the Water Conservation Programs. Key personnel include the full-time water conservation coordinator who serves as LADWP's CUWCC representative, oversees conservation policies, and coordinates with other LADWP staff on the implementation of all the LADWP programs to ensure fulfillment with the annual water saving goals and CUWCC BMPs. Additional LADWP staff include the water conservation group that implement the various residential and commercial programs and the water conservation team (formerly known as the drought busters) that educate customers about the prohibited water uses, investigate claims of water waste and issue citations for water waste where warranted.

Specific conservation programs (past and present) associated with the CUWCC BMP categories are broken down in Exhibit 3G, and are fully discussed below. Appendix H contains the latest biennial reports provided to the CUWCC showing that LADWP has met all the BMP requirements.

## Awareness/Support Measures

Awareness/support measures can be active or passive. Active components include full metering of water use, assessment of volumetric sewer charges, and a conservation rate structure. Passive components typically include providing educational materials for schools, community and customer presentations, maintaining a conservation hotline, and a wide range of information distributed through customer bills, advertising in public venues, LADWP's website, and direct mail. Passive awareness/support measures provide the foundation for the conservation movement to build upon by raising water use awareness, water conservation program visibility, and encouraging community involvement.

In 2008, LADWP entered into an MOU with the Los Angeles Unified School District to further improve our water conservation outreach program. In FY 2009/10 LADWP budgeted approximately $500,000 in funding for educational programs within area schools. Programs included:

- Los Angeles Times in Education – Provided newspapers to 50,000 students in grades 4-12 and lesson packages for teachers on supply sources and conservation.

- "Thirsty City" Live Performances – Play presented to more than 4,300 students introducing students to water supply sources, water supply challenges, and conservation.

- Renewable Energy and Conservation Curriculum – 660 teachers were trained in an extensive model conservation program reaching approximately 50,000 $6^{th}$ grade students.

- Renewable Energy and Conservation Center – Funding was provided for a science teacher position to set up and establish a Renewable Energy and Conservation Center with students to be bused to center for hands-on lessons focusing on conservation and renewable energy.

- Outdoor Education Multi-Day Environmental Experiences – Approximately 700 students in 20 classes in grades 4-12 attended two or three days of outdoor education experiences focusing on environmental measures, including lessons on energy and water.

- Eastern Sierra Institute – Training of 25 teachers over three days about the environment and geology of the Eastern Sierra.

- Teacher Fellowships – Ten math and science teachers from middle and high schools served in fellowships at LADWP for six weeks during the fall and summer of 2008 working in multiple offices with the intent of developing classroom lessons based on the experiences.

- Infrastructure Academy – 40 students from the Infrastructure Academy completed water conservation audits at 120 schools, including fixture

## Exhibit 3G Current and Past Conservation Programs

| CUWCC BMP Category | Conservation Measures | pre 1985 | Year in Service |
|---|---|---|---|
| | ***Awareness/Support*** | | |
| | **Pricing** | | |
| Utility Operations – Water Waste Prohibition | Retrofit on Resale Ordinance | | 1998 |
| Utility Operations - Pricing and Operations | Tiered Rate Structure | | 1993 |
| Utility Operations – Water Waste Prohibition | Drought Buster Program | | 1990 |
| Utility Operations – Water Waste Prohibition | Emergency Water Conservation Plan Ordinance | | 1990 |
| Utility Operations –Conservation Coordinator | Full-time dedicated staff to conservation | x | |
| Utility Operations - Metering | Full Metering and Volumetric Pricing | x | |
| Utility Operations - Pricing | Sewer Charge using Volumetric Pricing | x | |
| Education - Public Information Programs | **Public Information** | | |
| | Drought Response Outreach | | 2008 |
| | Hotel & Restaurant Water Conservation Campaign | | 2008 |
| | ULFT Customer Satisfaction Survey | | 1992 |
| | Advertising | x | |
| | Bill Inserts | x | |
| | Brochures | x | |
| | Community Involvement Program | x | |
| | Exhibits | x | |
| | Hotline | x | |
| | Speakers Bureau | x | |
| | **School Education** | | |
| | LAUSD MOU | | 2008 |
| | High School in concert with the Environment - Student Home Water/Energy Survey | | 1994 |
| | Lower Elementary | x | |
| | Upper Elementary | x | |
| | Junior High | x | |
| | ***Residential*** | | |
| Residential | Residential Drought Resistant Landscape Incentive Program | | 2009 |
| Residential | High Efficiency Clothes Washer Incentive Program | | 1998 |
| Residential | Better Idea/Neighborhood Bill Reduction Service Program --Showerhead installation | | 1993 |
| Residential | Community-Based Organization Toilet Distribution Centers, Direct Install | | 1992 |
| Residential | High Efficiency Toilet Rebate | | 1990 |
| Residential | Home Water Surveys | | 1990 |
| Residential | Retrofit Kits Distribution | | 1988 |
| | ***Commercial/Industrial/Government*** | | |
| Commercial/Industrial/Institutional | Commercial/Industrial Drought Resistant Landscape Incentive Program | | 2009 |
| Commercial/Industrial/Institutional | Water Efficiency Requirements Ordinance | | 2009 |
| Commercial/Industrial/Institutional | General Services Dept. MOU to Retrofit Plumbing | | 2009 |
| Commercial/Industrial/Institutional | Public Agency Plumbing Audit and Training Program | | 2009 |
| Education - Public Information Programs | Targeted Literature Mailing | | 1993 |
| Commercial/Industrial/Institutional | Commercial/Industrial Conservation Guidebook | | 1992 |
| Commercial/Industrial/Institutional | Cooling Tower Manual and Workshops | | 1992 |
| Commercial/Industrial/Institutional | Commercial Rebate Program | | 1991 |
| Commercial/Industrial/Institutional | Interior Water Use Audits | | 1991 |
| Commercial/Industrial/Institutional | Technical Assistance Program (TAP) | | 1991 |
| Landscape; Commercial/Industrial/Institutional | Typical Audits | | 1991 |
| | ***Landscape*** | | |
| Landscape | Recreation and Parks MOU | | 2007 |
| Landscape | Large Turf Irrigation Controller Pilot Program | | 2000 |
| Landscape | Protector del Agua -- English and Spanish Language Workshops | | 1995 |
| Landscape | Improving Irrigation Performance Manual & Workshop | | 1993 |
| Landscape | Large Turf Audits and Audit Training | | 1993 |
| Education - Public Information Programs | Lawn Water Guide Direct Mailing (as requested) | | 1989 |
| Education - Public Information Programs | Demonstration Gardens | | 1988 |
| Landscape | Ten Percent Large Turf Water Reduction Program | | 1988 |
| | ***System Maintenance Measures*** | | |
| Utility Operations - Water Loss Control | Large Meter Replacement Program | | 2001 |
| Utility Operations - Water Loss Control | Fire Hydrant Shutoffs | | 1991 |
| Utility Operations - Water Loss Control | Meter Replacement Program | | 1988 |
| Utility Operations - Water Loss Control | Cement Mortar Lining of Pipelines | x | |
| Utility Operations - Water Loss Control | Corrosion/Cathodic Protection | x | |
| Utility Operations - Water Loss Control | Infrastructure Program | x | |

counts, analysis of toilet makes and models, and analysis of irrigation controllers and field conditions.

Included within the short-term strategies of the City of Los Angeles' Water Supply Action Plan is a strategy to increase water conservation in the City through an aggressive $2.3 million conservation education campaign. LADWP Public Affairs Office implemented a media campaign that included radio, TV, and newspaper advertisements, billboards, outreach to Neighborhood Councils; and marketing of City rebates for water-efficiency.

Another aspect of awareness/support is that of advocacy. LADWP has been instrumental in the development of more stringent standards for toilets (e.g. Supplementary Purchase Specification for ULF toilets) that are in use within the City as well as by other water agencies in California and other areas. LADWP also assisted in the adoption of higher residential clothes washer efficiency standards by the California Energy Commission. Recognizing the importance of this activity, LADWP actively participates in advocating local and statewide conservation research and planning.

## Residential Category

Multiple residential conservation programs were first developed and launched by LADWP during the drought of 1987 through 1992. In 1990, the ULF Toilet Rebate Program was initiated, followed two years later by the ULF Toilet Distribution Program. In 2003, a well-received free installation service component was added to the ULF Toilet Distribution Program that included free water-saving showerheads, faucet aerators and replacement toilet flapper valves. Today distribution of free faucet aerators and showerheads continues for all single-family, multi-family, and commercial customers.

In 2008 MWD initiated the region-wide SoCal Water$mart Program for residential water conservation. This program replaced previous LADWP rebate programs and rebate programs offered by individual water service providers throughout the MWD service area. This MWD sponsored program sets uniform rebate requirements across the MWD service area and provides a clearinghouse for processing rebates for all MWD member agency customers. Local agencies have the option of supplementing baseline rebate amounts to their customers through the program. LADWP has increased baseline rebates for several of the qualifying products. Eligible customers include residential customers residing in single-family and multi-family homes, even if multi-family residents do not receive a water bill.

Although the SoCal Water$mart Program has discontinued rebates for high efficiency toilets (HET), LADWP continues to provide local funding for rebates for its customers of $100 per HET which has proven to be highly successful with over 1,900 units installed in FY 2009/10 which equates to over 80 AFY in water savings.

Prior to initiation of the SoCal Water$mart Program, LADWP was assisted by community-based organizations (CBOs) to reach the milestone of more than 1.27 million toilets installed through December 31, 2006. CBOs were integral to LADWP's success, reaching into the communities they serve to convey the conservation message and directly undertake conservation activities. Benefits of this approach accrued to community participants through reduced water bills, to CBOs through employment opportunities and revenues earned, and to the City through significant water savings achieved. Prior to its discontinuation, the program was funded at more than $7 million annually. The toilets replaced through the program continue to produce estimated water savings of more than 44,000 AFY today.

LADWP initiated a High Efficiency Washer Rebate Program in 1998 promoting the purchase and installation of high efficiency washing machines saving both water and energy. As of January 2009, rebates have been paid for more than 66,100 machines purchased and installed throughout the City. The program's minimum efficiency requirements for rebate eligibility were increased in January 1, 2004, resulting in the promotion of higher efficiency models. Initial co-funding of the program was provided by the City's Department of Public Works Bureau of Sanitation and by the Southern California Gas Company.

In February of 2009 the High Efficiency Washer Rebate Program transferred from LADWP to the SoCal Water$mart Program with co-funding provided by MWD. Since the inception of the SoCal Water$mart Program and through June 2010, over 11,800 rebates for washing machines were issued to LADWP customers with a total annual savings of 368 AFY. Generally rebates are $300 per washing machine with a water factor (a measure of efficiency) of 4.0 or less. From April 22, 2010 through December 6, 2010, an additional $100 rebate was available through the California Cash for Appliances program for a total rebate of $400 per washing machine.

A sprinklerhead rotating nozzle retrofit rebate of $8 per nozzle is available through the SoCal Water$mart Program for a minimum of 25 nozzles. Replacing standard sprinkler heads with rotating nozzles can use up to 20 percent less water. Rotating nozzles are able to distribute water in a water-efficient manner more uniformly across a landscape than standard sprinklers. Spray from rotating nozzles is less likely to result in misting conditions, misdirection from winds, and reduces runoff onto pervious surfaces thus reducing dry-weather runoff. Between March 2009 and June 2010 2,878 rotating nozzle rebates were issued to LADWP customers saving approximately 12.7 AFY.

Rebates for installation of weather-based irrigation controllers are also available through the SoCal Water $mart Program. Rebates amounts are $200 per controller for landscape areas of less than one acre and $25 per station for landscape areas greater than one acre. Weather-based irrigation controllers provide customized irrigation schedules based on local site conditions and in response to weather changes. These smart controllers receive weather updates to automatically adjust the schedule and amount of water applied. Between March 2009 and June 2010 81 LADWP customers received rebates for installation of the controllers saving approximately 6.2 AFY.

Initially a synthetic turf rebate program was offered through the SoCal Water$mart Program, but has been discontinued as of June 1, 2010. The program provided rebates of $1.00 per square foot. Approximately 316,547 square feet of synthetic turf was installed by LADWP customers between February 2009 and June 2010 saving approximately 44.3 AFY.

LADWP through the SoCal Water$mart program is offering turf removal rebates of $1 per square foot up to $2,000 per residence. Not all MWD member agencies are participating in the turf removal program and participating agencies have additional requirements beyond MWD's requirements. Areas targeted for turf removal must currently be turf irrigated with potable water for a minimum of one year. All replacement materials must be permeable and either hand watered or irrigated with drip irrigation. A minimum of 250 square feet must be converted to be eligible for a rebate. No invasive plants are permitted and all exposed soil must be covered with mulch. Synthetic turf is an acceptable replacement if it is not used in right of ways or parkways. Applicants are required to maintain the converted area for ten years. The program commenced in December 2009, and as of FY 2009/10, over 280,000 square feet of turf area has been converted saving over 39 AFY. In conjunction with the turf removal program, LADWP is conducting a drip system pilot program and is offering free residential drip starter kits.

Water-saving showerheads and faucet aerators remain available to LADWP customers, free of charge, upon request. Approximately 12,124 showerheads and 14,792 faucet aerators were distributed between July 2007 and June 2010 saving approximately 241 AFY. During past water shortages, more than 1.5 million water conservation retrofit kits were distributed throughout Los Angeles; the kits included one-gallon toilet displacement bags, low-flow showerheads, and toilet leak detection tablets.

As part of past programs promoting residential water conservation measures, students conducted home water surveys through a resource efficiency education program implemented by LADWP in Los Angeles area high schools. Additionally, local community based organizations visited many Los Angeles residences throughout the year, assessing water conservation opportunities in the home and installing applicable measures to immediately capture water savings.

Another element of LADWP's past efforts was a toilet flapper valve replacement pilot program. Although long-term water savings from ULF toilets are predicated on timely replacement of leaking toilet flapper valves with appropriate replacement units, findings from the pilot program indicate a small incidence of leaking flapper valves in toilets rebated or distributed by LADWP. However, toilet leak testing and flapper valve replacement was added to the past ULF Toilet Distribution Program's installation service component for toilets not replaced through the program.

## Commercial/Industrial/ Institutional (CII) Category

This category represents some of the largest volume water users in LADWP's customer base, and represents a great deal of conservation potential. LADWP, in partnership with MWD, developed and has implemented a commercial rebate program entitled the Save Water Save a Buck Program, designed specifically for customers in the CII sector and multi-family residences with five or more units represented by a homeowners association. In the CII sector, the program provides rebates for water saving plumbing fixtures, food service equipment, and landscaping equipment. Within the multi-family sector the program provides rebates for high efficiency washers, high efficiency toilets, and landscape equipment. In addition, packaged water use efficiency solutions are being developed for specific business sectors. Efforts are also underway to better promote the financial incentives

## *Exhibit 3H*
## *CII Conservation Programs and Savings July 2007 through June 2010*

| Device Type | Rebate Amount Retrofit | Devices Installed | Estimated Annual Savings (AFY) |
|---|---|---|---|
| ***Save Water Save a Buck Program*** | | | |
| Current Programs | | | |
| High Efficiency Toilets (1.28 gpf or less) | $150 each ($50 new construction) | 58,432 | 2,408.60 |
| Zero and Ultra Low Water Urinals | $500 each ($250 new construction) | 6,063 | 630.9 |
| Cooling Tower pH Conductivity Controller | $3000 each | 41 | 79.7 |
| Cooling Tower Conductivity Controller | $625 each | 57 | 36.7 |
| Air Cooled Ice Machine | $300 each | 0 | 0 |
| Connectionless Food Steamer | $600 compartment | 23 | 5.8 |
| Dry Vacuum Pump (maximum 2.0 horsepower) | $125 per 0.5 horsepower | 8 | 0.7 |
| Water Broom | $150 each | 73 | 11.2 |
| Weather Based Irrigation Controller | $50 per station | 391 | 127.1 |
| Central Computer Irrigation Controller | $50 per station | 0 | 0 |
| Rotating Nozzles for Pop-up Spray Heads (25 minimum) | $8 each | 22,534 | 99.1 |
| High Efficiency Spray Nozzles for Large Rotary Sprinklers | $13 per head | 8,558 | 308.1 |
| Past Programs | | | |
| High Efficiency Coin Clothes Washer | - | 1,738 | 186.8 |
| Pre-Rinse Sprayhead | - | 5 | 0.8 |
| Steam Sterilizer Retrofit | - | 6 | 7.8 |
| X-Ray Processor Recirculation System | - | 1 | 3.2 |
| Synthetic Turf (square feet)[1] | - | 15,177 | 2.1 |
| **Subtotal Save a Buck Program** | - | | **3,908.70** |
| ***LADWP Inhouse Programs*** | | | |
| Commercial Showerheads | - | 5,180 | 85.3 |
| Commercial Faucet Aerators | - | 20,844 | 96.5 |
| Water Brooms | - | 262 | 40.2 |
| CII Landscape Program Turf Removal[2] | - | 1,251,043 | 95.6 |
| Technical Assistance Program[3] | - | - | 2358.4 |
| **Subtotal LADWP In-house** | - | | **2676** |
| **Total CII** | - | | **6584.8** |

1. Synthetic Turf rebates as of June 1, 2010 are available through LADWPs Technical Assistance Program.

2. Rebate amount varies and is determined during pre-approval process.

3. Rebates for Technical Assistance Program are $1.75 per 1,000 gallons saved over a two year period with a cap not to exceed the actual cost of the project. Devices installed vary per project.

available that make water conservation retrofits more cost effective for business and industry. LADWP takes full advantage of regional programs offered through MWD for the CII sector and for many product rebates, provides supplemental funding to boost the base rebate provided by MWD.

The Save Water Save a Buck Program was launched in 2001 to provide menu-based rebates for water conserving measures applicable to many types of CII facilities. Categories of products eligible for rebates, rebate amounts, number of rebates for the LADWP service area, and estimated savings are provided in Exhibit 3H for the period July 2007 through June 2010. During this period, an estimated annual savings of 6,585 AFY was achieved, inclusive of LADWP in-house programs and the Technical Assistance Program (TAP). The program design provides for ease of participation and has been well-received by LADWP customers. The program has been so successful that the SoCal Water$mart Program for residential customers was modeled after it.

LADWP created the Technical Assistance Program (TAP) in 1992 to provide custom-type incentives for retrofitting water-intensive equipment. Different from the Save Water Save a Buck Program, the TAP encourages site-specific projects and TAP incentives are based on a given project's water savings. Financial incentives up to $250,000 are available for products demonstrating water savings. Incentives are calculated at the rate of $1.75 per 1,000 gallons saved over a two-year period with a cap not to exceed the actual cost of the installed product. Projects must save a minimum of 150,000 gallons over a two-year period and operate for a minimum of five years. Eligible customers are CII or multi-family residential customers. Past TAP projects include cooling tower controller upgrades and x-ray processor recirculation systems. The estimated unit cost for TAP overall is about $228 per acre-foot saved with an annual savings of 2,358.4 AFY based on projects installed between July 2007 and programs until June 2010.

Similar to the residential turf removal program, LADWP has a turf removal program for commercial properties. This program started in September 2009 and the rebate is $1.00 per square foot of turf with the total project rebate amount as defined in the pre-approval letter provided by LADWP. Areas targeted for conversion must have live healthy turf irrigated with potable water (recycled water is ineligible) via automatic sprinkler valves when a project approval letter is provided by LADWP. Converted areas must contain enough plants to create at least 30 percent landscape coverage at maturity. Converted areas may not contain turf or synthetic turf (synthetic turf rebates are available through the TAP). All replacement materials must be permeable and plants must be climate appropriate or California native plants. A minimum of 250 square feet must be converted to be eligible for a rebate. No invasive plants are permitted and all exposed soil must be covered with three inches of mulch. If an irrigation system is used it must be a low flow drip or bubbler system. Applicants are required to maintain the converted area for 15 years.

Water-saving showerheads and faucet aerators are available to LADWP commercial customers, free of charge, upon request. Bathroom faucet aerators are provided in 1.5, 1.0, or 0.5 gallons per minute (gpm), kitchen faucet aerators are provided in 1.5 gpm, and showerheads are provided in 2.0 gpm. Approximately 5,180 showerheads and 20,844 faucet aerators were distributed between July 2007 and June 2010 saving approximately 181.8 AFY combined. LADWP additionally offers an in-house water broom program in addition to the rebates offered through the Save Water Save a Buck Program.

## Landscape Category

Recognizing that a substantial amount of water is used outdoors for irrigation, LADWP continues to invest in landscape irrigation efficiency programs and projects. In addition to the previously discussed landscape ordinances (Section 3.21.), LADWP has sponsored free

Drought-tolerant garden outside the LADWP John Ferraro Building.

training courses specifically targeting the City's large turf customers to help these customers comply with the landscape ordinance. To further assist this group, LADWP developed a guidebook, "Improving Irrigation Performance" to demonstrate ways for enhancing existing irrigation systems.

LADWP has also sponsored conservation and garden expos to highlight various aspects of efficient outdoor water use and planting practices, and emphasize native, drought-tolerant plants. Funding was provided for three demonstration gardens to showcase the use of drought-tolerant plants and flowers, including the landmark Lummis Home in Highland Park. Lawn watering guides were mailed to all single-family and duplex residences. Planting guides for native and drought-tolerant plants are also available upon request. Additionally, to demonstrate the beauty and appeal of a water-conserving landscape, LADWP's John Ferraro Building facility (below) has a drought-tolerant garden that is open to visitors year-round.

In addition to the Residential and Commercial Landscape Incentive Programs for turf removal, other types of landscape irrigation improvement projects are also funded through the TAP, with incentives calculated on the basis of a project's water savings. LADWP staff includes certified landscape auditors, and large landscape audits are available upon request.

LADWP is also investigating new programs using data obtained through pilot program efforts. A pilot program was conducted to determine the effectiveness of weather based irrigation controllers in large landscape applications. On the basis of the pilot program results showing water savings, financial incentives are available to LADWP customers for the purchase and installation of weather based irrigation controllers through the SoCal Water$mart and Save Water Save a Buck Programs. Additional efforts are being undertaken to make available a landscape irrigation education program for homeowner associations and other large landscape customers. This program would focus on common green areas in multi-unit complexes to improve irrigation efficiency, including irrigation system maintenance and repair, and plant selection.

LADWP has been implementing an internal program to retrofit outdoor landscaping at department-owned facilities to California-friendly and native plantings with efficient irrigation systems. Additionally, a joint effort between the Department of Recreation and Parks and LADWP is targeting public parks through the City Park Irrigation Efficiency Program. City parks with inefficient irrigation systems, leaks, and runoff problems are identified and upgraded with water efficient distribution systems and sprinkler heads, installation of smart irrigation controllers, and planting of California-friendly landscaping. Since the program began in 2007, seven parks have been completed and 4 new weather stations have been installed. An additional benefit of this program is the educational, trade training, and employment opportunity given to the youth of Los Angeles.

There is also potential for the use of non-potable water for irrigation, which can help extend the utility of the City's traditional water supplies. Through increased stormwater capture, groundwater recharge with captured storm and irrigation runoff, and recycled water, imported surface water and local groundwater used for landscape irrigation can be conserved. The potential to use such non-potable water supplies is further discussed in the Recycled Water and Watershed Management chapters (Chapters 4 and 7 respectively).

New Low Impact Development (LID) projects implemented within the City and innovative work by non-profit organizations demonstrate pioneering ways to conserve water for landscapes. As discussed in Chapter 7, LADWP's Watershed Management Group is proactively developing programs in conjunction with other departments to highlight water conservation through LID and implementing stormwater BMPs. A local non-profit, TreePeople, has partnered with various City departments, including LADWP on a number of stormwater capture projects.

For over a decade, TreePeople has demonstrated that rainwater is a viable local water resource. The Open Charter Elementary School Stormwater Project is one of several sustainable stormwater management systems that TreePeople installed in Los Angeles. Other examples include: the Center for Community Forestry which harvests rainwater from its entire hardscape into a 216,000 gallon underground cistern for landscape irrigation use; a retrofitted single-family residential home in South Los Angeles that captures a 100-year storm event on site; and a 7,600 square foot subsurface stormwater infiltration gallery on the Broadous Elementary School campus in Pacoima. Most recently, TreePeople partnered with the Los Angeles and San Gabriel Rivers Watershed Council, LADWP, and other state and federal agencies to retrofit an entire residential block on Elmer Avenue in Sun Valley. This project now intercepts stormwater from 40 acres upstream and infiltrates it back to the aquifer while also demonstrating effective distributed stormwater BMPs on residential homes.

In partnership with the Los Angeles County Department of Public Works, TreePeople was instrumental in developing the Sun Valley Watershed Management Plan: an alternative stormwater management plan that prioritizes green infrastructure and multi-benefit stormwater capture projects instead of stormdrains. Many projects have been completed, and more are scheduled for construction. These activities create the foundation that will lead to further landscape water conservation and stormwater capture to increase the water use efficiency of the City's limited water supplies.

## CASE STUDY:
## Los Angeles River Revitalization and the North Atwater Park Project

**Background**

The Los Angeles (LA) River flows 51 miles through some of the most diverse communities in Southern California—its first 32 miles are within the City of LA. The River has a year-round low flow due to contributions from upstream wastewater treatment plants, urban runoff, groundwater inflow, and natural springs, but can become a torrent of racing flows during the rainy season. The River is almost entirely concrete-lined except for a few reaches. Although the design of the River has served its flood control purpose, the River holds far greater potential to serve as a focal point for environmental restoration, economic growth, community revitalization, and recreation.

Realizing that the River should stand as a symbol of pride for the City of LA and its residents and that it should be a landmark for the public to enjoy and admire, the LA City Council established the Ad Hoc Committee on the River in 2002 and adopted the LA River Revitalization Master Plan (LARRMP) in 2007 (www.lariver.org). Led by the City's Bureau of Engineering and funded by the LA Department of Water and Power, the LARRMP was created through a collaboration of elected officials, city departments and agencies, residents, multi-disciplinary experts, and a wide variety of private and non-profit environmental and recreational groups. The LARRMP is a 25-to-50 year blueprint for transforming the City's stretch of the LA River into an extensive network of parks, walkways, bike paths, and diverse land uses that will ensure the growth and sustainability of healthy communities.

**Key Features**

In October 2010, the City celebrated the groundbreaking of the North Atwater Park Expansion and Creek Restoration project as the first project to emerge from the LARRMP, which is expected to be open to the public by December 2011. The project was undertaken in connection with the settlement of two Clean Water Act enforcement action, Santa Monica Baykeeper v. City of Los Angeles and United States, and State of California ex. Rel. California Regional Water Quality Control Board, Los Angeles Region v. City of Los Angeles and also funded in part by Proposition 50 through the California Resources Agency to improve River Parkways and the Integrated Resources Water Management. The project will use both structural and natural solutions to restore a degraded creek that is a tributary of the River while also expanding River-adjacent parkland with multiple recreational, wildlife habitat, and water quality benefits. The project will add nearly 3 acres to an existing 5-acre City park, connecting it to the River, where visitors will enjoy watching a wide variety of bird species that presently live in that soft-bottomed stretch of the River, framed by stunning views of Griffith Park in the distance. Some of the project's highlights include:

***Outdoor Classroom***

The project will encourage young children to explore nature via an educational gathering space near the LA River. This "outdoor classroom" will feature a nature-based art area for independent and guided activities—designed particularly for local students to learn about nature, native plants, and the opportunities and challenges associated with revitalizing the LA River.

***Native Demonstration Garden***

The park's central focus will be a demonstration garden, which will contain a variety of native plants that are used throughout the park, with interpretive displays to educate visitors about the plant species' characteristics, care, and relationship to water conservation. The park will only include native plants because they are considered "drought-tolerant" given their abilities to thrive in Southern California's climate, requiring much less water than other plants. The park's landscape design aims to set an example in the use of such plants, but also to educate the public on the merits of embracing native vegetation as an important component of solving the region's water crisis.

***Creek Restoration***

North Atwater Creek currently conveys polluted runoff to the River from an upstream stormdrain system that receives flow from a 40-acre urban area. The Creek will be restored and landscaped with native plants to prevent erosion and to naturally filter stormwater before it is discharged to the River, featuring a 1000-foot-long meandering streambed sustained by intermittent street runoff flows. Water quality improvements will include installation of a device at the entrance of the creek to intercept and capture trash and bacteria and special treatment of flows from adjacent equestrian facilities.

***Accommodating Visitors***

While the park's landscape design capitalizes on the opportunity to educate visitors about the many connections between urban life, nature, and water, its structural features do also. For example, the parking lot will be transformed by installing a gravel bioswale along the borders and replacing existing parking spaces with permeable surfaces. These changes will not only address surface water contamination, but also allow stormwater to infiltrate so that it will assist with groundwater augmentation.


**Summary**

The North Atwater Park project will utilize innovative Low Impact Development (LID) and Best Management Practice (BMP) technologies to simultaneously achieve a variety of benefits, including responsible water conservation, improved water quality, expanded wildlife habitat connectivity, co-located multi-generational recreation, and public education.

The park's goals recognize that, while it is important to transform the existing park into a beautiful, scenic landmark and natural resource, it is equally important to educate the public about the huge potential such achievements have in encouraging wiser water use practices. Fundamentally, the park is about water—respecting LA's water supply and celebrating the River—by simultaneously improving the survivability of our wildlife and human habitat. North Atwater Park is an example of what can happen when public agencies and residents tackle complicated problems with creative planning and successful collaboration.

"The LA River cause is reaching more and more people every day. We are incredibly encouraged by the USEPA's July 2010 decision regarding the River's federal protection status and particularly because of the context in which it was announced—President Obama's America's Great Outdoors initiative is exactly the kind of support we need now and the visit of so many distinguished Administration officials to the River reinforces the belief that the River is important to millions of people here and across the country."

Carol Armstrong, Ph.D., Environmental Supervisor, Project Manager, LA River Project Office

"The City's commitment to LA River revitalization has only gained in momentum over the years and we have now reached an important crossroads for answering the big questions—such as how to capture and reuse storm flows, how to expand our recycled water uses, how to ensure we have enough water to maintain critical wildlife habitat, and how much flood capacity can we add? The River is central to each and every one of the answers."

Larry Hsu, P.E., Senior Civil Engineer, Project Manager, LA River Project Office

## System Maintenance Category

Maintaining system infrastructure reduces water waste and allows for greater water accountability. Infrastructure maintenance is a high priority for LADWP. As discussed in Chapter 2, LADWP non-revenue water has an impressive historical 25-year average of 7 percent of the total water demand. LADWP maintains a 24 hour, 7 days per week leak response operation and repairs major blowouts that impact public safety immediately and typical leaks within 72 hours. Ongoing programs such as pipeline replacement, pipeline corrosion control, and meter replacement preserve the operational integrity of City water facilities, and aims to reduce unaccounted water losses.

In recent years, the LADWP has ramped up its pipeline replacement program from 70,000 liner feet annually to 95,000 linear feet annually.  Additionally, the LADWP Water System's Asset Management Group along with the Water Distribution Division are working to develop a predictive model that uses existing data relative to the factors which contribute to water main deterioration to determine a replacement priority for all pipe segments in the system. The results of this model along with criticality assessments and leak history can be used to focus replacement resources on pipe segments that are more likely to fail and disrupt service levels.



LADWP has also made significant progress in replacing and/or retrofitting water meters through its meter replacement program that started in 1988. As a result of extended flow or usage, the moving parts in a water meter can wear down and begin to under-register the actual water consumption. The meter replacement program has been valuable in ensuring the accuracy of the approximately 700,000 meters within the City.  Recently, all of the large-sized meters (3-in and larger) in the system were replaced as part of a Large Meter Replacement Program, and the LADWP is also replacing 35,000 small meters annually.

As part of the new requirements of the CUWCC Water Loss Control BMP amended in September 2009, LADWP has completed training in the American Water Works Association water audit method and component analysis process offered by CUWCC.  LADWP has also completed the standard water audit and balance using the American Water Works Association Water Loss software to determine the current volume of apparent and real water loss and the cost impact of these losses. As the final BMP condition, LADWP is on target to complete the required component analysis by July 2013. The goal of the component analysis is to identify volumes of water loss, the cause of the water loss and the value of the water loss for each component.

## 3.3 Future Programs, Practices, and Technology to Achieve Water Conservation

LADWP, on its own and in cooperation with other agencies, continues to investigate future programs, practices, and technology to improve water conservation.

### 3.3.1 Graywater

As defined by State regulations, graywater is untreated household wastewater that has not come into contact with toilet waste or unhealthy bodily wastes. It includes water sources from bathtubs, showers, bathroom wash basins, and water from clothes washing machines and laundry tubs. It specifically excludes water from kitchen sinks and dishwashers. Graywater is a drought-proof source of supply for subsurface landscape irrigation. Graywater regulations do not allow for its application using spray irrigation. Graywater is also not allowed to pond or runoff, discharge to or reach a storm drain system or surface water body, and is not permitted for irrigation of root crops or edible food crops that are directly in contact with the surrounding soil.

The Graywater Systems for Single Family Residences Act of 1992 legally incorporated the use of graywater as part of the California Plumbing Code. In September 1994, the City approved an ordinance that permitted the installation of graywater systems in residential homes. However, installing graywater systems under this act was costly in terms of both installation and maintenance. To address the current water shortage and reduce water demands, emergency graywater regulations added Chapter 16A (Part I) "Nonpotable Water Reuse Systems" to the 2007 California Plumbing Code. These regulations were approved by California Building Standards Commission in 2009 and became effective on August 4, 2009. Further revisions were made to the regulations and the regulations became permanent on January 12, 2010 with an effective date of January 20, 2010. These new code changes allow the use of certain types of untreated graywater systems as long as specific health requirements are met as defined by the authority having jurisdiction. The ordinance can be acquired from the City of Los Angeles Department of Building and Safety (LADBS) website at the following link.

http://ladbs.org/LADBSWeb/LADBS_Forms/InformationBulletins/IB-P-PC2008-012Graywater.pdf

Graywater systems in residential buildings are regulated by LADBS. LADBS requires a plumbing permit prior to construction, reconstruction, installation, relocation, or alteration of any graywater systems, treated or untreated. As of FY 2009/10, LADWP does not offer any rebates or incentives for graywater systems, but continues to assess the potential for this water conservation technology. LADWP is also reviewing the concept of assisting in the creation of ad hoc committees to develop a standard for graywater systems.

## Untreated Graywater Systems

Untreated graywater systems are systems where graywater is collected from non-toilet and non-kitchen sources and is utilized without treatment, for uses such as landscape irrigation. According to a 1999 study prepared by the Soap and Detergent Association, the average untreated graywater system in the US uses 6.3 gallons per day. In a 2010 White Paper prepared by Bahman Sheikh, for the WateReuse Association, Water Environment Federation, and American Water Works Association the potential for graywater generation in 2030, adjusted for conservation devices, is estimated at approximately 75.5 gallons per household per day. Potentially 50 percent of indoor potable water use could be re-used as graywater. Multiple manufacturers have developed untreated graywater systems and many households have installed such systems. However, these systems are not typically monitored, thus health and safety risks associated with the products have not been determined.

Under the recently approved revisions to the graywater system regulation, LADBS does not require a permit for untreated graywater systems supplied by only a clothes washer in a one or two-family dwelling as long as the system does not require modification of existing plumbing. Multiple requirements must be met for a system to be exempt from a permit, including but not limited to:

- Discharge shall be released not less than two inches below the surface of rock, mulch, or soil.
- Designs shall incorporate a means to allow the user to divert flow to the disposal area or the building sewer.
- Design of the system shall not allow contact with humans or pets.
- Water from diapers or other similarly soiled or infectious garments shall be diverted to the building sewer.
- Hazardous chemicals from washing activities, such as soiled rags, shall be diverted to the building sewer.
- An operation and maintenance manual shall be provided and remain with the building.

## CASE STUDY:
## Single-Family Home Graywater System

As a community environmental leader, Janie Thompson is taking extraordinary steps in efficient use of water and conservation. With the help of her husband, her household has become an excellent example of a rainwater capture residence, catching rain in 18 separate rain barrels with 60 gallons each. To save even more water, the couple is installing an impressive graywater network, distributing water to the furthest extent of their large 14,850 square foot property.

*"In June 2009, when the Mayor announced the ordinance limiting watering to two days per week, we freaked out, and originally thought most of our landscaping would die. With all of our conservation, rainwater capture, and use of graywater, our usage has dropped from 117 hcf to around 54 hcf per month in the summer months. We couldn't be happier. It just goes to show you how much most people in the City over water." – Janie Thompson*

Their existing graywater system currently uses the drainage pump from the clothes washer to pump water slightly up grade to tree and flower areas of the backyard. Upon exiting the washer, a 3-way valve reserves the option to divert washer effluent to the sewer system. The graywater piping travels beneath their raised foundation home, into the subsoil, and onto the areas it serves. Once construction is complete, all piping (left) will be buried with existing soil or mulch.

When the stream is pumped to the highest point of the yard, it is sent to numerous subsoil infiltration chambers, through a distribution system of 1" HDPE (High-density polyethylene) pipe. The infiltration chambers are made from 1 gallon paint buckets turned upside down with holes cut in the bottoms (below). The chambers allow for unobstructed exit flow and appropriate soil surface area for infiltration. In addition, they provide a significant volume for water storage during the surge of a pumped load of laundry. Plant roots are attracted toward these water outlets, essentially feeding on nutrients and organics in the graywater. The tops of the chambers are cutout for frequent access, and covered with mulch or stepping stone. The pipe exits can be checked as necessary to ensure free flow.

The next steps in the construction are connection of the bathtub and bathroom sinks. Effluent from these water sources will enter a surge tank and float switch assembly. A graywater dedicated pump will then automatically push water to existing and newly installed infiltration chambers throughout the yard.

Graywater used from these indoor sources will provide two main benefits. It will displace water used for irrigation and prevent additional water from entering the sewer. This decreases the load on the City sewer system and lowers the overall cost of treatment for the Bureau of Sanitation.

The water savings are approximated in the following table. Please note that the clothes washer is a high-efficiency front loading model. Showers are estimated at 10 minutes long with a showerhead using 2.5 gallons per min.

| Yearly Water Savings | | | | |
|---|---|---|---|---|
| **Washer** | 14 gal/use | 10 uses/wk | 140 gal/wk | 7,280 gal/yr |
| **Bathtub** | 40 gal/person/day | 3 people | 840 gal/wk | 43,680 gal/yr |
| **Bath Sink** | 2 gal/person/day | 3 people | 42 gal/wk | 2,184 gal/yr |
| | | | **Total** | 53,144 gal/yr |

## Treated Graywater Systems

Treated graywater systems treat water collected from non-kitchen and non-toilet sources for nonpotable reuse indoors and outdoors. Treated graywater systems for indoor use of graywater are not currently permitted by LADBS as there are no water quality standards nor mean to certify onsite treatment systems. Testing agencies are working to address safety concerns while manufacturers are working to improve the technology gap in the systems. Both manufacturers and testing agencies are working together to address gaps in standards to allow the future use of treated graywater for outdoor surface irrigation and for indoor uses in toilets and urinals.

The National Center for Disease Control and Prevention in conjunction with North Carolina State University is developing a program to examine the public health values and impacts associated with decentralized water reuse at eight project sites across the country. Under this program wastewater from homes would be treated to Title 22 standards as required by local health regulators. One of the proposed sites is located in Los Angeles County.

On the international level, treated graywater systems are used in both Europe and Australia. However, treated graywater systems in the United States are not common. A lack of accepted standards for graywater systems imposes a financial risk to companies manufacturing graywater systems. The International Association of Plumbing and Mechanical Officials (IAPMO) and NSF International are the two testing agencies working to develop standards for uniform treated graywater systems applicability in the US. LADWP is closely following the development of the NSF Standard 350 and IAPMO standards to ensure that once a set of standards have been approved by model codes and adopted by the Building Standards Commission, the citizens of Los Angeles can safely install treated graywater systems to maximize water reuse without any health and safety risks.

## 3.3.2 Demand Hardening

Although LADWP regularly assesses new water conservation opportunities, conservation programs may, at some point in time, diminish a customer's ability to further conserve water, in particular during short-term water supply shortages caused by droughts or other emergencies. This phenomenon is known as "demand hardening." The California Urban Water Agencies defines demand hardening as, "the diminished ability or willingness of a customer to reduce demand during a supply shortage as the result of having implemented long-term conservation measures." Long term conservation measures can include hardware conservation measures, such as the installation of high efficiency toilets and behavioral conservation, such as watering during specified periods of the day.

Demand hardening occurs when options available for reducing water use are limited as the customer base is saturated with hardware conversions causing efficient water usage patterns to prevail. During "dry" years, utility customers who have actively participated in water conservation programs can be disproportionately impacted by water reductions as there is a limited ability for further conservation. The impact of demand hardening would be most prevalent during water supply shortages where customers have already been implementing long-term water conservation measures. Proponents of demand hardening believe that implementation and saturation of new hardware-based conservation devices would generally not occur rapidly enough during a water supply shortage, such as a drought, to reduce short-term water use.

However, it can be argued that hardware-based conservation devices will continue to be developed, piloted and implemented, such as the previously discussed weather based irrigation controllers, thus improving the ability to further conserve in the future. During droughts, consumers will respond to the call for more conservation by behaviorally adjusting their water use through methods such as not leaving water running and taking shorter showers. Additionally, full saturation of current conservation devices has not occurred. For these reasons, others believe demand hardening is irrelevant and there is a continued need for aggressive conservation programs.

Full implementation of current conservation measures, including reducing leaks, has the potential to reduce per capita water demands even further. Past water conservation efforts have reduced water use within LADWP's service area even though the population has continued to expand as illustrated in Exhibit 3A. It is expected that future water conservation efforts will continue this trend as increased saturation of water saving hardware devices occurs and new hardware devices are developed.

Though not easily quantifiable, saturation of current water saving hardware devices and installation of future water saving hardware devices combined with potential demand hardening have the ability to impact demand forecasts. As a worst case scenario, demand hardening and its effects are considered in LADWP's water demand forecasts to ensure that the appropriate supply of water is planned for. However, LADWP will continue to maintain its aggressive water conservation program discussed within this section. In the future, LADWP's water demand forecasts will continue to be examined and adjusted accordingly to compensate for additional implementation of long-term water conservation measures as saturation increases and new technology results in new hardware devices.

## 3.3.3 Projected Water Conservation Savings

To assist in planning future water demands, meeting the Water Supply Action Plan goal, and complying with

## *Exhibit 3I*
## *Active Conservation Projections by Sector*

| Sector | Acre-feet per Fiscal Year | | | | |
|---|---|---|---|---|---|
| | 2014/2015 | 2019/2020 | 2024/2025 | 2029/2030 | 2034/2035 |
| Single-Family Residential | 3,416 | 5,882 | 8,349 | 10,815 | 12,249 |
| Multi-Family Residential | 871 | 1,504 | 2,137 | 2,770 | 3,150 |
| Commercial/Government | 7,969 | 16,000 | 24,030 | 32,061 | 39,629 |
| Industrial | 1,924 | 3,847 | 5,824 | 7,774 | 9,339 |
| Total Active Conservation Projections | 14,180 | 27,260 | 40,340 | 53,420 | 64,368 |

20x2020 requirements, LADWP has taken numerous steps to project future water conservation savings by major customer classification for indoor and outdoor use.

Indoor and outdoor active conservation through 2035 has been estimated by major billing sectors as provided in Exhibit 3I. Values presented are cumulative year to year. The bulk of conservation is expected to occur in the indoor portion of the commercial/government sector followed by the industrial sector. Past conservation programs have heavily focused on residential conservation reflecting the smaller residential conservation projections. Residential conservation initially provided the greatest volume saved for the cost. Water use in the CII sector is varied and relatively more expensive to achieve than in the residential sector.

To determine potential conservation savings for indoor water use in the CII sector, LADWP conducted a high-level study to first estimate CII water use for each subsector (e.g. hospitals, refineries, schools, business parks, restaurants, etc.) and indoor end-use (e.g., toilets, showers, kitchen, laundry, food processing, cooling/heating, etc.), and second determine the potential for indoor water savings for each subsector and end-use.  This study involved a sample of water use for approximately 150 of LADWP's largest CII customers to estimate total sector water use, along with employment data from Dunn & Bradstreet.  Additional data sources listed below were used to determine indoor end-use estimates for each subsector, as well as the potential for water savings.

- *BMP 9: A Handbook for Implementing Commercial Industrial & Institutional Conservation Programs. (2001). California Urban Water Conservation Council.*
- *Commercial and Institutional End Uses of Water. (2000). American Water Works Association Research Foundation.*
- *Waste Not, Want Not: The Potential for Urban Water Conservation in California. (2003). Pacific Institute.*
- *Water Efficiency in the Commercial and Institutional Sector: Considerations for a WaterSense Program. (2009). U.S. Environmental Protection Agency.*
- *Watersmart Guidebook---A Water-Use Efficiency Plan-Review Guide for New Businesses. (2008). East Bay Municipal Utility District.*
- *Santa Clara Valley Water District Commercial Institutional Industrial Water Use & Conservation Baseline Study. (2008). CDM.*
- *Water and Energy Efficiency Program for Commercial, Industrial, and Institutional Customer Classes in Southern California. (2009). U.S. Bureau of Reclamation.*
- *Water Use Efficiency Comprehensive Evaluation. (2006). CALFED Bay-Delta Program.*

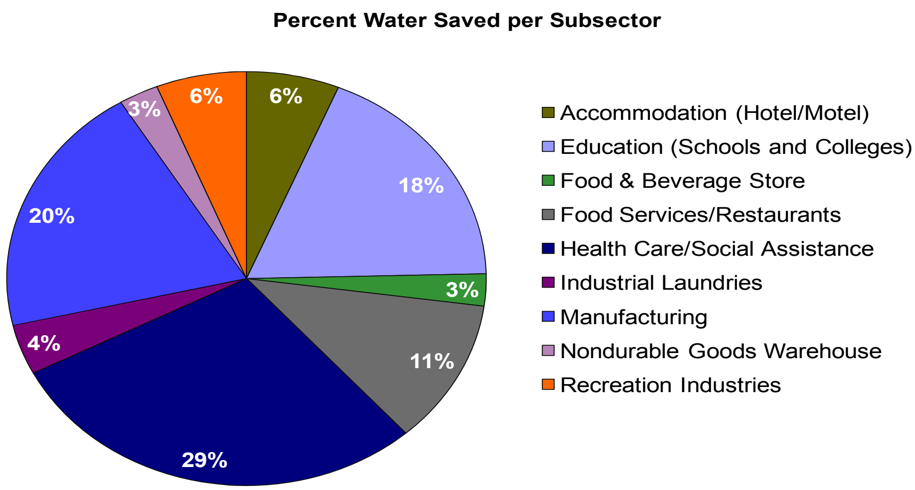
The study concluded that by targeting just the top 100 or so largest CII users, approximately 4,600 AFY of water could be saved (representing about 3 percent of total CII water use). The study also found that the subsectors that use the most water in the City are: health care (18%), education (14%), food services/drinking places (9%), accommodation (5%), fabricated metal product manufacturing (5%), textile mills (5%), amusement (4%), and food manufacturing (4%). The study also concluded that the potential for indoor water conservation was approximately 23,000 AFY or 15 percent of total CII water use. Exhibit 3J presents the breakdown of this potential indoor water conservation for subsectors and end-uses.

Outdoor water use as a percentage of total water use was approximated using three methodologies to determine the potential for outdoor water conservation savings. The methodologies and percent outdoor water use determined for each methodology are:

- Minimum-Maximum Methodology (outdoor water use is approximately 39.98 percent) – based on the premise that during wet months outdoor water use is minimal and during dry months outdoor water use is at its peak.

- Wastewater Treatment Plant Influent Methodology (outdoor water use is approximately 38.32 percent) – based on determining the average monthly influent flows to the City's four wastewater treatment plants during

***Exhibit 3J***
***Breakdown of Estimated CII Indoor Water Conservation Potential of 23,000 AF***



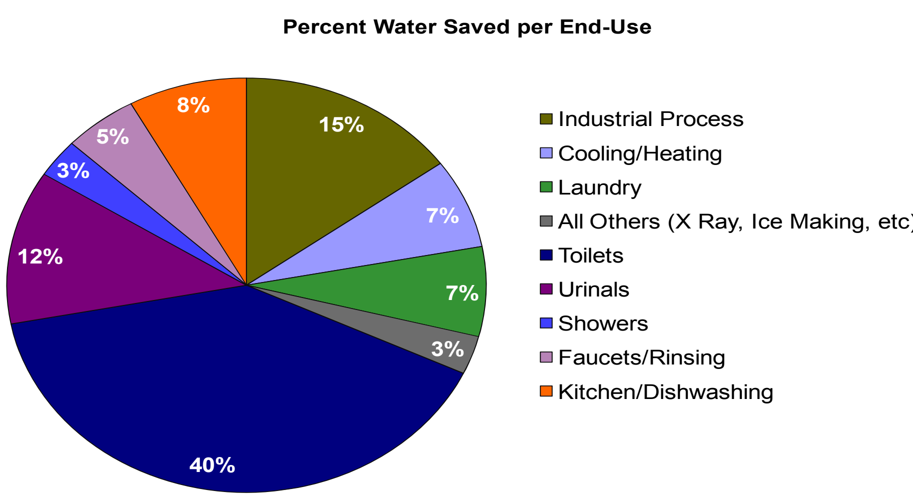



*Exhibit 3K*
*Potential Outdoor Water Use Savings by Sector*

| Customer Sector | Scenario 1 | Scenario 2 | Scenario3 |
|---|---|---|---|
| | (AFY) | | |
| Single-Family Residential | 13,246 | 42,464 | 100,901 |
| Multi-family | 5,956 | 19,095 | 45,371 |
| Commercial | 2,573 | 8,247 | 19,597 |
| **Total** | **21,774** | **69,806** | **165,870** |

the dry-weather months of June through September and adjusting for contract agency flows and dry-weather stormwater diversions.

- Infrared Analysis Methodology (outdoor water use is 39.67 percent) – based on an infrared analysis of the City to determine tree canopy and landscape coverages for use in estimating applicable water use requirements for greenscapes based on rainfall data, plant factors, evapotranspiration rates, and irrigation efficiencies.

The resultant range between the low and high outdoor water use percentage is approximately 1.35 percent. This narrow range resulting from the three methodologies confirms the methodologies are fairly accurate.

Greenscape areas related to commercial and residential land uses are the most likely areas to be targeted for outdoor water conservation. Rehabilitation of these areas to meet or exceed the evapotranspiration adjustment factor (ETAF) of 0.7 as required in the Model Water Efficient Landscape Ordinance would result in significant savings ranging from 21,774 to 165,870 AFY. Currently, these savings are not represented in the projected active conservation in Exhibit 3I. Exhibit 3K illustrates the potential savings under three scenarios by customer sectors. Scenario 1 represents an improvement in average irrigation efficiencies and/or installation of less water intensive vegetation to achieve and ETAF of 0.7. Scenario 2 represents an improvement in average irrigation efficiencies and/or replacement of high water use vegetation with less water intensive vegetation in the moderate to low water use range to achieve an ETAF of 0.49. Scenario 3 represents an improvement in average irrigation system efficiency and replacement of all vegetation with very low water use vegetation almost entirely dependent upon effective precipitation to achieve an ETAF of 0.07. This would require incentive programs, such as cash for grass programs. Other large greenscape area, including parks, cemeteries and golf courses, were not considered in the analysis as they would more than likely be preserved as turf or tree canopy areas to retain quality of life benefits. These areas are likely to be targets for recycled water use.

## 3.4 Cost & Funding

The cost range of conservation rebates, incentives, and hardware installation programs ranges from approximately $75/AF to $900/AF based on current LADWP conservation programs. More than $200 million has been invested in water conservation since 1991. Conservation is the cornerstone of LADWP's water demand management activities and ongoing investments will be made in viable programs, subject to funding availability and LADWP's ability to implement such programs. Outside sources of funding are sought to complement the City's resources. A stronger commitment is also being made to acquire outside grant funding for City conservation projects.

Currently, the funding sources for conservation are:

- Water Rates – Water conservation programs are primarily funded through water rates.
- MWD Conservation Credits Program - MWD offers both commercial and residential rebates to member agency customers that install specified conservation devices. The rebates equate to $195 per AF of water saved, or half the project cost whichever is less. In addition, MWD reimburses the LADWP for pre-approved projects when completed. In 2009 MWD reimbursed the Department $139,000 for a water broom distribution program. LADWP also expects to be reimbursed in 2011 through the MWD Member Agency Administered funding program for $968,000. The monies are reimbursement for 22.2 acres of turf reduction projects through the Department's Commercial/Industrial Drought Resistant Landscape Incentive Program.
- Outside Agency Co-Funding - Other agencies realizing benefits from conservation programs are solicited for co-funding of program costs.
- Grant Funding - LADWP has successfully received grant funding from the State under Proposition 13. A grant for $615,000 supplemented the rebate funding available for commercial ULF toilets and high efficiency clothes washers. LADWP expects to receive a final payment totaling $128,299 for the Commercial High Efficiency Clothes Washer and Ultra Low Flow Toilet Consolidated Water Use Efficiency grant. LADWP has already received $164,691 in support of 1,498 commercial high efficiency washer rebates. LADWP was awarded three grants in 2005 under Proposition 50, which are summarized below:
  - The Cooling Tower Conductivity Controller Replacement Program: Grant to improve the water efficiency of 100 cooling towers in the city of Los Angeles. Total grant amount up to $350,000. Expect completion in 2012.
  - The Los Angeles City Park Irrigation Efficiency Program: Grant to improve the irrigation efficiency at 15 City of Los Angeles municipal parks by installing Weather Based Irrigation Controllers and by upgrading irrigation piping and rotors. Total grant amount up to $362,000. Expect completion in 2011.
  - The Large Landscape "Smart Irrigation" Program: Grant to replace existing manually-adjusted irrigation controllers with "smart irrigation" Weather Based Irrigation Controllers at 75 large landscape customer sites. Total grant amount $131,000. Expect completion in 2011.

Chapter Four

# Recycled Water

## 4.0 Overview

LADWP is committed to significant expansion of recycled water in the City's water supply portfolio. Recognizing the multiple factors that are decreasing the reliability of imported water supplies, LADWP released the City of Los Angeles Water Supply Action Plan (Plan), "Securing L.A.'s Water Supply" in May of 2008. The Plan established the goal of using 50,000 AFY of recycled water to offset demands on potable supplies. In order to meet this goal, LADWP, in conjunction with the Los Angeles Department of Public Works Bureau of Sanitation (BOS), are working together to develop a Recycled Water Master Plan (RWMP). Opportunities to expand the water recycling program are being studied through development of the RWMP. Opportunities include expanding the recycled water distribution system for Non-Potable Reuse (NPR) such as for irrigation and industrial use, and replenishment of groundwater basins with highly purified recycled water. Beyond 50,000 AFY, LADWP expects to increase recycled water use by approximately 1,500 AFY annually, bringing the total to 59,000 AFY by 2035.

LADWP's water recycling program is dependent on the City's wastewater treatment infrastructure. Wastewater in the City of Los Angeles is collected and transported through some 6,500 miles of major interceptors and mainline sewers, more than 11,000 miles of house sewer connections, 46 pumping plants, and four treatment plants. BOS is responsible for the planning and operation of the wastewater program. The City's wastewater system serves 515 square miles, 420 square miles of which are within the City. Service is also provided to 29 non-City agencies through contract services. Exhibit 4A shows the City's four wastewater treatment plants and seven sewersheds that feed those plants. A portion of the treated effluent from these four wastewater plants is utilized by LADWP to meet recycled water demands.

As early as 1960, the City recognized the potential for water recycling and invested in infrastructure that processed water to tertiary quality, a high treatment standard for wastewater. This resulted in the building of tertiary wastewater treatment plants upstream instead of enlarging the two existing terminus treatment plants. These system enhancements brought about the City's expanded recycled water projects, which now supplement local and imported water supplies. The original policy allowing the use of recycled water was adopted by the State Legislature in 1969.

In 1979, LADWP began delivering recycled water to the Department of Recreation and Parks for irrigation of areas in Griffith Park. This service was later expanded to include Griffith Park's golf courses.

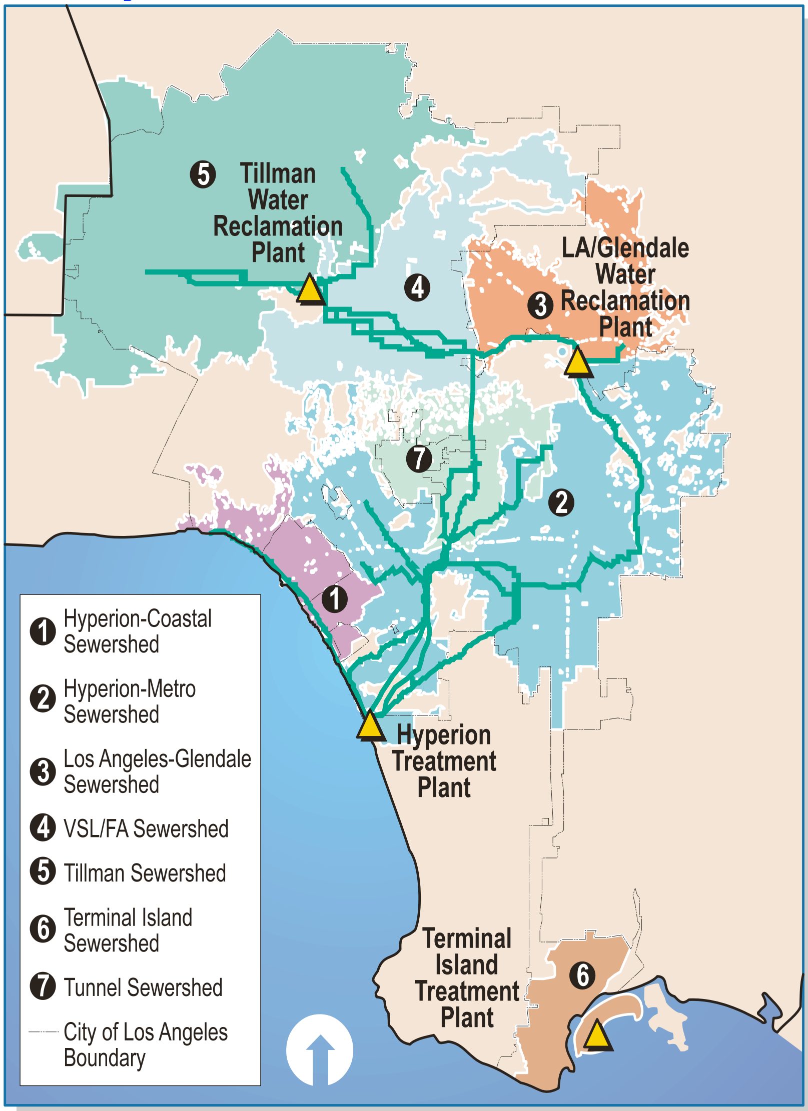



***Exhibit 4A City Wastewater Treatment Plants and Sewersheds***

In 1984, freeway landscaping adjacent to the park was also irrigated with recycled water. In addition, the Japanese Garden, Balboa Lake and Wildlife Lake in the Sepulveda Basin now utilize recycled water for environmentally beneficial reuse purposes. The Greenbelt Project, which carries recycled water from the Los Angeles-Glendale Water Reclamation Plant to Forest Lawn Memorial Park, Mount Sinai Memorial Park, Lakeside Golf Club of Hollywood and Universal Studios, began operating in 1992, and represents LADWP's first project to supply recycled water to non-governmental customers. LADWP continues to successfully implement the use of recycled water for various purposes. In 2009, phase 1 of the Playa Vista development began receiving recycled water. Playa Vista is the first planned development in the City that uses recycled water for all landscape needs. LADWP serves approximately 130 customers with recycled water for irrigation, industrial, and environmental beneficial uses. Future recycled water projects will continue to build on the success of these prior projects so that recycled water becomes a more prominent component of the City's water supply portfolio.

The City's water recycling projects seek to displace the use of potable water with recycled water for non-potable uses where infrastructure is available. In compliance with Chapters 7.0 and 7.5 of the California Water Code recycled water meets all of the following conditions:

- The source of recycled water is of adequate quality for these non-potable uses.
- The recycled water may be furnished for these uses at a reasonable cost to the user.
- The use of recycled water from the proposed source will not be detrimental to public health.
- The use of recycled water will not adversely affect downstream water rights or degrade water quality.

In addition, the California Water Code requires public agencies, such as the LADWP, to serve recycled water for non-potable uses if suitable recycled water is available.

LADWP is expanding irrigation and industrial/commercial uses of recycled water, and studying groundwater replenishment (GWR). Demand for recycled water is driven by customer acceptance of recycled water as a viable alternative to traditional potable supplies. Outreach efforts designed to educate the public on the viability of recycled water and its potential uses are an essential part of the process as the City's recycled water program expands.

## 4.1 Regulatory Requirements

Recycled water use is governed by regulations at the State and local levels. These regulations are based on multiple factors including the type of use and water quality. LADWP currently provides recycled water for non-potable reuse and is pursuing indirect potable reuse through GWR using advanced treated recycled water. Requirements for these two categories of recycled water use are different. This section provides a summary of the complex recycled water regulations. A more in-depth description of these regulations will be included as part of the RWMP.

### 4.1.1 Non-Potable Reuse Regulations

Non-potable water reuse regulations in the City of Los Angeles are governed by the California Department of Public Health (CDPH), State Water Resources Control Board (SWRCB), Los Angeles Regional Water Quality Control Board (LARWQCB) and the Los Angeles County Department of Public Health (LACDPH).

#### California Department of Public Health

Criteria and guidelines for the production and use of recycled water were established by the CDPH in the California Code of Regulations, Title 22, Division 4, and Chapter 3 (Title 22). Title 22, also known as Water Recycling Criteria, establishes required wastewater treatment levels and recycled water quality levels dependent upon the end use of the recycled water. Title 22 additionally establishes recycled water reliability criteria to protect public health.

Title 22 specifies recycled water use restrictions based on the potential degree of public exposure to the water and the distance of drinking water wells and edible crops from the area of intended use. Recycled water use applicability also depends on the different levels of treatment. A higher quality water will have a wider variety of applicable uses than a lower quality water. At a minimum, secondary treatment of wastewater is required for recycled water use. In the City of LA, however, all recycled water used is treated, at a minimum, to tertiary levels with additional disinfection. Wastewater treatment levels are discussed in detail in subsection 4.2 of this chapter. Title 22 allows for other treatment methods, subject to CDPH approval. The reliability of the treatment process and the quality of the product water must meet the Title 22 requirements specified for each allowable treatment level. Exhibit 4B provides a summary of the currently approved recycled water uses.

Areas where recycled water is used occur within defined boundaries. Title 22 stipulates use area requirements to protect public health. Use area regulations include requirements addressing recycled water application methods and runoff near domestic water supply wells, drinking fountains, and residential areas. Other requirements include posting signs notifying the public where recycled water is being used, utilization of quick couplers instead of hose bibs, and the prohibition against connecting recycled water systems with potable water systems. Dual-plumbed recycled water systems in buildings are also addressed. These systems must meet additional reporting and testing requirements.

To protect public health, Title 22 requires reliability mechanisms. During the design phase, a Title 22 Engineering Report is required to be submitted to CDPH and the local Regional Water Quality Control Board (RWQCB) for approval. Contents of the report include a description of the system and an explanation regarding how the system will comply with Title 22 requirements. Redundancy in treatment

## Exhibit 4B Allowable Title 22 Recycled Water Uses

| | |
|---|---|
| **Irrigation Uses** | |
| | Food crops where recycled water contacts the edible portion of the crop, including all root crops |
| | Parks and playgrounds |
| | School yards |
| | Residential landscaping |
| | Unrestricted access golf courses |
| | Any other irrigation uses not prohibited by other provisions of the California Code of Regulations |
| | Food crops, surface irrigated, above ground edible portion, and not contacted by recycled water |
| | Cemeteries |
| | Freeway landscaping |
| | Restricted access golf course |
| | Ornamental nursery stock and sod farms with unrestricted public access |
| | Pasture for milk animals for human consumption |
| | Non edible vegetation with access control to prevent use as park, playground or school yard |
| | Orchards with no contact between edible portion and recycled water |
| | Vineyards with no contact between edible portion and recycled water |
| | Non food bearing trees, including Christmas trees not irrigated less than 14 days before harvest |
| | Fodder and fiber crops and pasture for animals not producing milk for human consumption |
| | Seed crops not eaten by humans |
| | Food crops undergoing commercial pathogen destroying processing before consumption by humans |
| | Supply for impoundment |
| | Non restricted recreational impoundments, with supplemental monitoring for pathogenic organisms |
| | Restricted recreational impoundments and publicly accessible fish hatcheries |
| **Supply for Impoundment Uses** | |
| | Non restricted recreational impoundments, with supplemental monitoring for pathogenic organisms |
| | Restricted recreational impoundments and publicly accessible fish hatcheries |
| | Landscape impoundments without decorative fountains |
| **Supply for cooling or air conditioning** | |
| | Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or |
| | spraying that creates a mist |
| | Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative |
| | condenser, or spraying that creates a mist |
| **Other Uses** | |
| | Dual plumbing systems (flushing toilets and urinals) |
| | Priming drain traps |
| | Industrial process water that may contact workers |
| | Structural fire fighting |
| | Decorative fountains |
| | Commercial laundries |
| | Consolidation of backfill material around potable water pipelines |
| | Artificial snow making for commercial outdoor uses |
| | Commercial car washes, not heating the water, excluding the general public from washing process |
| | Industrial process water that will not come into contact with workers |
| | Industrial boiler feed |
| | Nonstructural fire fighting |
| | Backfill consolidation around non potable piping |
| | Soil compaction |
| | Mixing concrete |
| | Dust control on road and streets |
| | Cleaning roads, sidewalks and outdoor work areas |
| | Flushing sanitary sewer |
| | Groundwater replenishment |

units or other means to treat, store, or dispose of recycled water are required in case the treatment unit is not operating within specified parameters. Alarms for operators are required to indicate treatment plant process failures or power failures. In case of power failures, either back-up power, automatically activated short-term or long-term recycled water storage, or a means of disposal is required. Furthermore, system performance must be monitored by water quality sampling and analyses.

As mentioned previously, cross-connections between the potable and recycled water systems are not permitted. The California Code of Regulations, Title 17, Division 1, Chapter 5, Group 4 prevents cross-connections between potable water supply systems and recycled water supply systems. Title 17 specifies that water suppliers must implement cross-connection control programs and backflow prevention systems.

In addition to Title 22 and Title 17 requirements, CDPH has additional regulations and guidance established in the following documents:

- Guidelines for the Preparation of an Engineering Report for the Production, Distribution, and Use of Recycled Water (2001)

- Guidance Memo No. 2003-02: Guidance for the Separation of Water Mains and Non-Potable Pipelines (2003)

- Treatment Technology Report for Recycled Water (2007)

### State Water Resources Control Board and Los Angeles Regional Water Quality Control Board

In May 2009, the SWRCB adopted "Recycled Water Policy" developing uniform standards across all Regional Water Quality Control Boards for interpreting the "Anti-Degradation Policy". When planning and implementing recycled water projects the following must be taken into consideration:

- Mandate for recycled water use – encourages recycled water use and establishes targets to increase use.

- Salt/nutrient management plans –

requires submittal of salt/nutrient management plans by 2014.

- Landscape irrigation projects' control of incidental runoff and streamlined permitting – addresses controlling incidental runoff and streamlining permit processes for recycled water use in landscape areas.

- Groundwater replenishment – establishes requirements for groundwater replenishment projects.

- Anti-degradation – establishes that salt and nutrient management plans can address groundwater quality impacts.

- Chemicals of emerging concern – establishes a blue-ribbon advisory panel to develop a report on chemicals of emerging concern and update the report every five years.

Water recycling requirements for each of the City's applicable wastewater treatment plants engaged in water recycling are issued by the LARWQCB. These requirements specify end-users of recycled water and enforce treatment and use area requirements.

In July 2009, the SWRCB adopted a general landscape irrigation permit, "General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water" (General Permit). The General Permit streamlines the regulatory approval for landscape irrigation using recycled water. Agencies with existing water recycling requirements, such as the City, are not required to apply for the General Landscape Irrigation Permit.

Earlier in April 2009, the LARWQCB adopted a general region-wide permit, "General Waste Discharge and Water Recycling Requirements for Non-Irrigation Uses over the Groundwater Basins Underlying the Coastal Watersheds of Los Angeles and Ventura Counties" for non-irrigation uses of recycled water. Similar to the General Permit, this permit streamlines the permitting process and specifies the application process for qualifying projects.

### Los Angeles County Department of Public Health

Title 22 and Title 17 water use regulations are enforced by the LACDPH, Environmental Health Division. LACDPH has published "A Guide to Safe Recycled Water Use, Pipeline Construction and Installation" requiring compliance with Title 22, CDPH, and LARWQCB requirements. After CDPH has approved the plans and specifications and the City has an agreement to serve the customer, LACDPH reviews and approves all plans and specifications prior to construction. After construction LACDPH inspects the systems and conducts cross-connection, pressure, and back-flow prevention device tests. Recycled water use must occur in compliance with the Los Angeles County Recycled Water Advisory Committee's "Recycled Water Urban Irrigation User's Manual". Each site must also have a site supervisor responsible for recycled water use.

### City of Los Angeles

Recycled water responsibilities of the City of Los Angeles include complying with all LARWQCB permits for the wastewater treatment plants and production of recycled water, approving recycled water use sites, conducting post-construction inspections, and periodically inspecting use areas and site supervisor records.

LADWP customers are permitted to use recycled water when service is available per LADWP Ordinance No. 170435 (subsequently amended by Ordinance No. 178902 in 2008). Users are responsible for the operation and maintenance of their recycled water systems up to the connection point with LADWP. Users are required to use recycled water in accordance with Titles 22 and 17 and the "Recycled Water Urban Irrigation User's Manual."

## 4.1.2 Groundwater Replenishment Regulatory Requirements

The regulations governing recharge of groundwater or groundwater replenishment (GWR) with recycled water are established by the CDPH and LARWQCB. The City's GWR project as described in section 4.4.3 will be subject to these regulations.

For GWR, LADWP will implement advanced treatment that includes reverse osmosis, microfiltration, and advanced oxidation. This level of treatment addresses water quality concerns for the health of the basin along with emerging contaminants of concern.

### California Department of Public Health

Regulatory oversight of GWR projects is provided by the CDPH. CDPH regulates GWR projects under Title 22, making recommendations on a case-by-case basis after a public hearing. Requirements for replenishment are not provided in Title 22. Draft GWR Reuse Criteria, released in August 2008, are used by the CDPH to evaluate projects for approval or denial. The draft regulations are designed to protect public health by:

- Requiring recycled water to meet maximum contaminant levels (MCLs) established for drinking water.
- Establishing the volume of recycled water used based on Total Organic Carbon (TOC), dilution, and treatment levels.
- Requiring recycled water to be retained in a groundwater basin for six months before reaching a well used for drinking water with validation by a tracer study.
- Requiring quarterly monitoring for specified pollutants and chemicals and yearly monitoring of constituents indicating the presence of wastewater in produced recycled water and in downgradient monitoring wells.
- Implementing a source control program.
- Establishing additional requirements for projects with recycled water contributions greater than 50 percent, including a review by an Independent Advisory Panel.

As also required for non-potable reuse, project proponents must submit a Title 22 Engineering Report to the CDPH and LARWQCB for review. After completion of the report, the CDPH holds a public hearing followed by issuance of Findings of Fact and Conditions for submission to the LARWQCB.

### Los Angeles Regional Water Quality Control Board

Prior to the issuance of a permit, the LARWQCB reviews CDPH's Findings of Fact and Conditions and considers provisions in the adopted Los Angeles Basin Plan (Basin Plan) for the LARWQCB region, applicable State policies (including the SWRCB Recycled Water Policy), and applicable federal regulations if recycled water is discharged to "Waters of the U.S." The Basin Plan establishes water quality objectives for surface water and groundwater to protect beneficial uses. The LARWQCB then holds a public hearing to consider the permit. Ultimately, if approved, permits are issued by the LARWQCB in the form of water reclamation requirements and waste discharge requirements.

## 4.2 Wastewater Treatment Plants

There are four wastewater treatment plants owned and operated by the BOS. City wastewater treatment consists of a series of processes that, at a minimum, remove solids to a level sufficient to meet regulatory water quality standards. During the preliminary, primary, secondary, and tertiary treatment processes, progressively finer solid particles are removed. Preliminary treatment removes grit and large particles through grit removal basins and screening. Primary treatment relies on sedimentation to remove smaller solids. With most of the grit, large particles, and solids already removed, secondary treatment converts organic matter into harmless by-products and removes more solids through biological treatment and further sedimentation. At the end of secondary treatment, most solids will have been removed from the water. Tertiary treatment follows secondary treatment to eliminate the remaining impurities through filtration and chemical disinfection. At this stage, sodium hypochlorite (the chemical contained in household bleach) provides disinfection. All recycled water used within the City undergoes, at a minimum, tertiary treatment and disinfection. In the Harbor Area, recycled water also undergoes advanced treatment with microfiltration/reverse osmosis (MF/RO) and is injected into the Dominguez Gap Barrier to protect against seawater intrusion. MF/RO is a two-stage process using high-pressure membrane filters to remove microscopic impurities from the source water. Exhibit 4C summarizes the treatment levels, capacity, and average flows at the four plants.

***Exhibit 4C  Wastewater Treatment Plants Summary***

| WastewaterTreatment Plants | Treatment Level | Capacity (mgd) | Average Flows (mgd)[1] |
|---|---|---|---|
| Donald C. Tillman Water Reclamation Plant (DCT) | Tertiary to Title 22 standards with Nitrification/Denitrification | 80 | 32 |
| Los Angeles - Glendale Water Reclamation Plant (LAG) | Tertiary to Title 22 standards with Nitrification/Denitrification | 20 | 17 |
| Terminal Island Water Reclamation Plant (TIWRP) | Tertiary; Advanced treatment (MF/RO) of 5 mgd | 30 | 16 |
| Hyperion Treatment Plant (HTP) | Full secondary[2] | 450 | 299 |

1. Average FY 2009/10.flows. Approximately 13 mgd is currently diverted from DCT to HTP.

2. 34 mgd of full secondary treated water delivered to West Basin Water Reclamation Plant operated by West Basin Municipal Water District. Water treated to Title 22 standards for recycled water use.

Source: City of Los Angeles, Bureau of Sanitation, Draft Recycled Water Use FY 2009/10.

## 4.2.1 Donald C. Tillman Water Reclamation Plant

In service since 1985, the Donald C. Tillman Water Reclamation Plant (DCT) has an average dry-weather flow capacity of 80 million gallons per day (mgd) and currently treats about 32 mgd. During wet weather, treatment is limited to 40 mgd to prevent downstream infiltration surcharges on the sewer system while utilizing the remaining capacity for limited wet weather storage. Currently, the Los Angeles Department of Public Works – Bureau of Engineering (BOE) is designing wet-weather storage basins to allow year round operation at 80 mgd. The current level of treatment is Title 22 (tertiary) with nitrogen removal (nitrification/denitrification (NdN)). DCT provides recycled water for the Japanese Garden, Wildlife Lake, Lake Balboa, treatment plant reuse, and irrigation and industrial uses. Irrigation uses in the adjacent areas include golf courses, parks, and a sports complex. Industrial uses include the Valley Generating Station. The remaining tertiary-treated water is discharged into the Los Angeles River. A GWR project is being planned that will purify DCT effluent, utilizing advanced treatment to recharge the San Fernando Groundwater Basin. The project will initially recharge 15,000 AFY with the eventual goal of achieving 30,000 AFY.

## 4.2.2 Los Angeles-Glendale Water Reclamation Plant

The Los Angeles-Glendale Water Reclamation Plant (LAG) is a joint project of the City of Los Angeles and City of Glendale. LAG began treating wastewater in 1976. Its average dry-weather flow design capacity is 20 mgd and it currently treats about 17 mgd. Each city is entitled to 50 percent of the plant's capacity. The City of Pasadena purchased rights to 60 percent of Glendale's capacity but has not yet exercised these rights. The current level of treatment is Title 22 (tertiary) with nitrogen removal (NdN). Recycled water from the LAG provides landscape irrigation to Griffith Park and the Los Angeles Greenbelt Project, including Forest Lawn Memorial Park, Mount Sinai Memorial Park, Universal Studios, and the Lakeside Golf Course. The City of Glendale retains the right to half of the recycled water produced at the plant and serves a number of customers in their service area. As with the DCT, the remaining tertiary-treated water from LAG is discharged into the Los Angeles River.

## 4.2.3 Terminal Island Water Reclamation Plant

Originally built in 1935, the Terminal Island Water Reclamation Plant (TIWRP) has been providing secondary treatment since the 1970s. Tertiary treatment systems were added in 1996. TIWRP has a current average dry-weather flow capacity of 30 mgd and treats about 16 mgd. The recently completed Advanced Wastewater Treatment Facility adds MF/RO treatment to a portion of the wastewater effluent to produce approximately 3.0 mgd of recycled water. Recycled water is supplied to the Dominguez Gap Seawater Intrusion Barrier to reduce seawater intrusion into drinking water aquifers, and to LADWP's Harbor Generating Station for landscape irrigation. The remaining TIWRP effluent is discharged to the Los Angeles Harbor. Future recycled water production is expected to increase to more fully supply the Dominguez Gap Seawater Intrusion Barrier along with other potential customers in the Harbor Area.

## 4.2.4 Hyperion Treatment Plant

Operating since 1894, the Hyperion Treatment Plant (HTP) is the oldest and largest of the City's wastewater treatment plants. Its $1.2 billion construction upgrade, completed in 1999, allows for full secondary treatment. The current average dry-weather flow capacity of HTP is 450 mgd, with an average wastewater flow of 299 mgd. A majority of the treated water is discharged through a 5-mile outfall into the Santa Monica Bay, and the rest, approximately 31 mgd, is delivered to the West Basin Water Reclamation Plant to meet recycled demands in the West Basin Municipal Water District (WBMWD) service area and parts of the City of Los Angeles. As of 2008, approximately 37,000 AFY of water from HTP Plant is sold to WBMWD for additional treatment. A portion of this water is bought back by LADWP to serve to customers in West Los Angeles, and the rest is then used to meet recycled water demands in WBMWD's service area. Customers in West Los Angeles include Loyola Marymount University and Playa Vista.

## 4.2.5 Projected Wastewater Volume

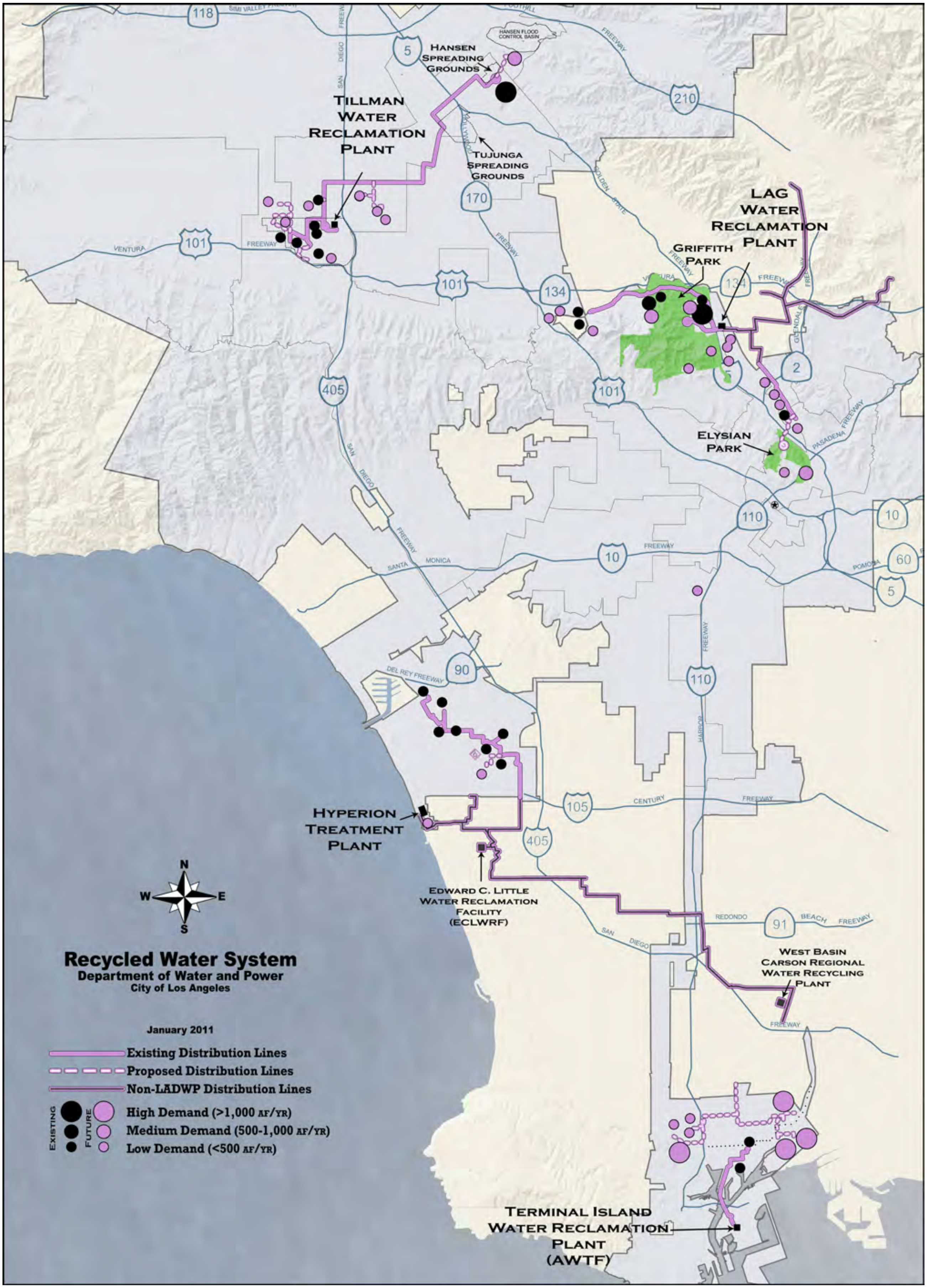
Average dry-weather wastewater influent projections for the City's wastewater treatment plants are expected to increase by approximately 20 percent over the next 25 years. Projections include flows from 29 agencies outside of the City with contracts for wastewater treatment. Wastewater effluent that is not recycled is discharged to either the Pacific Ocean via the Los Angeles River, or to outfalls leading directly to the Pacific Ocean. Wastewater treatment projections of average dry-weather flows through 2035, and associated disposal methods, are provided in Exhibit 4D.

***Exhibit 4D Wastewater Treatment Plant Average Dry-Weather Flows, Reuse and Discharge Method***

| Wastewater Treatment Plants | Reuse and Discharge Method | Average Dry-Weather Flow Projections (AFY) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Actual 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
| Donald C. Tillman Water Reclamation Plant | Recycling and Pacific Ocean via Los Angeles River | 36,000 | 84,000 | 86,000 | 88,000 | 90,000 | 93,000 |
| Los Angeles - Glendale Water Reclamation Plant | Recycling and Ocean via Los Angeles River | 19,000 | 25,000 | 27,000 | 29,000 | 32,000 | 34,000 |
| Terminal Island Water Reclamation Plant | Recycling and Outfall to Ocean | 18,000 | 19,000 | 19,000 | 19,000 | 20,000 | 20,000 |
| Hyperion Treatment Plant | Conveyance to WBMWD for Recycling and Ocean outfall | 335,000 | 340,000 | 346,000 | 352,000 | 366,000 | 381,000 |
| Total | | 408,000 | 468,000 | 478,000 | 488,000 | 508,000 | 528,000 |

Source: City of Los Angeles, Bureau of Sanitation, Draft Recycled Water Use FY 2009/10. 2015 – 2035 projections from Sanitation's "Project Flow Summary_consultants" file. Data is generated from "Mike Urban" sewer flow projection model, and represents sewershed flows.

## *Exhibit 4E*
## *Recycled Water System*



## 4.3 Existing Recycled Water Deliveries

The City has several recycled water projects currently providing recycled water for landscape irrigation, industrial, and commercial uses spread throughout four service areas:

- Harbor – located in the southern portion of the City and currently served by TIWRP.
- Central City (Metro) – located in the central/eastern portion of the City and served by LAG.
- San Fernando Valley – located in the northern portion of the City and served by DCT.
- Westside – located in the central/western portion of the City and served by HTP through the WBMWD Edward C. Little Water Recycling Facility (ECLWRF).

Locations of the service areas are depicted in Exhibit 4E. Recycled water service areas coincide with potable water service areas. Recycled water deliveries for 2009 were 38,000 AFY, inclusive of municipal and industrial, environmental, and in-plant reuse. Estimated annual average demands for online projects were 39,000 AFY.

### 4.3.1 Harbor Area

Recycled water in the Los Angeles Harbor Area is currently produced at the Advanced Water Treatment Facility (AWTF) located at the TIWRP. The AWTF began operating in 2002 with first deliveries to the Dominguez Gap Seawater Barrier in 2006. This project was developed jointly by LADWP, the Bureau of Sanitation (BOS), and BOE. Operation and maintenance is provided by BOS with funding from LADWP. Recycled water, treated using microfiltration and reverse osmosis, is currently used for landscape irrigation and groundwater injection with current demands of approximately 3,050 AFY. Treatment capacity of the AWTP is approximately 5,600 AFY. Excess recycled water is

*Exhibit 4F Harbor Recycling*

| Program | Existing Annual Demand (AFY) |
|---|---|
| Irrigation | |
| Harbor Generating Station | 50 |
| Seawater Barrier | |
| Dominguez Gap Barrier (Water Replenishment District) | 3,000 |
| **Total Harbor Water Recycling Project** | **3,050** |

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Existing and Tier 1 Recycled Water Systems TM, December 14, 2009 and LADWP Water Recycling Staff

discharged into the Los Angeles Harbor. Exhibit 4F summarizes typical annual demands in the Harbor Area. Currently two customers are served: LADWP's Harbor Generating Station and the Water Replenishment District (WRD).

### Water Replenishment District

The WRD's recycled water demands are approximately 3,000 AFY for groundwater injection for the Dominguez Gap Seawater Intrusion Barrier. 50 percent recycled water and 50 percent imported water is injected into the barrier to protect the West Coast Groundwater Basin from seawater intrusion.

LADWP is currently expanding recycled water infrastructure in the Harbor Area to serve large industrial and additional irrigation customers. This will increase recycled water usage by at least 9,300 AFY by FY 2014/15.

## 4.3.2 Metro Area

The Metro Recycled Water System has supplied the Metro Service Area with recycled water produced at LAG to irrigation customers since 1979. LAG provides recycled water treated to a tertiary level meeting Title 22 standards with nitrogen removal. As previously stated, recycled water produced at LAG is equally split between the cities of Los Angeles and Glendale. Current recycled water demands for the Metro Service Area are 1,930 AFY. Unused recycled water is discharged to the Los Angeles River. Exhibit 4G summarizes current demands for Metro Recycled Water System. Currently, eleven customers are served by the Metro Recycled Water System.

### Griffith Park Project

Started in 1979, the Griffith Park project was the City's first recycled water project. Recycled water is used to irrigate two golf courses, parkland, and the Los Angeles Zoo parking lot. Current demands in the Griffith Park Project's service area are 1,120 AFY.

### Greenbelt Project

Dedicated in 1992, the Los Angeles Greenbelt Project was the City's first commercial recycling project. Recycled water is used for landscape irrigation at Forest Lawn Memorial Park-Hollywood Hills, Mount Sinai Memorial Park, Lakeside Golf Course and Universal Studios. Current demands in the Greenbelt Project's service area are 720 AFY.

### Taylor Yard Project

Rio de Los Angeles State Park was connected as the first Taylor Yard project in July 2009. Recycled water is used for landscape irrigation on the park. Current demands in the Taylor Yard Project's service area are 90 AFY.

***Exhibit 4G Metro Recycling***

| Program | Existing Annual Demand (AFY) |
|---|---|
| Irrigation | |
| Greenbelt Project | 1120 |
| Griffith Park | 720 |
| Taylor Yard Project | 90 |
| **Total Irrigation** | **1,930** |

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Existing and Tier 1 Recycled Water Systems TM, December 14, 2009 and LADWP Water Recycling Staff

### *Exhibit 4H Valley Recycling*

| Program | Existing Annual Demand (AFY) |
|---|---|
| Irrigation | |
| Sepulveda Basin Project | 1570 |
| Van Nuys Area Project | 14 |
| **Subtotal Irrigation** | 1,584 |
| Industrial | |
| Hansen Area Project | |
| Valley Generating Station | 2,100 |
| DCT Reuse[1] | 2,920 |
| **Subtotal Industrial** | 5,020 |
| Environmental Use[2] | |
| Japanese Garden | 4,590 |
| Wildlife Lake | 7,700 |
| Balboa Lake | 14,700 |
| **Subtotal Environmental Use** | 26,990 |
| **Total Valley Recycled Water System** | **33,594** |

1. Based on 2006-2008 actual use.
2. Does not include environmental benefits provided to Los Angeles River.
Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Existing and Tier 1 Recycled Water Systems TM, December 14, 2009 and LADWP Water Recycling Staff

## 4.3.3 San Fernando Valley Area

The Valley Recycled Water System receives water from DCT to satisfy irrigation, environmental, and industrial demands. Recycled water is treated to a tertiary level meeting Title 22 standards with nitrogen removal. Current estimated recycled water demands for the San Fernando Valley Area are 33,594 AFY. Recycled water produced in excess of demand is discharged to the Los Angeles River providing added environmental benefits. Exhibit 4H summarizes current demands for the Valley Recycled Water System. The East Valley trunkline, a 54-inch-diameter pipeline, was previously constructed as the initial backbone of the Valley Recycled Water System's distribution system to deliver water throughout the San Fernando Valley for irrigation, commercial, and industrial use. Eleven customers are currently served by the Valley Recycled Water System, excluding DCT reuse and environmental use.

### Sepulveda Basin Project

LADWP began serving recycled water to portions of the Sepulveda Basin area in 2007. The latest project was added in 2010. Current recycled water customers in the Sepulveda Basin recreation area include Woodley Golf Course, Balboa Golf Course, Encino Golf Course, Anthony C. Beilenson Park, Van Nuys Golf Course and the Balboa Sports Complex. Current demands in the recreation area are 1,570 AFY.

### Van Nuys Area Project

The Van Nuys Area project currently provides recycled water for irrigation purposes to St. Elisabeth's Church, the First Foursquare Church of Van Nuys, Van Nuys High School, and LADWP's Power Distribution Station 81. Current Van Nuys Area Project demands are 14 AFY.

### Hansen Area Project

The Hansen Area project currently provides recycled water for industrial purposes to LADWP's Valley Generating

Station. Recycled water service began in 2008 and demands are approximately 2,100 AFY. Recycled water is used in a cooling tower for one of the generation units at the power generating facility.

### Donald C. Tillman Water Reclamation Plant Reuse

Recycled water is used at DCT for in-plant purposes. Demands vary from year to year based on needs. Between 2006 and 2008 an average of 2,920 AFY was used.

### Environmental Use

Recycled water from DCT has provided environmental benefits since 1984, commencing with deliveries to the Japanese Garden and followed by deliveries to Balboa Lake in 1990 and Wildlife Lake in 1991. Approximate demands are 26,990 AFY. Overflows from these facilities are discharged to the Los Angeles River to provide additional environmental benefits in conjunction with unused recycled water discharges to the river.

### Japanese Garden

The 6.5-acre Japanese Garden is located at the Sepulveda Dam Recreation Area. The Garden receives more than 10,000 visitors per year. DCT provides about 4,590 AFY of recycled water for the lake and landscaping at the Japanese Garden.

### Wildlife Lake

Located in the Sepulveda Basin, the Wildlife Lake uses about 7,700 AFY of recycled water from DCT for wildlife habitat management.

### Lake Balboa

Lake Balboa is the centerpiece of the Sepulveda Dam Recreation Area and is a popular recreational facility located in Anthony C. Beilenson Park. About 14,700 AF per year of recycled water is provided for this lake from DCT.

## 4.3.4 Westside Area

Recycled water supplied to the Westside Recycled Water System is provided by WBMWD via the Edward C. Little Water Recycling Facility (ECLWRF), located in the City of El Segundo, for irrigation and commercial (toilet flushing) demands. The ECLWRF further treats up to 40 mgd of secondary-treated effluent received from HTP to a tertiary level meeting Title 22 standards. Under an agreement between WBMWD and the City, WBMWD purchases secondary-treated effluent from HTP, and LADWP has a right to purchase up to 25,000 AFY of recycled water from the ECLWRF. Approximately 37,300 AF of secondary-treated effluent was purchased from HTP in 2008, and LADWP purchased 380 AF of recycled water to serve West Los Angeles. Recycled water not purchased by LADWP is sold to users within WBMWD's service area.

Deliveries of recycled water from the Westside Recycled Water System first began in 1996. To increase the use of recycled water in West Los Angeles, LADWP has constructed

***Exhibit 4I***
***Westside Recycled Water System Existing Annual Demand***

| Program | Existing Annual Demand (AFY) |
|---|---|
| Playa Vista Phase 1 (95 customers) | 205 |
| Coldwell Banker | 2 |
| Cal Trans at Playa Vista | 5 |
| Los Angeles International Airport | 158 |
| Westchester Golf Course | 62 |
| Loyola Marymount University | 64 |
| Westchester Park | 43 |
| Scattergood Generating Station | 31 |
| Carl Nelson Youth Park | 16 |
| The Parking Spot | 1 |
| Street Medians | 4 |
| Hyperion Treatment Plant[1] | 85 |
| Total Westside Recycled Water System | 676 |

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Existing and Tier 1 Recycled Water Systems TM, December 14, 2009 and LADWP Water Recycling Staff

more than five miles of distribution trunk lines to serve the Westchester, Los Angeles International Airport, and Playa Vista development areas. Current estimated recycled water demands in West Los Angeles are 676 AFY as shown in Exhibit 4I. Currently, 106 customers are served by the system.

### Playa Vista

Playa Vista is the first planned development in the City to use recycled water for the irrigation of all of its landscaping and for residential outdoor use. This project began receiving recycled water in 2009. Recycled water is required for outdoor use under the development's mitigation requirements established during the environmental review process. Recycled water is additionally used for toilet flushing in commercial buildings. Annual demands are approximately 200 AFY.

### Los Angeles International Airport

Los Angeles International Airport began using recycled water in 1996 for landscape irrigation purposes along its boundaries. Current demands for the airport are 158 AFY.

### Loyola Marymount University

Loyola Marymount University has been connected to the Westside system since 1996. Recycled water is used for landscape irrigation on a portion of the campus. Average annual demands are approximately 65 AFY.

### Westchester Golf Course

Westchester Golf Course began using recycled water in 2009 for irrigation. Current demands for the golf course are 62 AFY.

### Westchester Park and Carl Nelsen Youth Park

Westchester and Carl Nielsen Youth Parks both use recycled water for landscape irrigation. Both parks were connected to the system in 1996. Westchester Park demands are approximately 43 AFY and Carl Nielsen Youth Park demands are 16 AFY.

### Scattergood Generating Station

Scattergood Generating Station operated by LADWP and located in El Segundo receives recycled water to meet irrigation demands. Average annual demand is approximately 31 AFY. The pipeline servicing the facility is oversized to potentially provide cooling water in the future.

### Street Medians and The Parking Spot

Street medians on Manchester Avenue and The Parking Spot were connected to the recycled water system in 2008 and 2003, respectively. Recycled water is served to both facilities to meet irrigation demands. The Parking Spot is a commercially operated parking facility near Los Angeles International Airport. Demands for The Parking Spot are approximately 1 AFY and demands for the street medians are approximately 5 AFY.

### Hyperion Treatment Plant

HTP uses recycled water for both landscape irrigation and toilet flushing within the administration building. HTP was connected to the system in 1996. About 65 AF of recycled water are provided to HTP per year.

## 4.3.5 Comparison of 2010 Projections Versus Actual Use

LADWP has made progress in increasing recycled water use in the interim period between completion of the 2005 and 2010 UWMPs. Municipal and industrial recycled water use between 2005 and 2010 increased from 1,500 AFY to 6,703 AFY. The 2005 UWMP projected municipal and industrial recycled water

### *Exhibit 4J*
### *2005 UWMP Recycled Water Projections for 2010 versus Actual Use*

| Program | 2005 Projection for 2010 (AFY) | 09/10 Actual Use (AFY) |
|---|---|---|
| Municipal & Industrial Purposes[1] | 16,950 | 6,703 |
| Environmental Use[2] | 26,990 | 25,008 |
| **Total** | **43,940** | **31,711** |

1. These recycled water supplies offset the demand for imported water within LADWP's service area, but do not include DCT reuse of 2,920 AFY and deliveries to WBMWD of 34,000 AFY.

2. Typical environmental use is 26,990 AFY, but was not included in 2005 UWMP projection. Water is ultimately discharged into the Los Angeles River, providing additional environmental benefit. 2005 UWMP projections for 2010 are based on average demands.

Sources: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Existing and Tier 1 Recycled Water Systems TM, December 14, 2009; 2005 Urban Water Management Plan for the Los Angeles Department of Water Power, and LADWP Water Recycling Staff

use in 2010 would be approximately 16,950 AF, however actual use was lower than projected, as shown in Exhibit 4J. Environmental use of recycled water fluctuates slightly year to year based on lake levels, but is typically 26,990 AFY. For 2010 actual environmental use was 25,008 AF, or approximately 7 percent less than typical use. Overall total recycled water use in 2010 was approximately 27 percent less than projected.

Although LADWP did not meet the 2010 recycled water projection, program progress has been made, including the completion of multiple projects since 2005 as described in Section 4.3.1 through 4.3.4. Additional projects that are proposed for construction in the near future are described in Section 4.4, Recycled Water Master Planning Documents. Additionally, LADWP in conjunction with the BOS is currently developing the City's Recycled Water Master Plan (RWMP) to guide future optimization of this supply source with the goal of increasing municipal and industrial use of recycled water to 50,000 AFY.

## 4.4 Recycled Water Master Planning Documents

LADWP, in partnership with BOS, is developing the RWMP to identify projects to offset 50,000 AFY of potable water supplies with recycled water and to maximize recycled water use into the future. As previously discussed, in the City of Los Angeles' Water Supply Plan, "Securing LA's Water Supply", LADWP established a goal of 50,000 AFY of recycled water use to reduce the need for potable water and diversify LADWP's available water supply options. Exhibit 4K summarizes LADWP's timeline to achieve the goal of recycling 50,000 AFY

### *Exhibit 4K*
### *Recycled Water Master Planning Documents Implementation Timeline*

| Timeline | Reuse Volume[1] (AFY) | Description |
|---|---|---|
| Existing as of Fiscal Year 2009/2010 | 6,700 | Existing demands already being served |
| Recycled Water Use by 2015 | 20,000 | Near-Term projects already identified for implementation by 2015 |
| Groundwater Replenishment by 2021 | 15,000 | New groundwater replenishment opportunities as identified as part of the Groundwater Master Plan task |
| Non-Potable Reuse Recycled Water by 2029 | Up to 15,000 | New projects identified between 2015 and FY 2029 to serve existing potable customers as part of the non-potable reuse master plan |

1. Volume to offset municipal and industrial potable water demands. Does not include environmental use, in-plant reuse, and sales to WBMWD.

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Existing and Tier 1 Recycled Water Systems TM, December 14, 2009 and LADWP Water Recycling Staff.

by fiscal year (FY) 2029. This goal can be achieved sooner if additional funds are made available, such as State and Federal grants. The RWMP efforts were initiated in 2009 and are forecast for completion by the middle of 2011. To meet Near-Term challenges and plan for long-term recycled water the following major tasks were outlined for inclusion in the RWMP:

- Groundwater Replenishment Report
- Non-Potable Reuse Report
- Groundwater Replenishment Treatment Pilot Study
- Max Reuse Concept Report
- Satellite Feasibility Concept Report
- Existing System Reliability Concept Report

Within these tasks the RWMP will recommend where the recycled water system can be effectively expanded. A cost benefit analysis will be conducted to identify projects and potential customers based on location and projected use. A review of the wastewater treatment plants will be performed to determine how much recycled water can be supplied. The RWMP will also review available options for maximizing reuse through a combination of alternatives including expansion of non-potable irrigation/industrial uses, and groundwater replenishment (indirect potable reuse), with advanced treated recycled water.

The RWMP will include Near-Term recycled water projects (projects to be implemented through 2015 to achieve 20,000 AFY of recycled water use), expansion of the non-potable distribution system beyond 20,000 AFY, and groundwater replenishment with advanced treated recycled water. When combined with existing reuse, these options are expected to result in 50,000 AFY of reuse by FY 2029, exclusive of environmental reuse, in-plant reuse, and sales to WBMWD. Exhibit 4K provides a timeline for projects featured in the RWMP.

Recycled water projections in five year increments beginning in 2015 through 2035 are presented in Exhibit 4L. Total recycled water use is estimated to increase by approximately 39,000 AFY or 78 percent over the projection period. Environmental reuse and seawater intrusion barrier requirements are expected to remain constant at 26,990 AFY and 3,000 AFY, respectively. Municipal and industrial use, inclusive of in-plant reuse,

### *Exhibit 4L*
### *Recycled Water Use Projections*

| Category | Projected Use (AFY)[1] | | | | |
|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 |
| Municipal and Industrial | 20,000 | 20,400 | 27,000 | 29,000 | 29,000 |
| Indirect Potable Reuse (Groundwater Replenishment) | 0 | 0 | 15,000 | 22,500 | 30,000 |
| **Subtotal[2]** | **20,000** | **20,400** | **42,000** | **51,500** | **59,000** |
| Environmental[3] | 26,990 | 26,990 | 26,990 | 26,990 | 26,990 |
| Seawater Intrusion Barrier (Dominguez Gap Barrier) | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| **Total** | **49,990** | **50,390** | **71,990** | **81,490** | **88,990** |

1. Projected use by category is subject to change per completion of Recycled Water Master Plan, but overall total will not change. Does not include deliveries of 34,000 AFY of secondary treated water to WBMWD for further treatment to recycled water standards.

2. To offset potable use and included in supply reliability tables in Chapter 11.

3. Environmental use includes Wildlife Lake, Balboa Lake, and the Japanese Garden. Additional environmental benefits associated with recycled water discharges to the Los Angeles River are not included.

is expected to increase to 29,000 AFY or by approximately 45 percent. Indirect potable reuse (groundwater replenishment (GWR) with advanced treated recycled water is forecast to provide 15,000 AFY of GWR beginning in 2021. Recycled water use up to 2025 is inclusive of the Near-Term options under development in the RWMP. Projections for 2030 and 2035 assume that long-term options being developed as part of the RWMP will increase recycled water use by approximately 1,500 AFY annually beyond FY 2029. Once the alternatives for the RWMP are finalized, the allocation of recycled water use by the municipal, industrial, and GWR categories may change to achieve the RWMP's recycled water goal of 50,000 AFY by FY 2028/29.

Estimates of projected use and implementation timelines in the tables above, as well as the annual demands and service dates for individual customers in the following sections, may be affected by varying usage patterns of potential customers, timelines to reach agreements, potential financial constraints, and changing regulatory requirements.

## 4.4.1 Near-Term Projects through 2015

"Near-Term" projects are classified in the RWMP as projects that will result in recycled water service between July 1, 2009 and 2015 to achieve approximately 20,000 AFY of recycled water use to displace potable water use. All Near-Term projects are either in the planning, design, or construction stage. Near-Term project target customers have already been identified as potential recycled water users with a total demand of 15,021 AFY. Implementation of Near-Term projects will result in the connection of approximately 40 additional recycled water customers adding to the existing 130 customers. Full implementation of Near-Term projects with existing projects will result in annual recycled water deliveries of approximately 20,000 AFY, exclusive of both environmental use and DCT in-plant use (26,990 and 2,920 AFY, respectively). Near-Term projects fall primarily in the commercial/industrial sector, followed by the irrigation sector.

### Harbor Area

Two projects are planned to meet Near-Term demands in the Harbor Area: the Harbor Refineries Water Recycling Project and the Port of LA Harry Bridges Development, for an estimated total demand of 9,461 AFY. Uses include industrial, irrigation, and toilet flushing in commercial facilities. Most of the recycled water, approximately 9,520 AFY, will be used for industrial purposes, including cooling towers and boiler make-up water for large industrial customers. Exhibit 4M summarizes Near-Term demands for the Harbor Area.

Meeting demands in the Harbor Area will require construction of additional

***Exhibit 4M***
***Harbor Area Near-Term Estimated Demands***

| Type | Estimated AnnualDemand (AFY) | Estimated Service Date |
|---|---|---|
| Harbor Irrigation | 300 | 2014 |
| Port of LA Irrigation/Commercial/Industrial | 220 | 2015 |
| Harbor Commercial/Industrial | 9,000 | 2014-2015 |
| **Total Harbor Area Near-Term Demands** | **9,520** | |

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Existing and Near-Term Recycled Water Systems TM, December 14, 2009 and LADWP Water Recycling Staff infrastructure. Approximately 12 miles of 8- to 30-inch diameter pipeline and a 1 million gallon storage tank are proposed. All infrastructure to serve the Port of LA Harry Bridges Development will be constructed by the Los Angeles Harbor Department.

Through an agreement with WBMWD, LADWP will be supplied nitrified Title 22 water from the WBMWD Juanita Millender-McDonald Water Treatment Plant to supply recycled water to the Harbor Area.

### Metro Area

Nine water recycling projects and three customer connections are planned in the Metro Area to add annual demands of approximately 1,813 AFY. Almost all recycled water customers propose to use recycled water for irrigation. Commercial uses of recycled water include street sweeping, vehicle washing, train washing, and laundry. LAG will continue to meet all recycled water demands in the Metro Area. Exhibit 4N summarizes Near-Term demands for the Metro Area.

**Exhibit 4N**
**Metro Area Near-Term Estimated Demands**

| Type | Estimated Annual Demand (AFY) | Estimated Service Date |
|---|---|---|
| Irrigation | 1,713 | 2010-2015 |
| Commercial/ Industrial | 100 | 2011-2013 |
| **Total Metro Area Near-Term Demands** | **1,813** | |

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Existing and Near-Term Recycled Water Systems TM, December 14, 2009 and LADWP Water Recycling Staff

Multiple facilities are required in the Metro Area to meet Near-Term demands. Approximately five pump stations ranging in size from 600 to 1,800 gallons per minute are planned for construction. Three water tanks with a combined capacity 4.75 million gallons, including the conversion of an abandoned potable water tank in Griffith Park into a non-potable water storage tank, are necessary to meet demands. Pipeline construction will consist of 10 additional miles of pipeline ranging from 8- to 30-inch diameters, including conversion of an existing 16-inch pipeline to a 30-inch pipeline beneath Forest Lawn Road.

### Valley Area

In the Valley Area DCT will provide the potential Near-Term annual demands approximating 769 AFY. Almost all Near-Term use, except for 75 AFY, will be for irrigation purposes. These users are all located within close proximity to the existing recycled water system. Exhibit 4O summarizes the potential Near-Term demands for the Valley Area.

**Exhibit 4O**
**Valley Area Near-Term Estimated Demands**

| Type | Estimated Annual Demand (AFY) | Estimated Service Date |
|---|---|---|
| Irrigation | 769 | 2010-2013 |
| Commercial/ Industrial | 75 | 2010-2013 |
| **Total Valley Area Near-Term Demands** | **844** | |

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Existing and Near-Term Recycled Water Systems TM, December 14, 2009 and LADWP Water Recycling staff

Only minor facilities will be required to connect Near-Term users to the existing system. Approximately 2 miles of pipeline ranging from 16- to 20-inch in diameter are proposed. Additionally, one storage tank between 1 to 1.5 million gallons, and a pump station, will be required to meet demands.

### Westside Area

LADWP will continue to acquire recycled water from WBMWD to serve Near-Term demands of approximately 350 AFY in the Westside Area. Near-Term demands

## *Exhibit 4P*
## *Westside Area Near-Term Estimated Demands*

| Project | Estimated Annual Demand (AFY) | Estimated Service Date |
|---|---|---|
| Irrigation | | |
| Playa Vista Phase 2 | 100 | 2015 |
| Westchester High School | 10 | 2012 |
| **Subtotal Irrigation** | 100 | |
| Commercial/Industrial | | |
| LAX Cooling Towers | 240 | 2015 |
| **Subtotal Commercial/Industrial** | 240 | |
| **Total Westside Area  Near-Term Demands** | **350** | |

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Existing and Near-Term Recycled Water Systems TM, December 14, 2009 and LADWP Water Recycling Staff

include increasing use within the Playa Vista development, at LAX, and by adding five new customers. Approximately two-thirds of the water will be for irrigation purposes and one-third for commercial/industrial uses in cooling towers located at LAX. Exhibit 4P summarizes Near-Term demands for the Westside Area.

Serving Near-Term demands will require limited expansion of the existing recycled water system in the area as additional users connect to the existing system. Connection of the cooling towers at LAX will require construction of an additional 0.7 miles of 12-inch diameter pipeline.

## 4.4.2 Non-Potable Reuse Projects to be completed between 2015 - 2029

Non-potable reuse projects to be completed between 2015 and 2029 are being identified through the development of the RWMP. These projects will make up the balance of recycled water demand up to the 15,650 AFY non-potable reuse goal, which will contribute to achieving the overall city goal of 50,000 AFY of recycled water displacing potable water uses.

As presented in Exhibit 4Q, the project options would have a total demand of approximately 23,100 AFY, which is larger than the goal of up to 15,650 AFY. Ultimately, an implementation plan will be developed for the recommended project options with a target of beginning operations for all projects included in the implementation plan by FY 2029.

## *Exhibit 4Q*
## *Project Option Demands by Service Area*

| Service Area | Total Demand[1] (AFY) |
|---|---|
| Harbor | 3,300 |
| Metro | 6,100 |
| Valley | 10,100 |
| Westside | 3,600 |
| **Total** | **23,100** |

1. Includes customers with non-potable demand estimates greater than 5 AFY.

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Tier 2 Non-Potable Reuse Project Options, February 26, 2010

### Project Selection

An initial step for evaluating these projects involves identification of potential potable water customers that can utilize recycled water. These customers need to have sufficient demand and a viable use for recycled water. Irrigation-only customers were focused on first as they are generally easier to convert to recycled water use than commercial or industrial users. As described below, during development of the project options, potential additional recycled water customers were identified based on their non-potable water demands and distance from recycled water sources.

Next, recycled water project options were developed to meet the goal of maximizing recycled water use, while promoting cost efficiency, implementability and adaptability. Two primary steps were utilized to develop recycled water project options:

- Identification of project segments to serve each customer with non-potable demands in excess of 50 AFY.

- Identification of project options combining project segments that are linked and have similar unit costs.

The first step in the development of project options was to define general project areas based on customers with non-potable demands in excess of 50 AFY. In the project areas, transmission pipeline alignments (backbone alignments) and laterals were defined to connect customers with demands greater than 50 AFY to existing recycled water infrastructure. Alignments were then redefined to connect demand clusters of less than 50 AFY, but large enough for consideration as a large demand. Finally, distribution pipeline (laterals) alignments were determined to connect customers with demands less than 50 AFY to backbone alignments.

Initial project options and unit costs are being identified in the current phase of the RWMP. Options for non-potable reuse transmission (purple) pipelines are considered in conjunction with options developed for groundwater replenishment (see section 4.4.3). Additional information on recycled water unit cost is presented in section 4.4.5 – RWMP Cost and Funding.

### Recycled Water Supply Sources

Recycled water availability varies by service area. Additional supplies may be required to meet longer term demands between 2015 – 2029 that may require a combination of expanding existing facilities, service connections to neighboring agencies outside the City, new facilities, and satellite treatment facilities. Satellite treatment facilities are being investigated in the Metro, Valley, and Westside service areas. The RWMP is investigating options to ensure adequate supplies are available for each service area. As part of the RWMP, LADWP met with neighboring agencies in 2009 to explore potential opportunities for regional development of recycled water reuse facilities. These agencies are listed in Exhibit 4T, in section 4.4.6, Stakeholder Process and Agency Coordination.

## 4.4.3 Groundwater Replenishment

As part of the RWMP, LADWP is pursuing a Groundwater Replenishment (GWR) Project, also known as indirect potable reuse, using highly purified advanced treated recycled water from DCT for spreading in existing spreading basins in the San Fernando Valley area. An advanced water treatment facility is necessary to further treat tertiary effluent from DCT to produce highly purified recycled water for recharge. A minimum GWR goal of 15,000 AFY by 2021 has been set for recharging the San Fernando Basin, a major potable water supply for LADWP. This project would recharge a minimum of 15,000 AFY of advanced treated water in the existing Hansen Spreading Grounds and possibly the

Pacoima Spreading Basins by allowing the water to percolate into the aquifer. The City anticipates having the ability to eventually deliver greater amounts of water up to 30,000 AFY to the GWR.

The RWMP includes a GWR plan outlining various operational and capital infrastructure improvements required to meet these goals. Infrastructure improvements required to implement the GWR program include an advanced water treatment facility and pipelines to convey the product water to the spreading basins. Pipelines to convey water to the Hansen Spreading Grounds are already in place and were constructed as a part of the previous recycled water initiatives for the East Valley Water Recycling Project. However, if the Pacoima Spreading Basins will also receive water for spreading, then additional pipeline infrastructure will be required.

Native stormwater recharge will continue to occur at the spreading grounds in conjunction with the project. Currently, LADWP and the Los Angeles County Department of Public Works use multiple spreading grounds located in the eastern portion of the San Fernando Basin to recharge the underlying San Fernando Basin with stormwater. A detailed discussion of the San Fernando Basin and existing recharge operations is provided in Chapter 6, Local Groundwater.

Goals for the advanced water treatment plant include as described in the RWMP are:

- Minimum capacity of 15,000 AFY with the potential to expand to 30,000 AFY.

- Initially in service by 2021.

- Utilization of proven technologies that have demonstrated effective removal of regulated chemicals, constituents of emerging concern, and microorganisms; additional removal of constituents of wastewater origin of interest to CDPH, including pharmaceuticals, personal care products, and endocrine disrupting compounds.

- Product water shall comply with requirements from the CDPH, RWQCB, and SWRCB and be suitable for indirect potable reuse.

To develop and implement the project expeditiously, the advanced wastewater treatment plant will be based on the recently permitted Orange County Water District Groundwater Replenishment System Project. This system provides product water for indirect potable reuse by recharging a groundwater basin used for potable water and preventing seawater intrusion. Proposed technologies include microfiltration or ultrafiltration, reverse osmosis, advanced oxidation using ultraviolet light with hydrogen peroxide, and post-treatment for product water stabilization. As a by-product of advanced water treatment, brine is created. Multiple brine disposal alternatives are presented in the RWMP, and a final alternative will be selected upon completion of the plan.

LADWP is working closely with BOS and regulatory agencies to expedite completion of the project by 2021. Current ongoing tasks include completion of the RWMP, public outreach, pilot testing of GWR treatment processes, and ongoing participation of an independent advisory panel. Environmental documentation is expected to be initiated in 2011 and completed in 2013. The RWMP also outlines the regulatory approval steps required. Regulatory requirements for GWR are discussed in sub-section 4.1.2, GWR Regulatory Requirements.

### Independent Advisory Panel

GWR projects typically have the involvement of an independent third party with scientific and technical expertise to provide expert peer review of key aspects of the project, which can ensure the technical viability of the GWR and facilitate the regulatory process. To accomplish this, LADWP awarded a contract with the National Water Research Institute (NWRI) to form an Independent Advisory Panel (IAP) to provide expert peer review of the technical, scientific, regulatory, and policy aspects of the proposed GWR project, pilot project testing, and other potential groundwater replenishment projects to maximize reuse as part of the LADWP Recycled Master Planning Documents. The IAP process will provide a consistent, thorough, and transparent review of any proposed GWR projects and pilot testing during their critical formation phase, as well as during the long-term implementation phase.

NWRI has vast experience in the organization and administration of the IAP processes for other agencies such as the Orange County Water District Groundwater Replenishment System Project. NWRI will assist the IAP process by assembling the IAP members, developing a detailed scope and approach for the IAP's review, coordinating and facilitating meetings, and preparing IAP reports.

Some of the immediate activities that have been identified for the IAP to address during the initial participation include, but are not limited to review of the following:

- General approach for Recycled Water Master Planning
- Hydrogeology (in-basin groundwater blending)
- Treatment (barriers to replace the fifty-percent blend criteria)
- Reliability features of the Advanced Water Treatment Facility
- Source Control Evaluation for GWR
- Draft Engineering Report for GWR
- Response to technical concerns raised by regulators and the public

The "Independent Advisory Panel for the City of Los Angeles Groundwater Replenishment Project" consists of 13 members with scientific and/or professional expertise in issues related to the implementation of groundwater replenishment projects. The selection of members with different areas of expertise was based on the requirements of the California Department of Public Health Draft GWR Reuse Regulations dated August 2008, as well as the composition of panels used by the Orange County Water District and the City of San Diego for the implementation of similar groundwater replenishment projects.

NWRI convened the Independent Advisory Panel for the first time in October 2010 to receive introductory information about the recycled water program and groundwater replenishment project. The Panel is expected to be involved throughout the planning, permitting, design, environmental documentation, and implementation of the groundwater replenishment project.

### 4.4.4 Efforts Beyond 50,000 AFY

As part of the RWMP, LADWP is developing long-term alternatives to maximize recycled water use beyond 50,000 AFY. After 2029 and through 2035 LADWP expects to increase recycled water use by approximately 1,500 AFY annually. To maximize recycled water use LADWP is investigating the following options in its RWMP:

- Recycled water satellite treatment facilities.
- Expansion of recycled water systems.
- Increasing treatment levels at HTP to tertiary and advanced treatment.
- Reviewing opportunities for partnerships with agencies within and outside of the City.
- Treatment plant upgrades at DCT and LAG.
- Methods to increase reliability of the system.

Additionally, the RWMP will identify how the City can maximize recycled water usage into the future beyond the 50,000 AFY goal. The long-term recycled water alternatives analysis, as part of the RWMP, have not been completed. However, LADWP forecasts that in 2035, municipal and industrial recycled water deliveries along with groundwater replenishment will be approximately 59,000 AFY. In addition to this, 26,990 AFY will also be used for environmental beneficial reuse.

## 4.4.5 RWMP Cost and Funding

The capital cost of expanding the recycled water system to achieve the initial goal of displacing 50,000 AFY of potable water demand was initially estimated at approximately $1 billion. This cost is being refined as part of the RWMP and is expected to be updated by mid-August 2011.

### Unit Cost

Non-potable reuse and GWR projects are diverse, and result in a wide range of costs to implement and sustain. Non-potable reuse projects present numerous challenges, including distance from treatment plant and the associated transmission pipeline construction costs. This is weighed against customer size and recycled water adaptability to a particular commercial site or process. Initial findings of the RWMP have determined the approximate range of cost for water recycling projects to be from $600 to $1,500 per acre-foot. This approximation includes capital, operation, and maintenance costs.

### Funding

Capital costs for RWMP projects will be covered by the funding sources identified below, as well as other sources as they become available.

- Water Rates – LADWP water rates are the primary funding source for the recycled water program.

- Federal Funding – LADWP will pursue Federal funding as it becomes available. In the past LADWP has received funding for recycled water projects from the Federal Water Project Authorization and Adjustment Act of 1992, Public Law 102-575 (HR429), and the United States Bureau of Reclamation Title XVI Program.

- State Funding – LADWP will pursue State funding as it becomes available, through the SWRCB and DWR for recycled water projects. Propositions 13 and 50 had funds specifically marked for recycled water projects. Funding is available through Proposition 84, Integrated Regional Water Management, for implementation projects, including recycled water projects. Low-interest loans are available through the SWRCB for eligible projects.

- MWD Local Resources Program Incentive – The Local Resources Program provides funding for water recycling and groundwater recovery projects that prevent a new demand on MWD or displace an existing demand on MWD. Financial incentives up to $250 per acre-foot are available dependent upon MWD water rates and projects costs.

## 4.4.6 Outreach and Agency Coordination

Outreach with key stakeholders and the public, and coordination with agencies is necessary for the success of LADWP's recycled water program.

### Stakeholder Process

To encourage input as recycled water strategies are developed over the next few years in conjunction with the RWMP, LADWP has initiated an extensive outreach process. LADWP has developed two formats for participation of key stakeholders in the Recycled Water Advisory Group (RWAG), and for public participation in the Recycled Water Forums.

The more than 200 stakeholders invited to participate in the RWAG represent broad interests across the City, including community groups, environmental groups, neighborhood councils, homeowners' associations, and others. Approximately 65 stakeholders are participating in the process. The RWAG first met in 2009 and will have approximately five workshops per year over the next few years. Through the RWAG, stakeholders are provided the opportunity to represent their respective organizations, share input with LADWP and BOS, and convey information back to their organizations. Two main roles of the RWAG are:

1. Allow stakeholders to provide input on recycled water options from technical, environmental, financial, and social viewpoints.

2. Consider key project issues and discuss implementation challenges and acceptability.

Recycled Water Forums provide the general public an opportunity to learn about the LADWP Recycled Water Program and submit comments that will be considered before the RWMP is adopted.

## Agency Coordination

To maximize recycled water use and move forward with RWMP efforts, LADWP closely coordinated with agencies at the local and state levels. Coordination is necessary to ensure adequate funding, identification of end-users, adequate availability of supplies, permitting and regulatory approvals, and regional cooperation. If Federal funding opportunities become available, LADWP will also coordinate with the applicable Federal agencies. Exhibit 4R provides a summary list of agencies LADWP is currently coordinating with to maximize recycled water use.

## Financial Incentives

LADWP also coordinates recycled water end use with potential customers by assisting with facility retrofits and public education. Recycled water is provided to customers at a cost less than potable water. LADWP is also considering implementing a new incentive program designed to assist with onsite retrofits to convert customers to the use of recycled water.

**Exhibit 4R**
**Recycled Water Agency Coordination**

| | |
|---|---|
| Burbank Water and Power[1] | Los Angeles County Department of Public Works[1] |
| Central Basin Municipal Water District[1] | Metropolitan Water District of Southern California[1] |
| Glendale Water and Power[1] | Pasadena Water and Power[1] |
| Los Angeles County Sanitation Districts[1] | Water Replenishment District of Southern California[1] |
| Long Beach Water Department[1] | West Basin Municipal Water District[1] |
| Las Virgenes Municipal Water District[1] | Los Angeles Regional Water Quality Control Board |
| State Water Resources Control Board | Los Angeles County Department of Public Health |
| City of Los Angeles Department of Public Works, Bureau of Sanitation, Watershed Protection Division | City of Los Angeles Department of Public Works, Bureau of Sanitation |
| California Department of Public Health | |

1. Met with agencies individually to discuss potential regional recycled water use.


## 4.4.7 Recycled Water Quality

All recycled water provided by LADWP meets, at minimum, Title 22 standards. Title 22, Chapter 4, of the California Code of Regulations establishes water quality standards and treatment reliability criteria for water recycling to ensure public safety as discussed in Section 4.1. Title 22 standards are achieved with tertiary treatment and disinfection.

Advanced wastewater treatment is currently provided for the Dominguez Gap Seawater Barrier at the TIWRP by the AWTF. The AWTF has advanced treatment that includes microfiltration and reverse osmosis, which removes many of the impurities remaining after tertiary treatment and disinfection. This treatment will be implemented for the planned groundwater replenishment project being developed through the RWMP. Purified DCT effluent used to recharge the San Fernando Basin will undergo additional treatment, including microfiltration, reverse osmosis, and advanced oxidation. Exhibit 4C, located in Section 4.2, summarizes the level of treatment provided by each of the City's water reclamation plants.

Chapter Five

# Los Angeles Aqueduct System

## 5.0 Overview

Water has been an integral part of the City's history. The City's population and economy was initially supported through a combination of local surface flows primarily from the Los Angeles River, and groundwater pumping primarily from the San Fernando Basin. When it became apparent that much of the local groundwater supply and local surface flows were fully utilized, the citizens of Los Angeles under the leadership of William Mulholland, then Chief Engineer of the Los Angeles Water Bureau, approved by a 10 to 1 margin a $23 million bond measure to construct the First Los Angeles Aqueduct in 1913. This investment was equal to 12 percent of the entire City's assessed valuation at that time. Then in 1940, an additional $40 million was spent to extend the first aqueduct 40 miles north from the Owens River to streams that were tributaries to Mono Lake, see Exhibit 5A.

To meet the additional water needs of its population, the City decided to construct the second barrel of the Los Angeles Aqueduct in 1963, later to become known as the Second Los Angeles Aqueduct. Construction of the Second Los Angeles Aqueduct was completed in 1970. The second aqueduct increased the City's capacity to deliver water from the Mono Basin and the Owens Valley to Los Angeles from 485  cubic feet per second (cfs) to 775 cfs.

The value of the City's historical investment in the Los Angeles Aqueduct System is substantial. For nearly a century, the City has benefited from the delivery of high-quality, cost-effective water supplies from the eastern Sierra Nevada.

***Exhibit 5A***
***Los Angeles Aqueduct System***

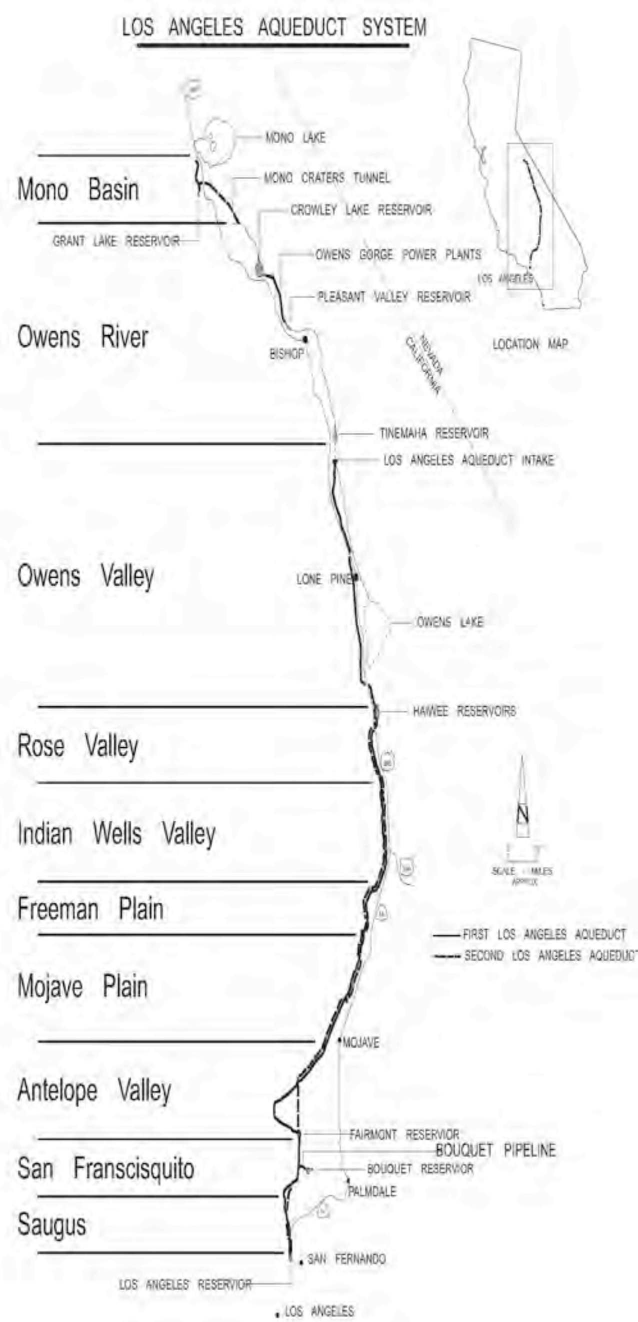
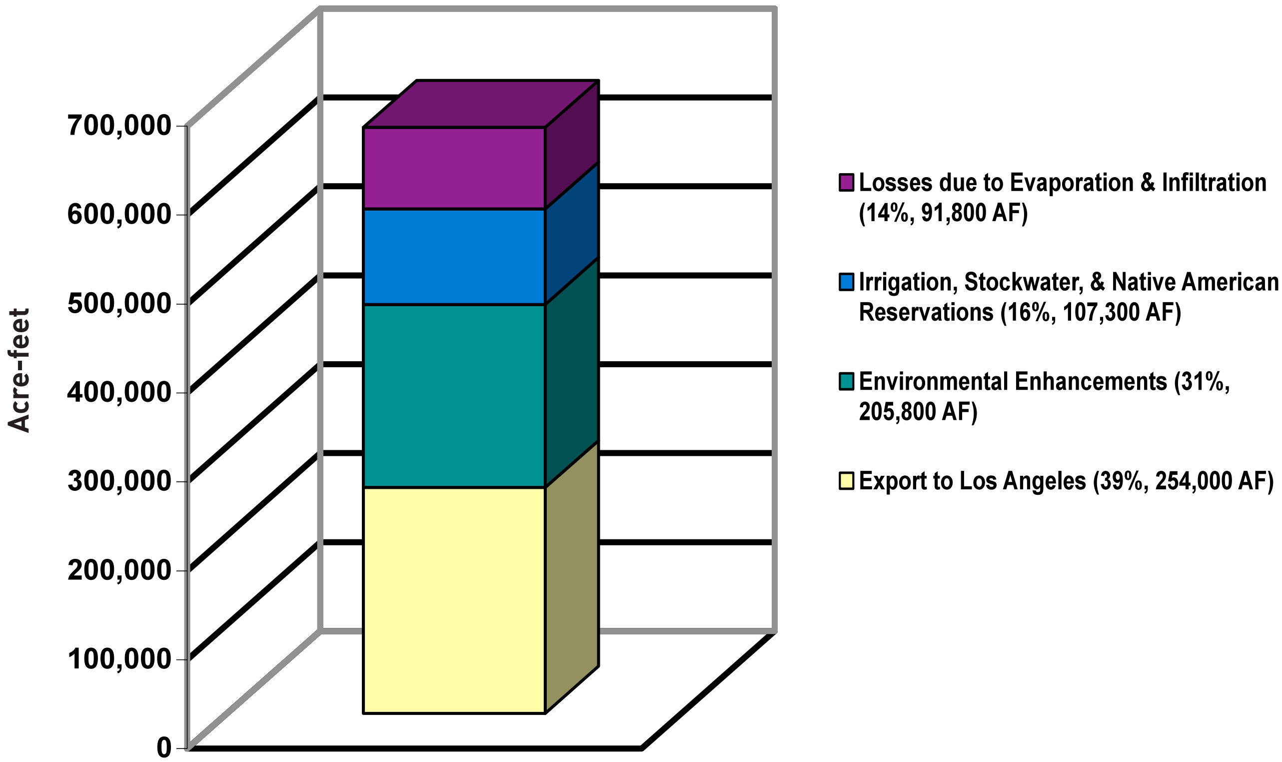


***Exhibit 5B***
***Mono Basin and Owens Valley Water Use Allocations***




Over time, environmental considerations have required that the City reallocate approximately one-half of the Los Angeles Aqueduct (LAA) water supply to environmental mitigation and enhancement projects. As a result, the City has used approximately 205,800 AF of water supplies for environmental mitigation and enhancement in the Owens Valley and Mono Basin regions in 2010, which is in addition to the almost 107,300 acre-feet per year (AFY) supplied for agricultural, stockwater, and Native American Reservations. Limiting water deliveries to the City from the LAA has directly led to increased dependence on imported water supply from the Metropolitan Water District of Southern California (MWD). LADWP's purchases of supplemental water from MWD in FY 2008/09 hit an all time high.

As indicated in Exhibit 5B, LAA deliveries comprise 39 percent of the total runoff in the eastern Sierra Nevada in an average year. The vast majority of water collected in the eastern Sierra Nevada stays in the Mono Basin, Owens River, and Owens Valley for ecosystem and other uses.

## 5.1 Historical Deliveries

Annual LAA deliveries are dependent on snowfall in the eastern Sierra Nevada. Years with abundant snowpack result in larger quantities of water deliveries from the LAA, and typically lower supplemental water purchases from MWD. Unfortunately, a given year's snowpack cannot be predicted with certainty, and thus, deliveries from the LAA system are subject to significant hydrologic variability.

The impact to LAA water supplies due to varying hydrology in the Mono Basin and Owens Valley is amplified by the requirements to release water for environmental restoration efforts in the eastern Sierra Nevada. Since 1989, when City water exports were significantly reduced to restore the Mono Basin's ecosystem, LAA deliveries from the Mono Basin and Owens Valley have ranged from 108,503 AF in FY 2008/09 to 466,584 AF in FY 1995/96. Average LAA deliveries since FY 1989/90 have been approximately 264,799 AF, about 42 percent of the City's total water needs.

The cyclical nature of hydrology is exhibited best by LAA deliveries over the last ten years. This general period was characterized by a series of wet years, followed by a series of dry years. From FY 2000/01 through 2009/10, LAA deliveries supplied an average of 36 percent of the City's water needs. The reliability impact of hydrologic cycles on LAA supplies is evident through historical deliveries. A broader look at how deliveries from the LAA have fluctuated from year to year is shown in Exhibit 5C.

A long term perspective of the general cycle of wet and dry years for the Owens Valley is evident in Exhibit 5D, particularly since the late 1960s. As illustrated, reliance solely on one water supply source is not practical. Therefore, the City relies on the LAA in combination with the Colorado River Aqueduct and the State Water Project as the City's primary imported water sources. These imported sources combined with local groundwater, recycled water, and conservation make up the City's total water supply portfolio. This portfolio of water resources is fundamental to LADWP's ability to deliver a reliable water supply to meet the needs of over 4 million residents of Los Angeles.

***Exhibit 5C***
***Historical Los Angeles Aqueduct Deliveries***

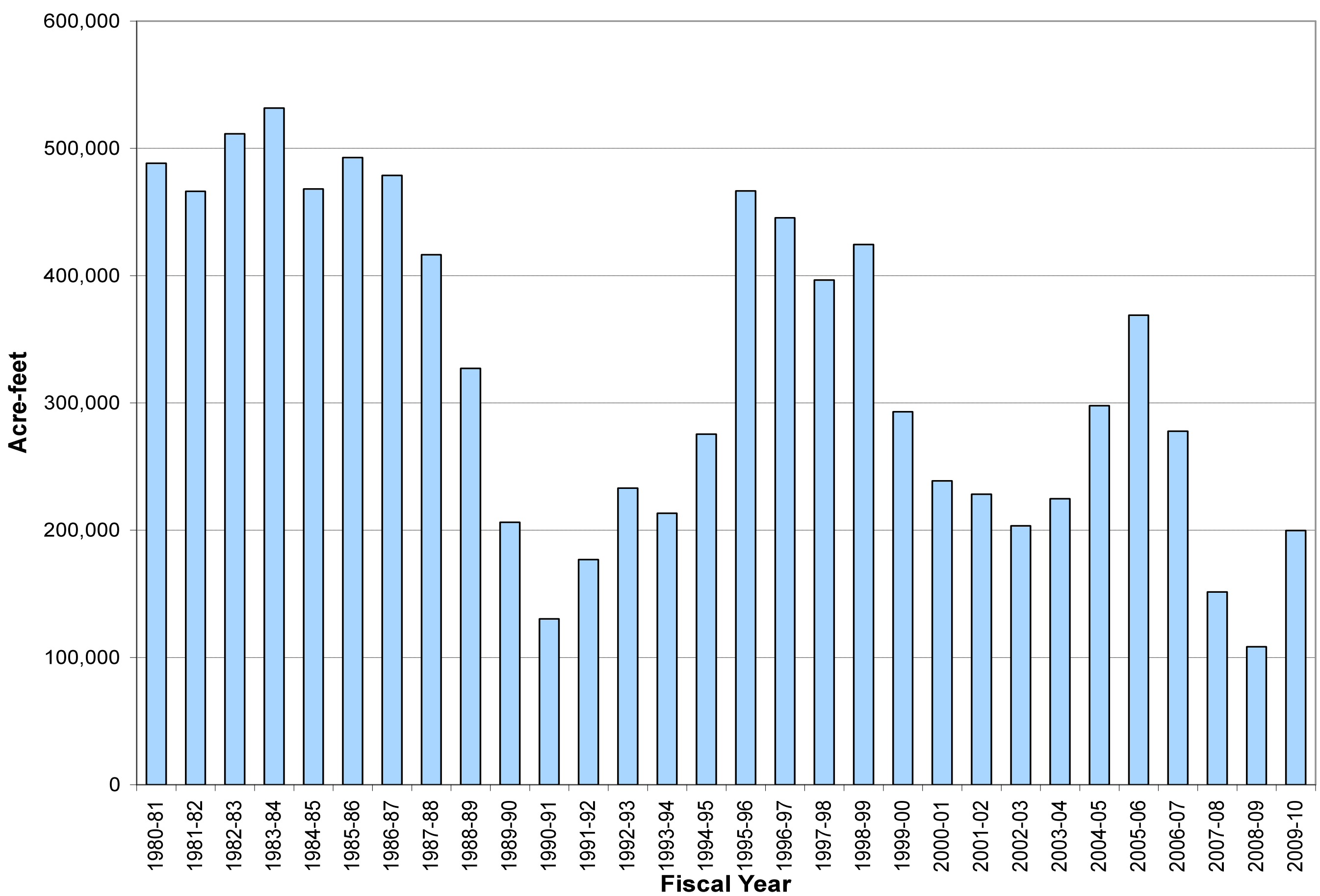
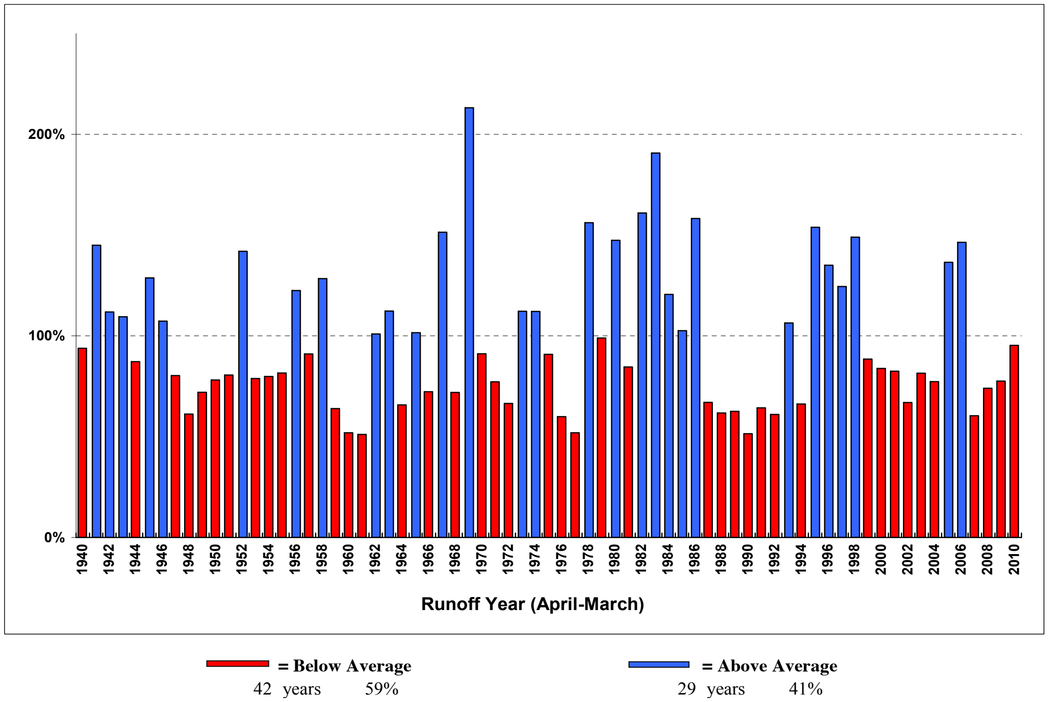


*Exhibit 5D Eastern Sierra Nevada Runoff Owens Valley - Percent of Normal*




## 5.2 Mono Basin and Owens Valley Supplies

Surface runoff from snowmelt in the eastern Sierra Nevada Mountains is the primary source of supply for the LAA. The LAA extends approximately 340 miles from the Mono Basin to Los Angeles. Water is conveyed the entire distance by gravity alone. LADWP regulates system output through storage control at seven reservoirs, beginning with Grant Lake Reservoir to the north and ending with Bouquet Reservoir to the south. The total combined reservoir storage capacity of the system is 300,560 AF. Hydroelectric power is also generated from 12 power plants along the LAA. Combined maximum capability of the power generation facilities is 205 mega-watts. Water-gathering activities for the LAA have a junior priority to meeting the Owens Valley and Mono Basin water obligations for environmental, domestic, agricultural, and recreational water needs.

The LAA is fed by runoff from the eastern slope of the Sierra Nevada Mountains. Runoff from the eastern slope reaches its maximum in the late spring and summer, after most of the year's precipitation has already occurred. The snowpack in the eastern Sierra Nevada provides natural storage for the LAA system. This snowpack storage is necessary in light of the minimal primarily regulatory storage capacity along the LAA system.

### Water Rights

The City's export of water from the eastern Sierra Nevada is based on 166 Pre-1914 and 16 Post-1914 water right diversion licenses on various streams in the Mono Basin and Owens Valley. The majority of the City's water rights were filed prior to 1914 with the Counties of Mono and Inyo Recorder's Office. All Post-1914 licenses were granted by the State Water Resources Control Board (SWRCB). The most significant basis for export of surface water from the eastern Sierra Nevada is an appropriation claim in 1905 to divert up to 50,000 miner's inches (1,250 cfs) from the Owens River at a location approximately 15 miles north of the town of Independence into the LAA for transport to Los Angeles. The City has since filed Supplemental Statements of Water Diversion and Use forms with the SWRCB for all LADWP diversions and licenses.

The City's water right licenses in the Mono Basin were amended by the SWRCB in 1994 through the Mono Lake Basin Water

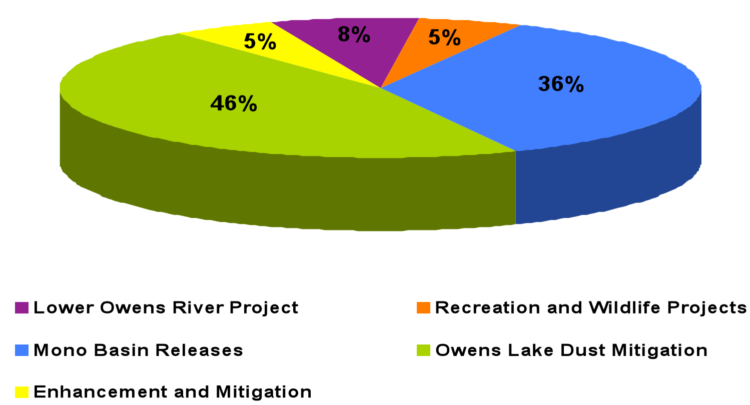
Right Decision 1631. Currently, water export from the Mono Basin is limited to 16,000 AFY based on a court order to raise the target elevation of Mono Lake and restore four streams that flow to Mono Lake.

The primary groundwater right through which Los Angeles has developed groundwater resources in the Owens Valley is based on ownership of a majority of the land (approximately 314,000 acres) and associated water rights in the Owens Valley. Management of the groundwater supply in the Owens Valley is according to a 1991 agreement between Inyo County and LADWP. The goal of this agreement is to avoid defined decreases and changes in vegetation, and to cause no significant effect on the environment which cannot be acceptably mitigated, while providing a reliable supply of water for export to Los Angeles and for use in Inyo County.

## 5.3 Environmental Issues and Mitigation

Over time an increasingly larger portion of the LAA water supply has been reallocated to the environment. As a result, the City's current supply for environmental enhancement in the Owens Valley and Mono Basin is approximately 205,800 AFY. To accommodate LAA delivery reductions due to these environmental enhancements, LADWP has funded conservation and water recycling programs to improve water use efficiency within the City. Exhibit 5E illustrates the breakdown of LAA water supply commitments by category for environmental enhancement and mitigation projects have been implemented as part of the City's commitment to meet the environmental water needs of the Owens Valley. Among these environmental projects, LADWP is diverting 10,700 AF of water from the LAA for Owens Valley enhancement and mitigation projects, 10,400 AF for recreation and wildlife projects, and 15,700 AF for the Lower Owens River Project (LORP). These annual environmental project diversions are in addition to water that provides environmental benefits in the Mono Basin and Owens Lake.

### *Exhibit 5E*
### *Mono Basin and Owens River Environmental Enhancement Commitments*




| Environmental Enhancement Commitments | AFY |
|---|---|
| Lower Owens River Project | 15,700 |
| Recreation and Wildlife Projects | 10,400 |
| Mono Basin Releases | 74,000 |
| Owens Lake Dust Mitigation | 95,000 |
| Enhancement and Mitigation | 10,700 |
| Total | 205,800 |

### Mono Basin

Currently, Mono Basin exports will remain at no more than 16,000 AFY until Mono Lake reaches its target elevation of 6,391 feet above mean sea level. Exhibit 5F provides the maximum export levels from the Mono Basin under specified conditions as defined in the SWRCB Decision D1631 that was issued on September 28, 1994. Since the long-term average of Mono Basin exports before 1994 was approximately 90,000 AFY, the net reduction in water exports in the Mono Basin is estimated at 74,000 AFY of water mainly from Grant Lake Reservoir, Lee Vining Creek, Walker Creek, Parker Creek, and Rush Creek. As of January

## Exhibit 5F
## Mono Lake Elevations and Exports

| Mono Lake Elevation (feet) | | Exports (AFY) |
|---|---|---|
| Transition | < 6,377 | 0 |
| | 6,377 - 6,380 | 4,500 |
| | 6,380 - 6,391 | 16,000 |
| | > 6,391 | export all runoff less minimum stream flow requirements and stream restoration flows |
| Post-Transition | < 6,388 | 0 |
| | 6,388 - 6,391 | 10,000 |
| | > 6,391 | export all runoff less minimum stream flow requirements and stream restoration flows |

## Exhibit 5G
## Lower Rush Creek Base and Peak Flow Requirements

| Hydrologic Condition | Base Flow (cfs) | | | | | | | Peak Flows (cfs) |
|---|---|---|---|---|---|---|---|---|
| | Apr | May - Jul | Aug - Sep | Apr - Sep | Oct- Mar | May - Aug | Sep - Mar | |
| Dry (runoff < 83,665 AF) | N/A | N/A | N/A | 31 | 36 | N/A | N/A | None |
| Dry-Normal I (runoff 83,655 - 91,590 AF) | N/A | N/A | N/A | 47 | 44 | N/A | N/A | 200 for 7 days |
| Dry-Normal II (runoff 91,590 - 100,750 AF) | N/A | N/A | N/A | 47 | 44 | N/A | N/A | 250 for 5 days |
| Normal (runoff 100,750 - 130,670 AF) | N/A | N/A | N/A | 47 | 44 | N/A | N/A | 380 for 5 days follows 300 for 7 days |
| Wet-Normal (130,760 - 166,700 AF) | N/A | N/A | N/A | 47 | 44 | N/A | N/A | 400 for 5 days followed by 350 for 10 days |
| Wet (166,700 - 195,400 AF) | N/A | N/A | N/A | 68 | 52 | N/A | N/A | 450 for 5 days followed by 400 for 10 days |
| Extreme Wet (runoff > 195,400 AF) | N/A | N/A | N/A | 68 | 52 | N/A | N/A | 500 for 5 days followed 400 for 10 days |

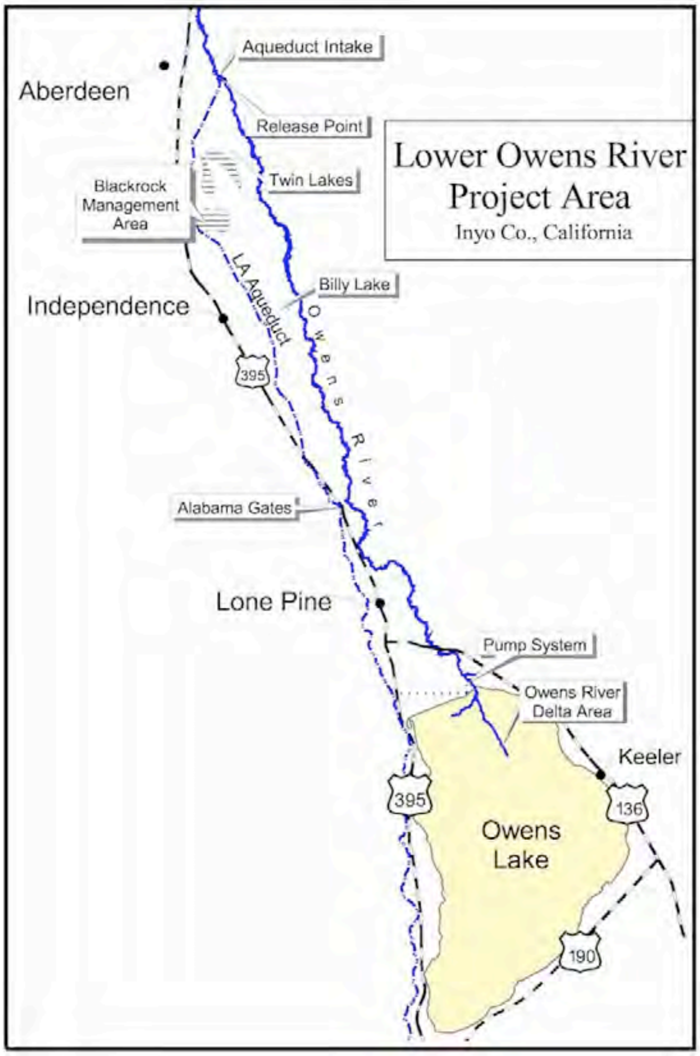
Source: Mono Basin Operations, Guidelines A-G

2011, Mono Lake is at elevation 6,382 feet. Extensive restoration and monitoring programs in the Mono Basin have improved the streams, riparian, fishery, and waterfowl habitats.

To effectively maintain continuous base and peak water flows to the ecosystem restoration area of Lower Rush Creek in the Mono Basin, LADWP completed construction of the Mono Gate One diversion facility upgrade in November 2009. Exhibit 5G summarizes the base and peak flow requirements for Lower Rush Creek. Base and peak flow requirements vary in relation to seven hydrologic conditions ranging from dry to extreme wet as identified by forecasted runoff for Mono Basin. Mono Gate One was originally constructed to release excess water from the LAA system during high flows by diverting water into Lower Rush Creek with a system of diversion boards. However, it had no monitoring or flow control capabilities and was not designed for precise flow metering or full-time diversion. Construction completed in the fall of 2009, the new Mono Gate has enabled LADWP to greatly improve measuring and flow capabilities, satisfying one of the operational requirements of the SWRCB.

### Lower Owens River Project

Beginning December 2006, the LORP, depicted in Exhibit 5H, releases water from the LAA to create a warm water fishery along a 62-mile section of the Owens River. Water is released near the LAA intake facility and a pump back station is located downstream to return




## *Exhibit 5H*
## *Lower Owens River Project Area*

## *Exhibit 5I*
## *Lower Owens River Base and Peak Seasonal Habitat Flow Requirements*

| Hydrologic Condition Forecasted[1] (Percent of Average Runoff) | Base Flow (cfs) | Peak Seasonal Habitat Flow[2] (cfs) |
|---|---|---|
| 50 percent or less | 40 | Base flow only |
| 70 percent | 40 | 100 |
| 100 percent or greater | 40 | 200 |

1. Runoff forecast determined by LADWP's Runoff Forecast Model for Owens River Basin based on April 1st snow survey.

2. Peak season habitat flows are proportionately ramped up from 40 cfs to 200 cfs based on the percent of average runoff forecasted greater than 50 percent and less than 100 percent.

flows to the LAA or to Owens Lake for dust control measures. In accordance with the Memorandum of Understanding between LADWP and Inyo County and the approved Environmental Impact Report, annual monitoring reports are to be prepared to measure project success. The first LORP Annual Monitoring Report was prepared in 2008.

The Memorandum of Understanding prescribes requirements for LORP flows. Both base flows and seasonal habitat peak flows are required for the LORP. A flow schedule is provided in Exhibit 5I. Seasonal habitat peak flows vary between 40 cfs (zero additional flows beyond the base flow requirements) to 200 cfs. For below average runoff years, seasonal habitat flows may be incrementally lowered from the average runoff year requirements of 200 cfs to 40 cfs (base flow) in proportion to the forecasted runoff flows in the watershed. Base flows are constant at 40 cfs regardless of forecasted runoff flows. It is estimated that the long-term use and transit losses from the project will be approximately 15,700 AFY.

## 5.4 Owens Lake Dust Mitigation

Historically, the Owens River was the main source of water for Owens Lake. Diversion of water from the river, first by farmers in the Owens Valley and then by the City, resulted in the lake being reduced to a small brine pool. The exposed lakebed became a major source of windblown dust resulting in the United States Environmental Protection Agency (USEPA) classifying the southern Owens Valley as a serious non-attainment area for particulates (dust) also known as PM10 emissions in 1991. The PM standard includes Particulate Matter with a diameter of 10 micrometers or less (0.0004 inches or one-seventh the width of a human hair). USEPA's health-based national air quality standard for PM-10 is 50 microgram per cubic meter (measured as an annual mean) and 150 microgram per cubic meter (measured as a daily concentration).

As a result of PM10 emissions exceeding regulations, the USEPA required California to prepare a State Implementation Plan to bring the region into compliance with Federal air quality standards by 2006. In July 1998, LADWP entered into a Memorandum of Agreement with the Great Basin Unified Air Pollution Control District that: 1) delineated the dust producing areas on the lakebed that needed to be controlled; 2) specified what measures must be used to control the dust; and 3) outlined a timetable for implementation of the control measures. The Memorandum of Agreement was incorporated into a formal air quality control State Implementation Plan by the Great Basin Unified Air Pollution Control District. The plan was approved by the USEPA in October 1999.

LADWP's water use for Owens Lake Dust Mitigation has been gradually increased over the years. Exhibit 5J summarizes yearly water use for the Owens Lake Dust Control Project. Currently, up to 95,000 AF per year of water could be diverted from the LAA for dust mitigation at Owens Lake, greatly exceeding the 55,000 AFY anticipated in the 2005 UWMP. In August 2009, the Board of Water and Power Commissioners of the City of Los Angeles required LADWP to implement water conservation measures on Owens Lake to reduce LAA diversions to below the peak of 95,000 AFY for existing and future dust control projects.

### *Exhibit 5J*
### *Yearly Water Use on Owens Lake (Fiscal Year)*

| Fiscal Year | Total AF |
|---|---|
| 2002/03 | 23,937 |
| 2003/04 | 31,362 |
| 2004/05 | 29,494 |
| 2005/06 | 29,413 |
| 2006/07 | 54,849 |
| 2007/08 | 67,262 |
| 2008/09 | 59,187 |
| 2009/10 | 75,428 |
| 2010/11 | 95,000 |

* Fiscal year 2010/11 is projected

Since 2001, LADWP has diverted water from the LAA for the Owens Lake Dust Control Project. A combination of shallow flooding, managed vegetation, and a small amount of gravel are used at various lakebed locations as Best Available Control Measures for dust control mitigation on almost 40 square miles. Exhibit 5K provides a description of the Best Available Control Measures. LADWP has completed 9.2 square miles of shallow flooding, 0.5 square miles of modified shallow flooding, and 0.4 square miles of sand fence as part of the Phase 7 project in accordance with the 2008 State Implementation Plan. However, LADWP had proposed 3.1 square miles of a new waterless dust control measure called Moat and Row which was disallowed by the California State Lands Commission in April 2010. LADWP is working with the District to develop an alternative solution for the areas originally proposed for Moat and Row. LADWP has been ordered to complete an additional 2 square miles of dust control known as the Phase 8 project. LADWP is seeking a lease from the California State Lands Commission to construct Gravel Best Available Control Measures for Phase 8 as it does not require water for operation.

## *Exhibit 5K*
## *Dust Control Mitigation Best Available Control Measures*

| Dust Control Measures | | Description |
|---|---|---|
| Shallow Flooding | Sheet Flooding | Releases water from arrays of low-flow water outlets spaced at intervals of between 60 and 100 feet along pipelines laid along lake bed contours. Pipelines are spaced between 500 and 800 feet apart. This arrayed configuration of water delivery creates large, very shallow sheets of braided water channels. Water depths in sheet flooded areas are typically at most a few inches deep. The lower edge of sheet flooded areas has containment berms to capture and pond excess flows. The water slowly flows across the typically very flat lake bed surfaces downhill to tail-water ponds where pumps recirculate the water back to the outlets. To maximize project water use efficiency, flows to sheet flow areas are regulated at the outlets so that only sufficient water is released to keep the soil wet. Any water that does reach the lower end of the control area is collected and recirculated back through the water delivery system. |
| | Shallow Flooding (Pond Flooding) | Water containment berms that allow ponds to be formed that submerge the emissive lake bed areas. These ponds are up to four feet deep. The containment berms are typically rock-faced to protect them from delivery to the pond area until the pond reaches a size and depth sufficient to submerge the required amount of emissive water. Water delivery then ceases until evaporation reduces the pond size to a set minimum. |
| Managed Vegetation | | Control measure consists of creating a farm-like environment from barren playa. The saline soil must first be reclaimed with the application of relatively fresh water and then planted with salt-tolerant plants that are native to the Owens Lake basin. Thereafter, soil fertility and moisture inputs must be managed to encourage rapid plant development and maintenance. Existing Managed Vegetation areas are irrigated with buried drip irrigation tubing and a complex network of buried drains to capture excess water for reuse on the Managed Vegetation area or in Shallow Flooding areas. Managed Vegetation is sustainable at Owens Lake only if salt from the naturally occurring shallow groundwater is prevented from rising back into the rooting zone. |
| Gravel Blanket | | A four-inch layer of coarse gravel laid on the surface of the Owens Lake playa will prevent emissions by preventing the formation of efflorescent evaporate salt crusts, because the large pore spaces between the gravel particles disrupt the capillary movement of saline water to the surface where it can evaporate and deposit salts. The gravel also creates a surface that has a high threshold wind velocity so that direct movement of the large gravel particles is prevented and the finer particles of the underlying lake bed soils are protected. Gravel Blankets are effective on essentially any type of soil surface. |

As part of an Interim Management Plan, LADWP and Inyo County have agreed to conduct a joint study to explore the feasibility of extracting and utilizing brine laden groundwater beneath Owens Lake to supplement the water supply necessary for dust mitigation activities. This feasibility study is scheduled for completion by November 2011. If groundwater pumping is considered feasible and acceptable, LADWP will first need to obtain required approval from Great Basin Unified Air Pollution Control District, California State Lands Commission, California Department of Fish and Game, and Inyo County.

## 5.5 Water Quality

As land owners of much of the Mono Basin and Owens River watersheds, LADWP has placed strict limits on the extent of development impacting the City-owned watersheds. Snowmelt from the eastern Sierra Nevada contains low total organic carbon (TOC), bromide concentrations, and other constituents that can form disinfectant byproducts during the water treatment process. LADWP conducts routine monitoring of all of its water supplies for over 170 constituents and contaminants. Ninety-eight of the constituents and contaminants have enforceable standards.

The LAA supply is the main source of arsenic in LADWP's water supply. Arsenic is collected as the Owens River flows volcanic formations in the vicinity of Hot Creek in Long Valley. Geothermal springs in these areas have arsenic concentrations of around 200 parts per billion (ppb). Concentrations are dramatically reduced as water in the area mixes with snow melt and other pristine water sources. Historic untreated LAA water arsenic concentrations have ranged from 10 to 74 ppb. During the latest 3-year routine compliance monitoring cycle from 2007 to 2009, the highest arsenic concentration after treatment was 8.1 ppb, while the average arsenic concentration within LADWP's water distribution system was 3.3 ppb, both well below the current Federal and State drinking water standard of 50 ppb. In light of potential, more stringent arsenic regulations, LADWP is taking a proactive approach in addressing this issue by investigating and planning enhanced coagulation treatment.

LADWP completed an evaluation and preliminary design report for enhanced coagulation at the Los Angeles Aqueduct Filtration Plant in December 2006 as a means of addressing future water quality regulations faced by LADWP, including arsenic. An enhanced coagulation facility using the process as outlined in the report is planned as part of the treatment process at the Los Angeles Aqueduct Filtration Plant by 2021.

To comply with the Stage 2 Disinfectants and Disinfection Byproducts Rule, another water quality improvement effort being implemented is the conversion from chlorine to chloramine residual disinfectant. This transition, which is expected to be completed by April 2014, will allow LADWP to maintain the same high level of disinfection in its water supply while freeing itself from other potential disinfection issues associated with the use of chlorine. The use of chloramines will provide additional operational flexibility by allowing the blending of purchased MWD water (which is chloraminated) into the LADWP distribution system without the problems associated with creating a chlorine/chloramines interface when blending the two supplies.

## 5.6 Projected Deliveries

Near-term water deliveries are forecasted for the LAA using two models, the Runoff Forecast Model and the Los Angeles Aqueduct Simulation Model (LAASM). These two models used accurately predict the amount of water available from this the LAA.

The Runoff Forecast Model is used to predict total Owens Valley and Mono Basin stream runoff. The model's estimating equations were developed using historic rainfall and snowfall, as well as streamflow data of each year. Model input consists of 6 months of antecedent rainfall and streamflow data, as well as the final snowpack levels on April 1st. The model's output is the forecasted runoff for the Owens Valley and Mono Basin during the twelve month period following April 1st, assuming that median rainfall occurs during those twelve months.

Runoff flows from the Owens Valley to the City of Los Angeles are modeled by the LAASM. LAASM uses the output of the Forecast Model as input, along with estimates of various uses within the Owens Valley. LAASM uses historically derived estimating equations to forecast various losses, including evaporation and infiltration, as well as other inflows such as unmetered springs. The final output from LAASM is the volume of LAA water projected to be delivered to the City of Los Angeles.

Taking the foreseeable factors discussed earlier in this chapter into consideration, the average annual long-term LAA delivery over the next 25 years, using the 50-year average hydrology from FY 1956/57 to 2005/06, is expected to be approximately 254,000 AFY and gradually decline to 244,000 AFY due to climate change impact. Deliveries for a series of dry years, using FY 1988/89 through 1992/93 hydrology, are expected to range from approximately 48,520 AFY to 105,770 AFY. A single dry year minimum of 48,520 AFY is expected with a repeat of the FY 1990/91 hydrology. Detailed projections of LAA deliveries by year are provided in Chapter 11, Water Service Reliability Assessment.

## 5.7 LAA Delivery Cost

The costs associated with the LAA water supply are primarily operation and maintenance costs. Therefore, the unit cost of importing water through the LAA to the City varies mainly with the quantity of water delivered, which is highly dependent on hydrological conditions. During dry years, the amount of water delivered to the City decreases, which results in an increase to the unit cost. Over the years, eastern Sierra Nevada environmental enhancement project have also contributed to rising overall LAA delivery cost. The Owens Lake Dust Mitigation and Lower Owens River Project are two examples. Exhibit 5L summarizes the historical unit cost of treated water from the LAA. The peaks occurred when LAA deliveries significantly decreased during FY 1990/91, 2002/03, and 2008/09 with the LAA delivering 130,300 AF at $499/AF; 203,400 AF at $419/AF; and 108,500 AF at $1,003/AF respectively.

Exhibit 5M shows the unit cost of LAA treated water from FY 2005/06 to 2009/10. The 5-year average was $563/AF. The sharp increase in FY 2008/09 was due to LAA deliveries being the lowest on record.

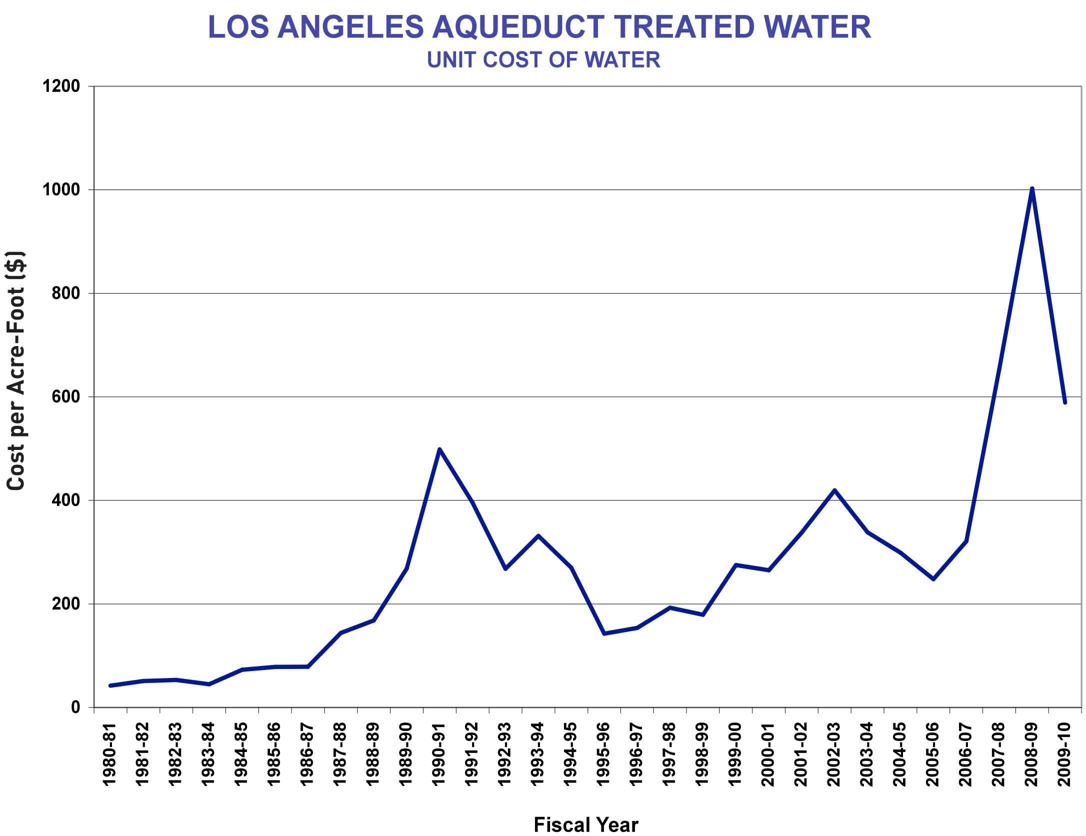



***Exhibit 5L Historical Cost of LAA Treated Water***

| Fiscal Year | 2005/06 | 2006/07 | 2007/08 | 2008/09 | 2009/10 |
|---|---|---|---|---|---|
| Unit Cost | $248 | $321 | $654 | $1,003 | $589 |

***Exhibit 5M Annual Unit Cost***

Chapter Six
# Local Groundwater

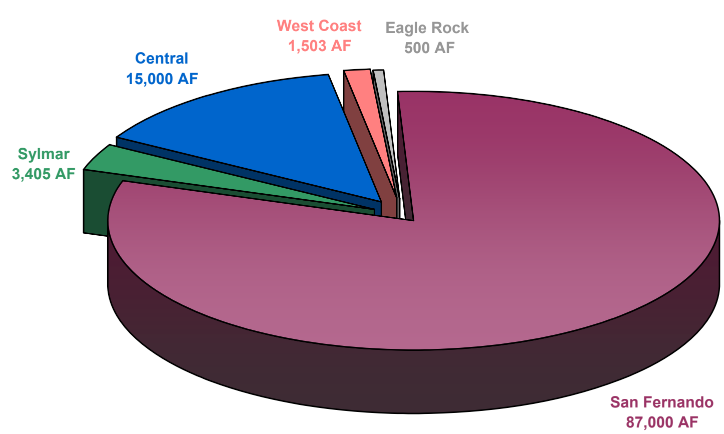
## 6.0 Overview

A key resource that the City has relied upon as the major component of its local supply portfolio is local groundwater. Over the last ten years local groundwater has provided approximately 12 percent of the total water supply for Los Angeles, and historically has provided nearly 30 percent of the City's total supply during droughts when imported supplies become less reliable. In recent years, contamination issues have impacted LADWP's ability to fully utilize its local groundwater entitlements. Additionally, reduction of natural infiltration due to expanding urban hardscape and channelization of stormwater runoff has resulted in declining groundwater elevations. In response to contamination issues and declining groundwater levels, LADWP is working on treatment for the San Fernando Basin's (SFB) groundwater and is making investments to recharge local groundwater basins through stormwater recharge projects, while at the same time replacing or rehabilitating old and deteriorating stormwater capture facilities. LADWP anticipates that groundwater treatment facilities in SFB will be in operation by Fiscal Year Ending (FYE) 2021 which will allow LADWP to pump its full groundwater entitlement. With the addition of utilizing stored water credits in the San Fernando Basin and Sylmar Basin, groundwater pumping will increase up to 111,500 Acre-Feet (AF) starting FYE 2021.

## 6.1 Groundwater Rights

The City owns water rights in the San Fernando, Sylmar, Eagle Rock, Central, and West Coast Basins. All of these basins are adjudicated by decree through Superior Court Judgments (Appendix F). The combined water rights in these

***Exhibit 6A***
***Annual Local Groundwater Entitlement***




**Total: 107,408 AF per year**

basins total approximately 107,408 AFY. Water rights in the Upper Los Angeles River Area (ULARA), which comprises the San Fernando, Sylmar, and Eagle Rock basins, total approximately 90,905 AFY which translates into approximately 87,000 AFY in the SFB, 500 AFY in the Eagle Rock Basin, and 3,405 AFY in the Sylmar Basin. Water rights in the Central and West Coast Basins are 15,000 AFY and 1,503 AFY, respectively. However, LADWP does not exercise its pumping rights in Eagle Rock Basin and West Coast Basin at this time. Exhibit 6A summarizes the City's annual local groundwater entitlements by basin.

### The ULARA Groundwater Basin Adjudication

The City's entitlements in the San Fernando, Sylmar, and Eagle Rock Basins were established in a Judgment by the Superior Court of the State of California for the County of Los Angeles in Case No. 650079, The City of Los Angeles, Plaintiff, vs. Cities of San Fernando, et. al., Defendants, dated January 26, 1979 (San Fernando Judgment) and the 1984 Sylmar Basin Stipulation (1984 Stipulation). Appendix F contains the Judgment and 1984 Stipulation. The Judgment was based on maintaining a safe yield operation for the basin, whereby groundwater extractions over the long-term will be maintained in a manner that does not create an overdraft condition in the basin. The Judgment and 1984 Stipulation limit groundwater extraction and establish a court-appointed Watermaster and an Administrative Committee made up of a representative from each of the five water supply agencies overlying the ULARA Basins. The five public agencies are the City of Los Angeles, the City of Glendale, the City of San Fernando, the City of Burbank, and the Crescenta Valley Water District.

The Watermaster assists the Court in administering and enforcing the provisions of the San Fernando Judgment and 1984 Stipulation. Among other duties, the Watermaster monitors groundwater levels, recharge operations, recycled water use, extractions, water imports and exports, and reports all significant water-related events in the Basin to the Court and to the parties of the Judgments. The activities of the Watermaster are key components for the effective management of the groundwater resources in the ULARA Basins. Key tasks of the Watermaster for the SFB include:

- To monitor radiological and synthetic organic compounds (SOCs) every three years.

- To continue to work with key regulators, such as the Los Angeles Regional Water Quality Control Board (LARWQCB), California Department of Public Health (CDPH), California Department of Toxic Substance Control (CDTSC), and the United States Environmental Protection Agency (USEPA), to expedite clean-up of groundwater at or near known contamination sites.

- To continue to support the ongoing activities of the City of Los Angeles and others to recharge the groundwater basin at existing spreading basins on the east side of the San Fernando Valley.

- To help determine the technical feasibility of using advanced treated recycled water to recharge the groundwater basin.

- To continue to work with the Los Angeles Department of Public Works, Bureau of Sanitation, Watershed Protection Division, to enhance groundwater recharge of local basins via the Standard Urban Stormwater Mitigation Plans (SUSMP) procedures for stormwater infiltration at new development and redevelopment project sites.

- To work with local purveyors in an effort to increase the quantity and quality of the groundwater database for the entire ULARA basin.

## *Exhibit 6B*
## *Local Groundwater Basin Supply*
**Fiscal Year (July through June in AF)**

| Groundwater Basin | 2005/06 | 2006/07 | 2007/08 | 2008/09 | 2009/10 | Average | Percentage |
|---|---|---|---|---|---|---|---|
| San Fernando | 35,486 | 75,640 | 57,060 | 49,106 | 62,218 | 55,902 | 79% |
| Sylmar | 1,844 | 3,901 | 4,046 | 576 | 2,998 | 2,673 | 4% |
| Central | 13,290 | 13,358 | 12,207 | 11,937 | 11,766 | 12,512 | 17% |
| Total | 50,620 | 92,899 | 73,313 | 61,619 | 76,982 | 71,087 | 100% |

### Historical Groundwater Production

On average over the past five years, about 83 percent (58,575 AFY) of the City's local groundwater supply was extracted from ULARA groundwater basins, while the Central Basin provided 17 percent (12,512 AFY). Exhibit 6B summarizes the City's local groundwater production by basin over the last five years.

Historically, LADWP operates groundwater production by utilizing conjunctive use of surface water and groundwater to optimize the supply and demand balance. Through conjunctive use, the timing of groundwater extractions can be used to meet varying demands. In the past, LADWP prevented groundwater overdraft during multiple dry years through strategic pumping. When successive dry years occured, LADWP pumped at greater than average rates for the first few years of the drought, and then pumped at lower rates in subsequent years.

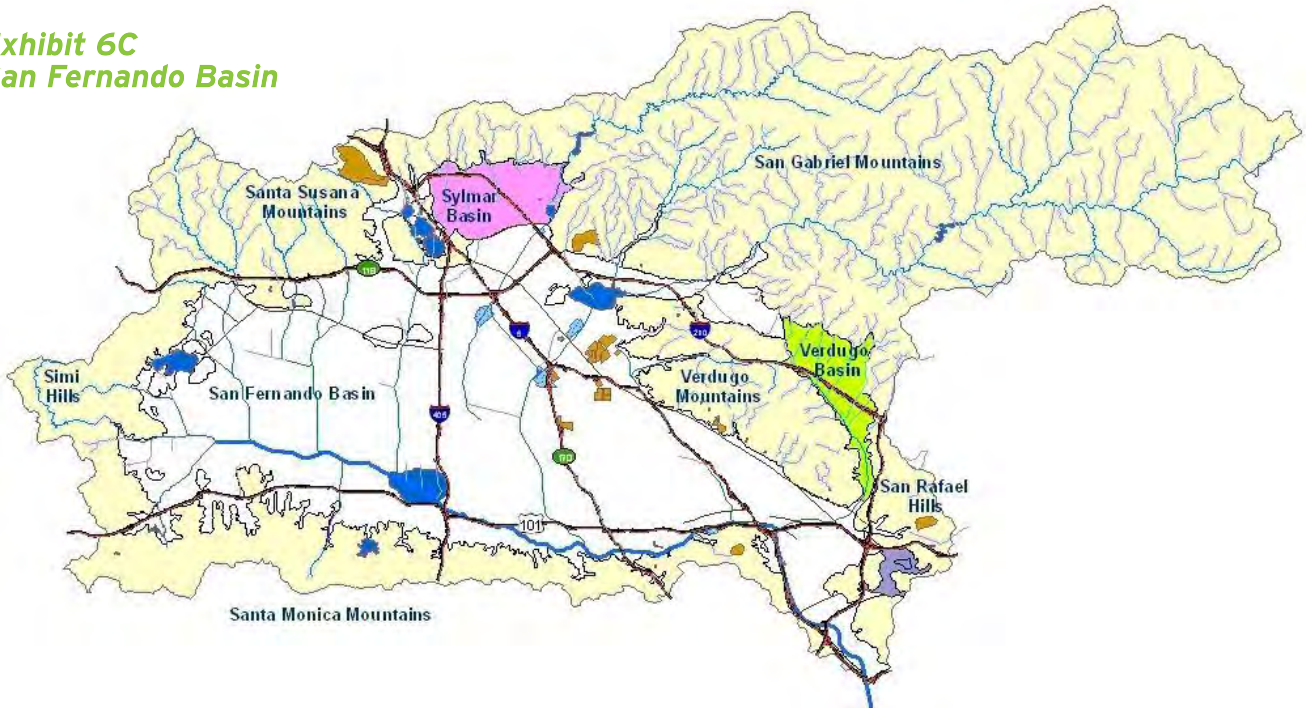
Since 2007, groundwater contamination issues in the SFB have greatly limited LADWP's ability to pump its full groundwater entitlement. As a result, LADWP has been pumping the maximum amount of water not impacted by contamination and therefore has not been able to utilize conjunctive use strategies for groundwater operations. When the clean-up of the SFB is complete, LADWP will be able to return to these strategic pumping strategies to ensure reliability and protect against groundwater overdraft in dry years.

## 6.2 San Fernando Basin

The primary source of local groundwater for the City is the SFB, which provided over 79 percent of the City's groundwater supply ranging from 35,486 AFY to 75,640 AFY during the period FY 2005/06 to FY 2009/10. The SFB is the largest of the four ULARA basins. The SFB consists of 112,000 acres and comprises 91.2 percent of the total area in ULARA. It is bounded on the east by the Verdugo Mountains; on the north by the Little Tujunga Syncline and the San Gabriel and Santa Susana Mountains; on west by the Simi Hills; and on the south by the Santa Monica Mountains. A map of the basin is shown in Exhibit 6C. (ULARA Watermaster Service Report, Water Year [October to September] 2008/09)

LADWP has ten major wellfields within the SFB containing 115 wells: the Crystal Springs, Headworks, Tujunga, Rinaldi-Toluca, North Hollywood, Erwin, Verdugo, Whitnall, Pollock, and North Hollywood Operable Unit Wellfields. Of the ten major wellfields, LADWP is currently not pumping only at Headworks. These wells were generally installed over a period spanning from 1924 to 1991, with the most recent installations being the Rinaldi-Toluca Wellfield in 1988 and the Tujunga Wellfield in 1991. Collectively these ten wellfields have the ability to pump and serve approximately 547 cubic feet per second (cfs) of water, of which the recent Rinaldi-Toluca and Tujunga wells comprise about 38 percent or 210 cfs.

***Exhibit 6C***
***San Fernando Basin***




## Groundwater Rights

In accordance with the San Fernando Judgment, the City has the right to all native water within the SFB, based on its Pueblo Rights, and has the right to City water that is imported and returns through infiltration into the SFB. With the native safe yield being fixed at 43,660 AFY and the return of imported water averaging approximately 43,000 AFY, the combined total equates to an average SFB entitlement for the City of approximately 87,000 AFY. The return of imported water right for LADWP is based on 20.8 percent of all water delivered within the San Fernando Basin including recycled water. The Judgment provides for storage of water within the basin when the amount pumped is less than the annual entitlement, and a portion of these stored water credits can be pumped in future years to supplement the City's water supply. The direct spreading of both imported and recycled water receives 100 percent stored water credit. Increasing LADWP's groundwater pumping rights due to stormwater capture activities will require an amendment to the San Fernando Judgment based on a demonstrated increase in groundwater levels.

In September 2007, the Cities of Los Angeles, Glendale and Burbank entered into a ten-year Interim Agreement for the Preservation of the San Fernando Basin Water Supply (Interim Agreement). The Interim Agreement is intended to address the overall long-term decrease in stored groundwater within the basin. The Interim Agreement restricts withdrawal of stored water credits and incorporates basin losses into groundwater basin accounting.

Under the Interim Agreement, stored water credits will be reduced for each party by 1 percent annually to account for outflow from the basin. Additionally as described in the Interim Agreement, a proportion of stored water credits available for use during a water year (Available Credits) will be calculated each year, and that proportion not available for use during a given year (Reserve Credits) will be reserved for later use. As of October 1, 2009, the City had a stored water credit of nearly 406,313 AF in the SFB, however LADWP's Available Credit or maximum allowable withdrawal of stored water credits for the year beginning October 1, 2009 was 108,574 AF. LADWP's Reserve Credits total was 321,316 AF. Reserve Credits (stored water credits minus available stored water credits) will not be available until groundwater levels in the basin recover to a level that will allow for their safe withdrawal. Total Reserve Credits held by all parties in the basin were 376,433 AF as of October 1, 2009.

## Water Quality

During well testing in the SFB, trace levels of the contaminants trichloroethylene (TCE), perchloroethylene (PCE), and other volatile organic compounds (VOCs) were detected in the past. The presence of these contaminants is due to improper chemical disposal practices historically conducted by numerous companies in the San Fernando Valley utilizing such materials. Additionally, in the 1990s, detectable amounts of hexavalent chromium and perchlorate were found in various wells within the SFB. Since the 1990s, SFB wells have also shown a trend of increasing nitrate levels. The source of nitrates is the result of decades of agricultural activity in the San Fernando Valley.

While LADWP is permitted to withdraw its allotted entitlement of 87,000 AFY from the SFB including a portion of its additional stored water, 2007 was the first year LADWP was unable to pump its allotted entitlement due to contamination impacts. LADWP has 115 wells in the SFB of which 57 wells have been inactivated due to contamination. These inactive wells represent a lost pumping capacity of approximately 236 cfs or 44 percent of LADWP's pumping capacity. Of the remaining 58 active wells, with a combined pumping capacity of approximately 304 cfs, 45 have recorded concentrations for various contaminants above the Maximum Contaminant Level (MCL). Most notable among these contaminants of concern are the VOCs (especially TCE, PCE, and carbon tetrachloride), nitrates, and perchlorate. The remaining 13 wells have recorded marginal levels of contamination, mostly due to VOCs. Hexavalent chromium threatens to be a significant future risk to LADWP's wells. Lastly, LADWP's two largest wellfields, Tujunga and Rinaldi-Toluca, which were the most recently-installed wells in an area believed to be outside the known contamination areas, are being significantly impacted by unknown contamination sources.

LADWP has developed programs to accelerate treatment for the SFB groundwater which includes a comprehensive Groundwater System Improvement Study, installing monitoring wells, interim wellhead treatment, and working with regulatory agencies and government officials to identify those responsible for the contamination.

## Agency Cooperation of SFB Remediation

LADWP actively coordinates with the CDPH, LARWQCB, CDTSC, and USEPA to pursue protective and remedial measures for the SFB. The CDPH, LARWQCB, and CDTSC are the three regulatory agencies with enforcement responsibilities within the SFB. The LARRWQCB and the CDTSC issue enforcement directives for pollutant sites and guide the development of cleanup workplans and the cleanup of polluted groundwater sites. The CDPH oversees the quality of potable water from groundwater sources.

In 1987, LADWP entered into a Cooperative Agreement with the USEPA to conduct the "Remedial Investigation of Groundwater Contamination in the San Fernando Valley." Under this agreement, LADWP has received funds from the USEPA's Superfund Program to carry out: (1) construction, operation, and maintenance of the North Hollywood Operable Unit, which consists of a groundwater treatment facility and a system of eight production wells (construction completed in 1989); and (2) completion of the Remedial Investigation to characterize the SFB and the nature and extent of its groundwater contamination. The Remedial Investigation included: (a) the installation in 1992 of 88 shallow and clustered monitoring wells that were developed to monitor contamination plumes of TCE, PCE, and nitrates in the SFB; (b) the development of a groundwater flow model (Flow Model) and the preparation of the Remedial Investigation report that was completed for the USEPA in 1992; and (c) on-going monitoring for TCE, PCE, nitrates, and emerging contaminants.

The Flow Model is a three-dimensional computer simulated model of the SFB based on the MODFLOW model program code that was developed by the United States Geological Survey. It consists of four layers that represent the various depth zones of the SFB. Geologic and hydrogeologic data for the basin, which was generated through field investigation, was analyzed to develop the physical site characterization of the basin for the MODFLOW Flow Model. The Flow Model produced simulated groundwater levels, gradients, and their fluctuations as a function of time. Based on field monitoring and Flow Model simulations, groundwater production strategies are reviewed and adjusted monthly to balance the City's water supply need with SFB management.

## San Fernando Basin Treatment

In coordination with other agencies, LADWP has completed or is planning various projects to maintain its rights to use the SFB as a reliable local water supply for the City. The following are some of LADWP's completed, current, and planned projects for the SFB. Recharge projects are discussed separately in Chapter 7, Watershed Management.

**Groundwater System Improvement Study**
LADWP is working on a 6-year, $19.0-million Groundwater System Improvement Study (GSIS) in the SFB that will provide vital information to assist in developing both short- and long-term projects to maximize the use of the SFB. The $11.5-million GSIS professional service contract was awarded in February 2009.

The GSIS will aim to cover the following main objectives:

- Provide an independent study to identify, characterize, and evaluate emerging water quality constituents for the San Fernando Basin.
- Provide an independent expert evaluation of LADWP's existing groundwater facilities and its current operational strategies to address current issues on water quality regulations and groundwater treatments. Provide expert advice on the need of refurbishing existing groundwater wells.
- Research and evaluate the need for the installation of new monitoring wells in the SFB to characterize the basin for the constituents of concern.
- Develop a research monitoring program to characterize the nature and extent of the various constituents of concern that may pose a risk to LADWP maximizing the utility of the SFB.
- Provide independent expert recommendations on economically feasible short and long-term capital improvement projects to address all regulatory agency requirements.

Through the GSIS, LADWP has begun developing a conceptual layout for Groundwater Treatment Facilities in the SFB that will include treatment facilities in the vicinity of LADWP's North Hollywood, Rinaldi-Toluca, and Tujunga Well Fields. It is anticipated that construction of the Groundwater Treatment Facilities could begin as early as July 2016. Construction of the Groundwater Treatment Facilities will greatly reduce LADWP's reliance on costly and scarce imported water supplies. The Groundwater Treatment Facilities will also enable LADWP to benefit from its activities to enhance local supplies through groundwater recharge and stormwater projects. An integral part of LADWP's Groundwater Treatment Facilities will be to work closely with the USEPA and the Cities of Burbank and Glendale to ensure that the facilities operations do not adversely affect the on-going cleanup activities being conducted by the aforementioned agencies. Towards this end, LADWP plans to enter into a Groundwater Management Plan with the USEPA.


As of November 2010, the work progress has included: a technical review of USEPA's Focused Feasibility Study for the North Hollywood Operable Unit; preparation of conceptual layouts and renderings for the proposed Groundwater Treatment Facilities in the vicinity of the North Hollywood, Rinaldi-Toluca and Tujunga Well Fields; providing assistance in the planning aspects for the installation of approximately 40 new monitoring wells in the San Fernando Basin; and providing an independent study to identify, characterize and evaluate emerging water constituents.

**Tujunga Wellfield Joint Project**

LADWP and MWD have developed a joint project utilizing simple liquid-phase granular activated carbon to recover the use of two of the City's contaminated groundwater production wells in the Tujunga Wellfield. The total estimated cost of this project was approximately $7.0 million and was completed in November 2009. LADWP received the permit from the CDPH in May 2010 and started to discharge into the distribution system on May 18, 2010.

**Tujunga Wellfield Contamination**

The Initial Discovery of the source of contamination at the Tujunga Wellfield by the USEPA and CDTSC is ongoing. Phase I is completed and has not conclusively identified the source of the contamination. The next phase will involve drilling 4 to 7 deep monitoring wells immediately up gradient of the wellfield to determine the direction of the contamination plumes. The well drilling is expected to be completed late 2012. LADWP is intending to construct up to 22 additional monitoring wells near other wellfields south of the Tujunga Wellfield. Water quality data from the new monitoring wells will assist with further characterizing the groundwater contamination in the SFB. Drilling of these additional wells is expected to begin in Fall 2011 and continue until Winter 2013.

**North Hollywood Operable Unit**

In 1989, the North Hollywood Operable Unit was placed into service with a capacity of 2,000 gallons per minute, or 3,230 AFY. This facility has one aeration tower with vapor-phase granular activated carbon air emissions control system. This technology uses air to remove the VOCs from the groundwater and uses the vapor-phase granular activated carbon to remove the VOCs from the air stream before it exits into the atmosphere. The fifteen year consent decree expired on December 31, 2004, however, the VOC plume has not been completely remediated. In Water Year 2008/2009, 1,038 AF of VOC contaminated groundwater was treated.

The USEPA is expected to start construction of the North Hollywood Operable Unit Second Remedy possibly as soon as 2014 to improve containment of contamination from two sites, the Honeywell and Lockheed sites. The primary plume contains high concentrations of VOCs, chromium, and other contaminants of concern. The USEPA issued the Record of Decision in September of 2009. The first technical meeting with the potentially responsible party was held in July 2010. A consent decree is expected in late 2011. The Record of Decision recommends more than doubling the capacity plus adding liquid phase granular activated carbon (a secondary treatment), construction of up to 37 monitoring wells, three new extraction wells, deepen existing well #1, rehabilitation of existing wells, and treatment of chromium and 1-4 Dioxane. As of 2010, Honeywell is continuing its removal of chromium plume at the source of contamination.

**Chromium Treatment Research**

A cost-effective treatment technology to remove low levels of hexavalent chromium from water does not exist for large scale applications. In 2001, LADWP, along with the Cities of Burbank, Glendale, and San Fernando, and the National Water Research Institute, entered into a research partnership with the American Water Works Association Research Foundation to identify and bench-test new technologies that can remove hexavalent chromium to extremely low levels. This research is being conducted in anticipation of a new standard for hexavalent chromium.

**Pollock Wells Treatment Plant**

In 1999, the Pollock Wells Treatment Plant was constructed and placed in service. This project was funded by LADWP, and it includes a groundwater treatment facility with four liquid-phase granular activated carbon units. Over 3,000 gallons per minute (4,840 AFY) of groundwater is treated by direct adsorption with granular activated carbon to remove VOCs before delivery to customers.

**Remedial Investigation**

In 1992, the Remedial Investigation to characterize the nature and extent of groundwater contamination in the SFB was completed for the USEPA. The Remedial Investigation activity included the construction of 88 shallow and clustered monitoring wells, which were developed to monitor contamination plumes of TCE, PCE, and nitrates in the SFB. These monitoring wells are also being used to monitor for emerging chemicals.

**Biological Treatment Pilot Test**

LADWP will be studying the effectiveness of biological treatment on removal of VOCs contaminants from the Tujunga Wellfield groundwater. Biological treatment is a proven technology for removal of perchlorate and nitrate contaminants from groundwater which are also present in the Tujunga Wellfield groundwater. If biological treatment can also effectively remove VOCs from the groundwater, LADWP can significantly reduce the capital as well as future operations and maintenance costs associated with cleanup and removal of contaminants from the Tujunga Wellfield groundwater.

**Pilot Test of Advance and Emerging Groundwater Treatment Technologies**

LADWP is investigating the utilization of other advance and/or emerging groundwater treatment technologies for removal of VOCs and perchlorate for possible pilot study(ies) at the Rinaldi-Toluca Wellfield within the next few years.

## 6.3 Sylmar and Eagle Rock Basins

The Sylmar Basin has provided slightly over 4 percent of the City's local groundwater ranging from 576 AF to 4,046 AF from FY 2005/06 through FY 2009/10. The Sylmar Basin, in the northern part of ULARA, consists of 5,600 acres and comprises 4.6 percent of the ULARA area. It is bounded on the north and east by the San Gabriel Mountains; on the west by a topographic divide in the valley fill between the Mission Hills and the San Gabriel Mountains; and on the south by the Little Tujunga syncline, which separates it from the SFB. (ULARA Watermaster Service Report, Water Year 2008/09) LADWP originally had a total of 3 production wells installed in the Sylmar Basin between 1961 and 1977. One of these wells was removed from service and is no longer utilized. The remaining wells have the capacity to pump 5 cfs.

The Eagle Rock Basin is the smallest of the four basins. It is located in the extreme southeast corner of ULARA. It consists of 800 acres and comprises 0.6 percent of the total ULARA area. LADWP is not pumping in the Eagle Rock Basin currently. The safe yield of Eagle Rock Basin is derived from imported water delivered by LADWP. There is no measurable native safe yield. LADWP has the right to extract the entire safe yield of the basin. Currently, the groundwater is being pumped by a private party and LADWP is reimbursed for such pumping in accordance with the San Fernando Judgment.

### Groundwater Rights

In 1996 upon the recommendation of the Watermaster, the ULARA Administrative Committee approved a temporary safe yield increase for the Sylmar Basin thus temporarily increasing LADWP's rights from 3,105 AFY to 3,255 AFY for a ten-year period. Per the 1984 Stipulation, the safe yield minus private party overlying rights are to be equally split between LADWP and the City of San Fernando. In 2006, a subsequent evaluation of the safe yield was conducted and completed in accordance with Section 8.2.10 of the 1984 Stipulation. Upon recommendation of the parties, the Court approved a new stipulation further increasing the temporary safe yield of the basin and resulting in a temporary increase in LADWP's rights to 3,405 AFY subject to multiple conditions. Conditions imposed on LADWP and the City of San Fernando include installing groundwater monitoring wells to assist in determining basin outflows. This new stipulation became effective on October 1, 2006 and is set to expire on October 1, 2016.

Stored water credits accumulated in the basin are determined by adding the previous years stored water credit and the extraction right for the previous year together and then subtracting the actual extractions for the previous year. As of October 1, 2009, LADWP has accrued 9,423 AF of stored water credits in the Sylmar Basin. In 2006, the Watermaster recommended LADWP to begin pumping these rights due to the large amount of stored water credits. LADWP has proposed the Mission Wells Improvement Project to initiate pumping the credits and to replace the existing wells that have significantly deteriorated. As proposed, the project consists of constructing a water tank, three wells, and other operational facilities at the Mission Wellfield. Phase 1 was completed in February 2009 and involved replacement of the water tank that was beyond its useful life. Phase 2 is in the planning stages and consists of three new wells with operational facilities and is forecast for completion in August 2014. These new facilities will allow LADWP to pump its current entitlement of 3,405 AFY on an annual basis and draw from its existing stored water credits.

## Water Quality

Groundwater quality issues have occurred in the Sylmar Basin related to TCE contamination at one of the two production wells. The effluent from the wellfield is managed in such a way that the groundwater quality meets or surpasses water quality standards. Primary limitations on pumping are related to the deterioration of pumping facilities and not contamination. However, the Mission Wells Improvement Project as previously discussed, will replace the deteriorated wells and increase production capacity to allow LADWP to pump its annual water rights.

## 6.4 Central Basin

From FY 2005/2006 through FY 2009/10, the Central Basin has provided on average approximately 17 percent of LADWP's local groundwater supply ranging from 11,766 AF to 13,358 AF through wells in two major production fields. The Central Basin Watermaster Service area overlies about 227 square miles of the Central Basin in the southeastern part of the Los Angeles Coastal Plain in Los Angeles County. The Watermaster Service Area is bounded by the Newport-Inglewood Uplift on the southwest, the Los Angeles-Orange County line on the southeast, and an irregular line that approximately follows Stocker Street, Martin Luther King Boulevard, Alameda Street, Olympic Boulevard, the boundary between the City of Los Angeles and unincorporated East Los Angeles, and the foot of the Merced and Puente Hills on the north. Twenty-three incorporated cities and several unincorporated areas are within the Central Basin Watermaster Service Area. Groundwater within the basin provides a large portion of the water supply needed by overlying residents and industries. In FY 2008/09, there were 140 parties with rights to water within the Central Basin (Central Basin Watermaster Service Report, FY 2009/10).

Two LADWP facilities provide groundwater supplies in the Central Basin, the Manhattan Wells and the 99th Street Wells. The active Manhattan Wells were installed between 1928 and 1974 and have a production capacity of 16.9 cfs. Wells at the 99 th Street location were installed between 1974 and 2002 and have a production capacity of 7.4 cfs.

While the 99th Street Wells are newer and have relatively little mechanical or other problems, the Manhattan Wells are much older and have experienced maintenance problems and are approaching the end of their useful life. To restore the City's pumping capacity, LADWP is working on plans to install two new production wells, replace two deteriorated wells, and improve other related facilities at the Manhattan Wells site.

## Groundwater Rights

More than 50 years ago, groundwater overdraft and declining water levels in the Central Basin threatened the area's groundwater supply and caused seawater intrusion in the southern part of the Central Basin. However, timely legal action and adjudication of the water rights halted the overdraft and prevented further damage to the Central Basin. Today, groundwater use in the Central Basin is restricted to the allowed pumping allocations by a 1966 Superior Court Judgment and is monitored by a court-appointed Watermaster, the Department of Water Resources (DWR). Annually, the Watermaster prepares a Watermaster Service Report indicating groundwater extractions, replenishment operations, imported water use, recycled water use, finances of Watermaster services, administration of the water exchange pool, and significant water-related events in the Central Basin.

The City's entitlement in the Central Basin of 15,000 AFY was established in a judgment by the Superior Court of the State of California for the County of Los Angeles through the Central Basin Judgment (Case No. 786,656 –second amended judgment). In addition to its annual entitlement, the Central Basin Judgment allows for carryover of unused water rights up to a maximum total cumulative amount of 20 percent of the purveyor's pumping allocation and also allows for over extraction of an additional 20 percent under emergency situations that would be debited against the purveyor's following year entitlement. The City uses its carryover storage right for operational flexibility and conjunctive use. LADWP has allowable carryover storage of 3,000 AF into FY 2010/11.

The Central Basin or West Coast Basin Judgements do not permit storing water in the basin for later extraction. Through the assistance of a facilitator, multiple parties with groundwater rights have developed a draft framework to allow conjunctive use groundwater storage in the basins and are seeking amendment of the Judgments to allow groundwater storage. Two separate cases are currently in the Superior Court on the storage framework issue.

## Water Quality

Although the Manhattan and 99$^{th}$ Street Well fields in the Central Basin are located only approximately 4 miles apart, there is a large difference in water quality between the facilities. One of the Manhattan Wells currently exceeds the MCL of 5 ppb for TCE. The effluent from the wellfield is managed in such a way that the groundwater quality meets or surpasses water quality standards.

Water from 99$^{th}$ Street Wellfield complies with the National Primary Drinking Water Regulations, but requires treatment to comply with the National Secondary Drinking Water Regulations for manganese and iron. These contaminants are not considered to present a risk to human health, but at existing concentrations the contaminants may present taste, color, and odor problems. Corrosion control treatment using zinc orthophosphate as a sequestering agent and sodium hypochlorite to oxidize manganese has been in place at the wellfield for twenty years. Hydrogen sulfide is also present but not an imminent threat to the reliability of this well supply when chlorinated. In 2002, two new wells were drilled and placed into operation. During the first several months of operation of the new wells, numerous color complaints were received from customers. Adjustments in the treatment process were made which improved water quality.

## 6.5 West Coast Basin

LADWP has not been able to pump its water entitlement from the West Coast Basin since 1980 due to localized groundwater contamination issues and deterioration of the wells at the Lomita Wellfield. The West Coast Basin underlies 160 square miles in the southwestern part of the Los Angeles Coastal Plain in Los Angeles County. The West Coast Basin is bounded on the west by Santa Monica Bay, on the north by Ballona Escarpment, on the east by the Newport-Inglewood Uplift, and on the south by San Pedro Bay and the Palos Verdes Hills. Twenty incorporated cities and several unincorporated areas overlie the West Coast Basin (West Coast Basin Watermaster Service Report, FY 2009/10).

### Groundwater Rights

In 1945, when intrusion of sea water caused by declining water levels threatened the quality of the groundwater supply, legal action was taken to halt the overdraft and prevent further damage to the West Coast Basin. In 1955, the Superior Court of Los Angeles County appointed the DWR as the Watermaster to administer an Interim Agreement, and in 1961, the Court retained the DWR as the Watermaster of the Final West Coast Basin Judgment (Case No. 506,806 –amended judgment). Similar to the Central Coast Basin, an annual Watermaster Service Report is prepared. The West Coast Basin Judgment provided the City with a right to 1,503 AFY of groundwater.

### Water Quality

Groundwater quality problems in the West Coast Basin were previously related to high levels of total dissolved solids and chlorides. LADWP halted operations in the basin in September of 1980 with closure of the Lomita Well Field, and intends to study the feasibility and cost of restoring groundwater pumping.

## 6.6 Unadjudicated Basins

The Central and West Los Angeles Areas include the Hollywood Basin and Santa Monica Basin. Both Basins are unadjudicated. In the past, LADWP studied the potential for utilizing these basins for increased groundwater supply. It was determined that developing groundwater was not recommended due to water quality and cost considerations. However, LADWP intends to revisit the potential for increased groundwater production from these two basins. It is anticipated that available supplies remain low and water quality issues remain, but as the cost of imported water increases, it is prudent to reconsider this local water source.

## 6.7 Water Quality Goals and Management

The groundwater management efforts that LADWP has undertaken have resulted in all groundwater delivered to customers meeting or exceeding all water quality regulations. As part of its regulatory compliance efforts, LADWP works with the CDPH to perform water quality testing on production and monitoring wells.

### Groundwater Monitoring

LADWP conducts extensive field and laboratory tests throughout the year for hundreds of different chemicals, such as arsenic, chromium, lead, and disinfection by-products, to ensure that they are will within the safe levels before we serve the water to our customers.

Every well that is pumped to supply water to the City is actively monitored by LADWP as required by CDPH. LADWP's groundwater monitoring program is comprised of several distinct components, including monitoring of metals, coliform bacteria, inorganics, volatile organic

### *Exhibit 6D*
### *Operating Limits of Regulated Compounds*

| Compound | State of California Limit | LADWP Operational Goals | LADWP Added Safety Margin |
|---|---|---|---|
| Trichloroethylene (TCE) | 5 ppb | 3 ppb | 40% |
| Perchloroethylene (PCE) | 5 ppb | 3 ppb | 40% |
| Nitrate ($NO_3$) | 45 ppm | 30 ppm | 33% |
| Perchlorate ($ClO_4$) | 6 ppb | 4 ppb | 33% |
| Total Chromium | 50 ppb | 30 ppb | 40% |

compounds (VOCs) and unregulated compounds such as vanadium, boron, and perchlorate. The frequency and level of monitoring (i.e., annually, quarterly, or monthly), depending on the level of contamination found in each well.

Monitoring for all contaminants is performed at entry points into the distribution system in close proximity to where the water is being pumped from the wells. If water quality problems are detected, the well source is immediately isolated and retested.

## Operating Goals

LADWP has established operating goals for TCE, PCE, nitrates, perchlorate, and total chromium that are more stringent than the maximum contaminant levels (MCLs) permitted by Federal or State regulations. These stricter operational goals provide an additional safety margin from these contaminants for City customers. Exhibit 6D summarizes these water quality goals and compares them with the State-regulated requirements, which are generally more stringent than Federal requirements.

TCE and PCE compounds are commonly used in industries requiring metal degreasing. PCE is also used in dry cleaning and automotive repair industries.

Nitrate is a concern because of its acute effect of impeding the uptake of oxygen to the blood. Infants (who are in the earliest stages of development) are most sensitive to the effects of nitrates. The current standard for nitrate is 45 parts per million (ppm). A single exceedence of the nitrate standard is classified as an acute violation requiring immediate public notification. Treatment for nitrates may eventually become necessary for affected City groundwater supplies.

In October 2007, a MCL was adopted for perchlorate of 6 ppb. Perchlorate is an inorganic compound that is most commonly used in the manufacture of rocket fuels, munitions, and fireworks. In addition to its detection in groundwater, the compound has also been detected in Colorado River Aqueduct water.

## Managing Emerging Contaminants of Concern

LADWP addresses emerging contaminants on many levels: 1) by encouraging  the development of standardized testing to enable early detection and supporting the regulatory framework by providing early occurrence data, 2) by advocating good science and a balanced approach to risk assessment, 3) by seeking to gain a risk perspective with other existing contaminants to manage the emerging contaminants in the absence of regulations, 4) by supporting early interpretation of emerging contaminants in collaboration with research and regulatory agencies, and 5) by supporting the research to develop cost-effective treatment for the removal and management of these emerging contaminants.

An example of how LADWP addresses an emerging contaminant is chromium VI (otherwise known as hexavalent chromium). Hexavalent chromium does not have an enforceable drinking water standard at this time. However, hexavalent chromium is included in the State total chromium standard of 50 ppb. CDPH is expected to establish drinking water standards for the compound in the near future. Chromium is a heavy metal that has been used in industry for various purposes including electroplating, leather tanning, and textile manufacturing, as well as controlling biofilm formation in cooling towers. LADWP began low level monitoring of hexavalent chromium long before monitoring was required by regulators. LADWP supported new health-effects research needed to support risk assessment, and advocated a balanced approach to risk management. LADWP funded research to develop new treatment technologies to reduce hexavalent chromium detection levels.

Most recent among emerging contaminants are pharmaceutically active compounds and personal care products that are finding their way into rivers, lakes, and waterways from urbanized areas. There are concerns about the occurrence and effects of endocrine disrupters, hormone-shifting compounds, and pharmaceuticals. Technology now allows the detection of compounds down to the parts per trillion levels, thus some of these compounds are now being detected. The risk assessment field is finding it difficult to keep pace with advances in analytical detection technology. The question of these contaminants posing a health risk at low levels needs more investigation. LADWP will continue to proactively address emerging contaminants through early monitoring and utilization of a balanced approach to risk management.

LADWP will be incorporating appropriate treatment processes into future groundwater treatment facilities. LADWP has and will continue to solicit input from stakeholders to properly plan and develop processes for removal and treatment of emerging contaminants. LADWP's Recycled Water Advisory Group (RWAG) is an example of ongoing efforts to solicit input.

***Exhibit 6E***
***Historical Cost of Groundwater Pumping***

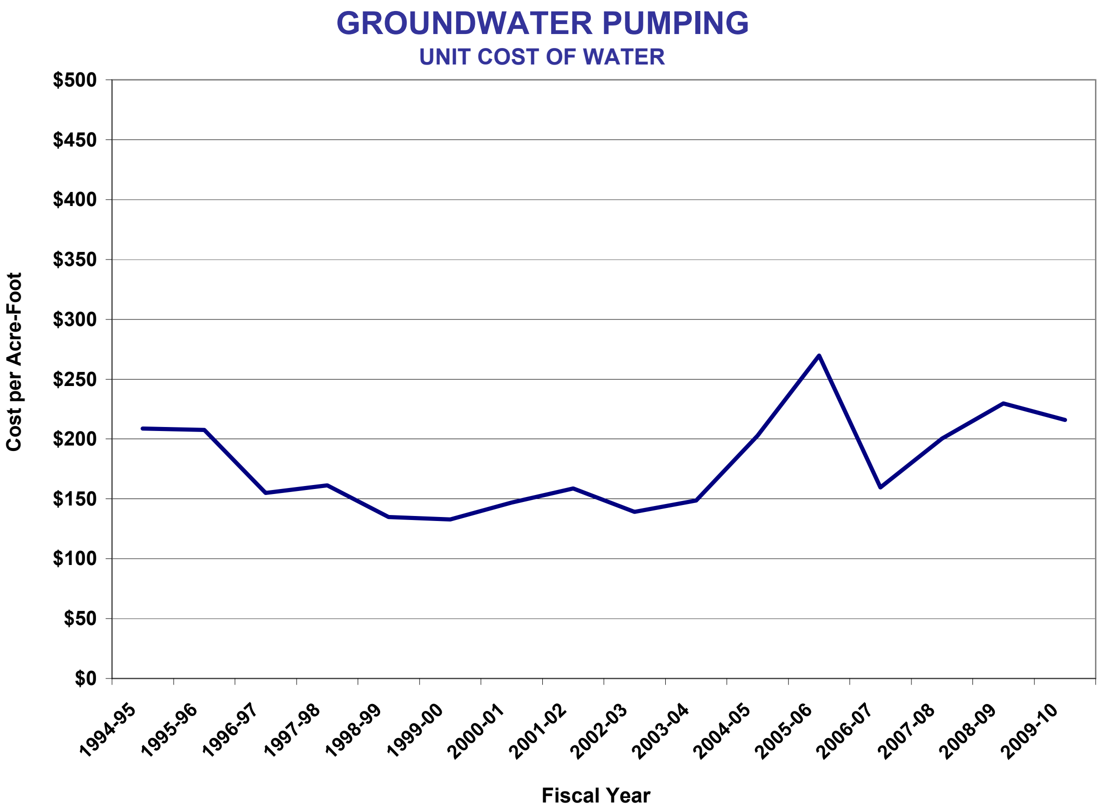



***Exhibit 6F***
***Annual Unit Cost ($/AF)***

| Fiscal Year | 2005/06 | 2006/07 | 2007/08 | 2008/09 | 2009/10 |
|---|---|---|---|---|---|
| Unit Cost | $270 | $160 | $200 | $230 | $216 |

## 6.8 Groundwater Pumping Cost

The costs associated with groundwater pumping are primarily operation and maintenance costs. Therefore, the unit cost of groundwater pumping varies mainly with the quantity of water delivered. Exhibit 6E summarizes the historical unit cost of groundwater pumping.

Exhibit 6F shows the unit cost of groundwater pumping from FY 2005/2006 to FY 2009/2010. The 5-year average was $215/AF.

## 6.9 Groundwater Production Projections

Historically, with conjunctive use management of groundwater, storing imported water in the groundwater basins during wet and normal years, groundwater production can actually be increased during dry years. LADWP operated its groundwater resources in this manner. On average, LADWP pumped its adjudicated right of approximately 107,000 AFY, but in dry years LADWP could pump larger quantities of groundwater. For the purposes of an average, single-dry, and multi-dry year analysis, after the implementation of groundwater treatment for the SFB and completing the construction of new wells in the Sylmar and Central Basins, 110,405

AFY is assumed to be the City's local groundwater production in 2035. After completion of groundwater treatment for the SFB, if successive dry years occur, LADWP would likely pump at greater-than-average levels for the first few dry years, then start pumping at lower levels in order to prevent groundwater overdraft. LADWP would then replenish the groundwater in wet or normal years following the successive dry period. Exhibit 6G provides groundwater pumping projections by basin between 2010 and 2035 for average, single-dry, and multi-year dry weather conditions in five-year increments.

Not included in the figure below is increased groundwater pumping due to groundwater replenishment of advanced treated wastewater, as well as enhanced stormwater recharge. This Urban Water Management Plan projects increased groundwater pumping through groundwater replenishment of advanced treated wastewater of 15,000 AFY, and increased groundwater pumping through enhanced stormwater recharge of and additional 15,000 AFY, both by 2035.

### *Exhibit 6G*
### *Groundwater Production 2010 to 2035 for Average, Single-Dry, and Multi-Year Dry Weather Conditions*

| Basin | FY 2009/10 | FY 2014/15 | FY 2019/20 | FY 2024/25 | FY 2029/30 | FY 2034/35 |
|---|---|---|---|---|---|---|
| | AFY | | | | | |
| San Fernando | 62,218 | 21,000 | 76,800 | 92,000 | 92,000 | 92,000 |
| Sylmar | 2,998 | 4,500 | 4,500 | 4,500 | 4,500 | 3,405 |
| Central | 11,766 | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| Total | 76,982 | 40,500 | 96,300 | 111,500 | 111,500 | 110,405 |

- 2015 San Fernando pumping levels are decreased due to anticipated well contamination from plume migration.
- Assumes existing annual rights to 87,000 AFY in SFB will remain unchanged. The groundwater treatment facilities are expected to be in operation in FY 2020/21. Storage credit of 5,000 AFY will be used to maximize the pumping thereafter.
- Sylmar Basin production temporarily increases to 4,500 AFY to avoid the expiration of stored water credits then return back to the entitlement of 3,405 AFY in FY 2030/31.

Chapter Seven
# Watershed Management

## 7.0 Overview

This Urban Water Management Plan projects that additional stormwater capture projects will provide for increased groundwater pumping rights in the San Fernando Basin of 15,000 AFY. Stormwater capture projects will also provide 10,000 AFY of additional water conservation from capture and reuse solutions such as rain barrels and cisterns, for a total of 25,000 AFY by fiscal year ending 2035. The Stormwater Capture Master Plan (refer to Section 7.3 below) will comprehensively evaluate stormwater capture potential within the City.

Stormwater runoff from urban areas is an underutilized resource. Within the City of Los Angeles, the majority of stormwater runoff is directed to storm drains and ultimately channeled into the ocean. Unused stormwater reaching the ocean carries with it many pollutants that are harmful to marine life. In addition, local groundwater aquifers that should be replenished by stormwater are receiving less recharge than in the past due to increased urbanization. Urbanization has increased the City's hardscape, which has resulted in less infiltration of stormwater and a decline in groundwater elevations.

In addition, development has encroached onto waterway floodplains requiring the channelization of these waterways that once recharged the groundwater aquifers with large volumes of stormwater runoff. When the floodplains were undergoing rapid development, LADWP and the Los Angeles County Flood Control District (LACFCD) reserved several parcels of land for use as spreading facilities. These facilities are adjacent to some of the largest tributaries of the Los Angeles River, and the Pacoima and Tujunga Washes.

During average and below average years, these spreading facilities are very effective at capturing a large portion of the stormwater flowing down the tributaries. However they are incapable of capturing a significant portion of the flows during wet and extremely wet years. Weather patterns in Los Angeles are highly variable, with many periods of dry years and wet years. Some climate studies predict that these patterns may become more extreme in the future.

Furthermore, a significant portion of the watershed is not located adjacent to large tributaries and therefore, cannot be served by existing spreading facilities. These areas are the urbanized low-lying flatlands that also produce stormwater, therefore a strategy to create and implement distributed stormwater infiltration solutions is needed. These distributed solutions include widespread, smaller projects at the neighborhood scale and landscape changes at the individual parcel scale.

With increased attention being placed on stormwater capture, other challenging conditions beyond imperviousness and climate patterns have been identified.

These include antiquated spreading facilities, landfills adjacent to spreading facilities, floodplain encroachment, substructures, and other man-made conditions that limit the ability to capture stormwater for later use.  Some conditions such as the antiquated delivery systems at the spreading facilities can easily be retrofitted with new gates and telemetry. Other conditions such as the presence of large sanitary landfills adjacent to spreading facilities, are more difficult to rectify.

In January 2008, LADWP created the Watershed Management Group which is responsible for developing and managing the water system's involvement in emerging issues associated with local and regional stormwater capture. The Watershed Management Group coordinates activities with other agencies, departments, stakeholders and community groups for the purpose of planning and developing projects and initiatives to improve stormwater management within the City. The Group's primary goal is to increase stormwater capture by enhancing existing centralized stormwater capture facilities and promoting distributed stormwater infiltration systems to achieve the City's long-term strategy of enhancing local stormwater capture. While working to increase stormwater capture for improving long-term groundwater reliability, other watershed benefits can be achieved including increased water conservation, improved water quality, open space enhancements, and flood control.

Additionally, the City is investigating recharge of the San Fernando Basin (SFB) with advanced treated recycled water. A more in-depth discussion of efforts to maximize groundwater recharge with advanced treated recycled water is provided in Chapter 4, Recycled Water.

## 7.1 Importance of Watershed Management to Groundwater Supplies

Managing native stormwater is a necessary step towards maintaining groundwater elevations in the underlying groundwater basin. Urbanization and its associated increase in impervious surfaces has altered the ability of groundwater basins to naturally replenish pumped groundwater. Stormwater systems in the City were designed primarily for flood control to convey stormwater runoff to the Pacific Ocean as quickly as possible, therefore minimizing the potential for flooding or damage to structures while maximizing land available for development. Within LADWP's service area, the SFB is the most amenable to regional stormwater capture and recharge through spreading basins because of its predominantly sandy soils. However, stormwater that once percolated into the groundwater in the underlying SFB is now being channeled across impervious surfaces then through concrete-lined canals or conduits to areas outside of the San Fernando Valley.

The essential task of watershed management is to retain as much stormwater runoff as possible for groundwater recharge. Groundwater recharge is the process of increasing an aquifer's water content through percolation of surface water. This occurs in the SFB primarily with captured stormwater but also with imported water. Groundwater recharge is essential to maintain groundwater supplies, address the overall long-term decrease in stored groundwater within the SFB, and ensure the long-term water supply reliability of the SFB. Furthermore, increasing groundwater recharge and improving groundwater levels in the SFB could potentially lead to larger pumping rights for LADWP in the future.

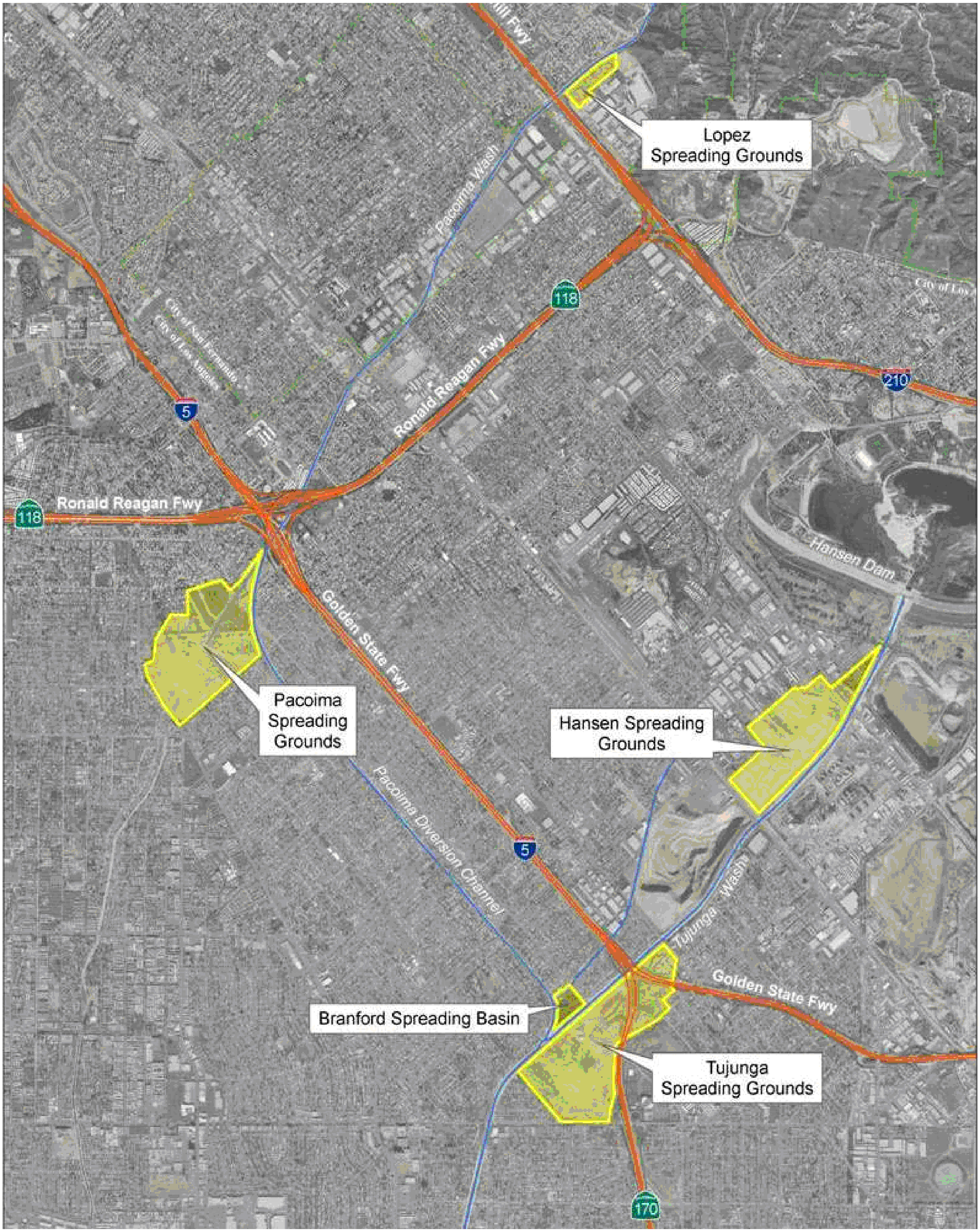
During storm events, large portions of stormwater are captured with existing facilities for spreading purposes. LADWP coordinates these activities with the LACFCD to effectively recharge the SFB through the spreading of native stormwater. Flood control facilities are the primary means to divert native runoff into the spreading ground facilities listed and mapped on Exhibits 7A and 7B. LACFCD oversees operations at the Branford, Hansen, Lopez, and Pacoima Spreading Grounds. The Tujunga Spreading Grounds are operated by LACFCD in partnership with LADWP. LADWP has the ability to spread imported supplies at the Tujunga Spreading Grounds and the Pacoima Spreading Grounds for storage in the SFB, but LADWP has not utilized imported water for groundwater recharge since 1998.

### *Exhibit 7A*
### *SFB Spreading Grounds Operations Data*

| | | Annual Spreading (AF) | |
|---|---|---|---|
| **Facility** | **Location** | **Average[1]** | **Historic High** |
| Branford | Mission Hills, CA | 549 | 2,142 |
| Hansen | Sun Valley, CA | 13,834 | 35,192 |
| Lopez | Lake View Terrace, CA | 527 | 1,735 |
| Pacoima | Pacoima, CA | 6,453 | 22,972 |
| Tujunga | Sun Valley, CA | 4,419 | 21,115 |
| | Total | 25,782 | 83,156 |

1. Historic average through water year ending September 2009.

## *Exhibit 7B*
## *Spreading Ground Facility Locations*



## 7.2 Additional Benefits of Watershed Management

Watershed management provides additional important benefits to the City of Los Angeles, including surface water quality improvements, water conservation, open space enhancements, and flood control.

Water quality improvements are necessary because stormwater runoff is a conveyance mechanism that transports pollutants from the watershed into waterways and ultimately the Pacific Ocean. Pollutants include, but are not limited to, bacteria, oils, grease, trash, and heavy metals. The City must also comply with adopted Total Maximum Daily Loads (TMDLs) for pollutants. TMDLs set maximum limits for a specific pollutant that can be discharged to a water body without causing the water body to become impaired or limiting certain uses, such as water body contact during recreation. In 2008, the Los Angeles Board of Public Works adopted the Water Quality Compliance Master Plan for Urban Runoff (WQCMPUR). This 20-year plan provides a strategy for cleaning stormwater and runoff to protect the City's waterways and the Pacific Ocean. Capturing stormwater runoff for groundwater recharge removes a portion of the pollutant conveyance mechanism which reduces downstream pollution and thereby assists the City with water quality compliance and improving the overall health of its waterways.

Water conservation is achieved by enhancing the capture and management of localized runoff for local uses. Centralized and distributed mechanisms that provide for water conservation include spreading grounds, rain barrels, and residential cisterns.

Open space enhancement is an added benefit of groundwater recharge projects, which typically provide additional open space areas that may include passive and/or active recreation, educational opportunities, and habitat restoration. Most projects involve increasing vegetation and recreational amenities to create opportunities for wildlife habitat and a recreational/educational resource for the local community. Additionally, open space enhancements assist the City in improving the overall quality of life for residents.

Flood control benefits are achieved when additional storage capacity is added to the storm drain system. Groundwater recharge projects reduce potential flooding by diverting a portion of storm flows into recharge areas, thereby increasing the overall capacity of the storm drain system.

## 7.3 Stormwater Capture Master Plan

The Stormwater Capture Master Plan (Stormwater Plan) will investigate potential strategies for advancement of stormwater and watershed management in the City. The Stormwater Plan will be used to guide decision makers in the City when making decisions affecting how the City will develop both centralized and distributed stormwater capture goals. The Stormwater Plan will include evaluation of existing stormwater capture facilities and projects, quantify the maximum stormwater capture potential, develop feasible stormwater capture alternatives (i.e., projects, programs, potential policies, etc.), and provide potential strategies to increase stormwater capture. The Stormwater Plan will also evaluate the multi-beneficial aspects of increasing stormwater capture, including potential open space alternatives, improved downstream water quality, and peak flow attenuation in downstream channels, creeks, and streams such as the Los Angeles River.

The Stormwater Plan will recommend stormwater capture projects, programs, policies, and incentives for the City of Los Angeles.

Benefits of the Stormwater Plan include:

- Investigation of stormwater capture models such as the Groundwater Augmentation Model and the Watershed Management Modeling System to identify maximum potential groundwater recharge.
- Increased water conservation.
- Improved water quality .
- Reduced peak flow in the Los Angeles River.
- Project partners and supporters include:
- City of Los Angeles Department of Water and Power
- City of Los Angeles Department of Public Works
- County of Los Angeles Department of Public Works
- TreePeople, Inc.

A Request for Proposal for the Stormwater Plan was released on February 24, 2011. The contract is anticipated to be awarded by the last quarter of 2011, and completion of the Stormwater Plan will take approximately 24 months.

## 7.4 TreePeople – Memorandum of Agreement

The Memorandum of Agreement (MOA) with TreePeople has been forged to facilitate a high-level of collaboration between LADWP and TreePeople with the aim of fostering a more sustainable Los Angeles. The partnership it outlines leverages TreePeople's experience in public education and agency integration to further the long-term sustainability objectives of LADWP. Specifically, LADWP and TreePeople are working together to research opportunities within LADWP's facilities and operations for widespread groundwater recharge. This research includes an educational component wherein LADWP and TreePeople learn about each other's initiatives and core business. Ultimately, this exchange of ideas will help the two partners develop concepts for projects that will increase stormwater capture for groundwater recharge.

LADWP was an early sponsor of the TreePeople Trans-agency Resources for Environmental and Economic Sustainability (T.R.E.E.S.) Project, during which time TreePeople developed best management practices for capturing, cleaning and using stormwater; published the handbook Second Nature; created a computerized cost-benefit model; and facilitated a number of design workshops for public agencies. TreePeople has also been integral to the construction and management of three demonstration sites -- a single-family home (Hall House) retrofitted to capture all the rainwater onsite, and two elementary schools (Broadous and Open Charter) that feature strategic landscaping and a cistern or underground infiltrators. LADWP has supported public tours and educational materials for Hall House, and is a key partner in the school projects which were partially funded through the Cool Schools and Sustainable Schools programs.

The overlap between the objectives of LADWP and those of TreePeople is notable in the Tujunga Wash and Sun Valley watersheds, where both have been especially active. Stakeholder processes in which the two have worked successfully to further mutual goals include the City's Integrated Resources Plan, the Greater Los Angeles County Integrated Regional Water Management Plan, and development of the objectives of the California Urban Water Conservation Council.

## 7.5 Centralized Stormwater Capture Projects

Existing stormwater capture facilities are inadequate for capturing runoff during very wet years. Weather patterns vary dramatically in Los Angeles with very wet years and very dry years. Therefore, new projects are necessary to expand the capability to capture a larger portion of stormwater flows during wet years. LADWP is working proactively in close partnership with LACFCD on multiple stormwater projects, as listed in Exhibit 7C. These projects will increase centralized stormwater recharge capacity by approximately 26,000 AFY in the SFB, raising groundwater levels and ensuring the future water supply reliability of the SFB. These projects are designed to maximize groundwater recharge into the SFB by increasing the total average recharge to approximately 51,700 AFY.

Multiple opportunities exist to develop new recharge projects and improve existing recharge projects in the SFB. LADWP, in collaboration with LACFCD has supported and contributed resources toward the design, construction, and implementation of a variety of projects to increase groundwater recharge of the SFB. Additionally, multiple agreements between LADWP and LACFCD have been approved to facilitate the preparation of recharge studies, design work, and construction of projects in the SFB for groundwater recharge, flood protection, and other benefits.

### *Exhibit 7C*
### *Planned Centralized Stormwater Capture Programs*

| Project | Current Annual Recharge (AFY) | Increased Annual Capture/ Recharge (AFY) | Expected Annual Recharge (AFY) | Estimated Project Completion | Total Project Cost (millions) | LADWP Share (millions) |
|---|---|---|---|---|---|---|
| Sheldon-Arleta Gas Collection System | - | 4,000 [1] | - | Complete Nov 2009 | $8.20 | $6.30 |
| Big Tujunga Dam Rehabilitation [3] | - | 4,500 | - | July 2011 | $105.70 | $9.00 |
| Hansen Spreading Grounds Upgrade | 13,834 | 1,200 | 17,284 [2] | Dec 2011 | $9.30 | $4.80 |
| Tujunga Spreading Grounds Upgrade | 4,419 | 8,000 | 18,669 [4] | 2015 | $24.00 | $24.00 |
| Pacoima Spreading Grounds Upgrade | 6,453 | 2,000 | 8,453 | 2015 | $32.00 | $16.00 |
| Lopez Spreading Grounds Upgrade | 527 | 750 | 1,277 | 2016 | $8.00 | $4.00 |
| Strathern Wetlands Park | - | 900 | 900 [5] | 2016 | $46.00 | $4.00 |
| Hansen Dam Water Conservation | - | 3,400 | 3,400 | 2017 | $5.00 | $2.50 |
| Valley Generating Station Stormwater Capture | - | 700 | 700 | 2018 | $9.70 | $9.70 |
| Branford Spreading Basin Upgrade | 549 | 500 | 1,049 | 2018 | $4.00 | $2.00 |
| **Total Estimated Yield** | **25,782** | **25,950** | **51,732** | | **$251.90** | **$82.30** |
| Total Expenditure-to-date | | | | | | $18.60 |
| Total Expenditure Remaining | | | | | | $63.70 |

1. This will allow increased collection of 4,000 AFY at Tujunga Spreading Grounds.
2. Includes 1/2 benefits from Big Tujunga Dam Rehabilitation Project.
3. No recharge occurs at the facility. All additional capture has been divided between Hansen & Tujunga Spreading Grounds.
4. Including benefits from Sheldon-Arleta Project and 1/2 benefits from Big Tujunga Dam Rehabilitation Project.
5. To be recharged at Sun Valley Park.

**Sheldon-Arleta Methane Gas Collection Project**. In 1998, a task force comprised of representatives from LADWP, other City departments (Bureau of Sanitation (BOS), Bureau of Engineering, and Environmental Affairs) and the Upper Los Angeles River Area Watermaster was formed to review the issues surrounding the recharge of groundwater through spreading at the Tujunga Spreading Grounds. The objective of this Task Force was to maximize water spreading at the Tujunga Spreading Grounds without causing off-site landfill gas migration. An outcome of the Task Force was the Sheldon-Arleta Methane Gas Collection Project. The project is designed to restore the original Tujunga Spreading Grounds capacity of 250 cubic feet per second (cfs) with the potential for future enhancement by bringing the Tujunga Spreading Basins closest to the Sheldon-Arleta landfill back online. The Tujunga Spreading Grounds are located adjacent to the closed Sheldon-Arleta Landfill. During spreading operations, water displaces air from the ground potentially increasing migration of methane gas generated by the landfill. In the past, elevated levels of methane gas have been detected in the surrounding communities. Therefore, restrictions were enacted curtailing spreading operations to 20 percent of their original capacity. This project is a joint effort between LADWP and BOS to replace the methane gas collection system within the landfill and thereby contain methane gas onsite. The project is being implemented by LADWP through LABOS's Proposition "O" Clean Water Bond program. Proposition "O" funded approximately $3 million of the $9 million cost. Construction began in 2007 and was completed in November 2009.

**Big Tujunga Dam – San Fernando Groundwater Enhancement Project**. LADWP and LACFCD approved Cooperative Agreement No. 47717 on September 18, 2007 for the Big Tujunga Dam –San Fernando Groundwater Enhancement Project. This Project will increase stormwater capture and provide other benefits including improvements in flood prevention and environmental enhancement through seismically retrofitting the dam and spillway. Annual stormwater capture will increase by 4,500 AFY for a total capture amount of 6,000 AFY. The project is integrated with the following projects in this section: Hansen Spreading Grounds Enhancement Project, Tujunga Spreading Grounds Enhancement Project, and the Sheldon-Arleta Methane Gas Collection Project. Both the Greater Los Angeles County Integrated Regional Watershed Management Plan and the Tujunga/Pacoima Watershed Plan are being incorporated into the Project. LADWP is contributing $9 million of the $105 million project cost. Construction of the project is in progress with an anticipated completion date by July 2011.

**Hansen Spreading Grounds Enhancement Project.** The Hansen Spreading Grounds is a 120 acre parcel located adjacent to the Tujunga Wash Channel downstream from the Hansen Dam. Under Cooperative Agreement No. 47739, the LACFCD and LADWP propose to modernize the facility to increase intake and storage capacity thereby improving groundwater recharge, flood protection and water quality while providing recreational benefits and native habitat improvements. To accomplish the goals of the project, a phased approach is being proposed. Phase 1A will deepen and reconfigure the existing basins; Phase 1B will improve the intake capacity by replacing a radial gate with a new rubber dam and telemetry system; and Phase 2 will develop other compatible uses such as recreational trails and native habitat for the community. Estimated recharge is 17,284 AFY, and estimated cost of this project is $10 million of which LADWP will fund $5 million. The Phase 1A reconstruction of the spreading grounds was completed in December 2009 and the Phase 1B intake structure will be completed in December 2011.

**Tujunga Spreading Grounds Enhancement Project.** The Tujunga Spreading Grounds Enhancement Project is designed to increase average annual stormwater capture by 8,000 AFY through relocating and automating the current intake structure on the Tujunga Wash, installation of an automated intake structure on the Pacoima Wash, and reconfiguration of the Tujunga Spreading Basins. Other multiple benefits include habitat improvements, passive recreation, educational opportunities, flood protection, and water quality improvements. Owned by LADWP, the Tujunga Spreading Grounds are operated by LACFCD in conjunction with other facilities along the Tujunga and Pacoima Wash Channels. Construction is expected to begin in 2012.

**Valley Generating Station Stormwater Capture Project**. LADWP is leading efforts to capture and infiltrate stormwater from the Valley Generating Station, from adjacent streets, and from the Tujunga Wash Channel. Phase 1 will capture and infiltrate all stormwater from the Valley Generating Station. Phase 2 will divert water mainly from the Hansen

Spreading Grounds for infiltration at the abandoned gravel pit at the generating station. Total stormwater capture is estimated at 700 AFY. Project designs are expected to be completed at the end of 2013.

**Pacoima Spreading Grounds Enhancement Project.** LADWP in conjunction with LACFCD is proposing to upgrade the Pacoima Spreading Grounds by improving the intake and stormwater storage capacity. Annual average stormwater capture is expected to increase by approximately 2,000 AFY with completion of the project. Other project benefits include flood protection, water quality improvements, and passive recreation. The final concept report and design has an expected completion date by the end of 2012.

**Lopez Spreading Grounds Enhancement Project.** The Lopez Spreading Grounds Enhancement Project involves deepening the existing Lopez Spreading Grounds and improving the intake and delivery system. LACFCD is the lead agency for the project. Additional groundwater recharge to the SFB of approximately 750 AFY is expected from the project. Project designs are anticipated to begin in 2013.

**Strathern Wetlands Park Project.** The Strathern Wetlands Park Project involves the conversion of a 45-acre gravel pit into a multipurpose facility for flood protection, stormwater retention, treatment, groundwater recharge, habitat restoration, and recreation. Estimated stormwater capture is approximately 900 AFY. Proposition "O" funding of $17.8 million has been approved for acquisition of the site. LACFCD purchased the land and project planning is underway. Designs are expected in 2012, and construction is expected to occur in two phases from 2013 to 2016.

**Hansen Dam Water Conservation Project.** In 1999 the U.S. Army Corps of Engineers completed a feasibility study to examine operational changes and facility improvements at the Hansen Dam as part of a cost-shared study with LACFCD.

**Pacoima Dam Reservoir Sediment Removal Project.** The Pacoima Dam Reservoir Sediment Removal Project involves removing sediment from behind Pacoima Dam to increase storage volume. The sediment build-up behind the dam has decreased the capacity to about 3,300 acre-feet. In the fall of 2009 approximately 80 percent of the Pacoima Dam watershed was burned. This damage will likely increase sediment flow into the reservoir above the estimates provided based on 2005 topography. The project will involve excavating 5 million cubic yards of sediment and increasing the storage volume by 3,000 acre-feet. Increased storage would decrease the number of reservoir spill events and increase the available recharge flow for the Pacoima and Lopez Spreading Grounds. The excavation will extend over 7,000 feet upstream of the existing dam. The project will produce an additional annual water recharge benefit of 670 AFY.

**Branford Spreading Basin Upgrade.** The Branford Spreading Basin Project will remove fine silts from the basin and install new pumps to drain the basin. These pumps could be used to drain the existing facility into the Tujunga Spreading Grounds. The expected additional recharge for this project is approximately 500 AFY.

## 7.6 Distributed Stormwater Capture

Throughout the City there are opportunities to capture localized dry and wet weather runoff for local reuse. However, Los Angeles' storm drain systems have historically been designed to protect life and property from flood impacts by quickly redirecting rainfall and runoff from impervious surfaces into the City's storm drain system and ultimately the Pacific Ocean without regard to water quality impacts. The September 2, 2002 Municipal Stormwater National Pollutant Discharge Elimination System Permit

(NPDES Permit No. CAS004001) for the Los Angeles region requires all new development or redevelopment projects to develop and comply with a Standard Urban Stormwater Mitigation Plan (SUSMP) to reduce runoff leaving the project site and to improve the project's water quality impacts.

Recently the City has taken initial steps towards promoting distributed capture and infiltration of runoff through development of a suite of distributed runoff demonstration projects. Distributed stormwater capture (also known as decentralized stormwater capture) is defined as any groundwater recharge system capturing less then 500 AF or any direct stormwater capture system capturing less then 10 AF. In addition, the City is close to adopting a Low Impact Development (LID) ordinance requiring retention of stormwater onsite for new and redevelopment projects which extends beyond SUSMP regulations. The Watershed Management Group is working with the Los Angeles and San Gabriel Rivers Watershed Council (LASGRWC), TreePeople, BOS, Department of Building and Safety, Los Angeles County Department of Public Works (LACDPW), The River Project and others to evaluate and study the impacts of localized stormwater capture and source control within the City.

LADWP is providing various resources for projects that would enhance the City's ability to capture additional dry and wet weather runoff for beneficial use. Both dry and wet weather runoff can be beneficially used. Dry weather runoff occurs in the absence of rainfall while wet weather runoff occurs as a direct result of rainfall. Dry weather runoff is typically related to inefficient irrigation systems, overwatering, and other wasteful outdoor water use practices. Wet weather runoff represents a significantly larger volume of water than dry weather runoff. Exhibit 7G summarizes the potential water yield and average unit cost of the different resources available to increase localized capture and infiltration of runoff.

### 7.6.1 Watershed Council – Water Augmentation Study

The Los Angeles Basin Water Augmentation Study is a long-term research project, initiated in 2000, created to determine the benefits of implementing a broad-based approach to stormwater infiltration within the Los Angeles Region. The study was led by the Los Angeles & San Gabriel Rivers Watershed Council in partnership with local, state, and federal agencies and organizations, with major support from the U.S. Bureau of Reclamation. LADWP assisted in the funding and creation of the study report as part of the Technical Advisory Committee.

While centralized strategies such as spreading basins and dams are reliable and effective methods to capture stormwater, increased urbanization, high land costs, and scarcity of imported water for recharge signal the need to pursue additional stormwater capture methods. Furthermore, centralized stormwater infiltration is unable to capture the entire watershed which leaves a large quantity of additional stormwater to be tapped into. The Los Angeles Basin Water Augmentation Study research has concluded that decentralized strategies (distributed stormwater capture such as rainbarrels & cisterns) would provide a local and reliable supply of water that would not negatively impact groundwater quality. Distributed stormwater capture and infiltration system techniques provide a viable means of augmenting groundwater recharge and reducing the overall cost of treating urban runoff. Based on the findings of this study, the Los Angeles Basin Water Augmentation Study partnership moved forward on a demonstration project in a single family residential home neighborhood in northeast San Fernando Valley to validate the study findings.

## CASE STUDY:
## Elmer Avenue Neighborhood Retrofit Project

**The Background**

Initiated in 2000, the Los Angeles Basin Water Augmentation Study (WAS) is a long-term research project led by the Los Angeles & San Gabriel Rivers Watershed Council in partnership with eight local, state, and federal agencies of which LADWP is an active partner. The study is evaluating the practical potential to improve surface water quality and increase local groundwater supplies through infiltration of urban stormwater runoff.

Based on positive findings of the study, the WAS partnership moved forward with a demonstration project to display an integrated and comprehensive approach to water management by retrofitting a neighborhood with strategies to address water conservation, pollution reduction and treatment, flooding, and habitat restoration. The Elmer Avenue Neighborhood Retrofit Project was chosen after an extensive selection process that evaluated neighborhoods based on more than 80 criteria.

**The Project**

The Elmer Avenue Neighborhood Retrofit Project commenced in July 2009 and was completed in June 2010 and cost approximately $2.5 million. Elmer Avenue receives stormwater runoff from approximately 40 acres of upstream residential area causing flooding in most storms. To address this runoff, the project encompasses improvements to both the public right-of-way as well as the private residences. As such, the project required active interaction and cooperation between the WAS partnership and the residents to work together and come up with a solution for the neighborhood.

***Public Right-of-Way Improvements:***

*Infiltration Gallery-*

A large infiltration gallery was installed underneath the street right-of-way which is estimated to infiltrate 16 acre-feet annually. The gallery is a sub-surface groundwater collection system, shallow in depth, constructed with perforated pipes into which runoff water flows and is then allowed to infiltrate into the ground to recharge the local groundwater basin.

*Bioswale-*

The newly installed sidewalks include bio-swales in the parkways to capture and treat stormwater runoff from the local sub-watershed mostly from residential land use. The bioswales are open shallow channels with gently sloped sides and bottoms filled with vegetation and rip rap where stormwater runoff is collected. Bioswales help reduce the flow velocity and treat stormwater runoff by filtering it through the vegetation in the channel, through the subsoil matrix, and/or into the underlying soils. In addition, bioswales trap particulate pollutants (suspended solids and trace metals), promote infiltration and serve as part of the whole stormwater drainage system installed for this project.

***Private Residence Improvements:***

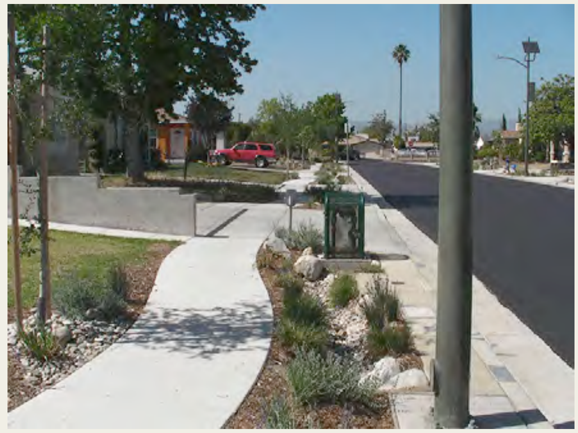
Numerous improvements were offered to residents who chose to participate to help reduce runoff as well as exercise better outdoor water conservation such as porous pavers, rain gardens, rain barrels, and drought-tolerant and native landscaping.

**<u>The Benefits</u>**

The finished project incorporates a mixture of strategies to produce multiple levels of benefits (to the neighborhood but also to the local, regional, and national community whom can take this work as an encouraging model):

- Capture stormwater and dry-weather runoff to prevent flooding and decrease pollution of local rivers and oceans
- Reduce impermeable surfaces and increase groundwater recharge
- Improve neighborhood aesthetics through increased green space and public right-of-way improvements
- Increase community awareness of watershed issues
- Encourage community awareness of water and associated environmental issues.

As a result of the success and positive feedback from citizens for the Elmer Avenue Neighborhood Retrofit Project, a second phase is currently underway at Elmer Avenue to retrofit its alleyway. Such small projects aim to spark large change by showing citizens and other communities that they also can make changes and improve their neighborhoods to be more water-efficient and environmentally friendly.



"By turning our yards into rain gardens and our streets into water recharge facilities, we can ensure clean water for the future. In contrast to a typical urban street, Elmer Avenue now reduces flooding and water pollution, improves water quality, replenishes groundwater supplies, and increases native habitat."

Nancy Steele, Executive Director
Los Angeles and San Gabriel Rivers Watershed Council

"This project is a prime example of how homeowners and the city can work together on a project that demonstrates smart watershed management through stormwater capture and water conservation measures that are beautiful and effective"

Edward Belden, Water Programs Manager
Los Angeles and San Gabriel Rivers Watershed Council

## 7.6.2 Integrated Water Resources Plan Analysis

As part of the City's Integrated Water Resources Plan, further described in Chapter 10, the City investigated the beneficial reuse of urban runoff for both dry and wet weather conditions.

### 7.6.2.1 Dry Weather Runoff Options

The beneficial use option for dry weather runoff consists of runoff capture, treatment, and reuse. For dry weather flow, most of the runoff could potentially be diverted directly for beneficial use, particularly during the summer months when demands for non-potable water are high (due to the higher irrigation demands in the summertime). The level of treatment of the runoff before beneficial use would be determined by the ultimate use of the water.

A computer modeling analysis was performed during development of the Integrated Water Resources Plan based on the recycled water demands in Los Angeles and the available dry weather runoff. Based on the data, the model determined which of the recycled water demands could be realistically met through treated runoff. The dry weather runoff available for reuse throughout the City is estimated at 97 mgd (approximately 26,000 million gallons per year). Exhibit 7D identifies the amount of this runoff that could, after treatment, be used to meet the recycled water demands.

### 7.6.2.2 Wet Weather Runoff Options

#### Rain Barrels

Rain barrels are distributed stormwater capture devices used to store rainwater collected from roofs via roof rain gutter systems. Harvested water can be used for outdoor irrigation at a later time. Rain barrels vary in size with a typical rain barrel holding approximately 55 gallons that can be readily installed under any residential roof gutter downspout. Installation of rain barrels at residences

***Exhibit 7D***
***Potential Non-Potable Water Demands Met with Dry Weather Treated Runoff***

| Service Area | Total Demand Served | |
|---|---|---|
| | (AF per year) | (million gallon per year) |
| Aliso Wash | 1,400 | 460 |
| Canoga | 3,250 | 1,050 |
| Reseda | 2,900 | 950 |
| Tujunga / Burbank | 9,050 | 2,950 |
| LA River Reach 3 | 1,100 | 360 |
| Dominguez Channel | 8,500 | 2,770 |
| Compton Creek | 1,450 | 470 |
| Ballona | 10,850 | 3,530 |
| Verdugo Wash | 100 | 30 |
| LA River/Arroyo | 9,600 | 3,130 |
| Total | 48,200 | 15,700 |

Source: City of Los Angeles Integrated Resources Plan, Facilities Plan, Volume 3: Runoff Management

## CASE STUDY:
## Ballona Creek Watershed Rainwater Harvesting Pilot Program

Funded by the Safe Neighborhood Parks, Clean Water, Clean Air and Coastal Protection Bond Act of 2000 (Prop 12), a partnership between the Santa Monica Bay Restoration Commission and the California Coastal Conservancy, the City of Los Angeles, Department of Public Works, Bureau of Sanitation, Watershed Protection Division (Stormwater Program) began the City's first free Rainwater Harvesting pilot program in July 2009. The goal of this program is to engage as many property owners as possible by installing one downspout and rainbarrel retrofit per property thereby allowing the maximum number of residences engaged.

Liz Herron, Land Use Chair of Mt. Washington Association, supports rainwater harvesting systems: "Rain barrel systems serve environmental purposes by allowing homeowners to collect the rainwater for personal irrigational purposes. It also reduces the amount of rainwater entering into the streets and ocean. These residential systems are successful programs that save water and prevent pollution."

Designed to conserve potable water and reduce the amount of polluted rainwater that runs untreated into the ocean, the $1-million pilot plan has enough funds to install 490 residential rain barrels, provide consultation on rain gardens, and provide one custom-made commercial planter box for each of ten businesses. It is estimated to save 584,100 gallons of water each year. The City estimates there are roughly 18 rain events in Los Angeles each year filling each barrel at least once each time.

In a typical year, about 9,600 gallons of water is generated on an average 1,000-square foot residential City roof top. If each of the 400,000 residential parcels in the City were to install a single rain barrel, the City estimates that about 400 million gallons of water would be saved, thereby reducing the demand for water. An evaluation of the program is scheduled for completion in Spring 2011.

The 55-gallon capacity rain barrel was chosen because the weight of 200 pounds is relatively manageable. The rain barrels are also made from food-grade plastic, repurposed from containers in case the harvested rainwater is used to grow food. They are equipped with mesh netting to keep out debris and mosquitoes and connected to the downspouts by a trained rain barrel installation specialist.

Planter boxes that businesses are eligible for will be custom-made to fit the layout and dimensions of the property. The City will be working with each business to make sure they are content with the presentation of the planter box.

The program addresses the City's broad problems of water scarcity and stormwater pollution. Currently outdoor water usage accounts for 1/3 of the average family's overall water consumption. The Rainwater Harvesting program helps to meet the City's water conservation goals by reducing the amount of potable water used for irrigation and other outdoor purposes.

throughout Los Angeles could potentially capture 2,400 AFY assuming 400,000 residences, an annual average rainfall of 15.6 inches, one 55-gallon rain barrel installed per residence, and an average roof area of 500 square feet. If overflow infiltration is provided, and/or greater roof area is utilized, annual rainfall volume captured can be significantly greater.

## Cisterns

Cisterns are larger than rain barrels and can range from 100 to 10,000 or more gallons. They store diverted runoff from roof areas and other impervious surfaces. This stored runoff can provide a source of untreated water for gardens and compost, free of most sediment and dissolved salts. Because residential irrigation can account for up to 40 percent of domestic water consumption, water conservation measures such as cisterns can be utilized to reduce demands, especially during hot summer months.

An analysis of the effect of installing cisterns in all single family and multi-family residences in the City was conducted as part of the Integrated Water Resources Plan, which was based on projected household demands, irrigation needs, and historical rainfall data. The results showed that during a storm event of 0.45 inches, the result of installing 1,000-gallon cisterns at all single-family and multi-family residences in the City would be a maximum capture of approximately 440 million gallons. This provides a substantial amount of water conservation and reduction in potable water demands within the City.

The primary beneficial use of dry and wet weather runoff is to meet irrigation demands. These demands are typically non-existent during rain events and low throughout the rainy season. Therefore, the wet weather runoff would need to be stored until the demand exists. This can be done through a regional and/or a localized approach. A regional approach to seasonal storage could include the use of out-of-service reservoirs for seasonal storage. A localized approach would be to construct distributed underground storage facilities in open spaces, parks, schools, etc. throughout the City.

Exhibit 7E demonstrates a modular storage media that holds the runoff in a honeycomb-like box under the ground.

***Exhibit 7E***
***Construction of Underground Cistern for Stormwater Capture***
***(Photo courtesy of TreePeople)***

### *Exhibit 7F Underground Storage Potential throughout the City*

| Land Use | Acres (acres) | Potential Storage Volume[1] (million gallons) |
|---|---|---|
| Open space | 6,000 | 15,000 |
| Schools (assume only ~ 25 percent suitable land) | 1,500 | 4,000 |
| Alleys | 900 count | Unknown |
| Total | 7,500 | 19,000 |

Note: 1. Maximum storage potential shown assumes 4.22 million gallons of storage per acre of land. Actual usable volume may be less.

Source: City of Los Angeles Integrated Resources Plan, Facilities Plan, Volume 3: Runoff Management

The storage media has approximately 95 percent voids, so almost all of the storage volume would be filled with water. The maximum depth is 8 feet, which translates to approximately 2.44 million gallons per acre of water storage potential. The containers can also be constructed to be impermeable to prohibit infiltration.

According to studies conducted during the development of the Los Angeles Integrated Water Resources Plan, the City currently has an estimated open space area of 6,000 acres, which includes parks, open space, and vacant lots. School sites are also a potential option for installing modular storage media under playgrounds and athletic fields. The total school area in the City is approximately 6,000 acres. Assuming that only 25 percent of this area has no buildings or other structures, this equals approximately 1,500 acres of potentially suitable land. Additionally, there are approximately 900 abandoned or no longer maintained alleys of various unknown dimensions that could potentially be converted to underground storage facilities. Exhibit 7F summarizes the approximate underground storage potential throughout the City.

The City has the potential to store a considerable volume of wet weather runoff in order to meet the potential future surface water quality regulations if the underground storage options were utilized. This stored water could then be drawn down and beneficially used during the dry weather months.

## Rain Gardens

Rain gardens are another simple form of relatively small scale rainwater harvesting. As gardens or depressions, usually constructed sub-grade, they act as small retention/percolations basins for rainwater collection. Not only do they provide for an attractive landscape, but they are effective in treating and infiltrating stormwater for local groundwater recharge.

While extremely functional, these are basically regular gardens and can be designed to fit well into the surrounding landscape. Many cities and states across the country have extensive rain garden programs, and years of research have gone into their design and performance. Acting as a bio-retention systems, rain gardens treat runoff naturally as it seeps underground. In the case of lowered percolation rates or in hillside developments, rain gardens are typically installed with impermeable liners and supplied with under drains.

Unit cost of rain gardens are similar to that of rain barrels, as the mechanism for collecting water is the same. Cost is dependent upon the form and extent of construction and on the type and quantity landscape used, as well as the associated maintenance. Installation of rain gardens at residences throughout Los Angeles, assuming 400,000 residences, could potentially capture 6,400 AFY assuming an annual average rainfall of 15.6 inches, and an average roof area of 500 square feet. Under these conditions, assuming a 10-15 year lifespan, the cost of rain gardens varies from $308-$5,000 / AF.

### Neighborhood Recharge

Neighborhood recharge involves installing recharge facilities in portions of vacant urban lots, abandoned alleys, and City parklands, where the soil is highly permeable. This option involves installing underground storage (such as a honeycomb shaped device shown in Exhibit 7F, but without the lining to allow infiltration). This would allow the runoff to be stored underground, while still maintaining a safe area above ground for human activity. The runoff would be pumped or would flow by gravity to the site where it would be collected temporarily until it is able to infiltrate.

The amount of runoff that could be managed by neighborhood recharge was determined as part of the Los Angeles Integrated Water Resources Plan by assuming that only the east San Fernando Valley area has predominantly permeable soils appropriate for infiltration (though there may be other areas within the City that could be usable for recharge with smaller-scale projects). Based on an analysis by the City's Geographical Information System, the maximum total area available for neighborhood recharge facilities is approximately 831 acres, which includes vacant urban lots, abandoned alleys, and 25 percent of City parklands. Assuming an infiltration rate of 2 feet per day, the maximum runoff that could potentially be managed by recharge facilities would be 550 million gallons per day (mgd).

## 7.6.3 Distributed Stormwater Capture Projects

As an outgrowth of the Los Angeles Integrated Water Resources Plan, neighborhood recharge concept efforts are moving from the conceptual stage visualized in the Los Angeles Integrated Water Resources Plan to actual identified projects in the City which infiltrate wet weather runoff as close as possible to the point of origin. A few of the identified projects are highlighted here.

**Whitnall Highway Power Line Easement Stormwater Capture Project.** This project involves the capture, treatment, and infiltration of stormwater from streets in the eastern San Fernando Valley using LADWP's Whitnall Power Line Easement in the lower Sun Valley Watershed. Average annual recharge is estimated at 110 AFY. Additional uses of the project site may include open space and recreational enhancements. Designs are anticipated for completion by the end of 2011.

**Elmer Avenue Neighborhood Retrofit Project.** In December of 2008, the City of Los Angeles partnered with TreePeople and the LASGRWC to retrofit an existing neighborhood in the Sun Valley portion of Los Angeles that is prone to flooding during wet weather events. A combination of Best Management Practices such as vegetated swales, infiltration trenches, rain gardens, rain barrels, native and climate appropriate landscaping, roof gutters, street tree plantings, and aligning driveways to drain to vegetated swales are incorporated into this project. This project was designed to capture and infiltrate the equivalent of a 2-year storm in order to increase groundwater recharge. Project funding was provided by the US Bureau of Reclamation, DWR, LACDPW, MWD, Water Replenishment District of Southern California and LADWP. Construction was completed in June 2010.

**Woodman Avenue Multi-Beneficial Stormwater Capture Project.** LADWP in partnership with the BOS Watershed Protection Division and The River Project, a non-profit organization, are developing the Woodman Avenue Median Retrofit Demonstration Project to capture, treat, and infiltrate stormwater runoff along a portion of Woodman Avenue. The Project will replace the existing median with pre-treatment devices, a vegetated swale, and an underground retention system. Project benefits include reductions in localized flooding, open space enhancements, groundwater recharge, and native habitat enhancement. The CalFed Watershed Program awarded the project a $1.6 million grant. Construction is expected to be completed by the end of 2012.

**North Hollywood Alley Retrofit BMP Demonstration Project.** The project's goal is to demonstrate the ability to infiltrate stormwater near the point of origin while increasing groundwater recharge, reducing flooding, and improving water quality. Four segments of alleyways in the San Fernando Valley are proposed to be retrofitted with pervious surfaces and diversion of flows from intersecting streets into these alleyways. Construction began in early 2011.

**Laurel Canyon Parkway Infiltration Swale Project.** Construction of the Laurel Canyon Parkway Infiltration Swale Project will involve construction of an infiltration trench and parkway swale between the street curb and sidewalk near the Tujunga Spreading Grounds in the San Fernando Valley. Stormwater will be collected and infiltrated into the groundwater from the local residential neighborhood. The project is currently in the conceptual stage.

## 7.6.4 Low Impact Development and Best Management Practices

LADWP, in conjunction with other City departments, is developing programs to highlight water conservation through Low Impact Development (LID) and installation of BMPs. LID is a stormwater management strategy that has been adopted by many localities across the country over the past several years. It is a stormwater management approach that is designed to reduce runoff of water and pollutants from the site(s) at which they are generated.

The past few decades of stormwater management have resulted in the current convention of control-and-treatment strategies. They are largely engineered, end-of-pipe practices that have been focused on controlling peak flow rate and suspended solids concentrations. Conventional practices, however, fail to address the widespread and cumulative hydrologic modifications within the watershed that increase stormwater volumes and runoff rates and cause excessive erosion and stream channel degradation.

In general, implementing integrated LID practices into new development and retrofit of existing facilities can result in enhanced environmental performance while at the same time reducing development costs when compared to traditional stormwater management approaches.

According to the U.S. Environmental Protection Agency, infrastructure costs associated with LID practices as compared to traditional stormwater treatment practices result in significant cost savings ranging between 15 percent and 80 percent less than traditional practices. BMPs consist of practices designed to infiltrate runoff for groundwater recharge, reduce runoff volume, and capture rainwater for reuse. Programs under development include pilot projects, retrofitting of existing facilities, new development standards, and assistance in ordinance development.

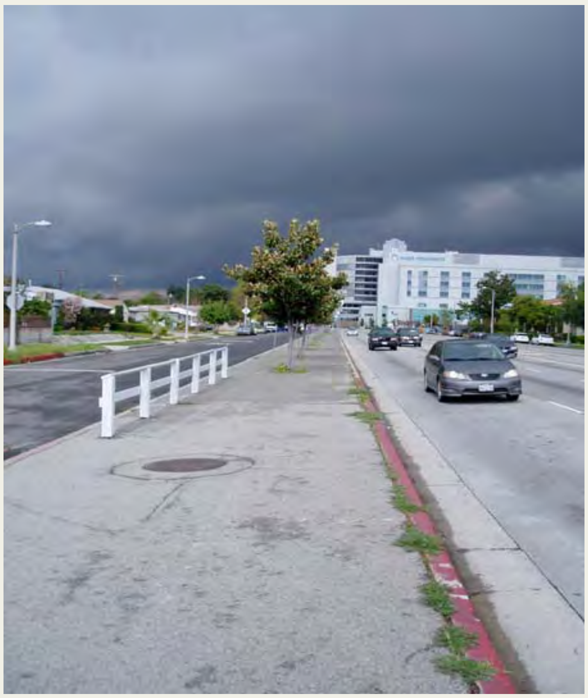
### Retrofit of LADWP Facilities to Meet LID Standards

LADWP is assessing its existing facilities for potential retrofits using LID BMPs. LID BMPs under consideration include pervious pavement, stormwater capture, curb cuts, bioretention cells, and amended soils. Expected benefits include:

- Increased groundwater recharge.
- Decreased outdoor water use.
- Increased compliance with stormwater regulations.

## CASE STUDY:
## Woodman Avenue Multi-Beneficial Stormwater Capture Project

Originally proposed by the local Panorama City Neighborhood Council for the Tujunga-Pacoima Watershed Plan, the Woodman Avenue project represents an innovative example of stormwater capture, which includes extensive benefits for the environment, the City's groundwater basin, and the surrounding community. The Woodman Avenue median is located along the west side of Woodman Avenue from Lanark Street to Saticoy Street in Panorama City.



The project's construction will be relatively simple but effective. The project will capture surface runoff from approximately 130 acres that currently flows along street gutters to storm drains, through the Tujunga Wash and ultimately down the Los Angeles River and into the Pacific Ocean. Instead flows will now be directed through pre-treatment devices into a vegetated swale and an underground retention system for groundwater basin infiltration. The vegetated swale and underground retention/infiltration system will replace an existing 16-foot wide, 3,500-foot long concrete median. After construction of the project, participants will conduct active monitoring of water flows, water quality, and vegetation for approximately three years. This data should provide valuable information to facilitate the development of future projects, and optimize system processes.

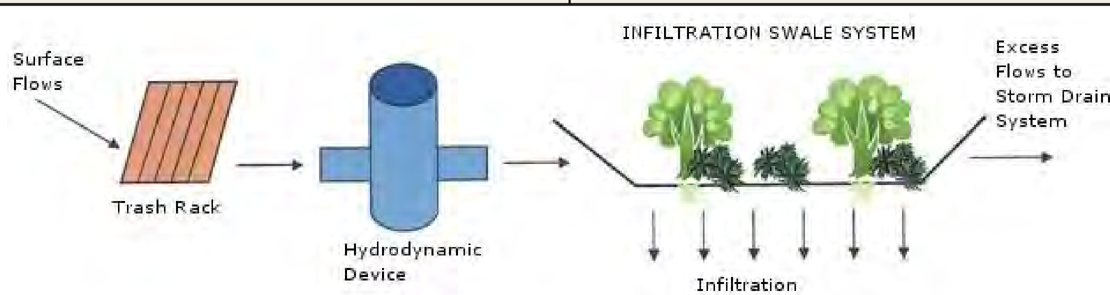
The direct water resource related benefits from this project are three fold. First, the additional water captured will recharge the San Fernando Groundwater Basin with approximately 80 AF per year. This replenishes the City's local groundwater supply, and helps protect pumping rights for City, which ultimately guarantees a more reliable water supply. Secondly, diverted flow alleviates local flooding, particularly during sizable rain events. Finally, the infiltration prevents contaminant carrying runoff and debris from entering local waterways and ultimately coastal areas.

Also recognized are the Community benefits associated with this project. These include creation of open space enhancements such as improved aesthetics and pedestrian access near schools, a walking path, benches, and native vegetation. The River Project will be running an active education program with the local community, including workshops with nearby business owners/residents and the introduction of a curriculum for students at the local elementary school. The organization's goal is to get the students involved in monitoring and maintenance of the project as part of their service learning requirements. Establishing knowledge of sustainable water supplies with the City's youth is an investment in constituent water use practices for generations to come.

Project participants include the Panorama City Neighborhood Council, Council District 6, the Los Angeles Bureau of Sanitation, the Los Angeles Bureau of Street Services, the State of California Water Resources Control Board (SCWRCB), The River Project, and LADWP. This cooperative partnership is anticipating the project's construction to begin in 2012.

State funding used for the project is provided through Proposition 50. SCWRCB has dedicated $1.6 million through the CALFED Watershed Grant Program, which covers roughly half of the overall project cost.

Melanie Winter from The River Project speaks positively of this stormwater capture project: "The community's involvement in the watershed planning process helped them identify a prime opportunity site that maximizes all the potential benefits. It helps reduce our dependence on imported supplies, addresses peak flows, improves water quality, and re-establishes habitat. It's gratifying to receive State funding to work in a well-rounded partnership to implement this integrated watershed project conceived at the grassroots level."



- Improved environmental conditions for employees and the public.

- Improved public image.

- Increased awareness of LID and provide examples for residents.

- Compliance with Model Water Efficient Landscape Ordinance.

### New LADWP Facility Development Using LID Standards

LADWP's Watershed Management Group is developing a framework for implementation of LIDs and BMPs during the new facility development process. Within the framework, LID and BMPs are taken into consideration during the planning, design, implementation, and maintenance processes associated with new LADWP facilities. Benefits include:

- Reductions in costs associated with stormwater infrastructure and landscape maintenance.

- Reduced costs for grading by using natural drainage.

- Reduced sidewalk costs by using narrower sidewalks.

- Increased groundwater recharge.

- Reduced runoff volume and pollutant loading.

- Reductions in long-term maintenance and operation costs by using climate appropriate landscaping.

- Reduction in life cycle costs of replacing or rehabilitating pipe and below ground infrastructure.

### Assistance in Ordinance Development

LADWP is represented on the City of Los Angeles Landscape & Stream Protection Ordinances Joint Meeting Committee through the Watershed Management Group. Other committee members include the Department of Recreation and Parks, the Department of Public Works, the Department of Environmental Affairs, the City Planning Department, and the Department of Building and Safety. The committee is tasked with developing ordinances for city-wide implementation that will reduce water use and improve groundwater recharge among other multiple benefits. Ordinances under review include the:

- Green Building Ordinance using the US Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building Rating System.

- LID Ordinance to incorporate improvements in stormwater management at the point of origin.

- Stream Protection Ordinance to incorporate methodologies for improving surface and groundwater quality.

- Hillside Ordinance revisions to include modifications in policies regarding front yards, side yards, height, fire protection, street access, lot coverage, off-street parking requirements, and exceptions in relation to the ordinances above.

## 7.6.5 Future Distributed Stormwater Programs

LADWP continues to investigate the potential for implementation of future distributed stormwater programs. Through its Watershed Management Group, LADWP will continue to develop partnerships and programs to improve utilization of stormwater runoff for outdoor water use and groundwater recharge. Potential programs that could be considered in the future include rain barrel/cistern/rain garden rebates and retrofit incentives for installation of LID BMPs.

## 7.7 Integrated Regional Water Management Plan (IRWMP) Program

LADWP is a participating agency in the IRWMP which encompasses 92 cities in the Greater Los Angeles County Region. The IRWMP aims to address the water quality, resource, and supply issues of the region. A final plan was adopted on December 16, 2006.

Highlights of the plan that pertain to watershed issues include:

- Short and long term objectives to comply with water quality regulations (including TMDLs) by improving the quality of urban runoff, stormwater, and wastewater.
- Optimize local water resources to reduce the region's reliance on imported water.
- Long term priority to protect groundwater supplies through stormwater recharge.
- Target goal to reduce and reuse 150,000 AFY (40%) of dry weather urban runoff and capture and treat an additional 170,000 AFY (50%) for a total target of 90%.
- Target goal to reduce and reuse 220,000 AFY (40%) of stormwater runoff from developed areas and capture and treat an additional 270,000 AFY (50%) for a total of 90%.

For more detailed information on the IRWMP, please refer to Chapter 10.

## *Exhibit 7G Cost Analysis*

| Water Source | Water Yield (AFY) | Average Unit Cost ($/AF) |
|---|---|---|
| Centralized Stormwater Capture[1] | 25,950 | $60 - $300 |
| Distributed Stormwater Capture | | |
| Urban Runoff Plants[2] | 5,000 | $4,044 |
| Rain Barrels[3] | 2,400 | $278 - $2,778 |
| Cisterns[4] | 8,000 | $2,426 |
| Rain Gardens[5] | 5,960 | $149 - $1,781 |
| Neighborhood Recharge[6] | 12,000 | $3,351 |

Notes:
1. Water Yield and cost are based on LADWP's current planned centralized stormwater capture projects. Additional centralized stormwater capture potential will be identified once the Stormwater Capture Master Plan is complete. Cost assumes 50 year project life.

2. Source: City of Los Angeles Integrated Resources Plan (2004); updated from 2004 to 2009 dollars using annual CPI index for LA-Riverside-Orange County MSA .

3. Source: TreePeople. Assumes 30 year life, one 55 gallon barrel per residence, 15.6 in annual rainfall (LA average) with 18 rain events per year (> ¼ in), and a collection roof area of 500 square feet. Minimum case assumes only material cost of $75 barrel and infiltration of 50 percent of barrel overflow into a permeable area such as a rain garden. Maximum case assumes $250 per barrel with installation cost included, and zero infiltration of overflow (worst case). Water yield assumes median between min/max range with 400,000 residences; 2010 dollars

4. Source: City of Los Angeles Integrated Resources Plan (2004); updated from 2004 to 2009 dollars using annual CPI index for LA-Riverside-Orange County MSA; capturing and reusing stormwater on-site for schools and government only.

5. Source: TreePeople. Assumes 30 year life, 15.6 in annual rainfall, an average roof collection area of 500 square feet, $2.50 - $25.66 / $ft^2$ (min/max) for rain garden construction, and 26.6- 31.0 $ft^2$ (min/max) rain garden size with 5.3% - 6.2% of contributing roof area respectively. Yield is based on 400,000 residences; 2010 dollars

6. Source: City of Los Angeles Integrated Resources Plan (2004); updated from 2004 to 2009 dollars using annual CPI index for LA-Riverside-Orange County MSMSA.

## 7.8 Cost Analysis

Exhibit 7G compares side by side the various watershed management opportunities LADWP is pursuing and/or investigating to add to its water portfolio.

It is important to note that the centralized stormwater capture values are based on the planned projects listed in Section 7.5. LADWP is currently compiling a Stormwater Capture Master Plan (see Section 7.3) which will investigate the maximum potential for stormwater capture within the City (for both centralized and distributed capture). Nevertheless, even with this fraction of the potential, it is clear that centralized stormwater capture is a very cost effective, plentiful water supply asset to be pursued. Recognizing its great potential, LADWP will proceed with its efforts on the centralized stormwater capture projects listed in Section 7.5, and closely monitor findings of the Stormwater Capture Master Plan to determine future potential centralized stormwater capture projects.

Distributed stormwater capture values are based on the maximum potential achievable by the City. While the cost listed is high, distributed stormwater capture options are highly variable based on a variety of factors such as the magnitude of the overall program, project locations, etc. Furthermore, distributed stormwater capture projects yield additional benefits to the public outside of water supply generation such as flood control, restored native habitat, community beautification, public right of way improvements, water conservation, as well as private residence safety and aesthetic improvements. LADWP will continue to investigate these options to evaluate the best approach to establish a cost effective program that will help add to LADWP's water portfolio.

## 7.9 Summary

There is a significant potential for increased stormwater capture in the City to create new water supplies. While stormwater capture occurs to replenish the SFB, the majority of stormwater runoff is not captured. Increased urbanization has decreased natural infiltration, thereby contributing to declines in local groundwater levels. Given the significant potential increased stormwater capture can play in a local, reliable water supply, LADWP is developing a Stormwater Capture Master Plan to determine overall stormwater capture targets and strategies to achieve those targets over the next twenty years.

City departments, other governmental agencies, non-profit organizations and numerous stakeholders recognize the necessity for public agencies to coordinate their activities toward improving stormwater capture. Increased stormwater capture can be used to augment local water supplies, improve water quality, restore natural waterways, and enhance neighborhoods.

For water supply benefits, stormwater can be captured in rain barrels or cisterns for reuse; or infiltrated through spreading basins, rain gardens, underground infiltration galleries, permeable surfaces or other green infrastructure and low impact development Best Management Practices.

**Increased Groundwater Production due to Stormwater Infiltration**

The UWMP projects that by 2035 there will be a minimum of 15,000 AFY of increased groundwater pumping in the SFB due to water supply augmentation through stormwater infiltration. In order to increase groundwater production, it must be determined that not only have groundwater levels recovered to sustain existing safe yield pumping amounts, but documented additional infiltration is occurring that could potentially increase the safe yield. Increasing the safe yield will require concurrence by the Watermaster and the courts to amend the basin judgment. Amending the judgment would be a lengthy process involving all basin pumpers.

Existing managed infiltration by the LACFCD results in an average of 25,782 AFY of recharge (see Exhibit 7A). LADWP has planned projects to double this amount (see Exhibit 7C). However, at this time there is not enough information to determine the quantity of additional stormwater infiltration required to restore groundwater levels required to sustain safe yield pumping, or to justify an increase in the safe yield. More studies must be conducted to determine how much more infiltration must be developed to increase the safe yield and groundwater production. The Stormwater Capture Master Plan will identify the potential acre-feet per year quantities available for recharge, and develop an implementation plan to augment the groundwater basin through centralized and decentralized infiltration projects and programs.

In addition to the proposed LADWP stormwater infiltration projects identified in Exhibit 7C, initiatives such as the proposed City of Los Angeles Low Impact Development Ordinance will augment stormwater infiltration by requiring stormwater capture for new development.

**Capture and Reuse**

By 2035, the UWMP projects 10,000 AFY of additional water conservation through rain barrels and cisterns. There have been some limited programs to distribute rain barrels, but much more remains to be done to achieve these projected stormwater capture amounts. The LADWP Stormwater Capture Master Plan will help identify how to achieve this goal.

Exhibit 7H summarizes existing and projected increased annual average stormwater capture and infiltration capability.

### *Exhibit 7H*
### *Stormwater Capture Summary*

| **Existing and Planned Annual Average Centralized Stormwater Capture** | |
|---|---|
| Estimated existing annual average centralized stormwater infiltration | 25,017 AFY |
| Planned increase in annual average centralized stormwater infiltration | 25,950 AFY |
| Total Existing and Planned Annual Average Stormwater Infiltration | 50,967 AFY |

| **Projected Total Increase in Water Supplies from Stormwater Capture** | |
|---|---|
| Projected 2035 increased annual groundwater production | 15,000 AFY |
| Projected 2035 distributed stormwater capture and reuse | 10,000 AFY |
| Total Projected 2035 Increased Water Supplies | 25,000 AFY |

Chapter Eight

# Metropolitan Water District Supplies

## 8.0 Overview

As a member agency, the City of Los Angeles purchases water from the Metropolitan Water District of Southern California (MWD) to supplement its supplies from local groundwater, Los Angeles Aqueduct (LAA) deliveries, and recycled water. LADWP has historically purchased MWD water to make up the deficit between demand and other City supplies. As a percentage of the City's total water supply, MWD water varies from 4 percent in Fiscal Year (FY) 1983/84 to 71 percent in FY 2008/09 with the 5-year average of 52 percent between FY 2005/06 and FY 2009/10. Exhibit 1F in Chapter 1 illustrates the City's reliance on MWD water during dry years and increasingly in recent years as LAA supply as been cut back for environmental enhancement projects. Although the City plans to reduce its reliance on MWD supply, it has made significant investments in MWD and will continue to rely on the wholesaler to meet its current and future supplemental water needs.

MWD is the largest water wholesaler for domestic and municipal uses in California providing nearly 19 million people with on average 1.7 billion gallons of water per day to a service area of approximately 5,200 square miles. MWD was formed by the MWD Act and exists pursuant to this statute which was enacted by the California Legislature in 1927. MWD's adopted purpose is to develop, store, and distribute water to Southern California residents. In 1928, MWD was incorporated as a public agency following a vote by residents in 13 cities in Southern California. Operating solely as a wholesaler, MWD owns and operates the Colorado River Aqueduct (CRA), is a contractor for water from the California State Water Project (SWP), manages and owns in-basin surface storage facilities, stores groundwater within the basin via contracts, engages in groundwater storage outside the basin, and conducts water transfers to provide additional supplies for its member agencies. Today, MWD has 26 member agencies consisting of 11 water districts, one county water authority, and 14 cities, including the City of Los Angeles.

This Urban Water Management Plan projects LADWP's reliance on MWD water supplies will be reduced by half from the current five-year average of 52 percent of total demand to 24 percent by FY 2034/35 under average weather conditions.

### 8.0.1 History

Initially formed to import water into the Southern California region, MWD's first project was to build the CRA to import water from the Colorado River. The City of Los Angeles provided the capital dollars to initiate and complete land surveys of all proposed alignments for the Aqueduct. Construction was financed through $220 million in bond sales during the Great Depression. Ten years after initiating construction, Colorado River water reached Southern California in 1941. To meet further water demands in the southern California region, MWD contracted with the SWP in 1960 for almost half of the SWP's water supplies which are delivered from the San Francisco Bay-Delta region into Southern California via the California Aqueduct. After completion of the California Aqueduct, deliveries of SWP water were first received in 1972.

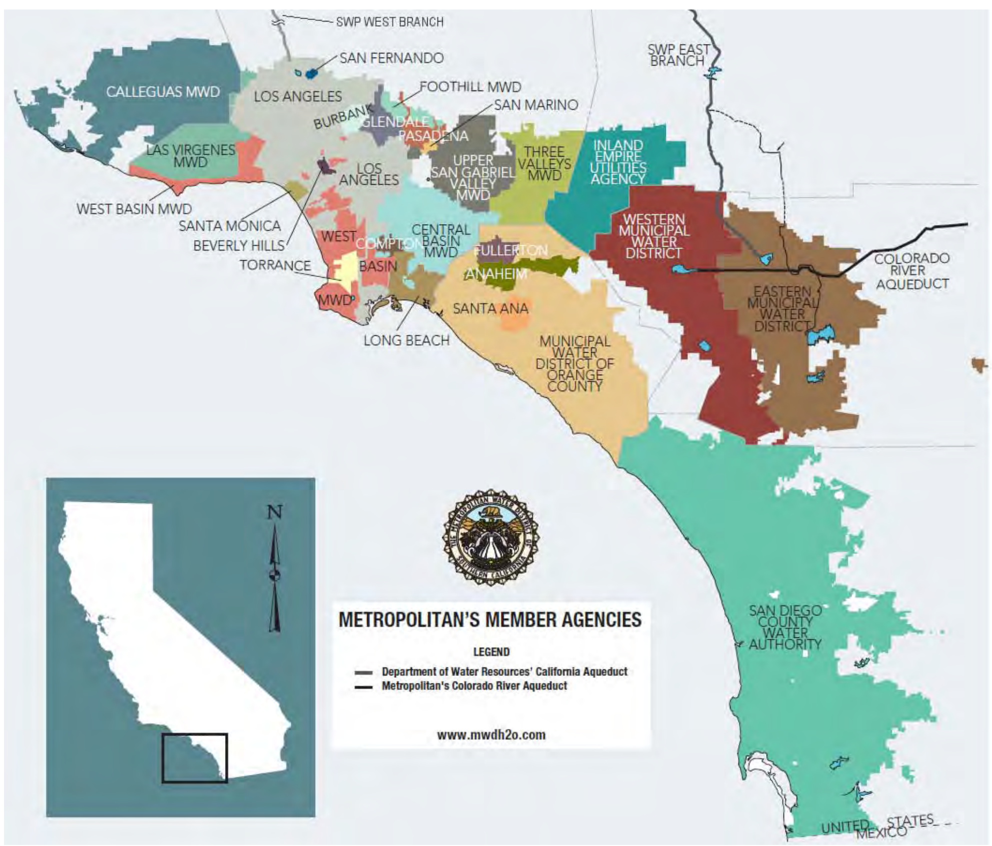
## 8.0.2 Governance

MWD is governed by a Board of Directors composed of 37 individuals with a minimum of one representative from each of MWD's 26 member agencies. The allocation of the directors and voting rights are determined by each agency's assessed valuation. The City of Los Angeles has four Directors on MWD's Board and controls 19.44 percent of the vote. MWD's Administrative Code defines various tasks which the Board has delegated to MWD staff. A General Manager oversees MWD staff. The General Manager, General Auditor, General Counsel, and Ethics Officer serve under direction and authority given directly by the Board.

## 8.0.3 Service Area

Originally serving an area of 675 square miles in 1928, MWD's service area has grown to approximately 5,200 square miles serving 19 million people via its 26 member agencies. MWD's service area covers portions of Los Angeles, Ventura, Orange, Riverside, San Bernardino, and

***Exhibit 8A***
***MWD Service Area***




Courtesy of The Metropolitan Water District of Southern California

San Diego counties as depicted in Exhibit 8A. MWD member agencies serve 152 cities and 89 unincorporated areas. Member agencies provide wholesale, retail, or a combination of wholesale/retail water sales in their individual service territories.

## 8.0.4 Major Infrastructure

MWD delivers approximately 6,000 AF per day of treated and untreated water to its member agencies through its vast infrastructure network. Major facilities include the CRA, pumping plants, pipelines, treatment plants, reservoirs, and hydroelectric recovery power plants. A summary of the major facilities and capacities are provided in Exhibit 8B and Exhibit 8C illustrates the geographic locations of the facilities.

### *Exhibit 8B Major MWD Facilities Summary*

| Facility | Units | Capacity |
|---|---|---|
| **Colorado River Aqueduct** | | |
| Aqueduct | 242 miles | 1.3 million AFY |
| Pumping Plants | 5 plants | 1,617 feet of total lift |
| **Pipelines** | 819 miles | |
| **Water Treatment Plants** | | |
| Joseph Jensen | | 750 mgd |
| Robert A. Skinner | | 630 mgd |
| F.E. Weymouth | | 520 mgd |
| Robert B. Diemer | | 520 mgd |
| Henry J. Mills | | 220 mgd |
| Total Treatment Capacity | | 2,640 mgd |
| **Reservoirs** | | |
| Diamond Valley Lake | | 810,000 AF |
| Lake Matthews | | 182,000 AF |
| Lake Skinner | | 44,000 AF |
| Copper Basin | | 24,200 AF |
| Gene Wash | | 6,300 AF |
| Live Oak | | 2,500 AF |
| Garvey | | 1,600 AF |
| Palos Verdes | | 1,100 AF |
| Orange County | | 212 AF |
| Total Reservoir Capacity | | 1,071,912 AF |
| **Hydroelectric Recovery Plants** | 16 plants | 122 megawatts |

### *Exhibit 8C Major MWD Facilities*


Courtesy of The Metropolitan Water District of Southern California

## 8.1 Supply Sources

Colorado River supplies, State Water Project supplies, In-Basin Storage, Outside-Basin Storage, and Water Transfers together comprise MWD's total system water supply sources. These sources provide supplemental water to meet the demands in Ventura, Los Angeles, Riverside, Orange, San Bernardino and San Diego Counties.

## 8.1.1 Colorado River

The Colorado River forms California's border with Arizona to the east. The drainage area in California that contributes water to the Colorado River is relatively small and has an arid climate. Accordingly, California has no major tributaries contributing water to the Colorado River.

The Colorado River Board of California is the California state agency given authority to protect the interests and rights of the state and its citizens in matters pertaining to the Colorado River. The Board is comprised of 10 gubernatorial appointees representing the LADWP, MWD, San Diego County Water Authority, Palo Verde Irrigation District, Coachella Valley Water District, Imperial Irrigation District, Department of Water Resources, Department of Fish and Game, and two public members.

## 8.1.1.1 The Law of the River

The Secretary of the Interior is vested with the responsibility to manage the mainstream waters of the Colorado River pursuant to applicable federal law. This responsibility is carried out consistent with a body of documents referred to as the Law of the River. Water rights to Colorado River water are governed by a complex collection of federal laws, state laws, a treaty with Mexico, other agreements with Mexico, Supreme Court decrees, contracts with the Secretary, interstate compacts, state, and administrative actions at the federal and state levels. Collectively, these documents and associated interpretations are commonly referred to as the "Law of the River" and govern water rights and operations on the Colorado River.

The following are particularly notable among these documents:

1. The Colorado River Compact of 1922, which apportioned beneficial consumptive use of water between the Colorado River Upper Basin and Lower Basin, and defined the term "States of the Lower Division" to mean the States of Arizona, California, and Nevada. Serving as the basis of the "Law of the River," the Compact apportioned water to each basin in anticipation of a dam on the Colorado River. The Upper Basin is the portion of the Basin upstream of Lee Ferry, Arizona, while the Lower Basin is downstream of this point. Each basin was apportioned 7.5 million acre-feet (MAF) annually, and the Lower Basin received the option to an additional 1 MAF annually based on excess flows. California is within the Lower Basin along with Arizona and Nevada.

2. The Boulder Canyon Project Act (Act) of 1928, enacted by Congress to authorize construction of Hoover Dam and the All-American Canal. The Act required that water users in the Lower Basin have a contract with the Secretary, and established the responsibilities of the Secretary to direct, manage, and coordinate the operation of Colorado River dams and related works in the Lower Basin. The Act stipulated conditions, one of which required California to limit Colorado River water use to 4.4 MAF annually plus one-half of the excess water unapportioned by the Colorado River Compact. To satisfy the condition, the California Legislature enacted the Limitation Act in 1929 limiting its use of Colorado River water to the basic apportionment of 4.4 MAF.

3. The California Seven Party Agreement of 1931. Developed in response to the Limitation Act and through regulations adopted by the Secretary, which established the relative priorities of rights among major users of Colorado River water in California. The Seven Party Agreement apportioned California's share of Colorado River water to California contractors. Within the agreement, priorities were established for each of the four agencies holding contracts for Colorado River water with the U.S. Bureau of Reclamation. These priorities are shown in Exhibit D. Seven priorities were established with the first four priorities satisfying California's allocation of 4.4 MAF annually and the fifth and sixth priorities relating to California's share of excess Colorado River flows. MWD holds the fourth and fifth priorities. The fourth priority allocates 550 thousand acre-feet (TAF) of California's apportionment to MWD and the fifth priority allocates 662 TAF of California's share of excess flows to MWD.

4. The 1944 Treaty (and subsequent minutes of the International Boundary and Water Commission) related to the quantity and quality of Colorado River water delivered to Mexico. The Treaty guaranteed an annual quantity of 1.5 MAF to be delivered in accordance with the provisions of the Treaty.

5. The 1963 United States Supreme Court Decision in Arizona v. California, which confirmed the Lower Basin mainstream apportionments of:

   2.8 million acre-feet per year (AFY) for use in Arizona,

   4.4 million AFY for use in California, and

   0.3 million AFY for use in Nevada provided water for Indian reservations and other federal reservations in Arizona, California, and Nevada; and confirmed the significant role of the Secretary in managing the mainstream Colorado River within the Lower Basin.

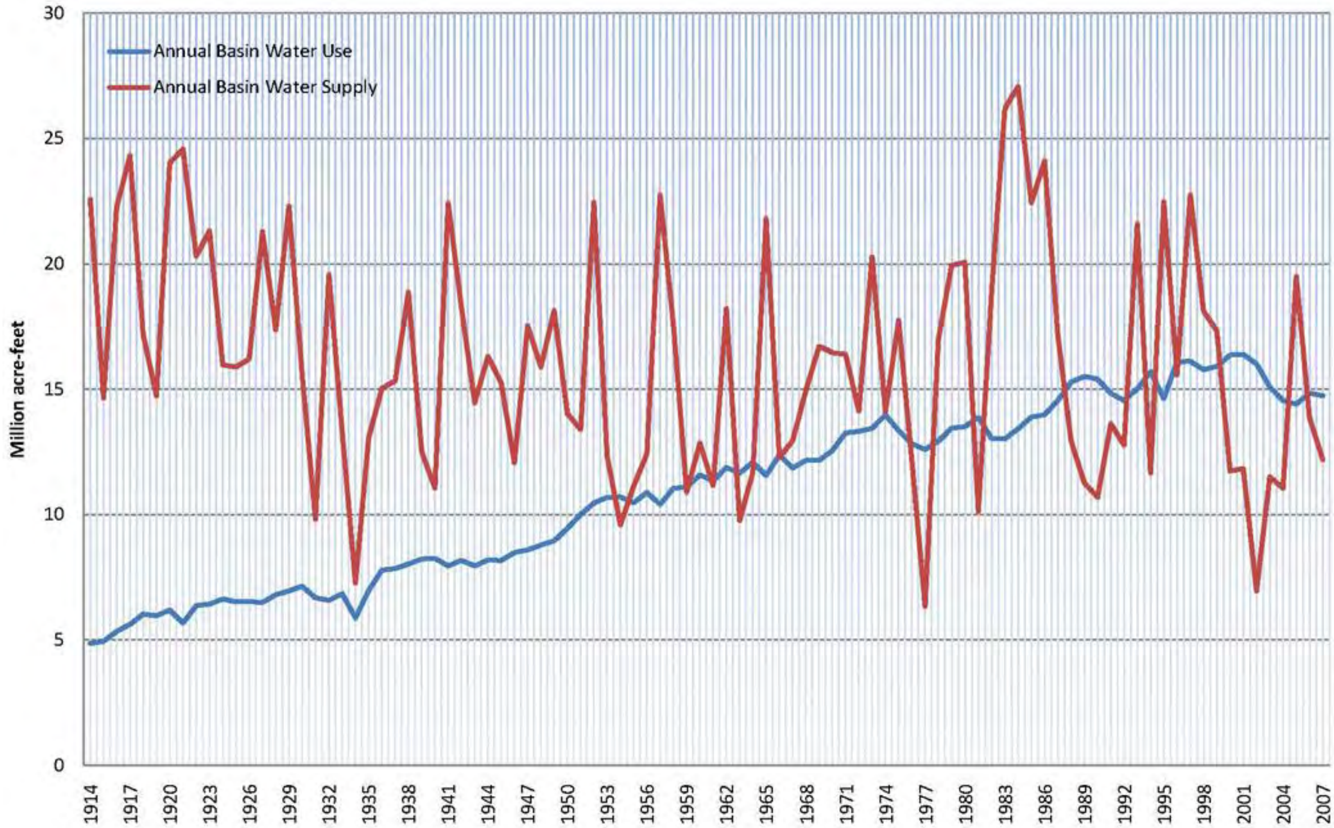
6. The 1964 United States Supreme Court Decree (Decree) in *Arizona v. California* which implemented the Supreme Court's 1963 decision; allocated 50 percent of the surplus water available for use in California; and allowed the Secretary to release water apportioned to but unused in one state for use in the other two states. The Decree was supplemented over time after its adoption and the Supreme Court entered a Consolidated Decree in 2006 which incorporates all applicable provisions of the earlier-issued Decrees.

7. The Colorado River Basin Project Act of 1968, which authorized construction of a number of water development projects including the Central Arizona Project (CAP); provided existing California, Arizona, and Nevada water contractors a priority over the CAP and other users of the same character in Arizona and Nevada whenever less than 7.5 million AFY is available; and required the Secretary to develop the Long Range Operating Criteria and issue an Annual Operating Plan for mainstream reservoirs.

### *Exhibit 8D*
### *Listing of Priorities - Seven Party Agreement*

| Priority Number | Agency and Description of Service Area | Beneficial Consumptive Use (Acre-feet/year) |
|---|---|---|
| 1 | Palo Verde Irrigation District - 104,500 acres | 3,850,000 |
| 2 | Yuma Project, California Portion, not exceeding 25,000 acres | |
| 3(a) | Imperial Irrigation District | |
| 3(b) | Palo Verde Irrigation District - 16,000 acres | |
| 4 | Metropolitan Water District, City of Los Angeles and/or others on the coastal plain | 550,000 |
| 5 | Metropolitan Water District, City of Los Angeles and/or others on the coastal plain | 662,000 |
| 6(a) | Imperial Irrigation District | 300,000 |
| 6(b) | Palo Verde Irrigation District - 16,000 acres of adjoining mesa | |
| | **Total** | **5,362,000** |

***Exhibit 8E***
***Historical Annual Colorado River Supply and Use***

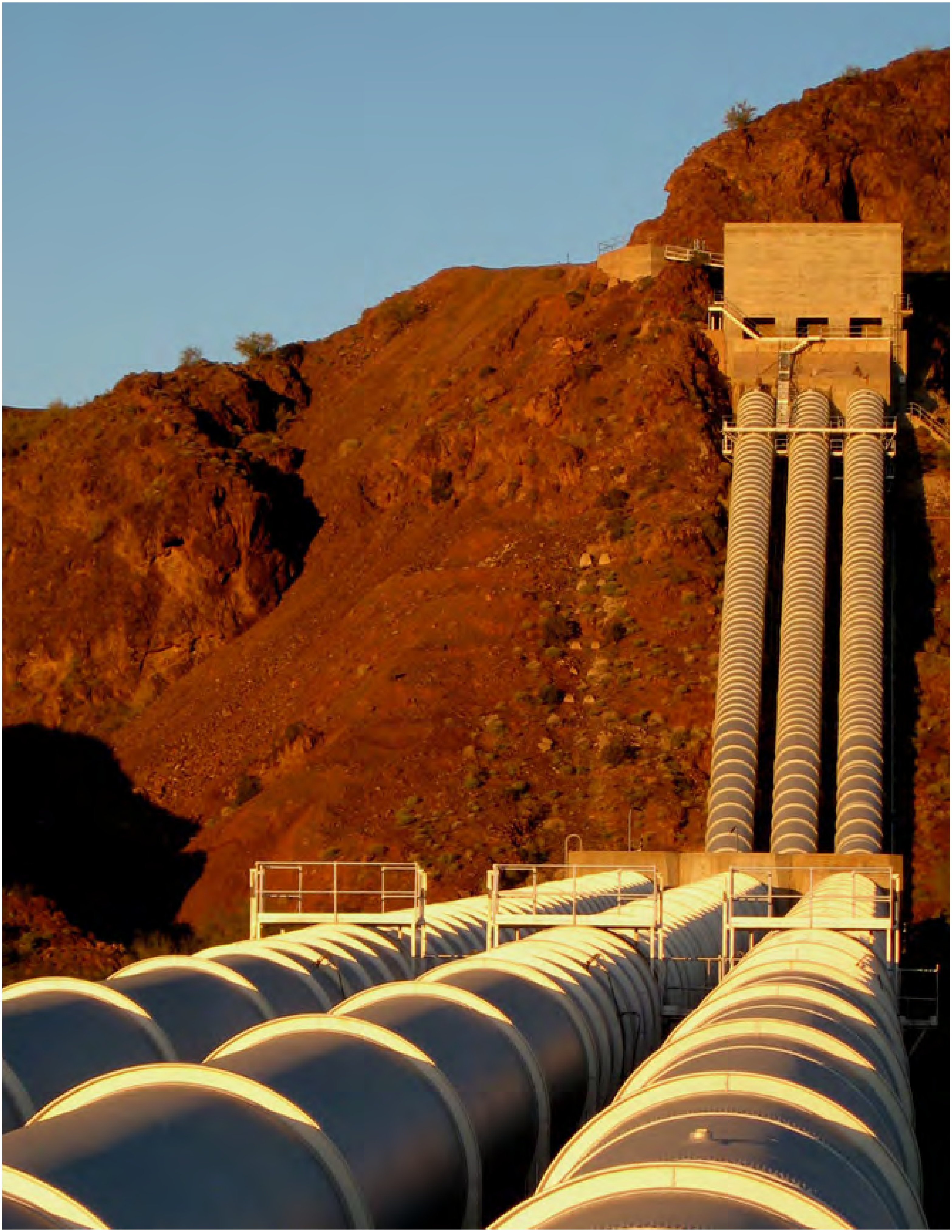



## 8.1.1.2 Colorado Supply Reliability

Exhibit 8E illustrates the historical annual Colorado River Basin supply and demand beginning 1914 through 2007. The steady increase of demand has caught up with the supply.

Reliability of CRA water for MWD has decreased overtime as a consequence of multiple events. Historically, California had used up to 5.4 million AFY as Arizona and Nevada were not using their normal apportionments of Colorado River water and surplus water was made available by the Secretary. The 1964 Decree and the 2006 Consolidated Decree of the US Supreme Court in *Arizona v. California* confirmed California's allocation was limited to 4.4 MAF annually. As a result, MWD can now only rely on its fourth priority allocation of 550 TAF annually. Prior to this, MWD was able to satisfy its fifth priority allocation with Nevada and Arizona's unused water. However, in 1985 Arizona began increasing deliveries to its Central Arizona Project reducing the availability of unused apportionment to fill MWD's fifth priority.

Because of dry years on the Colorado River system and Arizona and Nevada using their full apportionment, the U.S. Secretary of Interior asserted that California must come up with a plan to live within its 4.4 MAF apportionment. Therefore, users from California have developed California's Colorado River Water Use Plan (California Plan). The users included: MWD, Palo Verde Irrigation District (PVID), Imperial Irrigation District (IID), and Coachella Valley Water District (CVWD). This plan identifies actions that California will take to operate within its 4.4 million acre-foot entitlement. Exhibit 8F and Exhibit 8G illustrate the historical total Colorado River Basin storage and the historical Lake Mead elevation, which show a protracted dry period beginning around 1999.



California currently consumes its normal apportionment of 4.4 million AFY. The order of priority is as follows:

1. PVID - gross area of 104,500 acres of land in the Palo Verde Valley.

2. Yuma Project-Reservation Division - not exceeding a gross area of 25,000 acres in California.

3(a). IID - lands in the Imperial Valley served by the All-American Canal. Export out of basin, primarily agricultural usage. Also, second 63,000 AF in priority 6(a) and balance of any remaining priority 6(a) and 7 water available.

3(b). CVWD - lands in the Coachella Valley served by the Coachella Branch of the All-American Canal. Export out of basin, agricultural usage. Also third 119,000 AF in priority 6(a) and balance of any remaining priority 6(a) and 7 water available.

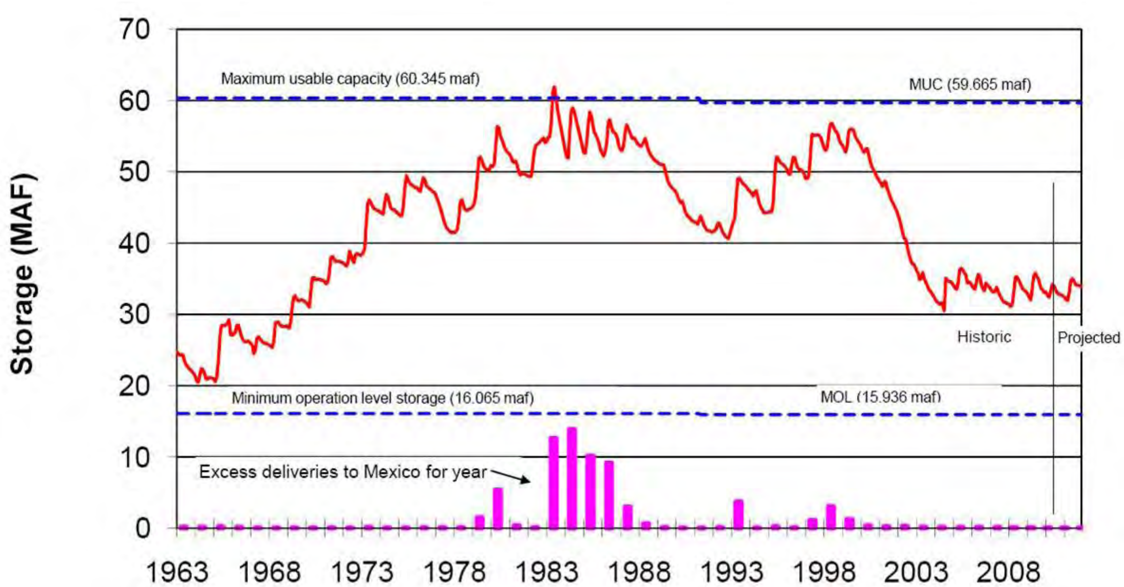
3(c). PVID - 16,000 acres of land on the Lower Palo Verde Mesa, also priority 6(b).

4. MWD – 550,000 AF, also 662,000 AF in priority 5, and first 38,000 AF in 6(a)

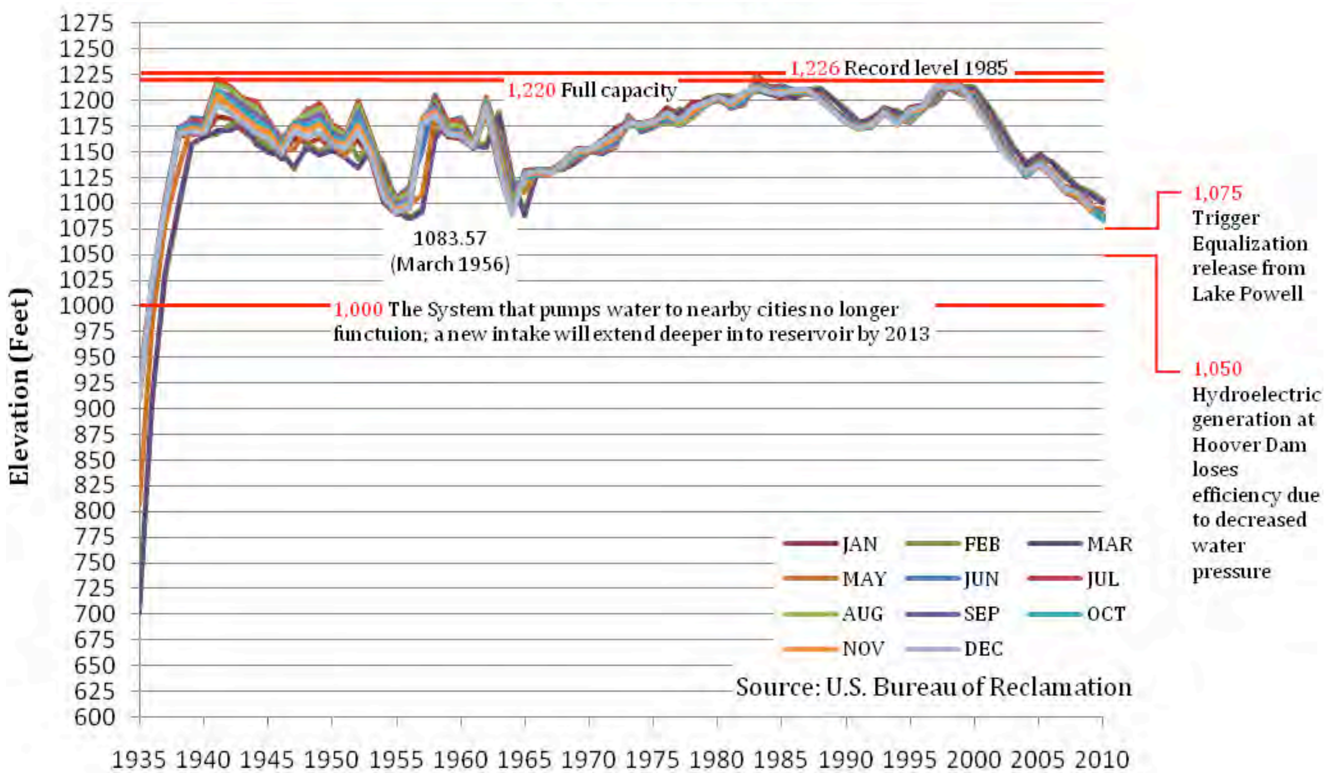
A component of the California Plan was completion of the Quantification Settlement Agreement (QSA) in 2003, which established baseline water use for each California party with Colorado River water rights. Key to the agreement is the quantification of IID at 3.1 MAF and CVWD at 330 TAF. Completion of the QSA facilitates the transfer of water from agricultural agencies to urban water suppliers by allowing water conserved on farm land to be made available for urban use. As a result of litigation, the QSA and eleven other agreements were ruled invalid on February 11, 2010. MWD in conjunction with CVWD and the SDCWA have appealed the court's decision. Ultimately, the total impact of the court's decisions on MWD's Colorado River supplies cannot be determined at this time pending the outcome of the appeal. However, MWD's existing conservation, land fallowing, and transfer programs for Colorado River supplies are independent of the QSA and will not be impacted by the QSA lawsuit.

Along with MWD's apportionment, MWD has developed a number of water supply programs to improve reliability of Colorado River supplies, such as agricultural water transfers and storage programs, and has multiple programs under development as listed in Exhibit 8G. Developed programs in conjunction

### *Exhibit 8F*
### *Historical Total Colorado River Basin Storage*



## *Exhibit 8G*
## *Historical Lake Mead Elevation*




The bathtub ring at Lake Mead, August 2010, lake elevation 1,087 feet.

## Exhibit 8H
## MWD's CRA Forecast Supplies in 2035, Average Year (1922 - 2004 Hydrology)

| Program | Supply (Thousands of AF)/ Year |
|---|---|
| **Current** | |
| Basic Apportionment - Priority 4 | 550 |
| Imperial Irrigation District/MWD Conservation Program | 85 |
| Priority 5 Apportionment (Surplus) | 13 |
| Palo Verde Irrigation District Land Management Crop Rotation and Water Supply Program | 133 |
| Lower Colorado Water Supply Project | 5 |
| Lake Mead Storage Program | 400 |
| Quechan Settlement Agreement Supply | 7 |
| Forbearance for Present Perfected Rights | -47 |
| Coachella Valley Water District State Water Project/QSA Transfer Obligation | -35 |
| Desert Water Agency and Coachella Valley Water District SWP Table A Obligation | -155 |
| Desert Water Agency and Coachella Valley Water District SWP Table A Transfer Call-back | 82 |
| Desert Water Agency and Coachella Valley Water District Advance Delivery Account | 73 |
| Drop 2 Reservoir Funding | 25 |
| Southern Nevada Water Authority Agreement | 0 |
| **Subtotal of Current Programs** | **1,136** |
| **Programs Under Development** | |
| Additional Palo Verde Irrigation District Transfers | 62 |
| Arizona Programs - Central Arizona Project | 50 |
| California Indians/Other Agriculture | 10 |
| ICS Exchange | 25 |
| Agreements with Coachella Valley Water District | 35 |
| Hayfield Groundwater Extraction Project | 0 |
| **Subtotal of Proposed Programs** | **182** |
| **Additional Non-MWD CRA Supplies** | |
| San Diego County Water Authority/ Imperial Irrigation District Transfer | 200 |
| Coachella and All-American Canal Lining | |
| To San Diego County Water Authority | 80 |
| To San Luis Rey Settlement Parties[1] | 16 |
| **Subtotal of Non-MWD CRA Supplies** | **296** |
| **Maximum CRA Supply Capability[2]** | **1,614** |
| **Minus Supply CRA Capacity Constraint of 1.25 MAF Annually** | **-364** |
| **Maximum Forecast CRA Deliveries** | **1,250** |
| **Minus Non-MWD Supplies[3]** | **-296** |
| **Maximum MWD Supply Capability[4]** | **954** |

1. Subject to satisfaction of conditions specified in agreement among MWD, the US, and the San Luis Rey Settlement Parties
2. Total amount of supplies available without taking into consideration of CRA capacity constraint of 1.25 MAF annually.
3. Exchange obligation for San Diego County Water Authority - Imperial Irrigation District transfer and the Coachella and All-American Canal Lining Projects.
4. The amount of CRA water available to MWD after meeting exchange obligations.

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

with MWD's apportionment will provide MWD with approximately 1.14 MAF in 2035 under an average year (1922 – 2004 hydrology). Proposed programs under development could add another 182 TAF per year. Non-MWD supplies conveyed through the CRA are forecast at 296 TAF for a total CRA supply capability of 1.61 MAF. However, the CRA has a supply capacity constraint of 1.25 MAF. After subtracting MWD's conveyance obligation of non-MWD supplies, MWD's supplies for 2035 under average year, single-dry year (1977 hydrology), and multi-dry year (1990 – 1992 hydrology) scenarios are all forecast at 954 TAF. Exhibit 8H summarizes the CRA supply forecast for 2035 under an average year.

## 8.1.1.3 Water Quality Issues

Water quality issues for Colorado River supplies cover high salinity levels, perchlorate, nutrients, uranium, chromium VI, N-nitrosodimethlamine (NDMA), and pharmaceuticals and personal care products (PPCPs). High salinity levels present the most significant issue and the only foreseeable water quality constraint for the Colorado River supply. MWD expects its source control programs for the CRA to adequately address the other water quality issues. MWD has also bolstered its water security measures across all of its operations since 2001, including an increase in water quality tests. Details of MWD's water quality initiatives are available in MWD's 2010 Regional Urban Water Management Plan (RUWMP).

### Salinity

Water obtained from the Colorado River has the highest salinity levels of all MWD supply sources averaging 630 mg/L since 1976. Salts are eroded from saline sediments deposited in prehistoric marine environments in the Colorado River Basin (Basin), dissolved by precipitation, and conveyed into the Basin's water courses. Salinity issues have been recognized in the Basin for over 30 years. The seven basin states formed the Colorado River Basin Salinity Control Forum (Forum) to mutually cooperate on salinity issues in the Basin. The Forum recommended the U.S. Environmental Protection Agency (USEPA) to act upon the Forum's proposal and in response the USEPA approved water quality standards and established numeric criteria for controlling salinity increases. Each Basin State adopted the water quality standards, which are designed to limit the flow-weighted average annual salinity level to 1972 levels or below. An outgrowth of the Forum was the Colorado River Basin Control Program. At the core of the program is the reduction in salts entering the river system by intercepting and controlling non-point sources, wastewater, and saline hot springs. Salinity reduction projects have reduced salinity concentration of Colorado River water by over 100mg/L, which equates to approximately $264 million per year in avoided damages (2005 dollars).

MWD adopted a Salinity Management Policy in 1999 with the goal of achieving salinity concentrations of less than 500 mg/L at delivery. To reduce salinity levels, Colorado River supplies are blended with SWP water supplies to achieve the salinity target. In some years, the target is not possible to achieve as a result of hydrologic conditions that increase salinity on the Colorado River and decrease SWP water available for blending. Additionally, to maximize the use of recycled water for agriculture, MWD attempts to import lower salinity imported water during the spring/summer months to reduce salinity levels in recycled water supplies.

### Perchlorate

In 1997 perchlorate was first detected in the Colorado River. It was attributed to an industrial site upstream of the Las Vegas Wash in Nevada which drains to the river. Subsequently, an additional perchlorate plume was found to be migrating from an additional industrial site, but had not reached the Las Vegas Wash. Since the initial discovery of contamination, remediation efforts have significantly reduced perchlorate loading from the Las Vegas Wash. At Lake Havasu, downstream of the convergence of the Las Vegas Wash and Colorado River, perchlorate levels have decreased from 9 µg/L at their peak in 1998 to less than 6 µg/L in October 2002. Since June 2006, typical levels have been less than 2 µg/L.

## Nutrients

Excessive nutrient levels in water can stimulate algal and aquatic weed growth leading to taste and odor concerns. Nutrients include both phosphorous and nitrogen compounds. Other impacts of algal and aquatic weed growth include reductions in operating efficiencies and potentially provide an additional food source for invasive aquatic species, such as quagga and zebra mussels.

Naturally, the Colorado River system has relatively low concentrations of phosphorous. Additional loading to the system as upstream urbanization increases has the ability to increase phosphorous concentrations and impact MWD's ability to blend low nutrient concentration CRA water with high nutrient concentration SWP water. MWD continues to work with agencies located along the lower Colorado River to improve wastewater management in order to reduce phosphorous loading.

## Uranium

Near Moab, Utah, a 16-million ton pile of uranium tailings located approximately 750 feet from the Colorado River is a potential source of uranium loading to the river. In 1999, the US Department of Energy began remediating the site by removing tailings and treating contaminated groundwater. Complete removal of the pile is expected by 2025 or 2019 if additional funding is secured. MWD is tracking clean-up progress and continues to support rapid clean-up of the site.

To address recent uranium mining claims in the vicinity of the Colorado River and the Grand Canyon Area, MWD has sent letters to the Secretary of Interior to highlight MWD's concern of source water protection and recommended close federal oversight. In 1999, the Department of Interior placed a two-year hold on mining claims for 1 million acres adjacent to the Grand Canyon area to conduct additional analyses and H.R. 644, Grand Canyon Watersheds Protection Act, was introduced in 2009. H.R. 644, if approved, would prohibit new mining activities around the Grand Canyon area.

## Chromium VI

Chromium VI has been detected in a groundwater aquifer in the vicinity of the Colorado River near Topock, Arizona. The source of the contamination is a natural gas compression site operated by Pacific Gas and Electric (PG&E) that previously used chromium VI in its operations. Monitoring upstream and downstream of the site range from non-detect (0.03 µg/L) to 0.06 µg/L which are considered within the background range for the river. MWD is actively involved in the corrective action process through its participation in stakeholder workgroups and partnerships with State and federal regulators, Indian tribes, and other stakeholders. The Final Environmental Impact Report (EIR) for the Topock Chromium VI remediation project is complete and has been certified by California Department of Toxic Substances Control. U.S. Department of Interior has issued a Federal Record of Decision which states that PG&E holds sole responsibility for the substantial threat of the release of Chromium VI near Topock, Arizona. A time-critical removal action is authorized and PG&E's clean-up operations are under the direction and oversight of the Department of Toxic Substances Control.

## NDMA and Pharmaceuticals and Personal Care Products

N-nitrosodimenthylamine is a by-product formed by secondary disinfection of some natural waters with chloramines. MWD is

involved with projects to understand the potential sources of NDMA precursors in its source watersheds and to develop treatment strategies to minimize NDMA formation at its water treatment facilities. In 2007, MWD initiated monitoring efforts to measure PPCPs in its source supplies. PPCPs have been detected at very low levels (low ng/L level; parts per trillion) consistent with monitoring results from other utilities. MWD is involved with programs to improve analytical testing methods, characterize PPCP in drinking water sources in California, and effects of PPCPs on groundwater recharge and recycled water use.

## 8.1.2 State Water Project

MWD began receiving water from the SWP in 1972. MWD is the largest of 29 contractors for water from the SWP, holding a contract for 1.912 MAF per year, or 46 percent of the total contracted amount of the 4.173 MAF ultimate delivery capacity of the project. Variable hydrology, environmental issues, and regulatory restrictions in the San Francisco Bay/ Sacramento-San Joaquin River Delta (Bay-Delta) have periodically reduced the quantity of water that the SWP delivers to MWD.

## Exhibit 81
## State Water Project Major Facilities


Courtesy of the State of California Department of Water Resources

### 8.1.2.1 Major State Water Project Facilities

The SWP is owned by the State of California and operated by the Department of Water Resources (DWR) delivering water to two-thirds of the population of California and 750,000 acres of farmland. The SWP system consists of 701 miles of aqueduct, 34 storage facilities totaling 5.8 MAF of storage, five hydro-electric power plants, four pumping-generating plants, 17 pumping plants, and three pump stations. Exhibit 8I illustrates the location of major SWP facilities. SWP facilities originate in Northern California at Lake Oroville on the Feather River. Water released from Lake Oroville flows into the Feather River, goes downstream to its confluence with the Sacramento River, and then travels into the Bay-Delta. Water is pumped from the Bay-Delta region to contractors in areas north and south of the San Francisco Bay and south of the Bay-Delta. SWP deliveries consist solely of untreated water. In addition to delivering water to its contractors, the SWP is operated to improve water quality in the Bay-Delta region, control flood waters, and provide recreation, power generation, and environmental enhancement.

MWD receives SWP water at three locations: Castaic Lake in Los Angeles County, Devil Canyon Afterbay in San Bernardino County, and Box Spring Turnout at Lake Perris in Riverside County. In addition, MWD has flexible storage rights of 65 TAF at Lake Perris at the terminus of the East Branch of the SWP and 153.95 TAF at Castaic Lake at the terminus of the West Branch.

### 8.1.2.2 Contract Allocations

Contract allocations, also known as entitlements, for SWP contractors are provided by DWR in a table commonly referred to as Table A and shown in Exhibit 8J. Allocations are based on the original projected SWP maximum yield of 4.173 MAF. Table A is a tool used by DWR to allocate fixed and variable SWP costs and yearly water entitlements to the contractors. Table A contract amounts do not reflect actual deliveries a contractor should expect to receive. MWD has a Table A contract amount of 1.912 MAF. MWD's full Table A contract amount was made available to MWD for the first time in 2006.

DWR annually approves the amount of contract allocations SWP contractors will receive. The contract allocation amount received by contractors varies based on contractor demands and projected available water supplies. Variables impacting projected water supplies include snowpack in the Sierra Nevada, capacity available in reservoirs, operational constraints, and demands of other water users. Operational constraints include pumping restrictions related to fish species listed as either threatened or endangered under the federal or state Endangered Species Acts. Contractors' requests for portions of their entitlements cannot always be met. In some years there are shortages and in other years surpluses. In 2008 and 2009, SWP contractors received only 35 percent and 40 percent, respectively, of their SWP contract allocations.

DWR bi-annually prepares the State Water Project Delivery Reliability Report to provide contractors with current and projected water supply availability for SWP. The 2009 draft released in January 2010 indicates expected deliveries for multiple-dry year periods will vary from 32 to 38 percent of maximum Table A amounts and for multiple-year wet periods, 72 to 94 percent of maximum Table A amounts. Overall the report shows increased reductions in water deliveries on average when compared to the previous 2007 report. Factors impacting deliveries include environmental constraints and hydrologic changes as a result of climate change.

***Exhibit 8J Table A Maximum Annual SWP Amounts (acre-feet)***

**Contractor Maximum SWP Table A**

**North Bay**

| | |
|---|---|
| Napa County Flood Control and Water Conservation District | 29,025 |
| Solano County Water Agency | 47,756 |
| **Subtotal** | **76,781** |

**South Bay**

| | |
|---|---|
| Alameda County Flood Control and Water Conservation District, Zone 7 | 80,619 |
| Alameda County Water District | 42,000 |
| Santa Clara Valley Water District | 100,000 |
| **Subtotal** | **222,619** |

**San Joaquin Valley**

| | |
|---|---|
| Oak Flat Water District | 5,700 |
| Kings County | 9,305 |
| Dudley Ridge Water District | 57,343 |
| Empire West Side Irrigation District | 3,000 |
| Kern County Water Agency | 998,730 |
| Tulare Lake Basin Water Storage District | 95,922 |
| **Subtotal** | **1,170,000** |

**Central Coastal**

| | |
|---|---|
| San Luis Obispo County Flood Control and Water Conservation District | 25,000 |
| Santa Barbara County Flood Control and Water Conservation District | 45,486 |
| **Subtotal** | **70,486** |

**Southern California**

| | |
|---|---|
| Antelope Valley-East Kern Water Agency | 141,400 |
| Castaic Lake Water Agency | 95,200 |
| Coachella Valley Water District | 121,100 |
| Crestline-Lake Arrowhead Water Agency | 5,800 |
| Desert Water Agency | 50,000 |
| Littlerock Creek Irrigation District | 2,300 |
| Mojave Water Agency | 75,800 |
| Metropolitan Water District of Southern California | 1,911,500 |
| Palmdale Water District | 21,300 |
| San Bernardino Valley MWD | 102,600 |
| San Gabriel Valley MWD | 28,800 |
| San Gorgonio Pass Water Agency | 17,300 |
| Ventura County Flood Control District | 20,000 |
| **Subtotal** | **2,593,100** |
| **Delta Delivery Total** | **4,132,986** |

**Feather River**

| | |
|---|---|
| Butte County | 27,500 |
| Plumas County Flood Control and Water Conservation District | 2,700 |
| Yuba City | 9,600 |
| **Subtotal** | **39,800** |
| Total | **4,172,786** |

In addition to MWD's Table A amount, MWD has long term agreements in place to obtain additional SWP supplies through five other programs:

- Article 21
- Turnback Pool
- Yuba River Accord
- San Luis Carryover Storage
- Desert Water Agency and Coachella Valley Water District Table A Transfer

Article 21 is in reference to a provision in the SWP contract with DWR that allows SWP contractors, such as MWD, to take additional water deliveries in addition to Table A amounts. Article 21 water is only available under certain conditions as outlined in Article 21. SWP Article 21 of the contracts permits delivery of water excess to delivery of SWP Table A and some other water types to those contractors requesting it. SWP Article 21 water is apportioned to those contractors requesting it in the same proportion as their SWP Table A.

Turnback Pool (Pool) water allows a contractor that has been allocated Table A annual entitlement that the contractor will not use to sell that water to other SWP contractors through the Pool. If there are more requests from contractors to purchase water from the Pool than the amount in the Pool, the water in the Pool is allocated among those contractors requesting water in proportion to their Table A entitlements. If requests to purchase water from the Pool total are less than the amount of water in the Pool, the sale of water is allocated to the selling contractors in proportion to their respective amounts of water in the Pool.

In 2007, MWD and DWR signed an agreement allowing MWD to participate in the Yuba Dry Year Water Purchase Program. Under this program, transfers are available from the Yuba County Water Agency during dry years up to 2025. MWD completed purchases of 26.4 TAF and 42.9 TAF in 2008 and 2009, respectively.

As part of the Monterey Amendment, which modified the contractors' long term contracts with DWR, the use of carryover storage by contractors was permitted in the San Luis Reservoir for use during dry years. Carryover storage is curtailed if it impedes with the storage of SWP water for project needs.

MWD entered into a transfer agreement with the DWA and CVWD for their Table A contract amounts in exchange for an equal amount of water from the CRA. Both DWA and CVWD are SWP contractors, but have no physical connections to obtain SWP water. MWD is able to transfer CRA water to both agencies as a result of their locations adjacent to CRA facilities. DWA and CVWD have a combined Table A amount of 1.912 MAF per year. MWD additionally can provide DWA and CVWD with deliveries of MWD's other SWP water supplies and non-SWP supplies utilizing SWP facilities, thus allowing MWD additional flexibility in managing its water supply portfolio.

MWD also engages in short-term transfer agreements using SWP facilities to bolster supplies as opportunities become available as discussed in the Groundwater Storage and Transfers sub-section. Historically, MWD has obtained transfers through the Governor's Water Bank, Dry-Year Purchase Programs, and the State Water Contractors Water Transfer Program.

MWD expects to receive 2.046 MAF through its SWP supplies in 2035 under average conditions (1922 – 2004 hydrology). Exhibit 8K summarizes MWD's SWP supplies by program. Current programs are expected to result in 1.441 MAF and programs under development are expected to add an additional 605 TAF. Under multi-year dry conditions (1990 – 1992 hydrology), MWD expects to receive only 956 TAF and 1,003 TAF under a single-dry year (1977 hydrology).

### 8.1.2.3 Water Quality Issues

Water quality issues for SWP supplies include total organic carbon (TOC), bromide, arsenic, nutrients, NDMA, and PPCPs. TOC and bromide in SWP water present the greatest water quality issues and have restricted MWD's ability to use SWP water at various times as the contaminants form disinfection byproducts during water treatment processes. MWD has initiated a process to upgrade its treatment processes to ozone disinfection to reduce formation of disinfection byproducts and lift potential restrictions on SWP water usage. MWD requires low salinity levels of SWP water to meet blending requirements for CRA water, and therefore, any increase in salinity levels in SWP supplies is a concern to MWD.

MWD supported DWR in the establishment of a policy regarding water quality of non-SWP water transported through the SWP system and in the expansion of Municipal Water Quality Investigations Programs to include additional monitoring and advanced warnings to contractors that may impact water treatment processes.

MWD is utilizing its water supply portfolio options to conduct water quality exchanges to reduce TOC and bromide. MWD has stored SWP water during periods of high water quality in groundwater storage basins for later use when SWP is at a lower water quality. These storage programs were initially designed to provide water during dry SWP conditions, but a few of these programs are now operated for dual-purposes.

TOC and bromide in high concentrations lead to the formation of disinfection byproducts when source water is treated with disinfectants, such as chlorine. Agricultural drainage to the Bay-Delta and seawater comingling with Bay-Delta supplies increases these contaminants. The Bay Delta Conservation Plan (BDCP) has outlined multiple options to improve the water supply reliability and habitat protection, which is being prepared through a collaboration of state, federal, and local water agencies, state and

***Exhibit 8K***
***MWD Forecast Supplies of SWP Water in 2035, Average Year (1922 - 2004 Hydrology)***

| Program | Supply (Thousands of AF) |
|---|---|
| Current | |
| MWD Table A | 1,026 |
| Desert Water Agency and Coachella Valley Water District SWP Table A Transfer | 155 |
| San Luis Carryover Storage[1] | 208 |
| Article 21 Supplies | 52 |
| Yuba River Accord Purchase | 0 |
| **Subtotal of Current Programs[2]** | **1,441** |
| Programs Under Development | |
| Delta Conveyance Improvements | 605 |
| Integrated Resources Plan SWP Target[3] | 0 |
| **Subtotal of Proposed Programs[2]** | **605** |
| **Maximum SWP Supply Capability[2]** | **2,046** |

1. Includes carryover water from Desert Water Agency and Coachella Valley Water District.
2. Does not include transfers and water banking associated with SWP.
3. Remaining supply needed to meet Integrated Resources Plan target.

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

federal fish agencies, environmental organizations, and other interested parties. The overall goal of BDCP is identifying water flow and habitat restoration actions to both improve water supply reliability and recover endangered and sensitive species and their habitats Bay-Delta. MWD is in the process of computing upgrades to its water treatment plants to use ozone as the primary disinfectant. Ozone disinfection is very effective treatment for control of bromate formation and will allow MWD to treat higher quantities of SWP supplies without blending those supplies with CRA water.

## Arsenic

SWP supplies not banked in MWD's SWP groundwater storage programs naturally contain low levels of arsenic ranging from non-detect to 4.0 μg/L and do not require additional treatment for arsenic removal. SWP supplies banked in at least one of these groundwater storage programs contain arsenic levels close to or at the regulatory threshold of 10 μg/L requiring additional treatment for arsenic removal. Historically, MWD has at times restricted flows from one groundwater storage program as a result of arsenic levels. One groundwater storage partner has initiated a pilot arsenic removal program, albeit raising the cost of the groundwater storage program. Arsenic can also be removed at water treatment plants by increasing coagulant doses. To handle arsenic removed during water treatment processes, MWD has had to invest in solids handling facilities.

## Nutrients

Nutrient levels in SWP water are significantly higher than in Colorado River water. Both phosphorous and nitrogen compounds are a concern in SWP water, but similar to CRA supplies phosphorous is the limiting nutrient. Nutrient sources in SWP water include wastewater discharges, agricultural drainage, and sediments from nutrient rich soils in the Bay-Delta. MWD reservoirs have been temporarily bypassed at times as a result of taste and odor events related to nutrients leading to short-term supply impacts.

MWD is working with other water agencies also receiving SWP water from the Bay-Delta region to reduce the impact of nutrient loading from wastewater plants discharging to the Bay-Delta. To assist in managing its operations, MWD has implemented an algae monitoring and management program designed to provide warnings in advance of algae and taste and odor issues at its reservoirs allowing adjustments in other system operations.

## NDMA and Pharmaceuticals and Personal Care Products

Similar to all of its water supply sources, NDMA and PPCPs are constituents of emerging concern. As described above for Colorado River supplies, MWD is involved with efforts to address both NDMA and PPCPs.

## Salinity

Over the long term salinity concentrations in SWP water are significantly lower than in CRA water, but the timing of supply availability and total dissolved solids (TDS) concentrations can vary in response to hydrologic conditions. Additionally, salinity concentrations vary in the short term in response to seasonal and tidal flow patterns. MWD requires lower salinity SWP water to blend with CRA water to meet salinity requirements for its member agencies. MWD's blended salinity objective is 500 mg/L.

Environmental constraints also impact MWD's ability to meet its salinity objective. Since 2007, pumping operations in the Bay-Delta have been limited to prevent environmental harm (as discussed in the Bay-Delta Issues subsection below). MWD must rely on higher salinity CRA water resulting in an exceedance in MWD's salinity objective at times.

SWP salinity concentrations as specified in the SWP Water Service Contract have not been met. Article 19 of SWP Water Service Contract specifies ten-year average salinity concentrations of 220 mg/L and a monthly maximum of 440 mg/L. MWD is working with DWR and other agencies to reduce salinity in SWP Bay-Delta supplies through multiple programs. These programs include modifying agricultural drainages and completing basin plans on the San Joaquin River, modifying levees around flooded islands in the Bay-Delta, and installing gates to reduce transportation of salts from seawater.

## 8.1.2.4 Bay-Delta Issues

The Bay-Delta is a major waterway at the confluence of the Sacramento and San Joaquin rivers serving multiple and at times conflicting purposes exacerbated during dry years when water to meet the needs of both people and the environment is in short supply. Approximately two-thirds of Californians receive at least a portion of their water from the Bay-Delta. Almost all water delivered via the SWP to Southern California must pass through the Bay-Delta. Runoff from more than 40 percent of the state is also conveyed through the Bay-Delta forming the eastern edge of the San Francisco bay's estuary. A large portion of the Bay-Delta region lies below sea level and is protected by more than 1,100 miles of levees to prevent flooding. Deterioration of the Bay-Delta ecosystem coupled with infrastructure concerns, hydrologic variability, climate change, litigation, regulatory restrictions, and previously discussed water quality issues have resulted in supply reliability challenges for SWP contractors who depend upon the Bay-Delta for water supplies.

### Environmental

As an estuarine environment, the Bay-Delta provides habitat for migratory and resident fish and birds, including those placed on the threatened or endangered species list under the federal or California Endangered Species Act (ESA). Five fish species residing in the Bay-Delta were listed as endangered under the ESA, and one additional species was listed as threatened in 2009 under the California ESA. As a result of a combination of lawsuits regarding the ESA listed species and biological opinions and incidental take permits (permits for inadvertently harming ESA listed species) from the U.S. Fish and Wildlife Service and National Marine Fisheries Service, SWP exports and pumping operations in the Bay-Delta have been significantly curtailed. However, DWR prepared a Water Allocation Analysis in 2010 indicating that MWD could receive 150 to 200 TAF less water than forecast for 2010 under average hydrologic conditions. Ongoing litigation, additional species listing, and regulations could further curtail pumping operations and have an additional adverse impact on MWD's supplies and reserves. MWD has filed a lawsuit in conjunction with other SWP contractors challenging one of the biological opinions. As discussed below under the Delta Plan, the Delta Vision process is designed to develop long term solutions to these issues.

### Infrastructure

Bay-Delta channels are constrained by a levee system to protect below sea level islands in the Bay-Delta from flooding. Land in the Bay-Delta subsides mainly from ongoing oxidation of aerated peat soils. Some islands are presently twenty feet or more below sea level. Land subsidence is expected to continue which increases the risk of levee failure and island flooding. Many of the levees are old and do not meet modern engineering standards. A catastrophic earthquake could cause widespread levee failure shutting down SWP operations for an extended period of time. Following a levee failure, the flow of water onto an island can pull saline water from the San Francisco Bay into the central Bay-Delta area and, if coupled with pumping in the south Bay-Delta, draw saline water into the south Bay-Delta area. Therefore, pumping in the south Bay-Delta may need to be stopped or slowed down for an extended period, and additional flows may

Photo courtesy of The Metropolitan Water District of Southern California.

need to be released from Lake Oroville to flush saline water out of the Bay-Delta. Any salinity introduced into Bay-Delta may also impact Bay-Delta water quality for an extended period of time.

Recognizing the need for protecting these vulnerable Bay-Delta levees, the Bay-Delta Levees Program was formed to coordinate improvements to and maintenance of the Bay-Delta levees. Over the next few years, the DWR and other agencies will conduct a Comprehensive Program Evaluation. This program will supplement existing risk studies, develop a strategic plan, recommend priorities, and provide estimates for the Bay-Delta Levees Program.

## 8.1.2.5 Delta Plan

Former California Governor Arnold Schwarzenegger established the Delta Vision Process in 2006 to address ongoing Bay-Delta conflicts through long-term solutions. The independent Blue Ribbon Task Force completed their vision for sustainable management of the Bay-Delta in 2008. After delivery of the Delta Vision recommendations and goals, the State Legislature initiated the process to conduct information hearings and draft legislation. Ultimately, the Governor called the Seventh Extraordinary Session to address the Bay-Delta and water issues in the State. Resulting legislation included the approval of SB 1 X7 addressing Bay-Delta policy reforms and governance of the Bay-Delta.

A key concept of SB 1 X7 is the formation of a Delta Stewardship Council (Council). The Council is an independent State agency tasked to equally further the goals of Delta restoration and water supply reliability. One of the Council's first major tasks is to develop, adopt, and begin implementation of a Delta Plan by January 1, 2012. Key requirements of the plan as summarized in the MWD RUWMP are:

- Further the coequal goals of ecosystem restoration and water supply reliability.
- Attempt to reduce risks to people, property, and State interests.
- Promote Statewide water conservation, water use efficiency, and sustainable use of water to achieve the coequal goals.
- Improvements to water conveyance/storage and operations of such facilities to achieve the coequal goals.
- Consider including the Bay Delta Conservation Plan (BDCP) into the Delta Plan and allow the BDCP to be eligible for State funding if specific conditions are met.

The BDCP is a joint effort of State and federal fish agencies; State, Federal, and local water agencies; environmental organizations; and other parties with the goal of providing for both improvements in water reliability through securing long-term permits to operate the SWP and species/habitat protection in the Delta. MWD is a member of the Steering Committee. An outcome of the plan will be the identification of water flow and habitat restoration actions that assist in recovery of ESA listed and sensitive species and their associated habitats in the Bay-Delta. A range of options to accomplish the outcome will be carried forward to the environmental review phase.

Photo courtesy of The Metropolitan Water District of Southern California.

## 8.1.3 In-Basin Storage

In basin-storage facilities play a key role in maintaining MWD's reliability during droughts or other imported water curtailments and emergency outages. In-basin storage facilities consist of surface reservoirs and contracted groundwater basin storage. Conjunctive use of surface reservoirs and groundwater basins was first initiated by MWD in the 1950's. Long term storage goals for in-basin storage facilities were established in MWD's Water Surplus and Drought Management Plan (WSDM). The WSDM plan allows storage for hydrology variances, water quality, and SWP and CRA issues.

MWD has established emergency in-basin storage requirements based on a major earthquake that could potentially cutoff all supplies for six months from the all aqueducts serving the region, the CRA, both SWP branches, and LADWP's LAA. Under this scenario, MWD would maintain deliveries by suspending interruptible deliveries, implementing mandatory water use reductions of 25 percent of normal-year demands, water would be made available from surface reservoir and groundwater supplies stored as part of MWD's interruptible supply program, and full local groundwater production would occur. MWD's emergency storage requirement is a function of projected demands and varies with time.

### 8.1.3.1 Surface Reservoirs

MWD owns and operates seven in-basin surface storage reservoirs. Four of the reservoirs, Live Oak, Garvey, Palos Verdes, and Orange County, are used for regulatory purposes and do not provide drought or emergency storage. Additionally, MWD owns and operates two reservoirs, Copper Basin and Gene Wash, along the CRA outside of the basin for system regulation purposes. Outside its basin, MWD has 1.45 MAF storage rights in Lake Mead on the Colorado River pursuant to its intentionally created surplus agreement with the U.S. Bureau of Reclamation. MWD also has storage rights in DWR's SWP terminal reservoirs, Lake Perris and Castaic Lake, as previously discussed. The total capacity of all in-basin surface reservoirs, inclusive of the rights in the terminal reservoirs, is 1.26 MAF, as listed in Exhibit 8L.

MWD operates its three main storage reservoirs, Diamond Valley Lake, Lake Skinner and Lake Matthews, for dry-year, emergency, and seasonal storage. MWD has identified a dry-year storage capacity goal of 620 TAF by 2020. To date, this goal has been met and will be sustained with storage at Diamond Valley Lake and the two terminal reservoirs. Under an average year scenario for 2035 (1922-1994 hydrology), 576 TAF per year

### *Exhibit 8L*
### *MWD's In-Basin Surface Reservoir Capacity*

| Reservoir | Capacity (AF) |
|---|---|
| *Dry Year/Emergency/Seasonal Storage Purposes* | |
| Diamond Valley Lake | 810,000 |
| Lake Matthews | 182,000 |
| Lake Skinner | 44,000 |
| Lake Perris (Storage Rights)[1] | 65,000 |
| Castaic Lake (Storage Rights)[1] | 153,940 |
| Subtotal | 1,254,940 |
| *Regulatory Purposes* | |
| Live Oak | 2,500 |
| Garvey | 1,600 |
| Palos Verdes | 1,100 |
| Orange County | 212 |
| Subtotal | 5,412 |
| **Total Reservoir Capacity** | **1,260,352** |

1. MWD holds storage rights for flexible use in DWR terminal storage facilities, Lake Perris and Castaic Lake. In addition, MWD has emergency storage of 334 TAF in DWR's reservoirs.

of in-basin surface storage is projected to be available, exclusive of emergency supplies, as summarized in Exhibit 8M.

MWD reserves a portion of its in-basin surface reservoir storage capacity for emergencies. MWD's emergency surface reservoir storage portfolio is split between storage in its three main reservoirs and DWR reservoirs. MWD's emergency storage capacity, based on demands for 2030, is forecast to be approximately 610 TAF. Approximately 276 TAF is projected to be stored in MWD's facilities and the balance of 334 TAF in DWR's facilities. The balance of available storage capacity, 975 TAF, is for dry-year and seasonal storage.

Any additional reservoir capacity is used for seasonal storage and system operations. Seasonal storage is required to meet peak demands. MWD incorporates reserves of 5 percent into reservoir operations to account for imported water transmission infrastructure maintenance that would restrict or temporarily halt imported water flows.

## 8.1.3.2 Contracted Groundwater Basin Storage

To improve reliability, MWD engages in contracted groundwater basin storage within the basin area. By 2020, MWD aims to develop an annual dry supply of 300 TAF. To meet this goal, MWD has worked with local water agencies to increase groundwater storage. Groundwater storage occurs using the following methods:

- Direct delivery – Water is delivered directly by MWD to local groundwater storage facilities through the use of injection wells and spreading basins.
- In-lieu delivery – Water is delivered directly to a member agency's distribution system and the member agency uses the delivered water and forgoes pumping allowing water to remain in storage.

MWD engages in three main types of storage programs: replenishment,

### *Exhibit 8M*
### *MWD Forecast Supplies of In-Basin Surface Storage Supplies in 2035, Average Year (1922 - 2004 Hydrology)*

| Program | Supply (Thousands of AF)/Year |
|---|---|
| In-Basin Surface Storage (Diamond Valley Lake, Lake Skinner, Lake Matthews) | 444 |
| Lake Perris and Castaic Lake MWD Storage Rights | 132 |
| **Maximum MWD Supply Capability** | **576** |

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

cyclical, and conjunctive use. These programs are designed to deliver water to agencies prior to the actual need for the demands, allowing MWD to store supplies for use in dry years. Since 2007, MWD has used these programs to address SWP shortages. MWD provides financial incentives and funding to assist agencies to assist with developing storage programs.

Replenishment programs provide water to agencies at a discounted cost and can be withdrawn by the recipient after one year. Cyclic storage contracts allow surplus imported water to be delivered for recharge in advance of the actual water purchase. The delivered water is in excess of an agency's planned and budgeted deliveries. The agency purchases the water at a later time when it has a need for groundwater replenishment deliveries.

Conjunctive use contracts allow MWD to request an agency to withdraw previously stored MWD water from storage during dry periods or emergencies. Agencies must pay MWD the current water rate when they are requested to withdraw water from storage. Water withdrawn from storage allows MWD to temporarily curtail deliveries by an equal amount. MWD currently has ten conjunctive use programs with a combined storage capacity of 421.9 TAF and a dry-year yield of 117.3 TAF per year as summarized in Exhibit 8N.

MWD prepared a Groundwater Assessment Study in 2007 in conjunction with local agencies and groundwater basin managers. As indicated in the report, there is substantial groundwater storage available in the basin, but there are multiple challenges that must be met to utilize the identified storage. Challenges include infrastructure limitations, contamination, legal issues, and funding.

To further increase the availability of in-basin groundwater storage, MWD has identified nine potential storage programs in the basin and an additional two

### *Exhibit 8N In-Basin Conjunctive Use Programs*

| Program | Storage Capacity (Thousands of AF) | Dry-Year Yield (Thousands of AF/Year) | Balance 12/31/09 (Thousands of AF) |
|---|---|---|---|
| Los Angeles County | | | |
| Long Beach Conjunctive Use Project | 13 | 4.3 | 6.4 |
| Foothill Area GW Storage Project | 9 | 3 | 0.6 |
| Long Beach Conjunctive Use Project: Expansion in Lakewood | 4 | 1.2 | ` |
| City of Compton Conjunctive Use Program | 2 | 0.8 | 0 |
| Upper Claremont Heights Conjunctive Use | 3 | 1 | 0 |
| Orange County | | | |
| Orange County GW Conjunctive Use Program | 66 | 22 | 8.6 |
| San Bernardino County | | | |
| Chino Basin Programs | 100 | 33 | 23 |
| Live Oak Basin Conjunctive Use Project | 3 | 1 | 0.7 |
| Riverside County | | | |
| Elsinore Groundwater Storage Program | 12 | 4 | 0 |
| Ventura County | | | |
| North Las Posas Groundwater Storage Program | 210 | 47 | 43.5 |
| **Total** | 421.9 | 117.3 | 84.6 |

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

### *Exhibit 80*
### *MWD Forecast Supplies of In-Basin Groundwater Storage in 2035, Average Year (1922 - 2004 Hydrology)*

| Program | Supply (Thousands of AF/Year) |
|---|---|
| Current | |
| Conjunctive Use | 115 |
| Cyclic Storage | 139 |
| LADWP Tujunga Well Field Groundwater Recovery Project | 12 |
| Subtotal of Current Programs | 266 |
| Programs Under Development | |
| Raymond Basin Conjunctive Use | 22 |
| Subtotal of Programs Under Development | 22 |
| **Maximum MWD Supply Capability** | **288** |

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

programs are under development. The Raymond Basin Conjunctive Use Program and the LADWP Groundwater Recovery Project are expected to add an additional 34 TAF per year in 2035 under an average year (1922 – 2004 hydrology).

In 2009, a reconnaissance-level analysis was prepared for analyzing the potential for using recycled water as a supply source for a conjunctive use program. The study concluded up to 100 TAF of groundwater storage and production could be potentially developed in four major groundwater basins using Los Angeles County Department of Sanitation supplies. MWD initiated a formal study in 2010 to further study. This concept along with the potential to use City of Los Angeles recycled water supplies from the Hyperion Wastewater Treatment Plant as an additional source.

Exhibit 80 provides a summary of forecast groundwater storage supplies available in 2035 under an average year (1922 -2004 hydrology). Approximately 289 TAF per year are forecast to be available.

## 8.1.4 Groundwater Storage and Water Transfers

MWD engages in groundwater storage outside of the basin and water transfers to increase the reliability of SWP dry-year supplies. Groundwater storage and water transfers were initiated by MWD in response to concerns that MWD's supply reliability objectives could not be met by the SWP. Groundwater storage and transfer programs were developed to allow MWD to reach its SWP reliability goal. All groundwater storage and water transfer programs designed to bolster SWP reliability are located within the vicinity of the SWP or Central Valley Project (CVP) facilities to facilitate the ultimate deliver of water to MWD. Groundwater storage programs involve agreements allowing MWD to store its SWP contract Table A water in excess of MWD demands and to purchase water for storage. MWD calls for delivery of the stored water during dry years. Transfers involve purchases by MWD from willing sellers during dry years when necessary.

***Exhibit 8P***
***MWD Forecast Supplies of Groundwater Storage and Transfers in 2035, Average Year (1922 - 2004 Hydrology)***

| Program | Supply (Thousands of AF/Year) |
|---|---|
| Current | |
| San Bernardino Valley MWD Minimum Purchase | 20 |
| San Bernardino Valley MWD Option Purchase | 29 |
| Central Valley Storage and Transfers | |
| Semitropic Water Banking and Exchange Program | 69 |
| Arvin-Edison Water Management Program | 75 |
| San Bernardino Valley MWD Program | 50 |
| Kern Delta Water Management Program | 50 |
| **Subtotal of Current Programs** | **293** |
| Programs Under Development | |
| Mojave Groundwater Storage Program | 43 |
| North of Delta/In-Delta Transfers | 33 |
| San Bernardino Valley MWD Central Feeder | 5 |
| Shasta Return | 18 |
| Semitropic Agricultural Water Reuse | 11 |
| **Subtotal of Proposed Programs** | **110** |
| **Maximum Supply Capability** | **403** |

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

Exhibit 8P summarizes MWD's out of basin groundwater storage and transfer programs supplies in 2035, under an average year (1922 – 2004 hydrology). Current programs are expected to deliver 293 TAF in 2035. Five programs under development are forecasted to deliver an additional 110 TAF for a total of 403 TAF in 2035.

## 8.1.4.1 Groundwater Storage

MWD has four Central Valley groundwater storage programs with a fifth program under development as described below.

The Semitropic Water Banking and Exchange Program is a partnership formed in 1994 between Semitropic Water Storage District (SWSD), MWD, and five other banking partners. The bank has a total storage capacity of 650 TAF, of which MWD has 350 TAF of storage volume. During years of excess SWP deliveries, beyond MWD's demands, a portion of MWD's SWP entitlement water is stored for withdrawal during dry years. Deliveries for storage are transferred via SWP facilities for direct use by agricultural users that in turn forgo pumping an equal volume of water. In dry years, water is pumped from storage to SWP facilities for delivery to MWD or entitlements are exchanged. MWD's average annual supply capability for a dry year (1977 hydrology) is 125 TAF and for multiple dry years (1990 – 1992 hydrology) is 107 TAF. By the end of 2009, MWD had 45 TAF in storage.

Since 1997, MWD has had an agreement with Arvin-Edison Water Storage District to use 350 TAF of storage in its groundwater basins. The agreement was amended in 2008 to include the South Canal Improvement project to deliver higher quality water to MWD. During wet years, MWD delivers SWP water in excess of its demands for storage and receives return water in dry years in a similar manner as the Semitropic program, except a combination of SWP and CVP facilities are used to transfer the water and water can be stored by a combination of direct spreading or in lieu use by agricultural users. MWD's average supply capability is 75 TAF for either a single dry year (1977 hydrology) or multiple dry years (1990 – 1992 hydrology). In 2009, MWF had 95 TAF in storage.

The San Bernardino Municipal Water District Program (SBMWD) allows for the purchase and storage of SWP water on behalf of MWD. MWD has a minimum purchase agreement with SBMWD of 20 TAF per year of SBMWD's SWP Table A amount. Additionally, MWD has the option to purchase SBMWD's additional SWP allocation when available and the first right-of-refusal to purchase additional SWP supplies available to SBMWD beyond the minimum and option agreements. If MWD does not require the minimum purchase amount for operations, MWD can store up to 50 AF for future use in dry years within SBMWD's groundwater basins. Water is delivered to MWD via SWP facilities and groundwater pumping conveyed through local connections to MWD's service area. MWD's average annual supply capability for a dry year (1977 hydrology) is 70 TAF and for multiple dry years (1990 – 1992 hydrology) is 37 TAF. By the end of 2009, MWD had no water in storage and deliveries have been suspended upon a mutual agreement between MWD and SBMWD.

MWD entered into an agreement with the Kern Delta Water District (Kern-Delta) for the Kern-Delta Water Management Plan in 2001 to allow up to 250 TAF of groundwater storage. During wet years MWD delivers SWP water in excess of its demands for storage and receives return water in a similar manner as the Semitropic program, except the water can be stored by direct recharge or in lieu use by agricultural users. Per terms of the agreement, MWD can potentially store beyond 250 TAF. In dry years, water is pumped from storage to SWP facilities for delivery to MWD or entitlements are exchanged. When the project is completed 50 TAF per year of dry year supply can be withdrawn. At the close of 2009, MWD had 10 TAF in storage and expects to fully withdraw the amount in 2010.

The Mojave Groundwater Storage Program is currently a demonstration project between MWD and Mojave Water Agency. Similar to the other groundwater storage programs, MWD's excess SWP water will be stored during wet years for withdrawal during dry years. When fully operational, the program is expected to have a dry year yield of 35 TAF.

### 8.1.4.2 Transfers

MWD utilizes Central Valley water transfers to obtain additional supplies originally destined for agricultural users on an as needed basis. Past transfer agreements have used both spot markets and option contracts. Spot markets occur when there are willing sellers and buyers. Option contracts lock-in MWD's ability to have the option to purchase supplies if needed. Additionally, MWD has multiple long-term transfer programs under

***Exhibit 8Q***
***MWD Historic Central Valley Water Transfers***

| Program | Purchases by MWD[1] (AF/Year) |
|---|---|
| 1991 Governor's Water Bank | 215,000 |
| 1992 Governor's Water Bank | 10,000 |
| 1994 Governor's Water Bank | 100 |
| 2001 Dry Year Purchase Program | 80,000 |
| 2003 MWD Transfer Program | 126,230 |
| 2005 State Water Contractors Water Transfer Program[2] | 0 |
| 2008 State Water Contractors Water Transfer Program | 26,621 |
| 2009 Governor's Water Bank | 36,900 |

1. Transfers requiring use of Bay-Delta result in a water loss of 20 percent. Transfers requiring the California Aqueduct for delivery to MWD's service area result in a 3 percent water loss.
2. 127,275 in options were secured, but not needed.

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

development. MWD's ability to conduct transfers and the amount of water to be transferred using SWP facilities are a function of hydrologic conditions, market conditions, and pumping restrictions in the Bay-Delta region. Transfers may require the use of the Bay-Delta for conveyance dependent upon the origin of the water. Historic transfers, as listed in Exhibit 8Q, indicate MWD is capable of negotiating contracts with agricultural districts and the State's Drought Water Bank to obtain transfers. MWD also has demonstrated it can work with DWR and the U.S. Bureau of Reclamation (USBR). Cooperation of both agencies is required as transfers use a combination of DWR's SWP and USBR's CVP facilities. Transfers from north of the Bay-Delta result in the loss of 20 percent of the water during conveyance while transfers via the California Aqueduct to MWD's service area result in the loss of 3 percent water during conveyance. During dry years and when pumping capacity in the Bay-Delta is available, MWD expects to be able to transfer 125 TAF through SWP facilities.

## Exhibit 8R
## MWD System Forecast Supplies and Demands, Average Year (1922 - 2004 Hydrology)

| Forecast year | Supply (Thousands of AF per Year) | | | | |
|---|---|---|---|---|---|
| | **2015** | **2020** | **2025** | **2030** | **2035** |
| Current Programs | | | | | |
| In-Basin Surface Reservoir and Groundwater Storage | 685 | 931 | 1,076 | 964 | 830 |
| State Water Project[1] | 1,550 | 1,629 | 1,763 | 1,733 | 1,734 |
| Colorado River Aqueduct | | | | | |
| Colorado River Aqueduct Supply[2] | 1,507 | 1,529 | 1,472 | 1,432 | 1,429 |
| Aqueduct Capacity Limit[3] | 1,250 | 1,250 | 1,250 | 1,250 | 1,250 |
| Colorado Aqueduct Capability | 1,250 | 1,250 | 1,250 | 1,250 | 1,250 |
| **Capability of Current Programs** | **3,485** | **3,810** | **4,089** | **3,947** | **3,814** |
| Demands | | | | | |
| Firm Demands on MWD | 1,826 | 1,660 | 1,705 | 1,769 | 1,826 |
| Imperial Irrigation District - San Diego County Water Authority Transfers and Canal Linings[4] | 180 | 273 | 280 | 280 | 280 |
| **Total Demands on MWD** | **2,006** | **1,933** | **1,985** | **2,049** | **2,106** |
| **Surplus** | **1,479** | **1,877** | **2,104** | **1,898** | **1,708** |
| Programs Under Development | | | | | |
| In-Basin Surface Reservoir and Groundwater Storage | 206 | 306 | 336 | 336 | 336 |
| State Water Project[1] | 382 | 383 | 715 | 715 | 715 |
| Colorado River Aqueduct | | | | | |
| Colorado River Aqueduct Supply | 187 | 187 | 187 | 182 | 182 |
| Aqueduct Capacity Limit[2] | 0 | 0 | 0 | 0 | 0 |
| Colorado Aqueduct Capability | 0 | 0 | 0 | 0 | 0 |
| **Capability of Programs Under Development** | **775** | **876** | **1,238** | **1,233** | **1,233** |
| **Maximum MWD Supply Capability** | **4,260** | **4,686** | **5,327** | **5,180** | **5,047** |
| **Potential Surplus** | **2,254** | **2,753** | **3,342** | **3,131** | **2,941** |

1. Includes water transfers and groundwater banking associated with SWP.
2. Includes 296 TAF of non-MWD supplies conveyed in CRA for Imperial Irrigation District - San Diego County Water Authority Transfers and Canal Linings.
3. CRA has a capacity constraint of 1.25 MAF per year.
4. Does not include 16 TAF subject to satisfaction of conditions specified in agreement among MWD, the US, and the San Luis Rey Settlement

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

## 8.2 MWD Supply Reliability and Projected LADWP Purchases

MWD's 2010 Integrated Water Resources Plan (IRP) update serves as the foundation for supply forecasts discussed in the RUMWP and continues to ensure system reliability for its member agencies. The 2010 IRP update concluded that the resource targets identified in previous updates, taking into consideration changed conditions identified since that time, will continue to provide for 100 percent reliability through 2030. MWD's subsequent evaluation to extend the resource targets by an additional five years through their 2010 draft RUWMP also concluded the same full reliability during average (1922 – 2004 hydrology), single dry (1977 hydrology), and multiple dry years (1990 - 1992 hydrology). For each of the scenarios, there is a surplus in every forecast year. Exhibit 8R summarizes MWD's reliability in five year increments extending to 2035.

The City purchases MWD water to make up the deficit between demand and other City supplies. Whether LADWP can provide reliable water services to the residents of Los Angeles is highly dependent on MWD's assurance on supply reliability. However, the recent water supply shortage caused by dry weather and pumping restrictions in the Bay-Delta prompted the City to develop a more sustainable water supply portfolio with emphasis on local water supplies such as recycled water, groundwater cleanup, stormwater capture, and conservation. LADWP's reliance on MWD water supply is projected to be cut in half from the current five-year average of 52 percent of the total demand to 24 percent by 2034-35 under average weather conditions.

The reliability of MWD's water supply is more fully discussed in Chapter 10, Integrated Resources Planning. The projected LADWP water purchase is further discussed in Chapter 11, Water Service Reliability Assessment under various weather scenarios.

## 8.3 MWD Rate Structure and LADWP's Purchased Water Costs

### 8.3.1 MWD Rate Structure

MWD's rates are structured on a tier–based system with two tiers and a surplus category. Nine major elements determine the actual price a member agency will pay for deliveries. All of the elements are volumetric based except for two fixed rates, the Readiness-to Serve Charge and the Capacity Charge.

Tier 1 rates are reflective of actual costs of existing supplies and are designed to recover most of the supply costs. Member agencies are allocated a specified volume of Tier 1 water that can be purchased within a given year. In 2011, LADWP's Tier 1 limit is 304,970 AF. Any purchases above this are charged at the Tier 2 rate. MWD has instituted a temporary Bay-Delta surcharge to recover costs associated with lower SWP deliveries related to pumping restrictions. The surcharge will remain in effect until SWP yields improve.

Tier 2 rates send a price signal associated with MWD's costs of developing additional long-term firm supply options. Member agencies with growing demands on MWD will have a higher proportion of deliveries within the Tier 2 range.

Surplus water is water in excess of consumptive municipal and industrial demands. Surplus water is available at two discounted levels dependent upon the end use. Replenishment Program water is discounted for replenishing local agency supplies. The program has been suspended as a result of dry conditions and uncertain future supplies. The Interim Agricultural Water Program (IAWP) provides discounted water for agricultural use. This program is being phased out and will terminate beginning in 2013.

## *Exhibit 8S*
## *MWD Rates and Charges*

| Rates and Charges | Effective Rate January 1 | | |
|---|---|---|---|
| | 2010 | 2011 | 2012 |
| Tier 1 Supply Rate ($/AF) | 101 | 104 | 106 |
| Delta Supply Surcharge ($/AF) | 69 | 51 | 58 |
| Tier 2 Supply Rate ($/AF) | 280 | 280 | 290 |
| System Access Rate ($/AF) | 154 | 204 | 217 |
| Water Stewardship Rate ($/AF) | 41 | 41 | 43 |
| System Power Rate ($/AF) | 119 | 127 | 136 |
| Full Service Untreated Volumetric Cost ($/AF) | | | |
| Tier 1 | 484 | 527 | 560 |
| Tier 2 | 594 | 652 | 686 |
| Replenishment Water Untreated ($/AF) | 366 | 409 | 442 |
| Interim Agricultural Water Untreated ($/AF) | 416 | 482 | 537 |
| Treatment Surcharge ($/AF) | 217 | 217 | 234 |
| Full Service Treated Volumetric Cost ($/AF) | | | |
| Tier 1 | 701 | 744 | 794 |
| Tier 2 | 811 | 869 | 920 |
| Treated Replenishment Water ($/AF) | 558 | 601 | 651 |
| Treated Interim Agricultural Water Program ($/AF) | 615 | 687 | 765 |
| Readiness-to-Serve Charge ($/M) | 114 | 125 | 146 |
| Capacity Charge ($/cfs) | 7,200 | 7,200 | 7,400 |

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

Exhibit 8S summarizes the rates and charges for member agencies effective on January 1 of 2010, 2011, and 2012.

## 8.3.2 LADWP's Purchased Water Costs

MWD's water rates vary from $484 per AF of tier 1 untreated water to $811 per AF of tier 2 treated water in 2010. The average unit cost of MWD water supply depends on the proportions of treated water and untreated water, tier 1 water, and tier 2 water purchased in a given period. From 2003 to 2009, LADWP purchased 88 percent tier 1 water and 12 percent tier 2 water, and 70 percent untreated water and 30 percent treated water on average. The tier 2 water purchase varied from no purchase in 2005 and 2006 to 29 percent in 2007 and 2008. The treated water purchase varied from 20 percent in 2007 to 46 percent in 2005. Exhibit 8T illustrates the various combinations.

The Readiness-to-Serve Charge and Capacity Charge are predetermined fixed charges for each member agency and not affected by the quantity of MWD water purchased. However, they add on to the unit cost of the City's MWD water purchase. The City's current share of the Readiness-to-Serve Charge is 15.12 percent or $17.24 million in 2010. The Capacity Charge is calculated based on the summer daily peak flow from the previous three years. The City's 2010 Capacity Charge is $5.9 million based on the daily peak flow of 822 cfs in 2008 summer. Both charges added an additional $110 per AF to the unit cost of LADWP's MWD water purchase in 2010.

## *Exhibit 8T*
## *Percentage of LADWP's Purchased Water in Various MWD Rate Categories*

| MWD Deliveries | Tier 1 | | Tier 2 | | Total Tier 1 | Total Tier 2 | Total Untreated | Total Treated |
|---|---|---|---|---|---|---|---|---|
| Calender Year | **Untreated** | **Treated** | **Untreated** | **Treated** | | | | |
| | % | % | % | % | % | % | % | % |
| **2003** | 73 | 22 | 4 | 2 | 95 | 5 | 76 | 24 |
| **2004** | 71 | 25 | 3 | 1 | 96 | 4 | 74 | 26 |
| **2005** | 54 | 46 | 0 | 0 | 100 | 0 | 54 | 46 |
| **2006** | 58 | 42 | 0 | 0 | 100 | 0 | 58 | 42 |
| **2007** | 56 | 15 | 25 | 5 | 71 | 29 | 80 | 20 |
| **2008** | 48 | 23 | 23 | 6 | 71 | 29 | 71 | 29 |
| **2009** | 67 | 20 | 10 | 3 | 87 | 13 | 77 | 23 |
| **2010** | 62 | 38 | 0 | 0 | 100 | 0 | 62 | 38 |
| **Average** | 61 | 29 | 8 | 2 | 90 | 10 | 69 | 31 |

Chapter Nine

# Other Water Supplies

## 9.0 Overview

LADWP continually investigates other feasible water supplies to ensure the sustainability of water supply for the City of Los Angeles. In recent years, LADWP has actively pursued and investigated various supply options including water transfers and banking and seawater desalination. Evaluating the viability of these and other water resource options is a key element to ensuring the City's future water supply reliability. Such options, with proper planning, can contribute toward fulfilling future demand under various conditions. Future water resource challenges, which include increased demand that must be met without increasing imported supply, warrant thoughtful consideration of these and other feasible water supply resources.

Following is a discussion of other water resource options as mentioned above, highlighting LADWP's progress in developing each alternative source of water. Factors that affect feasibility and influence potential implementation are also discussed, as well as advances that facilitate development of the resource option. Of the water supplies discussed in this chapter, LADWP is planning to pursue water transfers of up to 40,000 Acre-Feet (AF) by Fiscal Year 2014/15.

## 9.1 Water Transfers and Banking

Water transfers involve the lease or sale of water or water rights between consenting parties. Water Code Section 470 (The Costa-Isenberg Water Transfer Act of 1986) states that voluntary water transfers between water users can result in a more efficient use of water, benefiting both the buyer and the seller. The State Legislature further declared that transfers of surplus water on an intermittent basis can help alleviate water shortages, save capital outlay development costs, and conserve water and energy. This section of the Water Code also obligates the California Department of Water Resources (DWR) to facilitate voluntary exchanges and transfers of water.

DWR is required to establish an ongoing program to facilitate the voluntary exchange or transfer of water and implement the various State laws that pertain to water transfers. In response to this mandate, DWR established an internal office dedicated specifically to water transfers in June 2001 and has developed various definitions and policies for transfers. Of particular importance are the rules protecting existing water rights. Water rights cannot be lost when they are transferred to another user if the transferor has an underlying right to the transferred water. DWR also developed three fundamental rules specifically regarding water transfers:

- There can be no injury to any legal user of water.
- There can be no unreasonable effect on fish and wildlife.
- There can be no unreasonable economic effects to the economy in the county of origin.

Water banking, a form of conjunctive use, is the storage of water in groundwater basins for future use. Typically, during wet periods water is stored or banked within groundwater basins for potential extraction during dry periods. Water banking sets up accounts to track the volumes of water recharged and extracted per terms of contract agreements between water agencies. Water banking may occur outside of a water agency's service area. If the water agency's own conveyance facilities are not directly adjacent to the water bank, stored water can be extracted and transferred through wheeling and exchange via other conveyance and storage facilities. Such movements of water involve institutional transfer agreements among water users and agencies.

### 9.1.1 LADWP Opportunities

LADWP plans on acquiring water through transfers to replace a portion of LAA water used for environmental enhancements in the eastern Sierra Nevada. The City would purchase water when available and economically beneficial for storage or delivery to LADWP's transmission and distribution system. The City is seeking non-State Water Project (SWP) water to replace the reallocation of LAA water supply for environmental enhancements. MWD holds an exclusive contractual right to deliver SWP entitlement water into its service territory, which includes the City of Los Angeles. Purchasing only non-SWP supplies will ensure the City's compliance with MWD's SWP contract.

To facilitate water transfers, LADWP is constructing an interconnection between the LAA and the SWP's California Aqueduct, located where the two aqueducts intersect in the Antelope Valley (see photo below). This interconnection, the Neenach Pumping Station will allow for water transfers from the East Branch of the SWP to the LAA system, as well as provide operational flexibility in the event of a disruption of flows along the LAA System. Construction of the Neenach Pumping Station required a four-way agreement between DWR, MWD, LADWP, and the Antelope Valley-East Kern Water Agency (AVEK). When completed, the Neenach Pumping Station facility will be owned by DWR but will be designated as an AVEK interconnection. The Neenach Pumping Station will be operated on behalf of the LADWP. MWD is involved in the agreement to provide consent for the transferred water to enter its service territory.

LADWP's current goal is to transfer up to 40,000 AFY once the Neenach Pumping Station facilities are in place. This will provide LADWP with the ability to replace some LAA supplies that have been reallocated to environmental enhancement projects in the Mono Basin and Owens Valley. This will also provide increased operational flexibility and cost savings for LADWP customers.

A demonstration study will be performed during the Neenach Pumping Station's first two years of operations. This study will include an evaluation of the operational and water quality impacts of the Neenach Pumping Station.

To supplement water transfers, LADWP also investigated the feasibility of water banking. A request for proposal (RFP) was issued in 2008 and five proposals were received for evaluation to identify the most mutually beneficial water banking program. However, after this evaluation

Neenach Temporary Pumping Station, construction site, looking northerly, taken September 16, 2010, by Aqueduct Aerial Patrol.

process, LADWP decided to not pursue full scale water banking projects at this time.

The City supports statewide water transfer legislation that will ensure the efficient use of the State's limited water resources and provide safeguards for the environment, public facilities, water conservation efforts and local economies. LADWP will continue to develop a responsible water transfer program that can assist in replacing City supplies that have been reallocated to the environment in the Eastern Sierra Nevada.

### 9.1.2 MWD Opportunities

Regionally, MWD has been active with water transfers and banking, seeking and implementing agreements and cooperative arrangement opportunities to supplement Southern California's water supply. MWD's water transfer activities are classified as *spot transfers, option transfers, core transfers, storage transfers,* or *exchanges*. Each activity is described briefly below.

- *Spot transfers* make water available through a contract entered into the same year that the water is delivered.
- *Option transfers,* through multi-year or single-year contracts, allow MWD to obtain water on an "as-needed" basis.
- *Core transfers* make water available through multi-year contracts that convey specific water entitlement to MWD each year.

- *Storage transfers* allow MWD to store and later recover available water that can then be transported immediately to Southern California.

- *Exchange agreements* involve the transfer to MWD of another agency's entitlements in exchange for water entitled to MWD from another source.

MWD is in the process of developing and implementing transfer/storage projects in the Central Valley, and off-stream banking and dry year supplies of Colorado River water. Water transfers, including the programs highlighted below, are an important element of California's plan to live within its 4.4 million acre-feet per year entitlement to Colorado River water. These programs have also helped MWD adjust to regulatory restrictions on State Water Project pumping from the San Francisco Bay-Delta. Current and potential MWD transfer, storage, and exchange agreements/activities include:

- Semitropic Water Storage Program

- Kern Delta Water District Water Management Program

- Arvin-Edison Water Transfer and Storage Program, Kern County

- San Bernardino Valley Transfer and Storage Program

- Desert Water Agency/Coachella Valley Water District Exchange Program

- Palo Verde Land Management, Crop Rotation, and Water Supply Program

- Hayfield Groundwater Storage Project (under development)

- Southern Nevada Water Authority and Metropolitan Storage and Interstate Release Agreement

- Central Valley Water Transfers

- Yuba Accord Dry Year Purchase Program

- Lower Colorado Water Supply Project

- Lake Mead Water Storage Program

- Drop 2 Reservoir Funding

- Arizona Exchange (under development)

- Yuma Desalter Exchange (under development)

- California Indians Exchange (under development)

- Expansion of Southern Nevada Water Authority Agreement (under development)

- ICS Exchange Program (under development)

- Expansion of Palo Verde Land Management, Crop Rotation, and Water Supply Program (under development)

- Mojave Water Agency Exchange Demonstration Program (under development)

- North of Delta/In Delta Transfers (under development)

- North Kern/Desert Water Agency Exchange (under development)

- Shasta Return Project

- Semitropic Agricultural Water Reuse Demonstration Project (under development)

- San Bernardino Valley MWD Central Feeder Project (under development)

- Chuckwalla Groundwater Storage Program (under development)

- Coachella Valley Water District Agreement (under development)

MWD's water rate structure is designed to allow water transfers using MWD infrastructure by establishing a water wheeling rate, which is a combination of the System Access Rate, Water

Stewardship Rate, System Power Rate, and if treated water is delivered, a Treatment Surcharge. This wheeling rate applies to all water conveyed through MWD's infrastructure, regardless of the agency using the system. MWD's unbundled rate structure and its associated wheeling rate encourage development of water markets by providing for competition at the supply level; MWD's member agencies can purchase supplies from any source and pay MWD's wheeling rate to transmit the water. MWD's current water rate structure establishes charges for each component on a per acre-foot basis for all water moving through MWD's system. As of January 1, 2011, current wheeling rate charges are:

- System Access Rate: $204/AF
- Water Stewardship Rate: $41/AF
- System Power Rate: $127/AF
- Treatment Surcharge: $217/AF

The System Access Rate recovers costs associated with conveyance and distribution capacity to meet average annual demands. The Water Stewardship Rate recovers the cost associated with providing financial incentives for investments in local water resources, such as water conservation and recycled water programs. The System Power Rate recovers the cost of power required to move water through MWD's system. The Treatment Surcharge applies to all water that is treated at one of MWD's five treatment plants.

MWD's water rate structure also incorporates a tiered supply rate format. The first tier price applies to a fixed base quantity of water as defined by each MWD member agency's purchase order contract. The second tier price reflects the incremental cost for MWD to acquire additional supplies that are above the first tier contract base amount.

## 9.2 Seawater Desalination

Seawater desalination, the process of removing salts and other impurities from seawater, has reached an all-time high in terms of worldwide production capacity. According to the International Desalination Association, between 2007 and 2009, worldwide seawater desalination capacity increased by approximately thirty percent to a total capacity of 9.5 billion gallons per day. This is partly driven by the fact that the cost to desalinate water has decreased significantly due to technological and process advancements. Of the more than 14,000 seawater and groundwater desalination plants in operation worldwide, the majority are located in the Middle East, where energy costs are relatively low. The world's largest seawater desalination plant in Saudi Arabia produces 232 mgd of desalted water. In contrast, the largest facility in the United States, located in Tampa Bay, FL, produces 25 mgd.

LADWP's current water resource strategy does not include seawater desalination as a water supply. There are concerns with cost and the environmental impacts associated with the implementation of desalination. LADWP is primarily focused on enhancing recycling and conservation. While desalination may be explored further in the future, it currently represents only a supply alternative.

### 9.2.1 Desalination Technology

Technology to desalt seawater to produce potable water which meets or exceeds drinking water standards has been available for some time, but has not been widely implemented primarily due to its high cost. Although the cost to desalinate seawater is still more expensive than obtaining water from conventional sources, continued research and development, as well as large scale projects are being implemented in the United States and other parts of the world to improve technology and further drive costs down. Additionally, increasing costs associated with new water supplies and existing supplies is reducing the cost differential between desalinated water and other water sources improving the viability of desalinated water as a part of an overall water supply portfolio.

The two basic seawater desalination processes are: 1) use of the distillation process to evaporate water from salts; and 2) use of semi-permeable membranes to filter the water while straining out the salts. While distillation has been the dominant seawater desalination technology (primarily in the Middle East), current worldwide desalination development is rapidly migrating toward membrane technology. Facilities using distillation are still prevalent in the Middle East. However, new plant installations are increasingly taking advantage of technological advancements (higher yield and lower energy requirements) in membrane-based process technology. Today, membrane filtration accounts for over half of the world's desalting capacity.

### 9.2.2 DWR Desalination Efforts

Recognizing the potential of seawater as a water resource, the DWR through a legislative mandate, convened a California Water Desalination Task Force in 2002. The task force was responsible for making recommendations to the State Legislature on potential opportunities, impediments, and the State's role in furthering desalination technology.

The task force was effective in providing a forum in which stakeholders could convene and discuss critical issues related to desalination. Key seawater desalination issues that have been raised through the task force fall into six general categories: environmental, economic, permitting, engineering, planning, and coordination.

To assist in addressing these issues, the California Water Desalination Task Force has developed draft guidelines for developing environmentally and economically acceptable desalination projects. These include the following:

- Each project should be considered on its own merits.

- Sponsoring agencies should be determined early in the planning process.

- Public and permitting agencies should be engaged early in the planning process.

- Collaborative processes should be used to enhance support for project implementation.

- A feedback loop should be incorporated to allow for continuously revisiting and revising the project at each step of the planning process.

- Key decision points (e.g., costs, environmental acceptability) should be identified to test the general feasibility of the project as early in the planning process as possible.

After establishment of the task force, desalination was added to the California State Water Plan as an alternative for consideration in regional water supplies. Furthermore, in 2008, DWR published the *California Desalination Planning Handbook*, building upon the task force's efforts. The handbook provides guidance on determining appropriate conditions for desalination plants, addressing concerns, and building public trust.

Proposition 50, Chapter 6, has provided funding for desalination research, feasibility studies, pilot projects, and construction of new facilities. Over $45 million was distributed under this proposition in two rounds of funding for both seawater and groundwater desalination. Fund recipients included LADWP.

With increasing demand for water and limited new supply options, the future value of seawater desalination as a part of California's water supply portfolio has become apparent. Within Southern California, a range of 270,000 AFY to 422,000 AFY of desalinated seawater could be potentially produced based on current efforts (see Exhibit 9A). While this production represents less than five percent of the region's total water supplies, it is nonetheless considered by water planners as an important part of the region's water supply portfolio.

## 9.2.3 MWD Desalination Efforts

MWD first incorporated desalinated seawater as a potential new water supply source in its 2003 Integrated Resources Plan Update. Subsequently in 2009, MWD's Board of Directors created a special committee on Desalination and Recycling to study MWD's role in regional efforts to develop desalination facilities.

In response to a proposal solicitation in 2001, MWD received proposals by five member agencies to provide up to 142,000 AFY of potable water. To provide an incentive for the development of desalinated seawater, MWD is offering subsidies of up to $250 for each acre-foot (326,000 gallons) of desalinated seawater produced. LADWP, Long Beach Water Department (LBWD), West Basin Municipal Water District (WBMWD), Municipal Water District of Orange County, and San Diego County Water Authority (SDCWA) submitted detailed proposals that qualified for the MWD's Seawater Desalination Program. Exhibit 9A summarizes the status of the desalination efforts in MWD's service area, including projects not in the Seawater Desalination Program. Each of these agencies serves coastal areas, and is looking to desalination as a means to further diversify its water supply portfolio.

## 9.2.4 LADWP Seawater Desalination Efforts

### Scattergood Generating Station Seawater Desalination Plant

LADWP initiated efforts in 2002 to evaluate seawater desalination as a potential water supply source with the goals of improving reliability and increasing diversity in its water supply portfolio. These efforts led to the selection of Scattergood Generating Station as a potential site for a seawater desalination plant. For the City, seawater desalination is a potential resource that could also offset supplies that had been committed from the LAA for environmental restoration in the eastern Sierra Nevada. As an identified project in MWD's Seawater Desalination Program, the proposed full-scale project would have qualified for MWD's grant of $250 per AF of water produced. However, in May 2008, LADWP decided to focus on water conservation and water recycling as the primary strategies in creating a sustainable water supply for the City.

While seawater desalination is not a potential water supply strategy at this time, studies performed to date have provided beneficial data that in the future can assist LADWP with any future evaluations of seawater desalination. Completed studies include the LADWP Proposed Seawater Desalination Plant Site Selection Fatal Flaw Analysis (2002), LADWP Seawater Desalination Facility Feasibility Study for the Scattergood Generating Station in Playa Del Rey (2004), Brine Dilution Study for the LADWP Desalination Project at Scattergood Generating Station (2005), and Scattergood Seawater Desalination Pilot Project Preliminary Evaluation Report (2008).

## *Exhibit 9A*
## *Desalination Efforts in MWD Service Area*

| Project Name | Member Agency | Capacity (AFY) | Status |
|---|---|---|---|
| **MWD Seawater Desalination Program** | | | |
| Long Beach Seawater Desalination | Long Beach | 10,000 | Pilot Study[1] |
| Los Angeles Seawater Desalination | LADWP | 28,000 | On-hold |
| South Coast Coastal Ocean Desalination | Municipal Water District of Orange County | 16,000 - 28,000 | Pilot Study |
| Carlsbad Seawater Desalination | San Diego County Water Authority | 56,000 | Permitting Complete |
| West Basin Seawater Desalination | West Basin Municipal Water District | 20,000 | Pilot Study[1] |
| Subtotal | | 130,000 - 142,000 | |
| **Other Potential Projects in MWD Service Area** | | | |
| Huntington Beach Seawater Desalination | Municipal Water District of Orange County | 56,000 | Initiating Permitting |
| Camp Pendleton Seawater Desalination | San Diego County Water Authority | 56,000 - 168,000 | Planning |
| Rosarito Beach Seawater Desalination | San Diego County Water Authority | 28,000 - 56,000 | Feasibility Study |
| Subtotal | | 140,000 - 280,000 | |
| Total | | 270,000 - 422,000 | |

1. Full scale feasibility studies in progress.

Source: Annual Progress Report to the State Legislature, Achievements in Conservation, Recycling, and Groundwater Recharge, February 2010.

To determine the proper site location for a City desalination plant, LADWP conducted the LADWP Proposed Seawater Desalination Plant Site Selection Fatal Flaw Analysis evaluating three City-owned coastal power generating plants. Based on the findings from this analysis, LADWP initially decided to investigate development of a 12 to 25 mgd desalination facility at the Scattergood Generating Station.

Optimum capacity of a future desalting facility at the Scattergood Generating Station was evaluated in the LADWP Seawater Desalination Facility Feasibility Study. Results of the study indicated a 25 mgd facility would be the most economical. Estimated capital costs for a 25 mgd facility were approximately $148.5 million in 2004 dollars with an annual operations and maintenance cost of $28.9 million (2004 dollars) resulting in a total water cost of approximately $1,257 per AF. The study also identified the five-mile Hyperion Treatment Plant Outfall, which is adjacent to the Scattergood Generating Station, as the most environmentally advantageous method to dispose of the brine concentrate produced from the desalting process.

In an effort to develop an environmentally compatible project, LADWP evaluated the feasibility of discharging the desalted concentrate into Hyperion Wastewater Treatment Plant's 5-mile outfall. The Brine Dilution Study for the LADWP Desalination Project at Scattergood Generating Station performed by the Scripps Institute of Oceanography found that there are potential environmental benefits to the Santa Monica Bay's marine biology due to improved salt balance if the effluent discharged by the Hyperion Wastewater Treatment Plant were to include brine from a desalination facility.

In March 2008 the Preliminary Evaluation Report of the Scattergood Generation Station Seawater Desalination Pilot Project was completed. This was the first task of multiple tasks that was to ultimately result in the operation of a pilot plant. Co-funded by the US Bureau of Reclamation and DWR through Proposition 50 funding the overall goal was to further investigate the viability of seawater desalination for LADWP. Recommendations on site specific technologies and processes were provided for carry over to the pilot plant design stage. Items for further study included subsurface intake evaluation, cooling alternatives for warm water, second pass reverse osmosis, post treatment stabilization, and finished water blending strategy.

After completion of the first task, the other tasks were not initiated reflecting the City's new primary strategies of conservation and recycled water to create a sustainable water supply for the City. Studies completed to date and LADWPs other seawater desalination efforts discussed below have provided important data that could assist LADWP if the decision is made to move forward with seawater desalination in the future.

## Other LADWP Seawater Desalination Efforts

LADWP historically engaged in multiple partnerships to advance seawater desalination in Southern California. Seawater desalination is hindered by multiple challenges including, but not limited to, capital costs, operating costs, environmental considerations, water quality, and public acceptance. To overcome these challenges, LADWP has supported efforts to lower the capital and operating costs of producing desalinated ocean water. LADWP also participated with California stakeholders through multiple venues, such as the MWD and the California Water Desalination Task Force to develop desalination study projects within Southern California.

LADWP, LBWD, and the United States Bureau of Reclamation partnered in the construction of a 300,000 gpd prototype seawater desalination facility to complete testing of LBWD's proprietary two-stage nanofiltration process (using membranes that require lower operating pressures and thus, the potential for lower operating costs). LBWD successfully performed a 9,000-gpd bench-scale testing of this technology and began testing on a larger scale in October 2006 at LADWP's Haynes Generating Station in Long Beach. In March 2010, LBWD completed its testing and subsequently prepared the final report.

LADWP also partnered with the WBMWD and other agencies in the American Water Works Association Research Foundation Tailored Collaboration project, "Water Quality Implications for Large-Scale Applications of MF/RO Treatment for Seawater Desalination." A 30,000-gpd pilot facility operating off the coast of El Segundo, California, from 2002 to 2008, was tested for membrane performance, water quality, and operational cost.

In a joint study by LADWP, LBWD, and WBMWD, preliminary sampling of raw seawater quality was initiated at three potential seawater desalination sites - Scattergood Generating Station in Playa Del Rey, Haynes Generating Station in Long Beach, and El Segundo Power Generating Station. Water quality analysis on the seawater was performed at various times of the year to analyze seawater quality variations during storm events when city surface runoffs drain into the ocean. The next step would be to collaborate with the California Department of Health Services on developing guidelines to ensure that product water from future desalting facilities will meet all State and Federal water quality regulations.

## 9.3 Other Water Supplies Yield and Cost

The range of water supplies, the unit cost, risks, and other benefits besides reductions in water demands for water transfer and seawater desalination are presented in Exhibit 9B. LADWP recognizes the value of these water supplies in offsetting unanticipated changes to supply or demand. Strategic water planning necessarily includes continuous monitoring of existing and future alternative water resources.

### *Exhibit 9B*
### *Other Water Supplies*

| Other Water Supplies | | | | |
|---|---|---|---|---|
| **Water Supply Alternatives** | **Potential Water Yield (AFY)** | **Average Unit Cost ($/AF)** | **Implementation Risks** | **Additional Benefits** |
| Seawater Desalination [1] | 25,000 | $1,300-$2,000 | Environmental permitting may be difficult. | Replaces water committed to the environment. Hedges against climate change. |
| Water Transfer | 40,000 | $440-$540[2] | Wheeling and other institutional issues must be addressed. | Replaces water committed to the environment. |

| For Comparison Purposes: |
|---|
| Local Groundwater Pumping Unit Cost = $230/AF |
| MWD Treated Tier 2 Water Supply Unit Cost = $811/AF |

Notes:

1. Source: Metropolitan Water District of Southern California Integrated Water Resources Plan 2010 Update – Report No. 1373. While the ocean is a virtually unlimited supply, yield shown here is the maximum given available land, outfall capacity, and other constraints.
2. Cost includes cost of water and wheeling fees. Treatment costs not included.

Chapter Ten

# Intergrated Resources Planning

## 10.0 Overview

Integrated resources planning is a process used by many water and wastewater providers to meet their future needs in the most effective way possible, and with the greatest public support. The integrated planning process incorporates:

- Public stakeholders in an open, participatory process.
- Multiple objectives such as reliability, cost, water quality, environmental stewardship, and quality of life.
- Risk and uncertainty.
- Partnerships with other agencies, institutions, and non-governmental organizations.

LADWP has been actively involved in integrated resources planning since 1993, when the Metropolitan Water District of Southern California (MWD) initiated the region's first Integrated Resources Plan (IRP). LADWP was an active member of the technical workgroup that oversaw the development of alternatives and recommendations from MWD's IRP. In 1999, the City embarked on its first IRP for wastewater, stormwater and water supply. LADWP was a partner in this effort, working with the City's Bureau of Sanitation (BOS). In 2006, the Greater Los Angeles County IRWMP was approved. LADWP is a member of the IRWMP Leadership Committee and serves as the chair of the of the Upper Los Angeles River Watersheds sub-region for the IRWMP region.

## 10.1 City of Los Angeles Integrated Water Resources Plan

### 10.1.1 Description and Purpose

The City's Integrated Water Resources Plan (IRP) is a unique approach of technical integration and community involvement to guide policy decisions and water resources facilities planning. As part of the IRP development, an Environmental Impact Report (EIR) was prepared identifying the recommended alternatives for implementing the City's wastewater, runoff, and recycled water programs to meet its 2020 needs. On November 14, 2006, the City Council unanimously adopted the IRP recommendations and implementation strategy and certified the final EIR. The IRP development was a seven year stakeholder-driven process and was an innovative approach to guide the City's policy decisions and facilities planning. The IRP recognizes the interrelationship of water, wastewater, and runoff management in forming a future vision for the City's water resources activities and functions. In the past, the City traditionally utilized single-purpose planning efforts for each agency, such as one plan for wastewater and a separate plan for water supply. With the IRP, the City can meet its 2020 needs in a more cost-effective and sustainable way by addressing and integrating all its water resources. Additionally, the IRP was designed to meet multiple objectives, including evaluation of innovative supply opportunities that were once thought of as being too expensive. The City's LADWP and BOS are partners in this effort, joined by public stakeholders and other agencies.

The objectives for the IRP were developed by the City and public stakeholders, and represent the major reasons why the plan was developed. These objectives are:

- Protect public health and safety
- Effectively manage system capacity
- Protect the environment
- Enhance cost efficiency
- Protect quality of life
- Promote education

The IRP was developed in three phases. The first phase set policy guidelines for managing the City's water resources for the next 20 years. The second phase had three main deliverables: (1) detailed facility plans for wastewater, stormwater, and recycled water; (2) comprehensive financial plans for wastewater and stormwater; and (3) a certified Environmental Impact Report (EIR). The third phase of the IRP, which is now underway, represents implementation of the facility plans and more detailed studies to support implementation.

### 10.1.2 Integrated Watershed Approach

By taking an integrated watershed approach, the IRP identified opportunities that would normally not have been identified if water, wastewater, and stormwater were planned separately. The IRP recognized that all of the City's water resources are linked from a technical, social, and institutional aspect.

The City's IRP has also assisted in identifying partnerships between City agencies for project implementation potentially leading to increases in outside funding from grants and low-interest loans.

An example is the potential three-way partnership between the City's Department of Recreation and Parks, BOS, and LADWP. Land reclamation of blighted industrial and warehouse uses allows the City to create more parks and recreational areas while simultaneously allowing for underground storage of wet weather runoff for subsequent beneficial reuse. With this integrated approach, the City can potentially obtain more parkland, assist BOS in reducing wet weather runoff to improve water quality, and assist LADWP in increasing water supplies. The integrated approach also allows the City to better position itself for grants and loans that typically prioritize projects that demonstrate multiple benefits (e.g., water quality, water supply and recreation).

### 10.1.3 Stakeholder Involvement

A key element of the IRP was involvement of stakeholders throughout the entire IRP process. Stakeholders represented a wide range of the City's interests including, but not limited to, community, business, and environmental organizations. Stakeholders were instrumental in development of the guiding principles and identification of innovative water resource opportunities.

During Phase 2, stakeholders participated in a Steering Group. Steering Group members regularly attended scheduled workshops and provided on going input on the technical, environmental, and financial development of the IRP. Members provided necessary feedback to keep the facilities planning efforts aligned with the decision-making process. The Steering Group also considered key project issues in regards to the development of alternatives, such as facilities siting, implementation risks, and acceptability of costs associated with projects.

## 10.1.4 IRP Alternatives

The IRP evaluated a broad range of integrated alternatives. Each alternative represented different combinations of wastewater treatment options, wastewater collection system options, recycled water options, conservation options, and dry and wet weather urban runoff management options.

Twenty-one (21) preliminary alternatives were created with different focuses, allowing stakeholders and decision-makers to see trade-offs in key planning objectives. Based on the evaluation of the preliminary alternatives, nine (9) hybrid alternatives were created that incorporated the best elements from the preliminary alternatives in order to improve overall performance. City staff recommended the top-scoring four (4) hybrid alternatives to be carried through to the EIR process. Public stakeholders concurred with staff recommendations.

In November 2006, City Council approved the staff-recommended alternative, which consists of "Go-Projects", "Go-If-Triggered Projects" and "Go-Policy Directions". "Go-Projects" are projects recommended for immediate implementation because the flow and regulatory triggers have already been met. "Go-If-Triggered Projects" will only be implemented if or when additional information or circumstances, such as regulatory requirements, population growth, or increases in sewage flow, materialize. "Go-Policy Directions" are specific directions to City staff on further studies and evaluations necessary to progress on programmatic elements.

## 10.1.5 IRP Implementation Status

LADWP, in partnership with the City's Department of Public Works, has been working collaboratively along with other City departments on coordinating and implementing the various IRP recommendations. As part of the IRP implementation phase, the City has worked on keeping IRP stakeholders engaged through annual stakeholder meetings. Through these meetings, the City has provided updates on the IRP implementation and has obtained valuable input from stakeholders on IRP related issues. In addition, the Board of Water and Power Commissioners and the Board of Public Works have held three public joint meetings to review the IRP progress and provide directions on policy issues. Since the adoption of the IRP by the City Council in November 2006, a number of initiatives have been undertaken by the City which fulfill the IRP goals, including the Green Streets and Green Alleys Committee, the development of a Low Impact Development Ordinance, Conservation Initiatives (Chapter 3), the Recycled Water Master Plan (Chapter 4), and Watershed Management (Chapter 7). Projects and policies in the IRP implementation strategy are detailed below. Some projects are currently being implemented, while others continue to be monitored for triggers or policy direction:

## Go Projects

- Construct wastewater storage facilities at Donald C. Tillman Water Reclamation Plant (DCT).

- Construct wastewater storage facilities at Los Angeles-Glendale Water Reclamation Plant (LAG).

- Construct recycled water storage facilities at LAG.

- Construct solids handling and truck loading facility at Hyperion Treatment Plant (HTP).

- Construct two new sewer lines, Glendale Burbank Interceptor Sewer and Northeast Interceptor Sewer Phase II.

## Go-If-Triggered Projects

- Potential upgrades at DCT to advanced treatment at current capacity (if triggered by regulations and/or decision to reuse DCT effluent for groundwater replenishment).

- Potential expansion and upgrade of DCT to 100 mgd (if triggered by an increase in population, regulations, and/or groundwater replenishment decision). In the unlikely event that the overall framework for recycled water changes to disallow its use, then HTP would be potentially expanded to 500 mgd instead.

- Potential upgrades at LAG to advanced treatment at current capacity (if triggered by regulations and/or availability of downstream sewer capacity).

- Design and construction of additional secondary clarifiers at HTP to provide 450 mgd operational performance.

- Design and construction of up to 12 solids digesters at HTP (if triggered by increased biosolids production in the service area).

- Design and construction of Valley Spring Interceptor Sewer.

Of the "Go-Policy Directions" which provide specific directions to City staff on further studies and evaluations necessary to progress on programmatic elements., those applicable to or with the potential to impact LADWP operations include:

## Recycled Water – Non-Potable Uses

- Direct LADWP and the Department of Public Works to work together to maximize recycled water use and identify recycled water for non-potable uses in the TIWRP service area, west side, and LAG service areas. LADWP is to conduct additional Tier 1 and 2 customer analyses to verify potential demands and feasibility and develop a long-range marketing strategy for recycled water that includes a plan for recruiting and retaining new customers.

- Direct the Department of Building and Safety to evaluate and develop ordinances to require installation, where feasible, of dual plumbing for new multi-family, commercial and industrial development, schools, and government properties in the vicinity of existing or planned recycled water distribution systems in coordination with the Los Angeles River (LA River) Revitalization Master Plan. Proximity and demand will be considered when determining feasibility. The dual plumbing will consist of separate plumbing and piping systems, one for potable water and the second for recycled water for non-potable uses, such as irrigation and industrial use.

- Direct the Department of Public Works and LADWP to continue to coordinate, where feasible, the design/construction of recycled water distribution piping (purple pipe) with other major public works projects, including street widening, and LA River Revitalization Master Plan project areas. Also coordinate with other agencies, including the Metropolitan Transit Authority and Caltrans, on major transportation projects.

### Recycled Water –Indirect Potable Uses (Groundwater Replenishment)

- Direct LADWP to develop a public outreach program to explore the feasibility of implementing groundwater replenishment with advanced treated recycled water.

### Recycled Water – Environmental Uses

- Direct LADWP and the Department of Public Works to continue to provide water from DCT to Lake Balboa, Wildlife Lake, and the Japanese Garden at Sepulveda Basin, and the LA River to meet baseline needs for habitat.

### Water Conservation

- Direct LADWP to continue conservation efforts, including programs to reduce outdoor water usage through the use of smart irrigation devices on City properties, schools, and large developments (those with 50 dwelling units or 50,000 gross square feet or larger), and to increase incentives to residential properties.

- Direct LADWP to work with the Department of Building and Safety in continued conservation efforts by evaluating and considering new water conservation technologies, including no-flush urinal technology.

- Direct LADWP to continue to work with the Department of Building and Safety on conservation efforts by evaluating and developing a policy that requires developers to implement individual water meters for all new apartment buildings.

- Direct LADWP to continue conservation awareness efforts, including increasing education programs on the benefits of using climate-appropriate plants with an emphasis on California friendly plants for landscaping or landscaped areas developed in coordination with the LA River Revitalization Master Plan, and to develop a program of incentives for implementation.

- Direct the City Planning Department to consider development of a City directive to require use of California friendly plants in all City projects where feasible and not in conflict with other facilities usage.

### Runoff Management – Wet Weather Runoff

- Direct the Department of Public Works to review SUSMP (Standard Urban Stormwater Management Plan) requirements to determine ways to require, where feasible, on-site filtration and/or treatment/reuse, rather than treatment and discharge, including in-lieu fees for projects where infiltration is infeasible.

- Direct the Department of Building and Safety to evaluate and modify applicable codes to encourage the installation of all feasible Best Management Practices (BMPs), including the use of porous pavement to maximize on-site capture and retention and/or infiltration of stormwater instead of discharge to the street and storm drain.

- Direct the Department of Public Works and the City Planning Department to evaluate the possibility of requiring porous pavement in all new public facilities in coordination with the LA River Revitalization Master Plan, and developments larger than one acre. Program feasibility should consider slope and soil conditions.

- Direct the City Planning Department to evaluate ordinances that would need to be changed to reduce the area of on private properties that can be paved with non-permeable pavement.

- Direct the Department of Public Works to evaluate and implement integration of porous pavements into sidewalks and street programs where feasible.

- Direct the Department of Public Works, LADWP, and the Department of Recreation and Parks to prepare a concept report and determine the feasibility of developing a powerline easement demonstration project for greening, public access, stormwater management, and groundwater replenishment.

- Direct the Department of Public Works and LADWP to work with the Los Angeles Unified School District to determine the feasibility of developing projects for both new and retrofitted schools, as well as for government/City-owned facilities, to implement stormwater management BMPs (cisterns to store runoff for irrigation, reduce paving and hardscapes, add infiltration basins).

- Direct the Department of Public Works, the General Services Department, and the Department of Recreation and Parks, to identify sites that can provide on-site percolation of wet-weather runoff in surplus properties, vacant lots, parks/open spaces, abandoned alleys in the East Valley area, and along the LA River in the East San Fernando Valley where feasible. Program feasibility should consider slope and soil conditions.

- Direct the Department of Public Works, the General Services Department, and the Department of Transportation to maximize unpaved open space in City-owned properties and parking medians by using all feasible BMPs and by removing all unnecessary pavement.

- In the context of developing Total Maximum Daily Load (TMDL) implementation plans, direct the Department of Public Works to consider diversion of dry weather runoff from Ballona Creek to constructed wetlands, wastewater system, or urban runoff plants for treatment and/or beneficial use. For inland creeks and storm drains tributary to the LA River, direct the Department of Public Works to consider diversion of dry weather runoff to the wastewater system or constructed wetlands or treatment/retention/infiltration basins.

- Direct the General Services Department, in coordination with the City Planning Department and the Department of Public Works, to evaluate feasibility of all City properties identified as surplus for potential development of multi-benefit projects to improve stormwater management, water quality, and groundwater recharge.

## Los Angeles River

The IRP planning effort included the Los Angeles River (LA River). The LA River is a valuable resource to the City providing habitat as well as recreational and economic opportunities.  Since the City's water reclamation plants were built, recycled water has been released to the LA River resulting in the development of significant environmental benefits from riparian habitat in the unlined portions of the LA River near Glendale, to regionally significant migratory shore bird habitat in Long Beach. As a result, many efforts have been developed to protect existing habitat and promote interest in habitat restoration and river revitalization.

The IRP established that treated wastewater is needed for the operation of Lake Balboa, the Japanese Gardens, and the Wildlife Lake in the Sepulveda Basin. Treated wastewater flows through these features and ultimately is released to the LA River from DCT. The remainder of the treated wastewater produced by the City's water reclamation plants is available for recycled water use and distribution to LADWP customers.

Shortly after work on the IRP began, the Los Angeles City Council's Ad Hoc Committee on the LA River (Ad Hoc Committee) was formed to address LA River revitalization. LADWP staff routinely attends Ad Hoc Committee meetings and functions and monitors LA River-related activities.

LADWP also funded the preparation of a Los Angeles River Revitalization Master

Plan which was approved in 2007. This plan addresses economic development opportunities, water quality, water resources, flood control, and recreation along the Los Angeles River. The plan also discusses opportunities to improve access to the Los Angeles River and increase community awareness.

In addition, LADWP staff also actively participates on the City's LA River Task Force, which was formed in response to instructions by the Ad Hoc Committee to:

- Inventory all current and future City department projects, studies, and programs along the LA River.
- Assess opportunities for future funding, projects, and studies.
- Coordinate LA River related activities of City departments and other agencies.
- Partner with the U.S. Army Corps of Engineers for a Habitat Restoration Project Study.

LADWP recognizes the importance of the Los Angeles River as a resource that provides multiple benefits to the City.

### 10.1.6 Agency Coordination

LADWP was a partner with BOS in developing the IRP along with public stakeholders and other agencies. As with any integrated plan that extends beyond traditional departmental boundaries and government jurisdictions, close coordination is required with multiple City, state, and federal agencies including but not limited to, the Cities of Burbank and Glendale, County of Los Angeles, Caltrans, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and the City Department of Recreation and Parks. Since approval of the IRP, ongoing project implementation and "Go-Policy Directions" continue to require close coordination with City departments and with the agencies listed above.

### 10.1.7 IRP Implications for City's Urban Water Management Plan

One of the primary purposes for developing the IRP was to explicitly consider the relationship between wastewater facility planning and other water resources issues, such as water supply and urban runoff. Implementation of the IRP has and will continue to result in increased beneficial reuse of water, water conservation, and groundwater supplies. IRP alternatives examined ways to decrease potable water needs by expanding the City's recycled water program; increase water efficiency by installing smart irrigation and other water efficient devices that reduce irrigation and indoor water demands; and increase groundwater resources by using wet weather runoff to recharge the aquifer. All of these options will have to be tested from a technical, institutional, and public acceptance perspective. Ongoing work on programmatic elements identified in the "Go-Policy Directions" applicable to LADWP will continue to investigate means of increasing local water supplies, water conservation, and groundwater recharge opportunities in an integrated manner. The IRP has demonstrated that by integrating water resources planning for the City, more opportunities for water supply development can be identified.

## 10.2 Greater Los Angeles County Integrated Regional Water Management Plan (IRWMP)

### 10.2.1 Description and Purpose

The Los Angeles County Department of Public Works led efforts to develop an

Integrated Regional Water Management Plan for the Greater Los Angeles County Region. Water quality, resource, and supply issues within the region are complex and managed by a myriad of government agencies subjected to a plethora of regulations. Exponential growth over the last century has required water managers to develop creative solutions to meet growing demands. Previously, projects addressing water issues were designed to appease single-focused visions and solutions of organizations operating independently. At the core of the plan, a clear vision and direction for the sustainable management of water resources within the region for the next twenty years was formulated. Over 1,600 projects were collected and synthesized for inclusion in the plan bringing together hundreds of local government agencies to cooperatively develop cost-effective, sensible, and economically feasible solutions to address regional water issues. New partnerships were forged between potential funding partners from within and outside the region. An innovative partnership between agencies was formed to create a new model of integrated regional planning to address competing water demands, water supply reliability, and project financing.

An Interim Draft of the IRWMP was adopted by the Leadership Committee on June 28, 2006 with a final plan adopted on December 16, 2006. To date the IRWMP has received $25 million from the Department of Water Resources (DWR) under Proposition 50, Chapter 8, for implementation of fourteen priority projects identified in the plan and $1.5 million from DWR for development of the IRWMP. Since completion of the document a revised Memorandum of Understanding (MOU) was executed by each of the sixteen agencies serving on the Leadership Committee for the purpose of developing, administering, updating, and implementing the IRWMP.

## Region

The IRWMP region encompasses 92 cities, portions of four counties, and hundreds of government agencies and districts spread over 2,058 square miles. Approximately 10.2 million residents, or equivalent to roughly 28 percent of the population of California, reside within the region. To facilitate input, variations in geographic and water management strategies, and effective planning the region was further subdivided into five sub-regions:

- Lower San Gabriel and Los Angeles River Watersheds
- North Santa Monica Bay Watersheds
- South Bay Watersheds
- Upper Los Angeles River Watersheds
- Upper San Gabriel River and Rio Hondo Watersheds

## Mission and Purpose

A collaborative process resulted in the following mission statement of the IRWMP: "To address the water resources needs of the Region in an integrated and collaborative manner." The IRWMP recognizes that in order to meet future needs water supply planning must be integrated with other resource strategies. Additionally, in a region with significant urban challenges, including population growth, densification, traffic congestion, poor air quality, and quality of life issues, it is imperative to consider water resources management in conjunction with other urban planning issues. The IRWMP's purpose is to proactively:

- Improve water supplies
- Enhance water supply reliability
- Improve surface water quality
- Preserve flood protection
- Conserve habitat
- Expand recreational access

## 10.2.2 Stakeholder Involvement

Over 1,400 invitations to participate in the IRWMP process were sent out to cities, counties, agencies, districts, disadvantaged communities, and community organizations. Stakeholders participated in workshops, project identification, and development of the IRWMP. Stakeholders were involved in the development of the IRWMP through participation in regional workshops, subregional workshops, and the Leadership Committee. Stakeholders assisted in the following:

- Development of the IRWMP mission and objectives.
- Refinement of procedures for incorporation of projects into the IRWMP.
- Identification of implementation strategies.
- Recommendation of stakeholder workshop improvements.

## 10.2.3 Recommended Projects

Over 1,600 projects were submitted and analyzed for inclusion in the IRWMP. This list was narrowed down to fourteen priority projects that met the objectives and priorities established by the IRWMP process and assisted in meeting the targets established for the planning region. Objectives and priorities were established to guide the project selection process. The IRWMP is a living document and will be updated as needed. Projects can continuously be submitted as they are identified by stakeholders.

### Objectives and Priorities

Six objectives and six long-term priorities were developed through the stakeholder process to guide project selection based on stakeholder input and previously completed documents, including UWMPs, MWD's IRP, Common Ground (San Gabriel & Los Angeles Rivers and Mountains Conservancy Plan), Santa Monica Bay Restoration Plan, and watershed plans for the major tributaries in the region.

The objectives of the IRWMP are to:

- Optimize local water resources to reduce the Region's reliance on imported water.
- Comply with water quality regulations (including TMDLs) by improving the quality of urban runoff, runoff, stormwater, and wastewater.
- Protect and improve groundwater and drinking water quality.
- Protect, restore, and enhance natural processes and habitats.
- Increase watershed friendly recreational space for all communities.
- Maintain and enhance public infrastructure related to flood protection, water resources, and water quality.
- Long term regional priorities are to:
- Maintain a regional and sub-regional structure to oversee plan implementation and ensure continued stakeholder input.
- Optimize use of recycled water, groundwater, desalination, and stormwater to enhance water supply reliability.
- Reduce demand on imported water sources.
- Protect groundwater supplies.

- Improve surface water quality to meet applicable water quality regulations, including TMDLs.

- Preserve open space, conserve and restore functional habitats, and protect special-status species.

## Targets

Targets for the region were developed to assist in prioritizing projects. Targets include:

- Increase water supply reliability by providing 800,000 AFY of additional water supply and demand reduction through conservation, including infiltration or reuse of 130,000 AFY of reclaimed water.

- Reduce and reuse 150,000 AFY (40%) of dry weather urban runoff and capture and treat an additional 170,000 AFY (50%) for a total target of 90 percent.

- Reduce and reuse 220,000 AFY (40%) of stormwater runoff from developed areas and capture and treat an additional 270,000 AFY (50%) for a total of 90 percent.

- Treat 91,000 AFY of contaminated groundwater.

- Restore 100+ linear miles of functional riparian habitat and associated buffer habitat.

- Restore 1,400 acres of functional wetland habitat.

- Develop 30,000 acres of recreational open space focused in under-served communities.

- Repair/replace 40 percent of aging water resources infrastructure.

## Projects

Fourteen priority projects were developed for the Greater Los Angeles County region. As a regional plan encompassing an area larger than LADWP's service area, many of the IRWMP projects do not directly benefit LADWP's service area, but rather provide benefits towards improving water resources in the region as a whole. However, LADWP can utilize the results of these projects and apply the knowledge to potentially develop similar programs within the service area. Brief descriptions of the priority projects are provided below.

***Southeast Water Reliability Project***

The Southeast Water Reliability Project consists of an 11.4 mile recycled water transmission pipeline from the City of Pico Rivera to the City of Vernon to complete Central Basin Municipal Water District's recycled water transmission system. Recycled water will be mainly provided by the County Sanitation Districts of Los Angeles County via the San Jose Creek Water Reclamation Plant.

***Joint Water Pollution Control Plant Marshland Enhancement***

The Joint Water Pollution Control Plant Marshland Enhancement Project is designed to improve and maintain plant and wildlife habitat at the seventeen acre freshwater marshland located at the Joint Water Pollution Control Plant (JWPCP) in Carson. As proposed, the project will serve as a mitigation measure for upgrading the JWPCP to full secondary wastewater treatment. The JWPCP is operated by the County Sanitation Districts of Los Angeles County.

***Large Landscape Water Conservation, Runoff Reduction, and Educational Program (Central Basin)***

The Large Landscape Water Conservation, Runoff Reduction, and Education Program is an end-use water management program to reduce runoff and address water/energy management associated with large landscapes, residential land uses, and street medians within the Central Basin Municipal Water District's service area. Weather-based irrigation controllers coupled with Geographic Information Systems (GIS) to monitor runoff and two-way communication technologies will provide necessary information to address emergency, drought, and end-use management challenges.

***Large Landscape Water Conservation, Runoff Reduction, and Educational Program (West Basin)***

West Basin Municipal Water District's (WBMWD) Large Landscape Water Conservation, Runoff Reduction, and Educational Program is a four-component project. The first component targets large landscape sites of 1 acre or more by providing centralized weather-based irrigation controllers with the goal of conserving 1 AFY per acre of land. The second component provides 1,350 rebates for the purchase of smart irrigation controllers for the top residential water users. A third component consists of developing and offering classes on residential landscaping for residences and businesses. The last component involves installing ten "Ocean Friendly" demonstration gardens throughout watersheds in the service area.

***Las Virgenes Creek Restoration Project***

The City of Calabasas is initiating the Las Virgenes Creek Restoration Project to restore 450 linear feet of a concrete-lined section of the creek to a natural function. Native vegetation will be planted in place of the concrete liner to establish connectivity between riparian habitat north and south of the existing liner.

***Malibu Creek Watershed Urban Water Conservation and Runoff Reduction Project***

As proposed, the Malibu Creek Watershed Urban Water Conservation and Runoff Reduction Project seeks to conserve water and reduce runoff in the City of Westlake Village and within the Las Virgenes Municipal Water District's (LVMWD) service area. Irrigation controllers on city-owned land in Westlake Village will be replaced with weather-based irrigation controllers. Within the LVWMD service area, indoor conservation will be addressed by continuing rebates for residential and multi-family customers to install water saving devices. This project will also continue existing efforts to reduce urban runoff and outdoor conservation in the LVMWD service area by targeting customers with persistent and substantial irrigation runoff in the vicinity of storm drains. These customers are offered water-efficient equipment rebates and free on-site assistance to upgrade irrigation systems to eliminate runoff.

***Morris Dam Water Supply Enhancement Project***

The Morris Dam Water Supply Enhancement Project would allow the capture of additional local runoff (5,720 AF) for groundwater recharge and extraction in the San Gabriel River watershed. This project would reduce the minimum pool required by the Los Angeles County Flood Control District (LACFCD) to prevent sediment damage to the outlet works of the dam by modifying the dam valves and control systems.

***Pacoima Wash Greenway Project***

The Pacoima Wash Greenway will treat storm runoff from neighborhoods adjacent to the wash in a series of parks incorporating stormwater treatment BMPs along the wash. Project development will be a joint effort between the City of San Fernando and the Mountains Recreation and Conservation Authority.

***San Gabriel Valley Riparian Habitat Arundo Removal Project***

Arundo donax, a non-native plant classified federally and by California as noxious weed, will be removed from approximately 30 acres of riparian habitat in the San Gabriel Watershed. Removal will increase surface water flows to the Rio Hondo percolation basins and improve native habitat.

***Solstice Creek Restoration Project***

The Solstice Creek Restoration Project will restore side drainages of Solstice Creek and areas negatively impacting riparian habitat through sediment and invasive species introduction. This project is part of an overall larger project to restore Solstice Creek.

***South Los Angeles Wetlands Park***

The South Los Angeles Wetlands Park project will involve purchasing a 9 acre parcel in Los Angeles on Avalon Boulevard for conversion to a wetlands park. As proposed, the wetlands park will treat urban runoff from a 520 acre area through installation of a series of BMPs. Park vegetation will consist of plants not requiring supplemental irrigation.

***Whittier Narrows Water Reclamation Plant Ultraviolet (UV) Disinfection***

The Whittier Narrows Water Reclamation Plant UV Disinfection project will convert current disinfection processes at the 15 mgd plant to a UV disinfection process. Currently, tertiary-treated water is disinfected to Title 22 recycled water standards using chloramination resulting in the production of NDMA byproducts.

***Wilmington Drain Restoration Multiuse***

As proposed, the Wilmington Drain Restoration Multiuse Project involves restoration of the Wilmington Drain. Restoration will involve creation of a public park, improved public access, native revegetation, stormwater treatment, and educational signage. The drain is within the City on an easement held by the LACFCD.

***North Atwater Creek Restoration***

As a component of the overall Los Angeles River Revitalization Plan, the North Atwater Creek Restoration Project will restore North Atwater Creek at North Atwater Park by providing stormwater runoff capture and treatment and the provision of habitat linkage to the Los Angeles River. Additionally, the project will provide an educational component and includes BMP implementation at adjacent horse stables and riding trails.

## 10.2.4 Implications of IRWMP for LADWP's Urban Water Management Plan

LADWP is a member of the IRWMP Leadership Committee and additionally serves as the chair of the of the Upper Los Angeles River Watersheds sub-region for the IRWMP region. As member of the Leadership Committee, LADWP is a signatory to the MOU for the IRWMP approved by the Board of Water and Power Commissioners on July 15, 2008.

Participating agencies in the IRWMP coordinate and share information concerning water resources management planning programs and projects, share grant funding information, and improve and maintain overall communication among the participants. Coordination and information sharing assists LADWP and other agencies in achieving their respective missions and contribute to overall IRWMP goals.

## 10.3 MWD's 2010 Integrated Resources Plan

Approved by the Board on October 12, 2010, the updated IRP is MWD's strategic plan for water reliability through the year 2035. The plan was developed through a collaborative process which incorporated input from water districts, local governments, stakeholder groups and the public. The earliest version of the IRP, which dates back to 1996, sets a regional reliability goal of meeting "full-service demands at the retail level under all foreseeable hydrologic conditions." The 2010 IRP maintains this reliability goal by seeking to stabilize MWD's traditional imported water supplies and establish water reserves to withstand California's inevitable dry cycles and growth in water demand.

The 2010 IRP update has three main objectives: (1) develop an Emergency Response Plan for hydrologic, regulatory, and other types of uncertainties in the Bay-Delta; (2) identify energy-efficient and cost-effective energy management initiatives; and (3) evaluate the reliability of the IRP Preferred Resource Mix through 2035, adjust targets as needed to reflect changed conditions, and extend resource targets through 2035.

The 2010 IRP manages regional resource needs utilizing three baseline components. It begins with baseline efforts – or core resource strategies – designed to maintain reliable water supplies. Its second component – the uncertainty buffer – activates buffer actions to mitigate short-term changes. If changed conditions become more pronounced, there is a final component – foundational actions – which are strategies for securing additional water resources.

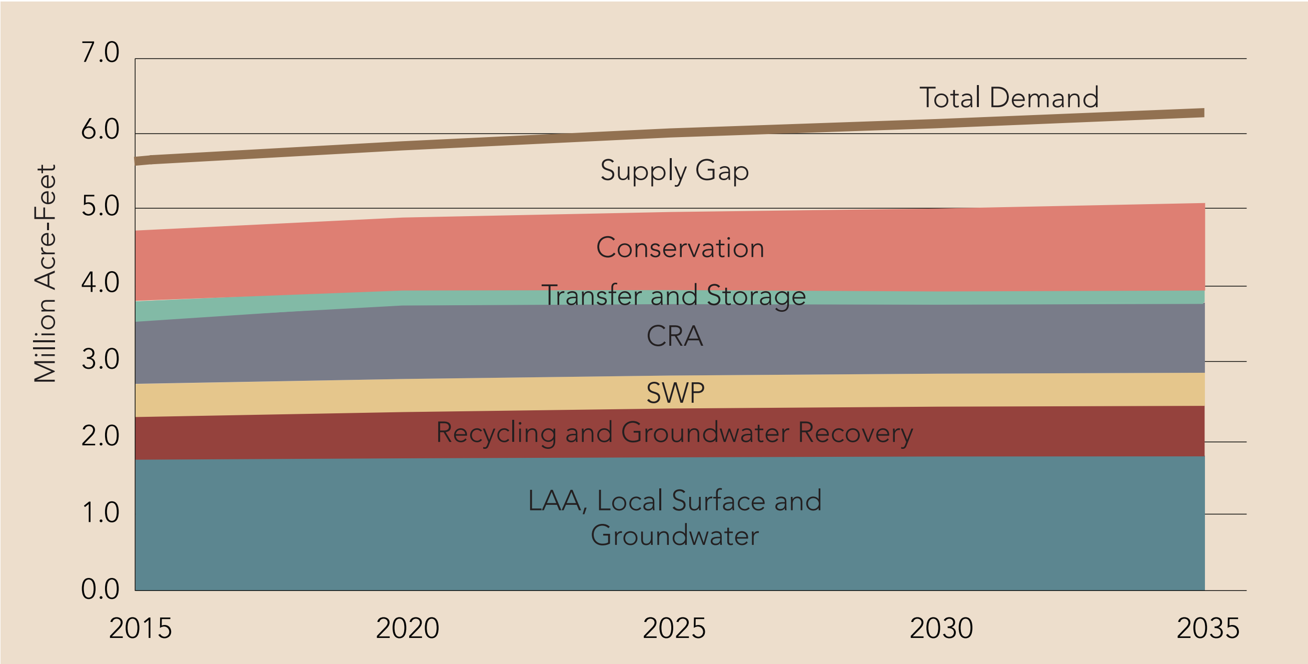
Additionally, the 2010 IRP takes additional steps to promote water use efficiency to further ensure reliability. It spells out a strategy to buffer the region from

### *Exhibit 10A*
### *MWD's IRP Resource Targets*

| IRP Resource Targets | 2004 IRP Update 2025 | 2010 IRP Update 2025 | Change | 2010 IRP Update 2035 |
|---|---|---|---|---|
| Conservation | 1,107,000 | 1,412,000 | 305,000 | 1,538,000 |
| Local Projects* | 750,000 | 905,000 | 155,000 | 928,000 |
| Colorado River Aqueduct ** | 1,250,000 | 1,250,000 | 0 | 1,250,000 |
| State Water Project | 650,000 | 713,000 | 63,000 | 713,000 |
| Groundwater Conjunctive Use | 300,000 | 300,000 | 0 | 300,000 |
| Central Valley/ State Water Project Storage and Transfers | 550,000 | 1,070,000 | 520,000 | 1,092,000 |
| MWD Surface Water Storage*** | 620,000 | 620,000 | 0 | 620,000 |

* Includes recycled water, brackish groundwater desalination, and seawater desalination
** Target for specific year types, the CRA is not intended to be full at all times
*** Represents the total amount that can be withdrawn from surface reservoirs
Source: MWD (2010)

*Exhibit 10B*
*Meeting Regional Water Needs Through MWD's IRP*




future changing circumstances through accelerated conservation and local supply development. And it advances long-term planning for potential future contingency resources, such as stormwater capture, large-scale seawater desalination, and local resource development through an adaptive management approach which will allow MWD, for the first time, to make direct equity investments and/or enter into partnerships for the development of local supply projects.

A summary of the 2004 IRP update and 2010 update targets are shown in Exhibit 10A.

Exhibit 10B shows regional water demands without conservation from 2015 to 2035 under dry weather. The graph also depicts the supply sources and water conservation identified in MWD's 2010 IRP update.

Exhibit 10B shows regional water demands without conservation from 2015 to 2035 under dry weather. The graph also depicts the supply sources and water conservation identified in MWD's 2010 IRP Update.

## 10.3.1 Stakeholder Participation

Like the preparation of previous IRPs, the crafting of the 2010 IRP was a collaborative effort. MWD sought input from its 26 public member agencies, retail water agencies, the public and other stakeholders including water and wastewater managers, environmental interests, and the business community. In preparation of MWD's IRP, all member agencies were closely involved, including LADWP. Additionally, LADWP was an active member of the technical workgroup.

To provide more direct involvement by MWD's Board in the 2010 IRP preparation, the IRP Steering Committee was created. This committee met on a regular basis to be briefed by MWD staff, review proposed resource strategies and provide recommended policy options. A Strategic Policy Review was conducted through a series of board workshops and managed public forums to help Metropolitan evaluate its future role for the region.

The managed public forums were regional assemblies held at critical milestones during the IRP development that provided a platform to collectively discuss strategic direction and regional water solutions. Participants in these assemblies included elected officials, board members, water agency managers, local retail water providers, groundwater basin managers, and public stakeholders from the business community, environmental groups, agricultural interests, and the general public.

## 10.3.2 Funding MWD's IRP

In accordance with the MWD Board's adoption of the IRP update, a revised Long-Range Finance Plan (LRP) was also developed and approved by the MWD Board. The LRP (2010) identifies MWD's planned capital improvement program (CIP) and operating expenses from 2015 to 2035.

The following summarizes MWD's CIP and operating expenses needed to implement the IRP:

- **Core Resources** (Fixed costs to maintain Bay-Delta habitat conservation and conveyance program, LRP contracts, CRA programs, and conservations funding) – costs for water supply will increase from the current $853/AF in 2015 to $1,484/AF in 2035.
- **Water Use Efficiency** – costs for water supply will increase from the current $892/AF in 2015 to $1,608/AF in 2035.
- **Capital Expenditures** – costs for water supply will increase from $919/AF in 2015 to $1,844/AF in 2035.
- **Demand Management & Local Projects** – costs from water supply will increase from $953/AF to $2,021/AF in 2035.

## 10.3.3 IRP Implications for City's Urban Water Management Plan

As LADWP evaluates its water supply options, it is important to understand the significance of a reliable and cost-effective water supply from MWD. The City's water supply reliability is directly linked to MWD's reliability, and LADWP's local supply development uses the cost of MWD water as one of the benchmarks for feasibility evaluation. Through its 2010 IRP update, MWD has shown that it will be able to meet the supplemental needs of all its member agencies reliably through 2035, even during prolonged drought events. MWD has also developed a plan to implement and finance the approved IRP targets.

Chapter Eleven

# Water Supply Reliability and Financial Integrity

## 11.0 Overview

Providing a reliable water supply in a semiarid climate with high variability in weather is challenging. And because LADWP currently imports a substantial portion of its surface water from the Los Angeles Aqueduct (LAA) and Metropolitan Water District of Southern California (MWD), it is even more challenging. Imported surface supplies are highly variable due to climate and hydrology, and they are also subject to environmental restrictions. To diversify its water supply portfolio, LADWP has made and will continue to make significant investments in groundwater, recycled water, stormwater capture and water conservation. These local water supplies tend to be more reliable than imported water because they have less variability due to climate, weather, and environmental restrictions. And by investing in these local supplies, the City's urban environment is protected and enhanced.

## 11.1 Unit Cost and Funding of Supplies

### 11.1.1 Unit Cost Summary of Supplies

Unit costs play an important role in planning future water supply development and determining where supply investments provide the greatest benefits to LADWP. Unit costs of production vary dramatically by water supply source. Exhibit 11A summarizes the unit cost for each water supply source.

Among LA's existing and planned water supplies, costs per acre-foot ranged from a high of $1,500 for certain recycled water projects to a low of $215 for locally produced groundwater. LAA supply requires operation and maintenance costs regardless of water availability. Therefore, hydrology and increased water for environmental commitments in the Eastern Sierras result in LAA unit cost fluctuations from year to year. Local groundwater supply is the least expensive source. However, its production is limited by contamination. Unit costs for MWD purchased water vary based on tier allocations. MWD's water rates vary from $527 per AF of Tier 1 untreated water to $869 per AF of Tier 2 treated water in 2011. LADWP has a Tier 1 allocation of 304,970 AF. Any purchases above this amount will be at the Tier 2 rates. Conservation is relatively inexpensive and offsets water supplies that may otherwise be required to meet demand. Conservation unit costs are based on costs of conservation rebate and incentive programs and their potential water use reduction. Recycled water costs are project specific and vary widely depending on the infrastructure requirements of each project. Water transfers using a future connection between the LAA and the California Aqueduct are planned. Water transfer costs will include the purchase price of water and conveyance fees.

Unit costs for potential water supplies such as stormwater reuse and increased groundwater production from stormwater recharge are highly variable based on a variety of factors including the size of the overall program, project locations, etc. Centralized stormwater capture unit costs are based on LADWP's current planned centralized stormwater capture projects, and distributed stormwater capture unit costs are based on various sources as referenced in Chapter 7, Watershed Management. Stormwater projects are joint efforts among agencies, City departments, stakeholders and community groups and yield additional benefits beyond water supply.

Seawater desalination unit costs are based on estimates from MWD's 2010 IRP. Seawater desalination was a planned supply identified in the 2005 UWMP but is excluded from this 2010 UWMP. Its impacts to marine habitats and high energy consumption make seawater desalination less desirable compared to options such as recycled water, conservation, and stormwater capture.

## *Exhibit 11A Unit Costs of Supplies*

| Water Source | Chapter Reference | Average Unit Cost ($/AF) |
|---|---|---|
| **Los Angeles Aqueduct**[1] | **Chapter 5 - Los Angeles Aqueduct System** | $563 |
| **Groundwater**[1] | **Chapter 6 - Local Groundwater** | $215 |
| **Metropolitan Water District**[2] | **Chapter 8 - Metropolitan Water District Supplies** | $527 - $869 |
| **Conservation** | **Chapter 3 - Conservation** | $75 - $900 |
| **Recycled Water** | **Chapter 4 - Recycled Water** | $600 - $1,500 |
| **Water Transfer** | **Chapter 9 - Other Potential Supplies** | $440 - $540 |
| **Stormwater Capture** | **Chapter 7 - Watershed Management** | |
| - Centralized Stormwater Capture | | $60 - $300 |
| - Distributed Stormwater Capture | | |
| Urban Runoff Plants | | $4,044 |
| Rain Barrels | | $278 - $2,778 |
| Cisterns | | $2,426 |
| Rain Gardens | | $149 - $1,781 |
| Neighborhood Recharge | | $3,351 |
| **Seawater Desalination** | **Chapter 9 - Other Potential Supplies** | **$1,300 - $2,000** |

[1] Los Angeles Aqueduct supply and groundwater supply are based on FY2005/06 to FY2009/10 five-year average.
[2] MWD Water Rates effective on January 1, 2011.

## 11.1.2 Funding of Supplies

Funding for water resource programs and projects are primarily provided through LADWP water rates, with supplemental funding provided by the MWD, and state and federal grants. Funding for water conservation, water recycling, and stormwater capture projects has increased significantly in recent years. Currently, approximately $100 million is collected annually through water rates for the LADWP's water resource programs. The current level of annual expenditures is believed to be sufficient to achieve projected goals for conservation, water recycling, and stormwater capture. However, achieving the goals for contaminated groundwater treatment in the San Fernando Basin will require water rate increases. LADWP will also seek reimbursement from potential responsible parties to assist with groundwater treatment program costs.

The timeframe for achieving water resource goals as outlined in the 2008 document Securing L.A.'s Water Supply was based on the assumption that there would be additional increases in water rates to achieve the stated goals. With the exception of groundwater treatment, the 2010 UWMP assumes existing amounts of revenue.

Water Resource Project Funding

- Water Rates – An existing component of water rates currently provides approximately $100 million annually for water conservation, water recycling, and stormwater capture programs.

- MWD – Currently provides funding up to $250 per AF for water recycling through their Local Resources Program. MWD also provides some water conservation incentive funding through rebates equal to $195 per AF of water saved or half the product cost whichever is less.

- State Funds – Funds for recycling, conservation, and stormwater capture have been available on a competitive basis though voter approved initiatives, such as Propositions 50 and 84. The proposed 2012 Water Bond also includes potential funding for groundwater cleanup. Occasionally low or zero-interest loans are also available though State Revolving Fund programs.

- Federal Funds – Federal funding for recycling is available through the U.S. Army Corps of Engineers, via periodic Water Resource Development Act legislation, and the U.S. Bureau of Reclaimation's Title XVI program.

- Potentially Responsible Parties – LADWP may be able to recover some costs for groundwater cleanup from potentially responsible parties.

Receipt of state or federal funding will allow water resource goals to be achieved sooner than projected, or allow for increased local supply development.

## 11.2 Reliability Assessment Under Different Hydrologic Conditions

## 11.2.1 Los Angeles Aqueducts

Water supply from the LAA can vary substantially from year to year due to hydrology. In very wet years, LAA supply can exceed 500,000 AFY. During average year weather conditions (50-year average hydrology from Fiscal Year 1956/57 to 2005/06) LAA supply is projected to gradually decrease from 254,000 AFY to 244,000 AFY by 2035 due to climate change impact. Critical dry year (defined as a repeat of a 1990/91 drought) supplies can be as low as 48,520 AFY.

In the last decade environmental considerations have required the City to reallocate approximately one-half of the LAA water supply to environmental mitigation and enhancement projects. Reducing water deliveries to the City from the LAA has resulted in less water independence, and therefore, increased dependence on imported water supply from MWD.

## 11.2.2 Groundwater

Groundwater is also affected by local hydrology. However, with conjunctive use management of groundwater—storing imported water in the groundwater basins during wet and average years - groundwater production can actually be increased during dry years. During average weather conditions, LADWP projects it will pump approximately between 40,500 AFY and 111,500 AFY of groundwater during the projection period to Fiscal Year (FY) 2034/35. These projections are based on LADWP's planned Groundwater Treatment Facilities being operational in FY 2020/21 and groundwater storage credits of 5,000 AFY being used to maximize production thereafter. Although in dry years LADWP can pump larger quantities of groundwater, a more conservative approach was adopted by assuming the same level of projected groundwater production for both single dry year and multi-dry year analysis.

Groundwater is vulnerable to contamination. The clean-up of the contamination in San Fernando Basin will facilitate the plan of storing additional recycled water and stormwater for future extraction and is critical to ensuring the reliability of the City's groundwater supplies. The Groundwater Treatment Facilities will address this issue and restore LADWP's ability to fully utilize its local groundwater entitlements and will facilitate additional storage and extraction programs.

## 11.2.3 Conservation

LADWP has developed conservation goals to decrease water use in the City and to comply with the new State 20 percent by 2020 requirements. Multiple actions will be taken to increase water conservation including public education, targeting the CII sector, reducing outdoor water use, and continuing participation in MWD's rebate programs. LADWP is planning to increase water conservation levels by over 60,000 AFY between 2010 and 2035, assuming average weather conditions.

Conservation can be seen as both a demand control measure and/or a source of supply. Of the local supplies being pursued, additional planned conservation is the biggest contributor toward reducing MWD purchases and increasing local supply reliability through 2035 and is therefore a crucial supply asset for LADWP.

## 11.2.4 Recycled Water

Recycled water is based on wastewater effluent flows, which do not vary significantly due to hydrology. Therefore, recycled water use is mainly limited by system capacities and demands. These facts make recycled water a more reliable supply than imported water. As outlined in Chapter 4 on Recycled Water, LADWP is planning extensive expansion of its recycled water system not only to include expansion of irrigation and industrial uses, but also to include groundwater replenishment. Under average weather conditions, recycled water supply for irrigation and industrial purposes is projected to increase from 20,000 AFY in 2015 to 29,000 AFY in 2035. Groundwater replenishment with recycled water is projected to be 30,000 AFY in 2035. For a critical dry year available recycled water supplies would not change.

## 11.2.5 Water Transfers

Water transfers are being developed to replace a portion of the City's Los Angeles Aqueduct water that has been dedicated for environmental enhancement uses in the Eastern Sierra Nevada. Water acquired through transfers helps increase water supply reliability for the City. The Los Angeles Aqueduct and California Aqueduct interconnection is under construction and estimated to be completed after May 2013. LADWP is expected to enter into agreements to obtain 40,000 AF per year under average weather conditions beginning in FY 2014/15 and continuing through 2035.

## 11.2.6 MWD Imported Supplies

LADWP has historically purchased MWD water to make up the deficit between in-City demand and local supplies. The City relies on MWD water to a greater extent in dry years and has been increasing its dependence in recent years as LAA supplies have been reduced due to increased environmental mitigation and enhancement demands.

Historically, water from MWD (like supplies from the LAA) has been subject to severe variability due to water shortages (i.e., 1976/77, 1987-1992, and 2007-2010). This is a result of MWD's core sources of water supply being the Colorado River and SWP, both of which are highly affected by hydrology. More recently, restrictions to protect threatened fish species have further decreased pumping from the Bay-Delta, and limited SWP supplies available to MWD. After the 1987-1992 water shortage, MWD started to diversify its water supply portfolio. Partnering with its member agencies, MWD launched its first Integrated Resource Plan (IRP) in 1993 and most recently updated it in 2010. As a result of the resource targets in the IRP, MWD implemented a variety of projects and programs designed to reduce its dependency on imported water during water shortages and environmental triggering of SWP pumping restrictions. Efforts have included: (1) providing financial incentives for local projects and conservation; (2) increasing surface storage via Diamond Valley Lake, Lake Mead, and the use of SWP terminal reservoirs; (3) groundwater storage programs in the Central Valley, Imperial Valley, and Coachella Valley; (4) short- and long-term water transfers; and (5) contracted groundwater storage programs with participating member agencies.

In the 2010 IRP Update, MWD developed a three-part adaptive resource strategy that includes: (1) meeting demands by building on existing core resources to provide reliability under foreseen conditions; (2) implementing a supply buffer of 10 percent of retail demand through multiple actions to adapt to short-term uncertainty; and (3) implementing adaptive management through low-regret foundation actions, monitoring key vulnerabilities and bringing adaptive resources online, if required, and (4) using a comprehensive approach to meet specific needs and degrees of shortages. The 2010 IRP adaptive management concept seeks to mitigate against supply uncertainty to further increase reliability.

MWD's 2010 IRP Update concluded that the resource targets identified in previous IRP updates, taking into consideration changed conditions identified since that time, will continue to provide for 100 percent reliability through 2035 for all its member agencies. MWD's 2010 Regional Urban Water Management Plan also concluded the same full reliability through 2035 during average (1922 – 2004 hydrology), single dry (1977 hydrology), and multiple dry years (1990 - 1992 hydrology). For each of these scenarios there is a projected surplus of supply in every forecast year (see Exhibit 11B). The projected surpluses are based on the capability of current supplies and range from 1 percent to 106 percent. When

## *Exhibit 11B*
## *MWD Supply Capability and Projected Demands (in AFY)*

| Single Dry-Year MWD Supply Capability and Projected Demands | | | | | |
|---|---|---|---|---|---|
| Fiscal Year | 2015 | 2020 | 2025 | 2030 | 2035 |
| Capability of Current Supplies | 2,457,000 | 2,782,000 | 2,977,000 | 2,823,000 | 2,690,000 |
| Projected Demands | 2,171,000 | 2,162,000 | 2,201,000 | 2,254,000 | 2,319,000 |
| Projected Surplus | 286,000 | 620,000 | 776,000 | 569,000 | 371,000 |
| Projected Surplus % (Proj. Surplus/Proj. Demands) | 13% | 29% | 35% | 25% | 16% |
| Supplies under Development | 762,000 | 862,000 | 1,036,000 | 1,036,000 | 1,036,000 |
| Potential Surplus | 1,048,000 | 1,482,000 | 1,812,000 | 1,605,000 | 1,407,000 |
| Potential Surplus % (Potential Surplus/ Proj. Demands) | 48% | 69% | 82% | 71% | 61% |
| **Multiple Dry-Year MWD Supply Capability and Projected Demands** | | | | | |
| Fiscal Year | 2015 | 2020 | 2025 | 2030 | 2035 |
| Capability of Current Supplies | 2,248,000 | 2,417,000 | 2,520,000 | 2,459,000 | 2,415,000 |
| Projected Demands | 2,236,000 | 2,188,000 | 2,283,000 | 2,339,000 | 2,399,000 |
| Projected Surplus | 12,000 | 229,000 | 237,000 | 120,000 | 16,000 |
| Projected Surplus % (Proj. Surplus/Proj. Demands) | 1% | 10% | 10% | 5% | 1% |
| Supplies under Development | 404,000 | 553,000 | 733,000 | 755,000 | 755,000 |
| Potential Surplus | 416,000 | 782,000 | 970,000 | 875,000 | 771,000 |
| Potential Surplus % (Potential Surplus/ Proj. Demands) | 19% | 36% | 42% | 37% | 32% |
| **Average Year MWD Supply Capability and Projected Demands** | | | | | |
| Fiscal Year | 2015 | 2020 | 2025 | 2030 | 2035 |
| Capability of Current Supplies | 3,485,000 | 3,810,000 | 4,089,000 | 3,947,000 | 3,814,000 |
| Projected Demands | 2,006,000 | 1,933,000 | 1,985,000 | 2,049,000 | 2,106,000 |
| Projected Surplus | 1,479,000 | 1,877,000 | 2,104,000 | 1,898,000 | 1,708,000 |
| Projected Surplus % (Proj. Surplus/Proj. Demands) | 74% | 97% | 106% | 93% | 81% |
| Supplies under Development | 588,000 | 689,000 | 1,051,000 | 1,051,000 | 1,051,000 |
| Potential Surplus | 2,067,000 | 2,566,000 | 3,155,000 | 2,949,000 | 2,759,000 |
| Potential Surplus % (Potential Surplus/ Proj. Demands) | 103% | 133% | 159% | 144% | 131% |

Source: MWD 2010 Regional Urban Water Management Plan Tables 2-9 to 2-11.

including supplies under development, the potential surplus increases to between 19 percent and 159 percent of projected demand.

As part of the implementation of MWD's IRP, MWD and its member agencies worked together to develop MWD's Water Surplus and Drought Management Plan (WSDM Plan) in 1999. The WSDM Plan established broad water resource management strategies to ensure MWD's ability to meet full service demands at all times and provides principles for supply allocation if the need should ever arise. The WSDM Plan splits MWD's resource actions into two major categories: Surplus Actions and Shortage Actions. The Shortage Actions of the WSDM Plan are split into three sub-categories: Shortage, Severe Shortage, and Extreme Shortage. Under Shortage conditions, MWD will make withdrawals from storage and interrupt long-term groundwater basin replenishment deliveries. Under Severe Shortage conditions, MWD will call for extraordinary drought conservation in the form of voluntary savings from retail customers, interrupt 30 percent of deliveries to Agricultural Water Program users, call on its option transfer water, and purchase water on the spot market. The overall objective of MWD's IRP and WSDM Plan is to ensure that shortage allocations of MWD water supplies are not required.

Under Extreme Shortage conditions, MWD allocates supplies to its member agencies in accordance with its Water Supply Allocation Plan (WSAP). If shortage allocations are required, MWD will rely on the calculations established in its WSAP adopted in 2008. The plan equitably allocates shortages among its member agencies based on need with adjustments for growth, local investments, changes in supply conditions, demand hardening, and water conservation programs.

## 11.2.7 Potential Supplies

Other planned and potential water supplies that LADWP is exploring include capturing stormwater for reuse and infiltration leading to increased groundwater production (see Chapter 7). The beneficial reuse of stormwater presents significant opportunity and the development of these supplies will offset the need to import additional supplemental supplies from MWD. The City must also reduce pollutants in impaired receiving waters (rivers, creeks, and beaches in the Santa Monica and Los Angeles watersheds) as required by the Clean Water Act. By managing urban runoff during dry and wet periods, this pollution will be reduced.

Traditional ways of managing urban runoff would be to divert the runoff into existing wastewater treatment plants and/or build satellite treatment plants specifically designed to treat urban runoff. During the City's IRP process, stakeholders expressed the desire to examine other ways to manage runoff that would reduce pollution and provide for other benefits such as water supply and open space. These methods involve local and regional storage of wet weather runoff for groundwater infiltration, on-site storage and recovery of wet weather runoff for irrigation using cisterns and other devices, and reuse of treated dry weather effluent for irrigation (much like recycled water). As an outgrowth of the City's IRP, neighborhood recharge concept efforts are moving from the conceptual stage visualized in the IRP to actual projects in the City to infiltrate wet weather runoff as close as possible to the point of origin with multiple projects either complete, under construction, or in final design.

Under average weather conditions LADWP is projecting stormwater capture and reuse in 2015 could reach 2,000 AFY and increase to 10,000 AFY by 2035. Additionally, increased groundwater production from stormwater infiltration will potentially be 15,000 AFY in 2035. This increased groundwater production potential is contingent on modifying the court judgment which governs extractions from the San Fernando Groundwater Basin. If these resources reach fruition, LADWP will be able to reduce imported supplies purchased from MWD by 25,000 AFY in 2035 under average weather conditions.

## 11.2.8 Service Area Reliability Assessment

To determine the overall service area reliability, LADWP defined three hydrologic conditions: average year (50-year average hydrology from FY 1956/57 to 2005/06 ); single dry year (such as a repeat of the FY 1990/91 drought); and multi-dry year period (such as a repeat of FY1988/89 to FY1992/93). The average

***Exhibit 11C***
***LADWP Supply Reliability FYE 2006-2010 Average***

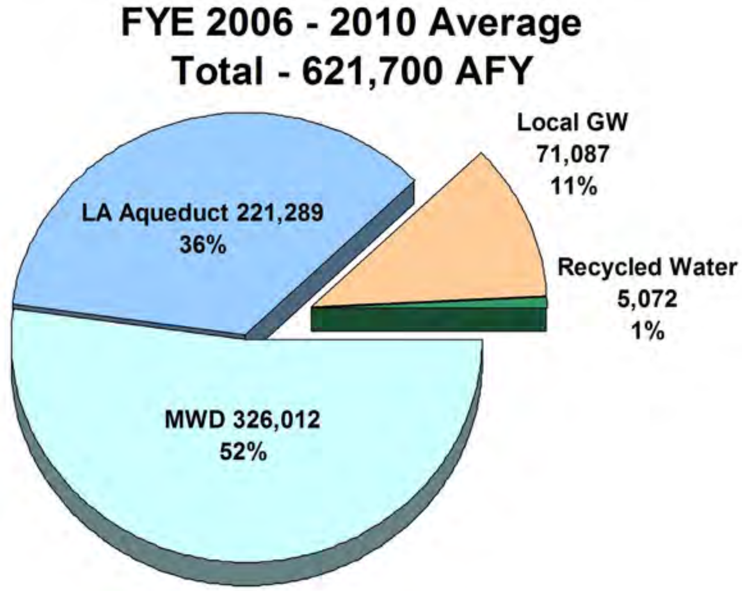
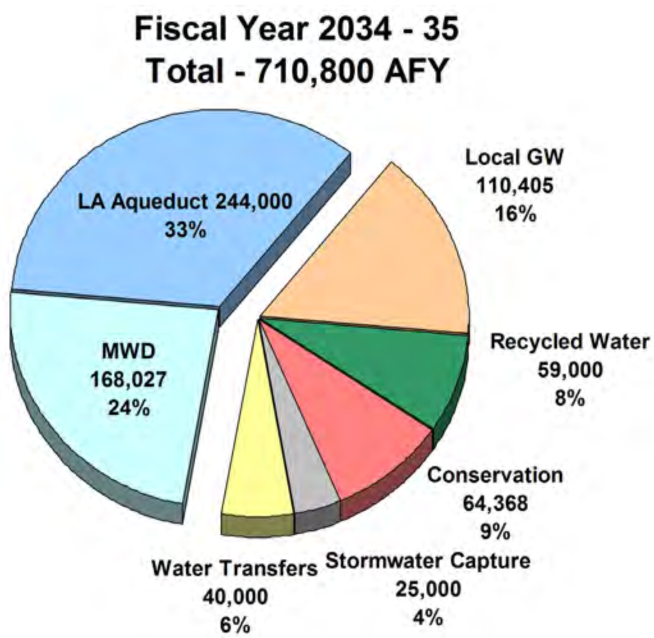



***Exhibit 11D***
***LADWP Supply Reliability Under Average Weather Conditions in Fiscal Year 2034-35***




Note: Charts do not reflect approximately 100,000 AF of existing conservation

year demand is based on the forecasted median demand as shown in Exhibit 2J. Weather patterns and water demands were further studied to determine single dry year demand and multi-dry year demands. The single dry year demand is estimated to be 6 percent higher than the forecasted median demand. The multi-dry year demands are increased above the forecasted median demands by the following percentages: 1st year – 4 percent, 2nd year – 5 percent, 3rd year – 6 percent, 4th year – 0 percent, and 5th year – 2 percent.

The water supply reliability summaries are shown in Exhibit 11C for the 5-year average from FY 2005/06 to FY 2009/10 and in Exhibit 11 D for FY 2034/35 under average weather conditions, with new water conservation shown as a supply source. The exhibits show that the City's reliance on MWD supply will decrease from 52 percent to 24 percent by FY 2034/35 while the combined imported supplies of LAA and MWD water will decrease from 88 percent to 57 percent by FY 2034/35. The locally-developed supplies will increase from 12 percent to 43 percent by FY 2034/35.

Exhibits 11E and 11F tabulate the service reliability assessment for normal and single dry year conditions, respectively. Exhibits 11G through 11K show reliability assessments in five year increments from 2010 to 2035 with each five year period assuming that a multiple dry year condition occurs. For these reliability tables, existing water conservation has been already subtracted from projected demands, but new water conservation is included as a supply source. Demands are met by the available supplies under all scenarios.

### *Exhibit 11E*
### *Service Area Reliability Assessment for Average Weather Year*

| Demand and Supply Projections (in acre-feet) | FY2009-10 Actual | Average Weather Conditions (FY 1956/57 to 2005/06) Fiscal Year Ending on June 30 | | | | |
|---|---|---|---|---|---|---|
| | | 2015 | 2020 | 2025 | 2030 | 2035 |
| **Total Demand** | **555,477** | **614,800** | **652,000** | **675,600** | **701,200** | **710,800** |
| **Existing / Planned Supplies** | | | | | | |
| Los Angeles Aqueduct[1] | 199,739 | 252,000 | 250,000 | 248,000 | 246,000 | 244,000 |
| Groundwater[2] | 76,982 | 40,500 | 96,300 | 111,500 | 111,500 | 110,405 |
| Conservation | 8,178 | 14,180 | 27,260 | 40,340 | 53,419 | 64,368 |
| Recycled Water | | | | | | |
| - Irrigation and Industrial Use | 6,703 | 20,000 | 20,400 | 27,000 | 29,000 | 29,000 |
| - Groundwater Replenishment | 0 | 0 | 0 | 15,000 | 22,500 | 30,000 |
| Water Transfers | 0 | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| Subtotal | 291,602 | 366,680 | 433,960 | 481,840 | 502,419 | 517,773 |
| **MWD Water Purchases** With Existing/Planned Supplies | 263,875 | 248,120 | 218,040 | 193,760 | 198,781 | 193,027 |
| **Total Supplies** | **555,477** | **614,800** | **652,000** | **675,600** | **701,200** | **710,800** |
| **Potential Supplies** | | | | | | |
| Stormwater Capture | | | | | | |
| - Capture and Reuse (Harvesting) | 0 | 2,000 | 4,000 | 6,000 | 8,000 | 10,000 |
| - Increased Groundwater Production (Recharge) | 0 | 0 | 2,000 | 4,000 | 8,000 | 15,000 |
| Subtotal | 0 | 2,000 | 6,000 | 10,000 | 16,000 | 25,000 |
| **MWD Water Purchases** With Existing/Planned/Potential Supplies | 263,875 | 246,120 | 212,040 | 183,760 | 182,781 | 168,027 |
| **Total Supplies** | **555,477** | **614,800** | **652,000** | **675,600** | **701,200** | **710,800** |

[1] Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impacts.
[2] North Hollywood/Rinaldi-Toluca Treatment Complex is expected to be in operation in FY 2019-20. Tujunga Groundwater Treatment Plant is expected to be in operation in 2020-21. Storage credit of 5,000 afy will be used to maximize the pumping in FY 2020-21 and thereafter. Sylmar Basin production was increased to 4,500 AFY from FY 2014-15 to FY 2029-30 to avoid the expiration of stored water credits, then go back to its entitlement of 3,405 AFY in FY 2030-31.

## *Exhibit 11F*
## *Service Area Reliability Assessment for Single Dry Year*

| Demand and Supply Projections (in acre-feet) | FY2009-10 Actual | Single Dry Year (FY1990-91) Fiscal Year Ending on June 30 | | | | |
|---|---|---|---|---|---|---|
| | | 2015 | 2020 | 2025 | 2030 | 2035 |
| **Total Demand** | **555,477** | **651,700** | **691,100** | **716,100** | **743,200** | **753,400** |
| **Existing / Planned Supplies** | | | | | | |
| Los Angeles Aqueduct[1] | 199,739 | 48,520 | 48,120 | 47,720 | 47,330 | 46,940 |
| Groundwater[2] | 76,982 | 40,500 | 96,300 | 111,500 | 111,500 | 110,405 |
| Conservation | 8,178 | 14,180 | 27,260 | 40,340 | 53,419 | 64,368 |
| Recycled Water | | | | | | |
| - Irrigation and Industrial Use | 6,703 | 20,000 | 20,400 | 27,000 | 29,000 | 29,000 |
| - Groundwater Replenishment | 0 | 0 | 0 | 15,000 | 22,500 | 30,000 |
| Water Transfers | 0 | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| Subtotal | 291,602 | 163,200 | 232,080 | 281,560 | 303,749 | 320,713 |
| **MWD Water Purchases** With Existing/Planned Supplies | 263,875 | 488,500 | 459,020 | 434,540 | 439,451 | 432,687 |
| **Total Supplies** | **555,477** | **651,700** | **691,100** | **716,100** | **743,200** | **753,400** |
| **Potential Supplies** | | | | | | |
| Stormwater Capture | | | | | | |
| - Capture and Reuse (Harvesting) | 0 | 2,000 | 4,000 | 6,000 | 8,000 | 10,000 |
| - Increased Groundwater Production (Recharge) | 0 | 0 | 2,000 | 4,000 | 8,000 | 15,000 |
| Subtotal | 0 | 2,000 | 6,000 | 10,000 | 16,000 | 25,000 |
| **MWD Water Purchases** With Existing/Planned/Potential Supplies | 263,875 | 486,500 | 453,020 | 424,540 | 423,451 | 407,687 |
| **Total Supplies** | **555,477** | **651,700** | **691,100** | **716,100** | **743,200** | **753,400** |

[1] Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impacts.
[2] North Hollywood/Rinaldi-Toluca Treatment Complex is expected to be in operation in FY 2019-20. Tujunga Groundwater Treatment Plant is expected to be in operation in 2020-21. Storage credit of 5,000 afy will be used to maximize the pumping in FY 2020-21 and thereafter. Sylmar Basin production was increased to 4,500 AFY from FY 2014-15 to FY 2029-30 to avoid the expiration of stored water credits, then go back to its entitlement of 3,405 AFY in FY 2030-31.

## *Exhibit 11G*
## *Service Area Reliability Assessment for Multi-Dry Years (2011-2015)*

| Demand and Supply Projections (in acre-feet) | FY2009-10 Actual | Multiple Dry Years (FY1988-89 to FY1992-93) Fiscal Year Ending on June 30 | | | | |
|---|---|---|---|---|---|---|
| | | 2011 | 2012 | 2013 | 2014 | 2015 |
| **Total Demand** | **555,477** | **590,000** | **608,200** | **626,500** | **602,900** | **627,100** |
| **Existing / Planned Supplies** | | | | | | |
| Los Angeles Aqueduct[1] | 199,739 | 86,330 | 98,560 | 48,520 | 94,360 | 105,770 |
| Groundwater[2] | 76,982 | 61,090 | 53,660 | 46,260 | 47,300 | 40,500 |
| Conservation | 8,178 | 9,380 | 10,580 | 11,780 | 12,980 | 14,180 |
| Recycled Water | | | | | | 0 |
| - Irrigation and Industrial Use | 6,703 | 7,500 | 8,300 | 9,000 | 15,500 | 20,000 |
| - Groundwater Replenishment | 0 | 0 | 0 | 0 | 0 | 0 |
| Water Transfers | 0 | 0 | 0 | 0 | 0 | 40,000 |
| Subtotal | 291,602 | 164,300 | 171,100 | 115,560 | 170,140 | 220,450 |
| **MWD Water Purchases** With Existing/Planned Supplies | 263,875 | 425,700 | 437,100 | 510,940 | 432,760 | 406,650 |
| **Total Supplies** | **555,477** | **590,000** | **608,200** | **626,500** | **602,900** | **627,100** |
| **Potential Supplies** | | | | | | |
| Stormwater Capture | | | | | | |
| - Capture and Reuse (Harvesting) | 0 | 0 | 0 | 0 | 0 | 2,000 |
| - Increased Groundwater Production (Recharge) | 0 | 0 | 0 | 0 | 0 | 0 |
| Subtotal | 0 | 0 | 0 | 0 | 0 | 2,000 |
| **MWD Water Purchases** With Existing/Planned/Potential Supplies | 263,875 | 425,700 | 437,100 | 510,940 | 432,760 | 404,650 |
| **Total Supplies** | **555,477** | **590,000** | **608,200** | **626,500** | **602,900** | **627,100** |

[1] Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impacts.
[2] North Hollywood/Rinaldi-Toluca Treatment Complex is expected to be in operation in FY 2019-20. Tujunga Groundwater Treatment Plant is expected to be in operation in 2020-21. Storage credit of 5,000 afy will be used to maximize the pumping in FY 2020-21 and thereafter. Sylmar Basin production was increased to 4,500 AFY from FY 2014-15 to FY 2029-30 to avoid the expiration of stored water credits, then go back to its entitlement of 3,405 AFY in FY 2030-31.

## *Exhibit 11H*
## *Service Area Reliability Assessment for Multi-Dry Years (2016-2020)*

| Demand and Supply Projections (in acre-feet) | Multiple Dry Years (FY1988-89 to FY1992-93) Fiscal Year Ending on June 30 | | | | |
|---|---|---|---|---|---|
| | 2016 | 2017 | 2018 | 2019 | 2020 |
| **Total Demand** | **647,100** | **661,200** | **675,400** | **644,600** | **665,100** |
| **Existing / Planned Supplies** | | | | | |
| Los Angeles Aqueduct[1] | 86,330 | 98,560 | 48,520 | 94,360 | 105,770 |
| Groundwater[2] | 37,350 | 37,350 | 37,350 | 42,280 | 96,300 |
| Conservation | 16,800 | 19,410 | 22,030 | 24,640 | 27,260 |
| Recycled Water | | | | | 0 |
| - Irrigation and Industrial Use | 20,000 | 20,200 | 20,300 | 20,400 | 20,400 |
| - Groundwater Replenishment | 0 | 0 | 0 | 0 | 0 |
| Water Transfers | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| Subtotal | 200,480 | 215,520 | 168,200 | 221,680 | 289,730 |
| **MWD Water Purchases** With Existing/Planned Supplies | 446,620 | 445,680 | 507,200 | 422,920 | 375,370 |
| **Total Supplies** | **647,100** | **661,200** | **675,400** | **644,600** | **665,100** |
| **Potential Supplies** | | | | | |
| Stormwater Capture | | | | | |
| - Capture and Reuse (Harvesting) | 2,400 | 2,800 | 3,200 | 3,600 | 4,000 |
| - Increased Groundwater Production (Recharge) | 400 | 800 | 1,200 | 1,600 | 2,000 |
| Subtotal | 2,800 | 3,600 | 4,400 | 5,200 | 6,000 |
| **MWD Water Purchases** With Existing/Planned/Potential Supplies | 443,820 | 442,080 | 502,800 | 417,720 | 369,370 |
| **Total Supplies** | **647,100** | **661,200** | **675,400** | **644,600** | **665,100** |

[1] Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impacts.
[2] North Hollywood/Rinaldi-Toluca Treatment Complex is expected to be in operation in FY 2019-20. Tujunga Groundwater Treatment Plant is expected to be in operation in 2020-21. Storage credit of 5,000 afy will be used to maximize the pumping in FY 2020-21 and thereafter. Sylmar Basin production was increased to 4,500 AFY from FY 2014-15 to FY 2029-30 to avoid the expiration of stored water credits, then go back to its entitlement of 3,405 AFY in FY 2030-31.

## *Exhibit 11I*
## *Service Area Reliability Assessment for Multi-Dry Years (2021-2025)*

| Demand and Supply Projections (in acre-feet) | Multiple Dry Years (FY1988-89 to FY1992-93) Fiscal Year Ending on June 30 | | | | |
|---|---|---|---|---|---|
| | 2021 | 2022 | 2023 | 2024 | 2025 |
| **Total Demand** | **683,000** | **694,500** | **706,100** | **670,900** | **689,100** |
| **Existing / Planned Supplies** | | | | | |
| Los Angeles Aqueduct[1] | 86,330 | 98,560 | 48,520 | 94,360 | 105,770 |
| Groundwater[2] | 111,500 | 111,500 | 111,500 | 111,500 | 111,500 |
| Conservation | 29,880 | 32,490 | 35,110 | 37,720 | 40,340 |
| Recycled Water | | | | | 0 |
| - Irrigation and Industrial Use | 20,400 | 21,000 | 23,000 | 25,000 | 27,000 |
| - Groundwater Replenishment | | 15,000 | 15,000 | 15,000 | 15,000 |
| Water Transfers | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| Subtotal | 288,110 | 318,550 | 273,130 | 323,580 | 339,610 |
| **MWD Water Purchases** With Existing/Planned Supplies | 394,890 | 375,950 | 432,970 | 347,320 | 349,490 |
| **Total Supplies** | **683,000** | **694,500** | **706,100** | **670,900** | **689,100** |
| **Potential Supplies** | | | | | |
| Stormwater Capture | | | | | |
| - Capture and Reuse (Harvesting) | 4,400 | 4,800 | 5,200 | 5,600 | 6,000 |
| - Increased Groundwater Production (Recharge) | 2,400 | 2,800 | 3,200 | 3,600 | 4,000 |
| Subtotal | 6,800 | 7,600 | 8,400 | 9,200 | 10,000 |
| **MWD Water Purchases** With Existing/Planned/Potential Supplies | 388,090 | 368,350 | 424,570 | 338,120 | 339,490 |
| **Total Supplies** | **683,000** | **694,500** | **706,100** | **670,900** | **689,100** |

[1] Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impacts.
[2] North Hollywood/Rinaldi-Toluca Treatment Complex is expected to be in operation in FY 2019-20. Tujunga Groundwater Treatment Plant is expected to be in operation in 2020-21. Storage credit of 5,000 afy will be used to maximize the pumping in FY 2020-21 and thereafter. Sylmar Basin production was increased to 4,500 AFY from FY 2014-15 to FY 2029-30 to avoid the expiration of stored water credits, then go back to its entitlement of 3,405 AFY in FY 2030-31.

## *Exhibit 11J*
## *Service Area Reliability Assessment for Multi-Dry Years (2026-2030)*

| Demand and Supply Projections (in acre-feet) | Multiple Dry Years (FY1988-89 to FY1992-93) Fiscal Year Ending on June 30 | | | | |
|---|---|---|---|---|---|
| | 2026 | 2027 | 2028 | 2029 | 2030 |
| **Total Demand** | **707,900** | **720,100** | **732,400** | **696,100** | **715,200** |
| **Existing / Planned Supplies** | | | | | |
| Los Angeles Aqueduct[1] | 86,330 | 98,560 | 48,520 | 94,360 | 105,770 |
| Groundwater[2] | 111,500 | 111,500 | 111,500 | 111,500 | 111,500 |
| Conservation | 42,960 | 45,570 | 48,190 | 50,800 | 53,420 |
| Recycled Water | | | | | 0 |
| - Irrigation and Industrial Use | 27,500 | 28,000 | 28,500 | 29,000 | 29,000 |
| - Groundwater Replenishment | 16,500 | 18,000 | 19,500 | 21,000 | 22,500 |
| Water Transfers | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| Subtotal | 324,790 | 341,630 | 296,210 | 346,660 | 362,190 |
| **MWD Water Purchases** With Existing/Planned Supplies | 383,110 | 378,470 | 436,190 | 349,440 | 353,010 |
| **Total Supplies** | **707,900** | **720,100** | **732,400** | **696,100** | **715,200** |
| **Potential Supplies** | | | | | |
| Stormwater Capture | | | | | |
| - Capture and Reuse (Harvesting) | 6,400 | 6,800 | 7,200 | 7,600 | 8,000 |
| - Increased Groundwater Production (Recharge) | 4,800 | 5,600 | 6,400 | 7,200 | 8,000 |
| Subtotal | 11,200 | 12,400 | 13,600 | 14,800 | 16,000 |
| **MWD Water Purchases** With Existing/Planned/Potential Supplies | 371,910 | 366,070 | 422,590 | 334,640 | 337,010 |
| **Total Supplies** | **707,900** | **720,100** | **732,400** | **696,100** | **715,200** |

[1] Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impacts.
[2] North Hollywood/Rinaldi-Toluca Treatment Complex is expected to be in operation in FY 2019-20. Tujunga Groundwater Treatment Plant is expected to be in operation in 2020-21. Storage credit of 5,000 afy will be used to maximize the pumping in FY 2020-21 and thereafter. Sylmar Basin production was increased to 4,500 AFY from FY 2014-15 to FY 2029-30 to avoid the expiration of stored water credits, then go back to its entitlement of 3,405 AFY in FY 2030-31.

## *Exhibit 11K*
## *Service Area Reliability Assessment for Multi-Dry Years (2031-2035)*

| Demand and Supply Projections (in acre-feet) | Multiple Dry Years (FY1988-89 to FY1992-93) Fiscal Year Ending on June 30 | | | | |
|---|---|---|---|---|---|
| | 2031 | 2032 | 2033 | 2034 | 2035 |
| **Total Demand** | **731,200** | **740,300** | **749,300** | **708,800** | **725,000** |
| Existing / Planned Supplies | | | | | |
| Los Angeles Aqueduct[1] | 86,330 | 98,560 | 48,520 | 94,360 | 105,770 |
| Groundwater[2] | 110,405 | 110,405 | 110,405 | 110,405 | 110,405 |
| Conservation | 55,600 | 57,800 | 60,000 | 62,200 | 64,368 |
| Recycled Water | | | | | 0 |
| - Irrigation and Industrial Use | 29,000 | 29,000 | 29,000 | 29,000 | 29,000 |
| - Groundwater Replenishment | 24,000 | 25,500 | 27,000 | 28,500 | 30,000 |
| Water Transfers | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| Subtotal | 345,335 | 361,265 | 314,925 | 364,465 | 379,543 |
| **MWD Water Purchases** With Existing/Planned Supplies | 385,865 | 379,035 | 434,375 | 344,335 | 345,457 |
| **Total Supplies** | **731,200** | **740,300** | **749,300** | **708,800** | **725,000** |
| **Potential Supplies** | | | | | |
| Stormwater Capture | | | | | |
| - Capture and Reuse (Harvesting) | 8,400 | 8,800 | 9,200 | 9,600 | 10,000 |
| - Increased Groundwater Production (Recharge) | 9,400 | 10,800 | 12,200 | 13,600 | 15,000 |
| Subtotal | 17,800 | 19,600 | 21,400 | 23,200 | 25,000 |
| **MWD Water Purchases** With Existing/Planned/Potential Supplies | 368,065 | 359,435 | 412,975 | 321,135 | 320,457 |
| **Total Supplies** | **731,200** | **740,300** | **749,300** | **708,800** | **725,000** |

[1] Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impacts.
[2] North Hollywood/Rinaldi-Toluca Treatment Complex is expected to be in operation in FY 2019-20. Tujunga Groundwater Treatment Plant is expected to be in operation in 2020-21. Storage credit of 5,000 afy will be used to maximize the pumping in FY 2020-21 and thereafter. Sylmar Basin production was increased to 4,500 AFY from FY 2014-15 to FY 2029-30 to avoid the expiration of stored water credits, then go back to its entitlement of 3,405 AFY in FY 2030-31.

## 11.3 Water Shortage Contingency Plan

The Los Angeles City Municipal Code Chapter XII, Article I, Emergency Water Conservation Plan is the City's water shortage contingency plan (see Appendix I). It was developed to provide for a sufficient and continuous supply of water in case of a water supply shortage in the service area. There are two scenarios that can cause a water shortage: 1) a severe hydrologic dry period affecting surface and groundwater supplies and 2) a catastrophic event that severs major conveyance and/or distribution pipelines serving water to the City. The following discusses LADWP's compliance with the UWMP Act as outlined in Section 10632 (a) (1) through (9) of the California Water Code.

### 11.3.1 Stages of Action – 10632 (a) (1)

As set forth in the Emergency Water Conservation Plan, the City has conservation phases or stages of action that can be undertaken in response to water supply shortages. Although there are no specific percentages of water shortage levels assigned to each phase, LADWP continually monitors water supplies and demands. As necessary, LADWP's Board of Water and Power Commissioners makes recommendations to the Mayor and City Council on the suggested conservation phase to address the water shortage conditions. The implementation of progressive conservation phases will cope with up to a 50 percent reduction in water supplies and roughly correspond to the water shortage percentages described below:

**No Shortage, Phase I (0 percent)**

Phase I prohibited uses of water are in effect at all times within the City. These prohibited uses, defined in article 10632 (a) (4) (see section 11.3.4), are intended to eliminate waste and increase public awareness of the need to conserve water. There are further stages of compounding actions in addition to the Phase I prohibited uses that might be imposed. Phase II to Phase V progressively responds to different severities of shortage and implement additional prohibited uses of water.

**Moderate Shortage, Phase II (roughly corresponding to >0 to 15 percent)**

1. Should Phase II be implemented, uses applicable to Phase I shall continue to be applicable, except as specifically provided herein.

2. No landscape irrigation shall be permitted on any day other than Monday, Wednesday, or Friday for odd-numbered street addresses and Tuesday, Thursday, or Sunday for even-numbered street addresses. Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address. Watering times shall be limited to: (a) Non-conserving nozzles (spray head sprinklers and bubblers) – no more than eight minutes per watering day per station for a total of 24 minutes per week; (b) Conserving nozzles (standard rotors and multi-stream rotary heads) – no more than 15 minutes per cycle and up to two cycles per watering day per station for a total of 90 minutes per week.

3. Upon written notice to LADWP, irrigation of sports fields may deviate from non-watering days to maintain play areas and accommodate event schedules; however, to be eligible for this means of compliance, a customer must reduce his overall monthly water use by LADWP's Board of Water and Power Commissioners' adopted degree of shortage plus an additional 5 percent from the customer baseline water usage within 30 days.

4. Upon written notice to LADWP, large landscape areas may deviate from the non-watering days by meeting the following requirements (1) must have approved weather-based irrigation controllers registered with LADWP (eligible weather-based irrigation controllers are those approved by MWD or the Irrigation Association Smart Water Application Technologies (SWAT) initiative (2) must reduce overall monthly water use by LADWP's Board of Water and Power Commissioners' adopted degree of shortage plus an additional 5 percent from the customer baseline water usage within 30 days; and (3) must use recycled water if it is available from LADWP.

5. These provisions do not apply to drip irrigation supplying water to a food source or to hand-held hose watering of vegetation, if the hose is equipped with a self-closing water shut-off device, which is allowed everyday during Phase II except between the hours of 9:00 am and 4:00 pm.

**Severe Shortage, Phase III (roughly corresponding to 15 to 20 percent shortage)**

1. Should Phase III be implemented, uses applicable to Phases I and II shall continue to be applicable, except as specifically provided herein.

2. No landscape irrigation shall be permitted on any day other than Monday for odd-numbered street addresses and Tuesday for even-numbered street addresses. Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address.

3. No washing of vehicles allowed except at commercial car wash facilities.

4. No filling of residential swimming pools and spas with potable water.

5. Upon written notice to LADWP, irrigation of sports fields may deviate from the specific non-watering days and be granted one additional water day (for a total of two watering days allowed). To be eligible for this means of compliance, a customer must reduce his overall monthly water use by LADWP's Board of Water and Power Commissioners' adopted degree of shortage plus an additional 10 percent from the customer baseline water usage within 30 days.

6. Upon written notice to LADWP, large landscape areas may deviate from the specific non-watering days and be granted one additional watering day (for a total of two watering days allowed) by meeting the following requirements (1) must have approved weather-based irrigation controllers registered with LADWP (eligible weather-based irrigation controllers are those approved by MWD or the Irrigation Association Smart Water Application Technologies (SWAT) initiative (2) must reduce overall monthly water use by LADWP's Board of Water and Power Commissioners' adopted degree of shortage plus an additional 10 percent from the customer baseline water usage within 30 days; and (3) must use recycled water if it is available from LADWP.

7. These provisions do not apply to drip irrigation supplying water to a food source or to hand-held hose watering of vegetation, if the hose is equipped with a self-closing water shut-off device, which is allowed everyday during Phase III except between the hours of 9:00 am and 4:00 pm.

**Critical Shortage, Phase IV (roughly corresponding to 20 to 35 percent shortage)**

1. Should Phase IV be implemented, uses applicable to Phases I, II, and III shall continue to be applicable, except as specifically provided herein.

2. No landscape irrigation allowed.

**Super Critical Shortage, Phase V (roughly corresponding to 35 to 50 percent shortage)**

1. Phase I, II, III, and IV shall continue to remain in effect.

2. The Board of Water and Power Commissioners is hereby authorized to implement additional prohibited uses of water based on the water supply situation. Any additional prohibitions shall be published at least once in a daily newspaper of general circulation and shall become effective immediately upon such publication and shall remain in effect until cancelled.

## 11.3.2 Driest Three-Year Supply – 10632 (a) (2)

In the event that three consecutive dry-years curtailing the City's LAA System deliveries should follow the 2010 water supply conditions, LADWP will rely on increased groundwater pumping and purchases from MWD to meet City water demands. This particular sequence is quantified in Exhibit 11L, including relevant assumptions.

During such severe drought periods, the City's supplemental water supplier MWD will use its WSAP in conjunction with the framework developed in its WSDM Plan. Developed by MWD with substantial input from its member agencies, the WSDM

### *Exhibit 11L*
### *Driest Three-Year Water Supply Sequence*

| **Demand and Supply Projections (in acre-feet)** | FY2009-10 Actual | **Followed by Repeat of Driest Three Consecutive Years FY1958/59 to 1960/61 Hydrology Fiscal Year Ending on June 30** | | |
|---|---|---|---|---|
| | | 2011 | 2012 | 2013 |
| **Total Demand** | **555,447** | **590,000** | **608,200** | **626,500** |
| **Existing / Planned Supplies** | | | | |
| Los Angeles Aqueduct | 199,739 | 104,530 | 50,849 | 59,382 |
| Groundwater | 76,982 | 61,090 | 53,660 | 46,260 |
| Conservation | 8,178 | 9,380 | 10,580 | 11,780 |
| Recycled Water | | | | |
| - Irrigation and Industrial Use | 6,703 | 7,500 | 8,300 | 9,000 |
| - Groundwater Replenishment | 0 | 0 | 0 | 0 |
| Water Transfers | 0 | 0 | 0 | 0 |
| Subtotal | 291,602 | 182,500 | 123,389 | 126,422 |
| **MWD Water Purchases** With Existing/Planned Supplies | 263,845 | 407,500 | 484,811 | 500,078 |
| **Total Supplies** | **555,447** | **590,000** | **608,200** | **626,500** |

Assumptions

1. Driest three consecutive years on record in LAA watershed (FY1958-59 to FY1960-61) averaged 28 percent of normal runoff.
2. LAA deliveries reflect increased releases for environmental restoration in the Owens Valley and Mono Basin.
3. Dry year demands are 5 percent greater than normal year demands
4. MWD's Water Surplus and Drought Management Plan actions are sufficient to meet LADWP demands.

Plan provides for the WSAP's needs-based allocation strategy, and establishes priorities for the use of MWD's water supplies to achieve retail reliability.

The following are actions that could be taken by MWD, in accordance with their WSDM Plan, to augment its water supplies prior to implementation of any WSAP drought allocation action:

1. Draw on Diamond Valley Lake storage.

2. Draw on out-of-region storage in Semitropic and Arvin-Edison Groundwater Banks.

3. Reduce/suspend local groundwater replenishment deliveries.

4. Draw on contractual groundwater storage programs in MWD's service area.

5. Draw on State Water Project terminal reservoir storage (per Monterey Agreement).

6. Call for voluntary conservation and public education.

7. Reduce deliveries from MWD's Interim Agricultural Water Program.

8. Call on water transfer options contracts.

9. Purchase transfers on the spot market.

10. Allocate imported water in accordance with the WSAP if necessary.

In 2008 MWD adopted the WSAP which is designed to allocate supplies among its member agencies in a fair and efficient manner. The WSAP establishes the formula for calculating member agency allocations if MWD cannot meet firm demands in a given year.

## 11.3.3 Catastrophic Supply Interruption Plan – 10632 (a) (3)

### Seismic Assessment of Major Imported Supplies

MWD performed a seismic risk assessment of its water distribution network to evaluate the impacts of seismic activity in the greater Southern California area. For MWD, there are three sources of imported water to the region: the Colorado River Aqueduct (CRA), the East SWP branch, and the West SWP branch. Each source was evaluated for the potential of failure during a seismic event. The SWP East branch is considered more vulnerable because the California Aqueduct's alignment follows the San Andreas fault-line and crosses over the San Andreas Fault at multiple locations. The SWP West branch and CRA are somewhat less vulnerable due to their proximity to the San Andreas fault-line, although the San Andreas Fault crosses all aqueducts entering the Southern California region. It crosses the SWP East branch three times, the SWP West branch once, the CRA once, and the LAA once.

LADWP investigated the ability of MWD to deliver Colorado River water into the west San Fernando Valley in the event that SWP supplies and LAA supplies are interrupted. This investigation included the two MWD service areas adjacent to the West San Fernando Valley, the Calleguas and Las Virgines Municipal Water Districts. If imported supply from the SWP and LAA are severed, MWD has prolonged emergency storage in Castaic and Pyramid Lakes. Given the proximity of MWD infrastructure to seismic activity on the San Andreas Fault, MWD staff predicts that if Castaic and Pyramid Lakes become disconnected from the City emergency repairs can be made to ensure that supply is not interrupted for an extended period of time. In a worst case scenario, if these sources are cut off from the City, 50 cubic feet per second of CRA water could be moved through

MWD's system to serve the west San Fernando Valley, Calleguas MWD, and Las Virgines MWD until repairs to the MWD facilities could be made. On-call contractors working around the clock could be deployed to repair seismic damage in as short as a two-week time period depending on the severity and location of the break(s). Due to these risks MWD's current storage policy is to maintain maximum emergency storage in both Pyramid and Castaic Lakes.

## Emergency Response Plan

LADWP has Emergency Response Plans (ERPs revised January 2011) in place to restore water service for essential use in the City if a disaster, such as earthquakes and power outages, should result in the temporary interruption of water supply. Department personnel responsible for water transportation, distribution, and treatment have established ERPs to guide the assessment, prioritization, and repair of City facilities that have incurred damage during a disaster.

An Emergency Operations Center (EOC) serves as a centralized point for citywide management of information about disasters and for coordination of all available resources. The EOC supports the City's Emergency Operations Organization to achieve its mission of saving lives, protecting property, and returning the City to normal operations in the event of a disaster. LADWP coordinates its efforts with the EOC and will utilize the EOC to resume water supply service after a catastrophic event.

**Earthquakes**

In the event of a major earthquake, LADWP has a Disaster Response Plan dedicated for the LAA in addition to its overall Emergency Response Plan. The Disaster Response Plan details procedures for operating the LAA following an earthquake in order to prevent further damage of the LAA. If the LAA is severed by seismic activity on the San Andreas fault and is temporarily unable to provide water to the City, LADWP will be able to use its water storage in the Bouquet Reservoir to provide water supply to the City while repairs are made. In addition to this resource, if the California Aqueduct is intact south of the Neenach Pump Station (First Los Angeles Aqueduct – State Water Project Connection), arrangements may be made to transfer LAA water through this connection into the California Aqueduct for delivery to MWD. Arrangements can then be made to deliver water to the City through one of MWD's connections.

**Power Outages**

Most of LADWP's major pump stations have backup generators in the event a major power outage disrupts the primary energy system. Backup generators are either powered by a separate electric source or have independent diesel power. The diesel powered backup supplies are capable of running for at least 24 hours. In the event of a major power outage, all pump stations are designed to automatically switch to their backup generators to prevent disruption of water service. In addition, LADWP keeps an adequate storage supply which is able to keep the water distribution system operable until power is restored.

## 11.3.4 Mandatory Water Use Prohibitions – 10632 (a) (4)

Phase I prohibited uses of the Emergency Water Conservation Plan contain 13 wasteful water use practices that are permanently prohibited for all City of Los Angeles customers. These prohibited uses are intended to eliminate waste and increase public awareness of the need to conserve water. During times of shortage, education and enforcement of the following provisions will be increased:

1. No customer shall use a water hose to wash any paved surfaces including, but not limited to, sidewalks, walkways, driveways, and parking areas, except to alleviate immediate

safety or sanitation hazards. This section shall not apply to LADWP approved water conserving spray cleaning devices. Use of water pressure devices for graffiti removal is exempt. A simple spray nozzle does not qualify as a water conserving spray cleaning device.

2. No customer shall use water to clean, fill, or maintain levels in decorative fountains, ponds, lakes, or similar structures used for aesthetic purposes unless such water is part of a recirculating system.

3. No restaurant, hotel, cafe, cafeteria, or other public place where food is sold, served, or offered for sale shall serve drinking water to any person unless expressly requested.

4. No customer shall permit water to leak from any pipe or fixture on the customer's premises; failure or refusal to affect a timely repair of any leak of which the customer knows or has reason to know shall subject said customer to all penalties for a prohibited use of water.

5. No customer shall wash a vehicle with a hose if the hose does not have a self-closing water shut-off device or device attached to it, or otherwise to allow a hose to run continuously while washing a vehicle.

6. No customer shall irrigate during periods of rain.

7. No customer shall water or irrigate lawn, landscape, or other vegetated areas between the hours of 9:00 a.m. and 4:00 p.m. During these hours, public and private golf courses greens and tees and professional sports fields may be irrigated in order to maintain play areas and accommodate event schedules. Supervised testing or repairing of irrigation systems is allowed anytime with proper signage.

8. All irrigating of landscape with potable water using spray head sprinklers and bubblers shall be limited to no more than ten minutes per watering station per day. All irrigating of landscape with potable water using standard rotors and multi-stream rotary heads shall be limited to no more than fifteen minutes per cycle and up to two cycles per watering day per station. Exempt from these irrigation restrictions are irrigation systems using very low drip type irrigation when no emitter produces more than four gallons of water per hour and micro-sprinklers using less than fourteen gallons per hour. This provision does not apply to Schedule F water customers or water service water service that has been granted the General Provision M rate adjustment under the City's Water Rates Ordinance, subject to the Customer having complied with best management practices for irrigation approved by the Department. The 9:00 a.m. to 4:00 p.m. irrigation restriction shall apply unless specifically exempt as stated in subsection 7 of the Emergency Water Conservation Ordinance.

9. No customer shall water or irrigate any lawn, landscape, or other vegetated area in a manner that causes or allows excess or continuous flow or runoff onto an adjoining sidewalk, driveway, street, gutter, or ditch.

10. No installation of single pass cooling systems shall be permitted in buildings requesting new water service.

11. No installation of non-recirculating systems shall be permitted in new conveyor car wash and new commercial laundry systems.

12. Operators of hotels and motels shall provide guests with the option of choosing not to have towels and linens laundered daily. The hotel or motel shall prominently display notice of this option in each bathroom using clear and easily understood language. LADWP shall make suitable displays available.

13. No large landscape areas shall have irrigation systems without rain sensors that shut-off the irrigation systems. Large landscape areas with approved weather-based irrigation controllers registered with LADWP are in compliance with this requirement.

## 11.3.5 Consumption Reduction Methods During Most Restrictive Stages – 10632 (a) (5)

### Short-Term Actions

During a water shortage or emergency condition, LADWP utilizes its Emergency Water Conservation Plan (11.3.1) to decrease water use as needed based on the severity of the shortage. The Emergency Water Conservation Plan is capable of reducing water use by up to 50 percent.

In addition, LADWP's existing rate structure (enacted in 1993) serves as a basis for further reducing consumption. First tier water allotments are reduced during shortages by the degree of the shortage. For single-family residential users, the adjusted first tier allotments apply for the entire year. For other users, the adjusted first tier allotments apply only during the high season (June 1 through October 31). Details of LADWP's water rate structure are provided in Appendix C – Water Rate Ordinance.

To provide immediate demand reductions and increase public awareness of the need to conserve water, additional measures can be phased in as the dry period continues. Included among these measures are water conservation public service announcements (through television and/or radio), billboard ads, flyer distributions, and conservation workshops. LADWP also actively participates in public exhibits to disseminate water conservation information within its service area. Conservation is a permanent and long-term ethic adopted by the City to counter the potentially adverse impacts of water supply shortages.

State law further regulates distribution of water in extreme water shortage conditions. Section 350-354 of the California Water Code states that when a governing body of a distributor of a public water supply declares a water shortage emergency within its service area, water will be allocated to meet needs for domestic use, sanitation, fire protection, and other priorities. This will be done equitably and without discrimination between customers using water for the same purpose(s).

### Long-Term Actions

LADWP's long-range water conservation program is driven by the need to continuously increase water use efficiency. This will reduce demand, extend supply, and therefore, provide greater reliability. Dry cycle experiences, public trust responsibilities, and regulatory mandates have raised the level of awareness within the City of Los Angeles of the need to approach demand reduction from a permanent and long-term perspective.

LADWP will continue to maintain and increase its existing conservation programs and pursue the development of new and innovative programs as outlined in Chapter 3, Water Conservation with the goal of reducing potable water demands by 60,000 AFY by 2035. Emphasis continues to be placed on structural conservation for the residential and CII sectors (HETs, high-efficiency washing machine rebates, etc.) which result in permanent per capita water use reduction. Substantial efforts are also being placed on landscape water use efficiency and CII conservation opportunities. It should, however, be recognized that the ability to achieve water reduction during shortages by requesting additional voluntary measures is likely to be more difficult in the future. As customers adjust to a conservation ethic and adopt permanent measures to reduce water use, their water demands harden and become less susceptible to voluntary conservation.

### 11.3.6 Penalties for Excessive Use (Non-Compliance to Prohibited Use) – 10632 (a) (6)

The Emergency Water Conservation Plan sets penalties for violations of prohibited uses outlined in Sections 10632 (a) (1) and (a) (4). The penalties vary by water meter size. For water meters smaller than two inches the following penalties shall apply:

1. The first violation consists of a written warning.
2. The second violation within the preceding 12 month period will result in a surcharge in the amount of $100 added to the customer's water bill.
3. The third violation within the preceding 12 month period will result in a surcharge in the amount of $200 added to the customer's water bill.
4. The fourth violation within the preceding 12 month period will result in a surcharge in the amount of $300 added to the customer's water bill.
5. After a fifth violation or subsequent violation within the preceding 12 month period, LADWP may install a flow-restricting device of 1 gpm capacity for services up to 1 ½ inches in size and comparatively sized restrictors for larger services or terminate a customer's service, in addition to the aforementioned financial surcharges. Such action shall only be taken after a hearing held by LADWP.

For water meters two inches and larger the following penalties shall apply:

1. The first violation consists of a written warning.
2. The second violation within the preceding 12 month period will result in a surcharge in the amount of $200 added to the customer's water bill.
3. The third violation within the preceding 12 month period will result in a surcharge in the amount of $400 added to the customer's water bill.
4. The fourth violation within the preceding 12 month period will result in a surcharge in the amount of $600 added to the customer's water bill.
5. After a fifth violation or subsequent violation within the preceding 12 month period, LADWP may install a flow-restricting device or terminate a customer's service, in addition to the aforementioned financial surcharges. Such action shall only be taken after a hearing held by LADWP.

## 11.3.7 Analysis and Effects on Revenues and Expenditures of Reduced Sales during Shortages – 10632 (a) (7)

The City's Water Rate Ordinance, adopted in June 1995 and last amended in June 2008, provides a remedy to the impact of reduced water sales on revenues in the form of a Water Revenue Adjustment Factor (Adjustment). The Adjustment recovers any shortage in revenue due to variation in water sales. It is intended to support a fiscal year revenue target that is deemed sufficient to cover LADWP's essential expenses. The formula takes into account target and actual revenues as well as projected water sales to determine the appropriate Adjustment.

The Adjustment is currently limited to $.18 per hundred-cubic-feet (one billing unit). It cannot exceed this limit unless the Board of Water and Power Commissioners determines that a surcharge in excess of $0.18 per hundred-cubic-feet is financially required and approval from the Los Angeles City Council is obtained. The Board of Water and Power Commissioners also has the authority to reduce the factor to less than the formula-calculated amount.

A billing factor is calculated annually on January 1 and is added to the standard commodity charge. The factor is set to zero if a negative value is calculated. A Water Revenue Adjustment Account is maintained and updated each month by LADWP. This account is adjusted annually on July 1.

The City's Water Revenue Adjustment Factor ensures that resources are available to fund LADWP activities aimed at providing continuous water service to Los Angeles water users, even during periods of low water sales.

## 11.3.8 Water Shortage Contingency Resolution or Ordinance – 10632 (a) (8)

A draft water shortage contingency declaration resolution is shown in Exhibit 11M. Moreover, the City's Emergency Water Conservation Plan Section 121.07.B has the following conservation phase implementation procedures:

"The Department (LADWP) shall monitor and evaluate the projected supply and demand for water by its Customers monthly, and shall recommend to the Mayor and Council by concurrent written notice the extent of the conservation required by the Customers of the Department in order for the Department to prudently plan for and supply water to its Customers. The Mayor shall, in turn, independently evaluate such recommendation and notify the Council of the Mayor's determination as to the particular phase of water conservation, Phase I through Phase V, that should be implemented. Thereafter, the Mayor may, with the concurrence of the Council, order that the appropriate phase of water conservation be implemented in accordance with the applicable provisions of this Article. Said order shall be made by public proclamation and shall be published one time only in a daily newspaper of general circulation and shall become effective immediately upon such publication. The prohibited water uses for each phase shall take effect with the first full billing period commencing on or after the effective date of the public proclamation by the Mayor. In the event the Mayor independently recommends to the Council a phase of conservation different from that recommended by the Department, the Mayor shall include detailed supporting data and the reasons for the independent recommendation in the notification to the Council of the Mayor's determination as to the appropriate phase of conservation to be implemented."

The City's Water Rate Ordinance No. 170435 also has specific provisions for LADWP's Board of Water and Power Commissioners, through a resolution, to determine the degree of shortage and apply corresponding commodity charges in case of a water shortage (see Section 11.3.5 and Appendix C – Water Rate Ordinance). If a water shortage is declared, certified copies of the resolution will be transmitted to the offices of the Mayor and of the Los Angeles City Clerk, and the Los Angeles City Council for final approval. This particular water shortage act is included under Section 3 – General Provisions, Article R – Shortage Year Rates of the City's Water Rate Ordinance.

### 11.3.9 Methodology to Determine Actual Water Use Reductions during Shortages – 10632 (a) (9)

Water use is monitored closely by LADWP throughout its service area regardless of the supply conditions. With 100 percent of its over 700,000 service connections metered, there is a high degree of accountability on the quantity of water used within the LADWP service area. Information from meter reads is collected for billing and accounting purposes, with reports prepared on a monthly basis from the data compiled. The actual

***Exhibit 11M***
***Draft Water Shortage Contingency Declaration Resolution***

BE IT RESOLVED that the Board of Water and Power Commissioners (Board) recognizes that a Water Shortage Contingency Plan has been prepared and incorporated into the City of Los Angeles 2010 Urban Water Management Plan pursuant to the Urban Water Management Planning Act; the Urban Water Management Plan is on file with the Secretary of the Board; this Board has reviewed and considered the information and recommendations contained in this document, and makes the following findings and determinations:

1.The water supply available to the City of Los Angeles is insufficient to meet the City's normal water supply needs; and

2.The Department of Water and Power has developed a Water Shortage Contingency Plan for the City of Los Angeles that compiles with all the requirements of the Urban Water Management Planning Act; and

3.The Urban Water Management Plan has been developed, adopted, and implemented pursuant to Article 3, Sections 10640 through 10645 of the Urban Water Management Planning Act; and

4.The Water Shortage Contingency Plan includes stages of action that can be taken in response to water supply shortages, including up to a 50 percent reduction in water supply, a driest three-year water supply scenario, mandatory water use prohibitions, and penalties for non-compliance; and

5.The Water Shortage Contingency Plan identifies both short-term and long-term actions to maximize water use efficiency and minimize the effects of the current water shortage as well as future water supply shortages.

BE IT FURTHER RESOLVED that this Board has adopted the Water Shortage Contingency Plan as incorporated in the Urban Water Management Plan, and declares the provisions of the Water Shortage Contingency Plan in full force and effect during the duration of this period of water shortage.

I HEREBY CERTIFY that the foregoing is a full, true, and correct copy of the resolution adopted by the Board of Water and Power Commissioners of the City of Los Angeles at its meeting held water reductions are determined by comparing the metered water use to the normal water use under average weather condition when no mandatory water conservation is imposed. Based on these criteria, the water use level of FY 2006/07 was selected as the base year or the normal year to determine the effectiveness of water reduction measures during the recent water supply shortage.

LADWP also used a conservation model to establish a weather-normalized demand to estimate conservation efforts within the City since the early 1990s. The model estimated City water demand without conservation efforts using population and weather variables. A new conservation model was developed in 2010 to account for additional factors such as economic recession and drought conservation. This model is discussed in Chapter 2, Water Demand. The City's conservation effort is derived by comparing estimated pre-conservation demand with actual demand. Conservation efforts derived from this model are shown in Chapter 3, Water Conservation.

## 11.4 Water Supply Assessments

### Background

In 1994, the California Legislature enacted Water Code Section 10910 (Senate Bill 901), which requires cities and counties, as part of California Environmental Quality Act (CEQA) review, to request the applicable public water system to assess whether the system's projected water supplies were sufficient to meet a proposed development's anticipated water demand. The intent was to link the land use and water supply planning processes to ensure that developers and water supply agencies communicate early in the planning process. However, a study of projects approved by local planning agencies revealed that numerous projects were exempted due to loopholes in the statute, and that the intent of the legislation had largely gone unfulfilled.

Subsequently, California Senate Bill (SB) 610 and SB 221, modeled after SB 901, amended State law effective January 1, 2002, to ensure that the original intent of the legislation is fulfilled. SB 610 and 221 are companion measures which seek to promote more collaborative planning between local water suppliers and cities and counties. These bills improve the link between information on water supply availability and certain land use decisions made by cities and counties. Both statutes require detailed information regarding water availability to be provided to the city and county decision-makers prior to approval of specified large development projects. Both statutes also require this detailed information be included in the administrative record that serves as the evidentiary basis for an approval action by the city or county on such projects. Both measures recognize local control and decision making regarding the availability of water for projects and the approval of projects.

Under SB 610, a water supply assessment (WSA) must be furnished to local governments for inclusion in any environmental documentation for specified types of development projects subject to CEQA. Specifically, SB 610 requires that for certain projects, the CEQA lead agency must identify a public water system that may supply water to the proposed project and request the public water system to determine the water demand associated with the project and whether such demand is included as part of the public water system's most recently adopted UWMP. If the projected water demand associated with the proposed project is accounted for in the most recently adopted UWMP, the public water system may incorporate the supporting information from the UWMP in preparing the elements of the assessment. If the proposed project's water demand is not accounted for in the most recently adopted UWMP, the WSA for the project shall include a discussion with regard to


whether the public water system's total projected water supplies available in normal, single dry, and multiple dry water years during a 20-year projection will meet the proposed project's water demand.

Per Section 10912 of the California Water Code, a project which is subject to the requirements of SB 610 includes: (1) a proposed residential development of more than 500 dwelling units; (2) a proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space; (3) a proposed commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space; (4) a proposed hotel or motel, or both, having more than 500 rooms; (5) a proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area; (6) a mixed-use project that includes one or more of the projects specified in this subdivision; or (7) a project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500 dwelling unit project.

The assessment would include an identification of existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project and water received in prior years pursuant to those entitlements, rights, and contracts. If the assessment concludes that water supplies will be insufficient, plans for acquiring additional water supplies would need to be presented.

Under SB 221, approval by a city or county of new large development projects requires an affirmative written verification of sufficient water supply; which is a "fail safe" mechanism to ensure that collaboration on finding the needed water supplies to serve a new large development occurs before construction begins.

## Methodology

During the years from 2005 to 2010, LADWP has received requests to develop over 40 WSAs. Each WSA performed by LADWP is carefully evaluated within the context of the current adopted UWMP and current conditions, such as restrictions on SWP pumping from the Sacramento-San Joaquin Delta imposed by a Federal court. MWD, from whom the City purchases its SWP and Colorado River water supplies, has also been actively developing plans and making efforts to provide additional water supply reliability for the entire Southern California region. LADWP coordinates closely with MWD to ensure implementation of MWD's water resource development plans and supplemental water reliability report prepared by MWD.

LADWP's UWMP uses a service area-wide method in developing City water demand projections. This methodology does not rely on individual development demands to determine area-wide growth. Rather, the growth in water use for the entire service area was considered in developing long-term water projections for the City to the year 2035. The driving factors for this growth are demographics, weather, and conservation. LADWP used anticipated growth in the various customer class sectors as provided by MWD who reallocated projected demographic data from the Southern California Association of Governments (SCAG) into member agencies' service areas. The data used was based on SCAG's 2008 Regional Transportation Plan Forecast.

As governed by City Charter Sections 673 and 677, LADWP can serve surplus water supplies to areas outside of the City boundaries. There are approximately 4,500 services for customers outside of the City, with a combined annual water use less than 1 percent of all water delivered. Water served outside of the City includes a surcharge to account for the increased MWD purchased water.

The water demand forecast model in the UWMP was developed using LADWP total water use, including the water served by LADWP for use outside of the City. The service area reliability assessment was performed for three hydrologic conditions: average year, single dry year, and multiple-dry years; and a Shortage Contingency Plan was developed to provide for a sufficient and continuous supply in LADWP's service area. This Shortage Contingency Plan included water provided for use outside of the City.

An important part of the water planning process is for LADWP to work collaboratively with MWD to ensure that anticipated water demands are incorporated into MWD's long-term water resources development plan and water supply allocation plan. The City's allotment of MWD water supplies under MWD's Water Supply Allocation Plan is based on the City's total water demand which includes services to areas outside the City. The ongoing collaboration between LADWP and MWD is critical in ensuring that the City's anticipated water demands are incorporated into the development of MWD's long-term Integrated Resources Plan (IRP). MWD's IRP directs a continuous regional effort to develop regional water resources involving all of MWD's member agencies. Successful implementation of MWD's IRP has resulted in reliable supplemental water supplies for the City from MWD.

In summary, the WSAs are performed to ensure that adequate water supplies would be available to meet the estimated water demands of the proposed developments during normal, single-dry, and multiple-dry water years, as well as existing and planned future uses of the City's water system. LADWP will continue to perform WSAs as part of its long-term water supply planning efforts for its service area.

## WSA Procedure

The CEQA lead agency, such as the City Planning Department or the Community Redevelopment Agency of the City of Los Angeles, evaluates the proposed project against the requirements for a WSA in accordance with the Water Code.

If the proposed project falls within the requirements for a WSA, a formal request is submitted to LADWP to perform a WSA.

In evaluating a proposed project's water demand, LADWP applies the Sewer Generation Factors (published by City of Los Angeles Bureau of Sanitation) to the development's project description for calculating indoor water use. Outdoor landscape water demand is calculated by using computer software which takes into account various factors such as landscape area square footage, location, and plant types. Historical billing records are used to establish existing baseline water demand on the property.

LADWP also encourages all projects to implement additional water conservation measures above and beyond the current water conservation ordinance requirements. As an example, if the proposed development is near an existing or future recycled water pipeline system, commitment to use recycled water for irrigation, toilet flushing and cooling towers is highly recommended as part of the additional conservation measures for the proposed development.

The net increase/decrease in water demand, which is the projected additional water demand of the development, is calculated by subtracting the existing baseline water demand and water saving amount from the total proposed water demand. If the land use of the proposed development is consistent with the City's General Plan, the projected water demand of the development is considered to be accounted for in the most recently adopted UWMP. The City incorporates the projected demographic data from the SCAG in its General Plan. MWD utilizes a land use based planning tool that allocates SCAG's projected demographic data into water service areas for their member agencies, which was adopted for water demand projection in the UWMP.

If the proposed land use is not consistent with the City's General Plan, the WSA will further evaluate if the projected supplies from the UWMP are able to accommodate the proposed project's water demand, which may include other resource options to offset the projected water demand.

All WSAs are subject to approval by the Board of Water and Power Commissioners. Upon approval, the CEQA lead agency is responsible for enforcing the requirements of the WSA as part of the approval for the project.

Chapter Twelve

# Climate Change

## 12.0 Overview

LADWP is considering the impacts of climate change on its water resources as an integral part of its long-term water supply planning. Climate change is a global-scale concern, but is particularly important in the western United States where potential impacts on water supplies can be significant for water agencies. Climate change can impact surface supplies from the Los Angeles Aqueduct (LAA), imported supplies from Metropolitan Water District (MWD), and local demands. As part of this impact analysis, LADWP completed a study to analyze the operational and water supply impacts of potential shifts in the timing and quantity of runoff along the LAA system due to climate change in the 21st Century. Such potential shifts may require LADWP to modify both the management of local water resources and LAA supplies. Projected changes in climate are expected to alter hydrologic patterns in the LAA's eastern Sierra Nevada Watershed through changes in precipitation, snowmelt, relative ratios of rain and snow, winter storm patterns, and evapotranspiration.

To understand some of the key issues surrounding climate change impacts, it is important to put it into the context of LADWP's water supplies. California lies within multiple climate zones. Therefore, each region will experience unique impacts due to climate change. Because LADWP relies on both local and imported water sources, it is necessary to consider the potential impacts climate change could have on the local watershed as well as the western and eastern Sierra Nevada watersheds. The western Sierra Nevada is where a portion of MWD's imported water originates and the eastern Sierra Nevada is where LAA supplies originate. It is also necessary to consider impact in the Colorado River Basin where Colorado River Aqueduct supplies originate.

Generally speaking, any water supplies that are dependent on natural hydrology are vulnerable to climate change, especially if the water source originates from mountain snowpack. For LADWP, the most vulnerable water sources subject to climate change impacts are imported water supplies from MWD and the LAA. However, local sources can expect to see some changes in the future as well. In addition to water supply impacts, changes in local temperature and precipitation are expected to alter water demand patterns. However, there is still general uncertainty within the scientific community regarding the potential impacts of climate change within the City of Los Angeles. LADWP will continue to stay abreast of developments in climate change to better understand its potential implications for the City's local and imported water supplies and in-city demands.

## 12.1 Potential Impacts of Climate Change on Water Service Reliability

Scientists predict future climate change scenarios using highly complex computer global climate models (GCMs) to simulate climate systems. Although most of the scientific community agrees that climate change is occurring and, as a result, mean temperatures for the planet will increase, the specific degree of this temperature increase cannot be accurately predicted. Predictions of changes in precipitation are even more speculative, with some scenarios showing precipitation increasing in the future and others showing the opposite.

It is important to acknowledge that the predictions of the GCMs lack the desired precision due to the presence of uncertainties inherent in the analyses. The uncertainty relating to future emissions of greenhouse gases (GHG) and the chaotic nature of the climate system leads to uncertainty in regard to the response of the global climate system to increases in GHG. In addition, the science of climate change still lacks a complete understanding of regional manifestations resulting from global changes, thus restraining the projecting ability of these models. However, these model's projections are consistent with the state of science today, and they help predict the manner in which hydrologic variables are likely to respond to a range of possible future climate conditions, and thus they provide invaluable insight for water managers in their decisions pertaining to water supply reliability.

The regional areas of interest in assessing climate change impacts to LADWP include the local service area and sources of origination for imported water supplies in northern California, eastern Sierra Nevada Mountains, and the Colorado River Basin. Data regarding climate change impacts for the various regions of interest is provided in this section.

## 12.1.1 Local Impacts

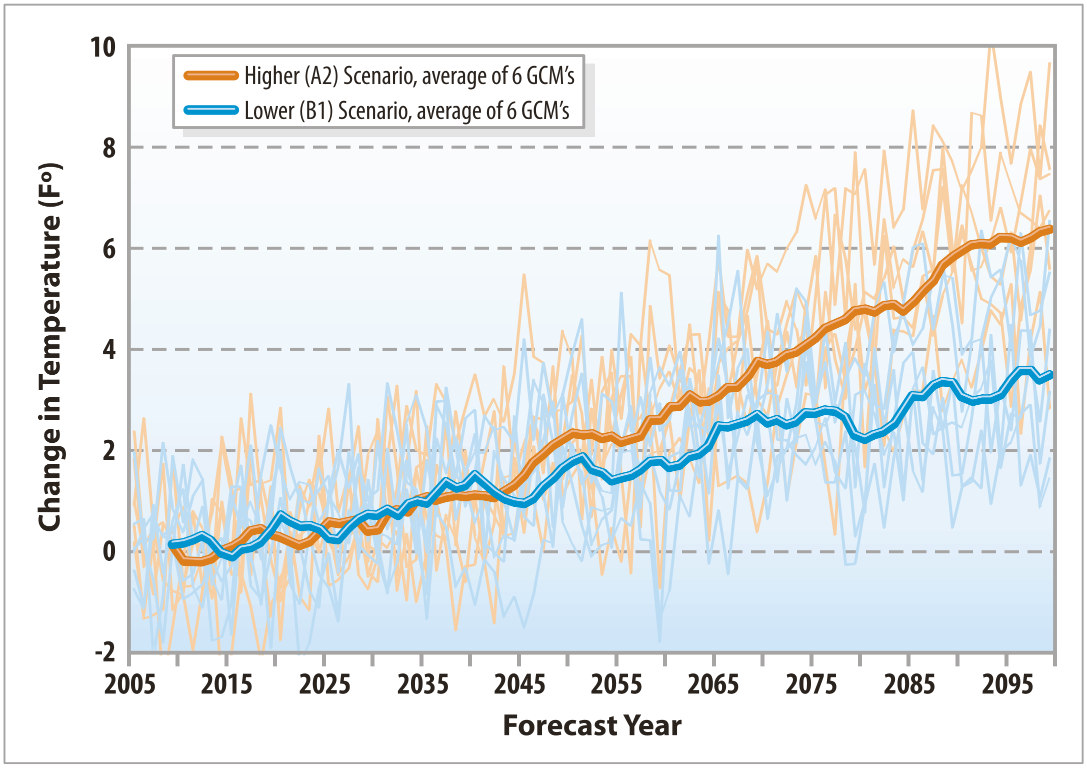
Most scientific experts believe that because of the uncertainty involved with each model, several models should be used to test the potential impact of climate change. To downsize the global coarse-scale climate projections to a regional level incorporating local weather and topography, the GCMs are "downscaled". For the City of Los Angeles, future projections of precipitation and temperature were obtained for six GCMs under two GHG emission scenarios (A2 - higher and B1 - lower) , . Exhibits 12A and 12B plot the changes in projected average annual mean temperature and precipitation, respectively for the model scenarios. The bold line represents the running average of all six models for each emission scenario. These six models were also used in preparation of the California Energy Commision – Public Interest Energy Research Program's study entitled *Climate Change Scenarios and Sea Level Rise Estimates for the 2008 California Climate Change Scenarios Assessment*, which investigated possible future climate changes throughout California.

Local climate changes within the vicinity of the LADWP service area are expected to include:

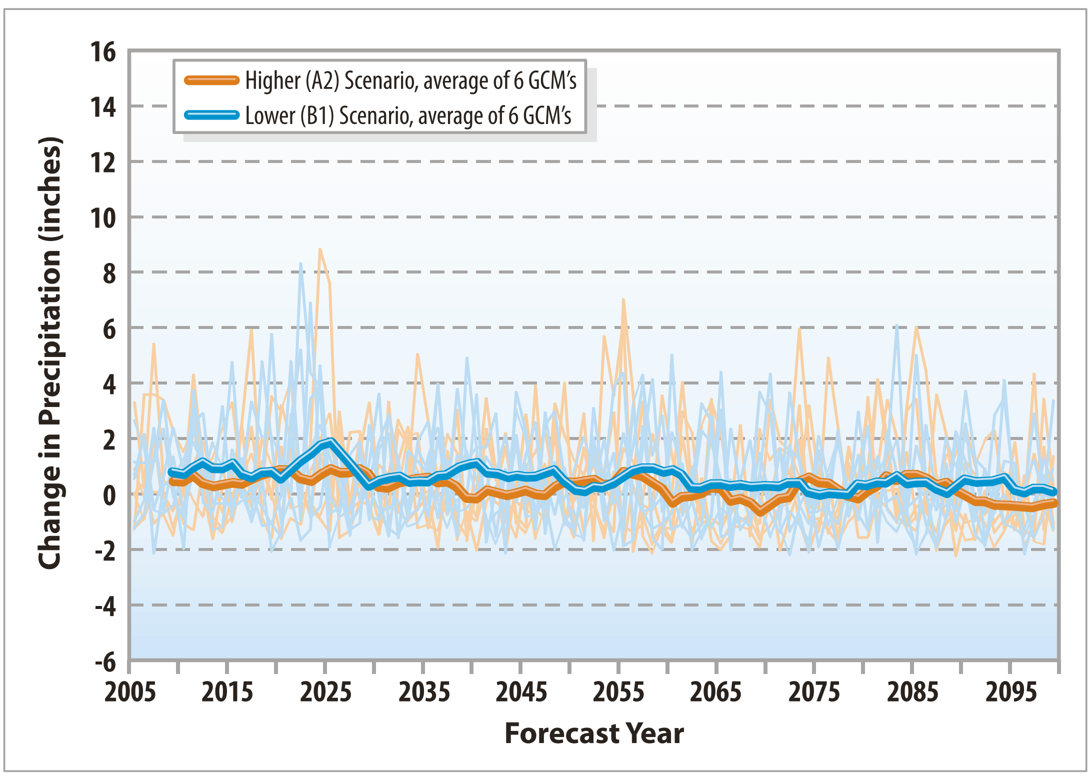
- An increase in average temperatures that will be more pronounced in the summer than in the winter with annual mean temperatures in year 2100 increasing greater than 3ºF when lower GHG emission scenarios are used and may exceed 6ºF when high higher emissions scenarios are used dependent upon the GCM employed.
- An increase in extreme temperatures.
- An increase in heat waves and dry periods that will extend for a longer duration.
- A slight decrease in precipitation coupled with increases in temperature will result in greater evapotranspiration.
- An increase in short-duration/high volume intense storm events during the winter.

The impact of these climate effects will likely be increased water demands for irrigation and cooling purposes earlier in the year and for longer periods coupled with decreased local surface runoff available to recharge groundwater basins. Other impacts might include an increase

### *Exhibit 12A*
### *Climate Change Impacts to Local Temperatures for Los Angeles*




### *Exhibit 12B*
### *Climate Change Impacts to Local Precipitation for Los Angeles*




Dan Cayan and Mary Tyree (University of California, San Diego, Scripps Institute of Oceanography) provided downscaled data for the City of Los Angeles under two emissions scenarios from six climate models: CNRM CM3, GFDL CM2.1, Miroc3.2 (medium resolution), MPI ECHAM5, NCAR CCSM3, NCAR PCM1.

Note: These scenarios do not bracket the highest and lowest emission futures possible, but represent a status quo approach (A2) and a pro-active mitigation (B1) approach to reduce carbon emissions in fire events impacting water quality and sedimentation, a decrease in groundwater recharge due to lower soil moisture, and sea level rise increasing seawater intrusion into coastal groundwater basins.

## 12.1.2 Los Angeles Aqueduct Impacts

The LAA is one of the major imported water sources delivering a reliable water supply to the City of Los Angeles. The LAA originates approximately 340 miles away gathering snowmelt runoff in the eastern Sierra Nevada; hence the LAA is subject to hydrologic variability which will be impacted by climate change. Since the majority of precipitation occurs during winter in the eastern Sierra Nevada watershed, water is stored in natural reservoirs in the form of snowpack, and is gradually released into streams that feed into the LAA during spring and summer. More detailed information regarding the LAA is presented in Chapter 5, Los Angeles Aqueduct Systems.

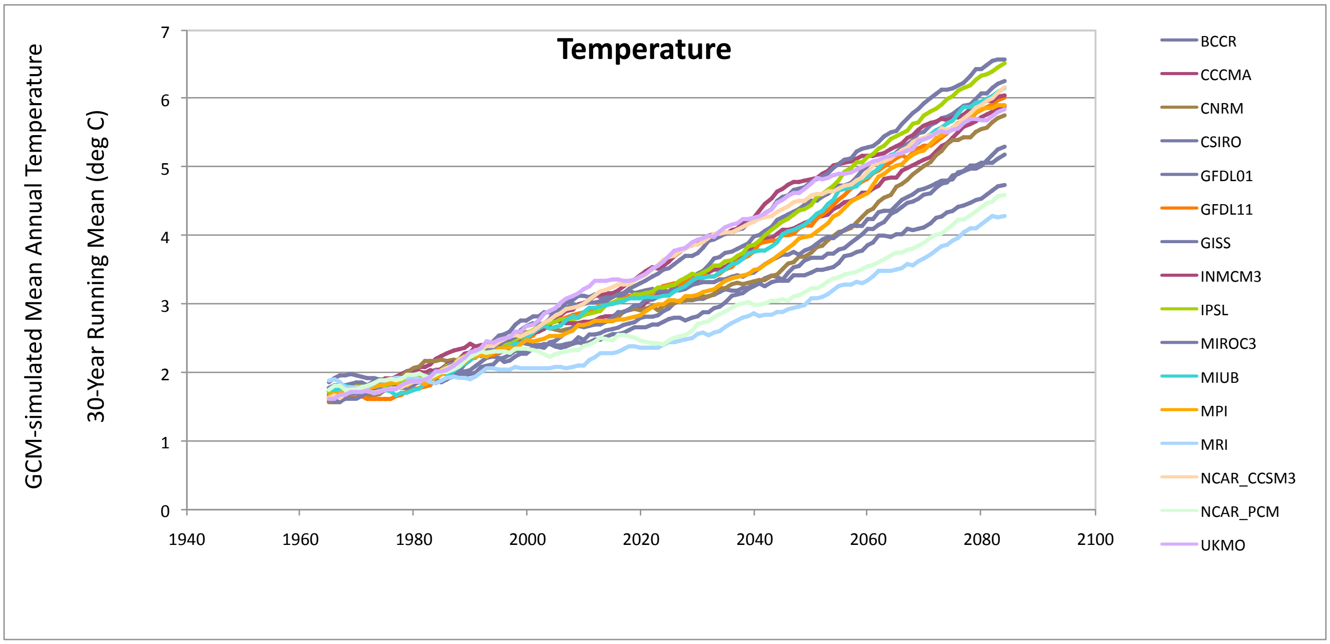
Higher concentrations of GHG in the atmosphere are often indications of pending climate change. These changes threaten the hydrologic stability of the eastern Sierra Nevada watershed through alterations in precipitation, snowmelt, relative ratios of rain and snow, winter storm patterns, and evapotranspiration, all of which have major potential impacts on the LAA water supply and deliveries.

To address the possible challenges posed by climate change on the LAA, LADWP completed a climate change study. The study evaluated the potential impacts of climate change on the eastern Sierra Nevada watershed and on LAA water supply and deliveries. It also investigated opportunities to improve the LAA system as a result of potential impacts in the 21st century. In this study, future climate conditions are predicted using a set of sixteen GCMs and two GHG emission scenarios.

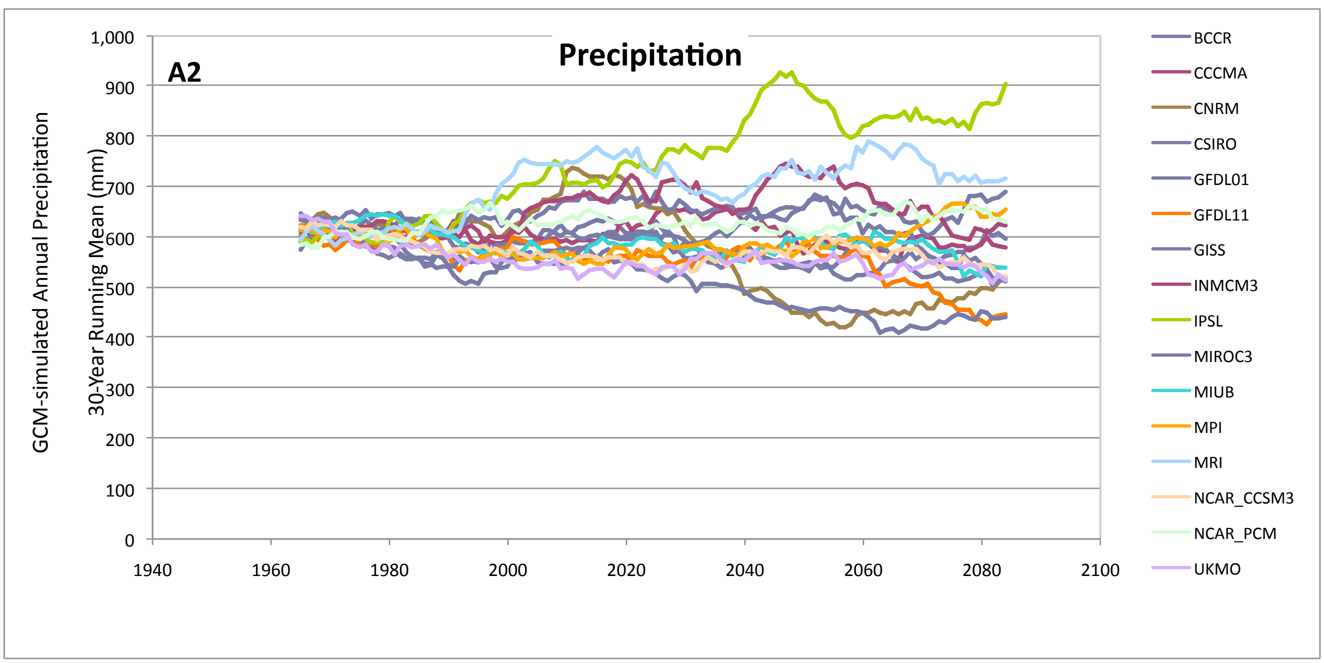
The impacts of these climate change scenarios and the associated hydrology on the LAA's eastern Sierra Watershed includes an analysis of historical temperature, precipitation, water quality, and runoff records. Hydrologic modeling was performed to estimate runoff changes from current conditions and to determine the impact of these runoff changes on the performance of the LAA infrastructure with regards to storage and conveyance to Los Angeles. As part of the evaluation of potential adaptation measures if existing infrastructure proves to be inadequate, recommendations were provided on how to modify the LAA infrastructure and operations to accommodate these impacts.

Results of the study show steady temperature increases throughout the 21st century and are consistent with other prior studies performed in the scientific community. Exhibit 12C displays the time series of 30-year running means of the projected temperature for the A2 GHG emission scenario (higher GHG emissions) averaged over the simulation area for each of the sixteen GCM models. All GCMs project temperature increases throughout the 21st century.

## Exhibit 12C
## 30-Year Time Series Projected Temperature Means for Eastern Sierra Nevada Watershed




## Exhibit 12D
## 30-Year Time Series Projected Precipitation Means for Eastern Sierra Nevada Watershed




On the other hand, forecasts for precipitation differ greatly between the GCMs. Some GCMs projected increases, but the majority of the model outputs projected decreases in precipitation over the study period. Exhibit 12D displays the time series of 30-year running means of the projected precipitation using the A2 GHG emission scenario (higher GHG emissions) averaged over the simulation area for each of the sixteen GCM models.

Temperature is the main climate variable that is projected to rise significantly in the coming years and decades. The rise in temperature directly affects several variables including:

- Whether precipitation falls as snow or rain.

- The ground-level temperature that determines the timing and rate of snowmelt.

- The temperature profile in the canopy that determines the rate of evapotranspiration.

Results have shown that future predictions for the early-21st century suggest a warming trend of 0.9 to 2.7˚F and almost no change in average precipitation. Mid-21st century projections suggest a warming trend of 3.6 to 5.4˚F and a small average decrease in precipitation, approximately 5 percent. This warming trend is expected to increase by the end of the 21st century, as the results indicate further warming of 4.5 to 8.1 ˚F and a decrease in precipitation of approximately 10 percent. In addition, results indicate an increase in the frequency and length of droughts in the end-of-century period.

Projected changes in temperature (warmer winters) will change precipitation patterns from snowfall to rainfall with a larger percentage coming as rain than historically encountered. Consequently, peak Snow Water Equivalent (SWE) and runoff are projected to undergo a shift in timing to earlier dates.

With a long term-shift in mean temperature of 3.6˚F, the snowpack of the eastern Sierras, at elevations of up to about 9,800 feet, is susceptible to earlier melt and less accumulation. On average, mean temperature rises are in the range of 3.6 to 10.8 ˚F resulting in about a 17 to 50 percent loss in snowpack storage, respectively. This vulnerability shows up in average to warm winters and will directly affect stream levels and stream discharge. This raises potential operational concerns for LADWP regarding adequate storage, especially the capacity of the LAA system to store the earlier runoff in surface reservoirs.

The projected temperature and precipitation dataset form the basis of the hydrologic model projections for runoff, SWE, and rain-to-snow ratio. To compare the future projections of these variables, the trends that dominated the second half of the 20th century are considered baselines for future trends. The baseline values for runoff, SWE, and rain-to-snow ratio are 0.6 million acre-feet (MAF), 15 inches, and 0.2, respectively. By early 21st century (2010 – 2039), results illustrate runoff is projected to undergo increases and decreases averaging between 0.5 to 0.85 MAF, the SWE is projected to undergo decreases and increases ranging between 10.6 to 19.0 inches, and the rain-to-snow ratio is projected to increase between 0.24 to 0.33. By mid-century (2040 – 2069), the same trends are expected to dominate, with runoff ranging between 0.34 to 0.9 MAF, the SWE ranging between 7.0 to 19.7 inches, and the rain-to-snow ratio increasing between 0.25 to 0.43. These trends are expected to govern until the end-of-century (2070 -2099) with runoff ranging between 0.35 to 1.1 MAF, the SWE ranging between 5.0 to 16.0 inches, and the rain-to-snow ratio increasing between 0.28 to 0.54. Exhibit 12E summarizes the projections for runoff, SWE, and rain-to-snow ratio for the 21st century.

### *Exhibit 12E*
### *Projected Runoff, Snow-Water Equivalent, and Rain-to-Snow Ratio for Eastern Sierra Nevada Watershed*

| | Runoff (MAF) | April 1 SWE (Inches) | Rain/Snow Ratio |
|---|---|---|---|
| **Baseline (Second Half of 20th Century)** | **0.6** | **15.0** | **0.2** |
| **Early 21st-century (2010-2039)** | 0.5 - 0.85 | 10.6 - 19.0 | 0.24 - 0.33 |
| **Mid-century (2040-2069)** | 0.34 - 0.9 | 7.0 - 19.7 | 0.25 - 0.43 |
| **End-of-century (2070-2099)** | 0.35 – 1.1 | 5.0 - 16.0 | 0.28 - 0.54 |

### Exhibit 12F
### Projected Rain to Precipitation Ratio Based on Projected Precipitation and Temperature

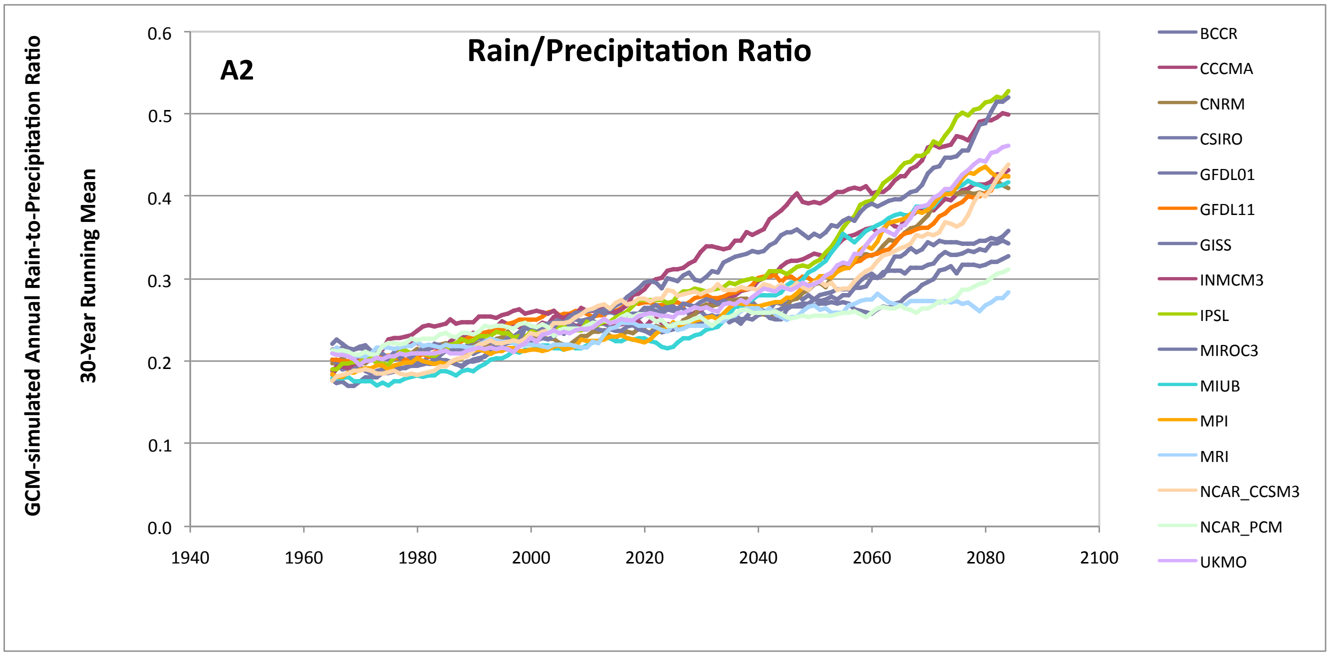



Exhibit 12F displays the rain-to-snow ratio based on the projected precipitation and temperature for the 16 GCMs. The rain-to-snow ratio is projected to increase throughout the 21st century, ranging between 0.24 to 0.33 by early 21st century, between 0.25 to 0.43 by mid-century, and between 0.28 to 0.54 by the end-of-century.

The increase of rain-to-snow ratio indicates the shift from snowfall to rainfall, specifically at low to moderate elevations, where the temperature tends to be warmer. This shift indicates more precipitation as liquid, and in turn, leads to loss of the snowpack. The snowpack is critical in providing seasonal storage by releasing winter precipitation in the spring and summer. The spring and summer snowmelt provides for increased soil moisture and stream flows needed to sustain both ecosystems and human populations.

Although the results above are quantitative in nature, it is important to account for the uncertainties inherent in these predictions. The results of this study will help guide the water managers in planning and developing water supply and infrastructure to ensure the reliability and sustainability of adequate water supply and delivery well into the future.

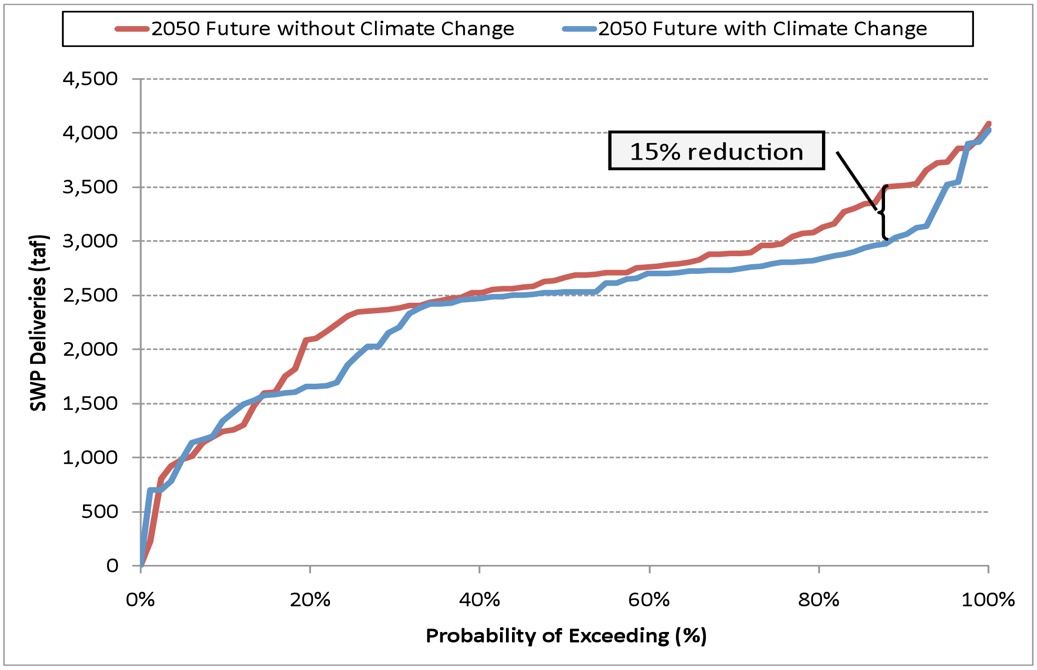
## 12.1.3 State Water Project Impacts

To date, most studies on climate change impacts to California's water supply have been conducted for the Northern California region. In August 2010, DWR released the 2009 State Water Project Delivery Reliability Report, which specifically analyzes changes in volume of water available under various climate change scenarios. DWR projected that SWP deliveries could be reduced by as much as 15 percent in some cases as illustrated in Exhibit 12G.

To incorporate climate change into its reliability reports, DWR reviewed 6 GCMs for year 2050 projections using lower emission and higher emission scenarios contained in *Using Future Climate Projections to Support Water Resources Decision Making in California* prepared in April 2009 by DWR. DWR selected the model most representing median effects on the SWP, which included a higher GHG scenario.

Climate change has the potential to disrupt SWP source supplies, impact conveyance, and alter storage levels in reservoir carryover storage. Annual Bay-Delta exports to areas south of the Bay-

## *Exhibit 12G*
## *Climate Change Impacts on SWP Delivery*




Delta are expected to decline 7 percent for the lower GHG emissions scenario and 10 percent for the higher emissions scenario. However, it should be noted that for the six GCMs under the lower and higher emission scenarios the range varies from a 2 percent increase to a 19 percent decrease illustrating the variability in the various GCMs.

By 2050, median reservoir carryover storage is projected to decline by 15 percent for the lower emissions scenario and 19 percent for the higher emissions scenario thereby reducing operational options if water shortages were to occur. Furthermore, by 2050 it is projected a water shortage worse than the 1977 drought could potentially occur in 1 out of every 6 to 8 years requiring acquisition of other supplies, reductions in water demands, or a combination thereof. An additional 575 to 850 TAF would be needed to maintain minimum SWP operation requirements and meet regulatory requirements. The main supply reservoirs on the SWP must maintain minimum water levels to allow water to pass through their lower release outlets in the dams. However, the April 2009 report does not consider the SWP vulnerable to a system interruption such as this under current conditions.

The primary effects of climate change on the SWP identified in the 2009 Reliability Report include, among others:

- More precipitation will fall as rain than snow.
- Reductions in Sierra snowpack.
- Sea level rise threatening the Bay-Delta levee system.
- Increased salinity in the Bay-Delta due to sea level rise requiring releases of freshwater from upstream reservoirs to maintain water quality standards.
- Shifted timing of snowmelt runoff into streams – spring runoff comes earlier resulting in increased winter flows and decreased spring flows.
- Increased flood events.

The most severe climate impacts in California are expected to occur in the Sierra watershed, where the SWP supply originates. Therefore, imported SWP water is extremely vulnerable to climate change.

## 12.1.4 Colorado River Aqueduct Impacts

Per MWD Board report titled "Report on Sustainable Water Deliveries from the Colorado River Factoring in Climate Change" and dated August 28, 2009, there have been numerous studies attempting to predict the impacts of climate change on the Colorado River. Several of the studies concluded that the Colorado River flow could be reduced by climate change by anywhere from 5 percent to 45 percent by the year 2050. The range of potential impacts can be very large thereby making it very challenging for water agencies to develop water management plans to address climate change impacts on the Colorado River Basin. Factors that have been identified and may contribute to this difficulty in narrowing the range of potential impacts of climate change on the Colorado River Basin include the following:

- The topography of the Colorado River Basin is difficult to model. Hydrologists have found that 80 percent of the flow of the Colorado River Basin is dependent upon the precipitation that falls in about 20 percent of the highest portions of the Upper Basin, in the mountains above 8,000 feet. Most global climate models are not precise enough to take into account the highly variable nature of the Colorado River Basin and can provide misleading results.

- There is a lack of data for much of the Colorado River Basin. While the runoff in the Colorado River Basin is well known, many other important watershed datasets are not readily available, including vegetation and soil type, soil moisture, wind, and solar radiation. These factors are important to predict future Colorado River flow and lack of data in remote areas presents uncertainty.

- Differences in modeling methods. Different modeling methods predict different runoff impacts from temperature increases due to GHG emissions. Each study used a different technique ranging from (1) using output from global climate models, to (2) statistical relationships relating temperature and precipitation to stream flow, to (3) a sophisticated model simulating soil moisture, snow accumulation and melt and evapotranspiration. Additionally, there is uncertainty in the level of GHG in the future based on the existing scientific literature.

In response to the potential impacts, MWD has worked to reduce demands by implementing water use efficiency programs in their service area including aggressive water conservation programs, and by increasing Colorado River supplies through programs such as agricultural to urban transfers.

## 12.2 Water and Energy Nexus

It is widely believed in the scientific community that the increase in concentrations of GHG in the atmosphere is a major contributing factor to climate change. As such, California is leading the way with laws that require reductions in GHG emissions and requirements to incorporate climate change impacts into long range water resource planning.

Carbon dioxide emissions into the atmosphere and the emissions of other GHGs are often associated with the burning of fossil fuels like crude oil and

## 12.2.1 State Water Project Supplies

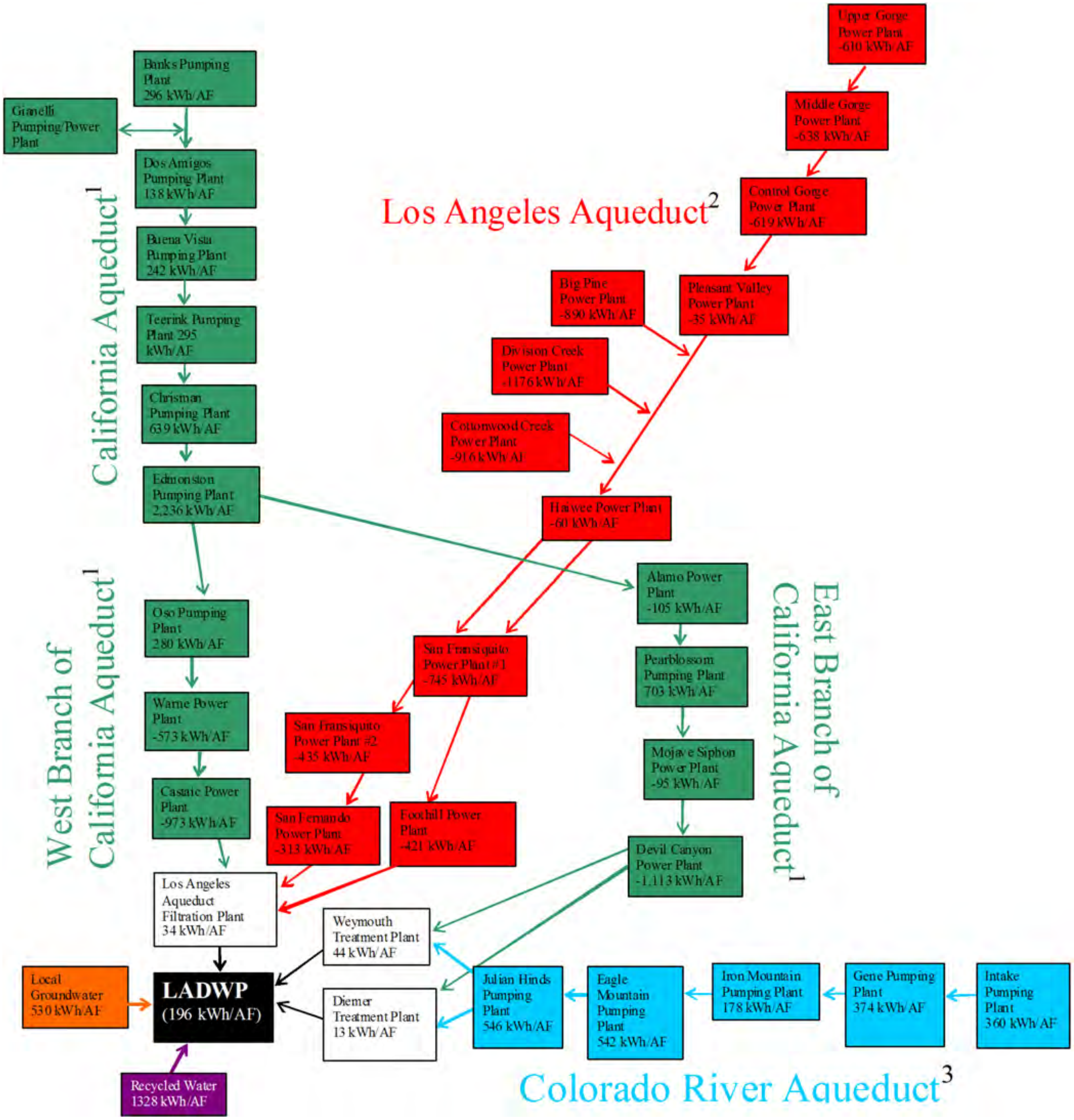
coal in the generation of energy. As a significant amount of energy is required for the movement of water over long distances and elevations, a link was subsequently realized between water supply conveyance and corresponding GHG emissions through its energy consumption. An assessment of the GHG emissions, sometimes also known as carbon footprint expressed in units of tons $CO_2$, could be estimated for water. Once the size of a carbon footprint is known, a strategy can be developed to better manage and reduce its impact on climate change.

LADWP has taken the initiative to study the nexus between water and energy consumption and to evaluate the associated carbon footprint of its water system. The most energy intensive source of water for LADWP is water purchased from MWD, which imports SWP supplies via the California Aqueduct and Colorado River supplies via the CRA. LADWP also imports water via the LAA, which is a net producer of energy. Local sources of water for LADWP include groundwater and recycled water. Exhibit 12H outlines the sources of LADWP's water supply as well as the energy profiles of each facility that provides water to LADWP. For those sources of water operated by LADWP, the energy intensity has been computed by dividing the total energy consumed/generated by the total water produced or processed by that source.

Water supplied to Los Angeles via the SWP originates from Northern California and the Bay-Delta and is conveyed along the 444-mile long California Aqueduct to Southern California. Six pump stations are required to lift the water to the point at which the California Aqueduct splits into two branches. At the zenith of the California Aqueduct in the Tehachapi Mountains, approximately 3,846 kilowatt hours per acre foot (kWh/AF) is required to lift the water from the start of the aqueduct. After the water passes through Edmonston Pumping Plant, the California Aqueduct separates into two branches, the West Branch and the East Branch. Along the West Branch, the water is lifted once more at the Oso Pumping Plant and then energy is recovered through hydro-electric generation at the Warne and Castaic Power Plants. By the time the West Branch reaches its terminus at Lake Castaic, the net energy consumed in transporting the water from the Bay-Delta is approximately 2,580 kWh/AF. Water supplied through the West Branch is provided to the San Fernando Valley, Western Los Angeles, and Central Los Angeles communities.

Along the East Branch, the water generates power at the Alamo Power Plant, is lifted once more at Pearblossom Pumping Plant, and then used for generation at Mojave Siphon and Devil Canyon Power Plants. At the East Branch terminus at Lake Perris, approximately 3,236 kWh/AF of energy has been expended in the transport. Water conveyed through the East Branch is provided to the Eastern Los Angeles and Harbor communities. The water supplied from the SWP is the most energy intensive source of water available to LADWP.

## *Exhibit 12H*
## *Energy Intensity of LADWP's Water Sources*




1.Source: Methodology for Analysis of the Energy Intensity of California's Water Systems. p. 27.

2.Generation on the Los Angeles Aqueduct is not considered in LADWP's total energy intensity.

3.Energy intensities for the Colorado River Aqueduct pumping stations were derived by multiplying the total energy intensity for the aqueduct by the proportion of load for each individual pumping station in relation to the total load for all five pump stations.

4.Positive numbers indicate power consumption due to pumping and negative numbers indicate power generation.

## 12.2.2 Colorado River Aqueduct Supplies

Water supplied from the Colorado River is imported via the 242 mile CRA operated by MWD. From the start of the aqueduct at Lake Havasu to its terminus at Lake Mathews, the water is lifted approximately 1,617 feet. Five pumping stations along the aqueduct lift the water to MWD's service area requiring approximately 2,000 kWh/AF. CRA water is the second most energy intensive water source for Los Angeles and is supplied to the eastern Los Angeles and Harbor communities. Together SWP water and CRA water comprise the total imported provided by MWD to LADWP. MWD imported water is the most expensive water source for LADWP in terms of both cost and energy.

## 12.2.3 Los Angeles Aqueduct Supplies

The LAA provides water from the Eastern Sierra watershed and is entirely gravity fed. As a result, no energy is required to import LAA water, making it the most desirable source of water in terms of energy intensity. There are twelve power generation facilities along the aqueduct system. On average, the LAA generates approximately 6,848 kWh/AF from water directly used to generate power. This number was determined using the same methodology as was used to determine the energy intensity for the two branches of the SWP. The individual energy intensities for each individual generating facility were summed up to arrive at the total energy intensity for the water used to generate power. However, when considered from the perspective of total amount of water delivered to Los Angeles via the LAA, the energy generated along the aqueduct is approximately 2,456 kWh/AF. The variance between the numbers can be attributed to the fact that not all water wheeled through the aqueduct is used to generate power and the fact that a portion of the water is introduced into the aqueduct system at a point downstream of several of the power plants. For the purposes of determining LADWP's total energy intensity, the energy intensity of the LAA is considered to be zero since the power generated does not directly offset the energy required for other sources of water. However, in terms of supply the LAA is able to offset the more energy intensive sources of water, consequently reducing the overall energy intensity of LADWP's water supplies. As LAA flows to Los Angeles are decreased due to environmental enhancement efforts in the Owens Valley and Mono Basin, LADWP is forced to increasingly rely on energy intensive water purchased from MWD. LAA water currently supplies approximately 37 percent of the demand for Los Angeles.

## 12.2.4 Local Groundwater Supplies

Groundwater currently accounts for approximately 11 percent of LADWP's water supply and has an average energy intensity of approximately 530 kWh/AF. As LADWP continues with its cleanup of the contaminated water in the San Fernando Basin, groundwater will play an increasingly important role in Los Angeles' water supply. Although there is potential for a future increase in the energy required to produce groundwater due to the introduction of new treatment technologies, groundwater is expected to remain a low energy source of water when compared to imported supplies purchased from MWD. Increasing groundwater production will allow LADWP to offset the energy intensive MWD sources and reduce its overall energy intensity.

## 12.2.5 Recycled Water Supplies

Recycled water is currently the smallest component of LADWP's water supply portfolio, with municipal and industrial uses accounting for less than 1 percent of total supplies. Currently, LADWP directly receives recycled water from three wastewater treatment plants operated by Bureau of Sanitation (BOS), two of which provide recycled water treated to a tertiary level: Los Angeles Glendale (LAG) Treatment Plant and Donald C. Tillman (DCT) Treatment Plant. The Terminal Island Treatment Plant (TITP) performs advanced treatment of recycled water in addition to tertiary treatment. LADWP also directly receives a small portion of recycled water from the West Basin Municipal Water District (WBMWD), which provides additional treatment of wastewater from the Hyperion Treatment Plant (HTP) in El Segundo. Since all water at the plants directly supplying recycled water to LADWP is treated to at least a tertiary level regardless of disposal or reuse, the energy cost to treat the water to this level is considered a sunk cost because the water would be treated whether it offsets potable use or not. The advanced treatment process at the TITP is beyond the requirements for discharge and is therefore not considered a sunk cost. The incremental energy required to treat water from tertiary levels to advanced treatment levels at TITP requires approximately 2,200 kWh/AF. Since the treatment energy at the other two plants is not considered additional energy, only the pumping energy is included in the overall LADWP recycled water energy intensity. For the LAG, the pumping requires approximately 690 kWh/AF, and for the DCT the pumping requires approximately 450 kWh/AF. A weighted average of these values gives recycled water an energy intensity of approximately 1,139 kWh/AF. In the future, this number will likely change as the recycled water infrastructure is expanded. In addition to the municipal and industrial recycled water that is considered in LADWP's total supplies, the plants produce significant additional volumes of recycled water that is beneficially used. Beneficial uses include the seawater barrier for the Dominquez Gap using recycled water from TITP and the Japanese Garden and Los Angeles River from DCT.

## 12.2.6 Treatment Energy

Another factor in determining the energy intensity of LADWP's water is the energy required to treat water. All LAA water and nearly all West Branch SWP water purchased by LADWP are treated at the Los Angeles Aqueduct Filtration Plant (LAAFP). For the LAAFP, the average treatment energy intensity is approximately 34 kWh/AF. The East Branch SWP water and the CRA water are primarily treated at the Weymouth Treatment Plant in the San Gabriel Valley and the Diemer Treatment Plant in Orange County. Both of these treatment plants are operated by MWD. The average energy intensity for Weymouth Treatment Plant is approximately 42 kWh/AF and supplies water to the East Los Angeles Community. The average energy intensity for the Diemer Treatment Plant is 13 kWh/AF and supplies water to the Harbor Community. The mix of SWP East Branch water and CRA water that flows through these two treatment plants varies depending on the regional hydrology of the two sources, but on average approximately 55 percent SWP East Branch water and 45 percent CRA water flows through each of these MWD treatment plants.

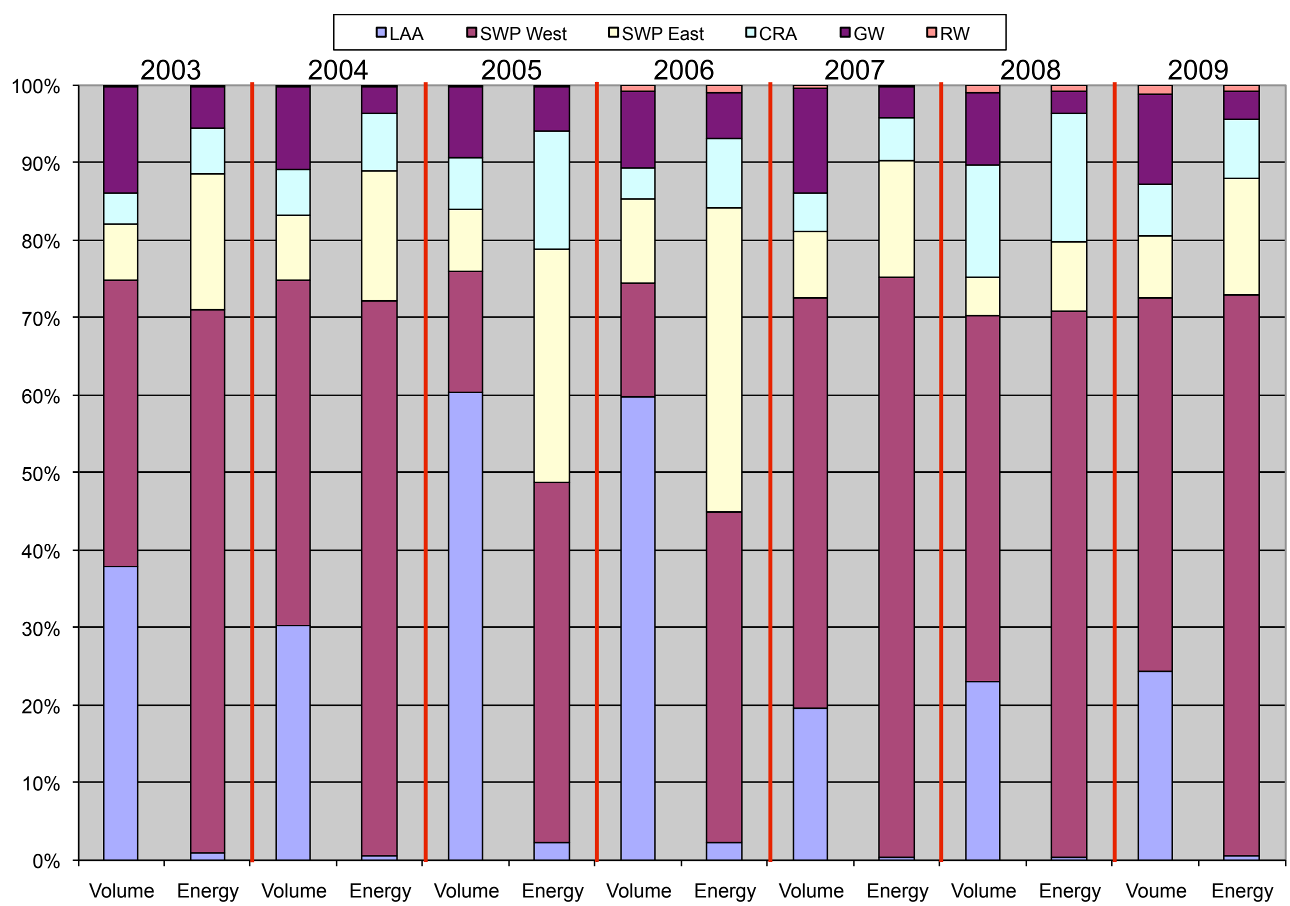
The proportion that each of the above mentioned sources contributes to the LADWP's total supplies is displayed in Exhibit 12I. Of note is the relationship that the volume of LAA flow has to the amount of SWP water imported into the system. In this case, the energy free LAA water is replaced by the energy intensive SWP water resulting in an increase in the overall energy intensity.

## 12.2.7 Distribution Energy

LADWP benefits from the topography of its service area in that much of the hydraulic head required for water distribution is provided by gravity. With the major sources of LADWP's water entering the service area at higher elevation than the rest of the City, the energy required for distribution is lower than much of the region. The average energy intensity for LADWP water distribution is approximately 196 kWh/AF.

Exhibit 12J shows the sum of the energy intensities for LADWP from each of the individual sources between 2003 and 2009. Exhibit 12K shows a graphical representation of the total energy intensity for LADWP for the same time period. An important detail is the influence that LAA water has on the total energy intensity for a given year. For those years with large volumes of LAA water, such as 2005 and 2006, the total energy intensity was correspondingly low. Alternatively, those years with low volumes of LAA water have high total energy intensity as a result of the energy requirements for imported MWD supplies

***Exhibit 12I***
***Proportion of Volume Delivered and Total Energy Intensity (Inclusive of Treatment)***



## *Exhibit 12J*
## *LADWP Energy Intensity 2003-2009*

| | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|
| Los Angeles Aqueduct (0 kWh/AF) | Volume (AF) | 251,942 | 202,547 | 368,839 | 378,922 | 129,400 | 147,365 | 137,084 |
| | Treatment Energy Intensity (kWh/AF)[1] | 34 | 34 | 34 | 34 | 34 | 34 | 34 |
| | Weighted Energy Intensity (kWh/AF) | 13 | 10 | 20 | 20 | 7 | 8 | 8 |
| State Water Project West Branch (2580 kWh/AF) | Volume (AF) | 244,218 | 296,722 | 95,538 | 93,694 | 350,302 | 304,221 | 270,653 |
| | Treatment Energy Intensity (kWh/AF)[1] | 34 | 34 | 34 | 34 | 34 | 34 | 34 |
| | Weighted Energy Intensity (kWh/AF) | 961 | 1,161 | 408 | 386 | 1,384 | 1,237 | 1,258 |
| State Water Project East Branch[3] (3236 kWh/AF) | Volume (AF) | 48,980 | 56,301 | 49,526 | 68,796 | 56,357 | 31,016 | 45,246 |
| | Treatment Energy Intensity (kWh/AF)[2] | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| | Weighted Energy Intensity (kWh/AF) | 241 | 275 | 264 | 354 | 278 | 157 | 262 |
| Colorado River Aqueduct[3] (2000 kWh/AF) | Volume (AF) | 26,374 | 39,124 | 40,522 | 25,445 | 33,098 | 93,047 | 37,012 |
| | Treatment Energy Intensity (kWh/AF)[2] | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| | Weighted Energy Intensity (kWh/AF) | 80 | 119 | 134 | 81 | 101 | 293 | 133 |
| Local Groundwater (530 kWh/AF) | Volume (AF) | 90,835 | 71,831 | 56,547 | 63,270 | 89,018 | 60,149 | 64,996 |
| | Weighted Energy Intensity (kWh/AF) | 72 | 57 | 49 | 53 | 71 | 50 | 61 |
| Recycled Water[4] (1,139 kWh/AF) | Volume (AF) | 1,759 | 1,774 | 1,401 | 4,890 | 3,639 | 7,081 | 7,489 |
| | Weighted Energy Intensity | 3 | 3 | 3 | 9 | 6 | 13 | 15 |
| Distribution (196 kWh/AF) | Volume (AF) | 664,108 | 668,300 | 612,373 | 635,017 | 661,814 | 642,879 | 562,480 |
| | Weighted Energy Intensity (kWh/AF) | 196 | 196 | 196 | 196 | 196 | 196 | 196 |
| **Total Volume Delivered (AF)** | | 664,108 | 668,300 | 612,373 | 635,017 | 661,814 | 642,879 | 562,480 |
| **Total Energy Intensity (kWh/AF)** | | 1,567 | 1,820 | 1,074 | 1,098 | 2,043 | 1,954 | 1,934 |

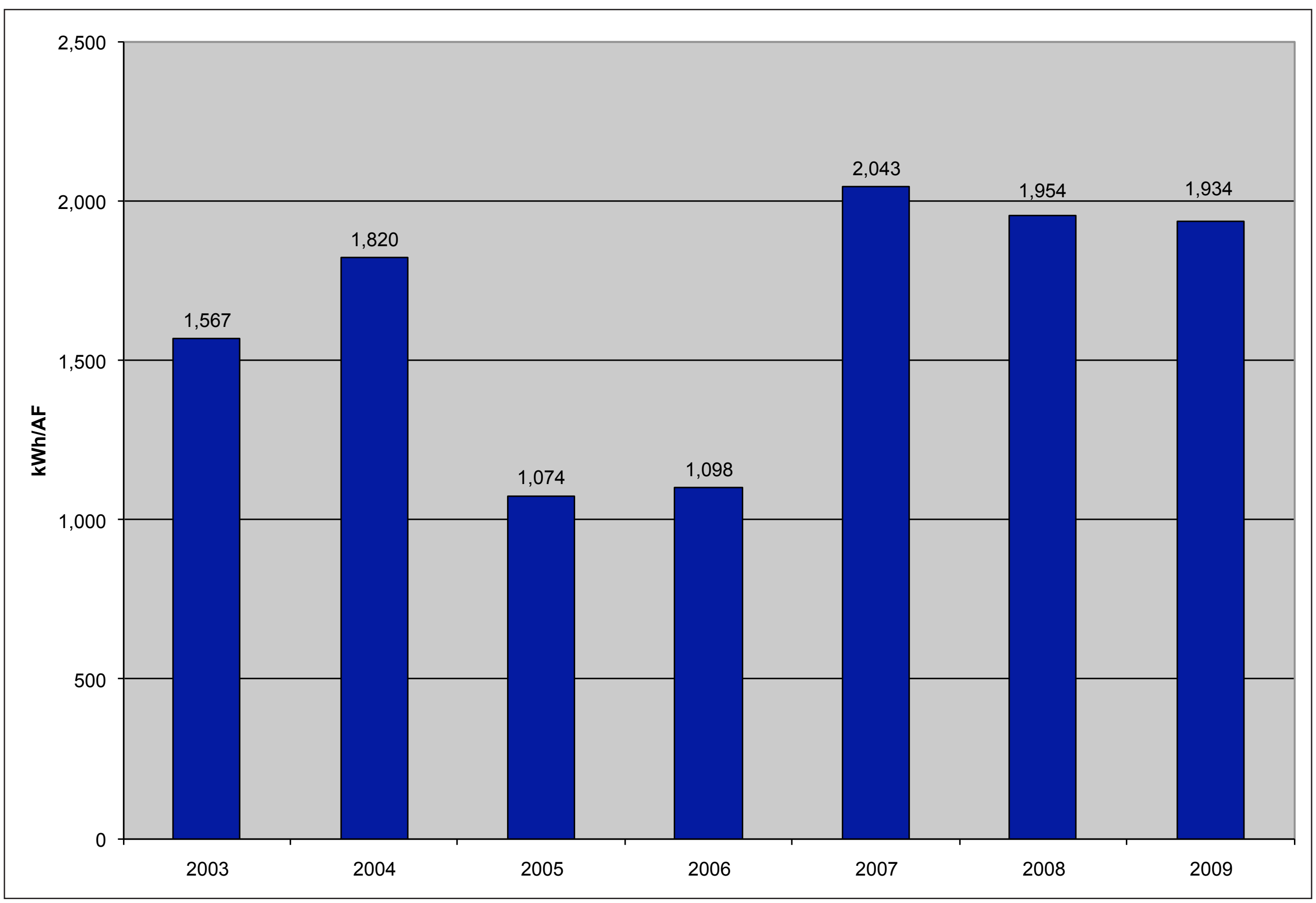
1. Los Angeles Aqueduct and State Water Project West Branch supplies are treated at the Los Angeles Aqueduct Filtration Plant
2. Colorado River Aqueduct and State Water Project East Branch supplies are treated at Weymouth and Diemer Filtration Plants operated by Metropolitan Water District of Southern California. The listed energy intensity is based on an average of the energy intensity for the two plants.
3. Amount of SWP water and CRA water delivered is based on the reported average ratio of the two sources in Weymouth Treatment Plant and Diemer Treatment Plant effluent from MWD annual Water Quality Report
4. Recycled water volume is based on use for municipal and industrial uses, not all beneficial uses. Energy intensity is a weighted average of energy used for pumping to customers and the incremental energy to treat from tertiary to advanced treatment.

## 12.2.8 Carbon Footprint

All of LADWP's water supply sources have an associated carbon footprint related to the energy required to pump the water. Exhibit 12L provides the annual carbon footprint by water source. Exhibit 12M shows a graphical representation of the total annual carbon footprint for the same time period. For imported sources, the 2007 CAMX (Western Electricity Coordinating Council California Subregion name) California average carbon emission of 0.72412 lbs $CO_2$/kWh was used to estimate the amount of carbon emissions produced per acre-foot of water imported. For local sources, the $CO_2$ metric LADWP reported to the California Climate Action Registry in 2007 was used to estimate the carbon emissions released in the production of this water. LAA is a net producer of energy and produces only green hydropower. There are no carbon emissions associated with water imported through the LAA.

As Los Angeles increases its reliance on energy intensive imported supplies from MWD, its overall energy intensity will increase. Reductions in LAA flows due to environmental mitigation have the consequence of increasing Los Angeles' reliance on supplies imported through the SWP via the California Aqueduct, and Colorado River through the CRA.

***Exhibit 12K***
***LADWP Annual Energy Intensity***



## *Exhibit 12L*
## *Annual Footprint by Carbon Source*

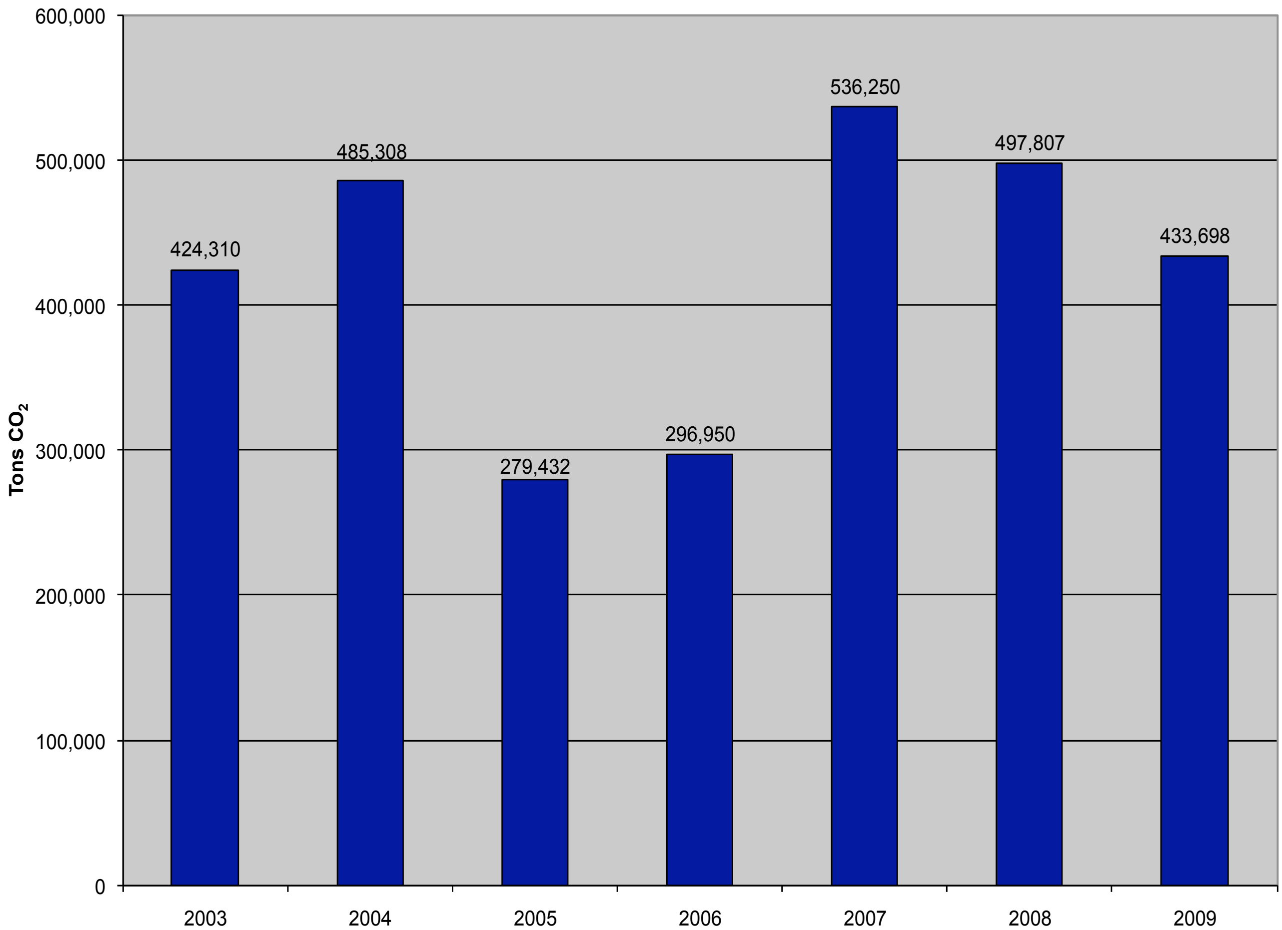
| | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|
| Los Angeles Aqueduct (0 kWh/AF) | Volume Delivered (AF) | 251,942 | 202,547 | 368,839 | 378,922 | 129,400 | 147,365 | 137,084 |
| | Energy Intensity (kWh/AF) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Weighted Energy Intensity (kWh/AF) | 13 | 10 | 20 | 20 | 7 | 8 | 8 |
| | Carbon Footprint (tons $CO_2$)[2] | 5,259 | 4,228 | 7,699 | 7,909 | 2,701 | 3,076 | 2,861 |
| State Water Project West Branch (2,580 kWh/AF) | Volume Delivered (AF) | 244,218 | 296,722 | 95,538 | 93,694 | 350,302 | 304,221 | 270,653 |
| | Weighted Energy Intensity (kWh/AF) | 961 | 1,161 | 408 | 386 | 1,384 | 1,237 | 1,258 |
| | Carbon Footprint (tons $CO_2$)[3] | 231,134 | 280,825 | 90,420 | 88,674 | 331,535 | 287,922 | 256,153 |
| State Water Project East Branch (3,236 kWh/AF) | Volume Delivered (AF) | 48,980 | 56,301 | 49,526 | 68,796 | 56,357 | 31,016 | 45,246 |
| | Weighted Energy Intensity (kWh/AF) | 241 | 275 | 264 | 354 | 278 | 157 | 262 |
| | Carbon Footprint (tons $CO_2$)[3] | 57,865 | 66,514 | 58,510 | 81,276 | 66,580 | 36,642 | 53,454 |
| Colorado River Aqueduct[1] (2,000 kWh/AF) | Volume Delivered (AF) | 26,374 | 39,124 | 40,522 | 25,445 | 33,098 | 93,047 | 37,012 |
| | Weighted Energy Intensity (kWh/AF) | 80 | 119 | 134 | 81 | 101 | 293 | 133 |
| | Carbon Intensity (lbs CO2/kWh) | 0.72412 | 0.72412 | 0.72412 | 0.72412 | 0.72412 | 0.72412 | 0.72412 |
| | Carbon Footprint (tons $CO_2$)[3] | 19,356 | 28,713 | 29,739 | 18,674 | 24,290 | 68,287 | 27,163 |
| Local Groundwater (530 kWh/AF) | Volume Delivered (AF) | 90,835 | 71,831 | 56,547 | 63,270 | 89,018 | 60,149 | 64,996 |
| | Weighted Energy Intensity (kWh/AF) | 72 | 57 | 49 | 53 | 71 | 50 | 61 |
| | Carbon Footprint (tons $CO_2$)[2] | 29,556 | 23,372 | 18,399 | 20,587 | 28,964 | 19,571 | 21,148 |
| Recycled Water (1,139 kWh/AF) | Volume Delivered (AF) | 1,759 | 1,774 | 1,401 | 4,890 | 3,639 | 7,081 | 7,489 |
| | Weighted Energy Intensity (kWh/AF) | 3 | 3 | 3 | 9 | 6 | 13 | 15 |
| | Carbon Footprint (tons $CO_2$)[2] | 1,230 | 1,240 | 980 | 3,419 | 2,545 | 4,951 | 5,237 |
| Distribution (196 kWh/AF) | Volume Delivered (AF) | 664,108 | 668,299 | 612,373 | 635,017 | 661,814 | 642,879 | 562,480 |
| | Weighted Energy Intensity (kWh/AF) | 196 | 196 | 196 | 196 | 196 | 196 | 196 |
| | Carbon Footprint (tons $CO_2$)[3] | 79,911 | 80,415 | 73,686 | 76,411 | 79,635 | 77,357 | 67,682 |
| **Total Volume Delivered (AF)** | | 664,108 | 668,299 | 612,373 | 635,017 | 661,814 | 642,879 | 562,480 |
| **Total Energy Intensity (kWh/AF)** | | 1,567 | 1,820 | 1,074 | 1,098 | 2,043 | 1,954 | 1,934 |
| **Total Carbon Footprint (tons $CO_2$)** | | 424,310 | 485,308 | 279,432 | 296,950 | 536,250 | 497,807 | 433,698 |

1. Amount of SWP water and CRA water delivered is based on average of the proportion of the two sources delivered to MWD Weymouth Treatment Plant and Diemer Treatment Plant for the calendar year

2. Based on 2007 $CO_2$ metric of 1.22789 lbs $CO_2$/kWh reported to the California Climate Action Registry

3. Based on eGRID 2007 CAMX (California Average) of 0.72412 lbs $CO_2$/kWh

*Exhibit 12M*
*Total Annual Carbon Footprint for Water Supply Portfolio*




## 12.3 Climate Change Adaption and Mitigation

Climate change strategies fall under two main categories: adaptation and mitigation. For water resources planning, a climate change adaptation strategy involves taking steps to effectively manage the impacts of climate change by making water demands more efficient and relying on supply sources that are less vulnerable to climate change. A mitigation strategy involves proactive measures that reduce greenhouse gas emissions, such as placing a stronger emphasis on using water resources requiring less greenhouse gas emissions. Both LADWP and its wholesale supplier for imported water, MWD, are implementing adaption and mitigation strategies as they become aware of potential climate change impacts.

It is imperative that supply options are carefully vetted and evaluated against both adaptation and mitigation goals, as they may conflict and work against each other. For example, desalination is a typical supply option that performs quite well in adapting to climate change impacts; however, due to the energy necessary to draw from and manage the supply source, it could result in higher greenhouse gas emissions if conventional energy sources are utilized.

## 12.3.1 LADWP Adaption and Mitigation

LADWP has outlined strategies to dramatically increase conservation and water recycling. Increasing conservation and water recycling encompasses both adaption and mitigation goals to address climate change. The UWMP calls for reducing potable demands by an additional 64,368 AFY through conservation and 59,000 AFY of additional recycled water use by fiscal year 2030. Additional adaption strategies under investigation by LADWP and the City includes beneficial reuse of stormwater as discussed in Chapters Seven and Nine, Watershed Management and Other Potential Water Supplies, respectively.

Conservation has a double savings in terms of energy intensity because not only does it save energy in importing or producing the water, but it also saves energy through reduction of end use, such as heating water for a shower or for a dishwasher and wastewater treatment. The anticipated conservation savings will not only help to provide Los Angeles a secure and dependable water supply, but it will also reduce the energy footprint of the water supply, and consequently the carbon footprint. A further discussion regarding conservation is provided in Chapter Three, Conservation.

Recycled water use reduces reliance on potable water imported through MWD and provides a year round drought resistant water supply source. While the energy consumption requirements to produce recycled water are greater than local and LAA supply sources, recycled water assists LADWP in bolstering its supply portfolio to address potential supply changes related to climate change. A further discussion regarding recycled water is provided in Chapter 4, Recycled Water.

There is still general uncertainty within the scientific community regarding the potential impacts of climate change for the City of Los Angeles. LADWP will continue to stay abreast of developments in climate change to better understand its potential implications to the City's water supplies to assist in further developing adaption and mitigation strategies.

## 12.3.2 MWD Adaption and Mitigation

MWD is taking an active approach to adapt and mitigate against climate changes in its operations. Adaption and mitigation measures include:

- Investments in local resources to diversify MWD's water supply portfolio.
- Tracking climate change legislation – MWD provides input and direction on legislation.
- Collaborating on climate change with state, federal, and non-governmental agencies.
- Monitoring state and local climate change actions.
- Investigating the water supply and energy nexus.
- Coordinating with large water retailers.
- Integrating climate change into integrated resource planning as discussed in Chapter 10, Integrated Resource Planning.
- Sharing climate change knowledge and providing support – founding member of Water Utility Climate Alliance.
- Adopting energy management policies to support cost-effective and environmentally responsible programs, projects, and initiative.

MWD has also taken structural adaption measures including construction of the Inland Feeder. The Inland Feeder completed in 2009 connects SWP supplies with MWD's CRA supplies and allows delivery of SWP supplies to MWD's major reservoir, Diamond Valley Lake. In relation to climate change, the project will increase conveyance capacity allowing more rain to be conveyed as projected snowpack levels decrease and allow MWD to capture rain associated with projected short duration high intensity storms.

Urban Water Management Plan

# Appendix A

## Urban Water Management Planning Act

# CALIFORNIA WATER CODE DIVISION 6
# PART 2.6. URBAN WATER MANAGEMENT PLANNING

All California Codes have been updated to include the 2010 Statutes.



## WATER CODE
## SECTION 10610-10610.4

**10610.** This part shall be known and may be cited as the "Urban Water Management Planning Act."

**10610.2.** (a) The Legislature finds and declares all of the following:

(1) The waters of the state are a limited and renewable resource subject to ever-increasing demands.

(2) The conservation and efficient use of urban water supplies are of statewide concern; however, the planning for that use and the implementation of those plans can best be accomplished at the local level.

(3) A long-term, reliable supply of water is essential to protect the productivity of California's businesses and economic climate.

(4) As part of its long-range planning activities, every urban water supplier should make every effort to ensure the appropriate level of reliability in its water service sufficient to meet the needs of its various categories of customers during normal, dry, and multiple dry water years.

(5) Public health issues have been raised over a number of contaminants that have been identified in certain local and imported water supplies.

(6) Implementing effective water management strategies, including groundwater storage projects and recycled water projects, may require specific water quality and salinity targets for meeting groundwater basins water quality objectives and promoting beneficial use of recycled water.

(7) Water quality regulations are becoming an increasingly important factor in water agencies' selection of raw water sources, treatment alternatives, and modifications to existing treatment facilities.

(8) Changes in drinking water quality standards may also impact the usefulness of water supplies and may ultimately impact supply reliability.

(9) The quality of source supplies can have a significant impact

on water management strategies and supply reliability.
(b) This part is intended to provide assistance to water agencies in carrying out their long-term resource planning responsibilities to ensure adequate water supplies to meet existing and future demands for water.

**10610.4.** The Legislature finds and declares that it is the policy of the state as follows:
(a) The management of urban water demands and efficient use of water shall be actively pursued to protect both the people of the state and their water resources.
(b) The management of urban water demands and efficient use of urban water supplies shall be a guiding criterion in public decisions.
(c) Urban water suppliers shall be required to develop water management plans to actively pursue the efficient use of available supplies.

## WATER CODE SECTION 10611-10617

**10611.** Unless the context otherwise requires, the definitions of this chapter govern the construction of this part.

**10611.5.** "Demand management" means those water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable and efficient use and reuse of available supplies.

**10612.** "Customer" means a purchaser of water from a water supplier who uses the water for municipal purposes, including residential, commercial, governmental, and industrial uses.

**10613.** "Efficient use" means those management measures that result in the most effective use of water so as to prevent its waste or unreasonable use or unreasonable method of use.

**10614.** "Person" means any individual, firm, association, organization, partnership, business, trust, corporation, company, public agency, or any agency of such an entity.

**10615.** "Plan" means an urban water management plan prepared pursuant to this part. A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses, reclamation and demand management activities. The components of the plan may vary according to an individual community or area's characteristics and its capabilities to efficiently use and conserve water. The plan shall address measures for residential, commercial, governmental, and industrial water demand management as set forth in Article 2 (commencing with Section 10630) of Chapter 3. In addition, a strategy and time schedule for implementation shall be included in the plan.

**10616.** "Public agency" means any board, commission, county, city and county, city, regional agency, district, or other public entity.

**10616.5.** "Recycled water" means the reclamation and reuse of wastewater for beneficial use.

**10617.** "Urban water supplier" means a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. An urban water supplier includes a supplier or contractor for water, regardless of the basis of right, which distributes or sells for ultimate resale to customers. This part applies only to water supplied from public water systems subject to Chapter 4 (commencing with Section 116275) of Part 12 of Division 104 of the Health and Safety Code.

## WATER CODE
## SECTION 10620-10621

**10620.** (a) Every urban water supplier shall prepare and adopt an urban water management plan in the manner set forth in Article 3 (commencing with Section 10640).

(b) Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier.

(c) An urban water supplier indirectly providing water shall not include planning elements in its water management plan as provided in Article 2 (commencing with Section 10630) that would be applicable to urban water suppliers or public agencies directly providing water, or to their customers, without the consent of those suppliers or public agencies.

(d) (1) An urban water supplier may satisfy the requirements of this part by participation in areawide, regional, watershed, or basinwide urban water management planning where those plans will reduce preparation costs and contribute to the achievement of conservation and efficient water use.

(2) Each urban water supplier shall coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable.

(e) The urban water supplier may prepare the plan with its own staff, by contract, or in cooperation with other governmental agencies.

(f) An urban water supplier shall describe in the plan water management tools and options used by that entity that will maximize resources and minimize the need to import water from other regions.

**10621.** (a) Each urban water supplier shall update its plan at least once every five years on or before December 31, in years ending in five and zero.

(b) Every urban water supplier required to prepare a plan pursuant to this part shall, at least 60 days prior to the public hearing on the plan required by Section 10642, notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. The urban water supplier may consult with, and obtain comments from, any city or county that receives notice pursuant to this subdivision.

(c) The amendments to, or changes in, the plan shall be adopted and filed in the manner set forth in Article 3 (commencing with Section 10640).

## WATER CODE
## SECTION 10630-10634

**10630.** It is the intention of the Legislature, in enacting this part, to permit levels of water management planning commensurate with the numbers of customers served and the volume of water supplied.

**10631.** A plan shall be adopted in accordance with this chapter that shall do all of the following:

(a) Describe the service area of the supplier, including current and projected population, climate, and other demographic factors affecting the supplier's water management planning. The projected population estimates shall be based upon data from the state, regional, or local service agency population projections within the service area of the urban water supplier and shall be in five-year increments to 20 years or as far as data is available.

(b) Identify and quantify, to the extent practicable, the existing and planned sources of water available to the supplier over the same five-year increments described in subdivision (a). If groundwater is identified as an existing or planned source of water available to the supplier, all of the following information shall be included in the plan:

(1) A copy of any groundwater management plan adopted by the urban water supplier, including plans adopted pursuant to Part 2.75 (commencing with Section 10750), or any other specific authorization for groundwater management.

(2) A description of any groundwater basin or basins from which the urban water supplier pumps groundwater. For those basins for which a court or the board has adjudicated the rights to pump groundwater, a copy of the order or decree adopted by the court or the board and a description of the amount of groundwater the urban water supplier has the legal right to pump under the order or decree. For basins that have not been adjudicated, information as to whether the department has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition.

(3) A detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

(4) A detailed description and analysis of the amount and location of groundwater that is projected to be pumped by the urban water supplier. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

(c) (1) Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage, to the extent practicable, and provide data for each of the following:

(A) An average water year.

(B) A single dry water year.

(C) Multiple dry water years.

(2) For any water source that may not be available at a consistent level of use, given specific legal, environmental, water quality, or climatic factors, describe plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable.

(d) Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.

(e) (1) Quantify, to the extent records are available, past and current water use, over the same five-year increments described in subdivision (a), and projected water use, identifying the uses among water use sectors, including, but not necessarily limited to, all of the following uses:

(A) Single-family residential.

(B) Multifamily.

(C) Commercial.

(D) Industrial.

(E) Institutional and governmental.

(F) Landscape.

(G) Sales to other agencies.

(H) Saline water intrusion barriers, groundwater recharge, or conjunctive use, or any combination thereof.

(I) Agricultural.

(2) The water use projections shall be in the same five-year increments described in subdivision (a).

(f) Provide a description of the supplier's water demand management measures. This description shall include all of the following:

(1) A description of each water demand management measure that is currently being implemented, or scheduled for implementation, including the steps necessary to implement any proposed measures, including, but not limited to, all of the following:

(A) Water survey programs for single-family residential and multifamily residential customers.

(B) Residential plumbing retrofit.

(C) System water audits, leak detection, and repair.

(D) Metering with commodity rates for all new connections and retrofit of existing connections.

(E) Large landscape conservation programs and incentives.

(F) High-efficiency washing machine rebate programs.

(G) Public information programs.

(H) School education programs.

(I) Conservation programs for commercial, industrial, and institutional accounts.

(J) Wholesale agency programs.
(K) Conservation pricing.
(L) Water conservation coordinator.
(M) Water waste prohibition.
(N) Residential ultra-low-flush toilet replacement programs.

(2) A schedule of implementation for all water demand management measures proposed or described in the plan.

(3) A description of the methods, if any, that the supplier will use to evaluate the effectiveness of water demand management measures implemented or described under the plan.

(4) An estimate, if available, of existing conservation savings on water use within the supplier's service area, and the effect of the savings on the supplier's ability to further reduce demand.

(g) An evaluation of each water demand management measure listed in paragraph (1) of subdivision (f) that is not currently being implemented or scheduled for implementation. In the course of the evaluation, first consideration shall be given to water demand management measures, or combination of measures, that offer lower incremental costs than expanded or additional water supplies. This evaluation shall do all of the following:

(1) Take into account economic and noneconomic factors, including environmental, social, health, customer impact, and technological factors.

(2) Include a cost-benefit analysis, identifying total benefits and total costs.

(3) Include a description of funding available to implement any planned water supply project that would provide water at a higher unit cost.

(4) Include a description of the water supplier's legal authority to implement the measure and efforts to work with other relevant agencies to ensure the implementation of the measure and to share the cost of implementation.

(h) Include a description of all water supply projects and water supply programs that may be undertaken by the urban water supplier to meet the total projected water use as established pursuant to subdivision (a) of Section 10635. The urban water supplier shall include a detailed description of expected future projects and programs, other than the demand management programs identified pursuant to paragraph (1) of subdivision (f), that the urban water supplier may implement to increase the amount of the water supply available to the urban water supplier in average, single-dry, and multiple-dry water years. The description shall identify specific projects and include a description of the increase in water supply that is expected to be available from each project. The description shall include an estimate with regard to the implementation timeline for each project or program.

(i) Describe the opportunities for development of desalinated water, including, but not limited to, ocean water, brackish water, and groundwater, as a long-term supply.

(j) For purposes of this part, urban water suppliers that are members of the California Urban Water Conservation Council shall be deemed in compliance with the requirements of subdivisions (f) and (g) by complying with all the provisions of the "Memorandum of Understanding Regarding Urban Water Conservation in California," dated December 10, 2008, as it may be amended, and by submitting the annual reports required by Section 6.2 of that memorandum.

(k) Urban water suppliers that rely upon a wholesale agency for a source of water shall provide the wholesale agency with water use projections from that agency for that source of water in five-year increments to 20 years or as far as data is available. The wholesale agency shall provide information to the urban water supplier for inclusion in the urban water supplier's plan that identifies and quantifies, to the extent practicable, the existing and planned sources of water as required by subdivision (b), available from the wholesale agency to the urban water supplier over the same five-year increments, and during various water-year types in accordance with subdivision (c). An urban water supplier may rely upon water supply information provided by the wholesale agency in fulfilling the plan informational requirements of subdivisions (b) and (c).

**10631.1.** (a) The water use projections required by Section 10631 shall include projected water use for single-family and multifamily residential housing needed for lower income households, as defined in Section 50079.5 of the Health and Safety Code, as identified in the housing element of any city, county, or city and county in the service area of the supplier.

(b) It is the intent of the Legislature that the identification of projected water use for single-family and multifamily residential housing for lower income households will assist a supplier in complying with the requirement under Section 65589.7 of the Government Code to grant a priority for the provision of service to housing units affordable to lower income households.

**10631.5.** (a) (1) Beginning January 1, 2009, the terms of, and eligibility for, a water management grant or loan made to an urban water supplier and awarded or administered by the department, state board, or California Bay-Delta Authority or its successor agency shall be conditioned on the implementation of the water demand management measures described in Section 10631, as determined by the department pursuant to subdivision (b).

(2) For the purposes of this section, water management grants and loans include funding for programs and projects for surface water or groundwater storage, recycling, desalination, water conservation, water supply reliability, and water supply augmentation. This section does not apply to water management projects funded by the federal American Recovery and Reinvestment Act of 2009 (Public Law 111-5).

(3) Notwithstanding paragraph (1), the department shall determine that an urban water supplier is eligible for a water management grant or loan even though the supplier is not implementing all of the water demand management measures described in Section 10631, if the urban water supplier has submitted to the department for approval a schedule, financing plan, and budget, to be included in the grant or loan agreement, for implementation of the water demand management measures. The supplier may request grant or loan funds to implement the water demand management measures to the extent the request is consistent with the eligibility requirements applicable to the water management funds.

(4) (A) Notwithstanding paragraph (1), the department shall

determine that an urban water supplier is eligible for a water management grant or loan even though the supplier is not implementing all of the water demand management measures described in Section 10631, if an urban water supplier submits to the department for approval documentation demonstrating that a water demand management measure is not locally cost effective. If the department determines that the documentation submitted by the urban water supplier fails to demonstrate that a water demand management measure is not locally cost effective, the department shall notify the urban water supplier and the agency administering the grant or loan program within 120 days that the documentation does not satisfy the requirements for an exemption, and include in that notification a detailed statement to support the determination.

(B) For purposes of this paragraph, "not locally cost effective" means that the present value of the local benefits of implementing a water demand management measure is less than the present value of the local costs of implementing that measure.

(b) (1) The department, in consultation with the state board and the California Bay-Delta Authority or its successor agency, and after soliciting public comment regarding eligibility requirements, shall develop eligibility requirements to implement the requirement of paragraph (1) of subdivision (a). In establishing these eligibility requirements, the department shall do both of the following:

(A) Consider the conservation measures described in the Memorandum of Understanding Regarding Urban Water Conservation in California, and alternative conservation approaches that provide equal or greater water savings.

(B) Recognize the different legal, technical, fiscal, and practical roles and responsibilities of wholesale water suppliers and retail water suppliers.

(2) (A) For the purposes of this section, the department shall determine whether an urban water supplier is implementing all of the water demand management measures described in Section 10631 based on either, or a combination, of the following:

(i) Compliance on an individual basis.

(ii) Compliance on a regional basis. Regional compliance shall require participation in a regional conservation program consisting of two or more urban water suppliers that achieves the level of conservation or water efficiency savings equivalent to the amount of conservation or savings achieved if each of the participating urban water suppliers implemented the water demand management measures. The urban water supplier administering the regional program shall provide participating urban water suppliers and the department with data to demonstrate that the regional program is consistent with this clause. The department shall review the data to determine whether the urban water suppliers in the regional program are meeting the eligibility requirements.

(B) The department may require additional information for any determination pursuant to this section.

(3) The department shall not deny eligibility to an urban water supplier in compliance with the requirements of this section that is participating in a multiagency water project, or an integrated regional water management plan, developed pursuant to Section 75026 of the Public Resources Code, solely on the basis that one or more of

the agencies participating in the project or plan is not implementing all of the water demand management measures described in Section 10631.

(c) In establishing guidelines pursuant to the specific funding authorization for any water management grant or loan program subject to this section, the agency administering the grant or loan program shall include in the guidelines the eligibility requirements developed by the department pursuant to subdivision (b).

(d) Upon receipt of a water management grant or loan application by an agency administering a grant and loan program subject to this section, the agency shall request an eligibility determination from the department with respect to the requirements of this section. The department shall respond to the request within 60 days of the request.

(e) The urban water supplier may submit to the department copies of its annual reports and other relevant documents to assist the department in determining whether the urban water supplier is implementing or scheduling the implementation of water demand management activities. In addition, for urban water suppliers that are signatories to the Memorandum of Understanding Regarding Urban Water Conservation in California and submit biennial reports to the California Urban Water Conservation Council in accordance with the memorandum, the department may use these reports to assist in tracking the implementation of water demand management measures.

(f) This section shall remain in effect only until July 1, 2016, and as of that date is repealed, unless a later enacted statute, that is enacted before July 1, 2016, deletes or extends that date.

**10631.7.** The department, in consultation with the California Urban Water Conservation Council, shall convene an independent technical panel to provide information and recommendations to the department and the Legislature on new demand management measures, technologies, and approaches. The panel shall consist of no more than seven members, who shall be selected by the department to reflect a balanced representation of experts. The panel shall have at least one, but no more than two, representatives from each of the following: retail water suppliers, environmental organizations, the business community, wholesale water suppliers, and academia. The panel shall be convened by January 1, 2009, and shall report to the Legislature no later than January 1, 2010, and every five years thereafter. The department shall review the panel report and include in the final report to the Legislature the department's recommendations and comments regarding the panel process and the panel's recommendations.

**10632.** (a) The plan shall provide an urban water shortage contingency analysis that includes each of the following elements that are within the authority of the urban water supplier:

(1) Stages of action to be undertaken by the urban water supplier in response to water supply shortages, including up to a 50 percent reduction in water supply, and an outline of specific water supply conditions that are applicable to each stage.

(2) An estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic

sequence for the agency's water supply.
(3) Actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.
(4) Additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street cleaning.
(5) Consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are appropriate for its area, and have the ability to achieve a water use reduction consistent with up to a 50 percent reduction in water supply.
(6) Penalties or charges for excessive use, where applicable.
(7) An analysis of the impacts of each of the actions and conditions described in paragraphs (1) to (6), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of reserves and rate adjustments.
(8) A draft water shortage contingency resolution or ordinance.
(9) A mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis.
(b) Commencing with the urban water management plan update due December 31, 2015, for purposes of developing the water shortage contingency analysis pursuant to subdivision (a), the urban water supplier shall analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas, as defined in subdivision (a) of Section 115921 of the Health and Safety Code.

**10633.** The plan shall provide, to the extent available, information on recycled water and its potential for use as a water source in the service area of the urban water supplier. The preparation of the plan shall be coordinated with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area, and shall include all of the following:
(a) A description of the wastewater collection and treatment systems in the supplier's service area, including a quantification of the amount of wastewater collected and treated and the methods of wastewater disposal.
(b) A description of the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.
(c) A description of the recycled water currently being used in the supplier's service area, including, but not limited to, the type, place, and quantity of use.
(d) A description and quantification of the potential uses of recycled water, including, but not limited to, agricultural irrigation, landscape irrigation, wildlife habitat enhancement, wetlands, industrial reuse, groundwater recharge, indirect potable reuse, and other appropriate uses, and a determination with regard to the technical and economic feasibility of serving those uses.
(e) The projected use of recycled water within the supplier's

service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected pursuant to this subdivision.

(f) A description of actions, including financial incentives, which may be taken to encourage the use of recycled water, and the projected results of these actions in terms of acre-feet of recycled water used per year.

(g) A plan for optimizing the use of recycled water in the supplier's service area, including actions to facilitate the installation of dual distribution systems, to promote recirculating uses, to facilitate the increased use of treated wastewater that meets recycled water standards, and to overcome any obstacles to achieving that increased use.

**10634.** The plan shall include information, to the extent practicable, relating to the quality of existing sources of water available to the supplier over the same five-year increments as described in subdivision (a) of Section 10631, and the manner in which water quality affects water management strategies and supply reliability.

## WATER CODE SECTION 10635

**10635.** (a) Every urban water supplier shall include, as part of its urban water management plan, an assessment of the reliability of its water service to its customers during normal, dry, and multiple dry water years. This water supply and demand assessment shall compare the total water supply sources available to the water supplier with the total projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and multiple dry water years. The water service reliability assessment shall be based upon the information compiled pursuant to Section 10631, including available data from state, regional, or local agency population projections within the service area of the urban water supplier.

(b) The urban water supplier shall provide that portion of its urban water management plan prepared pursuant to this article to any city or county within which it provides water supplies no later than 60 days after the submission of its urban water management plan.

(c) Nothing in this article is intended to create a right or entitlement to water service or any specific level of water service.

(d) Nothing in this article is intended to change existing law concerning an urban water supplier's obligation to provide water service to its existing customers or to any potential future customers.

# WATER CODE
# SECTION 10640-10645

**10640.** Every urban water supplier required to prepare a plan pursuant to this part shall prepare its plan pursuant to Article 2 (commencing with Section 10630).

The supplier shall likewise periodically review the plan as required by Section 10621, and any amendments or changes required as a result of that review shall be adopted pursuant to this article.

**10641.** An urban water supplier required to prepare a plan may consult with, and obtain comments from, any public agency or state agency or any person who has special expertise with respect to water demand management methods and techniques.

**10642.** Each urban water supplier shall encourage the active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan. Prior to adopting a plan, the urban water supplier shall make the plan available for public inspection and shall hold a public hearing thereon. Prior to the hearing, notice of the time and place of hearing shall be published within the jurisdiction of the publicly owned water supplier pursuant to Section 6066 of the Government Code. The urban water supplier shall provide notice of the time and place of hearing to any city or county within which the supplier provides water supplies. A privately owned water supplier shall provide an equivalent notice within its service area. After the hearing, the plan shall be adopted as prepared or as modified after the hearing.

**10643.** An urban water supplier shall implement its plan adopted pursuant to this chapter in accordance with the schedule set forth in its plan.

**10644.** (a) An urban water supplier shall submit to the department, the California State Library, and any city or county within which the supplier provides water supplies a copy of its plan no later than 30 days after adoption. Copies of amendments or changes to the plans shall be submitted to the department, the California State Library, and any city or county within which the supplier provides water supplies within 30 days after adoption.

(b) The department shall prepare and submit to the Legislature, on or before December 31, in the years ending in six and one, a report summarizing the status of the plans adopted pursuant to this part. The report prepared by the department shall identify the exemplary elements of the individual plans. The department shall provide a copy of the report to each urban water supplier that has submitted its plan to the department. The department shall also prepare reports and provide data for any legislative hearings designed to consider the effectiveness of plans submitted pursuant to this part.

(c) (1) For the purpose of identifying the exemplary elements of the individual plans, the department shall identify in the report those water demand management measures adopted and implemented by specific urban water suppliers, and identified pursuant to Section

10631, that achieve water savings significantly above the levels established by the department to meet the requirements of Section 10631.5.

(2) The department shall distribute to the panel convened pursuant to Section 10631.7 the results achieved by the implementation of those water demand management measures described in paragraph (1).

(3) The department shall make available to the public the standard the department will use to identify exemplary water demand management measures.

**10645.** Not later than 30 days after filing a copy of its plan with the department, the urban water supplier and the department shall make the plan available for public review during normal business hours.

# WATER CODE
# SECTION 10650-10656

**10650.** Any actions or proceedings to attack, review, set aside, void, or annul the acts or decisions of an urban water supplier on the grounds of noncompliance with this part shall be commenced as follows:

(a) An action or proceeding alleging failure to adopt a plan shall be commenced within 18 months after that adoption is required by this part.

(b) Any action or proceeding alleging that a plan, or action taken pursuant to the plan, does not comply with this part shall be commenced within 90 days after filing of the plan or amendment thereto pursuant to Section 10644 or the taking of that action.

**10651.** In any action or proceeding to attack, review, set aside, void, or annul a plan, or an action taken pursuant to the plan by an urban water supplier on the grounds of noncompliance with this part, the inquiry shall extend only to whether there was a prejudicial abuse of discretion. Abuse of discretion is established if the supplier has not proceeded in a manner required by law or if the action by the water supplier is not supported by substantial evidence.

**10652.** The California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code) does not apply to the preparation and adoption of plans pursuant to this part or to the implementation of actions taken pursuant to Section 10632. Nothing in this part shall be interpreted as exempting from the California Environmental Quality Act any project that would significantly affect water supplies for fish and wildlife, or any project for implementation of the plan, other than projects implementing Section 10632, or any project for expanded or additional water supplies.

**10653.** The adoption of a plan shall satisfy any requirements of state law, regulation, or order, including those of the State Water Resources Control Board and the Public Utilities Commission, for the preparation of water management plans or conservation plans; provided, that if the State Water Resources Control Board or the Public Utilities Commission requires additional information concerning water conservation to implement its existing authority, nothing in this part shall be deemed to limit the board or the commission in obtaining that information. The requirements of this part shall be satisfied by any urban water demand management plan prepared to meet federal laws or regulations after the effective date of this part, and which substantially meets the requirements of this part, or by any existing urban water management plan which includes the contents of a plan required under this part.

**10654.** An urban water supplier may recover in its rates the costs incurred in preparing its plan and implementing the reasonable water conservation measures included in the plan. Any best water management practice that is included in the plan that is identified in the

"Memorandum of Understanding Regarding Urban Water Conservation in California" is deemed to be reasonable for the purposes of this section.

**10655.** If any provision of this part or the application thereof to any person or circumstances is held invalid, that invalidity shall not affect other provisions or applications of this part which can be given effect without the invalid provision or application thereof, and to this end the provisions of this part are severable.

**10656.** An urban water supplier that does not prepare, adopt, and submit its urban water management plan to the department in accordance with this part, is ineligible to receive funding pursuant to Division 24 (commencing with Section 78500) or Division 26 (commencing with Section 79000), or receive drought assistance from the state until the urban water management plan is submitted pursuant to this article.

Urban Water Management Plan

# Appendix B

# Urban Water Management Plan Checklist and Standard Tables

# 2010 UWMP Checklist

| No. | UWMP Requirements | CA Water Code Reference | Subject | UWMP Location | UWMP Guidebook Standardized Table Locations | Additional Clarification |
|---|---|---|---|---|---|---|
| 1 | Provide baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data. | 10608.20(e) | System Demands | p 51-52 (Sec 3.1.2), Appendix G (2020 Water Use Target) | 13, 14, 15 | |
| 2 | Wholesalers: Include an assessment of present and proposed future measures, programs, and policies to help achieve the water use reductions. Retailers: Conduct at least one public hearing that includes general discussion of the urban retail water supplier's implementation plan for complying with the Water Conservation Bill of 2009. | 10608.36, 10608.26 (a) | System Demands | Appendix D - Four public worshops were held on 1/2/10, 1/20/10, 2/3/11, & 2/9/11. Final public hearings for the adoption was held on 5/3/11. | Not Applicable | |
| 3 | Report progress in meeting urban water use targets using the standardized form. | 10608.40 | Not Applicable | Standardized form not yet available | Not Applicable | |
| 4 | Each urban water supplier shall coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable | 10620(d)(2) | Plan Preparation | Various pages reference reports, communication, and coordination with City Planning, Bureau of Sanitation, MWD, SCAG, TreePeople, and other agencies & stakeholders. Appendix D documents public involments. | 1 | |
| 5 | An urban water supplier shall describe in the plan water management tools and options used by that entity that will maximize resources and minimize the need to import water from other regions. | 10620(f) | Water Supply Reliability | p 1 | Not Applicable | |
| 6 | Every urban water supplier required to prepare a plan pursuant to this part shall, at least 60 days prior to the public hearing on the plan required by Section 10642, notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments of changes to the plan. The urban water supplier may consult with, and obtain comments from, any city or county that receives notice pursuant to this subdivision. | 10621(b) | Plan Preparation | Appendix D (Notice of Meeting & Public Comments) | Not Applicable | |
| 7 | The amendments to, or changes in, the plan shall be adopted and filed in the manner set forth in Article 3 (commencing with Section 10640). | 10621(c) | Plan Preparation | To be enclosed with transmittal letter to DWR. | Not Applicable | |
| 8 | Describe the service area of the supplier | 10631(a) | System Description | p 1 & 30 (Sec 1.2) | Not Applicable | |
| 9 | (Describe the service area) climate | 10631(a) | System Description | p 34 (Sec1.2.3 & Exhibit 1E) | Not Applicable | |
| 10 | (Describe the service area) current and projected population . . . The projected population estimates shall be based upon data from the state, regional, or local service agency population projections within the service area of the urban water supplier… | 10631(a) | System Description | p 31-33 (Sec 1.2.2) | 2 | Provide the most recent population data possible. Use the method described in "Baseline Daily Per Capita Water Use." See Section M. |
| 11 | . . . (population projections) shall be in five-year increments to 20 years or as far as data is available. | 10631(a) | System Description | p 32 (Exhibit 1C) | 2 | 2035 and 2040 can also be provided to support consistency with Water Supply Assessments and Written Verification of Water Supply Documents |
| 12 | Describe . . . other demographic factors affecting the supplier's water management planning | 10631(a) | System Description | p 32 (Exhibit 1C), p 43 (Exhibit 2G), p 44 (socioeconomic variables) | Not Applicable | |
| 13 | Identify and quantify, to the extent practicable, the existing and planned sources of water available to the supplier over the same five-year increments described in subdivision (a). | 10631(b) | System Supplies | p 229 (Exhibit 11E) | 16 | The ‘existing’ water sources should be for the same year as the “current population” in line 10. 2035 and 2040 can also be provided to support consistency with Water Supply Assessments and Written Verification of Water Supply documents. |
| 14 | (Is) groundwater . . . identified as an existing or planned source of water available to the supplier . . .? | 10631(b) | System Supplies | p 123 (Exhibit 6B) & p 136 (Exhibit 6G) | 18, 19 | Source classifications are: surface water, groundwater, recycled water, storm water, desalinated sea water, desalinated brackish groundwater, and other. |

# 2010 UWMP Checklist

| No. | UWMP Requirements | CA Water Code Reference | Subject | UWMP Location | UWMP Guidebook Standardized Table Locations | Additional Clarification |
|---|---|---|---|---|---|---|
| 15 | (Provide a) copy of any groundwater management plan adopted by the urban water supplier, including plans adopted pursuant to Part 2.75 (commencing with Section 10750), or any other specific authorization for groundwater management. Indicate whether a groundwater management plan been adopted by the water supplier or if there is anyother specific authorization for groundwater management. Include a copy of the plan or authorization. | 10631(b)(1) | System Supplies | p 8 (Local Groundwater), Appendix F (Groundwater Basin Adjudications) | Not Applicable | |
| 16 | (Provide a) description of any groundwater basin or basins from which the urban water supplier pumps groundwater. | 10631(b)(2) | System Supplies | p 123, 129, 130, 132 (description of individual basin) | Not Applicable | |
| 17 | For those basins for which a court or the board has adjudicated the rights to pump groundwater, (provide) a copy of the order or decree adopted by the court or the board | 10631(b)(2) | System Supplies | Appendix F (Groundwater Basin Adjudications) | Not Applicable | |
| 18 | (Provide) a description of the amount of groundwater the urban water supplier has the legal right to pump under the order or decree. | 10631(b)(2) | System Supplies | p 121 (Sec 6.1, Exhibit 6A) | Not Applicable | |
| 19 | For basins that have not been adjudicated, (provide) information as to whether the department has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition. | 10631(b)(2) | System Supplies | Not Applicable | Not Applicable | |
| 20 | (Provide a) detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records | 10631(b)(3) | System Supplies | p 121-132, Exhibit 6B | 18 | |
| 21 | (Provide a) detailed description and analysis of the amount and location of groundwater that is projected to be pumped by the urban water supplier. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records. | 10631(b)(4) | System Supplies | p 136 | 19 | Provide projections for 2015, 2020, 2025, and 2030. |
| 22 | Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage, to the extent practicable, and provide data for each of the following: (A) An average water year, (B) A single dry water year, (C) Multiple dry water years. | 10631(c)(1) | Water Supply Reliability | p 223-227 (Sec 11.2 with description), p 229-235 (data, Exhibits 11E-11K) | 27, 28, 32, 33, 34 | |
| 23 | For any water source that may not be available at a consistent level of use - given specific legal, environmental, water quality, or climatic factors - describe plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable. | 10631(c)(2) | Water Supply Reliability | Sec 11.2.3 to 11.2.7 | 29, 30 | |
| 24 | Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis. | 10631(d) | System Supplies | p 195-199 | 20 | |

# 2010 UWMP Checklist

| No. | UWMP Requirements | CA Water Code Reference | Subject | UWMP Location | UWMP Guidebook Standardized Table Locations | Additional Clarification |
|---|---|---|---|---|---|---|
| 25 | Quantify, to the extent records are available, past and current water use, and projected water use (over the same five-year increments described in subdivision (a)), identifying the uses among water use sectors, including, but not necessarily limited to, all of the following uses: (A) Single-family residential; (B) Multifamily; (C) Commercial; (D) Industrial; (E) Institutional and governmental; (F) Landscape; (G) Sales to other agencies; (H) Sakine water intrusion barriers, groundwater recharge, or conjunctive use, or any combination thereof; (I) Agricultural. | 10631(e)(1) | System Demands | p 10 (Exhibit ES-G), p 45 (Exhibit 2J) | 3, 4, 5, 6, 7, 11 | Consider "past" to be 2005, present to be 2010, and projected to be 2015, 2020, 2025, and 2030. Provide numbers for each category for each of these years. |
| 26 | (Describe and provide a schedule of implementation for) each water demand management measure that is currently being implemented, or scheduled for implementation, including the steps necessary to implement any proposed measures, including, but not limited to, all of the following: (A) Water survey programs for single-family residential and multifamily residential customers; (B) Residential plumbing retrofit; (C) System water audits, leak detection, and repair; (D) Metering with commodity rates for all new connections and retrofit of existing connections;(E) Large landscape conservation programs and incentives; (F) High-efficiency washing machine rebate programs;(G) Public information programs; (H) School education programs; (I) Conservation programs for commercial, industrial, and institutional accounts; (J) Wholesale agency programs; (K) Conservation pricing; (L) Water conservation coordinator; (M) Water waste prohibition;(N) Residential ultralow- flush toilet replacement programs | 10631(f)(1) | DMMs | p 52-70 (Sec 3.2) | Not Applicable | (A) Water Survey for Single and Multi-family residential customers: Exhibit 3F, Exhibit 3G, Section 3.2.4 - Residential Category (B) Residential Plumbing Retrofit: Section 3.2.1 and 3.2.4, Exhibit 3G (C) System Water Audits, Leak Detection, and Repair: Exhibit 3F, Exhibit 3G, Section 3.2.4 - System Maintenance Category (D) Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections: Exhibit 3F, Exhibit 3G, Section 3.2.2 (E) Large Landscape Conservation Programs and Incentives: Exhibit 3F, Exhibit 3G, Section 3.2.4 - Landscape (F) High-Efficiency Washing Machine Rebate Programs: Exhibit 3F, Exhibit 3G, Section 3.2.4 - Residential (G) Public Information Programs: Exhibit 3F, Exhibit 3G, Section 3.2.4 - Awareness/Support Measures (H) School Education Programs: Exhibit 3F, Exhibit 3G, Section 3.2.4 - Awareness/Support Measures(I) Conservation Programs for Commercial, Industrial, and Institutional Accounts: Exhibit 3F, Exhibit 3G, Section 3.2.4 - Commercial/Industrial/Institutional Category (J) Wholesale Agency Programs: Not applicable (stated so in 3.2.3)<br>(K) Conservation pricing: Section 3.2.2, Exhibit 3F, Exhibit 3G (L) Water Conservation Coordinator: Exhibit 3F, Exhibit 3G, Section 3.2.4 (M) Water Waste Prohibition: Section 3.2.1, Exhibit 3F, Exhibit 3G (N) Residential Ultralow-flush Toilet Replacement Programs: Exhibit 3F, Exhibit 3G, Section 3.2.4 - Residential Category |
| 27 | A description of the methods, if any, that the supplier will use to evaluate the effectiveness of water demand management measures implemented or described under the plan. | 10631(f)(3) | DMMs | p 41-42 (Sec 2.2, Exhibits 2E & 2F), p 245-246 (Sec 11.3.9) | Not Applicable | |
| 28 | An estimate, if available, of existing conservation savings on water use within the supplier's service area, and the effect of the savings on the supplier's ability to future reduce demand. | 10631(f)(4) | DMMs | p 49 (Exhibit 3B) | 16 | |

# 2010 UWMP Checklist

| No. | UWMP Requirements | CA Water Code Reference | Subject | UWMP Location | UWMP Guidebook Standardized Table Locations | Additional Clarification |
|---|---|---|---|---|---|---|
| 29 | An evaluation of each water demand management measure listed in paragraph (1) of subdivision (f) that is not currently being implemented or scheduled for implementation. In the course of the evaluation, first consideration shall be given to water demand management measures, or combination of measures, that offer lower incremental costs than expanded<br>or additional water supplies. This evaluation shall do all of the following:<br>(1) Take into account economic and noneconomic<br>factors, including environmental, social, health, customer impact, and technological factors; (2) Include a cost-benefit analysis, identifying total benefits and total costs; (3) Include a description of funding available to implement any planned water supply project that would provide water at a higher unit cost; (4) Include a description of the water supplier's legal authority to implement the measure and efforts to work with other relevant agencies to ensure the implementation of the measure and to share the cost of implementation | 10631(g) | DMMs | Not Applicable. All items listed in paragraph (1) of subdivision (f) have been addressed aside from Wholesale agency programs which does not apply to LADWP | Not Applicable | This checklist item not applicable to LADWP. LADWP is implementing all demand management measures listed in paragraph (1) of subdivision (f) |
| 30 | (Describe) all water supply projects and water supply programs that may be undertaken by the urban water supplier to meet the total projected water use as established pursuant to subdivision (a) of Section 10635. The urban water supplier shall include a detailed description of expected future projects and programs, other than the demand management programs<br>identified pursuant to paragraph (1) of subdivision (f), that the urban water supplier may implement to increase the amount of the water supply available to the urban water supplier in average, single-dry, and multiple-dry water years. The description shall identify specific projects and include a description of the increase in water supply that is expected to be available from each project. The description shall include an estimate with regard to the implementation timeline for each project or program. | 10631(h) | System Supplies | p 98-101 (Exhibits 4L, 4M, 4N, 4O, 4P) | 26 | |
| 31 | Describe the opportunities for development of desalinated water, including, but not limited to, ocean water, brackish water, and groundwater, as a long-term supply. | 10631(i) | System Supplies | p 20 & 199 | 10 (Not Applicable) | |
| 32 | Include the annual reports submitted to meet the Section 6.2 requirement (of the MOU), if a member of the CUWCC and signer of the December 10, 2008 MOU. | 10631(j) | DMMs | Appendix H | Not Applicable | Since the CUWCC BMP Reporting Database is not available at this time, LADWP has attached the CUWCC BMP Reports from 2007-2008 which shows LADWP has met all the BMP coverage requirements. In addition, LADWP has submitted the necessary documentation to comply with the DMMs. |
| 33 | Urban water suppliers that rely upon a wholesale agency for a source of water shall provide the wholesale agency with water use projections from that agency for that source of water in five-year increments to 20 years or as far as data is available. The wholesale agency shall provide information to the urban water supplier for inclusion in the urban water supplier's plan that identifies and quantifies, to the extent practicable, the existing and planned sources of water as required by subdivision (b), available from the wholesale agency to the urban water supplier over the same five-year increments, and during various water-year types in accordance with subdivision (c). An urban water supplier may rely upon water supply information provided by the wholesale agency in fulfilling the plan informational requirements of subdivisions (b) and (c). | 10631(k) | System Supplies | p 226 (Exhibit 11B), p 229-235 (Exhibits 11E to 11K), p 238 (Exhibit 11L) | 12, 17, 29, 31 | Average year, single dry year, multiple dry years for 2015, 2020, 2025, and 2030. |

# 2010 UWMP Checklist

| No. | UWMP Requirements | CA Water Code Reference | Subject | UWMP Location | UWMP Guidebook Standardized Table Locations | Additional Clarification |
|---|---|---|---|---|---|---|
| 34 | The water use projections required by Section 10631 shall include projected water use for single-family and multifamily residential housing needed for lower income households, as defined in Section 50079.5 of the Health and Safety Code, as identified in the housing element of any city, county, or city and county in the service area of the supplier. | 10631.1(a) | System Demands | p 46 (Exhibit 2L) | 8 | |
| 35 | Stages of action to be undertaken by the urban water supplier in response to water supply shortages, including up to a 50 percent reduction in water supply, and an outline of specific water supply conditions which are applicable to each stage. | 10632(a)(1) | Water Supply Reliability | p 236-238 (Sec 11.3.1) | 35 | |
| 36 | Provide an estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency's water supply. | 10632(a)(2) | Water Supply Reliability | p 238-239 (Sec 11.3.2) | 31 | |
| 37 | (Identify) actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster. | 10632(a)(3) | Water Supply Reliability | p 239-240 (Sec 11.3.3) | Not Applicable | |
| 38 | (Identify) additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street cleaning. | 10632(a)(4) | Water Supply Reliability | p 240-242 (Sec 11.3.4) | 36 | |
| 39 | (Specify) consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are appropriate for its area, and have the ability to achieve a water use reduction consistent with up to a 50 percent reduction in water supply | 10632(a)(5) | Water Supply Reliability | p 242-243 (Sec 11.3.5) | 37 | |
| 40 | (Indicated) penalties or charges for excessive use, where applicable. | 10632(a)(6) | Water Supply Reliability | p 243 (Sec 11.3.6) | 38 | |
| 41 | An analysis of the impacts of each of the actions and conditions described in subdivisions (a) to (f), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of resserves and rate adjustments. | 10632(a)(7) | Water Supply Reliability | p 244 (Sec 11.3.7) | Not Applicable | |
| 42 | (Provide) a draft water shortage contingency resolution or ordinance. | 10632(a)(8) | Water Supply Reliability | p 244-245 (Sec 11.3.8) & Appendix I | Not Applicable | |
| 43 | (Indicate) a mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis. | 10632(a)(9) | Water Supply Reliability | p 41-42 (Sec 2.2, Exhibits 2E & 2F), p 245-246 (Sec 11.3.9) | Not Applicable | |
| 44 | Provide, to the extent available, information on recycled water and its potential for use as a water source in the service area of the urban water supplier. The preparation of the plan shall be coordinated with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area | 10633 | System Supplies | p 14-15, p 81-82 | 16, 21 | |
| 45 | (Describe) the wastewater collection and treatment systems in the supplier's service area, including a quantification of the amount of wastewater collected and treated and the methods of wasterwater disposal. | 10633(a) | System Supplies | p 88-91 (Sec 4-2, Exhibit 4D) | 21 | |
| 46 | (Describe) the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project. | 10633(b) | System Supplies | p 88-91 (Sec 4-2, Exhibits 4C & 4D) | 21, 22 | |

# 2010 UWMP Checklist

| No. | UWMP Requirements | CA Water Code Reference | Subject | UWMP Location | UWMP Guidebook Standardized Table Locations | Additional Clarification |
|---|---|---|---|---|---|---|
| 47 | (Describe) the recycled water currently being used in the supplier's service area, including, but not limited to, the type, place, and quantity of use. | 10633(c) | System Supplies | p 92-97 (Sec 4.3, Exhibits 4E - 4J) | 24 | |
| 48 | (Describe and quantify) the potential uses of recycled water, including, but not limited to, agricultural irrigation, landscape irrigation, wildlife habitat enhancement, wetlands, industrial reuse, groundwater recharge, indirect potable reuse, and other appropriate uses, and a determination with regard to the technical and economic feasibility of serving those uses | 10633(d) | System Supplies | p 97-105 (Sec 4.4.1 to 4.4.4, Exhibits 4K - 4Q) | 23 | |
| 49 | (Describe) The projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected pursuant to this subdivision. | 10633(e) | System Supplies | p 97-98 (Sec 4.4, Exhibit 4L), p 96-97 (Sec 4.3.5, Exhibit 4J) | 24, 25 | |
| 50 | (Describe the) actions, including financial incentives, which may be taken to encourage the use of recycled water, and the projected results of these actions in terms of acre-feet of recycled water used per year. | 10633(f) | System Supplies | p 105-106 (Sec 4.4.6) | 25 | |
| 51 | (Provide a) plan for optimizing the use of recycled water in the supplier's service area, including actions to facilitate the installation of dual distribution systems, to promote recirculating uses, to facilitate the increased use of treated wastewater that meets recycled water standards, and to overcome any obstacles to achieving that increased use | 10633(g) | System Supplies | p 97-107 (Sec 4.4) | 26 | |
| 52 | The plan shall include information, to the extent practicable, relating to the quality of existing sources of water available to the supplier over the same five-year increments as described in subdivision (a) of Section 10631, and the manner in which water quality affects water management strategies and supply reliability | 10634 | Water Supply Reliability | p 20-22 | 30 | For years 2015, 2020, 2025, 2030, and 2035 (changed this from 2010, 2015,…) |
| 53 | Every urban water supplier shall include, as part of its urban water management plan, an assessment of the reliability of its water service to its customers during normal, dry, and multiple dry water years. This water supply and demand assessment shall compare the total water supply sources available to the water supplier with the total projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and multiple dry water years. The water service reliability assessment shall be based upon the information compiled pursuant to Section 10631, including available data from state, regional, or local agency population projections within the service area of the urban water supplier. | 10635(a) | Water Supply Reliability | p 229-235 (Exhibits 11E to 11K) | 32, 33, 34 | |
| 54 | The urban water supplier shall provide that portion of its urban water management plan prepared pursuant to this article to any city or county within which it provides water supplies no later than 60 days after the submission of its urban water management plan | 10635(b) | Plan Preparation | Appendix D | Not Applicable | |
| 55 | Each urban water supplier shall encourage the active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan. | 10642 | Plan Preparation | Appendix D | Not Applicable | |

# 2010 UWMP Checklist

| No. | UWMP Requirements | CA Water Code Reference | Subject | UWMP Location | UWMP Guidebook Standardized Table Locations | Additional Clarification |
|---|---|---|---|---|---|---|
| 56 | Prior to adopting a plan, the urban water supplier shall make the plan available for public inspection and shall hold a public hearing thereon. Prior to the hearing, notice of the time and place of hearing shall be published within the jurisdiction of the publicly owned water supplier pursuant to Section 6066 of the Government Code. The urban water supplier shall provide notice of the time and place of hearing to any city or county within which the supplier provides water supplies. A privately owned water supplier shall provide an equivalent notice within its service area. | 10642 | Plan Preparation | Appendix D | Not Applicable | |
| 57 | After the hearing, the plan shall be adopted as prepared or as modified after the hearing. | 10642 | Plan Preparation | Adoption resolution included within cover page | Not Applicable | |
| 58 | An urban water supplier shall implement its plan adopted pursuant to this chapter in accordance with the schedule set forth in its plan. | 10643 | Plan Preparation | p 2-3 | Not Applicable | |
| 59 | An urban water supplier shall submit to the department, the California State Library, and any city or county within which the supplier provides water supplies a copy of its plan no later than 30 days after adoption. Copies of amendments or changes to the plans shall be submitted to the department, the California State Library, and any city or county within which the supplier provides water supplies within 30 days after adoption. | 10644(a) | Plan Preparation | To be enclosed with transmittal letter to DWR. | Not Applicable | |
| 60 | Not later than 30 days after filing a copy of its plan with the department, the urban water supplier and the department shall make the plan available for public review during normal business hours. | 10645 | Plan Preparation | To be enclosed with transmittal letter to DWR. | Not Applicable | |

**Table 1**
**Coordination with appropriate agencies**

| Coordinating Agencies[1,2] | Participated in developing the plan | Commented on the draft | Attended public meetings | Was contacted for assistance | Was sent a copy of the draft plan | Was sent a notice of intention to adopt | Not involved / No information |
|---|---|---|---|---|---|---|---|
| Department of Water Resources | | | | X | X | | |
| Metropolitan Water District | | | | X | | X | |
| Tree People | X | X | X | X | X | X | |
| City of Los Angeles Dept. of Planning | X | | | X | | | |
| City of Los Angeles Department of Public Works, Bureau of Sanitation | | | | X | | | |
| Upper Los Angeles River Area (ULARA) Watermaster | | | X | | | | |
| Los Angeles County Department of Public Works Flood Control District | | | X | | | | |
| San Gabriel Rivers Watershed Council | | | X | | | | X |
| Safe Neighborhood Parks | | | X | | | | |
| Panorama City Neighborhood Council | | | X | | | | |
| West Hollywood Neighborhood Council | | | X | | | | |
| Camp, Dresser, and McKee (CDM) | X | X | X | X | X | X | |
| Metropolitan Transit Authority (MTA) | | | X | | | | |
| Forest Lawn Memorial Park | | | X | | | | |
| Mt. Washington Association | | | X | | | | |
| Council District 14 | | | X | | | | |
| Arroyo Seco Neighborhood Council | | | X | | | | |
| Northridge West Neighborhood Council | | | X | | | | |
| Greywater Corps | | | X | | | | |
| Mar Vista Community Council | | | X | | | | |
| Greater Cypress Park NC | | | X | | | | |
| North East Trees | | | X | | | | |
| Reseda Neighborhood Council | | | X | | | | |
| LA Community Garden Council | | | X | | | | |
| Midtown Noho Neighborhood Council | | | X | | | | |
| River Project and Tujunga Watershed Council | | | X | | | | |
| Encino Neighborhood Council | | | X | | | | |
| Homeowners of Encino | | | X | | | | |
| WaterWoman | | | X | | | | |
| Sunland Tujunga Neighborhood Council | | | X | | | | |
| Studio City Neighborhood Council | | | X | | | | |
| Silverlake Reservoirs Conservancy | | | X | | | | |
| Society of Hispanic Professional Engineers | | | X | | | | |
| General public | | X | X | | X | | |

*[1] Indicate the specific name of the agency with which coordination or outreach occurred.*
*[2] Check at least one box in each row.*

**Table 2 (Exhibit 1C)**
**Population — current and projected**

| | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 - optional | Data source[2] |
|---|---|---|---|---|---|---|---|
| Service area population[1] | 4,100,260 | 4,172,760 | 4,250,861 | 4,326,012 | 4,398,408 | 4,467,560 | SCAG Regional Transportation Plan (2008) |

*[1] Service area population is defined as the population served by the distribution system. See Technical Methodology 2: Service Area Population (2010 UWMP Guidebook, Section M).*
*[2] Provide the source of the population data provided.*

**Table 3 (Exhibit 2J)**
**Water deliveries — actual, 2005**

| | 2005 | | | | |
|---|---|---|---|---|---|
| | Metered | | Not metered | | Total |
| Water use sectors | # of accounts | Volume | # of accounts | Volume | Volume |
| Single family | 476,201 | 233,192 | | | 233,192 |
| Multi-family | 114,656 | 185,536 | | | 185,536 |
| Commercial | 51,428 | 107,414 | | | 107,414 |
| Industrial/Governmental | 10,588 | 62,418 | | | 62,418 |
| Non-revenue (System Loss) | | 26,786 | | | 26,786 |
| Total | 652,873 | 615,346 | 0 | 0 | 615,346 |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

**Table 4 (Exhibit 2J)**
**Water deliveries — actual, 2010**

| | 2010 | | | | |
|---|---|---|---|---|---|
| | Metered | | Not metered | | Total |
| Water use sectors | # of accounts | Volume | # of accounts | Volume | Volume |
| Single family | 478,629 | 196,500 | | | 196,500 |
| Multi-family | 115,317 | 166,810 | | | 166,810 |
| Commercial | 50,017 | 96,675 | | | 96,675 |
| Industrial/Governmental | 10,671 | 52,877 | | | 52,877 |
| Non-revenue (System Loss) | | 32,909 | | | 32,909 |
| Total | 654,634 | 545,771 | 0 | 0 | 545,771 |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

| Table 5 (Exhibit 2J) Water deliveries — projected, 2015 | | | | | |
|---|---|---|---|---|---|
| | 2015 | | | | |
| | Metered | | Not metered | | Total |
| Water use sectors | # of accounts | Volume | # of accounts | Volume | Volume |
| Single family | | 225,699 | | | 225,699 |
| Multi-family | | 178,782 | | | 178,782 |
| Commercial | | 135,112 | | | 135,112 |
| Industrial/Governmental | | 18,600 | | | 18,600 |
| Non-revenue (System Loss) | | 41,370 | | | 41,370 |
| Total | 0 | 599,563 | 0 | 0 | 599,563 |

*Units (circle one): **acre-feet per year** million gallons per year cubic feet per year*

| Table 6 (Exhibit 2J) Water deliveries — projected, 2020 | | | | | |
|---|---|---|---|---|---|
| | 2020 | | | | |
| | Metered | | Not metered | | Total |
| Water use sectors | # of accounts | Volume | # of accounts | Volume | Volume |
| Single family | | 236,094 | | | 236,094 |
| Multi-family | | 193,220 | | | 193,220 |
| Commercial | | 133,597 | | | 133,597 |
| Industrial/Governmental | | 16,852 | | | 16,852 |
| Non-revenue (System Loss) | | 42,969 | | | 42,969 |
| Total | 0 | 622,732 | 0 | 0 | 622,732 |

*Units (circle one): **acre-feet per year** million gallons per year cubic feet per year*

| Table 7 (Exhibit 2J) Water deliveries — projected 2025, 2030, and 2035 | | | | | | |
|---|---|---|---|---|---|---|
| | 2025 | | 2030 | | 2035 - optional | |
| | metered | | metered | | metered | |
| Water use sectors | # of accounts | Volume | # of accounts | Volume | # of accounts | Volume |
| Single family | | 241,180 | | 246,879 | | 247,655 |
| Multi-family | | 202,999 | | 213,284 | | 218,762 |
| Commercial | | 129,761 | | 126,567 | | 120,420 |
| Industrial/governmental | | 14,708 | | 12,634 | | 10,513 |
| Non-revenue (System Loss) | | 43,627 | | 44,421 | | 44,272 |
| Total | 0 | 632,275 | 0 | 643,785 | 0 | 641,622 |

*Units (circle one): **acre-feet per year** million gallons per year cubic feet per year*

| Table 8 (Exhibit 2L) Low-income projected water demands | | | | | |
|---|---|---|---|---|---|
| Low Income Water Demands[1] | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| Single-family residential | 11,917 | 12,466 | 12,734 | 13,036 | 13,076 |
| Multi-family residential | 23,313 | 25,196 | 26,471 | 27,812 | 28,527 |
| Total | 35,230 | 37,662 | 39,205 | 40,848 | 41,603 |

*Units (circle one): **acre-feet per year** million gallons per year cubic feet per year*

*[1] Provide demands either as directly estimated values or as a percent of demand.*

| Table 9 - NOT APPLICABLE Sales to other water agencies | | | | | | | |
|---|---|---|---|---|---|---|---|
| Water distributed | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| name of agency | | | | | | | |
| name of agency | | | | | | | |
| name of agency | | | | | | | |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Units (circle one): acre-feet per year million gallons per year cubic feet per year*

| Table 10 - NOT APPLICABLE Additional water uses and losses | | | | | | | |
|---|---|---|---|---|---|---|---|
| Water use[1] | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 -opt |
| Saline barriers | | | | | | | |
| Groundwater recharge | | | | | | | |
| Conjunctive use | | | | | | | |
| Raw water | | | | | | | |
| Recycled water | | | | | | | |
| System losses | | | | | | | |
| Other (define) | | | | | | | |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Units (circle one): acre-feet per year million gallons per year cubic feet per year*

*[1] Any water accounted for in Tables 3 through 7 are not included in this table.*

| Table 11 (Exhibit 2J) Total water use | | | | | | | |
|---|---|---|---|---|---|---|---|
| Water Use | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| Total water deliveries (from Tables 3 to 7) | 615,346 | 545,771 | 599,563 | 622,732 | 632,275 | 643,785 | 641,622 |
| Sales to other water agencies (from Table 9) | - | - | - | - | - | - | - |
| Additional water uses and losses (from Table 10) | - | - | - | - | - | - | - |
| Total | 615,346 | 545,771 | 599,563 | 622,732 | 632,275 | 643,785 | 641,622 |

*Units (circle one): **acre-feet per year** million gallons per year cubic feet per year*

| Table 12 (Exhibit 11E) Retail agency demand projections provided to wholesale suppliers | | | | | | | |
|---|---|---|---|---|---|---|---|
| Wholesaler | Contracted Volume[3] | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 -opt |
| LADWP provided LA's demand projections to MWD on Feb. 22, 2011 | 203,313 | 263,875 | 248,120 | 218,040 | 193,760 | 198,781 | 193,027 |
| | | | | | | | |
| | | | | | | | |

*[3] Indicate the full amount of water (LADWP Purchase Order Commitment is minimum of 2,033,132.4 AF from 1/1/2003 to 1/1/2013. MWD is capable of providing more.)*

| Table 13 (Exhibit 3C; Appendix G)<br>Base period ranges | | | |
|---|---|---|---|
| **Base** | **Parameter** | **Value** | **Units** |
| 10- to 15-year base period | 2008 total water deliveries | 649,822 | *see below* |
| | 2008 total volume of delivered recycled water | 4,181 | *see below* |
| | 2008 recycled water as a percent of total deliveries | 1 | percent |
| | Number of years in base period[1] | 10 | years |
| | Year beginning base period range | 1996 | |
| | Year ending base period range[2] | 2005 | |
| 5-year base period | Number of years in base period | 5 | years |
| | Year beginning base period range | 2004 | |
| | Year ending base period range[3] | 2008 | |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

*[1] If the 2008 recycled water percent is less than 10 percent, then the first base period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater, the first base period is a continuous 10- to 15-year period.*

*[2] The ending year must be between December 31, 2004 and December 31, 2010.*

*[3] The ending year must be between December 31, 2007 and December 31, 2010.*

| Table 14 (Exhibit 3C; Appendix G)<br>Base daily per capita water use — 10- to 15-year range | | | | |
|---|---|---|---|---|
| **Base period year** | | **Distribution System Population** | **Daily system gross water use (AF)** | **Annual daily per capita water use (gpcd)** |
| **Sequence Year** | **Calendar Year** | | | |
| 1996 | | 3,568,651 | 610,144 | 153 |
| 1997 | | 3,584,227 | 628,265 | 156 |
| 1998 | | 3,613,170 | 587,398 | 145 |
| 1999 | | 3,653,878 | 619,467 | 151 |
| 2000 | | 3,705,600 | 659,121 | 159 |
| 2001 | | 3,770,806 | 657,873 | 156 |
| 2002 | | 3,829,677 | 667,145 | 156 |
| 2003 | | 3,881,069 | 650,664 | 150 |
| 2004 | | 3,925,129 | 688,213 | 157 |
| 2005 | | 3,955,022 | 614,072 | 139 |
| | | | **Base Daily Per Capita Water Use[1]** | 152 |

*[1] Add the values in the column and divide by the number of rows.*

| Table 15 (Exhibit 3C; Appendix G)<br>Base daily per capita water use — 5-year range | | | | |
|---|---|---|---|---|
| **Base period year** | | **Distribution System Population** | **Daily system gross water use (AF)** | **Annual daily per capita water use (gpcd)** |
| **Sequence Year** | **Calendar Year** | | | |
| 2004 | | 3,925,129 | 688,213 | 157 |
| 2005 | | 3,955,022 | 614,072 | 139 |
| 2006 | | 3,986,385 | 626,194 | 140 |
| 2007 | | 4,006,145 | 665,030 | 148 |
| 2008 | | 4,042,085 | 645,641 | 143 |
| | | | **Base Daily Per Capita Water Use[1]** | 145 |

*[1] Add the values in the column and divid by the number of rows.*

| Table 16 (Exhibit 11E)<br>Water supplies — current and projected | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Water Supply Sources** | | **2010** | **2015** | **2020** | **2025** | **2030** | **2035 - opt** |
| **Water purchased from[1]:** | **Wholesaler supplied volume (yes/no)** | | | | | | |
| **MWD Water Purchased** | **Yes** | 263,875 | 248,120 | 218,040 | 193,760 | 198,781 | 193,027 |
| **Supplier-produced groundwater[2]** | | 76,982 | 40,500 | 96,300 | 111,500 | 111,500 | 110,405 |
| **Los Angeles Aqueduct** | | 199,739 | 252,000 | 250,000 | 248,000 | 246,000 | 244,000 |
| **Conservation** | | 8,178 | 14,180 | 27,260 | 40,340 | 53,419 | 64,368 |
| **Recycled Water - Irrigation/Industrial Use** | | 6,703 | 20,000 | 20,400 | 27,000 | 29,000 | 29,000 |
| **Recycled Water - Groundwater Replenishment** | | 0 | 0 | 0 | 15,000 | 22,500 | 30,000 |
| **Water Transfers** | | 0 | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| | **Total** | **555,477** | **614,800** | **652,000** | **675,600** | **701,200** | **710,800** |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

*[1] Volumes shown here should be what was purchased in 2010 and what is anticipated to be purchased in the future. If these numbers differ from what is contracted, show the contracted quantities in Table 17.*

*[2] Volumes shown here should be consistent with Tables 17 and 18.*

| Table 17 (Exhibit 11E)<br>Wholesale supplies — existing and planned sources of water | | | | | | |
|---|---|---|---|---|---|---|
| **Wholesale sources[1,2]** | **Contracted Volume[3]** | **2015** | **2020** | **2025** | **2030** | **2035 - opt** |
| MWD provided LA's demand projections to LADWP on Jan. 24, 2011 | 203,313 | 397,748 | 413,628 | 414,180 | 417,533 | 418,378 |

*[1] If the water supplier is a wholesaler, indicate all customers (excluding individual retail customers) to which water is sold. If the water supplier is a retailer, indicate each wholesale supplier, if more than one.*

*[2] Indicate the full amount of water (LADWP Purchase Order Commitment is minimum of 2,033,132.4 AF from 1/1/2003 to 1/1/2013. MWD is capable of providing more.)*

| Table 18 (Exhibit 6B)<br>Groundwater — volume pumped | | | | | | |
|---|---|---|---|---|---|---|
| **Basin name(s)** | **Metered or Unmetered[1]** | **2006** | **2007** | **2008** | **2009** | **2010** |
| San Fernando | Metered | 35,486 | 75,640 | 57,060 | 49,106 | 62,218 |
| Sylmar | Metered | 1,844 | 3,901 | 4,046 | 576 | 2,998 |
| Central | Metered | 13,290 | 13,358 | 12,207 | 11,937 | 11,766 |
| | **Total groundwater pumped** | 50,620 | 92,899 | 73,313 | 61,619 | 76,982 |
| | **Groundwater as a percent of total water supply** | 8.0% | 13.8% | 11.3% | 10.0% | 14.1% |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

*[1] Indicate whether volume is based on volumeteric meter data or another method*

| Table 19 (Exhibit 6G)<br>Groundwater — volume projected to be pumped | | | | | |
|---|---|---|---|---|---|
| Basin name(s) | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| San Fernando | 21,000 | 76,800 | 92,000 | 92,000 | 92,000 |
| Sylmar | 4,500 | 4,500 | 4,500 | 4,500 | 3,405 |
| Central | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| Total groundwater pumped | 40,500 | 96,300 | 111,500 | 111,500 | 110,405 |
| Percent of total water supply[1] | 6.7% | 15.4% | 17.6% | 17.2% | 17.1% |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

*Include future planned expansion*

*[1] As a percentage of wet supplies excluding water conservation*

| Table 20 (Page 9-1)<br>Transfer and exchange opportunities | | | |
|---|---|---|---|
| Transfer agency | Transfer or exchange | Short term or long term | Proposed Volume |
| TBD | Transfer | Long Term | 40,000 |
| | | | |
| | | | |
| | | | |
| Total | | | |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

| Table 21 (Exhibit 4D)<br>Recycled water — wastewater collection and treatment | | | | | | | |
|---|---|---|---|---|---|---|---|
| Type of Wastewater | 2005 (actual) | 2010 (actual) | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| (1) Wastewater collected & treated in service area | 487,296 | 408,044 | 468,432 | 478,308 | 488,408 | 508,015 | 527,621 |
| (2) Volume that meets recycled water standard | 65,018 | 57,171 | 112,391 | 114,163 | 115,586 | 117,627 | 117,694 |
| (3) Secondary water sent to West Basin for Recycling | | 34,115 | 44,230 | 45,365 | 45,365 | 50,865 | 50,865 |
| Calculation to match Table 22 totals below = (1) - (2) - (3) | | 316,758 | 311,811 | 318,781 | 327,457 | 339,523 | 359,062 |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

(1) Only includes recycled water from DCT, LAG and TIWRP AWTF.

(3) Secondary water sent to West Basin is not included as part of LADWP recycled water.

| Table 22<br>Recycled water — non-recycled wastewater disposal | | | | | | | |
|---|---|---|---|---|---|---|---|
| Method of disposal | Treatment Level | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| Recycling and Pacific Ocean via Los Angeles River | Tertiary to Title 22 standards with Nitrification/Denitrification | 0 | 0 | 0 | 0 | 695 | 3,464 |
| Recycling and Ocean via Los Angeles River | Tertiary to Title 22 standards with Nitrification/Denitrification | 0 | 3,027 | 4,932 | 7,062 | 9,192 | 11,322 |
| Recycling and Outfall to Ocean | Tertiary; Advanced treatment (MF/RO) | 15,694 | 13,004 | 13,228 | 13,564 | 14,125 | 14,573 |
| Conveyance to WBMWD for Recycling and Ocean outfall | Full secondary | 301,064 | 295,781 | 300,620 | 306,831 | 315,511 | 329,703 |
| | Total | 316,758 | 311,811 | 318,781 | 327,457 | 339,523 | 359,062 |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

The following water is not included: All water treated to Title 22 standards, and Secondary Water delivered to West Basin.

| Table 23<br>Recycled water — potential future use | | | | | | | |
|---|---|---|---|---|---|---|---|
| User type | Description | Feasibility[1] | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| **Agricultural irrigation** | | | NA | NA | NA | NA | NA |
| **Landscape irrigation[2]** | | | 4,220 | 4,220 | 4,220 | 6,135 | 15,135 |
| **Commercial[3]** | | | 165 | 165 | 165 | 165 | 165 |
| **Golf course irrigation** | | | 1,400 | 1,400 | 1,400 | 1,400 | 1,400 |
| **Wildlife habitat** | | | 26,990 | 26,990 | 26,990 | 26,990 | 26,990 |
| **Wetlands** | | | | | | | |
| **Industrial reuse** | | | 9,300 | 9,300 | 9,300 | 9,300 | 9,300 |
| **Groundwater recharge (GWR)** | | | 0 | 15,000 | 15,000 | 30,000 | 30,000 |
| **Seawater barrier** | | | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| **Getothermal/Energy** | | | NA | NA | NA | NA | NA |
| **Indirect potable reuse** | | | NA | NA | NA | NA | NA |
| **Other (user type)** | | | | | | | |
| **Other (user type)** | | | | | | | |
| | Total | 0 | 45,075 | 60,075 | 60,075 | 76,990 | 85,990 |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

*[1] Technical and economic feasibility.*

*[2] Includes parks, schools, cemeteries, churches, residential, or other public facilities*

*[3] Includes commercial building use such as landscaping, toilets, HVAC, and commercial uses (car washes, laundries, nurseries, etc)*

| Table 24 (Exhibit 4J)<br>Recycled water — 2005 UWMP use projection compared to 2010 actual | | |
|---|---|---|
| Use type | 2010 actual use | 2005 Projection for 2010[1] |
| Agricultural irrigation | | |
| Landscape irrigation[2] | | |
| Commercial[3] | | |
| Golf course irrigation | | |
| Wildlife habitat | | |
| Wetlands | | |
| Industrial reuse | | |
| Groundwater recharge | | |
| Seawater barrier | | |
| Getothermal/Energy | | |
| Indirect potable reuse | | |
| Other (user type) - Municipal & Industrial Uses | 6,703 | 16,950 |
| Other (user type) - Environmental Uses | 25,008 | 26,990 |
| Total | 31,711 | 43,940 |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

*[1] From the 2005 UWMP. There has been some modification of use types. Data from the 2005 UWMP can be left in the existing catagories or modified to the new catagories, at the discretion of the water supplier.*

*[2] Includes parks, schools, cemeteries, churches, residential, or other public facilities)*

*[3] Includes commercial building use such as landscaping, toilets, HVAC, etc) and commercial uses (car washes, laundries, nurseries, etc)*

| Table 25 (Exhibit 4L & Sec 4.4.6)<br>Methods to encourage recycled water use (NA - Financial incentives incorporated into goals above) | | | | | | |
|---|---|---|---|---|---|---|
| | Projected Results | | | | | |
| Actions | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| Financial incentives | | | | | | |
| Cost savings, shared conservation of resources, environmental benefit, reliability | 6,703 | 20,000 | 20,400 | 27,000 | 29,000 | 29,000 |
| Sustainability (groundwater replenishment) | | | | 15,000 | 22,500 | 30,000 |
| Total | 6,703 | 20,000 | 20,400 | 42,000 | 51,500 | 59,000 |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

| Table 26 (Exhibits 4L, 4M, 4N, 4O, 4P)<br>Future water supply projects | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project name[1] | Projected start date | Projected completion date | Potential project constraints[2] | Normal-year supply[3] | Single-dry year supply[3] | Multiple-dry year first year supply[3] | Multiple-dry year second year supply[3] | Multiple-dry year third year supply[3] |
| **Recycling Projects** | | | | | | | | |
| Harbor Irrigation, Commercial, Industrial | 2009 | 2015 | Funding | 9520 | 9520 | 9520 | 9520 | 9520 |
| Metro Irrigation (llittle Commercial, Industrial) | 2009 | 2015 | Funding | 1813 | 1813 | 1813 | 1813 | 1813 |
| Valley Irrigation(little Commercial/Industrial) | 2009 | 2013 | Funding | 844 | 844 | 844 | 844 | 844 |
| Westside Irrigation, Commercial, Industrial | 2009 | 2015 | Funding | 350 | 350 | 350 | 350 | 350 |
| Indirect Potable Reuse (Groundwater Recharge) Initial Stage | 2015 | 2021 | Funding | 15000 | 15000 | 15000 | 15000 | 15000 |
| Indirect Potable Reuse (Groundwater Recharge) 2nd Stage | 2021 | 2035 | Funding | 15000 | 15000 | 15000 | 15000 | 15000 |
| Other Municipal and Industrial Projects | 2015 | 2035 | Funding | 16,473 | 16,473 | 16,473 | 16,473 | 16,473 |
| | | Total | 0 | 59,000 | 59,000 | 59,000 | 59,000 | 59,000 |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

*[1] Water volumes presented here should be accounted for in Table 16.*

*[2] Indicate whether project is likely to happen and what constraints, if any, exist for project implementation.*

*[3] Provide estimated supply benefits, if available.*

| Table 27 (Section 11.2.8)<br>Basis of water year data | |
|---|---|
| Water Year Type | Base Year(s) |
| **Average Water Year** | FY1956/57 to FY2005/06 |
| **Single-Dry Water Year** | FY1990/91 |
| **Multiple-Dry Water Years - Driest 5-year sequence** | FY1988/89 to FY1992/93 |
| **Multiple-Dry Water Years - Driest 3-year sequence** | FY1958/59 to FY1960/61 |

| Table 28<br>Supply reliability — historic conditions | | | | | |
|---|---|---|---|---|---|
| Average / Normal Water Year | Single Dry Water Year | Multiple Dry Water Years | | | |
| | | Year 1 | Year 2 | Year 3 | Year 4 |
| FY1956/57 to FY2005/06 | FY1990/91 | FY1988/89 | FY1989/90 | FY1990/91 | FY1991/92 |
| 360,509 | 130,325 | 327,181 | 206,215 | 130,325 | 176,888 |
| Percent of Average/Normal Year: | 36.2% | 90.8% | 57.2% | 36.2% | 49.1% |

** Showing LA Aqueduct supply reliability only. Groundwater & Recycled Water don't vary with weather. MWD supply is used to supplement insufficient local supplies and is not directly co-related to weather.*

| Table 29<br>Factors resulting in inconsistency of supply | | | | | | | |
|---|---|---|---|---|---|---|---|
| Water supply sources[1] | Specific source name, if any | Limitation quantification | Legal | Environmental | Water quality | Climatic | Additional information |
| Metropolitan Water District | | | x | x | | x | |
| Supplier-produced groundwater | | | | x | x | | |
| Los Angeles Aqueduct | | | x | x | | x | |
| Conservation | | | | | | x | |
| Recycled Water - Irrigation/Industrial Use | | | x | x | | x | |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

*[1] From Table 16.*

| Table 30 (Exhibit 6G)<br>Water quality — current and projected water supply impacts | | | | | | | |
|---|---|---|---|---|---|---|---|
| Water source | Description of condition | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| Groundwater - San Fernando Basin (See Exhibit 6G)* | Expected increased contamination issues (2015) and clean up programs expected to be completed (2021) | 24,782 | 66,000 | 10,200 | 0 | 0 | 0 |

***Yearly Quantities listed represent total amount of water LADWP is unable to pump from the SFB due to groundwater contamination. Contamination issues are resolved after completion of clean-up programs in 2021**

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

| Table 31 (Exhibit 11L)<br>Supply reliability — current water sources | | | | |
|---|---|---|---|---|
| Water supply sources[1] | Average / Normal Water Year Supply[2] | Multiple Dry Water Year Supply[2] | | |
| | | Year 2011 | Year 2012 | Year 2013 |
| **Los Angeles Aqueduct** | **254,000** | 104,530 | 50,849 | 59,382 |
| **Groundwater** | **106,500** | 61,090 | 53,660 | 46,260 |
| **Conservation** | **8,178** | 9,380 | 10,580 | 11,780 |
| **Recycled Water - Irrigation/Industrial Use** | **7,500** | 7,500 | 8,300 | 9,000 |
| **Recycled Water - Groundwater Replenishment** | **0** | 0 | 0 | 0 |
| **Water Transfers** | **0** | 0 | 0 | 0 |
| **MWD Water Purchases** | **245,522** | 407,500 | 484,811 | 500,078 |
| Percent of normal year: | 100.0% | 94.9% | 97.8% | 100.8% |

*Units (circle one):* ***acre-feet per year*** *million gallons per year* *cubic feet per year*

*[1] From Table 16.*

*[2] See Table 27 for basis of water type years.*

| Table 32 (Exhibits 2J, 11E)<br>Supply and demand comparison — normal year | | | | | |
|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| **Supply totals (from Table 16)** | 614,800 | 652,000 | 675,600 | 701,200 | 710,800 |
| **Demand totals (From Table 11)** | 599,563 | 622,732 | 632,275 | 643,785 | 641,622 |
| **Difference (Conservation)** | 15,237 | 29,268 | 43,325 | 57,415 | 69,178 |
| Difference as % of Supply | 2.5% | 4.5% | 6.4% | 8.2% | 9.7% |
| Difference as % of Demand | 2.5% | 4.7% | 6.9% | 8.9% | 10.8% |

*Units are in acre-feet per year.*

| Table 33 (Exhibit 11F)<br>Supply and demand comparison — single dry year | | | | | |
|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| **Supply totals[1,2]** | 651,700 | 691,100 | 716,100 | 743,200 | 753,400 |
| **Demand totals[2,3,4]** | 637,520 | 663,840 | 675,760 | 689,781 | 689,032 |
| **Difference** | 14,180 | 27,260 | 40,340 | 53,419 | 64,368 |
| Difference as % of Supply | 2.2% | 3.9% | 5.6% | 7.2% | 9.3% |
| Difference as % of Demand | 2.2% | 4.1% | 6.0% | 7.7% | 9.3% |

*Units are in acre-feet per year.*

*[1] Consider the same sources as in Table 16. If new sources of water are planned, add a column to the table and specify the source, timing, and amount of water.*

*[2] Provide in the text of the UWMP text that discusses how single-dry-year water supply volumes were determined.*

*[3] Consider the same demands as in Table 3. If new water demands are anticipated, add a column to the table and specify the source, timing, and amount of water.*

*[4] The urban water target determined in this UWMP will be considered when developing the 2020 water demands included in this table.*

| Table 34 (Exhibit 11G - Exhibit 11K)<br>Supply and demand comparison — multiple dry-year events | | | | | | |
|---|---|---|---|---|---|---|
| | | 2015 | 2020 | 2025 | 2030 | 2035 - opt |
| **Multiple-dry year first year supply** | **Supply totals[1,2]** | 608,200 | 661,200 | 694,500 | 720,100 | 740,300 |
| | **Demand totals[2,3,4]** | 597,620 | 641,790 | 662,010 | 674,530 | 682,500 |
| | **Difference** | 10,580 | 19,410 | 32,490 | 45,570 | 57,800 |
| | Difference as % of Supply | 1.7% | 2.9% | 4.7% | 6.3% | 7.8% |
| | Difference as % of Demand | 1.8% | 3.0% | 4.9% | 6.8% | 8.5% |
| **Multiple-dry year second year supply** | **Supply totals[1,2]** | 626,500 | 675,400 | 706,100 | 732,400 | 749,300 |
| | **Demand totals[2,3,4]** | 614,720 | 653,370 | 670,990 | 684,210 | 689,300 |
| | **Difference** | 11,780 | 22,030 | 35,110 | 48,190 | 60,000 |
| | Difference as % of Supply | 1.9% | 3.3% | 5.0% | 6.6% | 8.0% |
| | Difference as % of Demand | 1.9% | 3.4% | 5.2% | 7.0% | 8.7% |
| **Multiple-dry year third year supply** | **Supply totals[1,2]** | 602,900 | 644,600 | 670,900 | 696,100 | 708,800 |
| | **Demand totals[2,3,4]** | 589,920 | 619,960 | 633,180 | 645,300 | 646,600 |
| | **Difference** | 12,980 | 24,640 | 37,720 | 50,800 | 62,200 |
| | Difference as % of Supply | 2.2% | 3.8% | 5.6% | 7.3% | 8.8% |
| | Difference as % of Demand | 2.2% | 4.0% | 6.0% | 7.9% | 9.6% |

*Units are in acre-feet per year.*

*[1] Consider the same sources as in Table 16. If new sources of water are planned, add a column to the table and specify the source, timing, and amount of water.*

*[2] Provide in the text of the UWMP text that discusses how single-dry-year water supply volumes were determined.*

*[3] Consider the same demands as in Table 3. If new water demands are anticipated, add a column to the table and specify the source, timing, and amount of water.*

*[4] The urban water target determined in this UWMP will be considered when developing the 2020 water demands included in this table.*

| Table 35 (Section 11.3.1)<br>Water shortage contingency — rationing stages to address water supply shortages | | |
|---|---|---|
| **Stage No.** | **Water Supply Conditions** | **% Shortage** |
| Phase I | No Shortage | 0% |
| Phase II | Modereate Shortage | > 0 to 15% |
| Phase III | Severe Shortage | 15 to 20% |
| Phase IV | Critical Shortage | 20 to 35% |
| Phase V | Super Critical Shortage | 35 to 50% |

*[1] One of the stages of action must be designed to address a 50 percent reduction in water supply.*

| Table 36 (Section 11.3.4)<br>Water shortage contingency — mandatory prohibitions | |
|---|---|
| **Examples of Prohibitions** | **Stage When Prohibition Becomes Mandatory** |
| Using potable water for washing paved surfaces | Phase I |
| Using water to clean, fill, or maintain levels in decorative fountains, ponds, lakes, or similar structures for aethetic purposes | Phase I |
| Any public place where food is sold, served, or offered for sale should not serve water unless requested. | Phase I |
| No customer should permit water to leak from any pipe or fixture on customer's premises | Phase I |
| No customer shall wash a vehicle with a hose that does not have a self-closing water shut-off device | Phase I |
| No customer shall irrigate during periods of rain | Phase I |
| No customer shall irrigate between the hours of 9:00 a.m. and 4:00 p.m. | Phase I |
| Irrigating of landscape with potable water using spray head sprinklers and bubblers shall be limited to no more than ten minutes per watering station per day | Phase I |
| No customer shall irrigate in a manner that causes excess or continuous flow or runoff onto an adjoining sidewalk, driveway, street, gutter, or ditch | Phase I |
| No installation of single pass cooling systems shall be permitted in buildings requesting new water service. | Phase I |
| No installation of single pass cooling systems shall be permitted in new conveyor car wash and new commercial laundry systems | Phase I |
| Operators of hotels and motels provide guests with the option of choosing not to have towels and linens laundered daily | Phase I |
| No large landscape shall have irrigation systems without rain sensors that shut-off the irrigation systems | Phase I |
| No landscape irrigation shall be permitted on any day other than Monday, Wednesday, or Friday for odd-numbered street addresses and Tuesday, Thursday, or Sunday for even-numbered street addresses. Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address. Watering times shall be limited to: (a) Non-conserving nozzles (spray head sprinklers and bubblers) – no more than eight minutes per watering day per station for a total of 24 minutes per week; (b) Conserving nozzles (standard rotors and multi-stream rotary heads) – no more than 15 minutes per cycle and up to two cycles per watering day per station for a total of 90 minutes per week. | Phase II |
| No landscape irrigation shall be permitted on any day other than Monday for odd-numbered street addresses and Tuesday for even-numbered street addresses. Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address. | Phase III |
| No washing of vehicles allowed except at commercial car wash facilities. | Phase III |
| No filling of residential swimming pools and spas with potable water. | Phase III |

| Table 37 (Section 11.3.5)<br><br>Water shortage contingency — consumption reduction methods | | |
|---|---|---|
| **Consumption Reduction Methods** | **Stage When Method Takes Effect** | **Projected Reduction (%)** |
| LADWP's existing rate structure (enacted in 1993) serves as a basis for further reducing consumption. First tier water allotments are reduced during shortages by the degree of the shortage. For single-family residential users, the adjusted first tier allotments apply for the entire year. For other users, the adjusted first tier allotments apply only during the high season (June 1 through October 31). Details of LADWP's water rate structure are provided in Appendix C – Water Rate Ordinance. | During a water shortage or emergency condition | Up to 25% |
| Emergency Water Conservation Plan (UWMP Section 11.3.1) | Phase I is permanent with higher phases activated during a water shortage or emergency condition | Up to 50% |
| Water conservation public service announcements (through television and/or radio), billboard ads, flyer distributions, and conservation workshops. Participation in public exhibits to disseminate water conservation information within its service area. Conservation is a permanent and long-term application used within the City to counter the potentially adverse impacts of water supply shortages. | During a water shortage or emergency condition | |
| Water will be allocated to meet needs for domestic use, sanitation, fire protection, and other priorities. This will be done equitably and without discrimination between customers using water for the same purpose(s). | extreme water shortage conditions | |

| Table 38 (Section 11.3.6)<br>Water shortage contingency — penalties and charges | | |
|---|---|---|
| **Penalties or Charges** | **Stage When Penalty Takes Effect** | |
| Written Warning | First violation | For water meters smaller than two inches |
| Surchage in the amount of $100 | Second violation within preceding 12-month period | |
| Surchage in the amount of $200 | Third violation within preceding 12-month period | |
| Surchage in the amount of $300 | Fourth violation within preceding 12-month period | |
| LADWP may install a flow-restricting device of 1 gpm capacity for services up to 1 1/2 inches in size and comparatively sized restrictors for larger services or terminate a customer's service, in addition to aforementioned financial surcharges | Fifth violation or subsequent violation within preceding 12-month period | |
| Written Warning | First violation | For water meters two inches and larger |
| Surcharge in the amount of $200 | Second violation within preceding 12-month period | |
| Surcharge in the amount of $400 | Third violation within preceding 12-month period | |
| Surcharge in the amount of $600 | Fourth violation within preceding 12-month period | |
| LADWP may install a flow-restricting device or terminate a customer's service, in addition to aforementioned financial surcharges | Fifth violation or subsequent violation within preceding 12-month period | |

Urban Water Management Plan

# Appendix C

## Water Rate Ordinance

# Los Angeles

# Water Rates

**June 1, 1995**

Amended July 28, 1997,
February 4, 2000, June 20, 2004,
November 27, 2006, and June 19, 2008

Los Angeles Department of Water and Power

**Ordinance No. 170435**

As Amended by Ordinance No. 171639, Ordinance No. 173017,
Ordinance No. 175964, Ordinance No. 177968
and Ordinance No. 179802

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## RATE SCHEDULES



## GENERAL PROVISIONS

## R. SHORTAGE YEAR RATES

When the Board of Water and Power Commissioners, by resolution, finds and determines that the water supply available to the City of Los Angeles is insufficient to meet the City's normal water demand, it shall determine the degree of shortage and apply the corresponding commodity charges stated below, instead of the otherwise applicable commodity charges.

Certified copies of such resolution shall be transmitted to the offices of the Mayor, City Clerk, and the Council. At any time within such period as may be specified by resolution, which shall not be less than fifteen days after delivery of such certified copies to said offices, the Mayor, in writing, or the Council, by majority vote, may disapprove such resolution. If neither the Mayor nor the Council disapprove on said resolution within the period so specified, the same shall take effect upon the expiration of said period and shall be applicable to charges commencing on the first day of the billing cycle after the expiration of the period prescribed in the resolution. If the Mayor shall disapprove said resolution within said period, he shall forthwith advise the Council and the Board, in writing, of such disapproval. The Council shall thereupon consider such disapproval in the same manner as upon the reconsideration of an ordinance notwithstanding the veto of the Mayor, and if upon such consideration the Council shall, by the votes of two-thirds of the whole Council, determine that the Mayor's disapproval should be overruled, such disapproval by the Mayor shall be of no effect, and the said resolution of the Board shall forthwith take effect and shall be applicable to charges commencing on the first day of the billing cycle after the action by the Council overruling the Mayor's disapproval and the expiration of the period prescribed in the resolution.

The following commodity rates shall be substituted into the appropriate corresponding schedule and shall continue during the time that a water shortage determined by the Board of Water and Power Commissioners remains in effect.

1. Schedule A - Single-Dwelling Unit Residential Customers

   a. The first tier usage block shall be reduced by the degree of the shortage and shall be billed at the rate specified in Section 2.A.3.a.

   b. Second Tier Usage

      Usage above the first tier usage block as prescribed in Section 3.R.1.a above shall be billed as follows:

| Commodity Charge | Rate Per Hundred Cubic Feet |
|---|---|

10% Shortage

Low Season - November 1 through May 31
1.201 times the High Season rate specified in Section 2.A.3.b, rounded to the nearest penny

High Season - June 1 through October 31
1.201 times the High Season rate specified in Section 2.A.3.b, rounded to the nearest penny

15% Shortage

Low Season - November 1 through May 31
1.442 times the High Season rate specified in Section 2.A.3.b, rounded to the nearest penny

High Season - June 1 through October 31
1.442 times the High Season rate specified in Section 2.A.3.b, rounded to the nearest penny

20% Shortage

Low Season - November 1 through May 31
1.682 times the High Season rate specified in Section 2.A.3.b, rounded to the nearest penny

High Season - June 1 through October 31
1.682 times the High Season rate specified in Section 2.A.3.b, rounded to the nearest penny

25% Shortage

Low Season - November 1 through May 31
1.964 times the High Season rate specified in Section 2.A.3.b, rounded to the nearest penny

High Season - June 1 through May 31
1.964 times the High Season rate specified in Section 2.A.3.b, rounded to the nearest penny

2. Schedule B - Multi-Dwelling Unit Residential Customers

| Commodity Charge | Rate Per <u>Hundred Cubic Feet</u> |
| --- | --- |

<u>10% Shortage</u>

a. Up to 115% of Adjusted First Tier Usage Block shall be billed at the rate specified in Section 2.B.3.a.

b. Usage above 115% of Adjusted First Tier Usage Block shall be billed at 1.201 times the High Season rate specified in Section 2.B.3.b, rounded to the nearest penny.

<u>15% Shortage</u>

c. Up to 115% of Adjusted First Tier Usage Block shall be billed at the rate specified in Section 2.B.3.a.

d. Usage above 115% of First Tier Usage Block shall be billed at 1.442 times the High Season rate specified in Section 2.B.3.b, rounded to the nearest penny.

<u>20% Shortage</u>

e. Up to 110% of Adjusted First Tier Usage Block shall be billed at the rate specified in Section 2.B.3.a.

f. Usage above 110% of Adjusted First Tier Usage Block shall be billed at 1.682 times the High Season rate specified in Section 2.B.3.b, rounded to the nearest penny.

<u>25% Shortage</u>

g. Up to 110% of Adjusted First Tier Usage Block shall be billed at the rate specified in Section 2.B.3.a.

h. Usage above 110% of Adjusted First Tier Usage Block shall be billed at 1.964 times the High Season rate specified in Section 2.B.3.b, rounded to the nearest penny.

3. Schedule C – Commercial and Industrial Customers

| Commodity Charge | Rate Per <br> Hundred Cubic Feet |
|---|---|

10% Shortage

a. Up to 115% of Adjusted First Tier Usage Block shall be billed at the rate specified in Section 2.C.3.a.

b. Usage above 115% of Adjusted First Tier Usage Block shall be billed at 1.201 times the High Season rate specified in Section 2.C.3.b, rounded to the nearest penny.

15% Shortage

c. Up to 115% of Adjusted First Tier Usage Block shall be billed at the rate specified Section 2.C.3.a.

d. Usage above 115% of Adjusted First Tier Usage Block shall be billed at 1.442 times the High Season rate specified in Section 2.C.3.b, rounded to the nearest penny.

20% Shortage

e. Up to 110% of Adjusted First Tier Usage Block shall be billed at the rate specified Section 2.C.3.a.

f. Usage above 110% of Adjusted First Tier Usage Block shall be billed at 1.682 times the High Season rate specified in Section 2.C.3.b, rounded to the nearest penny.

25% Shortage

g. Up to 110% of Adjusted First Tier Usage Block shall be billed at the rate specified Section 2.C.3.a.

h. Usage above 110% of Adjusted First Tier Usage Block shall be billed at 1.964 times the High Season rate specified in Section 2.C.3.b, rounded to the nearest penny.

4. Schedule F - Publicly-Sponsored Irrigation; Recreational; Agricultural, Horticultural, and Floricultural Uses; Community Gardens and Youth Sports

| Commodity Charges | Rate Per Hundred Cubic Feet |
| --- | --- |

10% Shortage

a. First Tier Usage Block shall be billed at the rate specified in Section 2.F.3.a.

Monthly first tier usage blocks shall be established by the Department for domestic water use, landscape and large area irrigation after an audit has been completed, considering site conditions and based upon best management practices approved by the Board of Water and Power Commissioners, and shall be subject to periodic review and revision by the Department.

b. Second Tier Usage

Usage above the first tier usage block as prescribed in Section 3.R.4.a above shall be billed at 1.201 times the High Season rate specified in Section 2.F.3.c, rounded to the nearest penny.

15% Shortage

c. First Tier Usage Block shall be billed at the rate specified in Section 2.F.3.a.

Monthly first tier usage blocks shall be established by the Department for domestic water use, landscape and large area irrigation after an audit has been completed, considering site conditions and based upon best management practices approved by the Board of Water and Power Commissioners, and shall be subject to periodic review and revision by the Department.

d. Second Tier Usage

Usage above the first tier usage block as prescribed in Section 3.R.4.c above shall be billed at 1.442 times the High Season rate specified in Section 2.F.3.c, rounded to the nearest penny.

<u>20% Shortage</u>

e. First Tier Usage Block shall be billed at the rate specified in Section 2.F.3.a.

Monthly first tier usage blocks shall be established by the Department for domestic water use, landscape and large area irrigation after an audit has been completed, considering site conditions and based upon best management practices approved by the Board of Water and Power Commissioners, and shall be subject to periodic review and revision by the Department.

f. Second Tier Usage

Usage above the first tier usage block as prescribed in Section 3.R.4.e above shall be billed at 1.682 times the High Season rate specified in Section 2.F.3.c, rounded to the nearest penny.

<u>25% Shortage</u>

g. First Tier Usage Block shall be billed at the rate specified in Section 2.F.3.a.

Monthly first tier usage blocks shall be established by the Department for domestic water use, landscape and large area irrigation after an audit has been completed, considering site conditions and based upon best management practices approved by the Board of Water and Power Commissioners, and shall be subject to periodic review and revision by the Department.

h. Second Tier Usage

Usage above the first tier usage block as prescribed in Section 3.R.4.g above shall be billed at 1.964 times the High Season rate specified in Section 2.F.3.c, rounded to the nearest penny.

5. Adjustments and credits pursuant to General Provisions F, G, H, I, K, L, O and P shall be applied to the commodity charges set forth in this General Provision R in the same manner that they apply to the commodity charge set forth in Rate Schedules A, B, C, D, E, and F, inclusive.

6. The Adjusted First Tier Usage Block shall be each customer's maximum December through March average consumption for the three winter periods preceding the declared water shortage event reduced by the degree of water shortage, except that the minimum adjusted first tier usage for Schedule B customers only shall be twenty-eight (28) hundred cubic feet per month reduced by the degree of water shortage and the minimum adjusted first tier usage for Schedule C customers shall be one one-hundred cubic feet per month.

   Each customer's December through March average consumption that is applied at the beginning of each declared water shortage event shall continue to be applied during the time that a water shortage determined by the Board of Water and Power Commissioners remains in effect.

7. Those Schedules B and C customers that are found to not have established an Adjusted First Tier Usage Block based on prior usage may have an adjusted first tier usage block computation made by the Department that is based on the customer's water use characteristics, site conditions, and all applicable best management practices for conservation approved by the Board of Water and Power Commissioners.

8. Application of this General Provision R shall be subject to rules and regulations adopted by the Board of Water and Power Commissioners.

9. When the Board of Water and Power Commissioners determines that the water supply available to the City of Los Angeles is either sufficient, or if not sufficient, is better able to meet the City's normal water supply, it shall, by resolution, either terminate the implementation of these shortage year rates or determine the lesser degree of shortage and apply the applicable commodity charges stated above instead of the commodity charges theretofore implemented pursuant to this Provision R. Such determination shall become effective upon publication of the resolution.

Urban Water
Management Plan
# Appendix D

## Notice of Meeting and Public Comments

# PUBLIC NOTICES

# Public Notification

An extensive outreach campaign was conducted for the 2010 update of the LADWP Urban Water Management Plan (UWMP). As shown in the following table, a total of four workshops were conducted, seeking public input on the 2010 update. The first two workshops were held in January 2010 and were intended to receive input concurrent with the preparation of the 2010 UWMP draft. The third and fourth workshops were conducted in February 2011. These workshops were intended to present the 2010 draft UWMP and usher in the beginning of a 60 day period during which comments could be submitted. Comments were collected by LADWP and are shown in a separate section in the pages that follow.

| Event | Date | Time | Location | Attendees |
|---|---|---|---|---|
| Workshop 1 (2010) | 1/12/10 | 6:00 p.m. | Marvin Braude Constituent Center | 23 |
| Workshop 2 (2010) | 1/20/10 | 5:00 p.m. | Los Angeles River Center | 18 |
| Workshop 1 (2011) | 2/3/11 | 6:00 p.m. | LADWP Van Nuys Service Center | 30 |
| Workshop 2 (2011) | 2/9/11 | 6:00 p.m. | LADWP John Ferraro Building, Downtown Los Angeles | 44 |
| Final Public Hearing for LADWP Board Adoption | 5/3/11 | 1:30 p.m. | LADWP John Ferraro Building, Downtown Los Angeles | NA |

Following incorporation of comments and the production of a finalized version, the UWMP was adopted by the LADWP Board of Commissioners on May 3, 2011.

**E-mail Notification**

For notification of both rounds of workshops, a flyer was e-mailed to all City of Los Angeles neighborhood councils, homeowners organizations, and stakeholders. The flyer announcement is shown in the pages that follow.

**Media Publications**

For the February 2011 workshops, an announcement (see next pages) was published in the publications listed in the following table on the dates indicated. As shown, the announcement was also translated and included in multiple foreign language publications. Three example foreign language ads are included in the pages that follow.

| Media Outlet | Run date(s) |
|---|---|
| *Wave/Independent/Equal Access Media* | Thursday 1/27 |
| *Eastern Group Publications* | Thursday 1/27 |
| *LA Watts Times* | Thursday 1/27 |
| *LA Sentinel* | Thursday 1/27 |
| *Korean Daily* | Friday 1/28 |

| | |
|---|---|
| *Downtown News* | Monday 1/24 |
| *Philippine Media* (formally *California Examiner*) Filipino weekly (English language) | Thursday 1/27 |
| *La Opinion* (Spanish) | Friday 1/28 |
| *Our Weekly Newspaper* | Thursday 1/27 |
| *Palisadian Post* | Thursday 1/27 |
| *Beverly Press/Park LaBrea News* | Thursday 1/27 |
| *Tolucan Times-Wed.* | Wednesday 1/26 |
| *Korean Times* | Friday 1/28 |
| *Daily Breeze* | Friday 1/28 |
| *Daily News* | Friday 1/28 |
| *LA Business Journal* | Monday 1/24 |
| *SF Valley Business Journal* | Monday 1/24 |
| *Sing Tao (Chinese)* | Friday 1/28 |
| *CityWatch Web Site* | On-going to 2/9 |

**Website Posting**

The flyer notifications for both rounds of workshops and comments/responses from the January 2010 workshops were posted on the LADWP website www.ladwp.com. In addition, the workshop notification was posted on several other websites, including LADWPNews, Twitter, facebook, and neighborhood council web pages. Examples are included in the pages that follow.

**60-Day Notification**

60-days prior to LADWP Board adoption, the County of Los Angeles, and the Cities of Culver City and West Hollywood were notified (via e-mail and regular mail) of the anticipated adoption of the 2010 UWMP. In addition, the following publications were used for Notification of Board adoption on the dates specified. Letters and ads are shown in the pages that follow.

| Media Outlet | Run date(s) |
|---|---|
| *Metropolitan News* | Thursday 3/3/11 and 3/10/11 |
| *La Opinion* | |

**From:** Repp, Chris
**Sent:** Wednesday, December 22, 2010 11:26 AM
**Subject:** Urban Water Management Plan (UWMP) Workshops Rescheduled
**Attachments:** UWMP Workshop Rev 12.22.10.pdf

The workshops originally scheduled for January 13, and January 18, 2011 have been postponed to the following dates, times, and locations. We apologize for any inconvenience.

Thursday, February 3, 2011
6:00 p.m.
**VAN NUYS**
Van Nuys Service Center
14401 Saticoy Street

Wednesday, February 9, 2011
6:00 p.m.
**DOWNTOWN L.A.**
LADWP John Ferraro Building, Cafeteria Conference Room
111 N. Hope St.

Free Parking will be provided. The draft 2010 UWMP will be available for review after January 13, 2011 at http://www.ladwp.com.

For more information, contact Simon Hsu at (213) 367-2970.

See attached (revised) flyer.

---

**From:** Repp, Chris
**Sent:** Tuesday, December 14, 2010 8:26 AM
**Subject:** LADWP's Draft 2010 Urban Water Management Plan Workshops

The public is invited to hear an overview of the LADWP Water System's strategic priorities and preview the draft 2010 Urban Water Management Plan (UWMP) that will outline the City's long-term water resources management strategy. The UWMP is the City's master plan for water supply and resources management. All large California urban water agencies prepare a UWMP and provide an update to their plan every five years.

Please join us at one of the following workshops:

**Thursday, January 13 – 5:00 p.m.**
**CYPRESS PARK**
Los Angeles River Center Los Feliz Room
570 West Avenue 26

**Tuesday, January 18 – 5:00 p.m.**
**VAN NUYS**
Van Nuys Service Center
7501 Tyrone Avenue

**The draft 2010 UWMP will be available for review after January 13, 2011 at**

**http://www.ladwp.com.**

**For more information, contact Simon Hsu at (213) 367-2970.**

*See attached flyer.*

Los Angeles Department of Water & Power

# YOU ARE INVITED!

Please join the Los Angeles Department of Water and Power (LADWP) at a public workshop to share your views regarding Los Angeles' water supply as the City prepares it's

# 2010 Urban Water Management Plan

We would appreciate your thoughts and will be seeking your input on various topics and questions such as:

- What water resource options should LADWP pursue to meet future needs?
- What water management strategies should LADWP consider?
- How should LADWP manage water supplies during times of shortage?

---

## TUESDAY, JANUARY 12, 6:00 P.M.

VAN NUYS
Marvin Braude Constituent Center
6262 Van Nuys Blvd.

## WEDNESDAY, JANUARY 20, 5:00 P.M.

CYPRESS PARK
Los Angeles River Center – Los Feliz Room
570 West Avenue 26

---

Presentation to be followed by a group discussion. Light refreshments will be provided.

The City of Los Angeles 2005 Urban Water Management Plan is available on LADWP's web site at: http://www.ladwp.com/ladwp/cms/ladwp001354.jsp

**For more information, please contact**
**Simon Hsu at (213) 367-2970, or simon.hsu@ladwp.com**

**About LADWP's Urban Water Management Plan (UWMP):**
All large California urban water agencies prepare a UWMP and provide an update every five years. LADWP's UWMP offers a detailed discussion on the status of Los Angeles' imported water sources, and provides an update of future water supply and demand for the City. The Water Plan also discusses the management and development of water resources, as well as efforts relating to the efficient use water. Additional topics include existing and future water conservation measures, water recycling, and management of the City's groundwater basins.

As a covered entity under Title II of the Americans with Disabilities Act, the City of Los Angeles does not discriminate on the basis of disability and, upon request, will provide reasonable accommodation to ensure equal access to its programs, service and activities. To ensure availability, such request should be made 72 hours in advance by calling (213) 367-1361, TDD: 1(800) 432-7397.

Los Angeles Department of Water & Power

# Draft 2010 Urban Water Management Plan
# NEW WORKSHOP DATES*

**The public is invited to hear an overview of the LADWP Water System's strategic priorities and preview the draft 2010 Urban Water Management Plan that will outline the City's long-term water resources management strategy.**



*** Workshops originally scheduled for January 13 and 18 have been moved to:**

| THURSDAY, FEBRUARY 3 | WEDNESDAY, FEBRUARY 9 |
|---|---|
| 6:00 p.m. | 6:00 p.m. |
| **VAN NUYS** | **DOWNTOWN LOS ANGELES** |
| Van Nuys Service Center | LADWP John Ferraro Building, Cafeteria Conference Room |
| 14401 Saticoy Street | 111 N. Hope St. |

Free parking provided.

**Presentation to be followed by public comment.**
Public input received from the workshop will be considered for the final 2010 UWMP. The final 2010 UWMP will be presented for adoption by the LADWP Board of Commissioners in May 2011.

**About the UWMP:**
The UWMP will address requirements under California Water Code Sections 10610 through 10657. The purpose of the UWMP is to cover the management and development of water resources, as well as efforts relating to efficient use of water. The UWMP addresses the areas of existing and future water conservation measures, water recycling, stormwater capture, and management of the City's groundwater basins. In addition, the UWMP offers information on the status of Los Angeles' imported water sources, water quality issues, and projections of future water supply and demand for the City.

**Draft 2010 UWMP will be available at www.ladwp.com after January 13, 2011.**

**Written comments are due no later than March 15, 2011 by email to simon.hsu@ladwp.com, or by mail to:**

**LADWP - Water System**
**111 N. Hope Street, Room 1460**
**Los Angeles, CA 90012**
**Attn: Simon Hsu**

**For questions**, please call Simon Hsu at (213) 367-2970.

As a covered entity under Title II of the Americans with Disabilities Act, the City of Los Angeles does not discriminate on the basis of disability and, upon request, will provide reasonable accommodation to ensure equal access to its programs, service and activities. To ensure availability, such requests should be made 72 hours in advance by calling (213) 367-2970, TDD: 1 (800) 432-7397.

# Internet Outreach

## Twitter

workshop tomorrow morning? We want to hear fro… (cont)
http://deck.ly/~gplCB
9 Feb

LADWP LADWP
Come talk water with us: public workshop on the Urban Water Management Plan. Tonight, 6pm, Downtown LA. http://bit.ly/gRYYNF
9 Feb Favorite Retweet Reply

LADWP LADWP
Have your say on LADWP's long-range water plan at public workshop tomorrow night, 6pm in Downtown LA. ALL are invited! http://bit.ly/gRYYNF
8 Feb

ReadyLA ReadyLA

@LADWP
LADWP

Come talk water with us: public workshop on the Urban Water Management Plan. Tonight, 6pm, Downtown LA. http://bit.ly/gRYYNF

9 Feb via TweetDeck Favorite Retweet Reply

Retweeted by BernardCParks

## LADWP News

DATE: February 7, 2011 11:47:39 AM PST

LADWP News

**LOS ANGELES DEPARTMENT OF WATER AND POWER**
**111 North Hope St., Room 1520, Los Angeles, CA. 90012-5701**
**Phone (213) 367-1361 - After Hours (213) 367-3227**
**www.ladwp.com**

LA DWP Los Angeles Department of Water & Power

FOR IMMEDIATE RELEASE
February 7, 2011

### Urban Water Management Plan Workshop this Wednesday at 6pm in Downtown Los Angeles

*Help Us Plan LA's Water Future!*

**WHAT:** The public is invited to hear an overview of the LADWP Water System's strategic priorities and preview the draft 2010 Urban Water Management Plan that will outline the City's long-term water resources management strategy. Workshop attendees are invited to share their thoughts during the program.

**WHO:** LADWP Water System Representatives

**WHEN:** Wednesday, February 9, 2011
6:00 p.m.

**WHERE:** LADWP John Ferraro Building
Cafeteria Conference Room
111 N. Hope Street
Los Angeles, CA 9012
Map

**WHY:** LADWP is currently preparing the 2010 Urban Water Management Plan (UWMP), which will outline the City's long-term water resources management strategy. Public input received from the workshops will be considered for the final 2010 UWMP, to be presented for adoption by the LADWP Board of Commissioners in May 2011.

For more information on the UWMP workshop, click here.

# # #

SHARE

# facebook

facebook

Email Password Login

Keep me logged in Forgot your password?

Sign Up **Facebook helps you connect and share with the people in your life.**

I'm Attending

## LADWP Draft 2010 Urban Water Management Plan Workshop

Share · Public Event

**Time** Thursday, February 3 · 6:00pm - 9:00pm

**Location** Van Nuys Service Center
14401 Saticoy Street
Van Nuys, CA

**Created By** SOCAL ASLA

**More Info** http://www.lariver.org/

**Wall**

Export · Report Event

Facebook © 2011 · English (US)

Mobile · Find Friends · Badges · People · Pages · About · Advertising · Developers · Careers · Privacy · Terms · Help

# United Neighborhoods (Neighborhood Council) Website

| Board Members | Current Agenda |
|---|---|

## Urban Water Management Plan Workshop this Wednesday at 6pm in Downtown Los Angeles

Help Us Plan LA's Water Future!

WHAT:
The public is invited to hear an overview of the LADWP Water System's strategic priorities and preview the draft 2010 Urban Water Management Plan that will outline the City's long-term water resources management strategy. Workshop attendees are invited to share their thoughts during the program.
WHO:
LADWP Water System Representatives
WHEN:
Wednesday, February 9, 2011
6:00 p.m.
WHERE:
LADWP John Ferraro Building
Cafeteria Conference Room
111 N. Hope Street
Los Angeles, CA 9012
Map
WHY:
LADWP is currently preparing the 2010 Urban Water Management Plan (UWMP), which will outline the City's long-term water resources management strategy. Public input received from the workshops will be considered for the final 2010 UWMP, to be presented for adoption by the LADWP Board of Commissioners in May 2011.

For more information on the UWMP workshop, click here.

Foreign Language Publications Advertisements for February 2011 Public Workshops

**Korean Daily**


Los Angeles Department of Water & Power

# LA 시 수자원의 미래를 지키기 위한 전략 과제

LA 수도전력국의 전략적 우선과제의 개요와 LA 시의 장기적 수자원 관리 전략의 윤곽을 그릴 2010 어반 워터 매니지먼트 플랜 (UWMP)의 초안에 대해 함께 논의하고자 귀하를 초대합니다. 최종 2010 UWMP는 2011년 5월 LA 수도전력국 임원회에서 채택을 발표하게 됩니다.

## 퍼블릭 워크샵

**VAN NUYS**
2월 3일 목요일 오후 6시
Van Nuys Service Center
14401 Saticoy Street

**DOWNTOWN LOS ANGELES**
2월 9일 수요일 오후 6시
LADWP John Ferraro Building, Cafeteria Conference Room
111 N. Hope Street

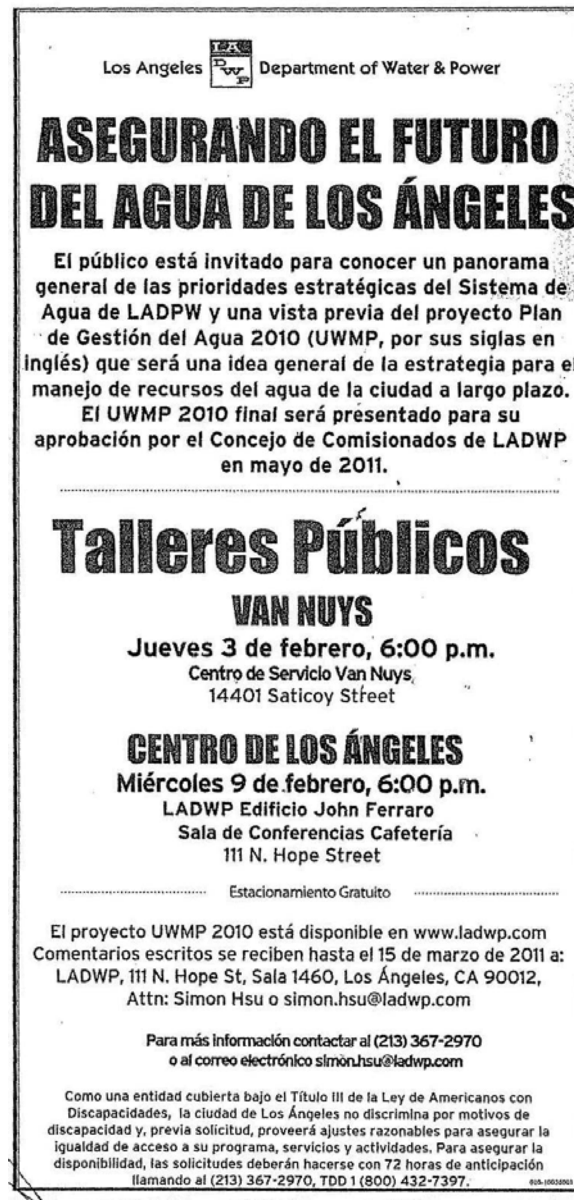
무료 파킹 제공

2010 UWMP 초안은 www.ladwp.com에서 확인하실 수 있으며
서면으로 된 의견은 2011년 3월 15일까지 아래의 주소나 이메일로 보내주십시오:
LADWP, 111 N. Hope St, Room 1460, Los Angeles, CA 90012,
Attn: Simon Hsu or simon.hsu@ladwp.com

더 자세한 사항은 (213) 367-2970으로 문의하시거나
Simon.hsu@ladwp.com으로 이메일을 보내주시길 바랍니다

As a covered entity under Title II of the Americans with Disabilities Act, the City of Los Angeles does not discriminate on the basis of disability and, upon request, will provide reasonable accommodation to ensure equal access to its programs, service and activities. To ensure availability, such requests should be made 72 hours in advance by calling (213) 367-2970, TDD: 1 (800) 432-7397.

**La Opinion**


Los Angeles Department of Water & Power

# ASEGURANDO EL FUTURO DEL AGUA DE LOS ÁNGELES

El público está invitado para conocer un panorama general de las prioridades estratégicas del Sistema de Agua de LADPW y una vista previa del proyecto Plan de Gestión del Agua 2010 (UWMP, por sus siglas en inglés) que será una idea general de la estrategia para el manejo de recursos del agua de la ciudad a largo plazo. El UWMP 2010 final será presentado para su aprobación por el Concejo de Comisionados de LADWP en mayo de 2011.

## Talleres Públicos

**VAN NUYS**
Jueves 3 de febrero, 6:00 p.m.
Centro de Servicio Van Nuys
14401 Saticoy Street

**CENTRO DE LOS ÁNGELES**
Miércoles 9 de febrero, 6:00 p.m.
LADWP Edificio John Ferraro
Sala de Conferencias Cafetería
111 N. Hope Street

Estacionamiento Gratuito

El proyecto UWMP 2010 está disponible en www.ladwp.com
Comentarios escritos se reciben hasta el 15 de marzo de 2011 a:
LADWP, 111 N. Hope St, Sala 1460, Los Ángeles, CA 90012,
Attn: Simon Hsu o simon.hsu@ladwp.com

Para más información contactar al (213) 367-2970
o al correo electrónico simon.hsu@ladwp.com

Como una entidad cubierta bajo el Título III de la Ley de Americanos con Discapacidades, la ciudad de Los Ángeles no discrimina por motivos de discapacidad y, previa solicitud, proveerá ajustes razonables para asegurar la igualdad de acceso a su programa, servicios y actividades. Para asegurar la disponibilidad, las solicitudes deberán hacerse con 72 horas de anticipación llamando al (213) 367-2970, TDD 1 (800) 432-7397.

## Sing Tao (Chinese)

Los Angeles Department of Water & Power

# 保障洛縣未來用水

歡迎民眾參加洛縣水電局介紹用水系統的策略重點
及預覽概述城市的長遠用水資源管理戰略的
2010城市用水資源管理計劃(UWMP)草案。
最終的2010城市用水資源管理計劃
將於2011年5月提交洛縣水電局董事會通過。

# 社區研討會

## VAN NUYS

**2/3/2011 (星期四) 下午六時**
Van Nuys Service Center
14401 Saticoy Street

## 洛杉磯市中心

**2/9/2011 (星期三) 下午六時**
LADWP John Ferraro Building, Cafeteria Conference Room
111 N. Hope Street

免費停車

**2010城市用水資源管理計劃(UWMP)草案詳情，**
**請上網至www.ladwp.com**
**書面意見請於3/15/2011前寄到：**
LADWP, 111 N. Hope St, Room 1460, Los Angeles, CA 90012,
Attn: Simon Hsu or simon.hsu@ladwp.com

**查詢電話：(213)367-2970或**
**電郵 simon.hsu@ladwp.com**

在美國殘障法案第二條所保障下，洛杉磯市沒有歧視殘障者的基本人權，並且一旦有所要求時，將會提供合理的協助，以確保對洛杉磯市之節目、服務以及活動的公平性。為確保時限有效，任何要求必須在72小時前撥打(213) 367-2970，聽力障礙者專線：1(800) 432-7397。

March 3, 2011

Mr. Sol Blumenfeld
Community Development Director
City of Culver City, Planning Division
9770 Culver Boulevard
Culver City, CA 90232

Dear Mr. Blumenfeld:

Subject: City of Los Angeles 2010 Urban Water Management Plan Public Hearing

The Los Angeles Department of Water and Power (LADWP) is providing this notice of a public hearing for our 2010 Urban Water Management Plan (UWMP). As part of its regularly scheduled meeting on May 3, 2011, the Los Angeles Board of Water and Power Commissioners will hold a public hearing during which members of the public may comment on the adoption of our 2010 UWMP. The hearing will be held on May 3, 2011 at 1:30 p.m. (tentative), 111 N. Hope Street, Room 1555, Los Angeles, CA 90042. Please check the website (http://www.ladwp.com) to confirm the start time.

The 2010 UWMP outlines the City of Los Angeles' (City) long-term water resources management strategy. It is the City's master plan for water supply and resources management. It includes details on LADWP's plans for recycled water, conservation, stormwater capture and other water resource options.

All large California urban water agencies prepare an UWMP every five years. The LADWP's 2010 UWMP is currently available for review on our website at (http://www.ladwp.com) by searching "UWMP."

If you have any questions or comments, please contact Mr. Simon Hsu of my staff at (213) 367-2970, or e-mail him at simon.hsu@ladwp.com.

Sincerely,

Thomas M. Erb
Director of Water Resources

CR:lsf
c: Mr. Simon Hsu

Department of Water and Power the City of Los Angeles

ANTONIO R. VILLARAIGOSA
*Mayor*

Commission
THOMAS S. SAYLES, *President*
ERIC HOLOMAN, *Vice-President*
CHRISTINA E. NOONAN
JONATHAN PARFREY
BARBARA E. MOSCHOS, *Secretary*

RONALD O. NICHOLS
*General Manager*

March 3, 2011

Ms. Gail Farber
Los Angeles County Department of Public Works
900 South Fremont Avenue
Alhambra, CA 91803

Dear Ms. Farber::

Subject: City of Los Angeles 2010 Urban Water Management Plan Public Hearing

The Los Angeles Department of Water and Power (LADWP) is providing this notice of a public hearing for our 2010 Urban Water Management Plan (UWMP). As part of its regularly scheduled meeting on May 3, 2011, the Los Angeles Board of Water and Power Commissioners will hold a public hearing during which members of the public may comment on the adoption of our 2010 UWMP. The hearing will be held on May 3, 2011 at 1:30 p.m. (tentative), 111 N. Hope Street, Room 1555, Los Angeles, CA 90042. Please check the website (http://www.ladwp.com) to confirm the start time.

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If you have any questions or comments, please contact Mr. Simon Hsu of my staff at (213) 367-2970, or e-mail him at simon.hsu@ladwp.com.

Sincerely,

Thomas M. Erb
Director of Water Resources

CR:lsf
c: Mr. Simon Hsu

Water and Power Conservation ...a way of life

111 North Hope Street, Los Angeles, California 90012-2607 *Mailing address:* Box 51111, Los Angeles 90051-5700
*Telephone:* (213) 367-4211 *Cable address:* DEWAPOLA

March 3, 2011

Mr. Oscar Delgado, Director
City of West Hollywood
Department of Public Works
8300 Santa Monica Boulevard
West Hollywood, CA 90069

Dear Mr. Delgado:

Subject: City of Los Angeles 2010 Urban Water Management Plan Public Hearing

The Los Angeles Department of Water and Power (LADWP) is providing this notice of a public hearing for our 2010 Urban Water Management Plan (UWMP). As part of its regularly scheduled meeting on May 3, 2011, the Los Angeles Board of Water and Power Commissioners will hold a public hearing during which members of the public may comment on the adoption of our 2010 UWMP. The hearing will be held on May 3, 2011 at 1:30 p.m. (tentative), 111 N. Hope Street, Room 1555, Los Angeles, CA 90042. Please check the website (http://www.ladwp.com) to confirm the start time.

The 2010 UWMP outlines the City of Los Angeles' (City) long-term water resources management strategy. It is the City's master plan for water supply and resources management. It includes details on LADWP's plans for recycled water, conservation, stormwater capture and other water resource options.

All large California urban water agencies prepare an UWMP every five years. The LADWP's 2010 UWMP is currently available for review on our website at (http://www.ladwp.com) by searching "UWMP."

If you have any questions or comments, please contact Mr. Simon Hsu of my staff at (213) 367-2970, or e-mail him at simon.hsu@ladwp.com.

Sincerely,

Thomas M. Erb
Director of Water Resources

CR:lsf
c: Mr. Simon Hsu

# 60-Day Notification Ads (March 3 and 10, 2011)

## La Opinion

TENGA PRESENTE que como parte de su reunión programada para el 3 de mayo de 2011, la Junta de Comisionados de Agua y Energía realizara una audiencia pu̇blica durante la cual cualquier mimbre del publico podrá comentar sobre la adopción del Plan de Gestión Urbano del Agua 2011 (UWMP, por sus siglas en inglés).

La audiencia se llevara a cabo a la 1:30 p.m. (tentativamente) el 3 de mayo de 2011, 111 N. Hope Street, Los Angeles, cuarto 1555.

Favor de revisar nuestro sitio en la red en: (http://www.ladwp.com) y buscar en "UWMP"

Los Angeles Department of Water and Power

## Metropolitan News

.RATION OF PUBLICATION

STATE OF CALIFORNIA

COUNTY OF LOS ANGELES

KIM HUGHES

DEPT OF WATER AND POWER
GOV'T LEGISLATIVE & PUB AFFAIR
111 N HOPE ST RM 1510
LOS ANGELES CA 90012

NOTICE
2010 URBAN WATER MANAGEMENT PLAN (UWMP)

HEARING/CLOSE/SALE DATE: 05/03/11

The undersigned says:

I am over the age of 18 years and a citizen of the United States. I am not a party to and have no interest in this matter. I am a principal clerk of the METROPOLITAN NEWS-ENTERPRISE*, a newspaper of general circulation in the City of Los Angeles, the Judicial District of Los Angeles, the County of Los Angeles, and the State of California, as adjudicated in Los Angeles Superior Court Case No. 601165. The notice, a printed copy of which appears hereon, was published on the following date(s): Mar 3,10, 2011

I declare under penalty of perjury that the foregoing is true and correct. Executed at Los Angeles, California on 03/10/11.

*signature*

**Metropolitan News-Enterprise**
P.O. Box 60859
Los Angeles, Ca 90060

*Phone: (213) 346-0033*
*Fax: (213) 687-3886*

Cust. Num.: 012120 Control Num.: 851942
Cust. Ref. Num.:

**NOTICE OF PUBLIC HEARING**
PLEASE TAKE NOTICE that as part of its regularly scheduled meeting on May 3, 2011, the Board of Water and Power Commissioners will hold a public hearing during which any members of the public may comment on the adoption of the 2010 Urban Water Management Plan (UWMP). The hearing will be held at 1:30 pm (tentative) on May 3, 2011, 111 N. Hope Street, Los Angeles, CA, Room 1555. Please check the website (http://www.ladwp.com) to confirm the start time.
The UWMP is currently accessible for review on our website (http://www.ladwp.com) by searching for "UWMP"
Los Angeles Department of Water and Power.
CN851942 Mar 3,10, 2011

*Page 1 of 1*

# PUBLIC COMMENTS

# WORKSHOP PUBLIC COMMENTS

Following is a summary of questions, comments received, as well as LADWP responses at public workshops on the City of Los Angeles Draft 2010 Urban Water Management Plan (UWMP). The first round of public workshops were held on January 12th and 20th, 2010 and then a second round was held on February 3rd and 9th, 2011.

## Los Angeles Department of Water and Power

### 2010 Urban Water Management Plan Public Workshop Comments/Suggestions for What Should be Included in the Plan

## INCLUDES LADWP COMMENT RESPONSES

**Date:** January 12 and January 20, 2010

**Time:** 6:00 – 8:30 pm and 5:00 – 7:00 pm (respectively)

**Location:** Marvin Braude Constituent Center, 6262 Van Nuys Blvd., Van Nuys, Room 1B
Los Angeles River Center, 570 West Avenue 26, Los Feliz Room

**Participants:** LADWP (Thomas Erb, David Pettijohn, Simon Hsu, Chris Repp), See Also attached sign-in sheet

**Meeting Objective:** To present a preliminary summary of the topics to be addressed in the 2010 Urban Water Management Plan (UWMP), and collect comments/suggestions for what should be included in the Plan from the public on these various topics.

If you feel your suggestion is not included, please let us know by e-mailing chris.repp@ladwp.com or calling (213)367-4736.

### Links for Workshop Requests

- Plume contamination drawings for the San Fernando Valley, Figures 3-1 to 3-8: http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/49aa6d700fbae1988825763200575b46/$FILE/2007_SFV_Report_1_Main.pdf
- Graywater systems for residential buildings from the Dept. of Building and Safety: http://www.ladbs.org/LADBSWeb/LADBS_Forms/InformationBulletins/IB-P-PC2008-012Graywater.pdf
- Summer 2009 Water Main Leak Preliminary Investigation Report (dated November 2009): http://www.ladwpnews.com/posted/1475/Summer_09_Water_Main_Leaks_Prelim_Investigation_Rpt_.398503.pdf

### Groundwater

1. **Comment:** The groundwater recharge program should be expanded. The vast majority of the LA River and other stormwater runoff wastefully flows directly to the ocean. Much more of the runoff within the City needs to be captured to recharge our aquifers or supplement other supplies.

   **Response:** LADWP will be preparing a Stormwater Capture Master Plan which will address the potential of stormwater capture infiltration and distributed stormwater capture projects. The Stormwater Capture Master Plan is covered in Section 7.3 of the draft report.

### Stormwater Capture and Graywater

2. **Comment:** Land use should be changed to allow more rainwater harvesting and stormwater capture. If a developer wants to build and consequently use more water, they should be required to provide open space to be used for stormwater capture. The City codes should have more emphasis on promoting stormwater capture.

**Response:** On December 17, 2010, the L.A. City Council directed the Los Angeles City Attorney to draft language for a Low Impact Development (LID) Ordinance addressing new development.

3. **Comment:** LADWP should communicate more with other City agencies (LA City Bureau of Engineering) on LA River and other watershed issues to increase stormwater capture.

   **Response:** LADWP is working with other City agencies and the LA County Flood Control District to enhance Stormwater Capture. This is detailed in Chapter 7 and 10, particularly in sections 7.1, 7.3, 7.7, and 10.2. LADWP involvement with the LA River is covered in section 10.2, under *Los Angeles River*, and *Agency Coordination.* A case study on the LA River Revitalization is also included in Chapter 3.

4. **Comment:** A good way to study sustainable use and stormwater capture potential is to get universities and large public facilities involved.

   **Response:** The Stormwater Capture Master Plan will examine alternative methods to implement Stormwater Capture.

5. **Comment:** In terms of Recycled Water Systems for private family residents, the City should implement incentives for graywater applications (see link on first page), rainbarrels, and cisterns.

   **Response:** LADWP continually assesses conservation programs. For stormwater capture solutions, the Stormwater Capture Master Plan will review potential incentives. The link to the graywater regulations is provided on the first page (Refer to "Links for Workshop Requests"). The Bureau of Sanitation conducted a pilot study for rain barrel use in the City. It is discussed in Chapter 7 of the draft report as "Case Study: Ballona Creek Watershed Rainwater Harvesting Pilot Program". The Bureau of Sanitation, Watershed Protection Division, began the City's first free Rainwater Harvesting pilot program in July 2009.

6. **Comment:** It would be advantageous if there was an action body or group within the City that the public could work with to speed the development of small scale rainwater capture and graywater applications.

   **Response:** LADWP will continue to look for ways to work with other agencies and stakeholders in advancing stormwater capture solutions. Implementation of Low Impact Development (LID) will significantly facilitate the development of stormwater capture and graywater applications. The link to the graywater regulation is provided on the first page. The LADWP website is currently being revised and should contain additional information on graywater once complete. See also response number 8.

7. **Comment:** In the UWMP there should be more emphasis on practical examples of stormwater capture and rainwater harvesting. More pamphlet materials would also be helpful.

   **Response: Chapter 7 –** Watershed Management provides three case studies on neighborhood recharge, rainwater harvesting, and stormwater capture. More information will be available following the completion of the Stormwater Capture Master Plan, as part of public outreach. See also response number 8.

8. **Comment:** The new UWMP plan should have specific guidelines and instructions of how to implement graywater and other water saving systems. This would include how to obtain permits from Building and Safety, and would streamline the entire process.

   **Response:** The link to the graywater regulations is provided on the first page (above) and Section 3.3.1 of the draft 2010 UWMP. It states that a permit is not required for untreated residential graywater systems using water from clothes washers. Furthermore, The LADWP webpage is currently being revised, and once complete will contain updated information on promoting graywater. The website will familiarize our customers with graywater and promote safe and legal installations of graywater systems. It will include various graywater systems, permits required, water saving estimates, frequently asked questions, and additional information resources. LADWP has obtained International Association of Plumbing and Mechanical Officials (IAPMO) approval to use and modify copyrighted material (i.e. graywater figures) to reflect California State regulations.

### Water Recycling

9. **Comment:** There should be an emphasis not only on large scale recycling but also on small scale recycling as in rainwater harvesting and graywater applications.

   **Response:** Section 7.6, entitled Distributed Stormwater Capture, discusses several types of de-centralized stormwater capture, including rain barrels, cisterns, rain gardens, and several neighborhood recharge projects. Graywater is discussed in the Conservation Chapter in Section 3.3.1 and mentioned in response 8 above.

10. **Comment:** Setting incremental goals for recycled water past 2019 onto 2035 is a positive step in meeting the challenge of dependence on imported water. Increasing the amount of recycled water used not only for environmental use, but to replace potable water, is the right direction for the City.

    **Response:** Chapter 4, Recycled Water, discusses these very issues, covering LADWP's recycled water program for the next 25 years. It includes plans for groundwater replenishment, along with recycled water "purple pipe" distribution projects to industries and businesses within the City.

### Costs

11. **Comment:** There is a concern of the increase of water rates, the costs for planned projects, and the marginal costs of various sources of water supply.

    **Response:** With the exception of the proposed groundwater remediation efforts in the San Fernando Valley, it is believed all resource initiatives in the 2010 UWMP can be funded with current water rates. The groundwater cleanup project is a very costly large scale project, and will require additional funding. Unit costs of various sources of supply are covered in Chapter 11, Section 11.1.

12. **Comment:** The additional funding from increased water rates should be used to improve the water infrastructure.

    **Response:** Infrastructure improvements (reliability), compliance with regulatory requirements (safety), increasing local supply, protecting the environment (sustainability) and maintaining competitive water rates are the top water priorities for LADWP.

13. **Comment:** The decision to implement particularly expensive projects throughout the City should be based more upon environmental and economical feasibility than on neighborhood influence. This benefits the greater good of the community.

    **Response:** When moving forward with expensive water resource projects, LADWP considers environmental and economical feasibility. A good example is that recycled water is favored over seawater desalination mainly because of its more competitive cost and lesser environmental impact.

## Los Angeles Department of Water and Power

### 2010 Urban Water Management Plan Public Workshop Comments/Suggestions for What Should be Included in the Plan

### New Developments

14. **Comment:** There should be a link between water supply and community development planning.

    **Response:** The link between water supply and development planning is explained in Section 11.4, Water Supply Assessments.

15. **Comment:** New developments (particularly those on multi family residences) should bear a greater burden for the costs of acquiring water. The cost of acquiring additional water supply is unjustly being shared by the rate payers.

    **Response:** This comment will be recorded and included in the appendix of the 2010 UWMP.

16. **Comment:** In terms of conservation, some high-density projects may be beneficial in ways such as allocating more open space that can be used for stormwater capture.

    **Response:** The City of Los Angeles is close to adopting a low impact development (LID) ordinance requiring stormwater capture for all new development.

### Climate Change

17. **Comment:** LADWP needs to educate constituents about the water crisis and the potential effects of dry climate conditions furthering the drought situation. The Department should enlist experts to provide insight into this challenge.

    **Response:** Chapter 12 is dedicated to the topic of climate change. LADWP is currently conducting a climate change study regarding its impacts on the Eastern Sierra watershed, which provides water to the Los Angeles Aqueduct.

### Conservation

18. **Comment:** Some of the lesser known Phase III Water Conservation Ordinance restrictions should not be lifted if they produce a City that is more responsible and efficient.

    **Response:** Conservation efforts in Los Angeles have proven very successful, and have significantly increased water use efficiency in the City. The Los Angeles City Council ultimately determines whether or not these restrictions are lifted. At this time LADWP does not recommend any changes.

19. **Comment:** LADWP should work with other City departments to ensure maximum public benefit with the incentive programs. Additional fees across departments may discourage the use of these incentives.

    **Response:** LADWP will keep this in mind to ensure incentive programs are effective. LADWP recently worked with the L.A. Department of Building and Safety (LADBS) to eliminate fees for turf removal in parkways.

20. **Comment:** Conservation alone is not adequate to sustain an increasing population. We will need to introduce additional and/or increased supplies.

    **Response:** Exhibit 11C of Section 11.2.8, entitled Service Area Reliability Assessment, highlights LADWP's plans to increase our local supplies significantly. This will reduce purchase of imported water from the Metropolitan Water District by approximately 50 percent by 2035.

# Los Angeles Department of Water and Power

## 2010 Urban Water Management Plan Public Workshop Comments/Suggestions for What Should be Included in the Plan

### Water Supplies

21. **Comment:** There is concern over the amount of water used for environmental reasons in the Owens Valley as this supply diversion significantly increases our dependence on imported water.

    **Response:** Annually, LADWP diverts up to 95,000 acre-ft (AF) of Los Angeles Aqueduct water for the Owens Lake Dust Mitigation Project. This is one of the City's many environmental challenges. LADWP is proposing dust mitigation solutions on Owens Lake that will not increase water usage from what is currently used.

22. **Comment:** There is concern about meeting our supplies with an ever growing City population, and an interest in seawater desalination. As costs of various water supplies increase, and technological improvements lower operating cost, it may eventually become economically feasible. However desalination still has its fair share of environmental challenges.

    **Response:** LADWP has studied seawater desalination and concluded that it presents too many economic and environmental obstacles at this time. LADWP has decided to focus its efforts on water conservation and recycling.

23. **Comment:** It would be beneficial to have a long term vision for eliminating the City's need for water imports.

    **Response:** See comment number 20.

### Miscellaneous

24. **Comment:** There is an interest in the cause of recent water main breaks (See also link on first page); it's relation to the two day water restriction, and the bombardment of overweight trucks.

    **Response:** The link on the first page shows the Summer 2009 Water Main Leaks Preliminary Investigation Report. In addition, the Conservation chapter shows the most recent Water Conservation Ordinance amendments, which implement revised Phase III restrictions. In the amendments, odd numbered addresses are allowed to water on Monday, Wednesday, or Friday, while even numbered addresses can water only on Tuesday, Thursday, or Sunday. This is designed to prevent large fluctuations of pressure within the water distribution system.

25. **Comment:** The City should set up a forum with blogs where the public can share ideas and comments on water related issues.

    **Response:** As discussed in comment number 6, the LADWP website is currently being revised. It will include Facebook and Twitter links.

## Los Angeles Department of Water and Power

## Summary of 2010 Urban Water Management Plan Public Workshops Comments and Suggestions with LADWP Responses

**Workshop 1:** February 3, 2011, Van Nuys Service Center, 14401 Saticoy St.

**Workshop 2:** February 9, 2011, LADWP John Ferraro Building, 111 N. Hope St.

**Attendees:** See attached sign-in sheets

### Water Demands

1. **Comment:** How long has the State Department of Water Resources required submittal of Urban Water Management Plans (UWMP)? Historically, how accurate have the projections been?

   **Response:** The water demand projections and UWMP have been a requirement since the UWMP Act was established in 1984. Historically, LADWP's projections have turned out to be higher than actual use. The 2010 UWMP is the first UWMP where water demand projections are significantly lower than previous versions. Section 2.3 provides a description of the demand forecast methodology.

2. **Comment:** Water demand projections are significantly lower than those developed in the 2005 UWMP. Why is this?

   **Response:** As stated above, previous projections were higher than what actually occurred. For this UWMP, LADWP devoted a lot of study on projected water demands and developed a new forecasting model. Water efficient practices and numerous regulations effecting water use are much more commonplace than in the past, which are expected to prevent significant increases in water demands.

3. **Comment:** The population increased in the last 30 years but water usage has seemed to decrease. However, LADWP has now projected a continual increase with population and increase in water demand. What is changing this historical trend?

   **Response:** Today, as compared to the 1970's and 1980's, the City has achieved a much higher level of conservation. This is why our water demand has stayed relatively the same even though the City population has increase by over 1 million since 1970. As the City continues to grow in population, water demand is projected to increase slightly.

4. **Comment:** Why is water use staying relatively the same versus a steady increase of population over time?

   **Response:** The City's water use has not increased significantly due changes in customer awareness and efficient use of water, more stringent plumbing standards, LADWP incentives and rebates, and requirements such as mandatory restrictions on water use.

5. **Comment:** Twenty five years from now what percentage of our water supply will come from local water supplies?

   **Response:** According to the UWMP 43 percent of water supplies will come from local sources in 2035. By increasing water conservation, recycled water, and stormwater capture, LADWP is projecting to cut the current average annual amount of MWD purchases in half in 25 years.

6. **Comment:** Through 2050, the Southern California Association of Governments (SCAG) projects the Southern California area to double in size from 15 to 30 million people. How can we meet these water requirements, especially considering that other adjacent cities are far behind LA and have not implemented such aggressive conservation measures?

   **Response:** The major focus of LADWP's UWMP is the development of increased local water supplies to lessen our dependence on imported water that must be shared with all of Southern California. Many other cities in Southern California are pursuing similar local water resource goals. State Senate Bill X7-7 (SBX7-7), passed by the State Senate in 2010 requires a 20 percent reduction in water use by all water agencies by 2020. This requirement will assist in driving other agencies to meet conservation targets.

7. **Comment:** The presentation shows a slight increase in Los Angeles Aqueduct supplies will increase in 2035. Why?

   **Response:** The most recent 5-year average Los Angeles Aqueduct deliveries are slightly lower than the historical average. The 2035 projection of Los Angeles Aqueduct deliveries assumes average weather conditions, with a slight decrease due to anticipated climate change impacts.

### Water Supplies and MWD

8. **Comment:** Where, how, and when is the connection between the State Water Project and Los Angeles Aqueduct (LAA) going to be built?

   **Response:** A turnout facility is currently being constructed where the Los Angeles Aqueduct and the California Aqueduct intersect in the Antelope Valley, a few miles west of the 14 freeway. The purpose of the facility is to allow the pumping of water from the California Aqueduct into the Los Angeles Aqueduct and allow LADWP to participate in water transfers from the water market. The turnout facility is currently under construction and should be in service by the summer of 2013.

9. **Comment:** Is there a document that summarizes the structure of water supplies for the City?

   **Response:** The UWMP is primary water resource planning documents. It is updated every 5 years.

10. **Comment:** Is LADWP planning to purchase more water from the Bay-Delta?

    **Response:** There are a number of water supply and environmental challenges in the Bay-Delta. As outlined in the UWMP, LADWP is planning on decreasing purchases from MWD, which imports water from the Bay-Delta. The UWMP discusses how local water supplies are being developed and how LADWP is planning to rely less on MWD.

11. **Comment:** MWD has been decreasing its allocations from the Bay-Delta via the State Water Project, and Colorado River storage has been decreasing as is evident in Lake Mead's low levels. The City's water demand will increase while LADWP's supply from MWD seems to decrease. How can LADWP reconcile this difference?

**Response:** LADWP projects a small increase in water use due to population increases, however the UWMP projects LADWP's reliance on MWD water supplies will be reduced by half; from the current five-year average of 52 percent of total demand to 24 percent by 2035 under average weather conditions. The reliability of MWD's water supplies from both the State Water Project and the Colorado River are discussed in detail in Chapters 8 and 11 of the UWMP.

12. **Comment:** What water will be exchanged when the connection between the California Aqueduct and the Los Angeles Aqueduct is developed?

    **Response:** LADWP will seek to purchase water from willing sellers, most likely agricultural entities. State Water Project supplies provided to agencies such as MWD will not be a source of these water purchases.

13. **Comment:** Is there a reciprocal agreement between Metropolitan Water District and LADWP on water transfers occurring at the connection of the California Aqueduct and Los Angeles Aqueduct?

    **Response:** Yes, there is a reciprocal agreement between MWD and LADWP. MWD has the exclusive right to sell State Water Project supplies within its service territory. LADWP has the ability to move non-State Water Project water through the California Aqueduct into LADWP's service territory.

14. **Comment:** Are there salinity problems with Colorado River water?

    **Response:** Salinity continues to be an issue with Colorado River water supplies. MWD addresses this through water blending. MWD blends Colorado River Aqueduct water with lower salinity State Water Project water.

## Water Conservation and Graywater

15. **Comment:** Is the new watering schedule going to decrease the effectiveness of LADWP's outdoor watering conservation efforts?

    **Response:** The new watering schedule went into effect in late August 2010. Since that time, water savings have been essentially unchanged compared to the period prior to the change. Overall monthly conservation savings continue at approximately 20 percent, with single-family residential savings at approximately 25 percent. LADWP will continue to monitor conservation.

16. **Comment:** LADWP should abandon the Irrigation Association Smart Water Application Technologies (SWAT) testing as a means of evaluating weather based irrigation controllers.

    **Response:** The SWAT project is an international utility/irrigation industry initiative to achieve landscape water use efficiency through the application of irrigation technology. It includes an independent third party testing protocol for weather based irrigation controllers. LADWP's Water Conservation staff is reviewing this suggestion with the individual who provided it.

17. **Comment:** LADWP should have more information and guides on graywater projects.

    **Response:** The LADWP website update will contain information on graywater. Included will be information on benefits, available alternative installations, costs and savings, and how to obtain permits.

## Water Recycling

18. **Comment:** What are LADWP's plans to use recycled water for environmental enhancement improvements?

    **Response:** Recycled water is currently being provided for the Sepulveda Basin Japanese Garden, Lake Balboa, the Wildlife Lake, and the Los Angeles River. Those commitments will be maintained as LADWP expands recycled water use.

19. **Comment:** Provide a description of the Recycled Water Master Plan.

    **Response:** Section 4.4 of the UWMP describes the components of Recycled Water Master Plan. Once complete, the Recycled Water Master Plan will act as a roadmap for how to expand recycled water in the City.

## Stormwater Capture

20. **Comment:** Why are the stormwater infiltration goals of 10,000 AF of rainwater harvesting and 15,000 AF of infiltration so low?

    **Response:** Currently, stormwater infiltrates and replenishes local groundwater basins so LADWP can fully exercise its pumping rights. The UWMP projects that by 2035 there will be a minimum of 15,000 AFY of increased groundwater pumping in the San Fernando Basin due to water supply augmentation through stormwater infiltration. In order to increase groundwater production, it must be determined that not only have groundwater levels recovered to sustain existing safe yield pumping amounts, but documented additional infiltration is occurring that could potentially increase the safe yield. Increasing the safe yield will require concurrence by the Watermaster and the courts to amend the basin judgment. Amending the judgment would be a lengthy process involving all basin pumpers. More studies must be conducted to determine how much more infiltration must be developed to increase the safe yield and groundwater production. The Stormwater Capture Master Plan will identify the potential acre-feet per year quantities available for recharge, and develop an implementation plan to augment the groundwater basin through centralized and decentralized infiltration projects and programs.

21. **Comment:** Provide a description of the Stormwater Capture Master Plan, and what is its cost?

    **Response:** A Request for Proposal for consulting services to prepare a Stormwater Capture Master Plan has been released. The Master Plan's goal is to study the potential for increased stormwater capture and identify feasible alternatives and estimated costs. The cost of the Master Plan will be determined once proposals are received and reviewed, and a contract negotiated.

22. **Comment:** The City states that it will cost $8 billion for stormwater capture projects. How does the Stormwater Capture Master Plan fit in with this cost?

    **Response:** While the City has potential obligations for improving stormwater quality, the Stormwater Capture Master Plan's focus is on developing new water supplies. However, the Stormwater Capture Master Plan will include input from other City departments and examine potential alternatives that achieve multiple objectives.

23. **Comment:** Watershed management needs to be evaluated on a regional level.

    Response: LADWP increasing coordinates with other agencies and organizations on watershed issues, including the United States Army Corps of Engineers, the Los Angeles County Flood Control District, the Greater Los Angeles Integrated Regional Water Management Group, the Los Angeles and San Gabriel Rivers Watershed Council, and numerous environmental organizations and stakeholders. LADWP will continue to work with others to improve regional coordination of watershed management.

24. **Comment:** Construction of more subsurface infiltration basins will help counteract the effects of hardscape in the City.

    Response: Agreed. LADWP participated in the Elmer Avenue Neighborhood Retrofit Demonstration Project, the North Hollywood Alley Retrofit Project, and other projects to highlight alternatives to impervious hardscape.

25. **Comment:** Required infiltration from roof gutters on property development should prevent more runoff

    Response: The City's Low Impact Development Ordinance will require stormwater capture and reuse on all new development. Capturing water from roof gutters is one available option to meet the Ordinance requirements.

26. **Comment:** Construction of reservoirs along the Los Angeles River is a good way to enhance infiltration of runoff along the Los Angeles River channel.

    Response: This option may be feasible if available parcels can be identified and obtained.

27. **Comment:** There are some areas in the City that have historically had repeated flooding. What is being done to solve this problem?

    **Response:** While flood control is not LADWP's primary mission, it is possible that areas prone to flooding may also be candidates for stormwater capture projects. Examples are the Elmer Avenue Neighborhood Retrofit Demonstration Project and the recently approved Woodman Avenue Multi-Beneficial Storm Water Capture Project. LADWP will seek involvement by other City departments during the preparation of the Stormwater Capture Master Plan to explore solutions that have multiple benefits.

28. **Comment:** There should be collaboration with the City Planning Department to regulate the structure of roofs and gutters on parking lots, etc., to promote infiltration and water reuse on new projects.

    **Response:** LADWP works with other City departments on ordinances to require stormwater capture for all new developments in the City. An example of this is the Low Impact Development (LID) ordinance, currently being drafted by the City Attorney. See Section 7.6.4.

29. **Comment:** How is LADWP working to increase capture of stormwater runoff in urban developments such as parking lots and other hardscape?

    **Response:** LADWP is currently participating in various stormwater capture demonstration projects in order to develop alternative city-approved construction standards and gather cost data. An example is the Elmer Avenue Neighborhood Retrofit Project. LADWP actively worked on the development of the Low Impact Development

Ordinance currently being drafted, and has begun the process to initiate a Stormwater Capture Master Plan to identify the potential for stormwater capture and identify alternative solutions.

30. **Comment:** Does LADWP partner with other agencies to promote more progressive parking lot strategies and similar approaches to increase stormwater capture?

    **Response:** LADWP worked with other City departments on the Low Impact Development Ordinance, and continues to work with other departments on the Green Streets Committee and stormwater capture demonstration projects. Increased stormwater capture from parking lots will be explored in the Stormwater Capture Master Plan.

## Groundwater

31. **Comment:** What is the percent make-up of the City's local groundwater supply?

    **Response:** Historically, 15 percent of the City's total water supply has come from local groundwater. However, due to contamination issues in the San Fernando Basin, the City's largest groundwater source, local groundwater currently comprises only 11 percent of overall water supplies.

32. **Comment:** LADWP has not been able to meet groundwater production as stated in previous Urban Water Management Plans. The Department needs to improve their approach to meet the long-range groundwater goals. How will LADWP do this?

    **Response:** Groundwater contamination has prevented LADWP from pumping its full entitlement. LADWP is conducting a comprehensive analysis of groundwater quality to determine the location and type of treatment necessary to fully clean up the contamination. The analysis will lead to specific groundwater treatment project proposals. With groundwater improvements in place, LADWP expects to meet long-range groundwater pumping goals.

33. **Comment:** Water supply issues in the Bay-Delta could be offset by using advanced treated groundwater. What type of treatment technologies are planned for groundwater cleanup in the San Fernando Basin?

    **Response:** The analysis of San Fernando Basin contaminants and potential treatment technologies is still being studied. However, potential treatment methods under review include: Air Stripping with Vapor Phase Granular Activated Carbon and Liquid Phase Granular Activated Carbon (for volatile organic compounds), Ion Exchange and/or Biological Treatment (for nitrate and perchlorate), Catalytic Media Filtration (for heavy metals), Ultraviolet Light/Hydrogen Peroxide (for 1,4, dioxane and NDMA), Filtration (for chromium 6), and Reverse Osmosis (for total dissolved solids).

34. **Comment:** Are there groundwater storage opportunities up North in areas outside of the City?

    **Response:** Yes. The Antelope Valley contains a large groundwater basin that can be used for groundwater storage. In the Antelope Valley, the City of Los Angeles is a party in current litigation to establish an adjudication that will potentially address storage rights. Other groundwater storage opportunities exist in the San Joaquin Valley. While groundwater storage outside of the Los Angeles basin can assist with water supply management, it is not a new water supply and is potentially costly. LADWP will continue to review opportunities for cost-effective groundwater storage outside of the Los Angeles basin.

## Costs

35. **Comment:** There is a significant concern over water rates and costs associated with all the projects in the 2010 UWMP.

    **Response:** The UWMP includes information on the costs of different resource options. With existing revenues for local supply development, LADWP believes we can achieve the water resource goals as stated in the 2010 UWMP, with the exception of the groundwater cleanup effort which will require rate increases. Section 11.1 addresses unit costs and funding.

36. **Comment:** The LADWP Power System is planning to significantly increase energy rates to support green energy sources. How will the Water System deal with the extra cost of the groundwater cleanup alongside the power cost increase?

    **Response:** All proposed rate increases are reviewed with Neighborhood Councils and the public, and the LADWP Board of Commissioners carefully considers the justification and impact of increased rates prior to making any decision. Also, all LADWP rate revisions require approval by the Los Angeles City Council.

## Climate Change

37. **Comment:** To what region does the climate change study apply?

    **Response:** The climate change study LADWP is conducting is specifically for the Eastern Sierra watershed that feeds the Los Angeles Aqueduct. However, Section 12.1 provides information on projected local climate change impacts.

## Miscellaneous

38. **Comment:** There is an interest in ocean desalination. Why is this not a water supply LADWP is pursuing?

    **Response:** Five years ago, LADWP conducted studies and began planning an ocean desalination pilot project adjacent to the Scattergood Power Generation Facility. However, we found desalination to be too costly and have numerous environmental challenges. LADWP determined that conservation and recycling are more cost effective, easier to implement, and more environmentally friendly.

39. **Comment:** Explain the inconsistency whereby City Planning Department updates to the General Plan are not in line with LADWP's updates for the 2010 UWMP projections.

    **Response:** The UWMP includes projected population increases provided by demographic projections from Southern California of Governments (SCAG) data. The City's General Plan also uses population forecasts provided by SCAG data; therefore, the UWMP projections are generally consistent with the City's General Plan as both use SCAG projections as their basis. Both of these planning documents are interdependent, however, their updates may not necessarily be on the same schedule.

40. **Comment:** The 2010 UWMP should state that the City's water allotment is based on the preferential rights agreement of the MWD Allocation Plan which is now a fixed number and does not increase with City's demographics or demand projections.

    **Response:** MWD adopted a Water Supply Allocation Plan in 2008 that is not based on preferential rights. If shortage allocations are required, the calculations established in the Water Supply Allocation Plan equitably allocate available supplies among MWD's member agencies primarily based on need, with adjustments to account for growth, local investments, changes in supply conditions, demand hardening, and water conservation programs.

41. **Comment:** LADWP is doing a good job of projecting demands and implementing conservation, recycling, and stormwater programs; however, LADWP still has a long way to go.

    **Response:** The 2010 Urban Water Management Plan highlights the significant potential for increased local resources development.

42. **Comment:** Financial incentives, either positive or negative, should be used to modify water use behavior. Rebates and incentives for exceptional conservation or citations for water waste will help encourage conservation and spread the word of efficient water use.

    **Response:** Since November 2008 the Water Conservation Team (formerly know as Drought Busters) have been enforcing the City's Emergency Water Conservation Ordinance, issuing both warnings and citations for water waste. Also, LADWP continues to offer rebates and incentives for all customer types.

43. **Comment:** Development should be limited and should be required to compensate for additional water needs.

    Response: In December 2009, the High Efficiency Plumbing Ordinance went into effect requiring the next generation of water efficient plumbing fixtures in all new development. Also, the City Attorney is currently drafting the Low Impact Development Ordinance for City Council approval that will require on-site stormwater capture for all new development.

44. **Comment:** In the "Securing L.A.'s Water Future" presentation, under Regulatory Requirements – Other, there are significant proposed expenditures of $337 million. What are these expenditures for?

    **Response:** The largest portion of these proposed expenditures are for air quality requirements at Owens Lake.

45. **Comment:** Please explain the high number of pipe breaks recently. Is it because of the watering schedule?

    **Response:** The expert panel formed to examine pipe breaks reviewed possible causes. The panel reviewed whether the 2-day per week watering schedule in place at the time was contributing to the increased frequency of pipe leaks. The 2-day per week watering schedule caused water system pressures to cycle more frequently than prior to watering restrictions. The panel theorized that these pressure cycles increased pipe breaks. In response to that analysis, the City Council modified the watering schedule to 3-days per week watering, with separate watering days for odd and even addresses.

46. **Comment:** Explain the budget for groundwater storage.

    **Response:** There is $2 million budgeted for groundwater storage in fiscal year 2010-11 to study groundwater storage opportunities outside of the Los Angeles basin.

47. **Comment:** How many miles of riveted steel pipe does LADWP have?

    **Response:** LADWP has 86.3 miles of riveted steel pipe within the city's water distribution system. In addition, the First Los Angeles Aqueduct contains 13.8 miles of riveted pipe.

48. **Comment:** Describe the power usage of the State Water Project in comparison to the Los Angeles Aqueduct?

    **Response**: As explained in the UWMP's Section 12.2 entitled "Water Energy Nexus", State Water Project supplies are the most energy intensive, ranging from approximately 2,580 kilowatt hours per acre foot (kWh/AF) for the west branch, to 3,236 kwh/AF for the east branch. The Los Angeles Aqueduct water is conveyed from the eastern Sierra Nevada watershed by gravity flow, and does not require pumping as compared to the State Water Project water. Los Angeles Aqueduct water requires no energy for delivery and generates hydroelectric power as it travels from the eastern Sierra Nevada to Los Angeles.

49. **Comment:** What is LADWP doing to install individual meters for multi-family residences?

    **Response:** LADWP supports efforts to encourage individual meters in new multi-family construction. Studies show that customers who pay individual water bills use water more efficiently.

50. **Comment:** When will electronic meters be used?

    **Response:** LADWP continues to investigate so-called smart water meters and at this time we do not have an estimate when they will begin to be introduced. Smart water meters allow for more frequent readings and can provide useful water information such as leak detection.

51. **Comment:** What is the current status of the Palos Verdes Reservoir in San Pedro? Is it empty?

    **Response:** The Palos Verdes Reservoir is owned and operated by MWD. It is in service, but looks empty since a floating cover is installed. This floating cover is one option that we are investigating for some of our own open reservoirs to meet water quality regulations.

52. **Comment:** Is most of the infrastructure work being done going to be performed by LADWP employees or will any of the work be contracted out?

    **Response:** Major water quality improvement projects, such as reservoir covers will be contracted out. Small diameter pipe replacement is performed by LADWP personnel. For large diameter pipelines, it is estimated that approximately half will be contracted out and half performed by LADWP personnel.

# WRITTEN PUBLIC COMMENTS

Following are responses to written correspondences (attached) from Accurate WeatherSet, S.Schron, Edward Saltzberg & Associates Forensic Mechanical Engineers, David Coffin, Phoenix, Aquacell, Heal the Bay, Joyce Dillard, Elmco/Duddy, Environmental Now, TreePeople, and Southern California Watershed Alliance on the City of Los Angeles Draft 2010 Urban Water Management Plan (UWMP).

## Responses to Written Questions

**Heal the Bay, 3/15/11**

**Question:** Why have water recycling goals decreased from the original target?

**Response:** Recycled water projections in the UWMP reflect what can be achieved with the existing amount of annual revenue. Receipt of federal or state grants will allow projections to be increased.

**Question:** LADWP should prioritize stormwater capture projects and set goals for new stormwater capture projects in Los Angeles. When will the Stormwater Capture Master Plan be completed?

**Response:** The Stormwater Capture Master Plan will address these suggestions. It is projected that the Master Plan will be completed by the fall of 2013.

**Joyce Dillard, 3/15/11**

**Question:** You conclude that outdoor water use is estimated at 39% of demand, but the water demand data in Exhibit 2C does not indicate a reason to come to that conclusion.

**Response:** The projection of outdoor water use is based on estimated water needs for landscape irrigation and an analysis of wastewater system flows compared to total water consumption. Section 2.1 of the UWMP discuss the analysis.

**Question:** What is the definition of non-revenue water use?

**Response:** Non-revenue water use is defined as the difference between the total water supplied to the City and total water sales. Non-revenue water consists of water for used for fire fighting, reservoir evaporation, pipeline leaks, meter errors, theft from hydrants, water used for street sweeping and pipeline flushing for water quality purposes.

**Environment Now, 3/15/11**

**Qustion:** Why has LADWP been behind on its water recycling targets compared to the original benchmark? Why have the water recycling goals decreased from the original target?

**Response:** The 2010 UWMP water recycling targets and current progress reflect the current level of revenue. Based on current levels of revenue, LADWP projects they can meet the current water recycling goals. If LADWP is successful in acquiring additional grants, then goals may be increased.

**TreePeople, 3/15/11**

**Question:** Page 11-8, Exhibit 11E: Note 1 indicates a loss in the LA Aqueduct at 0.1652% per year due to climate change. There is no indication of loss from MWD (California Aqueduct, and Colorado River Aqueducts) due to climate change. Does this account for MWD's projections?

**Response:** MWD's recently adopted 2010 Regional Urban Water Management Plan (RUWMP) and their 2010 Integrated Resources Plan (IRP) documents discuss in detail the potential impacts to supplies to the California and

Colorado River Aqueducts due to climate change. LADWP's draft 2010 Urban Water Management Plan (UWMP) makes references to these to MWD documents.

Although MWD's State Water Project (SWP) contract entitlement is 1,911 thousand acre-feet (TAF), projected SWP water deliveries to MWD are expected to be much less than their full entitlement due to many factors. The State's Department of Water Resources (DWR) issued the 2009 draft Reliability Report which identified climate change as one of the significant factors that could reduce future SWP water deliveries. MWD used the DWR's 2009 Reliability Report in reporting its SWP supply projections in its RUWMP, which was the source document for MWD SWP supplies as reported in the LADWP's 2010 UWMP.

The impacts of climate change is also projected to reduce Colorado River supplies, however, it's not expected to impact California as the state has senior water rights on the use of Colorado River water. Under the Seven Party Agreement of 1931 that divided California's share of the Colorado River supplies among the seven major water uses in the state, MWD's full Priority 4 Apportionment of Colorado River water has been consistently delivered and can reasonably be expected to be available in the future as indicated in their RUWMP. This is due in part to the fact that MWD's allocation of Colorado River holds a senior priority right to both Nevada and Arizona. In effect this means that any shortages on the Colorado River from climate change or other causes up to 1 million acre-feet will be born first by Arizona and Nevada before MWD is impacted.

Please note that MWD's SWP and Colorado River supply projections in their RUWMP indicate no reductions in deliveries even during extended dry periods because MWD has made numerous investments in other water supply and storage programs on the Colorado River, which are in addition to MWD's projected base apportionment and entitlement deliveries. MWD's 2010 IRP also establishes goals for a range of potential "buffer" supplies, up to approximately 500,000 acre-feet, to protect the region from possible shortages due to potential climate change and other impacts to its supplies.

**Southern California Watershed Alliance (3/28/11)**

**Question:** Regarding Exhibits 2I, 2J, and 2K. While projection of conservation savings go up, the demand seems to rise gradually until 2035. If you take the historic savings in the last few years and combine that with future investments why would demand continue to rise?

**Response:** Exhibit 2I was found to contain some errors and has been corrected and updated. It now shows that per capita water use consistently decreases. Though per capita water use decreases due to increased conservation efforts, demand will continue to increase in the future due to projected economic growth and population increases.

**Question:** Why, on page 3-5, did you choose Method 3 for reporting, when you are already at 19% conservation? If the current gallons per capita per day is 124, by taking this approach you are actually looking at a higher per capita into the future.

**Response:** LADWP reviewed all four available methods for compliance with the State's 20 percent by 2020 water use efficiency mandate and selected Method 3 because it is the most straightforward calculation method which also accounts for the City's past conservation investments.

## Responses to Written Comments

**Edward Saltzberg & Associates Forensic Mechanical Engineers, 2/28/11**

**Comment:** Have a list of abbreviations on a page that readers can refer to if they are not conversant with all of the acronyms. In the written material, spell out what an abbreviation stands for when it's first used in a section.

**Response:** LADWP has created a Glossary of Abbreviations and Terms which is included in the final 2010 UWMP, and reviewed the UWMP to spell out abbreviations when first used.

**Heal the Bay, 3/15/11**

**Comment:** LADWP should investigate reclaimed water purification as a water supply alternative in the future. LADWP should explore advanced wastewater treatment for future indirect or even direct potable use before exploring seawater desalination as an option for water supply.

**Response:** The UWMP outlines plans for groundwater replenishment of advanced treated recycled water in the San Fernando Valley. The current Recycled Water Master Plan is reviewing the long-term potential of advanced treated water from the Hyperion Wastewater Treatment Plant for groundwater replenishment as well as potential direct potable use.

**Comment:** LADWP should provide further support for Los Angeles Unified School District (LAUSD) to achieve the goals set forth in the LAUSD Water Savings Resolution. In addition to providing financial incentives for retrofits and for new zero-water urinal and high efficiency toilets used in a new construction project, LADWP should provide incentives for new fixtures in redevelopment and retrofit projects as well. In addition to these rebates, LADWP should consider expanding the purple pipe system to LAUSD schools.

**Response:** LADWP does provide conservation rebates and incentives for redevelopment and retrofit projects, in fact, these rebate amounts are significantly more than those for new construction. Some LAUSD schools are currently receiving recycled water. The Recycled Water Master Plan will identify expansion of purple pipe projects to reach additional schools.

**Mr. David Coffin, 3/7/11**

**Comment:** Water supply projections published in previous UWMP's between 1990 and 2005 have been much higher than actual water supply.

**Response:** It is true that previous UWMP water supply projections turned out to be higher than actual demands. However, it is important to point out that projections of supply reflect what can be produced and delivered if necessary to meet projected demands. If actual demands do not materialize at projected levels, then less supply is produced and delivered to meet those demands.

In previous UWMP's, LADWP anticipated that demands would gradually increase over time. This has not been the case for several reasons. The City has been successful in implementing one of the country's most aggressive water conservation programs. Additionally, demand forecasts could not foresee events such as economic recession, environmental and regulatory restrictions on Delta exports, and the recent multiple dry year conditions throughout California and the Southwest. All of these factors have lead to changes in customer water use behavior resulting in both increased water use efficiency and decreased demands.

The net effect of these changes were that LADWP produced and purchased less water to meet actual demands than was envisioned in previous UWMP's between 1990 and 2005.

**Comment:** UWMP's between 1990 and 2005 seriously miscalculated future groundwater supply projections.

**Response:** We agree that previous UWMP's contained groundwater projections that were significantly higher than the actual groundwater yield. There are several reasons for this over projection. For instance, previous UWMP's groundwater projections envisioned groundwater replenishment with recycled water which would increase groundwater yield. However, previous plans to replenish the groundwater basin with recycled water were halted following public opposition.

In addition, starting in the mid 1980's, LADWP significantly decreased groundwater pumping in order to minimize the migration of a contamination plume toward active wells in the San Fernando Groundwater Basin (SFB). Contamination issues in the SFB continue to adversely affect groundwater pumping. To restore LADWP's full groundwater pumping rights in the SFB, the 2010 UWMP incorporates plans for construction of groundwater contamination treatment facilities. Additionally, the 2010 UWMP includes increases in groundwater pumping due to groundwater replenishment with advanced treated recycled water as well as increased stormwater capture.

**Comment:** Water Supply Assessments should cite the UWMP and not the City's General Plan when assessing the proposed water demand for a project.

**Response:** LADWP does cite the UWMP in water supply assessments in accordance with Water Code Section 10910.

UWMP Section 11.4 Water Supply Assessments states that LADWP's UWMP uses anticipated growth as provided by demographic projections from Southern California of Governments (SCAG) data, re-allocated by MWD into LADWP's service area. The City's General Plan uses population forecasts as provided by SCAG data as well; therefore, the UWMP projections are consistent with the City's General Plan as both use SCAG projections as their basis.

In preparing water supply assessments, LADWP works with the Planning Department to confirm that all proposed projects conform to the City's General Plan.

**Comment:** The City's allocation of water from the Metropolitan Water District is based on property tax assessments and the value of the investments it has made with MWD infrastructure projects.

**Response:** The City's preferential rights to purchase water from MWD, as defined in Section 135 of the MWD Act, was not included in the development of MWD's Water Supply Allocation Plan (WSAP). While it is correct that the City may have this entitlement, no member agency, including the City, has historically ever invoked this entitlement during an allocation of water by MWD.

The WSAP is discussed in the UWMP, Section 11.2.6, entitled "MWD Imported Supplies". LADWP, along with other member agencies, worked collaboratively with MWD in developing the WSAP to equitably allocate water supplies during periods of a regional shortage by taking into account many factors including demands, growth, local investments, changes in supply conditions, and water conservation programs. Preferential entitlement was not a factor in developing the WSAP, which is fundamentally a needs-based allocation plan.

**Joyce Dillard, 3/15/11**

**Comment:** 2035 water demand projections for most customer service sectors exceed the 2005-2010 average water usage. You need to compare the projections with baseline per capita use to see if 20 percent by 2020 compliance can be obtained.

**Response:** Although water use in some customer sectors is projected in to increase, expanded water conservation and water recycling will offset this increase water use. LADWP projects we will be in compliance with 20 by 2020 requirements.

**Comment:** Recycled water cannot be sold to water down dust on horse ranches, yet you consider irrigation usage.

**Response:** The California Department of Public Health and Los Angeles Regional Water Quality Control Board recently provided approval for use of recycled water for dust control subject to certain conditions. LADWP recycled water staff will be working with interested customers to comply with the new regulations so recycled water use can be expanded.

**Comment:** Non-adjudicated groundwater basins such as the Santa Monica Basin and the Hollywood Basin are not addressed.

**Response:** Chapter 6 of the UWMP was amended to mention these unadjudicated basins, and LADWP's plans to revisit previous studies to determine the current potential for expanded groundwater supplies.

**TreePeople, 3/15/11**

**Comment:** Page 2-9 Exhibit 2I – Although we applaud LADWP's leadership in water conservation, we believe much greater water savings can be obtained and will be necessary to meet future local water needs. We believe that LADWP should continue to lead by setting conservation targets that well exceed the minimum 20 x 2020 state mandated goals. Exhibit 2I appears to assume no new innovation or transformation will take place beyond 2015.

**Response:** Exhibit 2I was based on a preliminary demand forecast model and contained erroneous data. It has now been corrected and updated.

**Comment:** Page 3-26: Identify next steps necessary for incorporating graywater systems into LADWP conservation programs.

**Response:** The section on graywater in Chapter 3 was amended to state that LADWP is reviewing the concept of assisting in the creation of ad hoc committees to develop a standard for graywater systems.

**Comment:** Page 7-10 references "Exhibit 7D" which "summarizes the potential water yield and average unit cost of the different resources available to increase localized capture and infiltration of runoff" is missing from the document, or is this referencing the cost table "Exhibit 7H"?

**Response:** The exhibit reference was corrected. Also, Exhibit 7H has now been revised to Exhibit 7G.

**Comment:** Page 7-17 and Exhibit 7H: Update cost table with new figures.

**Response:** Updates have been incorporated into the final 2010 UWMP. Exhibit 7H has been renamed to Exhibit 7G.

**Comment:** Replace "drought tolerant" with "climate appropriate" throughout the document. Climate appropriate is becoming the more accepted description for landscape transformation.

**Response:** This change has been made throughout the final 2010 UWMP.

**Comment:** Page 7-22, Section 7.6.5 Future Distributed Stormwater Programs: Add rain gardens to the list of potential rebates (TreePeople is beginning a pilot rain garden rebate program with the Watershed Management Group).

**Response:** A reference to rain gardens have been added to section 7.6.5.

**Comment:** Page 7-24 (revise language): "Furthermore, distributed stormwater capture projects yield additional benefits to the public outside of water supply generation such as flood control, restored native habitat, community beautification, public right of way improvements, water conservation, as well as private residence safety and aesthetic improvements."

**Response:** This suggested change has been made.

**Comment:** Chapter 7 General: Revisit the projected stormwater capture estimates as the Stormwater Capture Master Plan is finalized and projects come online. We believe that more than 25,000 acre feet per year can be captured by 2035.

**Response:** The Stormwater Capture Master Plan will comprehensively evaluate stormwater capture potential within the City. Once the Master Plan is complete, LADWP will be able to reevaluate its future stormwater capture goals.

**Comment:** Chapter 11, Exhibits 11E to 11L: Targets for stormwater capture stay consistent at 25,000 AF for both dry and normal years.

**Response:** The 15,000 AFY of increased groundwater production due to stormwater capture is anticipated to be available in every year. The 10,000 AFY of increased conservation due to stormwater capture and reuse will need further analysis in the Stormwater Capture Master Plan.

**Southern California Watershed Alliance, 3/28/11**

**Comment:** Given that the UWMP does not include desalination as a projected supply, the historical list of past planning on the issue is confusing and leads one to believe that there are plans to move forward.

**Response:** At this time LADWP has no plans to pursue ocean desalination as a supply.

FROM: Andrew Davis
Accurate WeatherSet

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Simon,

In the DRAFT 2010 URBAN WATER MANAGEMENT PLAN, I see page 11-15 section 4 (1) that it states

(1) must have approved weather-based irrigation controllers registered with LADWP (eligible weather- based irrigation controllers are those approved by MWD or the Irrigation Association Smart Water Application Technologies (SWAT) initiative

MWD uses only controller that passed the SWAT testing. So the statement of "approved by MWD or the Irrigation Association Smart Water Application Technologies (SWAT) initiative are equivalent.

SWAT testing a is bad requirement. SWAT testing is meaningless because:
1) SWAT testing is done in laboratory under highly technical conditions and not in the field with homeowners and contractors;
2) SWAT tests only one controller from each manufacturer which is programmed by the technical staff of the manufacturer;
3) test results cover only 30 days;
4) manufacturers may suppress bad results, pay another $3500 testing fee, reprogram their controller and resubmit for another test until the manufacturers get the results that they want.

Below are the published results from SWAT laboratory testing. All ten controllers scored identically on Irrigation Adequacy. All ten controllers scored nearly identically on Irrigation Excess. These nearly identical results were achieved even though their technologies differ widely. From these nearly identical SWAT results, you would expect all controllers to deliver the same water savings.

The results of SWAT testing by some manufacturers have varied over the years as manufactures have suppressed unfavorable results. These manufacturers have reprogrammed and resubmitted their controller for SWAT testing until they get nearly perfect results. Such tests are rigged by manufacturers and meaningless when measuring water conservation in the hands of homeowners and contractors in the field. Because of these flaws, Accurate WeatherSet has NOT submitted its controllers for testing at SWAT.

While SWAT testing "proves" that all controllers are nearly identical, field tests show that is NOT true.The most meaningful test of weather-based irrigation controllers in the field is the 309-page report submitted by MWD and EBMUD to Cal DWR. That engineering field-study was performed by Aquacraft and can be downloaded at http://www.aquacraft.com/Download_Reports/Evaluation_of_California_Smart_Controller_Programs_-_Final_Report.pdf

This most significant table in that 309-page, multi-year report of 1,000s of controllers shows water savings by manufacturer. Note the we, Accurate WeatherSet, saved MUCH MORE water than any of the other controllers AND our water saving ARE STATISTICALLY SIGNIFICANT and we have the lowest retail price. Look at column labeled **Avg.%Change in Outdoor Use for** water savings that are very different from SWAT testing.
This report shows that Accurate WeatherSet is the lowest cost (see Retail Price column) with the HIGHEST WATER SAVINGS (see **Avg.%Change in Outdoor Use**). Lowest cost with greatest water savings should be highest on your list of controllers to include and is another reason the use 309-page report and reject SWAT testing as your criteria. By achieving 33% outdoor water savings, our controller by itself can reduce water consumption nearly 20% water since 60% to 70% of all water that goes thru a residential meter is used on lawns. This is another reason to include our controller in LA's URBAN WATER MANAGEMENT PLAN.

Please note that the **95% Conf Interval**. Since standard deviation in the chart above was greater than the water savings for most controllers, most controllers did NOT save significant water. This report covers nearly 600 controllers installed in LADWP's service area (see Table ES.3) on page xix. One hundred of the controllers were from Accurate WeatherSet. So the water savings of ALL controllers was not statistically significant because our statistically significant water savings of our controllers was buried by the wide variation in water savings/excess of the other manufacturers.

This 309-page report contains the result of 1,000s of controllers, purchased, installed and programmed by homeowners and contractors. This is real-world testing, not testing in for 30 days in the a laboratory.

This report show the real results that you will have from weather-based irrigation controllers when purchased, installed and programmed by homeowners and contractors and should be used for LA's URBAN WATER MANAGEMENT PLAN to assure success.

Search thru the 309 page report for "SWAT" and see that the report also states that SWAT testing is not designed to measure water conservation.

If you use the 309-page, multi-year field report instead of SWAT testing, you will include my company. A happy feature of including us in your approved list of weather-based irrigation controllers is that you will include/help a company located in the City of Los Angeles in the neighborhood called Winnetka in the west San Fernando Valley. I understand that city agencies are dedicated to encouraging businesses to stay in LA.

Also, I suggest that you talk to Al Pinnaro in LA City Parks & Rec. Last year, he completed a 5-year field study of all the weather-based irrigation controllers and found  MANY problems, except with ours. He has ordered controllers from us for installation in LA City parks. You may reach him at 213-216-7351. If you want to give irrigation problems to LA residences and business, then ignore Al Pinnaro and use the SWAT laboratory results. If you want to give well-tested controllers, the listen to Pinnaor's experience over 5 years and eliminate some of the controllers based on his experience AND include us.

LA and California have led the country in science-based standards. Science-based water conservation is the next challenge. Please use the  309 page report and the experience of Al Pinnaro to determine which controllers to include in LA's URBAN WATER MANAGEMENT PLAN.

Will there be anymore public meetings?

Andrew Davis

**From:** ****@***.com

**Sent:** Sunday, January 30, 2011 10:30 AM

**To:** Hsu, Chiun-Gwo (Simon)

**Subject:** COMMENT/SUGGESTION

Evaporation of water from swimming pools during the summer time can be greatly reduced with the use of pool covers/blankets. I would like the DWP to offer some sort of REBATE for homeowners who invest in
pool covers/blankets. thank you, S. Schron

**Edward Saltzberg & Associates**
**Forensic Mechanical Engineers**
14733 Oxnard Street
Van Nuys, California 91411
818.994.2613
Fax.818.782.7792
Ed@ESaltzberg.com

February 28, 2011

LADWP-Water System

111 North Hope Street, Room #1460

Los Angeles, California 90012

Attn: Simon Hsu

RE: Urban Water management Plan

Dear Mr. Hsu:

I thought the publication of the water management plan was very good. However, I have a few suggestions to make it better.

1. Have a list of abbreviations on a page that readers can refer to if they are not conversant with all of the acronyms.

2. In the written material spelled out what an abbreviation stands for when its first used in a section.

3. Make sure that all graphs and charts are properly labeled as to what the units of the chart are. For example exh. 5B, are the units on the left acre feet? There are a few others where the units are not labeled or the title of the chart or graph does not clarify what the chart or graph represents.

I hope that these suggestions help improve the management plan.

Very truly yours,

Edward Saltzberg & Associates

Edward Saltzberg PE, CPD, FASPE

Pres.

# COMMENTS TO THE LOS ANGELES DEPARTMENT OF WATER AND POWER 2010 DRAFT URBAN WATER MANAGEMENT PLAN

March 7, 2011

Simon Hsu
Los Angeles Department of Water and Power
111 N. Hope St., Room 1460
Los Angeles, CA 90012

Thank you for the opportunity to comment on the LADWP draft 2010 Urban Water Management Plan ("UWMP" or "water plan").

Missing from past water plans published from 1990 through today has been a review of past water plans. Deliberation and adoption of a new water plan should be done with an understanding of how well the city has met stated goals in previous plans. Did they meet their targets and goals? Did they fall short? What lessons have been learned? Will the 2010 UWMP follow the same pattern as water plans before it?

Sections 1 and 2 provide an overview of the past water projections and how well the city met those projections.

1. **PROJECTED VERSUS ACTUAL WATER SUPPLY - A REVIEW OF PAST WATER PLANS**
   a. Water plans published between 1990 and 2005 seriously miscalculated future water supply projections (Figure 1). In one example the 1990 UWMP overstated the 2010 water supply projection by 41 percent.
   b. In every projection cited by UWMP's published between 1990 and 2010, records show that that the city's actual supply failed to meet expectations by a large amount.
   c. UWMP's routinely cited water supplies over 700,000 AF and as much as 799,000 AF, yet records show the city has never received more than 699,000 AF of water since 1986.

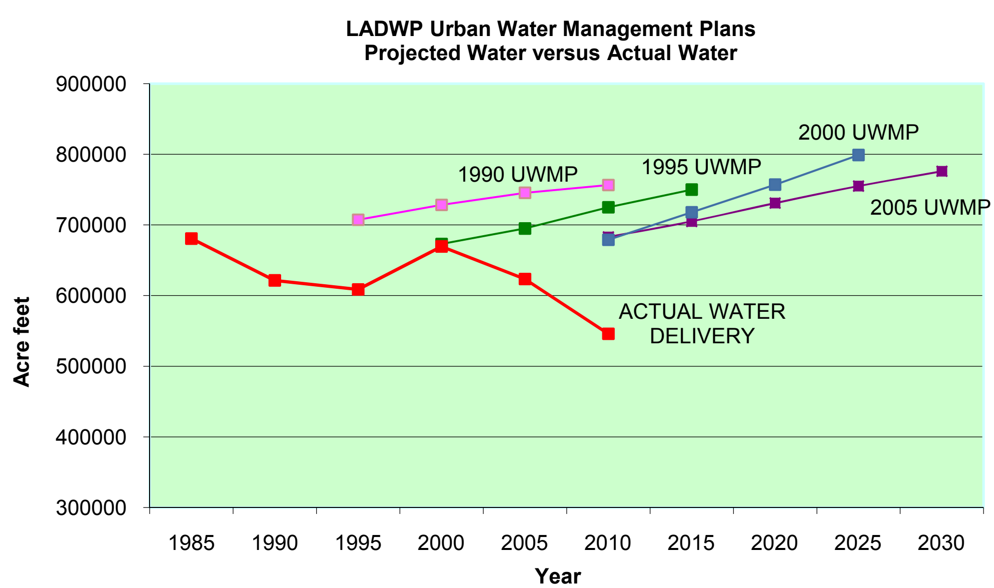


*Figure 1 – This chart plots the overstated projections of the past four urban water management plans (1990 through 2005) and compares them with actual water amount received by the LADWP. The 1990 UWMP over-projected water supply by 41 percent for 2010, enough for 146,000 single family housing units.*

Given the failure to meet nearly every past projection since 1990, At what point should UWMP's stop projecting supplies in excess of 700,000 AF when it is an historical fact that the DWP has never been able break through that level?

Twenty years of seriously overstated projections have lead city officials to believe that sufficient water supplies existed when they were faced with assessing infrastructure impacts of large developments seeking city permits. A total of 65 major projects were approved using the projected figures in the 2000 and 2005 UWMP. Records show that not one of the water supply projections used by these assessments were ever met by the city. The approvals of such projects and subsequent failure to meet these projections have led to water supply shortfalls and today's permanent drought conditions in the area served by LADWP.

2. **PROJECTED VERSUS ACTUAL GROUND WATER SUPPLY - A REVIEW OF PAST WATER PLANS**
   a. Water plans between 1990 and 2005 seriously miscalculated future groundwater supply projections. In some years as high as 195 percent. (See Figure 2)
   b. The city has not met groundwater supply projections anytime in water plans between 1990 and 2010.
   c. All water plans from 1990 through 2010 routinely projected groundwater pumping well above 100,000 AF annually though the actual amount received annually between 1990 and 2010 averaged just 83,582 AF.
   d. The 1995 UWMP over-projected groundwater pumping for 2005 by 178%. Likewise, the 2000 water plan overstated the 2005 projection by 195%.

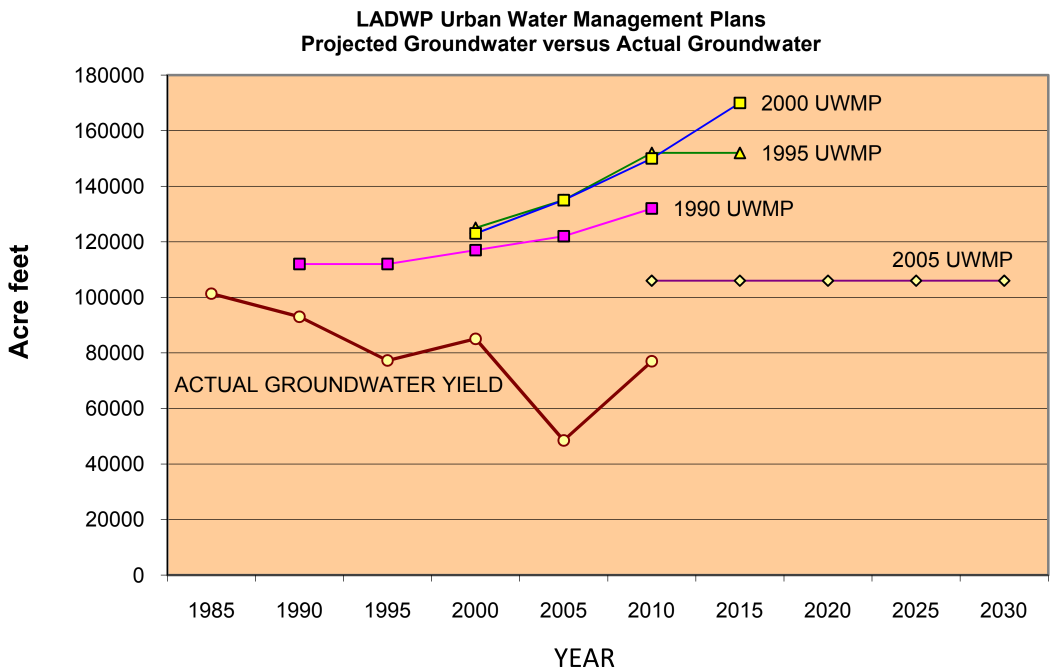


*Figure 2 – This chart summarizes the groundwater projections from the past four urban water management plans (1990 through 2005) and compares them with actual groundwater pumped by the LADWP. The 1990 UWMP over-projected water supply by 51 percent for 2010, enough for 150,000 single family housing units.*

3. **WATER SUPPLY ASSESSMENTS (Sec 11.4) – A SERIOUS DEPARTURE FROM THE PAST**
   a. The 2010 draft urban water management plan cites that *"If the land use of the proposed development is consistent with the City's General Plan, the projected water demand of the development is considered to be accounted for in the most recently adopted UWMP."*

   In this section the 2010 draft UWMP is inconsistent with Section 10910 (c)(1), (2) & (3) of the California Water Code. Section 10910 requires a city or county to cite the "most recently adopted urban water management plan”, not the General Plan as stated above when assessing the proposed water demand of a project.

> ***Section 10910****(c)*
> *(1) The city or county, at the time it makes the determination required under Section 21080.1 of the Public Resources Code, shall request each public water system identified pursuant to subdivision (b) to determine whether the projected water demand associated with a proposed project was included as part of the* ***most recently adopted urban water management plan*** *adopted pursuant to Part 2.6 (commencing with Section* ***10610****).*
> *(2) If the projected water demand associated with the proposed project was accounted for* ***in the most recently adopted urban water management plan,*** *the public water system may incorporate the requested information* ***from the urban water management plan*** *in preparing the elements of the assessment required to comply with subdivisions (d), (e), (f), and (g).*
> *(3)* ***If the projected water demand associated with the proposed project was not accounted for in the most recently adopted urban water management plan****, or the public water system has no urban water management plan, the water supply assessment for the project shall include a discussion with regard to whether the public water system's total projected water supplies available during normal, single dry, and multiple dry water years during a 20-year projection will meet the projected water demand associated with the proposed project, in addition to the public water system's existing and planned future uses, including agricultural and manufacturing uses.*

This section in the 2010 UWMP is a serious departure of past water assessments (See figure 3). If left in place, all new water supply assessments performed over the next five years (or until a new general plan is adopted) will be referencing a water plan that is no longer the most recent plan, and a plan that seriously overstates the city’s water supply.

**Findings**

The proposed Bundy Village and Medical Park Draft Project is estimated to increase water demand within the site by 170 acre-feet annually based on review of information submitted by the City Planning Department.

The 170 acre-feet increase falls within the available and projected water supplies for normal, single-dry, and multiple-dry years through the year 2030 as described in LADWP's year 2005 UWMP. LADWP finds that it will be able to meet the water demand of the Bundy Village and Medical Park Draft Project as well as existing and planned future water demands of its service area.

*Figure 3 – Typical finding found in water assessments for developments within the LADWP service area.*

b. The 2010 draft states that “The water demand forecast model in the UWMP was developed using LADWP total water use, including the water served by LADWP for use outside of the City.“

Given that demand has exceeded supply since the 1985 UWMP, the ‘demand forecast’ is no longer a useful model since it encourages drought conditions. The demand is based on population projections provided by the Southern California Association of Governments (SCAG) that encourage growth with reckless disregard to water supply. This model should be replaced with an annual water ‘supply forecast’ model that manages growth to avoid costly and damaging droughts.

**4. METROPOLITAN WATER DISTRICT (MWD)**

*a.* The 2010 LADWP UWMP notes that *“An important part of the water planning process is for LADWP to work collaboratively with MWD to ensure that anticipated water demands are incorporated into MWD’s long-term water resources development plan and water supply allocation plan. The City’s allotment of MWD water supplies under MWD’s water supply allocation plan is based on the City’s total water demand which includes services to areas outside the City.”*

The City's allotment of MWD water is not based on the city's total water demand but instead on property tax assessments and the value of the investments it has with MWD infrastructure projects. Combined, those investments have earned LADWP the rights to about 20.8 percent of MWD water. The rest is split up among the MWD's twenty-five other member agencies.

The City's full contractual allotment of water from MWD would be approximately 511,000 AF of water annually which is about 20.8 percent of MWD's total annual inventory[1].

However, the city's water annual allocation has been substantially limited because of *a)* legal restrictions caused by environmental over-commitment (damage caused to other regions of the state)[2], *b)* the rights of other member agencies, agricultural interests, and the rights of other states[3].

In 2007 the city received approximately 421,000 AF of water and in 2010 the city received only 262,538 despite increased demands.

David Coffin
8430 Truxton Ave.
Westchester, CA 90045

[1] Includes 1.91 million AF from State Water Project and 550,000 AF of Colorado River Aqueduct

[2] Sacramento Delta restrictions (Wanger 2007); LA/Inyo Long Term Water Agreement; State Water Resources Control Board issues decision 1631; 1997 LORP MOU Provisions.

[3] Sacramento Delta restrictions (Wanger 2007) and State of Arizona v. State of California 2006 Consolidated Decree.

March 9, 2011

Mr. Ronald Nichols
General Manager and Chief Engineer
Los Angeles Department of Water and Power
111 North Hope Street, Room 1550
Los Angeles, CA 90012

Dear Mr. Nichols:

Decentralized greywater and blackwater recycling have made a significant impact on the water supply in Sydney, Australia. Sydney Water, in collaboration with the state of New South Wales, has defined a goal to recycle 18 billion gallons of water per year by 2015 in the greater Sydney area. As of today, 78 greywater and blackwater projects are recycling and saving 8 billion gallons a year. Aside from the water savings, imagine the implications on the city's water and sewer systems – nothing short of dramatic.

The key ingredient to the progress in Sydney is the broad scale effort by Sydney Water. The utility recognized the potential for onsite greywater and blackwater recycling and has not only embraced, but encouraged the practice. Instead of leaving the green building movement to initiate comprehensive water conservation, Sydney Water decided to address water conservation at the source – their organization. Sydney Water understands they cannot do it alone and that promoting private decentralized recycling will make a more immediate impact on the water supply. I believe Los Angeles has the potential to make a similar impact with greywater and blackwater recycling – an impact that would serve current and future generations.

Upon reading the 2010 Los Angeles Urban Water Management Plan I find that it improperly addresses the potential for greywater and blackwater recycling. These topics should be a priority for the LADWP and I write this letter to ask that the Plan be revised to include funding dollars towards greywater and blackwater onsite reuse programs.

I also support the creation of ad hoc committees made up of manufacturers, consultants, engineers and experts in the field of onsite water recycling to begin work towards developing a standard for greywater and blackwater recycling in Los Angeles. Regulators and policymakers need to discuss and understand the benefits and challenges associated to implementing these solutions. For instance, where can this non-potable effluent make the most impact on water demands? Cooling towers, surface irrigation and toilet flushing are typically the heaviest water users and this is where the technology should be applied. Officials will also need to address the risks associated with onsite water recycling and this is where my firm can add significant value to the conversation.

My company, PHOENIX Process Equipment Co, has partnered with Aquacell, an industry leader in onsite water recycling in Australia, to usher in a safe and reliable solution for water recycling in the United States. Based on an integrated approach which includes consulting, installation, project management and operations of greywater and blackwater systems, Aquacell has a remarkable track record and serves as a great example how to properly implement this practice. Aquacell's success illustrates that if employed with care and risk management in mind, onsite water recycling can be safe and effective – all while providing the inhabitants of the building something to be proud of. I should also testify that as of today, Aquacell has no reported health incidents as a result of their systems.

I hope you will consider the accounts outlined above as an impetus to engage greywater and blackwater recycling more seriously at LADWP. Please let me know if I can be of any service to LADWP as you begin to research and adopt this practice. PHOENIX and Aquacell would be delighted to partner and/or assist LADWP at any level deemed appropriate.

Sincerely,

Mark Meredith
Product Manager, Aquacell

cc:
James McDaniel
Simon Hsu

aquacell
water recycling solutions

14 March 2011

Mr. Ronald Nichols
General Manager and Chief Engineer
Los Angeles Department of Water and Power
111 North Hope Street, Room 1550
Los Angeles, CA 90012

**Re: 2010 LA Urban Water Management Plan**

Dear Mr. Nichols,

I have read the 2010 Los Angeles Urban Water Management Plan and I believe it should be a priority to allocate more funding dollars towards greywater and blackwater onsite reuse programs in the plan. As green building initiatives such as LEED drive the building movement towards a more sustainable built environment, I believe LADWP has an opportunity to play a critical role in building a sustainable Los Angeles. By developing policies and a framework for onsite greywater and blackwater recycling, LADWP can take ownership of this significant water conservation measure and promote the use of these technologies to make a remarkable impact on the region's water supplies. A water crisis in Los Angeles will ultimately fall on the shoulders of LADWP, therefore I believe it is in the organization's best interest to promote water conservation measures such as onsite recycling to mitigate risks.

I support the creation of ad hoc committees made up of manufacturers, consultants, engineers and experts in the field of onsite water recycling to discuss the parameters and scope for developing a standard for greywater and blackwater recycling in Los Angeles.

My company, Aquacell, builds and operates water recycling plants for business, industry and government. Our focus is on non-potable (non-drinking) water for use in a variety of applications including surface irrigation, cooling tower makeup, clothes washing and toilet flushing. Aquacell's plants recycle greywater which is water discharged from showers, baths, basins and washing machines; and blackwater which is any water that has been contaminated with water discharged from a toilet.

Aquacell takes an integrated approach to water recycling plants including consulting, installation and project management for commercial and new residential developments. It also offers ongoing operations and maintenance agreements.

Aquacell staff has many years experience in the water industry and are very knowledgeable about each Australian state and territory's regulatory requirements. Our experience in Australia is that a properly structured regulatory framework can safely ensure decentralised recycled water systems, such as those we install in buildings and neighbourhoods can contribute in a major way to saving water and reducing hydraulic loading on water and sewer systems.

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With such a depth of knowledge and successful track record implementing onsite water recycling, Aquacell would be eager to partner with LADWP and contribute to the development of a viable approach to recycling water in Los Angeles.

Yours sincerely,

Colin Fisher
Managing Director

cc:
James McDaniel
Simon Hsu

14th March 2011

Mr. Ron Nichols
General Manager & Chief Engineer
Los Angeles Department of Water and Power
111 North Hope Street, Room 1550
Los Angeles, CA 90012

Dear Mr Nichols,

**RE: 2010 LA URBAN WATER MANAGEMENT PLAN**

I understand from reading the 2010 Los Angeles Urban Water Management Plan (LAUWMP) that the City of LA wants to establish a Water Management Framework that aims to reduce overall water demands for the city and improve Water Security. Obviously this will be a multi-prong approach given that water is primarily sourced from Los Angeles aqueducts, groundwater, and is imported with supplemental water purchases from MWD. We understand that Recycle water currently only contributes <1% of the total water supply.

The LAUWMP appears to look at Water Conservation mainly through pricing incentive schemes, improved water efficiency fixtures, and domestic graywater reuse, but hasn't realised the full potential that decentralised commercial graywater and blackwater systems can contribute to the City of LA's water management objectives.

Despite large scale recycling schemes being in place in LA since 1979 (when water was delivered to the Department of Recreation and Parks for irrigation of areas in Griffith), such centralised reuse schemes are limited to where they can be utilised by physical infrastructure constraints. Centralised systems typically only benefit very large scale water users (e.g. golf course, freeway irrigation), and then only those users who are also located directly next to where the distribution piping is built. Whilst significantly contributing to the city's overall Water security, developments that are located outside of the central recycled water distribution network are precluded from accessing the water saving benefits that a centralised reuse scheme provides.

Medium scale decentralised Plants (e.g. 15,000 – 100,000 gallons / day Plants) have an opportunity to afford a high level of flexibility to implement reuse schemes across a wider area of LA City than what current or future centralised systems offers, whilst being large enough to meet the costs associated with maintaining and demonstrating that public health risks are appropriately managed. Broadly speaking, decentralised graywater systems that manage the total water balance of a site can reduce on-site water demand/wastewater production by 30-50%, and blackwater reuse system can reduce on-site water demand/wastewater production by 70-90%. Developments that currently have significant water demands either through surface irrigation (e.g. any development with a sports fields, city or precinct gardens) or cooling towers are major candidates for decentralised systems because of their localised high water demands.

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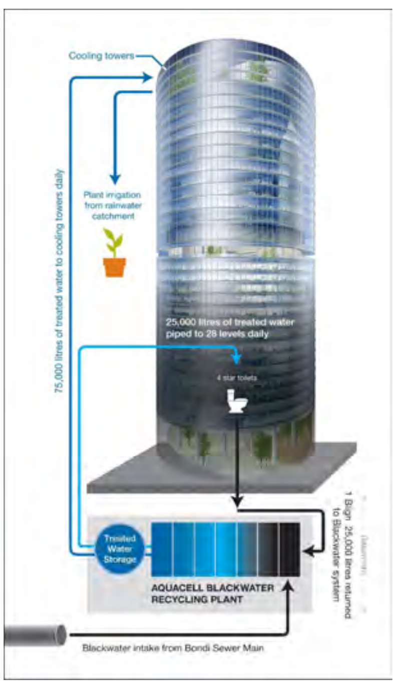
Aquacell is an Australian company that specialises in commercial graywater and blackwater reuse systems. We have both blackwater and greywater systems which have been operating for a number of years that can demonstrate what can be achieved. With more and more decentralised schemes coming on line in Australia, reuse ius becoming more widely accepted and consequently the interest is growing. The main project drivers why facilities look at decentralised reuse schemes cover a range of reasons, including: regulatory or development approval requirements, sourcing alternative water sources (e.g. to add to available water sources), green or environmental marketing, infrastructure solutions (either no sewer or sewer at limited capacity).

To demonstrate what can be done with decentralised schemes, I have attached an Aquacell case study of a 25,000 gallon a day blackwater reuse Plant that we have had operational for the last 5 years at a sports club in Western Sydney. The site treats blackwater generated from the site and uses it for surface irrigation of the sports fields. In addition to water saving measures, the site has also reduced fertiliser use by 30-50% due to the available nutrients in the effluent – another non-water environmental benefit. Note that nutrient removal can be done at other sites if required.

In addition to this, I show some schematically pictures below of a Blackwater to cooling tower system that Aquacell is in the final stages of project implementation – practical completion due May 2011. In this project, we are collecting 100% of the blackwater from a CBD building in Sydney (6,600 gal/day), plus drawing in an extra 25,000 gallon per day from the main Sydney sewer to reuse the effluent in the buildings cooling tower. Although technology for such schemes has existed for a number of years, the reason why this project can be considered in Sydney is because the regulatory framework is in place to allow it to legally occur.




We see that the key to tapping into the very significant potential that decentralised reuse Plants can offer, starts with the development of a LA city blueprint standard for graywater and blackwater reuse. It is important that this standard gets the right balance between protecting public health and also being commercially realistic. In Australia, Aquacell has seen a range of regulatory positions; some being too lax that let systems get through the cracks which perhaps havn't been fully scrutinised, while other regulations are driven too much by bureaucrats and academics and have subsequently imposed such unrealistic expectations on reuse systems that they become commercially inhibitive below any scheme less than 250,000 gallon per day. It therefore is important that when Standards for blackwater and graywater reuse are developed for LA City, they are done so by an ad hoc committee that is able to bring a range of expertise and perspectives to the table. This should not only include law makers, but also public health experts, commercial representatives that could benefit from implementing these systems (e.g. developers or facility owners), consultants and people with prior experience in operating decentralised reuse schemes.

I would be more than happy to share our experience in Australia with LA City to ensure that it steps forward with a pragmatic and protective Standard, which establishes a template for effectively and safely implementing reuse opportunities throughout the city of LA. Please don't hesitate to call or email if you require further information.

Sincerely

***Ian Kikkert***
*Business Development Engineer*
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*e) iank@aquacell.com.au*

Heal the Bay

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March 15, 2010

Attn: Simon Hsu
LADWP--Water System
111 N. Hope St. Room 1460
Los Angeles, CA 90012

**Re: Draft 2010 Urban Water Management Plan**

Dear Mr. Simon Hsu:

On behalf of Heal the Bay, we submit these comments regarding the City of Los Angeles Department of Water and Power Draft 2010 Urban Water Management Plan ("Plan" or "Draft UWMP"). We appreciate the opportunity to provide these comments.

There are many aspects of the Draft UWMP that we support. For instance, we agree with LADWP's prioritization of expanded water conservation and water recycling over the use of desalination to provide additional water supply. Heal the Bay supports the expansion of LADWP's recycled water system and the commitment to move towards a more sustainable water supply. However, we do have a few concerns with the Plan as drafted. LADWP should revert to a more ambitious goal for expanding recycled water use, provide additional support for stormwater capture, and investigate direct and indirect potable use of advanced treated water as a supply alternative. These and other concerns and suggestions are expressed below.

**LADWP should set more aggressive goals for water recycling.**

The goals the Draft UWMP sets for expanding recycled water use are not ambitious enough given the present condition of our current water supply and the available source water from POTWs. In fact, the goals provided are a major step backwards from previously set goals. The Draft UWMP states that LADWP has the goal of replacing 50,000 AFY of potable water with recycled water by 2029. When Heal the Bay began participation on the Recycled Water Advisory Task Force in 2009, the stated goal was "to produce 50,000 acre-feet of recycled water by 2019." Another stated action was to "pursue options to maximize recycling beyond 50,000 AFY." Of note, several members of RWAG held that we should look beyond this goal and increase the new recycling opportunities to 100,000 AFY by 2019. The revised goal stated in the Draft UWMP takes a major step backwards. Compounding this concern is the fact that LADWP has not met the goals set in the 2005 Urban Water Management Plan for recycled water usage, as noted in the Draft UWMP.

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LADWP should prioritize expanding demand and delivery of recycled water. The four major treatment plants operated by Los Angeles BOS produce enough treated water to allow for much more aggressive recycled water goals than are presented within this document. According to the draft, Los Angeles used approximately 550,000 acre-feet of water last year, and around half of that volume was imported through MWD (Draft UWMP Exhibit 1F). Los Angeles-Glendale, Donald C. Tillman, Terminal Island, and Hyperion Water Reclamation Plants combined produce an average of around 460,000 AFY. Utilizing recycled water in our region to the fullest extend could greatly reduce our reliance on imported water in Los Angeles. This is a crucial step toward a sustainable water future. It is critical that we use local reliable water, such as recycled water that would otherwise be discharged to the ocean, to offset the demand for imported water supplies as soon as possible. Thus, the Draft UWMP should be modified to, at a minimum, return to the more ambitious goal of 50,000 AFY of new recycled water usage by 2019. We urge LADWP to look beyond this initial goal and plan for 100,000 AFY by 2019.

**LADWP should prioritize stormwater capture projects and set goals for new stormwater capture projects in Los Angeles.**

Stormwater must be used as a resource in order for Los Angeles to achieve a sustainable water supply. Using stormwater as a water source requires less energy and results in far fewer environmental impacts than many other sources of water such as desalination and water importation. Stormwater proves to be a much more sustainable, cost-effective local water resource than desalinated water, yet no incentives are provided in the Draft UWMP for its capture and use throughout the region. We strongly encourage LADWP to create a policy that provides economic incentives for stormwater recharge and reuse projects. Further, the Plan should establish a goal for increased stormwater capture in Los Angeles. At a minimum, LADWP should set a goal of an additional 50,000 AFY by 2020 for stormwater capture projects. The Tujunga Spreading Grounds alone currently capture 8,000 AFY, with plans to expand to 16,000 AFY and the potential to capture 50,000 AFY, so we believe this is a realistic goal.

There are also opportunities for stormwater capture at the individual lot scale. In Section 7.6 (Distributed Stormwater Capture), the Draft UWMP highlights that "Installation of rain barrels at residences throughout Los Angeles… could potentially capture 6,400 AFY…" As you know, the City of Los Angeles had a very successful rain barrel pilot project. This would be a great program for LADWP to help fund and take city-wide. We also urge LADWP's continued support for the Low Impact Development Ordinance, which the City of Los Angeles is in the process of adopting. This ordinance will go a long way in using stormwater as a resource.

The Draft UWMP mentions that LADWP is partnering with Los Angeles City Department of Public Works, Los Angeles County Department of Public Works, and Treepeople Inc. to draft a Stormwater Capture Master Plan. When will the Stormwater Capture Master Plan be completed? Will it be released to the public for review? The Draft UWMP should discuss these goals in more detail and involve additional stakeholders in this effort.

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**LADWP should actively increase water conservation measures**

In the Draft UWMP, LADWP sets a water conservation goal of 50,000 AFY by 2019. In terms of conservation, the City has moved in the right direction, but there is more that can be done to provide conservation incentives. In addition to the measures mentioned in the Plan, LADWP should require that all public buildings get retrofitted with waterless urinals and other ultra-efficient conservation devices. New high-use visitor-serving commercial properties should be required to install these devices as well. In addition, LADWP should offer incentives for graywater treatment and reuse systems. Also, LADWP should push for the city to develop a landscape conservation ordinance that weans Los Angeles off of the use of thirsty non-native plants and requires the use of natives or xeriscape plants. Finally, water pricing needs to be more equitable city-wide and provide greater incentives to conserve.

**LADWP should investigate reclaimed water purification as a water supply alternative in the future.**

The Draft UWMP mentions that in 2002 LADWP identified Scattergood Generating Station as a potential site for a seawater desalination plant. While we support the fact that LADWP's current water resource strategy does not include seawater desalination as water supply due to environmental and cost considerations, we are concerned that this option is still being considered for future supply while there are still water saving projects that are "lower-hanging fruit". Before exploring seawater desalination as an option for water supply, LADWP should aggressively explore stormwater capture and water recycling as discussed above. In addition, LADWP should explore advanced wastewater treatment for future indirect or even direct potable use. Hyperion Treatment Plant, for example, produces nearly 360,000 AFY, most of which is discharged directly to the ocean. If this water were utilized, it would offset a significant portion of the freshwater needed in Los Angeles. Wastewater purification takes about a quarter of the energy that seawater desalination requires, strictly looking at thermodynamic considerations, and would not have as many negative environmental impacts as seawater desalination. This type of project has seen great success in other areas. The benefits and constraints of advanced wastewater treatment through reverse osmosis and microfiltration should be considered in the Draft UWMP.

If LADWP does pursue research of seawater desalination as a potential water supply, LADWP should focus on the least environmentally harmful types of desalination, such as subsurface cooling intakes, desalination of brackish water, or desalting Hyperion effluent in order to avoid some of the negative impacts of seawater desalination on marine life and energy usage. Several desalination proposals in California rely on co-locating with once-through cooled power plants, causing impingement and entrainment of marine life. Researching alternative forms of desalination to co-location with once-through cooled power plants would help inform future water supply technologies that pose a lower threat to marine life and are less energy intensive.

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**LADWP should provide further support for LAUSD to achieve the goals set forth in the LAUSD Water Savings Resolution.**

Los Angeles Unified School District (LAUSD) is one of the largest water consumers in the county. This past December, the LAUSD School Board passed a Water Savings Resolution with extremely ambitious goals for water conservation, water efficiency, and the offset of potable water with recycled water resources. LAUSD resolved to utilize recycled water, where available within one-half mile from the local utility distribution source, for irrigation and in urinals and toilets. In addition to providing financial incentives for every retrofit and for every new zero-water urinal and high efficiency toilet used in a new construction project, LADWP should provide incentives for new fixtures in redevelopment and retrofit projects as well. In addition to these rebates, LADWP should consider expanding the purple pipe system to LAUSD schools.

To summarize, LADWP should should set more aggressive goals for water recycling and stormwater capture, provide more support for widespread implementation of LID and Stormwater capture projects throughout Los Angeles, investigate reclaimed water purification for future as a water supply alternative, and provide further support for LAUSD to achieve the goals set forth in the LAUSD Water Savings Resolution. Thank you for your consideration of these comments. If you have any questions, please contact us at (310) 451-1500.

Sincerely,

Kirsten James, MESM
Water Quality Director

W. Susie Santilena, MS, E.I.T.
Water Quality Scientist

Comments to LADWP Draft 2010 Urban Water Management Plan due 3.15.2011

The **Population, Housing** and **Employment** history (1980) and projected (2035) shows increases of the following:

Total Population: 1,497,560 or 50.42%
Total Housing: 543,947 or 49.45%
Total Employment: 320,664 or 18.95%

In reference to "**Securing L.A.'s Water Supply**," you state:

"By 2028, the Plan envisioned a six-fold increase in recycled water supplies to a total of 50,000 AFY.

Similarly, by 2030, an increase of 50,000 AFY was planned for conservation. As described in the Plan, this aggressive approach included: investments in state-of-the-art technology; a combination of rebates and incentives; efficient clothes washers, and urinals; and long-term measures such as expansion of water recycling and remediating contaminated groundwater supplies. . A multi-faceted approach to developing a locally sustainable water supply was developed incorporating the following key short-term and long-term strategies:

Short-Term Conservation Strategies

- Enforcing prohibited uses of water
- Expanding prohibited uses of water
- Extending outreach efforts
- Encouraging regional conservation measures

- Long-Term Strategies
- Increasing water conservation through reduction of outdoor water use and new technology
- Maximizing water recycling
- Enhancing stormwater capture
- Accelerating groundwater basin clean-up
- Expanding groundwater storage
- Green Building Initiatives (added subsequent to the release of the Plan)"

**Land Use**, on the other hand is:

Single Family Dwellings: 121,470 acres of 40.2%

Other including specific plans, transportation, freeways, rights of way and other miscellaneous uses that are not zoned:  52,806 or 17.48%

Open Space/Parks: 40,263 acres or 13.32%

Multi-Family Dwellings: 34,189 acres or 11.31%

Commercial includes public facilities, libraries, public schools and government facilities:  30,083 acres or 9.96%

Manufacturing:  23,353 acres or 7.73%

**Historical Water Demand** has been **reduced**, on average from the 1986-1990 to the 2005-2010 periods:

Single Family Dwellings: 2,094 AF or 0.88%

Multifamily Dwellings:  17,033 AF or 8.63%

Commercial:  16,369 AF or 13.27%

Industrial:  7,301 AF or 23.94%

Government:  438 AF or 1.01%

Non-Revenue: 20,901 AF or 39.56%

Overall:  64,136 AF or 9.35%

You conclude that **outdoor water use** is estimated at 39% of demand, yet the usage above does not indicate a reason to come to that conclusion.  In fact, non-revenue almost matches that 30% outdoor demand.  What is the definition of non-revenue, city usage?

Your **2035 estimates** exceed the **2005-2010 Average usage** except in Industrial passive, Industrial passive and active; and Commercial/Government passive and active:

Single Family:

2005-2010: 236,154 AF
2035 Passive:  259,904 AF
2035 Passive and Active: 247,655 AF

Multifamily:

2005-2010: 180,279 AF
2035 Passive:  221.912 AF
2035 Passive and Active: 218,762 AF

Commercial/Government:

2005-2010: 149,895 AF
2035 Passive: 160,049 AF
2035 Passive and Active: 120,420 AF

Industrial:

2005-2010: 23,201 AF
2035 Passive: 19,852 AF
2035 Passive and Active: 10,513 AF

Non-Revenue:

2005-2010: 31,929 AF
2035 Passive: 49,042 AF
2035 Passive and Active: 44,272 AF

You need to compare these with the Baseline Per Capita Use to see if compliance can be obtained for the 20 X 2020. Those calculations are not included in this draft.

**Conservation** should not be used as a category of source. It is a method of reduction, so 9.05% needs to be replaced by source usage.

**Industrial** and **Manufacturing** bases need to be placed in reality. Is there an overall reduction of businesses with no future growth, or is growth planned in the manufacturing arena with more demand to be placed.

This plan needs to be overlaid with the LA Power Plan for consistency of forecasting. Both plans need to be consistent with the General Plan.

**Recycled Water**

You state:

"These include expanding the recycled water distribution system for Non-Potable Reuse (NPR) such as for irrigation and industrial use, along with replenishment of groundwater basins with highly purified recycled water. Beyond 50,000 AFY, LADWP expects to increase recycled water use by approximately 1,500 AFY annually, bringing the total to 59,000 AFY by 2035."

There are several problems here.

Recycled water needs to be treated for use. So far, these water cannot be sold to water down dust on horse ranches, yet you only consider irrigation usage.

Purple pipe is a capital expense limited to age of existing infrastructure, homes and subject to gravity for delivery.

Tanks and underground storage need to be addressed. There are legal issues with underground storage of groundwater in an adjudicated basin. Nothing is mentioned of the lawsuit against the **Water Replenishment District** regarding groundwater rights extraction and the Storage Framework in the Central Basin. The Storage Framework was not allowed.

Nothing is mentioned of West Basin and recycled water processing or of **CeLAC** Central Los Angeles County Regional Recycled Water Project.

Nothing is mentioned of the **2009-2010 Grand Jury Report** or the County's answer. There has been no City of Los Angeles response. The Grand Jury notes discrepancies with charts supplied.

**Storm water runoff** and **urban water runoff** is under the jurisdiction of the County of Los Angeles and the Los Angeles County Flood Control District. Runoff is not an asset of the City, the Bureau of Sanitation or the LADWP. We are attaching the United States Court of Appeals Ninth Circuit Opinion No. 10-56017 in a recent case involving the County of Los Angeles ETAL.

The assumption in this document is that the Bureau of Sanitation can partner with LADWP. Only LADWP can have possession, management and control of water and water rights, lands and facilities and can capture, transport, distribute and deliver water for the benefit of the City, its inhabitants and its customers.

**Non adjudicated groundwater basins** such as the Santa Monica Basin and the Hollywood Basin are not addressed. There are no groundwater extraction rights and storage would probably be applicable to the individual property owner.

**Groundwater replenishments projects** in the San Fernando Valley are part of the Greater Los Angeles County Integrated Regional Water Management Plan under the jurisdiction of the State Department of Water Resources.

**Greater Los Angeles County Integrated Regional Water Management Plan** shows the Metropolitan Water District Integrated Resource Plan Supply Targets and proportion of targets. There is no reconciliation in this report to the LADWP portion of those targets in all categories.

**Overall**, this report touches on aspects of water, but does not address the complexities of supply and demand in a realistic sense. Growth is evident without supply considerations and cost (demand). Green Building is so minimal, it should not even be considered as a method. Recycled water is not a reliable source at this point in time.

Capital costs and operation and maintenance funding are not addressed properly.

This leaves the inhabitants and customers in the City of Los Angeles at risk financially, in public health and safety issues and quality of life issues.

Joyce Dillard
P.O. Box 31377
Los Angeles, CA 90031

Attachment: Opinion No. 10-56017

elmco duddy
15070 Proctor Ave., City of Industry, CA 91746 626/333-9942 Fax/855-4811
9750 Birch Canyon Place, San Diego, CA 92126 858/437-0112 Fax/437-0117

March 13, 2011

To: Ronald O. Nichols, General Mgr. & Chief Engineer WP

First, let me congratulate you on your appointment as General Manager of the DWP. I, along with my fellow ASPE members look forward to your aggressive and far reaching plans for the City of Los Angeles.

I have had the opportunity to attend several DWP workshops in regards to the proposed 2010 Urban Water Management Plan and I applaud the efforts of the DWP to address the upcoming water shortage issues that face the Southern California region.

It goes without exception that we are facing issues that mirror the energy crisis that was addressed decades ago. That crisis forced the public and the industry to address fuel economy and most recently alternative power sources.

In reviewing the proposed plan, the issues of Graywater, Rainwater Harvesting and Stormwater Management I feel are areas that can be readily obtainable and cost effective. There are already Graywater systems being used not only worldwide, in particular Australia, but in the City of New York there is an existing commercial/residential application installed. The technology for Graywater, Rainwater Harvesting already exist meaning that the "wheel doesn't have to be re-invented" There are major Universities involved with these technologies, in particular UCLA and UC Davis.

The Water Purveyors and Utility Companies such as LADWP should develop a strategic plan to convince policy makers and building officials to accept these types of technological innovations which already have a successful track record in Australia.

Like any game changing effort, this will be a herculean task. That being said, rather than grinding slowly toward a solution, I propose that an ad-hoc committee be formed consisting of engineers, manufactures, contractors, university experts and DWP personnel to add to the Urban Plan specifically in these three areas with the mandate that a workable plan and technologies to go with it be presented for DWP review within the next 180 days. As a member of the industry that addresses these issues, I would be happy to serve on such a committee.

The recent tragedy in Japan is an example of how a catastrophe can affect both the water and power delivery when it is most needed.

I am enclosing separate sheets of industry professional signatures that likewise share my enthusiasm and concern for this task at hand. They represent members of the Los Angeles Chapter of ASPE.

Sincerely,

Bob Pehrson

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cc: James B Mc Daniel, Simon Hsu, Ms. Lorraine Paskett, Thomas Gackstetter, Thomas Erb, Dr. Parekh Pankaj, Amir Tabakh, Michael Benisek

March 15, 2010

Attn: Simon Hsu
LADWP – Water System
111 N. Hope St, Room 1460
Los Angeles, CA 90012

**Re. Recommended Amendments to Urban Water Management Plan 2010: Chapter Four**

Dear Mr. Hsu:

Environment Now submits the following comments to Los Angeles Department of Water & Power (LADWP) on its 2010 Urban Water Management Plan (UWMP). Environment Now (EN) is an independent, non-partisan, non-profit organization, founded in 1989. EN's mission is to be an active leader in creating measurably effective environmental programs to protect and restore California's environment.

Thank you for this opportunity to comment on the UWMP. California's water supply is becoming increasingly vulnerable as our population grows and landscape dries. To meet the challenges of our heightened demands and diminished supply, EN has supported the diversification of water supplies. EN has worked with water providers and clean water advocates to establish regulations that will bring millions of acre-feet of recycled water on-line —including reclaimed wastewater, captured stormwater, and recharged groundwater basins.

EN has been committed to helping LADWP reach water re-use targets since 2006. We formed partnerships between LADWP staff and community leaders to promote reclaimed water by addressing permitting concerns. In 2007, we formed the State Water Resources Control Board's stakeholder group including LADWP staff to draft the state's first "Recycled Water Policy." In 2008, we also worked with LADWP to host community workshops in order to allay concerns about the "toilet to tap" campaign. In 2009, we worked with LADWP to reconcile their Recycled Water Master Plan with 2005 and 2008 benchmarks. In 2010, we participated in the Recycled Water Advisory Group and supported the staff's plans to reach benchmarks with ongoing rate dedication to "environmental" projects such as recycled water.

The commitment to reclaimed water from community leaders and LADWP staff has been unwavering. For this reason, we are surprised to see rollbacks in the 2010 UWMP water re-use benchmarks. In its 2005 UWMP, LADWP forecasted 16,000 AFY by 2010 and 30,000 AFY by 2030. In 2008 the City of LA promised 50,000 AFY of reclaimed water by 2019 and 100,000 AFY by 2030. Unfortunately, LADWP appears to be plagued with rollbacks. Regardless of the community support and staff expertise, the agency has only met half its original benchmark with 8,000 AFY of reclaimed water on-line today. Now the 2010 UWMP projects a total of 59,000 AFY by 2035. This is considerably below its 2005 and 2008 benchmarks.

LADWP has considerable resources on which to draw for increased reclaimed water supplies. In addition to upgrading the Tillman Plant by 15,000 AFY, the Terminal Island plant could be expanded to 12,000 AFY with an additional 20,000 AFY transferred for treatment from Hyperion. Further, the L.A.-Glendale Plant tertiary water could be distributed for irrigation use rather than discharged into the LA River. Moreover, Hyperion remains a tremendous resource for nearly half-a-million AFY of reclaimed water if only it were upgraded. Even without Hyperion, the potential capacity for existing reclamation facilities is higher than the 2010 UWMP benchmark.

EN has provided comments regarding commitments and financing for reclaimed water on many occasions. Most recently, we provided verbal comments to General Manager, Ron Nichols, and staff on February 10, 2010. We do not see our comments reflected in your recent comment responses (published at: https://www.piersystem.com/go/doc/1643/992207/) To secure our comments are included and addressed, we are submitting these written comments.

Thank you again for this opportunity to comment on LADWP's 2010 UWMP. We look forward to working with the LADWP staff to implement these important reclaimed water plans and, ultimately, make the City of Los Angeles' water supply more reliable. If we can provide further research or comments please do not hesitate to contact us, cmandelbaum@environmentnow.org, 310-829-5568*241

Sincerely,

Caryn Mandelbaum
Freshwater Program Director

TreePeople

March 15, 2011

Los Angeles Department of Water and Power
111 N. Hope St
Los Angeles, CA 90012

To: Chris Repp, and Simon Hsu
Cc: Thomas Erb
RE: Urban Water Management Plan, 2010 Comments

Thank you for the opportunity to submit comments on the LADWP Draft Urban Water Management Plan, 2010. Should you have any questions about our comments and recommendations, feel free to call or email.

Sincerely,

Rebecca Drayse
Director, Natural Urban Systems Group

12601 Mulholland Drive Beverly Hills CA 90210 TEL 818 753-4600 FAX 818 753-4635 WWW.TREEPEOPLE.ORG

TreePeople comments and recommendations on the Draft 2010 Urban Water Management Plan dated January 14, 2011

**Chapter 2**

- **2-9, Exhibit 2I -** Although we applaud LADWP's leadership in water conservation, we believe much greater water savings can be obtained and will be necessary to meet future local water needs. We believe that LADWP should continue to lead by setting conservation targets that well exceed the minimum 20 x 2020 state mandated goals. Exhibit 2I appears to assume no new innovation or transformation will take place beyond 2015.

**Chapter 3**

- **3-16 to 3-18:** As residential outdoor water use (for irrigation needs) accounts for the bulk of water use, LADWP should create a stronger and more concerted public campaign focused on landscape transformation (turf to native, or climate appropriate landscaping). Most of the conservation savings have so far been seen in incorporating efficient technologies, however a greater savings can be had in embracing a new landscape ethic.

- **3-22, final paragraph –** Revise sentence to better reflect Watershed Council's leadership in the Elmer Avenue project. Suggested language: "**Most recently TreePeople, LADWP, and other state and federal agencies partnered on an effort led by the Los Angeles and San Gabriel Rivers Watershed Council, to retrofit an entire residential block on Elmer Avenue in Sun Valley.**"

- **3-26:** Identify next steps necessary for incorporating graywater systems into LADWP conservation programs.

**Chapter 6**

- **6-1, Section 6.1:** Explore opportunities to receive credit for additional stormwater recharge in the San Fernando Basin, particularly if large scale decentralized stormwater infiltration strategies are employed.

**Chapter 7**

- **7-10** references **"Exhibit 7D"** which "summarizes the potential water yield and average unit cost of the different resources available to increase localized capture and infiltration of runoff". It is missing from the document. Is the cost table in **"Exhibit 7H"** the proper reference here?

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- **7-17 and Exhibit 7H:** We recommend updating cost table (Exhibit H) according to the new figures TreePeople provided for internal review under separate cover. Update text in 7-17 to reflect new figures in Exhibit H.

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- **7-22, Section 7.6.5 Future Distributed Stormwater Programs:** Add rain gardens to the list of potential rebates (TreePeople is beginning a pilot rain garden rebate program with the Watershed Management Group).

- **From 7-24 (revise language):** "Furthermore, distributed stormwater capture projects yield additional benefits to the public outside of water supply generation such as **flood control, restored native habitat,** community beautification, public right of way improvements, **water conservation,** as well as private residence safety and aesthetic improvements."

- **General:** Revisit the projected stormwater capture estimates as the Stormwater Master Plan is finalized and new targets are established. We believe that significantly more than **25,000 acre feet per year** can be captured by **2035.**

**Chapter 11**

- **11-8, Exhibit 11E:** Note 1 indicates a loss in the LA Aqueduct at 0.1652% per year due to climate change. There is no indication of loss from MWD (California Aqueduct, and Colorado River Aqueducts) due to climate change. Does this account for MWD's projections?

- **Chapter 11, Exhibits 11E to 11L:** Targets for stormwater capture stay consistent at 25,000 AF for both dry and normal years. Can this be revised?

**General**

- Coordinate and package conservation, rainwater harvesting, low impact development, and graywater incentive programs to customers who implement these strategies. This will decrease implementation costs for these programs and increase consumer awareness of steps they can take to manage water supply.

- Replace "**drought tolerant**" with "**climate appropriate**" throughout the document. Climate appropriate is becoming the more accepted description for landscape transformation.

- Please replace "**Tree People**" with "**TreePeople**" (without a space) where referenced including the Table of Contents.

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Comments on 2010 Urban Water Management Plan

From: Conner Everts
Southern California Watershed Alliance

To: Tom Urb, Simon Hsu
LADWP

After reviewing your draft 2010 Urban Water Management Plan, attending your public workshops while making comments there, I just have a few final thoughts that I hope you will accept.

While I find this Urban Water Management Plan a vast improvement over past plans that I have commented on there are a couple of places where I think you do not give yourself enough credit. That is specifically the projections of per capita water use into the future, which is expressed in household use in Exhibit 21 on page 2-9 and Exhibit 2J with CII worked in and finally Exhibit 2K. While projection of conservation savings go up the demand seems to rise gradually until 2035. If you take the historic savings in the last few years and combine that with future investments why would demand continue to drop? La has that history and population has not been shown to 1) Be equal to SCAG or Department of Finance numbers or 2) mean increases of consumption.

This leads me to question why, on page 3-5, you chose Method 3 for reporting, when you are already at 19%. If current gpd is 124 by taking this approach you are actually looking at a higher per capita into the future. Other cities are taking a more aggressive approach, like Long Beach, which is about to reach 100 gpd, and therefore assuring the city of a full allocation under MWD's water shortage plan which then comes a real reliability factor. I believe that this should be discussed, as required, at a separate workshop.

There is an opportunity to make this a real planning tool for future water supply and inclusion of greywater, watershed management with stormwater, the City of LA's IRP make this plan very different. Inclusion and reference of LID and smart streets and the River Project's Tujunga Watershed plan would be helpful. Given that the 2020 Water Supply Plan does not list desalination, the historical list of past planning on the issue is confusing and leads one to believe that there are plans to move forward.

I wanted to attend the SCWC workshop last Friday at MWD and got this language:

**10608.26. (a) In complying with this part, an urban retail water supplier shall conduct at least one public hearing to accomplish all of the following:**
**(1) Allow community input regarding the urban retail water supplier's implementation plan for complying with this part.**
**(2) Consider the economic impacts of the urban retail water supplier's implementation plan for complying with this part.**
**(3) Adopt a method, pursuant to subdivision (b) of Section 10608.20,**

**for determining its urban water use target.**

We just interpreted this to mean that this public input should take place prior to when the UWMP is finalized, otherwise, if the public input takes place at the same time the plan is adopted, that input is pretty meaningless.

On another note, my fellow environmentalists and I have concerns with the direction and facilitation of the RWAG. We will attend the public workshops in support, like San Pedro this week but would like to talk about how we move forward. Lastly, the movement of AB 1180 is causing greater concern.

Again, thanks for your consideration and I am available if you want to talk about it.

Conner Everts

Urban Water Management Plan

# Appendix E

## References

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# Appendix F

## Groundwater Basin Adjudications

- San Fernando Basin – Judgment 650079
- Sylmar Basin – Judgment 650079
- Eagle Rock Basin – Judgment 650079
- West Coast Basin – Judgment 506806
- Central Basin – Judgment 786656

SUPERIOR COURT OF THE STATE OF CALIFORNIA

FOR THE COUNTY OF LOS ANGELES

| | | |
|---|---|---|
| THE CITY OF LOS ANGELES,<br>Plaintiff,<br>vs.<br>CITY OF SAN FERNANDO, ET AL.<br>Defendants. | ) | No. 650079<br>JUDGMENT |

There follows by consecutive paging Recitals (page 1), Definitions and List of Attachments (pages 1 to 6), Designation of Parties (page 6), Declaration re Geology and Hydrology (pages 6 to 12), Declaration of Rights (pages 12 to 21), Injunctions (pages 21 to 22), Continuing Jurisdiction (page 23), Watermaster (pages 23 to 29), Physical Solution (pages 29 to 34), and Miscellaneous Provisions (pages 34 to 35), and Attachments (pages 36 to 46). Each and all of said several parts constitute a single integrated Judgment herein.

1. RECITALS

This matter was originally tried before the Honorable Edmund M. Moor, without jury, commencing on March 1, 1966, and concluding with entry of Findings, Conclusions and Judgment on March 14, 1968, after more than 181 trial days. Los Angeles appealed from said judgment and the California Supreme Court, by unanimous opinion, (14 Cal. 3d 199) reversed and remanded the case; after trial of some remaining issues on remand, and consistent with the opinion of the Supreme Court, and pursuant to stipulations, the Court signed and filed Findings of Fact and Conclusions of Law. Good cause thereby appearing,

IT IS ORDERED, ADJUDGED AND DECREED:

2. DEFINITIONS AND ATTACHMENTS

2.1 Definitions of Terms. As used in this Judgment, the following terms shall have the meanings herein set forth:

[1] Basin or Ground Water Basin -- A subsurface geologic formation with defined boundary conditions, containing a ground water reservoir, which is capable of yielding a significant quantity of ground water.

[2] Burbank -- Defendant City of Burbank.

[3] Crescenta Valley -- Defendant Crescenta Valley County Water district.

[4] Colorado Aqueduct -- The aqueduct facilities and system owned and operated by MWD for the importation of water from the Colorado River to its service area.

[5] Deep Rock -- Defendant Evelyn M. Pendleton, dba Deep Rock Artesian Water Company.

[6] Delivered Water -- Water utilized in a water supply distribution system, including reclaimed water.

[7] Eagle Rock Basin -- The separate ground water basin underlying the area shown as such on Attachment “A”.

[8] Extract or Extraction -- To produce ground water, or its production, by pumping or any other means.

[9] Fiscal Year -- July 1 through June 30 of the following calendar year.

[10] Foremost -- Defendant Foremost Foods Company, successor to defendant Sparkletts Drinking Water Corp.

[11] Forest Lawn -- Collectively, defendants Forest Lawn Cemetery Association, Forest Lawn Company, Forest Lawn Memorial-Park Association, and American Security and Fidelity Corporation.

[12] Gage F-57 -- The surface stream gaging station operated by Los Angeles County Flood Control District and situated in Los Angeles Narrows immediately upstream from the intersection of the Los Angeles River and Arroyo Seco, at which point the surface outflow from ULARA is measured.

[13] Glendale -- Defendant City of Glendale.

[14] Ground Water -- Water beneath the surface of the ground and within the zone of saturation.

[15] Hersch & Plumb -- Defendants David and Eleanor A. Hersch and Gerald B. and Lucille Plumb, successors to Wellesley and Duckworth defendants.

[16] Import Return Water -- Ground water derived from percolation attributable to delivered imported water.

[17] Imported Water -- Water used within ULARA, which is derived from sources outside said watershed. Said term does not include inter-basin transfers wholly within ULARA.

[18] In Lieu Storage -- The act of accumulating ground water in a basin by intentional reduction of extractions of ground water which a party has a right to extract.

[19] Lockheed -- Defendant Lockheed Aircraft Corporation.

[20] Los Angeles -- Plaintiff City of Los Angeles, acting by and through its Department of Water and Power.

[21] Los Angeles Narrows -- The physiographic area northerly of Gage F-57 bounded on the east by the San Rafael and Repetto Hills and on the west by the Elysian Hills, through which all natural outflow of the San Fernando Basin and the Los Angeles River flow en route to the Pacific Ocean.

[22] MWD -- The Metropolitan Water District of Southern California, a pubic agency of the State of California.

[23] Native Safe Yield -- That portion of the safe yield of a basin derived from native waters.

[24] Native Waters -- Surface and ground waters derived from precipitation within ULARA.

[25] Overdraft -- A condition which exists when the total annual extractions of ground water from a basin exceed its safe yield, and when any temporary surplus has been removed.

[26] Owens-Mono Aqueduct -- The aqueduct facilities owned and operated by Los Angeles for importation to ULARA water from the Owens River and Mono Basin watersheds easterly of the Sierra-Nevada in Central California.

[27] Private Defendants -- Collectively, all of those defendants who are parties, other than Glendale, Burbank, San Fernando and Crescenta Valley.

[28] Reclaimed Water -- Water which, as a result of processing of waste water, is made suitable for and used for a controlled beneficial use.

[29] Regulatory Storage Capacity -- The volume of storage capacity of San Fernando Basin which is required to regulate the safe yield of the basin, without significant loss, during any long-term base period of water supply.

[30] Rising Water -- The effluent from a ground water basin which appears as surface flow.

[31] Rising Water Outflow -- The quantity of rising water which occurs within a ground water basin and does not rejoin the ground water body or is not captured prior to flowing past a point of discharge from the basin.

[32] Safe Yield – The maximum quantity of water which can be extracted annually from a ground water basin under a given set of cultural conditions and extraction patterns, based on the long-term supply, without causing a continuing reduction of water in storage.

[33] San Fernando -- Defendant City of San Fernando.

[34] San Fernando Basin -- The separate ground water basin underlying the area shown as such on Attachment "A".

[35] Sportsman's Lodge -- Defendant Sportsman's Lodge Banquet Association.

[36] Stored Water -- Ground water in a basin consisting of either (1) imported or reclaimed water which is intentionally spread, or (2) safe yield water which is allowed to accumulate by In Lieu Storage. Said ground waters are distinguished and separately accounted for in a ground water basin, notwithstanding that the same may be physically commingled with other waters in the basin.

[37] Sylmar Basin -- The separate ground water basin underlying the area indicated as such on Attachment "A".

[38] Temporary Surplus – The amount of ground water which would be required to be removed from a basin in order to avoid waste under safe yield operation.

[39] Toluca Lake -- Defendant Toluca Lake Property Owners Association.

[40] ULARA or Upper Los Angeles River Area – The Upper Los Angeles River watershed, being the surface drainage area of the Los Angeles River tributary to Gage F-57.

[41] Underlying Pueblo Waters -- Native ground waters in the San Fernando Basin which underlie safe yield and stored waters.

[42] Valhalla -- Collectively, Valhalla Properties, Valhalla Memorial Park, Valhalla Mausoleum Park.

[43] Van de Kamp -- Defendant Van de Kamp's Holland Dutch Bakers, Inc.

[44] Verdugo Basin -- The separate ground water basin underlying the area shown as such on Attachment "A".

[45] Water Year -- October 1 through September 30 of the following calendar year.

Geographic Names, not herein specifically defined, are used to refer to the places and locations thereof as shown on Attachment "A".

2.2 List of Attachments. There are attached hereto the following documents, which are by this reference incorporated in this Judgment and specifically referred to in the text hereof:

"A" -- Map entitled "Upper Los Angeles River Area", showing Separate Basins therein.

"B" -- List of "Dismissed Parties".

"C" -- List of "Defaulted Parties".

"D" -- List of "Disclaiming Parties".

"E" -- List of "Prior Stipulated Judgments."

"F" -- List of "Stipulated Non-Consumptive or Minimal-Consumptive Use Practices."

"G" -- Map entitled "Place of Use and Service Area of Private Defendants."

"H" -- Map entitled "Public Agency Water Service Areas."

*[Attachments B-H are available upon request from LADWP – UWMP Note 2005]*

## 3. PARTIES

3.1 Defaulting and Disclaiming Defendants. Each of the defendants listed on Attachment "C" and Attachment "D" is without any right, title or interest in, or to any claim to extract ground water from ULARA or any of the separate ground water basins therein.

3.2 No Rights Other Than as Herein Declared. No party to this action has any rights in or to the waters of ULARA except to the extent declared herein.

## 4. DECLARATION RE GEOLOGY AND HYDROLOGY

4.1 Geology.

4.1.1 ULARA. ULARA (or Upper Los Angeles River Area), is the watershed or surface drainage area tributary to the Los Angeles River at Gage F-57. Said watershed contains a total of 329,000 acres, consisting of approximately 123,000 acres of valley fill area and 206,000 acres of hill and mountain area, located primarily in the County of Los Angeles, with a small portion in the County of Ventura. Its boundaries are shown on Attachment "A". The San Gabriel Mountains form the northerly portion of the watershed, and from them two major washes--the Pacoima and the Tujunga--discharge southerly. Tujunga Wash traverses the valley fill in a southerly direction and joins the Los Angeles River, which follows an easterly course along the base of the Santa Monica Mountains before it turns south through the Los Narrows. The waters of Pacoima Wash as and when they flow out of Sylmar Basin are tributary to San Fernando Basin. Lesser tributary washes run from the Simi Hills and the Santa Susana Mountains in the westerly portion of the watershed. Other minor washes, including Verdugo Wash, drain the easterly portion of the watershed which consists of the Verdugo Mountains, the Elysian, San Rafael and Repetto Hills. Each of said washes is a non-perennial stream whose flood flows and rising waters are naturally tributary to the Los Angeles River. The Los Angeles River within ULARA and most of said tributary natural washes have been replaced, and in some instances relocated, by concrete-lined flood control channels. There are 85.3 miles of such channels within ULARA, 62% of which have lined concrete bottoms.

4.1.2 San Fernando Basin. San Fernando Basin is the major ground water basin in ULARA. It underlies 112,047 acres and is located in the area shown as such on Attachment "A". Boundary conditions of the San Fernando Basin consist on the east and northeast of alluvial contacts with non-waterbearing series along the San Rafael Hills and Verdugo Mountains and the Santa Susana Mountains and Simi Hills on the northwest and west and the Santa Monica Mountains on the south. Water-bearing material in said basin extends to at least 1000 feet below the surface. Rising water outflow from the San Fernando Basin passes its downstream and southerly boundary in the vicinity of Gage F-57, which is located in Los Angeles Narrows about 300 feet upstream from the Figueroa Street (Dayton Street) Bridge. The San Fernando Basin is separated from the Sylmar Basin on the north by the eroded south limb of the Little Tujunga Syncline which causes a break in the ground water surface of about 40 to 50 feet.

4.1.3 Sylmar Basin. Sylmar Basin underlies 5,565 acres and is located in the area shown as such on Attachment "A". Water-bearing material in said basin extends to depths in excess of 12,000 feet below the surface. Boundary conditions of Sylmar Basin consist of the San Gabriel Mountains on the north, a topographic divide in the valley fill between the Mission Hills and San Gabriel Mountains on the west, the Mission Hills on the southwest, Upper Lopez Canyon Saugus Formation on the east, along the east bank of Pacoima Wash, and the eroded south limb of the Little Tujunga Syncline on the south.

4.1.4 Verdugo Basin. Verdugo Basin underlies 4,400 acres and is located in the area shown as such on Attachment "A". Boundary conditions of Verdugo Basin consist of the San Gabriel Mountains on the north, the Verdugo Mountains on the south and southwest, the San

Rafael Hills on the southeast and the topographic divide on the east between the drainage area that is tributary to the Tujunga Wash to the west and Verdugo Wash to the east, the ground water divide on the west between Monk Hill-Raymond Basin and the Verdugo Basin on the east and a submerged dam constructed at the mouth of Verdugo Canyon on the south.

4.1.5 Eagle Rock Basin. Eagle Rock Basin underlies 807 acres and is located in the area shown as such on Attachment "A". Boundary conditions of Eagle Rock Basin consist of the San Rafael Hills on the north and west and the Repetto Hills on the east and south with a small alluvial area to the southwest consisting of a topographic divide.

4.2 Hydrology.

4.2.1 Water Supply. The water supply of ULARA consists of native waters, derived from precipitation on the valley floor and runoff from the hill and mountain areas, and of imported water from outside the watershed. The major source of imported water has been from the Owens-Mono Aqueduct, but additional supplies have been and are now being imported through MWD from its Colorado Aqueduct and the State Aqueduct.

4.2.2 Ground Water Movement. The major water-bearing formation in ULARA is the valley fill material bounded by hills and mountains which surround it. Topographically, the valley-fill area has a generally uniform grade in a southerly and easterly direction with the slope gradually decreasing from the base of the hills and mountains to the surface drainage outlet at Gage F-57. The valley fill material is a heterogeneous mixture of clays, silts, sand and gravel laid down as alluvium. The valley fill is of greatest permeability along and easterly of Pacoima and Tujunga Washes and generally throughout the eastern portion of the valley fill area, except in the vicinity of Glendale where it is of lesser permeability. Ground water occurs mainly within the valley fill, with only negligible amounts occurring in hill and mountain areas. There is no significant ground water movement from the hill and mountain formations into the valley fill. Available geologic data do not indicate that there are any sources of native ground water other than those derived from precipitation. Ground water movement in the valley fill generally follows the surface topography and drainage except where geologic or man-made impediments occur or where the natural flow has been modified by extensive pumping.

4.2.3 Separate Ground Water Basins. The physical and geologic characteristics of each of the ground water basins, Eagle rock, Sylmar, Verdugo and San Fernando, cause impediments to inter-basin ground water flow whereby there is created separate underground reservoirs. Each of said basins contains a common source of water supply to parties extracting ground water from each of said basins. The amount of underflow from Sylmar Basin, Verdugo Basin and Eagle Rock Basin to San Fernando Basin is relatively small, and on the average has been approximately 540 acre feet per year from the Sylmar Basin; 80 acre feet per year from Verdugo Basin; and 50 acre feet per year from Eagle Rock Basin. Each has physiographic, geologic and hydrologic differences, one from the other, and each meets the hydrologic definition of "basin". The extractions of water in the respective basins affect the other water users within that basin but do not significantly or materially affect the ground water levels in any of the other basins. The underground reservoirs of Eagle Rock, Verdugo and Sylmar Basins are independent of one another and of the San Fernando Basin.

4.2.4 Safe Yield and Native Safe Yield. The safe yield and native safe yield, stated in acre feet, of the three largest basins for the year 1964-65 was as follows:

| Basin | Safe Yield | Native Safe Yield |
|---|---|---|
| San Fernando | 90,680 | 43,660 |
| Sylmar | 6,210 | 3,850 |
| Verdugo | 7,150 | 3,590 |

The safe yield of Eagle Rock Basin is derived from imported water delivered by Los Angeles. There is no measurable native safe yield.

4.2.5 Separate Basins -- Separate Rights. The rights of the parties to extract ground water within ULARA are separate and distinct as within each of the several ground water basins within said watershed.

4.2.6 Hydrologic Condition of Basins. The several basins within ULARA are in varying hydrologic conditions, which result in different legal consequences.

4.2.6.1 San Fernando Basin. The first full year of overdraft in San Fernando Basin was 1954-55. It remained in overdraft continuously until 1968, when an injunction herein became effective. Thereafter, the basin was placed on safe yield operation. There is no surplus ground water available for appropriation or overlying use from San Fernando Basin.

4.2.6.2 Sylmar Basin. Sylmar Basin is not in overdraft. There remains safe yield over and above the present reasonable beneficial overlying uses, from which safe yield the appropriative rights of Los Angeles and San Fernando may be and have been exercised.

4.2.6.3 Verdugo Basin. Verdugo Basin was in overdraft for more than five consecutive years prior to 1968. Said basin is not currently in overdraft, due to decreased extractions by Glendale and Crescenta Valley on account of poor water quality. However, the combined appropriative and prescriptive rights of Glendale and Crescenta Valley are equivalent to the safe yield of the Basin. No private overlying or appropriative rights exist in Verdugo Basin.

4.2.6.4 Eagle Rock Basin. The only measure water supply to Eagle Rock Basin is import return water by reason of importations by Los Angeles. Extractions by Foremost and Deep Rock under the prior stipulated judgments have utilized the safe yield of Eagle Rock Basin, and have maintained hydrologic equilibrium therein.

## 5. DECLARATION OF RIGHTS

5.1 Right to Native Waters.

5.1.1 Los Angeles River and San Fernando Basin.

5.1.1.1 Los Angeles' Pueblo Right. Los Angeles, as the successor to all rights, claims and powers of the Spanish Pueblo de Los Angeles in regard to water rights, is the owner of a prior and paramount pueblo right to the surface waters of the Los Angeles River and the native ground waters of San Fernando Basin to meet its reasonable beneficial needs and for its inhabitants.

5.1.1.2 Extent of Pueblo Right. Pursuant to said pueblo right, Los Angeles is entitled to satisfy its needs and those of its inhabitants within its boundaries as from time to time modified. Water which is in fact used for pueblo right purposes is and shall be deemed needed for such purposes.

5.1.1.3 Pueblo Right -- Nature and Priority of Exercise. The pueblo right of Los Angeles is a prior and paramount right to all of the surface waters of the Los Angeles River, and native ground water in San Fernando Basin, to the extent of the reasonable needs and uses of Los Angeles and its inhabitants throughout the corporate area of Los Angeles, as its boundaries may exist from time to time. To the extent that the Basin contains native waters and imported waters, it is presumed that the first water extracted by Los Angeles in any water year is pursuant to its pueblo right, up to the amount of the native safe yield. The next extractions by Los Angeles in any year are deemed to be from import return water, followed by stored water, to the full extent of Los Angeles' right to such import return water and stored water. In the event of need to meet water requirements of its inhabitants, Los Angeles has the additional right, pursuant to its pueblo right, withdraw temporarily from storage Underlying Pueblo Waters, subject to an obligation to replace such water as soon as practical.

5.1.1.4 Rights of Other Parties. No other party to this action has any right in or to the surface waters of the Los Angeles River or the native safe yield of the San Fernando Basin.

5.1.2 Sylmar Basin Rights.

5.1.2.1 No Pueblo Rights. The pueblo right of Los Angeles does not extend to or include ground waters in Sylmar Basin.

5.1.2.2 Overlying Rights. Defendants Moordigian and Hersch & Plumb own lands overlying Sylmar Basin and have a prior correlative right to extract native waters from said Basin for reasonable beneficial uses on their said overlying lands. Said right is appurtenant to said overlying lands and water extracted pursuant thereto may not be exported from said lands nor can said right be transferred or assigned separate and apart from said overlying lands.

5.1.2.3 Appropriative Rights of San Fernando and Los Angeles. San Fernando and Los Angeles own appropriative rights, of equal priority, to extract and put to reasonable beneficial use for the needs of said cities and their inhabitants, native waters of the Sylmar Basin in excess of the exercised reasonable beneficial needs of overlying users. Said appropriative rights are:

| | |
|---|---|
| San Fernando | 3,580 acre feet |
| Los Angeles | 1,560 acre feet. |

5.1.2.4 No Prescription. The Sylmar Basin is not presently in a state of overdraft and no rights by prescription exist in said Basin against any overlying or appropriative water user.

5.1.2.5 Other Parties. No other party to this action owns or possesses any right to extract native ground waters from the Sylmar Basin.

5.1.3 Verdugo Basin Rights.

5.1.3.1 No Pueblo Rights. The pueblo right of Los Angeles does not extend to or include ground water in Verdugo Basin.

5.1.3.2 Prescriptive Rights of Glendale and Crescenta Valley. Glendale and Crescenta Valley own prescriptive rights as against each other and against all private overlying or appropriative parties in the Verdugo Basin to extract, with equal priority, the following quantities of water from the combined safe yield of native and imported waters in Verdugo Basin:

| | |
|---|---|
| Glendale | 3,856 acre feet |
| Crescenta Valley | 3,294 acre feet. |

5.1.3.3 Other Parties. No other party to this action owns or possesses any right to extract native ground waters from the Verdugo Basin.

5.1.4 Eagle Rock Basin Rights.

5.1.4.1 No Pueblo Rights. The pueblo right of Los Angeles does not extend to or include ground water in Eagle Rock Basin.

5.1.4.2 No Rights in Native Waters. The Eagle Rock Basin has no significant or measurable native safe yield and no parties have or assert any right or claim to native waters in said Basin.

5.2 Rights to Imported Waters.

5.2.1 San Fernando Basin Rights.

5.2.1.1 Rights to Recapture Import Return Water. Los Angeles, Glendale, Burbank and San Fernando have each caused imported waters to be brought into ULARA and to be delivered to lands overlying the San Fernando Basin, with the result that percolation and return flow of such delivered water has caused imported waters to become a part of the safe yield of San Fernando Basin. Each of said parties has a right to extract from San Fernando Basin that portion of the safe yield of the Basin attributable to such import return waters.

5.2.1.2 Rights to Store and Recapture Stored Water. Los Angeles has heretofore spread imported water directly in San Fernando Basin. Los Angeles, Glendale, Burbank and San Fernando each have rights to store water in San Fernando Basin by direct spreading or in lieu practices. To the extent of any future spreading or in lieu storage of import water or reclaimed water by Los Angeles, Glendale, Burbank or San Fernando, the party causing said water to be so stored shall have a right to extract an equivalent amount of ground water from San Fernando Basin. The right to extract waters attributable to such storage practices is an undivided right to a quantity of water in San Fernando Basin equal to the amount of such Stored Water to the credit of any party, as reflected in Watermaster records.

5.2.1.3 Calculation of Import Return Water and Stored Water Credits. The extraction rights of Los Angeles, Glendale, Burbank and San Fernando in San Fernando Basin in any year, insofar as such rights are based upon import return water, shall only extend to the amount of any accumulated import return water credit of such party by reason of imported water delivered after September 30, 1977. The annual credit for such import return water shall be calculated by Watermaster based upon the amount of delivered water during the preceding water year, as follows:

| | |
|---|---|
| Los Angeles: | 20.8% of all delivered water (including reclaimed water) to valley fill lands of San Fernando Basin. |
| San Fernando: | 26.3% of all imported and reclaimed water delivered to valley-fill lands of San Fernando Basin. |
| Burbank: | 20.0% of all delivered water (including reclaimed water) to San Fernando Basin and its tributary hill and mountain areas. |
| Glendale: | 20.0% of all delivered water (including reclaimed water) to San Fernando Basin and its tributary hill and mountain areas (i.e., total delivered water, [including reclaimed water], less 105% of total sales by Glendale in Verdugo Basin and its tributary hills). |

In calculating Stored Water credit, by reason of direct spreading of imported or reclaimed water, Watermaster shall assume that 100% of such spread water reached the ground water in the year spread.

5.2.1.4 Cumulative Import Return Water Credits. Any import return water which is not extracted in a given water year shall be carried over, separately accounted for, and maintained as a cumulative credit for purposes of future extractions.

5.2.1.5 Overextractions. In addition to extractions of stored water, Glendale, Burbank or San Fernando may, in any water year, extract from San Fernando Basin an amount not exceeding 10% of such party's last annual credit for import return water, subject, however, to an obligation to replace such overextraction by reduced extractions during the next succeeding water year. Any such overextraction which is not so replaced shall constitute physical solution water, which shall be deemed to have been extracted in said subsequent water year.

5.2.1.6 Private Defendant. No private defendant is entitled to extract water from the San Fernando Basin on account of the importation of water thereto by overlying public entities.

5.2.2 Sylmar Basin Rights.

5.2.2.1 Rights to Recapture Import Return Waters. Los Angeles and San Fernando have caused imported waters to be brought into ULARA and delivered to lands overlying the Sylmar Basin with the result that percolation and return flow of such delivered water has caused imported waters to become a part of the safe yield of Sylmar Basin. Los Angeles and San Fernando are entitled to recover from Sylmar Basin such imported return waters. In calculating the annual entitlement to recapture such import return water, Los Angeles and San Fernando shall be entitled to 35.7% of the preceding water year's imported water delivered by such party to lands overlying Sylmar Basin. Thus, by way of example, in 1976-77, Los Angeles was entitled to extract 2370 acre feet of ground water from Sylmar Basin, based on delivery to lands overlying said Basin of 6640 acre feet during 1975-76. The quantity of San Fernando's imported water to, and the return flow therefrom, in the Sylmar Basin in the past has been of such minimal quantities that it has not been calculated.

5.2.2.2 Rights to Store and Recapture Stored Water. Los Angeles and San Fernando each have the right to store water in Sylmar Basin equivalent to their rights in San Fernando Basin under paragraph 5.2.1.2 hereof.

5.2.2.3 Carry Over. Said right to recapture stored water, import return water and other safe yield waters to which a party is entitled, if not exercised in a given year, can be carried over for not to exceed five years, if the underflow through Sylmar Notch does not exceed 400 acre feet per year.

5.2.2.4 Private Defendants. No private defendant is entitled to extract water from within the Sylmar Basin on account of the importation of water thereto by overlying public entities.

5.2.3 Verdugo Basin Rights.

5.2.3.1 Glendale and Crescenta Valley. Glendale and Crescenta Valley own appropriative and prescriptive rights in and to the total safe yield of Verdugo Basin, without regard as to the portions thereof derived from native water and from delivered imported waters, notwithstanding that both of said parties have caused waters to be imported and delivered on lands overlying Verdugo Basin. Said aggregate rights are as declared in Paragraph 5.1.3.2 of these Conclusions.

5.2.3.2 Los Angeles. Los Angeles may have a right to recapture its import return waters by reason of delivered import water in the Basin, based upon imports during and after water year 1977-78, upon application to Watermaster not later than the year following such import and on subsequent order after hearing by the Court.

5.2.3.3 Private Defendants. No private defendant, as such, is entitled to extract water from within the Verdugo Basin on account of the importation of water thereto by overlying public entities.

5.2.4 Eagle Rock Basin Rights.

5.2.4.1 Los Angeles. Los Angeles has caused imported water to be delivered for use on lands overlying Eagle Rock Basin and return flow from said delivered imported water constitutes the entire safe yield of Eagle Rock Basin. Los Angeles has the right to extract or cause to be extracted the entire safe yield of Eagle Rock Basin.

5.2.4.2 Private Defendants. No private defendants have a right to extract water from within Eagle Rock Basin, except pursuant to the physical solution herein.

## 6. INJUNCTIONS

Each of the parties named or referred to in this Part 6, its officers, agents, employees and officials is, and they are, hereby ENJOINED and RESTRAINED from doing or causing to be done any of the acts herein specified:

6.1 Each and Every Defendant -- from diverting the surface waters of the Los Angeles River or extracting the native waters of SAN FERNANDO BASIN, or in any manner interfering with the prior and paramount pueblo right of Los Angeles in and to such waters, except pursuant to the physical solution herein decreed.

6.2 Each and Every Private Defendant -- from extracting ground water from the SAN FERNANDO, VERDUGO, or EAGLE ROCK BASINS, except pursuant to physical solution provisions hereof.

6.3 Defaulting and Disclaiming Parties (listed in Attachments “C” and “D”) -- from diverting or extracting water within ULARA, except pursuant to the physical solution herein decreed.

6.4 Glendale -- from extracting ground water from SAN FERNANDO BASIN in any water year in quantities exceeding its import return water credit and any stored water credit, except pursuant to the physical solution; and from extracting water from VERDUGO BASIN n excess of its appropriative and prescriptive right declared herein.

6.5 Burbank -- from extracting ground water from SAN FERNANDO BASIN in any water year in quantities exceeding its import return water credit and any stored water credit, except pursuant to the physical solution decreed herein.

6.6 San Fernando -- from extracting ground water from SAN FERNANDO BASIN in any water year in quantities exceeding its import return water credit and any stored water credit, except pursuant to the physical solution herein decreed.

6.7 Crescenta Valley -- from extracting ground water from VERDUGO BASIN in any year in excess of its appropriative and prescriptive right declared herein.

6.8 Los Angeles -- from extracting ground water from SAN FERNANDO BASIN in any year in excess of the native safe yield, plus any import return water credit and stored water credit of said city; provided, that where the needs of Los Angeles require the extraction of Underlying Pueblo Waters, Los Angeles may extract such water subject to an obligation to replace such excess as soon as practical; and from extracting ground water from VERDUGO BASIN in excess of any credit for import return water which Los Angeles may acquire by reason of delivery of imported water for use overlying said basin, as hereinafter confirmed on application to Watermaster and by subsequent order of the Court.

6.9 Non-consumptive and Minimal Consumptive Use Parties. The parties listed in Attachment "F" are enjoined from extracting water from San Fernando Basin, except in accordance with practices specified in Attachment "F", or pursuant to the physical solution herein decreed.

7. CONTINUING JURISDICTION

7.1 Jurisdiction Reserved. Full jurisdiction, power and authority are retained by and reserved to the Court for purposes of enabling the Court upon application of any party or of the Watermaster by motion and upon at least 30 days' notice thereof, and after hearing thereon, to make such further or supplemental orders or directions as may be necessary or appropriate, for interpretation, enforcement or carrying out of this Judgment, and to modify, amend or amplify any of the provisions of this Judgment or to add to the provisions thereof consistent with the rights herein decreed; provided, however, that no such modification, amendment or amplification shall result in a change in the provisions of Section 5.2.1.3 or 9.2.1 hereof.

8. WATERMASTER

8.1 Designation and Appointment.

8.1.1 Watermaster Qualification and Appointment. A qualified hydrologist, acceptable to all active public agency parties hereto, will be appointed by subsequent order of the Court to assist the Court in its administration and enforcement of the provisions of this Judgment and any subsequent orders of the Court entered pursuant to the Court's continuing jurisdiction. Such Watermaster shall serve at the pleasure of the Court, but may be removed or replaced on motion of any party after hearing and showing of good cause.

8.2 Powers and Duties.

8.2.1 Scope. Subject to the continuing supervision and control of the Court, Watermaster shall exercise the express powers, and shall perform the duties, as provided in this Judgment or hereafter ordered or authorized by the Court in the exercise of the Court's continuing jurisdiction.

8.2.2 Requirement for Reports, Information and Records. Watermaster may require any party to furnish such reports, information and records as may be reasonably necessary to determine compliance or lack of compliance by any party with the provisions of this Judgment.

8.2.3 Requirement of Measuring Devices. Watermaster shall require all parties owning or operating any facilities for extraction of ground water from ULARA to install and maintain at all times in good working order, at such party's own expense, appropriate meters or other measuring devices satisfactory to the Watermaster.

8.2.4 Inspection by Watermaster. Watermaster shall make inspections of (a) ground water extraction facilities and measuring devices of any party, and (b) water use practices by any party under physical solution conditions, at such times and as often as may be reasonable under the circumstances to verify reported data and practices of such party. Watermaster shall also identify and report on any new or proposed new ground water extractions by any party or non-party.

8.2.5 Policies and Procedures. Watermaster shall, with the advice and consent of the Administrative Committee, adopt and amend from time to time Policies and Procedures as may be reasonably necessary to guide Watermaster in performance of its duties, powers and responsibilities under the provisions of this judgment.

8.2.6 Data Collection. Watermaster shall collect and verify data relative to conditions of ULARA and its ground water basins from the parties and one or more other governmental agencies. Where necessary, and upon approval of the Administrative Committee, Watermaster may develop supplemental data.

8.2.7 Cooperation With Other Agencies. Watermaster may act jointly or cooperate with agencies of the United States and the State of California or any political subdivisions, municipalities or districts (including any party) to secure or exchange data to the end that the purpose of this Judgment, including its physical solution, may be fully and economically carried out.

8.2.8 Accounting for Non-consumptive Use. Watermaster shall calculate and report annually the non-consumptive and consumptive uses of extracted ground water by each party listed in Attachment "F".

8.2.9 Accounting for Accumulated Import Return Water and Stored Water. Watermaster shall record and verify additions, extractions and losses and maintain an annual and cumulative account of all (a) stored water and (b) import return water in San Fernando Basin. Calculation of losses attributable to Stored Water shall be approved by the Administrative Committee or by subsequent order of the Court. For purposes of such accounting, extractions in any water year by Glendale, Burbank or San Fernando shall be assumed to be first from accumulated import return water, second from stored water, and finally pursuant to physical solution; provided, that any such city may, by written notice of intent to Watermaster, alter said priority of extractions as between import return water and stored water.

8.2.10 Recalculation of Safe Yield. Upon request of the Administrative Committee, or on motion of any party and subsequent Court order, Watermaster shall recalculate safe yield of any basin within ULARA. If there has been a material long-term change in storage over a base period (excluding any effects of stored water) in San Fernando Basin the safe yield shall be adjusted by making a corresponding change in native safe yield of the Basin.

8.2.11 Watermaster Report. Watermaster shall prepare annually and (after review and approval by Administrative Committee) cause to be served on all active parties, on or before May 1, a report of hydrologic conditions and Watermaster activities within ULARA during the preceding water year. Watermaster's annual report shall contain such information as may be requested by the Administrative Committee, required by Watermaster Policies and Procedures or specified by subsequent order of this Court.

8.2.12 Active Party List. Watermaster shall maintain at all times a current list of active parties and their addresses.

8.3 Administrative Committee.

8.3.1 Committee to be Formed. An Administrative Committee shall be formed to advise with, request or consent to, and review actions of Watermaster. Said Administrative Committee shall be composed of one representative of each party having a right to extract ground water from ULARA, apart from the physical solution. Any such party not desiring to participate in such committee shall so advise Watermaster in writing.

8.3.2 Organization and Voting. The Administrative Committee shall organize and adopt appropriate rules and regulations to be included in Watermaster Policies and Procedures. Action of the Administrative Committee shall be by unanimous vote of its members, or of the members affected in the case of an action which affects one or more basins but less than all of ULARA. In the event of inability of the Committee to reach a unanimous position, the matter may, at the request of Watermaster or any party, be referred to the Court for resolution by subsequent order after notice and hearing.

8.3.3 Function and Powers. The Administrative Committee shall be consulted by Watermaster and shall request or approve all discretionary Watermaster determinations. In the event of disagreement between Watermaster and the Administrative Committee, the matter shall be submitted to the Court for review and resolution.

8.4 Watermaster Budget and Assessments.

8.4.1 Watermaster's Proposed Budget. Watermaster shall, on or before May 1, prepare and submit to the Administrative Committee a budget for the ensuing water year. The budget shall be determined for each basin separately and allocated between the separate ground water basins. The total for each basin shall be allocated between the public agencies in proportion to their use of ground water from such basin during the preceding water year.

8.4.2 Objections and Review. Any party who objects to the proposed budget, or to such party's allocable share thereof, may apply to the Court within thirty (30) days of receipt of the proposed budget from Watermaster for review and modification. Any such objection shall be duly noticed to all interested parties and heard within thirty (30) days of notice.

8.4.3 Notice of Assessment. After thirty (30) days from delivery of Watermaster's proposed budget, or after the order of Court settling any objections thereto, Watermaster shall serve notice on all parties to be assessed of the amount of assessment and the required payment schedule.

8.4.4 Payment. All assessments for Watermaster expenses shall be payable on the dates designated in the notice of assessment.

8.5 Review of Watermaster Activities.

8.5.1 Review Procedures. All actions of Watermaster (other than budget and assessment matters, which are provided for in Paragraph 8.4.2) shall be subject to review by the Court on its own motion or on motion by any party, as follows:

8.5.1.1 Noticed Motion. Any party may, by a regularly noticed motion, apply to the court for review of any Watermaster's action. Notice of such motion shall be served personally or mailed to Watermaster and to all active parties.

8.5.1.2 De Novo Nature of Proceedings. Upon the filing of any such motion, the Court shall require the moving party to notify the active parties of a date for taking evidence and argument, and on the date so designated shall review de novo the question at issue. Watermaster's findings or decision, if any, may be received in evidence at said hearing, but shall not constitute presumptive or prima facie proof of any fact in issue.

8.5.1.3 Decision. The decision of the Court in such proceeding shall be an appealable supplemental order in this case. When the same is final, it shall be binding upon the Watermaster and all parties.

## 9. PHYSICAL SOLUTION

9.1 Circumstances Indicating Need for Physical Solution. During the period between 1913 and 1955, when there existed temporary surplus waters in the San Fernando Basin, overlying cities and private overlying landowners undertook to install and operate water extraction, storage and transmission facilities to utilize such temporary surplus waters. If the injunction against interference with the prior and paramount rights of Los Angeles to the waters of the San Fernando and Eagle Rock Basins were strictly enforced, the value and utility of those water systems and facilities would be lost or impaired. It is appropriate to allow continued limited extraction from the San Fernando and Eagle Rock Basins by parties other than Los Angeles, subject to assurance that Los Angeles will be compensated for any cost, expense or loss incurred as a result thereof.

9.2 Prior Stipulated Judgments. Several defendants heretofore entered into separate stipulated judgments herein, during the period June, 1958 to November, 1965, each of which judgments was subject to the court's continuing jurisdiction. Without modification of the substantive terms of said prior judgments, the same are categorized and merged into this judgment and superseded hereby in the exercise of the Court's continuing jurisdiction, as follows:

9.2.1 Eagle Rock Basin Parties. Stipulating defendants Foremost and Deep Rock have extracted water from Eagle Rock Basin, whose entire safe yield consist of import return waters of Los Angeles. Said parties may continue to extract water from Eagle Rock Basin to supply their bottled drinking water requirements upon filing all required reports on said extraction with Watermaster and Los Angeles and paying Los Angeles annually an amount equal to $21.78 per acre foot for the first 200 acre feet, and $39.20 per acre foot for any additional water extracted in any water year.

9.2.2 Non-consumptive or Minimal-consumptive Operations. Certain stipulating defendants extract water from San Fernando Basin for uses which are either non-consumptive or have a minimal consumptive impact. Each of said defendants who have a minimal consumptive impact has a connection to the City of Los Angeles water system and purchases annually an amount of water at least equivalent to the consumptive loss of extracted ground water. Said defendants are:

Non-Consumptive

Walt Disney Productions

Sears, Roebuck & Co.

Minimal-Consumptive

Conrock Co., for itself and as successor to California Materials Co.; Constance Ray White and Lee L. White; Mary L. Akmadzich and Peter J. Akmadzich

Livingston Rock & Gravel, for itself and as successor to Los Angeles Land & Water Co.

The nature of each said defendant's water use practices is described in Attachment "F". Subject to required reports to and inspections by Watermaster, each said defendant may continue extractions for said purposes so long as in any year such party continues such non-consumptive or minimal-consumptive use practices.

9.2.3 Abandoned Operations. The following stipulating defendants have ceased extracting water from San Fernando Basin and no further need exists for physical solution in their behalf:

Knickerbocker Plastic Company, Inc.

Carnation Company

Hidden Hills Mutual Water Company

Southern Pacific Railroad Co.

Pacific Fruit Express Co.

9.3 Private Defendants. There are private defendants who installed during the years of temporary surplus relatively substantial facilities to extract and utilize ground waters of San Fernando Basin. Said defendants may continue their extractions for consumptive use up to the indicated annual quantities upon payment of compensation to the appropriate city wherein their use of water is principally located, on the basis of the following physical solution:

9.3.1 Private Defendants and Appropriate Cities. Said private defendants and the cities to which their said extractions shall be charged and to which physical solution payment shall be made are:

| | | Annual Quantities (acre feet) |
|---|---|---|
| Los Angeles | - Toluca Lake | 100 |
| | Sportsman's Lodge | 25 |
| | Van de Kamp | 120 |
| Glendale | - Forest Lawn | 400 |
| | Southern Service Co. | 75 |
| Burbank | - Valhalla | 300 |
| | Lockheed | 25 |

Provided that said private defendants shall not develop, install or operate new wells or other facilities which will increase existing extraction capacities.

9.3.2 Reports and Accounting. All extractions pursuant to this physical solution shall be subject to such reasonable reports and inspection as may be required by Watermaster.

9.3.3 Payment. Water extracted pursuant hereto shall be compensated for by annual payment to Los Angeles, and as agreed upon pursuant to paragraph 9.3.3.2 to Glendale and Burbank, thirty days from day of notice by Watermaster, on the following basis:

9.3.3.1 Los Angeles. An amount equal to what such party would have paid had water been delivered from the distribution system of Los Angeles, less the average energy cost of extraction of ground water by Los Angeles from San Fernando.

9.3.3.2 Glendale or Burbank. An amount equal to the sum of the amount payable to Los Angeles under paragraph 9.4 hereof and any additional charges or conditions agreed upon by either such city and any private defendant.

9.4 Glendale and Burbank. Glendale and Burbank have each installed, during said years of temporary surplus, substantial facilities to extract and utilize waters of the San Fernando Basin. In addition to the use of such facilities to recover import return water, the distribution facilities of such cities can be most efficiently utilized by relying upon the San Fernando Basin for peaking supplies in order to reduce the need for extensive new surface storage. Glendale and Burbank may extract annual quantities of ground water from the San Fernando Basin, in addition to their rights to import return water or stored water, as heretofore declared, in quantities up to:

| | |
|---|---|
| Glendale | 5,500 acre feet |
| Burbank | 4,200 acre feet; |

provided, that said cities shall compensate Los Angeles annually for any such excess extractions over and above their declared rights at a rate per acre foot equal to the average MWD price for municipal and industrial water delivered to Los Angeles during the fiscal year, less the average energy cost of extraction of ground water by Los Angeles from San Fernando Basin during the preceding fiscal year. Provided, further, that ground water extracted by Forest Lawn and Southern Service Co. shall be included in the amount taken by Glendale, and the amount extracted by Valhalla and Lockheed shall be included in the amount taken by Burbank. All water taken by Glendale or Burbank pursuant hereto shall be charged against Los Angeles' rights in the year of such extractions.

In the event of emergency, and upon stipulation or motion and subsequent order of the Court, said quantities may be enlarged in any year.

9.5 San Fernando. San Fernando delivers imported water on lands overlying the San Fernando Basin, by reason of which said city has a right to recover import return water. San Fernando does not have water extraction facilities in the San Fernando Basin, nor would it be economically or hydrologically useful for such facilities to be installed. Both San Fernando and Los Angeles have decreed appropriative rights and extraction facilities in the Sylmar Basin. San Fernando may extract ground water from the Sylmar Basin in a quantity sufficient to utilize its San Fernando Basin import return water credit, and Los Angeles shall reduce its Sylmar Basin extractions by an equivalent amount and receive an offsetting entitlement for additional San Fernando Basin extractions.

9.6 Effective Date. This physical solution shall be effective on October 1, 1978, based upon extractions during water year 1978-79.

## 10. MISCELLANEOUS PROVISIONS

10.1 Designation of Address for Notice and Service. Each party shall designate the name and address to be used for purposes of all subsequent notices and service herein by a separate designation to be filed with Watermaster within thirty (30) days after Notice of Entry of Judgment has been served. Said designation may be changed from time to time by filing a written notice of such change with the Watermaster. Any party desiring to be relieved of receiving notices of Watermaster activity may file a waiver of notice on a form to be provided by Watermaster. Thereafter such party shall be removed from the Active Party list. For purposes of service on any party or active party by the Watermaster, by any other party, or by the Court, of any item required to be served upon or delivered to such party or active party under or pursuant to the Judgment, such service shall be made personally or by deposit in the United States mail, first class, postage prepaid, addressed to the designee and at the address in the latest designation filed by such party or active party.

10.2 Notice of Change in Hydrologic Condition -- Sylmar Basin. If Sylmar Basin shall hereafter be in a condition of overdraft due to increased or concurrent appropriations by Los Angeles and San Fernando, Watermaster shall so notify the Court and parties concerned, and notice of such overdraft and the adverse effect thereof on private overlying rights shall be given by said cities as prescribed by subsequent order of the Court, after notice and hearing.

10.3 Judgment Binding on Successors. This Judgment and all provisions thereof are applicable to and binding upon not only the parties to this action, but also upon their respective heirs, executors, administrators, successors, assigns, lessees and licensees and upon the agents, employees and attorneys in fact of all such persons.

10.4 Costs. Ordinary court costs shall be borne by each party, and reference costs shall be borne as heretofore allocated and paid.

DATED: _______________, 1979.

_______________________________________
Judge of the Superior Court

HELM, BUDINGER & LEMIEUX
An Association, Including A
Professional Corporation
4444 Riverside Drive, Suite 201
Burbank, CA. 91505
(213) 849-6473

Attorneys for Defendant,
Dominguez Water Corporation

SUPERIOR COURT OF THE STATE OF CALIFORNIA
FOR THE COUNTY OF LOS ANGELES

| | |
|---|---|
| CALIFORNIA WATER SERVICE COMPANY, et al.,<br><br>Plaintiff,<br><br>vs.<br><br>CITY OF COMPTON, et al.,<br><br>Defendants. | No. 506,806<br>AMENDED<br>JUDGMENT<br><br>(DECLARING AND ESTABLISHING WATER RIGHTS IN THE WEST COAST BASIN, IMPOSING A PHYSICAL SOLUTION THEREIN AND ENJOINING EXTRACTIONS THEREFROM IN EXCESS OF SPECIFIED QUANTITIES.) |

SB 257081 v1: 06774.0096

INTRODUCTION

The above - entitled matter came on regularly for further trial before the Honorable George Francis, Judge of the Superior Court of the State of California, assigned by the Chairman of the Judicial Council to sit in this case on Friday the 21st day of July, 1961. Thereupon plaintiffs filed a dismissal of the action as to certain defendants named in the Complaint and in the Amended Complaint herein who are not mentioned or referred to in Paragraph III of this Judgment, and the further trial of the action proceeded in respect to the remaining parties.

The objections to the Report of Referee and to all supplemental Reports thereto, having been considered upon exceptions thereto filed with the Clerk of the Court in the manner of and within the time allowed by law, were overruled.

Oral and documentary evidence was introduced, and the matter was submitted to the Court for decision. Findings of Fact, Conclusions of Law and Judgment herein have heretofore been signed and filed.

Pursuant to the reserved and continuing jurisdiction of the Court under the Judgment herein, certain amendments to said Judgment and temporary Orders have heretofore been made and entered.

Continuing jurisdiction of the Court under said Judgment is currently assigned to the HONORABLE JULIUS M. TITLE.

The motion of defendant herein, DOMINGUEZ WATER CORPORATION, for further amendments to the Judgment, notice thereof and of the hearing thereon having been duly and regularly given to all parties, came on for hearing in Department 48 of the above-entitled Court on March 21, 1980, at 1:30 o'clock P.M., before said HONORABLE JULIUS M. TITLE. Defendant, DOMINGUEZ WATER CORPORATION, was represented by its attorneys, Helm, Budinger & Lemieux, and Ralph B. Helm. Various other parties were represented by counsel of record appearing on the Clerk's records. Hearing thereon was concluded on that date. The within "Amended Judgment" incorporates amendments and orders heretofore made to the extent presently operable and amendments pursuant to said last mentioned motion. To the extent this Amended Judgment is a restatement of the Judgment as heretofore amended, it is for convenience in incorporating all matters in one document, it is not a readjudication of such matters and is not intended to reopen any such matters. As used hereinafter the word "Judgment" shall include the original Judgment as amended to date.

NOW, THEREFORE, IT IS HEREBY ORDERED, ADJUDGED AND DECREED AS FOLLOWS:

I.

Existence of Basin and Boundaries Thereof.

There exists in the County of Los Angeles, State of California, an underground water basin or reservoir known and hereinafter referred to as "West Coast Basin", "West Basin" or the "Basin", and the boundaries thereof are described as follows:

Commencing at a point in the Baldwin Hills about 1300 feet north and about 100 feet west of the intersection of Marvale Drive and

Northridge Drive; thence through a point about 200 feet northeasterly along Northridge Drive from the intersection of Marvale and Northridge Drives to the base of the escarpment of the Potrero fault; thence along the base of the escarpment of the Potrero fault in a straight line passing through a point about 200 feet south of the intersection of Century and Crenshaw Boulevards and extending about 2650 feet beyond this point to the southerly end of the Potrero escarpment; thence from the southerly end of the Potrero escarpment in a line passing about 700 feet south of the intersection of Western Avenue and Imperial Boulevard and about 400 feet north of the intersection of El Segundo Boulevard and Vermont Avenue and about 1700 feet south of the intersection of El Segundo Boulevard and Figueroa Street to the northerly end of the escarpment of the Avalon-Compton fault at a point on said fault about 700 feet west of the intersection of Avalon Boulevard and Rosecrans Avenue; thence along the escarpment of the Avalon-Compton fault to a point in the Dominguez Hills located about 1300 feet north and about 850 feet west of the intersection of Central Avenue and Victoria Street; thence along the crest of the Dominguez Hills in a straight line to a point on Alameda Street about 2900 feet north of Del Amo Boulevard as measured along Alameda Street; thence in a straight line extending through a point located on Del Amo Boulevard about 900 feet west of the Pacific Electric Railway to a point about 100 feet north and west of the intersection of Bixby Road and Del Mar Avenue; thence in a straight line to a point located about 750 feet west and about 730 feet south of the intersection of Wardlow Road and Long Beach Boulevard at the escarpment of the Cherry Hill fault; thence along the escarpment of the Cherry Hill fault through the intersection of Orange Avenue and Willow Street to a point about 400 feet east of the intersection of Walnut and Creston Avenues; thence to a point on Pacific Coast Highway about 300 feet west of its intersection with Obispo Avenue; thence along Pacific Coast Highway easterly to a point located about 650 feet west of the intersection of the center line of said Pacific Coast Highway with the intersection of the center line of Lakewood Boulevard; thence along the escarpment of the Reservoir Hill fault to a point about 650 feet north and about 700 feet east of the intersection of Anaheim Street and Ximeno Avenue; thence along the trace of said Reservoir Hill fault to a point on the Los Angeles - Orange County line about 1700 feet northeast of the Long Beach City limit measured along the County line; thence along said Los Angeles - Orange County line in a southwesterly direction to the shore line of the Pacific Ocean; thence in a northerly and westerly direction along the shore line of the Pacific Ocean to the intersection of said shore line with the southerly end of the drainage divide of the Palos Verdes Hills; thence along the drainage divide of the Palos Verdes Hills to the intersection of the northerly end of said drainage divide with the shore line of the Pacific Ocean; thence northerly along the shore line of the Pacific Ocean to the intersection of said shore line with the westerly projection of the crest of the Ballona escarpment; thence easterly along the crest of the Ballona escarpment to the mouth of Centinela Creek; thence easterly from the mouth of Centinela Creek across the Baldwin Hills in a line encompassing the entire watershed of Centinela Creek to the point of beginning.

All streets, railways and boundaries of Cities and Counties herinabove referred to are as the same existed at 12:00 o'clock noon on August 20, 1961.

The area included within the foregoing boundaries is approximately 101,000 acres in extent.

II.

Definitions:

1. Basin, West Coast Basin and West Basin, as these terms are interchangeably used herein, mean the ground water basin underlying the area described in Paragraph I hereof.
2. A fiscal year, as that term is used herein, is a twelve month period beginning July 1 and ending June 30.
3. A water purveyor, as that term is used in Paragraph XII hereof, means a party which sells water to the public, whether a regulated public utility, mutual water company or public entity, which has a connection or connections for the taking of imported water through The Metropolitan Water District of Southern California, through West Basin Municipal Water District, or access to such imported water through such connection, and which normally supplies at

least a part of its customers' water needs with such imported water.

4. A water year, as that term is used herein, is a twelve month period beginning October 1 and ending September 30, until it is changed to a "fiscal year," as provided in Paragraph XVI hereof.

III.

Declaration of Rights - Water Rights Adjudicated.

Certain of the parties to this action have no right to extract water from the Basin. The name of each of said parties is listed below with a zero following his name, and the absence of such right in said parties is hereby established and declared. Certain of the parties to this action and/or their successors in interest (through September 30, 1978) are the owners of rights to extract water from the Basin, which rights are of the same legal force and effect and without priority with reference to each other, and the amount of such rights, stated in acre-feet per year, hereinafter referred to as "Adjudicated Rights" is listed below following such parties' names, and the rights of the last-mentioned parties are hereby declared and established accordingly. Provided, however, that the Adjudicated Rights so declared and established shall be subject to the condition that the water, when used, shall be put to beneficial use through reasonable methods of use and reasonable methods of diversion; and provided further that the exercise of all of said Rights shall be subject to a pro rata reduction, if such reduction is required, to preserve said Basin as a common source of water supply.

| PARTY AND SUCCESSOR, IF ANY | | ADJUDICATED RIGHT IN ACRE FEET, ANNUALLY |
|---|---|---|
| LERMENS, EVELYN | | 0.7 |
| (Formerly Alfred Lermens) | | |
| LENZINER, EMMA L. sued as Mrs. E.L. Leuziner | | 1.4 |
| LINDERMAN, ABRAHAM | | 0 |
| Second West Coast Basin Judgment | | |
| LISTON, LAWRENCE | 0.7 | 0 |
| Sold to R. Harris and L. Harris | -0.7 | |
| LITTLE, WILLIAM | 0.1 | 0 |
| Sold to Watt Industrial Properties | -0.1 | |
| LIZZA, PAT | | 0 |
| LOCHMAN, ERNEST C. | | 0 |
| LOCHMAN, WALTER | | |
| Second West Coast Basin Judgment | | |
| LONG, BEN | | 0 |
| Persilla Long, sued as Pricilla Long | | |
| LONG, JOHN | | 0 |
| LONG BEACH, CITY OF | | 0.7 |
| LOPEZ, FRANK | | 3.7 |
| LOPEZ, MANUEL | | 0 |
| one Rudolph E. Lopez | | |
| LOS ANGELES, CITY OF | | 1503.0 |
| LOS ANGELES CITY SCHOOL DISTRICT | | 0 |
| LOS ANGELES COUNTY (ALONDRA PARK) | 28.7 | 67.7 |
| Successor to Los Angeles County Flood Control District | 39.0 | |

LAGERLOF, SENICAL, DRESCHER & SWIFT
301 North Lake Avenue, 10th Floor
Pasadena, California 91101
(818) 793-9400 or (213) 385-4345

SUPERIOR COURT OF THE STATE OF CALIFORNIA

FOR THE COUNTY OF LOS ANGELES

| | |
|---|---|
| CENTRAL AND WEST BASIN WATER REPLENISHMENT DISTRICT, etc.,<br>Plaintiff,<br>v.<br>CHARLES E. ADAMS, et al.,<br>Defendants.<br>CITY OF LAKEWOOD, a municipal corporation,<br>Cross-Complaint,<br>v.<br>CHARLES E. ADAMS, et al.,<br>Cross-Defendants. | No. 786,656<br><u>SECOND AMENDED JUDGMENT</u><br>(Declaring and establishing water rights in Central Basin and enjoining extractions therefrom in excess of specified quantities.) |

The above-entitled matter duly and regularly came on for trial in Department 73 of the above-entitled Court (having been transferred thereto from Department 75 by order of the presiding Judge), before the Honorable Edmund M. Moor, specially assigned Judge, on May 17, 1965, at 10:00 a.m. Plaintiff was represented by its attorneys BEWLEY, KNOOP,

SB 257081 v1: 06774.0096

LASSLEBEN & WHELAN, MARTIN E. WHELAN, JR., and EDWIN H. VAIL, JR., and cross-complainant was represented by its attorney JOHN S. TODD. Various defendants and cross-defendants were also represented at the trial. Evidence both oral and documentary was introduced. The trial continued from day to day on May 17, 18, 19, 20, 21 and 24, 1965, at which time it was continued by order of Court for further trial on August 25, 1965, at 10:00 a.m. in Department 73 of the above-entitled Court; whereupon, having then been transferred to Department 74, trial was resumed in Department 74 on August 25, 1965, and then continued to August 27, 1965 at 10:00 a.m. in the same Department. On the latter date, trial was concluded and the matter submitted. Findings of fact and conclu-sions of law have heretofore been signed and filed. Pursuant to the reserved and continuing jurisdiction of the court under the judgment herein, certain amendments to said judgment and temporary orders have heretofore been made and entered. Continuing jurisdiction of the court for this action is currently assigned to HON. FLORENCE T. PICKARD. Motion of Plaintiff herein for further amendments to the judgment, notice thereof and of the hearing thereon having been duly and regularly given to all parties, came on for hearing in Department 38 of the above-entitled court on MAY 6, 1991 at 8:45 a.m. before said HONORABLE PICKARD. Plaintiff was represented by its attorneys LAGERLOF, SENECAL, DRESCHER & SWIFT, by William F. Kruse. Various defendants were represented by counsel of record appearing on the Clerk's records. Hearing thereon was concluded on that date. The within "Second Amended Judgment" incorporates amendments and orders heretofore made to the extent presently operable and amendments pursuant to said last mentioned motion. To the extent this Amended judgment is a restatement of the judgment as heretofore amended, it is for convenience in incorporating all matters in one document, is not a readjudication of such matters and is not intended to reopen any such matters. As used hereinafter the word "judgment" shall include the original judgment as amended to date. In connection with the following judgment, the following terms, words, phrases and clauses are used by the Court with the following meanings:

"Administrative Year" means the water year until operation under the judgment is converted to a fiscal year pursuant to Paragraph 4, Part I, p. 53 hereof, whereupon it shall mean a fiscal year, including the initial 'short fiscal year' therein provided.

"Allowed Pumping Allocation" is that quantity in acre feet which the Court adjudges to be the maximum quantity which a party should be allowed to extract annually from Central Basin as set forth in part I hereof, which constitutes 80% of such party's Total Water Right.

"Allowed Pumping Allocation for a particular Administra- tive year" and "Allowed Pumping Allocation in the following Administrative year" and similar clauses, mean the Allowed Pumping Allocation as increased in a particular Administrative year by an authorized carryovers pursuant to Part III, Subpart A of this judgment and as reduced by reason of any over-extractions in a previous Administrative year.

"Artificial Replenishment" is the replenishment of Central Basin achieved through the spreading of imported or reclaimed water for percolation thereof into Central Basin by a governmental agency.

"Base Water Right" is the highest continuous extractions of water by a party from Central Basin for a beneficial use in any period of five consecutive years after the commencement of over-draft in Central Basin and prior to the commencement of this action, as to which there has been no cessation of use by that party during any subsequent period of five consecutive years. As employed in the above definition, the words "extractions of water by a party" and "cessation of use by that party" include such extractions and cessations by any predecessor or predecessors in interest.

"Calendar Year" is the twelve month period commencing January 1 of each year and ending December 31 of each year.

"Central Basin" is the underground water basin or reservoir underlying Central Basin Area, the exterior boundaries of which Central Basin are the same as the exterior boundaries of Central Basin Area.

"Central Basin Area" is the territory described in Appendix "1" to this judgment, and is a segment of the territory comprising Plaintiff District.

"Declared water emergency" shall mean a period commencing with the adoption of a resolution of the Board of Directors of the Central and West Basin Water Replenishment District declaring that conditions within the Central Basin relating to natural and imported supplies of water are such that, without implementation of the water emergency provision of this Judgment, the water resources of the Central Basin risk degradation. In making such declaration, the Board of Directors shall consider any information and requests provided by water producers, purveyors and other affected entities and may, for that purpose, hold a public hearing in advance of such declaration. A Declared Water Emergency shall extend for one (1) year following such resolution, unless sooner ended by similar resolution.

"Extraction", "extractions", "extracting", "extracted", and other variations of the same noun and verb, mean pumping, taking, diverting or withdrawing ground water by any manner or means whatsoever from Central Basin.

"Fiscal year" is the twelve (12) month period July 1 through June 30 following.

"Imported Water" means water brought into Central Basin Area from a non-tributary source by a party and any predecessors in interest, either through purchase directly from The Metropolitan Water District of Southern California or by direct purchase from a member agency thereof, and additionally as to the Department of Water and Power of the City of Los Angeles, water brought into Central Basin area by that party by means of the Owens River Aqueduct.

"Imported Water Use Credit" is the annual amount, computed on a calendar year basis, of imported water which any party and any predecessors in interest, who have timely made the required filings under Water Code Section 1005.1, have imported into Central Basin Area in any calendar year and subsequent to July 9, 1951, for beneficial use therein, but not exceeding the amount by which that party and any predecessors in interest reduces his or their extractions of ground water from Central Basin in that calendar year from the level of his or their extractions in the preceding calendar year, or in any prior calendar year not earlier than the calendar year 1950, whichever is the greater.

"Natural Replenishment" means and includes all processes other than "Artificial Replenishment" by which water may become a part of the ground water supply of Central Basin.

"Natural Safe Yield" is the maximum quantity of ground water, not in excess of the long term average annual quantity of Natural Replenishment, which may be extracted annually from Central Basin without eventual depletion thereof or without otherwise causing eventual permanent damage to Central Basin as a source of ground water for beneficial use, said maximum quantity being determined without reference to Artificial Replenishment.

"Overdraft" is that condition of a ground water basin resulting from extractions in any given annual period or periods in excess of the long term average annual quantity of Natural Replenishment, or in excess of that quantity which may be extracted annually without otherwise causing eventual permanent damage to the basin.

"Party" means a party to this action. Whenever the term "party" is used in connection with a quantitative water right, or any quantitative right, privilege or obligation, or in connection with the assessment for the budget of the Watermaster, it shall be deemed to refer collectively to those parties to whom are attributed a Total Water Right in Part I of this judgment.

"Person" or "persons" include individuals, partner-ships, associations, governmental agencies and corporations, and any and all types of entities.

"Total Water Right" is the quantity arrived at in the same manner as in the computation of "Base Water Right", but including as if extracted in any particular year the Imported Water Use Credit, if any, to which a particular party may be entitled.

"Water" includes only non-saline water, which is that having less than 1,000 parts of chlorides to 1,000,000 parts of water.

"Water Year" is the 12-month period commencing October 1 of each year and ending September 30th of the following year.

In those instances where any of the above-defined words, terms, phrases or clauses are utilized in the definition of any of the other above-defined words, terms, phrases and clauses, such use is with the same meaning as is above set forth.

NOW THEREFORE, IT IS ORDERED, DECLARED, ADJUDGED AND DECREED WITH RESPECT TO THE ACTION AND CROSS-ACTION AS FOLLOWS:

I. DECLARATION AND DETERMINATION OF WATER RIGHTS OF PARTIES; RESTRICTION ON THE EXERCISE THEREOF.[1]

1. Determination of Rights of Parties.

(a) Each party, except defendants, The City of Los Angeles and Department of Water and Power of the City of Los Angeles, whose name is hereinafter set forth in the tabulation at the conclusion of Subpart 3 of Part 1, and after whose name there appears under the column "Total Water Right" a figure other than "0", was the owner of and had the right to extract annually groundwater from Central Basin for beneficial use in the quantity set forth after that party's name under said column "Total Water Right" pursuant to the Judgment as originally entered herein. Attached hereto as Appendix "2" and by this reference made a part hereof as though fully set forth are the water rights of parties and successors in interest as they existed as

[1]headings in the judgment are for purposes of reference and the language of said headings do not constitute, other than for such purpose, a portion of this judgment.

of the close of the water year ending September 30, 1978 in accordance with the Watermaster Reports on file with this Court and the records of the Plaintiff. This tabulation does not take into account additions or subtractions from any Allowed Pumping Allocation of a producer for the 1978-79 water year, nor other adjustments not representing change in fee title to water rights, such as leases of water rights, nor does it include the names of lessees of landowners where the lessees are exercising the water rights. The exercise of all water rights is subject, however, to the provisions of this Judgment is hereinafter contained. All of said rights are of the same legal force and effect and are without priority with reference to each other. Each party whose name is hereinafter set forth in the tabulation set forth in Appendix "2" of this judgment, and after whose name there appears under the column "Total Water Right" the figure "0" owns no rights to extract any ground water from Central Basin, and has no right to extract any ground water from Central Basin.

(b) Defendant The City of Los Angeles is the owner of the right to extract fifteen thousand (15,000) acre feet per annum of ground water from Central Basin. Defendant Department of Water and Power of the City of Los Angeles has no right to extract ground water from Central Basin except insofar as it has the right, power, duty or obligation on behalf of defendant The City of Los Angeles to exercise the water rights in Central Basin of defendant The City of Los Angeles. The exercise of said rights are subject, however, to the provisions of this judgment hereafter contained, including but not limited to, sharing with other parties in any subsequent decreases or increases in the quantity of extractions permitted from Central Basin, pursuant to continuing jurisdiction of the Court, on the basis that fifteen thousand (15,000) acre feet bears to the Allowed Pumping Allocations of the other parties.

(c) No party to this action is the owner of or has any right to extract ground water from Central Basin except as herein affirmatively determined.

2. <u>Parties Enjoined as Regards Quantities of Extractions</u>.

(a) Each party, other than The State of California and The City of Los Angeles and Department of Water and Power of The City of Los Angeles, is enjoined and restrained in any Administrative year commencing after the date this judgment becomes final from extracting from Central Basin any quantity of Water greater than the party's Allowed Pumping Allocation as hereinafter set forth next to the name of the party in the tabulation appearing in Appendix 2 at the end of this Judgment, subject to further provisions of this judgment. Subject to such further provisions, the officials, agents and employees of The State of California are enjoined and restrained in any such Administrative year from extracting from Central Basin collectively any quantity of water greater than the Allowed Pumping Allocation of The State of California as hereinafter set forth next to the name of that party in the same tabulation. Each party adjudged and declared above not to be the owner of and not to have the right to extract ground water from Central Basin is enjoined and restrained in any Administrative year commencing after the date this judgment becomes final from extracting any ground water from Central Basin, except as may be hereinafter permitted to any such party under the Exchange Pool provisions of this judgment.

(b) Defendant The City of Los Angeles is enjoined and restrained in any Administrative year commencing after the date this judgment becomes final from extracting from Central Basin any quantity of water greater than fifteen thousand (15,000) acre feet, subject to further provisions of this judgment, including but not limited to, sharing with other parties in any subsequent decreases or increases in the quantity of extractions permitted from Central Basin by parties, pursuant to continuing jurisdiction of the Court, on the basis that fifteen thousand (15,000) acre feet bears to the Allowed Pumping Allocations of the other parties. Defendant Department of Water and Power of The City of Los Angeles is enjoined and restrained in any Administrative year commencing after the date this judgment becomes final from extracting from Central Basin any quantity of water other than such as it may extract on behalf of defendant The City of Los Angeles, and which extractions, along with any extractions by said City, shall not exceed that quantity permitted by this judgment to that City in any Administrative year. Whenever in this judgment the term "Allowed Pumping Allocation" appears, it shall be deemed to mean as to defendant The City of Los Angeles the quantity of fifteen thousand (15,000) acre feet.

10. Effect of this Amended Judgment on Orders Filed Herein. This Second Amended Judgment shall not abrogate such rights of additional carry-over of unused water rights as may otherwise exist pursuant to orders herein filed June 2, 1977 and September 29, 1977.

THE CLERK WILL ENTER THIS SECOND AMENDED JUDGMENT FORTHWITH.

DATED: May 6, 1991

/s/ Florence T. Packard
Judge of the Superior Court

Urban Water Management Plan
# Appendix G

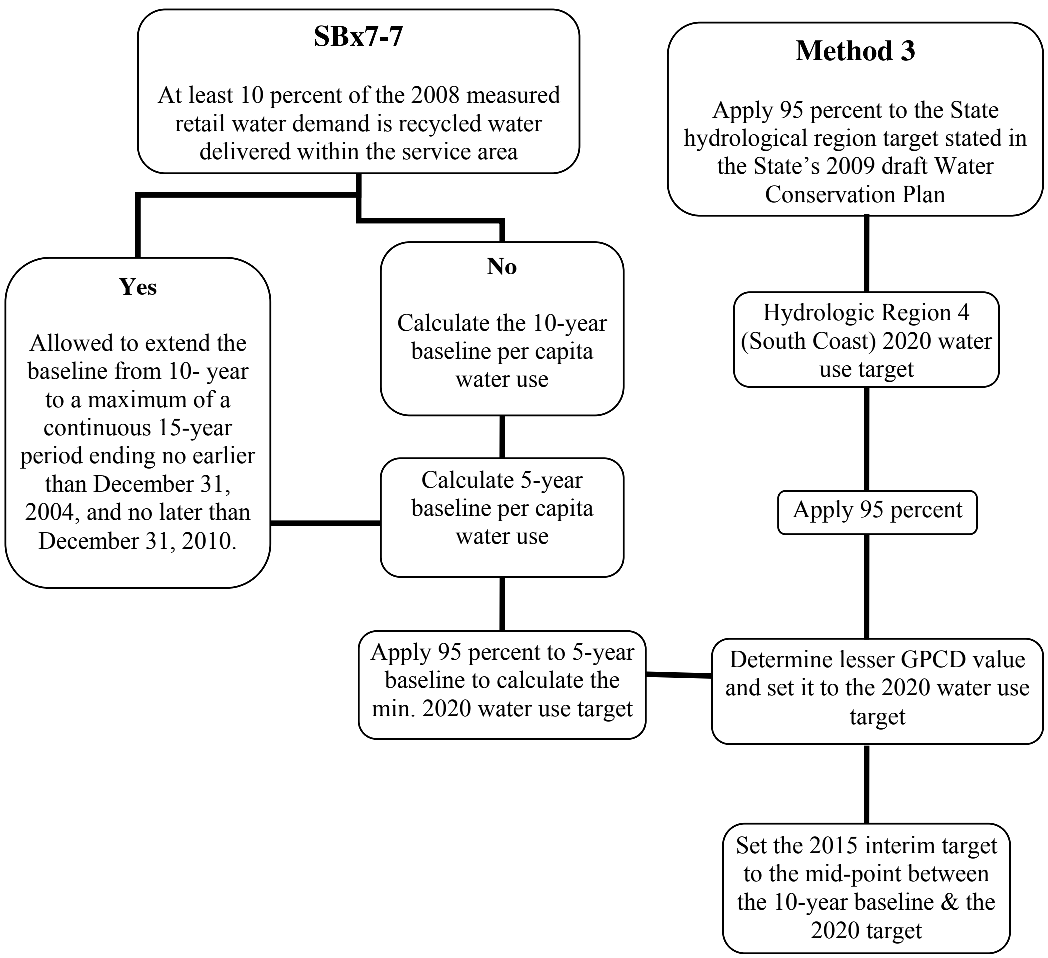
# Calculating LADWP's 2020 Water Use Target

# Calculating LADWP's Baseline and Compliance Urban Per Capita Water Use

## Introduction of Method 3

As an urban retail water supplier, LADWP is required to calculate and report the 2020 water use target and the 2015 interim target in the Urban Water Management Plan. Four methods are stipulated for calculating the 2020 water use target in the Water Conservation Act of 2009, SBX7-7, which is also incorporated in the California Water Code.

LADWP selected Method 3 for the calculation. Using Method 3, 95 percent of the applicable state hydrologic region target, as stated in the State's draft 20x2020 Water Conservation Plan dated April 30, 2009, is set as the 2020 water use target. However, according to California Water Code Section 10608.22, the 2020 water use target shall be no less than 5 percent of the urban retail water supplier's 5-year base daily per capita water use (baseline) if this 5-year baseline is greater than 100 gallons per capita per day (GPCD). The 2015 interim target is the mid-point between the 10- or 15-year baseline and the 2020 water use target. The following flow chart illustrates how to determine the 2020 target and 2015 interim target with Method 3.



## Determination of Hydrologic Region Water Use Target for LADWP

LADWP's service area is entirely located in the California State Hydrologic Region 4 – South Coast. As set forth in Table 8 of the State's draft 20x2020 Water Conservation Plan dated April 30, 2009, the 2020 water use target of Hydrologic Region 4 is 149 GPCD. LADWP's hydrologic region target is 142 GPCD or 95 percent of 149 GPCD.

| | |
|---|---|
| Hydrologic Region Interim Target (2015) | 165 GPCD |
| Hydrologic Region Target (2020) | 149 GPCD |
| 95% of the Hydrologic Region 4 Target | 142 GPCD |

## LADWP's Base Daily Per Capita Water Use (Baseline)

As defined in California Water Code Section 10608.12 (b), the baseline is the average gross water use expressed in GPCD and calculated over a continuous, multiyear base period. The 10- or 15-year baseline shall be a continuous period ending no earlier than December 31, 2004, and no later than December 31, 2010.

For an urban retail water supplier that meets at least 10 percent of its 2008 measured retail water demand through recycled water, it has the option of using a 10-year period plus up to an additional 5 years to a maximum of 15-year period for baseline calculation. LADWP can only use the 10-year baseline since it does not meet this requirement.

The 5-year baseline is also calculated for determining the minimum water use reduction requirement if the 5-year baseline is greater than 100 GPCD per Section 10608.22. The 5-year baseline shall be a continuous period ending no earlier than December 31, 2007, and no later than December 31, 2010.

### *Gross Water Use*

As defined in Section 10608.12 (g), LADWP's gross water use is the total volume of water entering the distribution system excluding the recycled water. All 4 LADWP's water sources: Los Angeles Aqueduct, local groundwater, MWD water, and recycled water, are metered before entering the distribution system.

***Gross Water Use = LAA deliveries + Local Groundwater + MWD Water***

***or Total Water Supplies – Recycled Water***

### *Service Area Population*

LADWP's service area population is based on the city-level population estimates published by State of California, Department of Finance (DOF) in *E-8 Historical Population and Housing Estimates for Cities, Counties and the State, 1990-2000, August 2007 and E-4 Population Estimates for Cities, Counties and the State, 2001-2010, with 2000 Benchmark, May 2010.* The service area population is adjusted from the City population by adding approximately 28,000 persons who live outside the City limits but within LADWP's service area, and reducing approximately 2,000 persons who live within the City limits but outside LADWP's service area.

***Service Area Population = City Population (DOF) + 28,000 – 2,000***

### *LADWP's 10-Year Baseline*

LADWP's 10-year baseline is calculated at 152 GPCD for the 10-year period beginning July 1, 1995 and ending June 30, 2005. It is used to determine the minimum water use reduction requirement per Section

10608.22. The following table shows the source data and the calculated annual GPCD for the 10-year period.

| Fiscal Year Ending June 30 | Total Water Supply (Acre-Feet) [1] | Recycled Water (Acre-Feet) [1] | Gross Water Use | City Population per DOF[2] | Service Area Population [3] | GPCD |
|---|---|---|---|---|---|---|
| 1996 | 612,164 | 2,020 | 610,144 | 3,542,651 | 3,568,651 | 153 |
| 1997 | 630,013 | 1,747 | 628,265 | 3,558,227 | 3,584,227 | 156 |
| 1998 | 588,847 | 1,449 | 587,398 | 3,587,170 | 3,613,170 | 145 |
| 1999 | 621,063 | 1,596 | 619,467 | 3,627,878 | 3,653,878 | 151 |
| 2000 | 661,106 | 1,984 | 659,121 | 3,679,600 | 3,705,600 | 159 |
| 2001 | 659,955 | 2,082 | 675,873 | 3,744,806 | 3,770,806 | 156 |
| 2002 | 669,051 | 1,907 | 667,145 | 3,803,677 | 3,829,677 | 156 |
| 2003 | 652,299 | 1,635 | 650,664 | 3,855,069 | 3,881,069 | 150 |
| 2004 | 690,266 | 2,053 | 688,213 | 3,899,129 | 3,925,129 | 157 |
| 2005 | 615,572 | 1,500 | 614,072 | 3,929,022 | 3,955,022 | 139 |

[1] Operation records are based on meter reads.
[2] Per DOF *E-8 Historical Population and Housing Estimates for Cities, Counties and the State, 1990-2000, August 2007 and E-4 Population Estimates for Cities, Counties and the State, 2001-2010, with 2000 Benchmark, May 2010.*
[3] Adjustments made to reflect the addition of approximately 28,000 persons who live outside City limits but within Water System service area, and the reduction of approximately 2,000 persons who live within the City limits but outside LADWP's service area.

| | |
|---|---|
| 10-Year Baseline between FYE 1996-2005 | 152 GPCD |

### *LADWP's 5-Year Baseline*

The 5-year baseline is calculated at 145 GPCD for the 5-year period beginning July 1, 2004 and ending June 30, 2008. It is used to determine the minimum water use reduction requirement per Section 10608.22. The following table shows the source data and the calculated annual GPCD for the 5-year period.

| Fiscal Year Ending June 30 | Total Water Supply (Acre-Feet) [1] | Recycled Water (Acre-Feet) [1] | Gross Water Use | City Population per DOF[2] | Service Area Population [3] | GPCD |
|---|---|---|---|---|---|---|
| 2004 | 690,266 | 2,053 | 688,213 | 3,899,129 | 3,925,129 | 157 |
| 2005 | 615,572 | 1,500 | 614,072 | 3,929,022 | 3,955,022 | 139 |
| 2006 | 627,612 | 1,417 | 626,194 | 3,960,385 | 3,986,385 | 140 |
| 2007 | 670,181 | 5,151 | 665,030 | 3,980,145 | 4,006,145 | 148 |
| 2008 | 649,822 | 4,181 | 645,641 | 4,016,085 | 4,042,085 | 143 |

[1] Operation records are based on meter reads.
[2] Per DOF *E-8 Historical Population and Housing Estimates for Cities, Counties and the State, 1990-2000, August 2007 and E-4 Population Estimates for Cities, Counties and the State, 2001-2010, with 2000 Benchmark, May 2010.*
[3] Adjustments made to reflect the addition of approximately 28,000 persons who live outside City limits but within Water System service area, and the reduction of approximately 2,000 persons who live within the City limits but outside LADWP's service area.

| | |
|---|---|
| 5-Year Baseline between FYE 2004-2008 | 145 GPCD |

## The 2020 Water Use Target and the 2015 Interim Water Use Target

According to California Water Code Section 10608.22, LADWP's 2020 water use target of 142 GPCD based on 95 percent of the hydrologic region target, shall be no less than 5 percent of the 5-year baseline of 145 GPCD, which is 138 GPCD. Therefore, LADWP's 2020 water use target shall be 138 GPCD. The 2015 interim target is the mid-point between the 10-year baseline of 152 GPCD and the 2020 water use target of 138 GPCD and is calculated at 145 GPCD per Section 10608.12 (j).

| | |
|---|---|
| 95% of the Hydrologic Region 4 Target | 142 GPCD |
| 95% of 5-Year Baseline | 138 GPCD |
| ***2020 Target = the lesser of the two above*** | ***138 GPCD*** |
| 10-Year Baseline | 152 GPCD |
| ***2015 Interim Target = the midpoint between 10-Year Baseline & 2020 Target*** | ***145 GPCD*** |

Urban Water
Management Plan
# Appendix H

# CUWCC Biennal Reports

# BMP Coverage Status Report 2007-2008

# BMP 1 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Exhibit 1 Coverage Requirement

An agency must meet three conditions to satisfy strict compliance for BMP 1.

Condition 1: Adopt survey targeting and marketing strategy on time
Condition 2: Offer surveys to 20% of SF accounts and 20% of MF units during report period
Condition 3: Be on track to survey 15% of SF accounts and 15% of MF units within 10 years of implementation start date.

### Test For Condition 1

**Latest Year RU to Implement Targeting/Marketing Program:** 1999

| | Single Family | Multi Family |
|---|---|---|
| **Year RU Reported Implementing Targeting/Marketing Program:** | 1990 | 1990 |
| **RU Met Targeting/Marketing Coverage Requirement:** | Yes | Yes |

### Test For Condition 2

**Latest Year Survey Program to Start:** 1998

Select a Reporting Period: 07-08

| | Single Family | Multi Family |
|---|---|---|
| **Res Survey Offers (%)** | 2.69% | 1.73% |
| **Survey Offers 20%** | No | No |

### Test For Condition 3

| | Completed Residential Surveys | |
|---|---|---|
| | Single Family | Multi Family |
| Total Completed Surveys through 2008 | 46,796 | 169,066 |
| Credit for Surveys Completed Prior to Implementation of Reporting Database | 53,384 | 67,216 |
| Total + Credit | 100,180 | 236,282 |
| **Res. Accounts in Base Year** | 464,661 | 724,199 |
| **RU Survey Coverage as % of Base Year Res Accounts** | 21.56% | 32.63% |
| **Coverage Requirement by Year 10 of Implementation per Exhibit 1** | 13.50% | 13.50% |
| **RU on Schedule to Meet 10 Year Coverage Requirement** | Yes | Yes |

# BMP 1 Coverage Status Summary

Water supplier has met the coverage requirements for this BMP.

# BMP 2 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Exhibit 1 Coverage Requirement

An agency must meet **one** of three conditions to satisfy strict compliance for BMP 2.

Condition 1: The agency has demonstrated that 75% of SF accounts and 75% of MF units constructed prior to 1992 are fitted with low-flow showerheads.

Condition 2: An enforceable ordinance requiring the replacement of high-flow showerheads and other water use fixtures with their low-flow counterparts is in place for the agency's service area.

Condition 3: The agency has distributed or directly installed low-flow showerheads and other low-flow plumbing devices to not less than 10% of single-family accounts and 10% of multi-family units constructed prior to 1992 during the reporting period.

## Test For Condition 1

| | | Single Family | | Multi Family | |
|---|---|---|---|---|---|
| Report Year | Report Period | Reported Saturation | Saturation 75%? | Reported Saturation | Saturation 75%? |
| 1999 | 99-00 | 99 | Yes | 99 | Yes |
| 2000 | 99-00 | 99 | Yes | 99 | Yes |
| 2001 | 01-02 | 99 | Yes | 99 | Yes |
| 2002 | 01-02 | 99 | Yes | 99 | Yes |
| 2003 | 03-04 | 99 | Yes | 99 | Yes |
| 2004 | 03-04 | 99 | Yes | 99 | Yes |
| 2005 | 05-06 | 99 | Yes | 99 | Yes |
| 2006 | 05-06 | 99 | Yes | 99 | Yes |
| 2007 | 07-08 | 99 | Yes | 99 | Yes |
| 2008 | 07-08 | 99 | Yes | 99 | Yes |

# BMP 2 Coverage Requirement Status

## Test For Condition 2

| Report Year | Report Period | RU has ordinance requiring showerhead retrofit? |
|---|---|---|
| 1999 | 99-00 | Yes |
| 2000 | 99-00 | Yes |
| 2001 | 01-02 | Yes |
| 2002 | 01-02 | Yes |
| 2003 | 03-04 | Yes |
| 2004 | 03-04 | Yes |
| 2005 | 05-06 | Yes |
| 2006 | 05-06 | Yes |
| 2007 | 07-08 | Yes |
| 2008 | 07-08 | Yes |

## Test For Condition 3

| 1992 SF Accounts | Num. Showerheads Distributed to SF Accounts | Single Family Coverage Ratio | SF Coverage Ratio 10% |
|---|---|---|---|
| 462,000 | 11,506 | 2.5% | No |

| 1992 MF Accounts | Num. Showerheads Distributed to MF Accounts | Multi Family Coverage Ratio | MF Coverage Ratio 10% |
|---|---|---|---|
| 710,000 | 37,083 | 5.2% | No |

# BMP 2 Coverage Status Summary

Water supplier has met the coverage requirements for this BMP.

# BMP 3 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Exhibit 1 Coverage Requirement

An agency must meet one of two conditions to be in compliance with BMP 3:

Condition 1: Perform a prescreening audit. If the result is equal to or greater than 0.9 nothing more needs be done.

Condition 2: Perform a prescreening audit. If the result is less than 0.9, perform a full audit in accordance with AWWA's Manual of Water Supply Practices, Water Audits, and Leak Detection.

**RU operates a water distribution system:** Yes

### Tests For Conditions 1 and 2

| Report Year | Report Period | Pre Screen Completed | Pre Screen Result | Full Audit Indicated | Full Audit Completed |
|---|---|---|---|---|---|
| 1999 | 99-00 | Yes | 93.8% | No | No |
| 2000 | 99-00 | Yes | 91.8% | No | No |
| 2001 | 01-02 | No | | | No |
| 2002 | 01-02 | No | | | No |
| 2003 | 03-04 | No | | | No |
| 2004 | 03-04 | No | | | No |
| 2005 | 05-06 | No | | | No |
| 2006 | 05-06 | No | | | No |
| 2007 | 07-08 | Yes | 95.2% | No | No |
| 2008 | 07-08 | Yes | 94.3% | No | No |

# BMP 3 Coverage Status Summary

Water supplier has met the coverage requirements for this BMP.

# BMP 4 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Exhibit 1 Coverage Requirement

For agencies signing the MOU prior to December 31, 1997:

100% of existing unmetered accounts to be metered and billed by volume of use by July 1, 2009.

For agencies signing the MOU after December 31, 1997:

100% of existing unmetered accounts to be metered and billed by volume of use by July 1, 2012 OR within six years of signing the MOU (whichever date is later). All retrofits must be completed no later than one year prior to the requirements of state law (January 1, 2025).

## Tests For Compliance

| | |
|---|---|
| **Total Meter Retrofits Reported through 2008** | 0 |
| **No. of Unmetered Accounts in Base Year** | 159 |
| **Meter Retrofit Coverage as % of Base Year Unmetered Accounts** | 0.0% |
| **Coverage Requirement by Year 10 of Implementation** | 90.0% |
| **RU on Schedule to Meet 10 Year Coverage Requirement** | Yes |

# BMP 4 Coverage Status Summary

Water supplier has met the coverage requirements for this BMP.

# BMP 5 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

**RU indicated "At least as effective as" implementation during report period:** Yes

## Exhibit 1 Coverage Requirement

An agency must meet three conditions to comply with BMP 5.

Condition 1: Develop water budgets for 90% of its dedicated landscape meter accounts within four years of the date implementation is to start.

Condition 2: (a) Offer landscape surveys to at least 20% of its CII accounts with mixed use meters each report cycle and be on track to survey at least 15% of its CII accounts with mixed use meters within 10 years of the date implementation is to start OR (b) Implement a dedicated landscape meter retrofit program for CII accounts with mixed use meters or assign landscape budgets to mixed use meters.

Condition 3: Implement and maintain customer incentive program(s) for irrigation equipment retrofits.

### Test For Condition 1

| Report Year | Report Period | BMP 5 Implementation Year | No. of Irrigation Meter Accounts | No. of Irrigation Accounts with Budgets | Budget Coverage Ratio | 90% Coverage Met by Year 4 |
|---|---|---|---|---|---|---|
| 1999 | 99-00 | 0 | 952 | 37 | 0.04 | NA |
| 2000 | 99-00 | 1 | 1198 | 118 | 0.10 | NA |
| 2001 | 01-02 | 2 | 949 | 132 | 0.14 | NA |
| 2002 | 01-02 | 3 | 949 | 175 | 0.18 | NA |
| 2003 | 03-04 | 4 | 955 | 249 | 0.26 | No |
| 2004 | 03-04 | 5 | 956 | 250 | 0.26 | No |
| 2005 | 05-06 | 6 | 879 | 252 | 0.29 | No |
| 2006 | 05-06 | 7 | 743 | 256 | 0.34 | No |
| 2007 | 07-08 | 8 | 745 | 258 | 0.35 | No |
| 2008 | 07-08 | 9 | 766 | 269 | 0.35 | No |

### Test For Condition 2a (survey offers)

Select Reporting Period: 07-08

**Large Landscape Survey Offers as % of Mixed Use Meter CII Accounts:** 0.0%

**Survey Offers Equal or Exceed 20% Coverage Requirement:** No

# BMP 5 Coverage Requirement Status

## Test For Condition 2a (surveys completed)

| | |
|---|---|
| **Total Completed Landscape Surveys Reported through 2008** | 530 |
| Credit for Surveys Completed Prior to Implementation of Reporting Database | 114 |
| Total + Credit | 644 |
| **CII Accounts with Mixed Use Meters in Base Year** | 74,316 |
| **RU Survey Coverage as % of Base Year CII Accounts** | 0.9% |
| **Coverage Requirement by Year 9 of Implementation per Exhibit 1** | 11.5% |
| **RU on Schedule to Meet 10 Year Coverage Requirement** | No |

## Test For Condition 2b (mixed use budget or meter retrofit program)

| Report Year | Report Period | BMP 5 Implementation Year | Agency has mix-use budget program | No. of mixed-use budgets |
|---|---|---|---|---|
| 1999 | 99-00 | 0 | no | 0 |
| 2000 | 99-00 | 1 | no | 0 |
| 2001 | 01-02 | 2 | no | |
| 2002 | 01-02 | 3 | no | |
| 2003 | 03-04 | 4 | no | 0 |
| 2004 | 03-04 | 5 | no | 0 |
| 2005 | 05-06 | 6 | no | 0 |
| 2006 | 05-06 | 7 | no | 0 |
| 2007 | 07-08 | 8 | no | 0 |
| 2008 | 07-08 | 9 | no | 0 |

| Report Year | Report Period | BMP 4 Implementation Year | No. of mixed use CII accounts | No. of mixed use CII accounts fitted with irrig. meters |
|---|---|---|---|---|
| 1999 | 99-00 | 1 | 74500 | 0 |
| 2000 | 99-00 | 2 | 71768 | 0 |
| 2001 | 01-02 | 3 | 76866 | 0 |
| 2002 | 01-02 | 4 | 77165 | 0 |
| 2003 | 03-04 | 5 | 76616 | 0 |
| 2004 | 03-04 | 6 | 77144 | 0 |
| 2005 | 05-06 | 7 | 62479 | 0 |
| 2006 | 05-06 | 8 | 63735 | 0 |
| 2007 | 07-08 | 9 | 60437 | 0 |
| 2008 | 07-08 | 10 | 60327 | 0 |

# BMP 5 Coverage Requirement Status

### Test For Condition 3

| Report Year | Report Period | BMP 5 Implementation Year | RU offers financial incentives? | Loans No. | Loans Total Amount | Grants No. | Grants Total Amount | Rebates No. | Rebates Total Amount |
|---|---|---|---|---|---|---|---|---|---|
| 1999 | 99-00 | 0 | yes | 0 | 0 | 0 | 0 | 1 | 1050 |
| 2000 | 99-00 | 1 | yes | 0 | 0 | 0 | 0 | 1 | 1740 |
| 2001 | 01-02 | 2 | yes | 0 | 0 | 0 | 0 | 4 | 133900 |
| 2002 | 01-02 | 3 | yes | 0 | 0 | 31 | 120000 | 5 | 22475 |
| 2003 | 03-04 | 4 | yes | 0 | 0 | 0 | 0 | 2 | 11624 |
| 2004 | 03-04 | 5 | yes | 0 | 0 | 0 | 0 | 5 | 21542 |
| 2005 | 05-06 | 6 | yes | 0 | 0 | 0 | 0 | 4 | 58760 |
| 2006 | 05-06 | 7 | yes | 0 | 0 | 16 | 80000 | 0 | 0 |
| 2007 | 07-08 | 8 | yes | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 07-08 | 9 | yes | 0 | 0 | 0 | 0 | 1 | 8538 |

# BMP 5 Coverage Status Summary

Water supplier has selected an "At Least As Effective As" option for this BMP.

# BMP 6 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Pre-2004 Exhibit 1 Coverage Requirement

An agency must meet one condition to comply with BMP 6.

Condition 1: Offer a cost-effective financial incentive for high-efficiency washers if one or more energy service providers in service area offer financial incentives for high-efficiency washers.

## Revised Exhibit 1 Coverage Requirement

An agency must meet two conditions to comply with BMP 6.

Condition 1: Offer cost-effective financial incentives for high-efficiency washers with Water Factors of 9.5 or less.

Condition 2: Meet Coverage Goal (CG=Total Dwelling Units x 0.0768) by July 1, 2008. Agencies signing the MOU after July 1, 2003, shall have a prorated Coverage Goal, based on implementation period of less than 4.0 years.

### Test For Condition 1

Agency offered cost-effective financial incentives for high-efficiency washers with Water Factors of 9.5 or less: yes

### Test For Condition 2

| | |
|---|---|
| Coverage Goal: | 91,304 |
| Total Coverage Points Awarded (incl. past credit): | 110,989 |
| % of Coverage Goal: | 121.6% |

# BMP 6 Coverage Status Summary

Water supplier has met the coverage requirements for this BMP.

# BMP 7 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Exhibit 1 Coverage Requirement

An agency must meet one condition to comply with BMP 7.

Condition 1: Implement and maintain a public information program consistent with BMP 7's definition.

### Test For Condition 1:07-08

| Report Year | Report Period | BMP 7 Implementation Year | RU Has Public Information Program |
|---|---|---|---|
| 1999 | 99-00 | 1 | Yes |
| 2000 | 99-00 | 2 | Yes |
| 2001 | 01-02 | 3 | Yes |
| 2002 | 01-02 | 4 | Yes |
| 2003 | 03-04 | 5 | Yes |
| 2004 | 03-04 | 6 | Yes |
| 2005 | 05-06 | 7 | Yes |
| 2006 | 05-06 | 8 | Yes |
| 2007 | 07-08 | 9 | Yes |
| 2008 | 07-08 | 10 | Yes |

# BMP 7 Coverage Status Summary

Water supplier has met the coverage requirements for this BMP.

# BMP 8 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Exhibit 1 Coverage Requirement

An agency must meet one condition to comply with BMP 8.

Condition 1: Implement and maintain a school education program consistent with BMP 8's definition.

### Test For Condition 1

| Report Year | Report Period | BMP 8 Implementation Year | RU Has School Education Program |
|---|---|---|---|
| 1999 | 99-00 | 1 | Yes |
| 2000 | 99-00 | 2 | Yes |
| 2001 | 01-02 | 3 | Yes |
| 2002 | 01-02 | 4 | Yes |
| 2003 | 03-04 | 5 | Yes |
| 2004 | 03-04 | 6 | Yes |
| 2005 | 05-06 | 7 | Yes |
| 2006 | 05-06 | 8 | Yes |
| 2007 | 07-08 | 9 | Yes |
| 2008 | 07-08 | 10 | Yes |

## BMP 8 Coverage Status Summary

Water supplier has met the coverage requirements for this BMP.

# BMP 9 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exception for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Exhibit 1 Coverage Requirement

An agency must meet two conditions to comply with BMP 9.

Condition 1: Agency has identified and ranked by use commercial, industrial, and institutional accounts.

Condition 2(a): Agency is on track to survey 10% of commercial accounts, 10% of industrial accounts, and 10% of institutional accounts within 10 years of date implementation to commence.

OR

Condition 2(b): Agency is on track to reduce CII water use by an amount equal to 10% of baseline use within 10 years of date implementation to commence.

OR

Condition 2(c): Agency is on track to meet the combined target as described in Exhibit 1 BMP 9 documentation.

## Test For Condition 1

| | |
|---|---|
| Ranked Commercial Customers | yes |
| Ranked Industrial Customers | yes |
| Ranked Institutional Customers | yes |
| Rank Coverage Met | Yes |

## Test For Condition 2a

| | Commercial | Industrial | Institutional |
|---|---|---|---|
| **Total Completed Surveys Reported through 2008** | 248 | 51 | 32 |
| Credit for Surveys Completed Prior to Implementation of Reporting Database | 32 | 3 | 8 |
| Total + Credit | 280 | 54 | 40 |
| **CII Accounts in Base Year** | 59,649 | 7,298 | 7,369 |
| **RU Survey Coverage as % of Base Year CII Accounts** | 0.5% | 0.7% | 0.5% |
| **Coverage Requirement by Year 9 of Implementation per Exhibit 1** | 7.7% | 7.7% | 7.7% |
| **RU on Schedule to Meet 10 Year Coverage Requirement** | No | No | No |

# BMP 9 Coverage Requirement Status

### Test For Condition 2b

| Coverage Year | Performance Target Savings (AF/Yr) | Performance Target Savings Coverage | Performance Target Savings Coverage Requirement | Coverage Requirement Met |
|---|---|---|---|---|
| 1999 | 5,097 | 3% | 0.5% | Yes |
| 2000 | 8,383 | 5% | 1% | Yes |
| 2001 | 12,281 | 8% | 1.7% | Yes |
| 2002 | 16,716 | 10% | 2.4% | Yes |
| 2003 | 21,743 | 14% | 3.3% | Yes |
| 2004 | 28,619 | 18% | 4.2% | Yes |
| 2005 | 29,420 | 18% | 5.3% | Yes |
| 2006 | 33,135 | 21% | 6.4% | Yes |
| 2007 | 33,819 | 21% | 7.7% | Yes |
| 2008 | 34,673 | 22% | 9% | Yes |

### Test For Condition 2c

| | |
|---|---|
| Total BMP 9 Surveys + Credit | 374 |
| **BMP 9 Survey Coverage** | 0.5% |
| **BMP 9 Performance Target Coverage** | 21.7% |
| **BMP 9 Survey + Performance Target Coverage** | 22.2% |
| **Combined Coverage Equals or Exceeds BMP 9 Survey Coverage Requirement?** | Yes |

## BMP 9 Coverage Status Summary

Water supplier has met the coverage requirements for this BMP.

# BMP 11 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Exhibit 1 Coverage Requirement

Agency shall maintain rate structure consistent with BMP 11's definition of conservation pricing.

## Test For Compliance

| | |
|---|---|
| **Fully metered?** | Yes |
| **Water Coverage Met?** | Yes |
| **Provide Sewer Service?** | No |
| **Sewer Coverage Met?** | Yes |

# BMP 11 Coverage Status Summary

**Water supplier has met the coverage requirements for this BMP.**

# BMP 11 Sewer Coverage Status Summary

**Agency does not provide sewer service**

# BMP 12 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Exhibit 1 Coverage Requirement

Agency shall staff and maintain the position of conservation coordinator and provide support staff as necessary.

### Test For Compliance

| Report Year | Report Period | Conservation Coordinator Position Staffed? | Total Staff on Team (incl. CC) |
|---|---|---|---|
| 1999 | 99-00 | yes | 6 |
| 2000 | 99-00 | yes | 5 |
| 2001 | 01-02 | yes | 5 |
| 2002 | 01-02 | yes | 6 |
| 2003 | 03-04 | yes | 6 |
| 2004 | 03-04 | yes | 6 |
| 2005 | 05-06 | yes | 6 |
| 2006 | 05-06 | yes | 6 |
| 2007 | 07-08 | yes | 5 |
| 2008 | 07-08 | yes | 5 |

# BMP 12 Coverage Status Summary

Water supplier has met the coverage requirements for this BMP.

# BMP 13 Coverage Requirement Status

**Reporting Unit ID** 152

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Date MOU Signed:** 9/12/1991

**Reporting Period:** 07-08

**Rep Unit Category:** Retail Only

**RU indicated "At least as effective as" implementation during report period:** No

**RU filed an exemption for this BMP during report period:** No exemption request filed

**If exemption filed, type:**

## Exhibit 1 Coverage Requirement

Implementation methods shall be enacting and enforcing measures prohibiting gutter flooding, single pass cooling systems in new connections, non-recirculating systems in all new conveyer car wash and commercial laundry systems, and non-recycling decorative water fountains.

## Test For Compliance

**Agency or service area prohibits:**

| Report Year | Gutter Flooding | Single-Pass Cooling Systems | Single-Pass Car Wash | Single-Pass Laundry | Single-Pass Fountains | Other | RU has ordinance that meets coverage requirement |
|---|---|---|---|---|---|---|---|
| 1999 | yes | no | no | no | yes | yes | No |
| 2000 | yes | no | no | no | yes | yes | No |
| 2001 | yes | no | no | no | yes | yes | No |
| 2002 | yes | no | no | no | yes | yes | No |
| 2003 | yes | no | no | no | yes | yes | No |
| 2004 | yes | no | no | no | yes | yes | No |
| 2005 | yes | no | no | no | yes | yes | No |
| 2006 | yes | no | no | no | yes | yes | No |
| 2007 | yes | Yes | Yes | Yes | yes | yes | Yes |
| 2008 | yes | Yes | Yes | Yes | yes | yes | Yes |

# BMP 13 Coverage Status Summary

Water supplier has met the coverage requirements for this BMP.

# BMP 14 Coverage Requirement Status

**Reporting Unit ID:** 152

**Base Year:** 1997

**Rep Unit Name:** Los Angeles Dept. of Water and Power

**Rep Unit Category:** Retail Only

## Exhibit 1 Coverage Requirement

An agency must meet one of the following conditions to be in compliance with BMP 14.

Condition 1: Retrofit-on-resale (ROR) in effect in service area
Condition 2: Water savings from toilet replacement programs equal to 90% of Exhibit 6 coverage requirement.

An agency with an exemption for BMP 14 is not required to meet one of the above conditions.
The report treats an agency with missing base year data required to compute the Exhibit 6 coverage requirement as out of compliance with BMP 14.

| Coverage Year | BMP 14 Data Submitted to CUWCC | Exemption Filed with CUWCC | ALAEA | ROR Ordinance in Effect | Exhibit 6 Coverage Req'mt (AF) | Toilet Replacement Program Water Savings (AF) |
|---|---|---|---|---|---|---|
| 1999 | ☒ | ☐ | ☐ | ☒ | 3,511 | 159,92 |
| 2000 | ☒ | ☐ | ☐ | ☒ | 9,987 | 188,96 |
| 2001 | ☒ | ☐ | ☐ | ☒ | 18,948 | 219,42 |
| 2002 | ☒ | ☐ | ☐ | ☒ | 29,980 | 250,86 |
| 2003 | ☒ | ☐ | ☐ | ☒ | 42,721 | 282,87 |
| 2004 | ☒ | ☐ | ☐ | ☒ | 56,857 | 315,57 |
| 2005 | ☒ | ☐ | ☐ | ☒ | 72,115 | 348,59 |
| 2006 | ☒ | ☐ | ☐ | ☒ | 88,259 | 381,44 |
| 2007 | ☒ | ☐ | ☐ | ☒ | 105,08 | 413,69 |
| 2008 | ☒ | ☐ | ☐ | ☒ | 122,41 | 444,64 |

## BMP 14 Coverage Status Summary: 2010

Water supplier has met the coverage requirements for this BMP.

# 2007 CUWCC Biennial Report

## Water Supply & Reuse

Reporting Unit: **Los Angeles Dept. of Water and Power**

Year: **2007**

### Water Supply Source Information

| Supply Source Name | Quantity (AF) Supplied | Supply Type |
|---|---|---|
| LA Aqueduct | 277942 | Imported |
| MWDSC | 295602 | Imported |
| Groundwater | 88906 | Groundwater |
| Recycled | 5186 | Recycled |
| Transfer | 1136 | Imported |
| Storage | 242 | Imported |

**Total AF: 669014**

Reported as of 6/10/10

## Accounts & Water Use

| Reporting Unit Name: | Submitted to CUWCC | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **02/08/2009** | **2007** |

| What is the reporting year? | Fiscal | Month Ending | June |
|---|---|---|---|

### A. Service Area Population Information:

1. Total service area population 4044080

### B. Number of Accounts and Water Deliveries (AF)

| Type | Metered | | Unmetered | |
|---|---|---|---|---|
| | No. of Accounts | Water Deliveries (AF) | No. of Accounts | Water Deliveries (AF) |
| 1. Single-Family | 481908 | 261323 | 0 | 0 |
| 2. Multi-Family | 123597 | 188149 | 0 | 0 |
| 3. Commercial | 72130 | 114298 | 0 | 0 |
| 4. Industrial | 6867 | 21838 | 0 | 0 |
| 5. Institutional | 7403 | 48320 | 0 | 0 |
| 6. Dedicated Irrigation | 745 | 248 | 0 | 0 |
| 7. Recycled Water | 42 | 6509 | 0 | 0 |
| 8. Other | 0 | 0 | 0 | 0 |
| 9. Unaccounted | NA | 32080 | NA | 0 |
| **Total** | 692692 | 672765 | 0 | 0 |
| | **Metered** | | **Unmetered** | |

Reported as of 6/10/10

## BMP 01: Water Survey Programs for Single-Family and Multi-Family Residential Customers

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2007** |

### A. Implementation

| | |
|---|---|
| 1. Based on your signed MOU date, 09/12/1991, your Agency STRATEGY DUE DATE is: | 09/11/1993 |
| 2. Has your agency developed and implemented a targeting/ marketing strategy for SINGLE-FAMILY residential water use surveys? | yes |
| a. If YES, when was it implemented? | 06/01/1990 |
| 3. Has your agency developed and implemented a targeting/ marketing strategy for MULTI-FAMILY residential water use surveys? | yes |
| a. If YES, when was it implemented? | 06/01/1990 |

### B. Water Survey Data

**Single**

| Survey Counts: | Family Accounts | Multi-Family Units |
|---|---|---|
| 1. Number of surveys offered: | 12500 | 12500 |
| 2. Number of surveys completed: | 5444 | 9913 |
| **Indoor Survey:** | | |
| 3. Check for leaks, including toilets, faucets and meter checks | yes | yes |
| 4. Check showerhead flow rates, aerator flow rates, and offer to replace or recommend replacement, if necessary | yes | yes |
| 5. Check toilet flow rates and offer to install or recommend installation of displacement device or direct customer to ULFT replacement program, as neccesary; replace leaking toilet flapper, as necessary | yes | yes |
| **Outdoor Survey:** | | |
| 6. Check irrigation system and timers | no | no |
| 7. Review or develop customer irrigation schedule | no | no |
| 8. Measure landscaped area (Recommended but not required for surveys) | no | no |
| 9. Measure total irrigable area (Recommended but not required for surveys) | no | no |
| 10. Which measurement method is typically used (Recommended but not required for surveys) | | None |
| 11. Were customers provided with information packets that included evaluation results and water savings recommendations? | no | no |
| 12. Have the number of surveys offered and completed, survey results, and survey costs been tracked? | yes | no |
| a. If yes, in what form are surveys tracked? | | database |

b. Describe how your agency tracks this information.

Contractor reporting & invoice support documentation

## C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? No

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## D. Comments

Period: FY 06-07. Interior assessments with installation of devices as needed (ULFTs, showerheads, aerators, flappers). Direct and indirect marketing for MF segment

Reported as of 6/10/10

## BMP 02: Residential Plumbing Retrofit

Reporting Unit:

**Los Angeles Dept. of Water and Power** BMP Form Status: **100% Complete** Year: **2007**

## A. Implementation

1. Is there an enforceable ordinance in effect in your service area requiring replacement of high-flow showerheads and other water use fixtures with their low-flow counterparts? yes

a. If YES, list local jurisdictions in your service area and code or ordinance in each:

City of Los Angeles "Water Closet, Urinal and Showerhead Regulations-Retrofit on Resale" Ordinance (No. 172075)

2. Has your agency satisfied the 75% saturation requirement for single-family housing units? yes

3. Estimated percent of single-family households with low-flow showerheads: 99%

4. Has your agency satisfied the 75% saturation requirement for multi-family housing units? yes

5. Estimated percent of multi-family households with low-flow showerheads: 99%

6. If YES to 2 OR 4 above, please describe how saturation was determined, including the dates and results of any survey research.

LA enacted an ordinance requiring all LADWP customers to install low flow showerheads & have installations certified or incur financial penalties for non-compliance. 99+% of LADWP customers have demonstrated compliance

## B. Low-Flow Device Distribution Information

1. Has your agency developed a targeting/ marketing strategy for distributing low-flow devices? yes

a. If YES, when did your agency begin implementing this strategy? 07/01/1988

b. Describe your targeting/ marketing strategy.

Direct mail to all SF customers; element of all survey pgms; req'd per L.A. ordinance; provided upon request to any residential customer; distributed with program ULFTs.

| Low-Flow Devices Distributed/ Installed | SF Accounts | MF Units |
|---|---|---|
| 2. Number of low-flow showerheads distributed: | 7694 | 24187 |
| 3. Number of toilet-displacement devices distributed: | 3 | 0 |
| 4. Number of toilet flappers distributed: | 118 | 1658 |
| 5. Number of faucet aerators distributed: | 9395 | 38148 |

6. Does your agency track the distribution and cost of low-flow devices? yes

a. If YES, in what format are low-flow devices tracked? Database

b. If yes, describe your tracking and distribution system :

Tracking: in-house inventory control; contractor invoices & support documentation. Distribution: direct install by CBOs; distribution by CBOs & through Conservation office.

## C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? No

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## D. Comments

Direct install accounts for vast majority of devices and cost.
Showerheads are 2.0 gpm

Reported as of 6/10/10

## BMP 03: System Water Audits, Leak Detection and Repair

| Reporting Unit: **Los Angeles Dept. of Water and Power** | BMP Form Status: **100% Complete** | Year: **2007** |
|---|---|---|

### A. Implementation

| | |
|---|---|
| 1. Does your agency own or operate a water distribution system? | yes |
| 2. Has your agency completed a pre-screening system audit for this reporting year? | Yes |
| 3. If YES, enter the values (AF/Year) used to calculate verifiable use as a percent of total production: | |
| a. Determine metered sales (AF) | 634178 |
| b. Determine other system verifiable uses (AF) | 0 |
| c. Determine total supply into the system (AF) | 666258 |
| d. Using the numbers above, if (Metered Sales + Other Verifiable Uses) / Total Supply is < 0.9 then a full-scale system audit is required. | 0.95 |
| 4. Does your agency keep necessary data on file to verify the values entered in question 3? | yes |
| 5. Did your agency complete a full-scale audit during this report year? | no |
| 6. Does your agency maintain in-house records of audit results or completed AWWA M36 audit worksheets for the completed audit which could be forwarded to CUWCC? | yes |
| 7. Does your agency operate a system leak detection program? | no |
| a. If yes, describe the leak detection program: | |

### B. Survey Data

| | |
|---|---|
| 1. Total number of miles of distribution system line. | 7228 |
| 2. Number of miles of distribution system line surveyed. | 0 |

### C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? No

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

### Voluntary Questions (Not used to calculate compliance)

### E. Volumes

| | Estimated | Verified |
|---|---|---|
| 1. Volume of raw water supplied to the system: | | |
| 2. Volume treated water supplied into the system: | | |
| 3. Volume of water exported from the system: | | |
| 4. Volume of billed authorized metered consumption: | | |

5. Volume of billed authorized unmetered consumption:

6. Volume of unbilled authorized metered consumption:

7. Volume of unbilled authorized unmetered consumption:

## F. Infrastructure and Hydraulics

1. System input (source or master meter) volumes metered at the entry to the:

2. How frequently are they tested and calibrated?

3. Length of mains:

4. What % of distribution mains are rigid pipes (metal, ac, concrete)?

5. Number of service connections:

6. What % of service connections are rigid pipes (metal)?

7. Are residential properties fully metered?

8. Are non-residential properties fully metered?

9. Provide an estimate of customer meter under-registration:

10. Average length of customer service line from the main to the point of the meter:

11. Average system pressure:

12. Range of system pressures: From to

13. What percentage of the system is fed from gravity feed?

14. What percentage of the system is fed by pumping and re-pumping?

## G. Maintenance Questions

1. Who is responsible for providing, testing, repairing and replacing customer meters?

2. Does your agency test, repair and replace your meters on a regular timed schedule?

a. If yes, does your agency test by meter size or customer category?:

b. If yes to meter size, please provide the frequency of testing by meter size:

Less than or equal to 1"

1.5" to 2"

3" and Larger

c. If yes to customer category, provide the frequency of testing by customer category:

SF residential

MF residential

Commercial

Industrial & Institutional

3. Who is responsible for repairs to the customer lateral or customer service line?

4. Who is responsible for service line repairs downstream of the customer meter?

5. Does your agency proactively search for leaks using leak

survey techniques or does your utility reactively repair leaks which are called in, or both?

6. What is the utility budget breakdown for:

| | |
|---|---|
| Leak Detection | $ |
| Leak Repair | $ |
| Auditing and Water Loss Evaluation | $ |
| Meter Testing | $ |

### H. Comments

Reported as of 6/10/10

## BMP 04: Metering with Commodity Rates for all New Connections and Retrofit of Existing

| Reporting Unit: **Los Angeles Dept. of Water and Power** | BMP Form Status: **100% Complete** | Year: **2007** |
|---|---|---|

### A. Implementation

| | |
|---|---|
| 1. Does your agency have any unmetered service connections? | No |
| a. If YES, has your agency completed a meter retrofit plan? | |
| b. If YES, number of previously unmetered accounts fitted with meters during report year: | |
| 2. Are all new service connections being metered and billed by volume of use? | Yes |
| 3. Are all new service connections being billed volumetrically with meters? | Yes |
| 4. Has your agency completed and submitted electronically to the Council a written plan, policy or program to test, repair and replace meters? | Yes |

5. Please fill out the following matrix:

| Account Type | Number of Metered Accounts | Number of Metered Accounts Read | Number of Metered Accounts Billed by Volume | Billing Frequency Per Year | Number of Volume Estimates |
|---|---|---|---|---|---|
| a. Single Family | 483433 | 483433 | 483433 | 6 | 0 |
| b. Multi-Family | 121693 | 121693 | 121693 | 6 | 0 |
| c. Commercial | 60327 | 60327 | 60327 | 12 | 0 |
| d. Industrial | 6552 | 6552 | 6552 | 12 | 0 |
| e. Institutional | 6707 | 6707 | 6707 | 12 | 0 |
| f. Landscape Irrigation | 766 | 766 | 766 | 12 | 0 |

### B. Feasibility Study

| | |
|---|---|
| 1. Has your agency conducted a feasibility study to assess the merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters? | no |
| a. If YES, when was the feasibility study conducted? (mm/dd/yy) | |

b. Describe the feasibility study:

| | |
|---|---|
| 2. Number of CII accounts with mixed-use meters: | 60437 |
| 3. Number of CII accounts with mixed-use meters retrofitted with dedicated irrigation meters during reporting period. | 0 |

### C. "At Least As Effective As"

| | |
|---|---|
| 1. Is your agency implementing an "at least as effective as" variant of this BMP? | No |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

Fire services are metered; hydrants are not.

## BMP 05: Large Landscape Conservation Programs and Incentives

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2007** |

### A. Water Use Budgets

| | |
|---|---|
| 1. Number of Dedicated Irrigation Meter Accounts: | 745 |
| 2. Number of Dedicated Irrigation Meter Accounts with Water Budgets: | 258 |
| 3. Budgeted Use for Irrigation Meter Accounts with Water Budgets (AF): | 0 |
| 4. Actual Use for Irrigation Meter Accounts with Water Budgets (AF): | 0 |
| 5. Does your agency provide water use notices to accounts with budgets each billing cycle? | yes |

### B. Landscape Surveys

| | |
|---|---|
| 1. Has your agency developed a marketing / targeting strategy for landscape surveys? | yes |
| a. If YES, when did your agency begin implementing this strategy? | 6/10/1996 |

b. Description of marketing / targeting strategy:

Work with LA Dept Rec & Parks, school district to audit and provide audit training. All accts applying for landscape incentives also audited. Review consumption history for excess use.

| | |
|---|---|
| 2. Number of Surveys Offered. | 15 |
| 3. Number of Surveys Completed. | 11 |

4. Indicate which of the following Landscape Elements are part of your survey:

| | |
|---|---|
| a. Irrigation System Check | yes |
| b. Distribution Uniformity Analysis | yes |
| c. Review / Develop Irrigation Schedules | yes |
| d. Measure Landscape Area | yes |
| e. Measure Total Irrigable Area | yes |
| f. Provide Customer Report / Information | yes |

| | |
|---|---|
| 5. Do you track survey offers and results? | yes |
| 6. Does your agency provide follow-up surveys for previously completed surveys? | yes |

a. If YES, describe below:

Accounts with poor distribution uniformity re-audited after system improvements completed

## C. Other BMP 5 Actions

| | |
|---|---|
| 1. An agency can provide mixed-use accounts with ETo-based landscape budgets in lieu of a large landscape survey program.<br>Does your agency provide mixed-use accounts with landscape budgets? | no |
| 2. Number of CII mixed-use accounts with landscape budgets. | 0 |
| 3. Do you offer landscape irrigation training? | yes |
| 4. Does your agency offer financial incentives to improve landscape water use efficiency? | yes |

| Type of Financial Incentive: | Budget (Dollars/ Year) | Number Awarded to Customers | Total Amount Awarded |
|---|---|---|---|
| a. Rebates | 100000 | 0 | 0 |
| b. Loans | 0 | 0 | 0 |
| c. Grants | 80000 | 0 | 0 |

| | |
|---|---|
| 5. Do you provide landscape water use efficiency information to new customers and customers changing services? | No |

a. If YES, describe below:

| | |
|---|---|
| 6. Do you have irrigated landscaping at your facilities? | yes |
| a. If yes, is it water-efficient? | yes |
| b. If yes, does it have dedicated irrigation metering? | yes |
| 7. Do you provide customer notices at the start of the irrigation season? | no |
| 8. Do you provide customer notices at the end of the irrigation season? | no |

## D. "At Least As Effective As"

| | |
|---|---|
| 1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? | Yes |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

The Los Angeles Department of Water and Power (LADWP) is taking a multi-pronged approach and implementing several programs to target our large landscapes (e.g. parks and schools) and commercial, industrial, and institutional (CII) customers having irrigated landscapes. LADWP implements the ambitious Technical Assistance Program (TAP), which is a custom financial incentive program offering CII and Multi-Family Residential customers in Los Angeles up to $250,000 for the installation of pre-approved equipment and products (including the design and installation of efficient irrigation systems) that demonstrate persistent water savings. LADWP staff is currently working with a major customer on significant modifications for a new proprietary process that will conserve a considerable amount of water annually. LADWP has entered into a Memorandum of Understanding (MOU) with the Los Angeles

Department of Recreation and Parks (RAP) for the purpose of funding water use efficiency improvements for large landscapes in City parks. These water conservation improvements that LADWP and RAP are working in partnership to advance include installation of weather-based irrigation controllers, high efficiency sprinkler heads, and repair or replacement of irrigation distribution systems. The MOU strengthens LADWP's commitment to conservation as a means of providing a sustainable source of water to the City of Los Angeles as adopted by the Board in the 2005 Urban Water Management Plan. In August of 2008, LADWP amended its Emergency Water Conservation Plan (a City Ordinance) to address the increasing water shortage. The Plan's requirements are applicable to all LADWP customers, and are focused primarily on landscape irrigation. The Plan permits customers to use water only during specified hours of the day and specified days of the week, depending on the declared severity of water shortage. Water allotment varies by each phase (I-VI), such that phase I has the least amount of restrictions and phase VI having the most stringent restrictions. LADWP is currently developing a proposal for "Shortage Year" Water Rates (Tier 1 and Tier 2) for both commercial and residential customers that will become effective in mid-2009. Customers will be required to conserve 15% below their Tier 1 allotment to avoid a bill increase; however, those who exceed their allotment must pay Tier 2 rates resulting in higher water bills. Shortage Year Water Rates are designed to ensure that costs are recovered without penalizing customers who conserve during the years when projected demand for water exceeds the available supply. As has been demonstrated by LADWP's 100% volumetric rate structure, price signal is a most effective conservation tool. In addition to the Ordinance modifications described above, LADWP has developed and is planning to launch a Turf Buy Back Program in 2009. This new program will pay single family residential and commercial customers $1.00 per square foot of turf removed and replaced with drought tolerant plants, mulch or permeable hardscape. Any subsequent irrigation requirements will be met with low volume drip or microspray emitters. LADWP is also in the process of expanding our recycled water program and are working with water intensive CII customers such as golf courses, parks, and refineries to promote and use recycled water. LADWP is currently converting all of our golf courses and parks to dedicated irrigation meters for the usage of recycled water. Our recycled water goal is to deliver at least 50,000 acre-feet per year by 2019. This will be done by expanding the "purple pipe" distribution system to new customers who can use recycled water for non-potable uses such as irrigation and industrial processes.

### E. Comments

Reported as of 6/10/10

## BMP 06: High-Efficiency Washing Machine Rebate Programs

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2007** |

### A. Implementation

1. Do any energy service providers or waste water utilities in your service area offer rebates for high-efficiency washers?

a. If YES, describe the offerings and incentives as well as who the energy/waste water utility provider is.

| | |
|---|---|
| 2. Does your agency offer rebates for high-efficiency washers? | yes |
| 3. What is the level of the rebate? | |
| 4. Number of rebates awarded. | |

## B. Rebate Program Expenditures

| | This Year | Next Year |
|---|---|---|
| 1. Budgeted Expenditures | | |
| 2. Actual Expenditures | | |

## C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? no

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## D. Comments

Reported as of 6/10/10

# BMP 07: Public Information Programs

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2007** |

## A. Implementation

1. How is your public information program implemented?
Wholesaler and retailer both materially participate in program
Which wholesaler(s)?
Metropolitan Water District of Southern California

2. Describe the program and how it's organized:
LADWP's Public Affairs Division works closely with the Water Conservation office. Information is made available on LADWP Web site, conservation publications distributed at public venues and by request (in English and Spanish); customer newsletter; Speakers Bureau and school presentations; fleet vehicle signage; posters and brochures in LADWP Customer Service Centers and City Council field offices; permanent water display located at Olvera Street, a popular Los Angeles landmark and tourist venue; a special flier regarding conservation was produced and inserted for distribution in the Los Angeles Times and Daily News in English and in Impacto in Spanish. Print advertisements were placed twice monthly beginning in November of 2005 and terminating December 2006 in various languages in the community press and major daily newspapers serving Los Angeles to Promote awareness of and participation in LADWP's residential water conservation programs. The LADWP Public Affairs Division prepares an outreach program annually based on the specific program needs of the Water Conservation office. Public Affairs implements the elements of the program which include development and production of collateral materials and exhibits; development and placement of all advertisements and public service announcements; development and posting of Web site announcements. MWDSC independently promotes conservation through various media channels and directly promotes programs via the bewaterwise.com website as well as by its program

implementation contractor.

3. Indicate which and how many of the following activities are included in your public information program:

| Public Information Program Activity in Retail Service Area | Yes/No | Number of Events |
|---|---|---|
| a. Paid Advertising | yes | 81 |
| b. Public Service Announcement | no | |
| c. Bill Inserts / Newsletters / Brochures | yes | 21 |
| d. Bill showing water usage in comparison to previous year's usage | yes | |
| e. Demonstration Gardens | no | |
| f. Special Events, Media Events | yes | 3 |
| g. Speaker's Bureau | yes | 5 |
| h. Program to coordinate with other government agencies, industry and public interest groups and media | yes | |

## B. Conservation Information Program Expenditures

1. Annual Expenditures (Excluding Staffing)

## C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? No

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## D. Comments

Reported as of 6/10/10

# BMP 08: School Education Programs

Reporting Unit:
**Los Angeles Dept. of Water and Power**

BMP Form Status:
**100% Complete**

Year:
**2007**

## A. Implementation

1. How is your public information program implemented?
Retailer runs program without wholesaler sponsorship

2. Please provide information on your region-wide school programs (by grade level):

| Grade | Are grade-appropriate materials distributed? | No. of class presentations | No. of students reached | No. of teachers' workshops |
|---|---|---|---|---|
| Grades K-3rd | yes | 2 | 490 | 13 |
| Grades 4th-6th | yes | 2 | 4325 | 13 |
| Grades 7th-8th | yes | 0 | 37800 | 13 |
| High School | yes | 0 | 56800 | 13 |

| | |
|---|---|
| 4. Did your Agency's materials meet state education framework requirements? | yes |
| 5. When did your Agency begin implementing this program? | 09/15/1975 |

### B. School Education Program Expenditures

1. Annual Expenditures (Excluding Staffing)

### C. "At Least As Effective As"

| | |
|---|---|
| 1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? | No |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

Teachers' guide and supporting materials funded and/or provided by LADWP. Dedicated LADWP staff coordinate with school district throughout the school year.

Reported as of 6/10/10

## BMP 09: Conservation Programs for CII Accounts

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2007** |

### A. Implementation

| | |
|---|---|
| 1. Has your agency identified and ranked COMMERCIAL customers according to use? | yes |
| 2. Has your agency identified and ranked INDUSTRIAL customers according to use? | yes |
| 3. Has your agency identified and ranked INSTITUTIONAL customers according to use? | yes |

### Option A: CII Water Use Survey and Customer Incentives Program

| | |
|---|---|
| 4. Is your agency operating a CII water use survey and customer incentives program for the purpose of complying with BMP 9 under this option? If so, please describe activity during reporting period: | yes |

| CII Surveys | Commercial Accounts | Industrial Accounts | Institutional Accounts |
|---|---|---|---|
| a. Number of New Surveys Offered | 25 | 10 | 4 |
| b. Number of New Surveys Completed | 25 | 10 | 4 |
| c. Number of Site Follow-ups of Previous Surveys (within 1 yr) | 10 | 6 | 1 |
| d. Number of Phone Follow-ups of Previous Surveys (within 1 yr) | 10 | 3 | 1 |
| **CII Survey Components** | **Commercial** | **Industrial** | **Institutional** |

| | Accounts | Accounts | Accounts |
|---|---|---|---|
| e. Site Visit | yes | yes | yes |
| f. Evaluation of all water-using apparatus and processes | yes | yes | yes |
| g. Customer report identifying recommended efficiency measures, paybacks and agency incentives | yes | yes | yes |

| Agency CII Customer Incentives | Budget ($/Year) | # Awarded to Customers | Total $ Amount Awarded |
|---|---|---|---|
| h. Rebates | 150000 | 6980 | 737808 |
| i. Loans | 0 | 0 | 0 |
| j. Grants | 350000 | 0 | 0 |
| k. Others | 0 | 0 | 0 |

### Option B: CII Conservation Program Targets

| | |
|---|---|
| 5. Does your agency track CII program interventions and water savings for the purpose of complying with BMP 9 under this option? | yes |
| 6. Does your agency document and maintain records on how savings were realized and the method of calculation for estimated savings? | yes |

7. **System Calculated** annual savings (AF/yr):

| CII Programs | # Device Installations |
|---|---|
| a. Ultra Low Flush Toilets | 4469 |
| b. Dual Flush Toilets | 1 |
| c. High Efficiency Toilets | 1404 |
| d. High Efficiency Urinals | 0 |
| e. Non-Water Urinals | 0 |
| f. Commercial Clothes Washers (coin-op only; not industrial) | 1037 |
| g. Cooling Tower Controllers | 23 |
| h. Food Steamers | 0 |
| i. Ice Machines | 0 |
| j. Pre-Rinse Spray Valves | 0 |
| k. Steam Sterilizer Retrofits | 0 |
| l. X-ray Film Processors | 0 |

8. **Estimated** annual savings (AF/yr) from agency programs not including the devices listed in Option B. 7., above:

| CII Programs | Annual Savings (AF/yr) |
|---|---|
| a. Site-verified actions taken by agency: | 0 |
| b. Non-site-verified actions taken by agency: | 0 |

## B. Conservation Program Expenditures for CII Accounts

| | This Year | Next Year |
|---|---|---|

| | | |
|---|---|---|
| 1. Budgeted Expenditures | 2750000 | 2750000 |
| 2. Actual Expenditures | 737808 | |

### C. "At Least As Effective As"

1. Is your agency implementing an "at least as effective as" variant of this BMP? No

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

## BMP 11: Conservation Pricing

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2007** |

### A. Implementation

#### Water Service Rate Structure Data by Customer Class

| | |
|---|---|
| **1. Single Family Residential** | |
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 274,814,458 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ , |
| **2. Multi-Family Residential** | |
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 188,638,894 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |
| **3. Commercial** | |
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 119,179,953 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |
| **4. Industrial** | |
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 23,200,289 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |
| **5. Institutional / Government** | |
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 32,620,283 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |

| | |
|---|---|
| **6. Dedicated Irrigation (potable)** | |
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 7,587,195 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |
| **7. Recycled-Reclaimed** | |
| a. Rate Structure | Uniform |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 2,665,729 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |
| **8. Raw** | |
| a. Rate Structure | Service Not Provided |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |
| **9. Other** | |
| a. Rate Structure | Service Not Provided |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |

## B. Implementation Options

### Select Either Option 1 or Option 2:

**1. Option 1: Use Annual Revenue As Reported**
V/(V+M) >= 70%
V = Total annual revenue from volumetric rates
M = Total annual revenue from customer meter/service (fixed) charges

Selected

**2. Option 2: Use Canadian Water & Wastewater Association Rate Design Model**
V/(V+M) >= V'/(V'+M')
V = Total annual revenue from volumetric rates
M = Total annual revenue from customer meter/service (fixed) charges
V' = The uniform volume rate based on the signatory's long-run incremental cost of service
M' = The associated meter charge

a. If you selected Option 2, has your agency submitted to the Council a completed Canadian Water & Wastewater Association rate design model?

b. Value for **V'** (uniform volume rate based on agency's long-run incremental cost of service) as determined by the Canadian Water & Wastewater Association rate design model:

c. Value for **M'** (meter charge associated with V' uniform volume rate) as determined by the Canadian Water & Wastewater Association rate design model:

## C. Retail Wastewater (Sewer) Rate Structure Data by Customer Class

| | |
|---|---|
| 1. Does your agency provide sewer service? (If YES, answer questions 2 - 7 below, else continue to section D.) | No |

**2. Single Family Residential**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

**3. Multi-Family Residential**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

**4. Commercial**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

**5. Industrial**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

**6. Institutional / Government**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

**7. Recycled-reclaimed water**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

## D. "At Least As Effective As"

| | |
|---|---|
| 1. Is your agency implementing an "at least as effective as" variant of this BMP? | No |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## E. Comments

Link to LADWP Water Rate Ordinance:
http://www.ladwp.com/ladwp/cms/ladwp001149.pdf

## BMP 12: Conservation Coordinator

| Reporting Unit: **Los Angeles Dept. of Water and Power** | BMP Form Status: **100% Complete** | Year: **2007** |
|---|---|---|

### A. Implementation

| | |
|---|---|
| 1. Does your Agency have a conservation coordinator? | yes |
| 2. Is a coordinator position supplied by another agency with which you cooperate in a regional conservation program ? | no |
| a. Partner agency's name: | |
| 3. If your agency supplies the conservation coordinator: | |
| a. What percent is this conservation coordinator's position? | 100% |
| b. Coordinator's Name | Thomas Gackstetter |
| c. Coordinator's Title | Water Conservation Manager |
| d. Coordinator's Experience and Number of Years | 20 |
| e. Date Coordinator's position was created (mm/dd/yyyy) | 12/11/1991 |
| 4. Number of conservation staff (FTEs), including Conservation Coordinator. | 5 |

### B. Conservation Staff Program Expenditures

| | |
|---|---|
| 1. Staffing Expenditures (In-house Only) | 597610 |
| 2. BMP Program Implementation Expenditures | 5989000 |

### C. "At Least As Effective As"

| | |
|---|---|
| 1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? | no |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

## BMP 13: Water Waste Prohibition

| Reporting Unit: **Los Angeles Dept. of Water and Power** | BMP Form Status: **100% Complete** | Year: **2007** |
|---|---|---|

### A. Requirements for Documenting BMP Implementation

| | |
|---|---|
| 1. Is a water waste prohibition ordinance in effect in your service area? | yes |

a. If YES, describe the ordinance:

Prohibits use of water on hardscape, gutter flooding, unattended leaks, mid-day watering, serving water in restaurants w/o request, non recirc fountains

| | |
|---|---|
| 2. Is a copy of the most current ordinance(s) on file with CUWCC? | yes |

a. List local jurisdictions in your service area in the first text box and water waste ordinance citations in each jurisdiction in the second text box:

City of Los Angeles Ord No. 166080

## B. Implementation

1. Indicate which of the water uses listed below are prohibited by your agency or service area.

| | |
|---|---|
| a. Gutter flooding | yes |
| b. Single-pass cooling systems for new connections | Yes |
| c. Non-recirculating systems in all new conveyor or car wash systems | Yes |
| d. Non-recirculating systems in all new commercial laundry systems | Yes |
| e. Non-recirculating systems in all new decorative fountains | yes |
| f. Other, please name<br>See above | yes |

2. Describe measures that prohibit water uses listed above:

Specific ordinance language, monetary penalties, service restrictions/shutoff. Cost of water/wastewater and common practice limits number of single pass systems

**Water Softeners:**

3. Indicate which of the following measures your agency has supported in developing state law:

| | |
|---|---|
| a. Allow the sale of more efficient, demand-initiated regenerating DIR models. | no |
| b. Develop minimum appliance efficiency standards that: | |
| i.) Increase the regeneration efficiency standard to at least 3,350 grains of hardness removed per pound of common salt used. | no |
| ii.) Implement an identified maximum number of gallons discharged per gallon of soft water produced. | no |
| c. Allow local agencies, including municipalities and special districts, to set more stringent standards and/or to ban on-site regeneration of water softeners if it is demonstrated and found by the agency governing board that there is an adverse effect on the reclaimed water or groundwater supply. | no |

| | |
|---|---|
| 4. Does your agency include water softener checks in home water audit programs? | no |
| 5. Does your agency include information about DIR and exchange-type water softeners in educational efforts to encourage replacement of less efficient timer models? | no |

## C. "At Least As Effective As"

| | |
|---|---|
| 1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? | no |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## D. Comments

# BMP 14: Residential ULFT Replacement Programs

| Reporting Unit: **Los Angeles Dept. of Water and Power** | BMP Form Status: **100% Complete** | Year: **2007** |
|---|---|---|

## A. Implementation

**Number of 1.6 gpf Toilets Replaced by Agency Program During Report Year**

| | Single-Family Accounts | Multi-Family Units |
|---|---|---|
| 1. Does your Agency have program(s) for replacing high-water-using toilets with ultra-low flush toilets? | yes | yes |
| **Replacement Method** | **SF Accounts** | **MF Units** |
| 2. Rebate | 2043 | 386 |
| 3. Direct Install | 5448 | 9912 |
| 4. CBO Distribution | 126 | 92 |
| 5. Other | 0 | 0 |
| **Total** | **7617** | **10390** |

**Number of 1.2 gpf High-Efficiency Toilets (HETs) Replaced by Agency Program During Report Year**

| | Single-Family Accounts | Multi-Family Units |
|---|---|---|
| 6. Does your Agency have program(s) for replacing high-water-using toilets with ultra-low flush toilets? | no | no |
| **Replacement Method** | **SF Accounts** | **MF Units** |
| 7. Rebate | | |
| 8. Direct Install | | |
| 9. CBO Distribution | | |
| 10. Other | | |
| **Total** | | |

**Number of Dual-Flush Toilets Replaced by Agency Program During Report Year**

| | Single-Family Accounts | Multi-Family Units |
|---|---|---|
| 11. Does your Agency have program(s) for replacing high-water-using toilets with ultra-low flush toilets? | no | no |
| **Replacement Method** | **SF Accounts** | **MF Units** |
| 12. Rebate | 0 | 0 |
| 13. Direct Install | 0 | 0 |
| 14. CBO Distribution | 0 | 0 |
| 15. Other | 0 | 0 |
| **Total** | **0** | **0** |

16. Describe your agency's ULFT, HET, and/or Dual-Flush Toilet programs for

single-family residences.

Rebate of $100 per toilet replaced or free toilet in exchange for old toilet (installed free on request). Rebate paid on ULFT, HET and Dual Flush.

17. Describe your agency's ULFT, HET, and/or Dual-Flush Toilet programs for multi-family residences.

Rebate of $75 per toilet replaced or free toilet in exchange for old toilet (installed free on request). Rebate paid on ULFT, HET and Dual Flush.

18. Is a toilet retrofit on resale ordinance in effect for your service area? yes

19. List local jurisdictions in your service area in the left box and ordinance citations in each jurisdiction in the right box:

| | |
|---|---|
| City of Los Angeles | Ord. No. 172075 |

## B. Residential ULFT Program Expenditures

1. Estimated cost per ULFT/HET replacement: 242.86

## C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? no

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## D. Comments

Cost per unit includes all programmatic costs.

# 2008 CUWCC Biennial Report

## Water Supply & Reuse

Reporting Unit: **Los Angeles Dept. of Water and Power**

Year: **2008**

### Water Supply Source Information

| Supply Source Name | Quantity (AF) Supplied | Supply Type |
|---|---|---|
| LA Aqueduct | 152642 | Imported |
| MWDSC | 421732 | Imported |
| Groundwater | 71023 | Groundwater |
| Recycled | 4273 | Recycled |
| Transfer | 1241 | Imported |
| Storage | 198 | Imported |

**Total AF: 651109**

Reported as of 6/10/10

## Accounts & Water Use

| Reporting Unit Name: | Submitted to CUWCC | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **02/08/2009** | **2008** |

| What is the reporting year? | Fiscal | Month Ending | June |
|---|---|---|---|

### A. Service Area Population Information:

1. Total service area population 4071873

### B. Number of Accounts and Water Deliveries (AF)

| Type | Metered | | Unmetered | |
|---|---|---|---|---|
| | No. of Accounts | Water Deliveries (AF) | No. of Accounts | Water Deliveries (AF) |
| 1. Single-Family | 482675 | 249530 | 0 | 0 |
| 2. Multi-Family | 124403 | 183064 | 0 | 0 |
| 3. Commercial | 72403 | 109091 | 0 | 0 |
| 4. Industrial | 6830 | 24257 | 0 | 0 |
| 5. Institutional | 7583 | 44803 | 0 | 0 |
| 6. Dedicated Irrigation | 766 | 264 | 0 | 0 |
| 7. Recycled Water | 45 | 4130 | 0 | 0 |
| 8. Other | 0 | 0 | 0 | 0 |
| 9. Unaccounted | NA | 37223 | NA | 0 |
| **Total** | 694705 | 652362 | 0 | 0 |
| | **Metered** | | **Unmetered** | |

Reported as of 6/10/10

## BMP 01: Water Survey Programs for Single-Family and Multi-Family Residential Customers

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2008** |

### A. Implementation

| | |
|---|---|
| 1. Based on your signed MOU date, 09/12/1991, your Agency STRATEGY DUE DATE is: | 09/11/1993 |
| 2. Has your agency developed and implemented a targeting/ marketing strategy for SINGLE-FAMILY residential water use surveys? | yes |
| a. If YES, when was it implemented? | 06/01/1990 |
| 3. Has your agency developed and implemented a targeting/ marketing strategy for MULTI-FAMILY residential water use surveys? | yes |
| a. If YES, when was it implemented? | 06/01/1990 |

### B. Water Survey Data

**Single**

| Survey Counts: | Family Accounts | Multi-Family Units |
|---|---|---|
| 1. Number of surveys offered: | 0 | 0 |
| 2. Number of surveys completed: | 0 | 0 |
| **Indoor Survey:** | | |
| 3. Check for leaks, including toilets, faucets and meter checks | yes | yes |
| 4. Check showerhead flow rates, aerator flow rates, and offer to replace or recommend replacement, if necessary | yes | yes |
| 5. Check toilet flow rates and offer to install or recommend installation of displacement device or direct customer to ULFT replacement program, as neccesary; replace leaking toilet flapper, as necessary | yes | yes |
| **Outdoor Survey:** | | |
| 6. Check irrigation system and timers | no | no |
| 7. Review or develop customer irrigation schedule | no | no |
| 8. Measure landscaped area (Recommended but not required for surveys) | no | no |
| 9. Measure total irrigable area (Recommended but not required for surveys) | no | no |
| 10. Which measurement method is typically used (Recommended but not required for surveys) | | None |
| 11. Were customers provided with information packets that included evaluation results and water savings recommendations? | no | no |
| 12. Have the number of surveys offered and completed, survey results, and survey costs been tracked? | yes | no |
| a. If yes, in what form are surveys tracked? | | manual activity |

b. Describe how your agency tracks this information.

In-house filing system

### C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? No

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

Period: FY 07-08 ULFT Rebate and D.I. programs end on 12/31/06. Marketing stops.

Reported as of 6/10/10

## BMP 02: Residential Plumbing Retrofit

Reporting Unit:
**Los Angeles Dept. of Water and** BMP Form Status: Year:

**Power** **100% Complete** **2008**

## A. Implementation

| | |
|---|---|
| 1. Is there an enforceable ordinance in effect in your service area requiring replacement of high-flow showerheads and other water use fixtures with their low-flow counterparts? | yes |

a. If YES, list local jurisdictions in your service area and code or ordinance in each:

City of Los Angeles "Water Closet, Urinal and Showerhead Regulations-Retrofit on Resale" Ordinance (No. 172075)

| | |
|---|---|
| 2. Has your agency satisfied the 75% saturation requirement for single-family housing units? | yes |
| 3. Estimated percent of single-family households with low-flow showerheads: | 99% |
| 4. Has your agency satisfied the 75% saturation requirement for multi-family housing units? | yes |
| 5. Estimated percent of multi-family households with low-flow showerheads: | 99% |

6. If YES to 2 OR 4 above, please describe how saturation was determined, including the dates and results of any survey research.

LA enacted an ordinance requiring all LADWP customers to install low flow showerheads & have installations certified or incur financial penalties for non-compliance. 99+% of LADWP customers have demonstrated compliance

## B. Low-Flow Device Distribution Information

| | |
|---|---|
| 1. Has your agency developed a targeting/ marketing strategy for distributing low-flow devices? | yes |
| a. If YES, when did your agency begin implementing this strategy? | 07/01/1988 |

b. Describe your targeting/ marketing strategy.

Direct mail to all SF customers; element of all survey pgms; req'd per L.A. ordinance; provided upon request to any residential customer; distributed with program ULFTs.

| Low-Flow Devices Distributed/ Installed | SF Accounts | MF Units |
|---|---|---|
| 2. Number of low-flow showerheads distributed: | 3812 | 12896 |
| 3. Number of toilet-displacement devices distributed: | 2 | 0 |
| 4. Number of toilet flappers distributed: | 39 | 11 |
| 5. Number of faucet aerators distributed: | 57 | 2300 |

| | |
|---|---|
| 6. Does your agency track the distribution and cost of low-flow devices? | yes |
| a. If YES, in what format are low-flow devices tracked? | Database |

b. If yes, describe your tracking and distribution system :

Tracking: in-house inventory control; Distribution through Water Conservation office to customers who call in and through LADWP account executivs.

## C. "At Least As Effective As"

| | |
|---|---|
| 1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? | No |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

Reported as of 6/10/10

## BMP 03: System Water Audits, Leak Detection and Repair

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2008** |

### A. Implementation

| | |
|---|---|
| 1. Does your agency own or operate a water distribution system? | yes |
| 2. Has your agency completed a pre-screening system audit for this reporting year? | Yes |
| 3. If YES, enter the values (AF/Year) used to calculate verifiable use as a percent of total production: | |
| a. Determine metered sales (AF) | 611008 |
| b. Determine other system verifiable uses (AF) | 0 |
| c. Determine total supply into the system (AF) | 648231 |
| d. Using the numbers above, if (Metered Sales + Other Verifiable Uses) / Total Supply is < 0.9 then a full-scale system audit is required. | 0.94 |
| 4. Does your agency keep necessary data on file to verify the values entered in question 3? | yes |
| 5. Did your agency complete a full-scale audit during this report year? | no |
| 6. Does your agency maintain in-house records of audit results or completed AWWA M36 audit worksheets for the completed audit which could be forwarded to CUWCC? | yes |
| 7. Does your agency operate a system leak detection program? | no |
| a. If yes, describe the leak detection program: | |

### B. Survey Data

| | |
|---|---|
| 1. Total number of miles of distribution system line. | 7228 |
| 2. Number of miles of distribution system line surveyed. | 0 |

### C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? No

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

### Voluntary Questions (Not used to calculate compliance)

---

### E. Volumes

| | Estimated | Verified |
|---|---|---|
| 1. Volume of raw water supplied to the system: | | |
| 2. Volume treated water supplied into the system: | | |
| 3. Volume of water exported from the system: | | |
| 4. Volume of billed authorized metered consumption: | | |

5. Volume of billed authorized unmetered consumption:

6. Volume of unbilled authorized metered consumption:

7. Volume of unbilled authorized unmetered consumption:

### F. Infrastructure and Hydraulics

1. System input (source or master meter) volumes metered at the entry to the:

2. How frequently are they tested and calibrated?

3. Length of mains:

4. What % of distribution mains are rigid pipes (metal, ac, concrete)?

5. Number of service connections:

6. What % of service connections are rigid pipes (metal)?

7. Are residential properties fully metered?

8. Are non-residential properties fully metered?

9. Provide an estimate of customer meter under-registration:

10. Average length of customer service line from the main to the point of the meter:

11. Average system pressure:

12. Range of system pressures: From to

13. What percentage of the system is fed from gravity feed?

14. What percentage of the system is fed by pumping and re-pumping?

### G. Maintenance Questions

1. Who is responsible for providing, testing, repairing and replacing customer meters?

2. Does your agency test, repair and replace your meters on a regular timed schedule?

a. If yes, does your agency test by meter size or customer category?:

b. If yes to meter size, please provide the frequency of testing by meter size:

Less than or equal to 1"

1.5" to 2"

3" and Larger

c. If yes to customer category, provide the frequency of testing by customer category:

SF residential

MF residential

Commercial

Industrial & Institutional

3. Who is responsible for repairs to the customer lateral or customer service line?

4. Who is responsible for service line repairs downstream of the customer meter?

5. Does your agency proactively search for leaks using leak

survey techniques or does your utility reactively repair leaks which are called in, or both?

6. What is the utility budget breakdown for:

| | |
|---|---|
| Leak Detection | $ |
| Leak Repair | $ |
| Auditing and Water Loss Evaluation | $ |
| Meter Testing | $ |

### H. Comments

Reported as of 6/10/10

## BMP 04: Metering with Commodity Rates for all New Connections and Retrofit of Existing

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2008** |

### A. Implementation

| | |
|---|---|
| 1. Does your agency have any unmetered service connections? | No |
| a. If YES, has your agency completed a meter retrofit plan? | |
| b. If YES, number of previously unmetered accounts fitted with meters during report year: | |
| 2. Are all new service connections being metered and billed by volume of use? | Yes |
| 3. Are all new service connections being billed volumetrically with meters? | Yes |
| 4. Has your agency completed and submitted electronically to the Council a written plan, policy or program to test, repair and replace meters? | Yes |

5. Please fill out the following matrix:

| Account Type | Number of Metered Accounts | Number of Metered Accounts Read | Number of Metered Accounts Billed by Volume | Billing Frequency Per Year | Number of Volume Estimates |
|---|---|---|---|---|---|
| a. Single Family | 483433 | 483433 | 483433 | 6 | 0 |
| b. Multi-Family | 121693 | 121693 | 121693 | 6 | 0 |
| c. Commercial | 60327 | 60327 | 60327 | 12 | 0 |
| d. Industrial | 6552 | 6552 | 6552 | 12 | 0 |
| e. Institutional | 6707 | 6707 | 6707 | 12 | 0 |
| f. Landscape Irrigation | 766 | 766 | 766 | 12 | 0 |

### B. Feasibility Study

| | |
|---|---|
| 1. Has your agency conducted a feasibility study to assess the merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters? | no |
| a. If YES, when was the feasibility study conducted? (mm/dd/yy) | |

b. Describe the feasibility study:

| | |
|---|---|
| 2. Number of CII accounts with mixed-use meters: | 60327 |
| 3. Number of CII accounts with mixed-use meters retrofitted with dedicated irrigation meters during reporting period. | 0 |

### C. "At Least As Effective As"

| | |
|---|---|
| 1. Is your agency implementing an "at least as effective as" variant of this BMP? | No |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

Fire services are metered; hydrants are not.

## BMP 05: Large Landscape Conservation Programs and Incentives

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2008** |

### A. Water Use Budgets

| | |
|---|---|
| 1. Number of Dedicated Irrigation Meter Accounts: | 766 |
| 2. Number of Dedicated Irrigation Meter Accounts with Water Budgets: | 269 |
| 3. Budgeted Use for Irrigation Meter Accounts with Water Budgets (AF): | 0 |
| 4. Actual Use for Irrigation Meter Accounts with Water Budgets (AF): | 0 |
| 5. Does your agency provide water use notices to accounts with budgets each billing cycle? | yes |

### B. Landscape Surveys

| | |
|---|---|
| 1. Has your agency developed a marketing / targeting strategy for landscape surveys? | yes |
| a. If YES, when did your agency begin implementing this strategy? | 6/10/1996 |

b. Description of marketing / targeting strategy:

Work with LA Dept Rec & Parks, school district to audit and provide audit training. All accts applying for landscape incentives also audited. Review consumption history for excess use.

| | |
|---|---|
| 2. Number of Surveys Offered. | 6 |
| 3. Number of Surveys Completed. | 6 |

4. Indicate which of the following Landscape Elements are part of your survey:

| | |
|---|---|
| a. Irrigation System Check | yes |
| b. Distribution Uniformity Analysis | yes |
| c. Review / Develop Irrigation Schedules | yes |
| d. Measure Landscape Area | yes |
| e. Measure Total Irrigable Area | yes |
| f. Provide Customer Report / Information | yes |

| | |
|---|---|
| 5. Do you track survey offers and results? | yes |
| 6. Does your agency provide follow-up surveys for previously completed surveys? | yes |

a. If YES, describe below:

Accounts with poor distribution uniformity re-audited after system improvements completed

## C. Other BMP 5 Actions

| | |
|---|---|
| 1. An agency can provide mixed-use accounts with ETo-based landscape budgets in lieu of a large landscape survey program.<br>Does your agency provide mixed-use accounts with landscape budgets? | no |
| 2. Number of CII mixed-use accounts with landscape budgets. | 0 |
| 3. Do you offer landscape irrigation training? | yes |
| 4. Does your agency offer financial incentives to improve landscape water use efficiency? | yes |

| Type of Financial Incentive: | Budget (Dollars/ Year) | Number Awarded to Customers | Total Amount Awarded |
|---|---|---|---|
| a. Rebates | 1000000 | 1 | 8538 |
| b. Loans | 0 | 0 | 0 |
| c. Grants | 80000 | 0 | 0 |

| | |
|---|---|
| 5. Do you provide landscape water use efficiency information to new customers and customers changing services? | No |

a. If YES, describe below:

| | |
|---|---|
| 6. Do you have irrigated landscaping at your facilities? | yes |
| a. If yes, is it water-efficient? | yes |
| b. If yes, does it have dedicated irrigation metering? | yes |
| 7. Do you provide customer notices at the start of the irrigation season? | no |
| 8. Do you provide customer notices at the end of the irrigation season? | no |

## D. "At Least As Effective As"

| | |
|---|---|
| 1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? | Yes |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

The Los Angeles Department of Water and Power (LADWP) is taking a multi-pronged approach and implementing several programs to target our large landscapes (e.g. parks and schools) and commercial, industrial, and institutional (CII) customers having irrigated landscapes. LADWP implements the ambitious Technical Assistance Program (TAP), which is a custom financial incentive program offering CII and Multi-Family Residential customers in Los Angeles up to $250,000 for the installation of pre-approved equipment and products (including the design and installation of efficient irrigation systems) that demonstrate persistent water savings. LADWP staff is currently working with a major customer on significant modifications for a new proprietary process that will conserve a considerable amount of water annually. LADWP has entered into a Memorandum of Understanding (MOU) with the Los Angeles

Department of Recreation and Parks (RAP) for the purpose of funding water use efficiency improvements for large landscapes in City parks. These water conservation improvements that LADWP and RAP are working in partnership to advance include installation of weather-based irrigation controllers, high efficiency sprinkler heads, and repair or replacement of irrigation distribution systems. The MOU strengthens LADWP's commitment to conservation as a means of providing a sustainable source of water to the City of Los Angeles as adopted by the Board in the 2005 Urban Water Management Plan. In August of 2008, LADWP amended its Emergency Water Conservation Plan (a City Ordinance) to address the increasing water shortage. The Plan's requirements are applicable to all LADWP customers, and are focused primarily on landscape irrigation. The Plan permits customers to use water only during specified hours of the day and specified days of the week, depending on the declared severity of water shortage. Water allotment varies by each phase (I-VI), such that phase I has the least amount of restrictions and phase VI having the most stringent restrictions. LADWP is currently developing a proposal for "Shortage Year" Water Rates (Tier 1 and Tier 2) for both commercial and residential customers that will become effective in mid-2009. Customers will be required to conserve 15% below their Tier 1 allotment to avoid a bill increase; however, those who exceed their allotment must pay Tier 2 rates resulting in higher water bills. Shortage Year Water Rates are designed to ensure that costs are recovered without penalizing customers who conserve during the years when projected demand for water exceeds the available supply. As has been demonstrated by LADWP's 100% volumetric rate structure, price signal is a most effective conservation tool. In addition to the Ordinance modifications described above, LADWP has developed and is planning to launch a Turf Buy Back Program in 2009. This new program will pay single family residential and commercial customers $1.00 per square foot of turf removed and replaced with drought tolerant plants, mulch or permeable hardscape. Any subsequent irrigation requirements will be met with low volume drip or microspray emitters. LADWP is also in the process of expanding our recycled water program and are working with water intensive CII customers such as golf courses, parks, and refineries to promote and use recycled water. LADWP is currently converting all of our golf courses and parks to dedicated irrigation meters for the usage of recycled water. Our recycled water goal is to deliver at least 50,000 acre-feet per year by 2019. This will be done by expanding the "purple pipe" distribution system to new customers who can use recycled water for non-potable uses such as irrigation and industrial processes.

### E. Comments

Reported as of 6/10/10

## BMP 06: High-Efficiency Washing Machine Rebate Programs

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2008** |

### A. Implementation

1. Do any energy service providers or waste water utilities in your service area offer rebates for high-efficiency washers?

a. If YES, describe the offerings and incentives as well as who the energy/waste water utility provider is.

| | |
|---|---|
| 2. Does your agency offer rebates for high-efficiency washers? | yes |
| 3. What is the level of the rebate? | |
| 4. Number of rebates awarded. | |

### B. Rebate Program Expenditures

| | This Year | Next Year |
|---|---|---|
| 1. Budgeted Expenditures | | |
| 2. Actual Expenditures | | |

### C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? no

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

Reported as of 6/10/10

## BMP 07: Public Information Programs

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2008** |

### A. Implementation

1. How is your public information program implemented?
Wholesaler and retailer both materially participate in program
Which wholesaler(s)?
Metropolitan Water District of Southern California

2. Describe the program and how it's organized:
LADWP's Public Affairs Division works closely with the Water Conservation office. Information is made available on LADWP Web site, conservation publications distributed at public venues and by request (in English and Spanish); customer newsletter; Speakers Bureau and school presentations; fleet vehicle signage; posters and brochures in LADWP Customer Service Centers and City Council field offices; permanent water display located at Olvera Street, a popular Los Angeles landmark and tourist venue; a special flier regarding conservation was produced and inserted for distribution in the Los Angeles Times and Daily News in English and in Impacto in Spanish. Print advertisements were placed twice monthly beginning in November of 2005 and terminating December 2006 in various languages in the community press and major daily newspapers serving Los Angeles to Promote awareness of and participation in LADWP's residential water conservation programs. The LADWP Public Affairs Division prepares an outreach program annually based on the specific program needs of the Water Conservation office. Public Affairs implements the elements of the program which include development and production of collateral materials and exhibits; development and placement of all advertisements and public service announcements; development and posting of Web site announcements. MWDSC independently promotes conservation through various media channels and directly promotes programs via the bewaterwise.com website as well as by its program

implementation contractor

3. Indicate which and how many of the following activities are included in your public information program:

| Public Information Program Activity in Retail Service Area | Yes/No | Number of Events |
|---|---|---|
| a. Paid Advertising | yes | 250 |
| b. Public Service Announcement | no | |
| c. Bill Inserts / Newsletters / Brochures | yes | 22 |
| d. Bill showing water usage in comparison to previous year's usage | yes | |
| e. Demonstration Gardens | no | |
| f. Special Events, Media Events | yes | 3 |
| g. Speaker's Bureau | yes | 10 |
| h. Program to coordinate with other government agencies, industry and public interest groups and media | yes | |

## B. Conservation Information Program Expenditures

1. Annual Expenditures (Excluding Staffing)

## C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? No

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## D. Comments

Reported as of 6/10/10

# BMP 08: School Education Programs

Reporting Unit:
**Los Angeles Dept. of Water and Power**

BMP Form Status:
**100% Complete**

Year:
**2008**

## A. Implementation

1. How is your public information program implemented?
Retailer runs program without wholesaler sponsorship

2. Please provide information on your region-wide school programs (by grade level):

| Grade | Are grade-appropriate materials distributed? | No. of class presentations | No. of students reached | No. of teachers' workshops |
|---|---|---|---|---|
| Grades K-3rd | yes | 0 | 0 | 0 |
| Grades 4th-6th | yes | 0 | 3600 | 0 |
| Grades 7th-8th | yes | 0 | 18500 | 0 |
| High School | yes | 0 | 29500 | 0 |

| | |
|---|---|
| 4. Did your Agency's materials meet state education framework requirements? | yes |
| 5. When did your Agency begin implementing this program? | 09/15/1975 |

### B. School Education Program Expenditures

1. Annual Expenditures (Excluding Staffing)

### C. "At Least As Effective As"

| | |
|---|---|
| 1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? | No |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

Teachers' guide and supporting materials funded and/or provided by LADWP. Dedicated LADWP staff coordinate with school district throughout the school year.

Reported as of 6/10/10

## BMP 09: Conservation Programs for CII Accounts

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2008** |

### A. Implementation

| | |
|---|---|
| 1. Has your agency identified and ranked COMMERCIAL customers according to use? | yes |
| 2. Has your agency identified and ranked INDUSTRIAL customers according to use? | yes |
| 3. Has your agency identified and ranked INSTITUTIONAL customers according to use? | yes |

### Option A: CII Water Use Survey and Customer Incentives Program

| | |
|---|---|
| 4. Is your agency operating a CII water use survey and customer incentives program for the purpose of complying with BMP 9 under this option? If so, please describe activity during reporting period: | yes |

| CII Surveys | Commercial Accounts | Industrial Accounts | Institutional Accounts |
|---|---|---|---|
| a. Number of New Surveys Offered | 15 | 7 | 4 |
| b. Number of New Surveys Completed | 15 | 7 | 4 |
| c. Number of Site Follow-ups of Previous Surveys (within 1 yr) | 6 | 4 | 1 |
| d. Number of Phone Follow-ups of Previous Surveys (within 1 yr) | 6 | 2 | 1 |

| CII Survey Components | Commercial | Industrial | Institutional |
|---|---|---|---|

| | Accounts | Accounts | Accounts |
|---|---|---|---|
| e. Site Visit | yes | yes | yes |
| f. Evaluation of all water-using apparatus and processes | yes | yes | yes |
| g. Customer report identifying recommended efficiency measures, paybacks and agency incentives | yes | yes | yes |
| **Agency CII Customer Incentives** | **Budget ($/Year)** | **# Awarded to Customers** | **Total $ Amount Awarded** |
| h. Rebates | 1500000 | 6605 | 925931 |
| i. Loans | 0 | 0 | 0 |
| j. Grants | 350000 | 0 | 0 |
| k. Others | 0 | 0 | 0 |

## Option B: CII Conservation Program Targets

| | |
|---|---|
| 5. Does your agency track CII program interventions and water savings for the purpose of complying with BMP 9 under this option? | yes |
| 6. Does your agency document and maintain records on how savings were realized and the method of calculation for estimated savings? | yes |

7. **System Calculated** annual savings (AF/yr):

| CII Programs | # Device Installations |
|---|---|
| a. Ultra Low Flush Toilets | 1127 |
| b. Dual Flush Toilets | 525 |
| c. High Efficiency Toilets | 1721 |
| d. High Efficiency Urinals | 1327 |
| e. Non-Water Urinals | 346 |
| f. Commercial Clothes Washers (coin-op only; not industrial) | 835 |
| g. Cooling Tower Controllers | 26 |
| h. Food Steamers | 13 |
| i. Ice Machines | 0 |
| j. Pre-Rinse Spray Valves | 2 |
| k. Steam Sterilizer Retrofits | 5 |
| l. X-ray Film Processors | 0 |

8. **Estimated** annual savings (AF/yr) from agency programs not including the devices listed in Option B. 7., above:

| CII Programs | Annual Savings (AF/yr) |
|---|---|
| a. Site-verified actions taken by agency: | 0 |
| b. Non-site-verified actions taken by agency: | 0 |

## B. Conservation Program Expenditures for CII Accounts

| | This Year | Next Year |
|---|---|---|

| | | |
|---|---|---|
| 1. Budgeted Expenditures | 2750000 | 2750000 |
| 2. Actual Expenditures | 925931 | |

## C. "At Least As Effective As"

1. Is your agency implementing an "at least as effective as" variant of this BMP? No

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## D. Comments

# BMP 11: Conservation Pricing

| Reporting Unit: | BMP Form Status: | Year: |
|---|---|---|
| **Los Angeles Dept. of Water and Power** | **100% Complete** | **2008** |

## A. Implementation

### Water Service Rate Structure Data by Customer Class

**1. Single Family Residential**

| | |
|---|---|
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 299,536,198 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ , |

**2. Multi-Family Residential**

| | |
|---|---|
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 216,210,111 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |

**3. Commercial**

| | |
|---|---|
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 138,218,700 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |

**4. Industrial**

| | |
|---|---|
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 30,670,561 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |

**5. Institutional / Government**

| | |
|---|---|
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 36,762,959 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |

| | |
|---|---|
| **6. Dedicated Irrigation (potable)** | |
| a. Rate Structure | Increasing Block Seasonal |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 7,965,994 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |
| **7. Recycled-Reclaimed** | |
| a. Rate Structure | Uniform |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 1,679,516 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |
| **8. Raw** | |
| a. Rate Structure | Service Not Provided |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |
| **9. Other** | |
| a. Rate Structure | Service Not Provided |
| b. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |
| c. Total Revenue from Customer Meter/Service (Fixed) Charges | $ 0 |

## B. Implementation Options

### Select Either Option 1 or Option 2:

**1. Option 1: Use Annual Revenue As Reported**
V/(V+M) >= 70%
V = Total annual revenue from volumetric rates
M = Total annual revenue from customer meter/service (fixed) charges

Selected

**2. Option 2: Use Canadian Water & Wastewater Association Rate Design Model**
V/(V+M) >= V'/(V'+M')
V = Total annual revenue from volumetric rates
M = Total annual revenue from customer meter/service (fixed) charges
V' = The uniform volume rate based on the signatory's long-run incremental cost of service
M' = The associated meter charge

a. If you selected Option 2, has your agency submitted to the Council a completed Canadian Water & Wastewater Association rate design model?

b. Value for **V'** (uniform volume rate based on agency's long-run incremental cost of service) as determined by the Canadian Water & Wastewater Association rate design model:

c. Value for **M'** (meter charge associated with V' uniform volume rate) as determined by the Canadian Water & Wastewater Association rate design model:

## C. Retail Wastewater (Sewer) Rate Structure Data by Customer Class

| | |
|---|---|
| 1. Does your agency provide sewer service? (If YES, answer questions 2 - 7 below, else continue to section D.) | No |

**2. Single Family Residential**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

**3. Multi-Family Residential**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

**4. Commercial**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

**5. Industrial**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

**6. Institutional / Government**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

**7. Recycled-reclaimed water**

| | |
|---|---|
| a. Sewer Rate Structure | |
| b. Total Annual Revenue | $ 0 |
| c. Total Revenue from Commodity Charges (Volumetric Rates) | $ 0 |

## D. "At Least As Effective As"

| | |
|---|---|
| 1. Is your agency implementing an "at least as effective as" variant of this BMP? | No |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## E. Comments

Link to LADWP Water Rate Ordinance:
http://www.ladwp.com/ladwp/cms/ladwp001149.pdf

## BMP 12: Conservation Coordinator

| | | |
|---|---|---|
| Reporting Unit:<br>**Los Angeles Dept. of Water and Power** | BMP Form Status:<br>**100% Complete** | Year:<br>**2008** |

### A. Implementation

| | |
|---|---|
| 1. Does your Agency have a conservation coordinator? | yes |
| 2. Is a coordinator position supplied by another agency with which you cooperate in a regional conservation program ? | no |
| a. Partner agency's name: | |
| 3. If your agency supplies the conservation coordinator: | |
| a. What percent is this conservation coordinator's position? | 100% |
| b. Coordinator's Name | Thomas Gackstetter |
| c. Coordinator's Title | Water Conservation Manager |
| d. Coordinator's Experience and Number of Years | 21 |
| e. Date Coordinator's position was created (mm/dd/yyyy) | 12/11/1991 |
| 4. Number of conservation staff (FTEs), including Conservation Coordinator. | 5 |

### B. Conservation Staff Program Expenditures

| | |
|---|---|
| 1. Staffing Expenditures (In-house Only) | 609562 |
| 2. BMP Program Implementation Expenditures | 6989200 |

### C. "At Least As Effective As"

| | |
|---|---|
| 1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? | no |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

## BMP 13: Water Waste Prohibition

| | | |
|---|---|---|
| Reporting Unit:<br>**Los Angeles Dept. of Water and Power** | BMP Form Status:<br>**100% Complete** | Year:<br>**2008** |

### A. Requirements for Documenting BMP Implementation

| | |
|---|---|
| 1. Is a water waste prohibition ordinance in effect in your service area? | yes |

a. If YES, describe the ordinance:

Prohibits use of water on hardscape, gutter flooding, unattended leaks, mid-day watering, serving water in restaurants w/o request, non recirc fountains

| | |
|---|---|
| 2. Is a copy of the most current ordinance(s) on file with CUWCC? | yes |

a. List local jurisdictions in your service area in the first text box and water waste ordinance citations in each jurisdiction in the second text box:

| | |
|---|---|
| City of Los Angeles | Ord No. 166080 |

### B. Implementation

1. Indicate which of the water uses listed below are prohibited by your agency or service area.

| | |
|---|---|
| a. Gutter flooding | yes |
| b. Single-pass cooling systems for new connections | Yes |
| c. Non-recirculating systems in all new conveyor or car wash systems | Yes |
| d. Non-recirculating systems in all new commercial laundry systems | Yes |
| e. Non-recirculating systems in all new decorative fountains | yes |
| f. Other, please name<br>See above | yes |

2. Describe measures that prohibit water uses listed above:

Specific ordinance language, monetary penalties, service restrictions/shutoff. Cost of water/wastewater and common practice limits number of single pass systems

**Water Softeners:**

3. Indicate which of the following measures your agency has supported in developing state law:

| | |
|---|---|
| a. Allow the sale of more efficient, demand-initiated regenerating DIR models. | no |
| b. Develop minimum appliance efficiency standards that: | |
| i.) Increase the regeneration efficiency standard to at least 3,350 grains of hardness removed per pound of common salt used. | no |
| ii.) Implement an identified maximum number of gallons discharged per gallon of soft water produced. | no |
| c. Allow local agencies, including municipalities and special districts, to set more stringent standards and/or to ban on-site regeneration of water softeners if it is demonstrated and found by the agency governing board that there is an adverse effect on the reclaimed water or groundwater supply. | no |

| | |
|---|---|
| 4. Does your agency include water softener checks in home water audit programs? | no |
| 5. Does your agency include information about DIR and exchange-type water softeners in educational efforts to encourage replacement of less efficient timer models? | no |

### C. "At Least As Effective As"

| | |
|---|---|
| 1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? | no |

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

### D. Comments

## BMP 14: Residential ULFT Replacement Programs

| Reporting Unit: **Los Angeles Dept. of Water and Power** | BMP Form Status: **100% Complete** | Year: **2008** |
|---|---|---|

## A. Implementation

**Number of 1.6 gpf Toilets Replaced by Agency Program During Report Year**

| | **Single-Family Accounts** | **Multi-Family Units** |
|---|---|---|
| 1. Does your Agency have program(s) for replacing high-water-using toilets with ultra-low flush toilets? | yes | yes |
| **Replacement Method** | **SF Accounts** | **MF Units** |
| 2. Rebate | 0 | 42 |
| 3. Direct Install | 0 | 0 |
| 4. CBO Distribution | 0 | 0 |
| 5. Other | 0 | 0 |
| **Total** | **0** | **42** |

**Number of 1.2 gpf High-Efficiency Toilets (HETs) Replaced by Agency Program During Report Year**

| | **Single-Family Accounts** | **Multi-Family Units** |
|---|---|---|
| 6. Does your Agency have program(s) for replacing high-water-using toilets with ultra-low flush toilets? | no | no |
| **Replacement Method** | **SF Accounts** | **MF Units** |
| 7. Rebate | | |
| 8. Direct Install | | |
| 9. CBO Distribution | | |
| 10. Other | | |
| **Total** | | |

**Number of Dual-Flush Toilets Replaced by Agency Program During Report Year**

| | **Single-Family Accounts** | **Multi-Family Units** |
|---|---|---|
| 11. Does your Agency have program(s) for replacing high-water-using toilets with ultra-low flush toilets? | no | no |
| **Replacement Method** | **SF Accounts** | **MF Units** |
| 12. Rebate | 0 | 0 |
| 13. Direct Install | 0 | 0 |
| 14. CBO Distribution | 0 | 0 |
| 15. Other | 0 | 0 |
| **Total** | **0** | **0** |

16. Describe your agency's ULFT, HET, and/or Dual-Flush Toilet programs for

single-family residences.

Residential ULFT rebate and distribution programs ended in 2007.

17. Describe your agency's ULFT, HET, and/or Dual-Flush Toilet programs for multi-family residences.

Residential ULFT rebate and distribution programs ended in 2007.

18. Is a toilet retrofit on resale ordinance in effect for your service area? yes

19. List local jurisdictions in your service area in the left box and ordinance citations in each jurisdiction in the right box:

| | |
|---|---|
| City of Los Angeles | Ord. No. 172075 |

## B. Residential ULFT Program Expenditures

1. Estimated cost per ULFT/HET replacement: 242.86

## C. "At Least As Effective As"

1. Is your AGENCY implementing an "at least as effective as" variant of this BMP? no

a. If YES, please explain in detail how your implementation of this BMP differs from Exhibit 1 and why you consider it to be "at least as effective as."

## D. Comments

Urban Water Management Plan

# Appendix I

# Emergency Water Conservation Plan

**ORDINANCE NO. 181288**

An ordinance amending Chapter XII, Article I of the Los Angeles Municipal Code to clarify prohibited uses and modify certain water conservation requirements of the Water Conservation Plan of the City of Los Angeles.

**THE PEOPLE OF THE CITY OF LOS ANGELES DO ORDAIN AS FOLLOWS:**

Section 1. Chapter XII, Article I, of the Los Angeles Municipal Code is amended in its entirety to read:

## ARTICLE I
## EMERGENCY WATER CONSERVATION PLAN

### SEC. 121.00. SCOPE AND TITLE.

This Article shall be known as The Emergency Water Conservation Plan of the City of Los Angeles.

### SEC. 121.01. DECLARATION OF POLICY.

It is hereby declared that because of the conditions prevailing in the City of Los Angeles and in the areas of this State and elsewhere from which the City obtains its water supplies, the general welfare requires that the water resources available to the City be put to the maximum beneficial use to the extent to which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented, and the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interests of the people of the City and for the public welfare.

### SEC. 121.02. DECLARATION OF PURPOSE.

The purpose of this Article is to provide a mandatory water conservation plan to minimize the effect of a shortage of water to the Customers of the City and, by means of this Article, to adopt provisions that will significantly reduce the consumption of water over an extended period of time, thereby extending the available water required for the Customers of the City while reducing the hardship of the City and the general public to the greatest extent possible, voluntary conservation efforts having proved to be insufficient.

### SEC. 121.03. DEFINITIONS

The following words and phrases, whenever used in this Article, shall be construed as defined in this Section unless from the context a different meaning is intended or unless a different meaning is specifically defined within individual Sections of this Article:

a. "**Article**" means the ordinance providing for "**The Emergency Water Conservation Plan of the City of Los Angeles**".

b. **"Baseline Water Usage"** means the amount of water used for the same period during Fiscal Year 2006-2007. The Baseline Water Usage for Customers without a water usage history prior to 2007 shall be calculated pursuant to a Department water budget.

c. "**Billing Unit**" means the unit amount of water used to apply water rates for purposes of calculating commodity charges for Customer water usage and equals one hundred (100) cubic feet or seven hundred forty-eight (748) gallons of water.

d. "**City**" means the City of Los Angeles.

e. "**City Council**" means the Council of the City of Los Angeles.

f. "**Conservation Phase**" means that level of mandatory water conservation presently required from Customers pursuant to this Article.

g. "**Customer**" means any person, persons, association, corporation or governmental agency supplied or entitled to be supplied with water service by the Department.

h. "**Department**" means the Los Angeles Department of Water and Power.

i. **"Drip Irrigation"** means an efficient and targeted form of irrigation in which water is delivered in drops directly to the plants roots where no emitter produces more than four (4) gallons of water per hour.

j. **"Even-numbered"** means street addresses ending with the following numerals: 0 (Zero), 2 (Two), 4 (Four), 6 (Six), 8 (Eight). Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address.

k. "**Gray Water**" means a Customer's second or subsequent use of water supplied by the Department on the Customer's premises, such as the use of laundry or bathing water for other purposes.

l. "**His**" as used herein includes masculine, feminine or neuter, as appropriate.

m. **"Irrigate"** means any exterior application of water, other than for firefighting purposes, dust control, or as process water, including but not limited to the watering of any vegetation whether it be natural or planted.

n. **"Large Landscape Area"** means an area of vegetation at least three acres in size supporting a business necessity or public benefit uses such as parks, golf courses, schools, and cemeteries, and includes without limitation Schedule F and Provision M rate Customers.

o. "**Mayor**" means the Mayor of the City of Los Angeles

p. **"Notice to the Department"** means written communication documenting compliance with all requirements and directed to the Department.

q. **"Odd-numbered"** means street addresses ending with the following numerals: 1 (One), 3 (Three), 5 (Five), 7 (Seven), 9 (Nine). Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address.

r. "**Officer**" means every person designated in Section 200 of the Los Angeles City Charter as an officer of the City of Los Angeles.

s. **"Potable Water"** means water supplied by the Department which is suitable for drinking and excludes recycled water from any source.

t. **"Private Golf Course"** means a facility with a business license where play is restricted to members and their guests, and does not include personal use facilities such as backyard golf greens or courses.

u. "**Process Water**" means water used to manufacture, alter, convert, clean, heat, or cool a product, or the equipment used for such purpose; water used for plant and equipment washing and for transporting of raw materials and products; and water used for community gardens, or to grow trees, plants, or turf for sale or installation.

v. **"Recycled Water"** means water which as a result of treatment of wastewater, is suitable for a direct beneficial use, or a controlled use as approved by the California Department of Public Health.

w. "**Section**" means a section of this Article unless some other ordinance or statute is specifically mentioned.

x. **"Single pass cooling systems"** means equipment where water is circulated only once to cool equipment before being disposed.

y. **"Sports Fields"** means a public or private facility supporting a business necessity or public benefit use that provides turf areas as a playing surface for individual and team sports, and does not include a facility on a residential property.

z. **"Station"** means those sprinklers or other water-emitting devices controlled by a single valve.

**SEC. 121.04. AUTHORIZATION.**

The various officers, boards, departments, bureaus and agencies of the City are hereby authorized and directed to immediately implement the applicable provisions of this Article upon the effective date hereof.

**SEC. 121.05. APPLICATION.**

The provisions of this Article shall apply to all Customers and property served by the Department wherever situated, and shall also apply to all property and facilities owned, maintained, operated, or under the jurisdiction of the various officers, boards, departments, bureaus or agencies of the City.

**SEC. 121.06. WATER CONSERVATION PHASES.**

**A.** No Customer of the Department shall make, cause, use, or permit the use of water from the Department for any residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Article. The waste or unreasonable use of water is prohibited.

**B.** For the purposes of this Article, a use of water by a tenant or by an employee, agent, contractor or other designee acting on behalf of a Customer whether with real or ostensible authority shall be imputed to the Customer. Nothing contained in this Article shall limit the remedies available to a Customer under law or equity for the actions of a tenant, agent, contractor or other acting on behalf of a Customer.

**SEC. 121.07. CONSERVATION PHASE IMPLEMENTATION.**

**A.** Notwithstanding any other provisions of this Article, the provisions of Section 121.08A, Phase I, Prohibited Uses applicable to all Customers, shall take effect immediately upon the effective date of this Article, shall be permanent and shall not be subject to termination pursuant to the provisions of this Article providing for the termination of a conservation phase.

**B.** The Department shall monitor and evaluate the projected supply and demand for water by its Customers monthly, and shall recommend to the Mayor and Council by concurrent written notice the extent of the conservation required by the Customers of the Department in order for the Department to prudently plan for and supply water to its Customers. The Mayor shall, in turn, independently evaluate such recommendation and notify the Council of the Mayor's determination as to the particular phase of water conservation, Phase I through Phase V that should be implemented. Thereafter, the Mayor may, with the concurrence of the Council, order that the appropriate phase of water conservation be implemented in accordance with the applicable provisions of this Article. Said order shall be made by public proclamation and shall be published one time only in a daily newspaper of general circulation and shall become effective immediately upon such publication. The prohibited water uses for each phase shall take effect with the first full billing period commencing on or after the effective date of the public proclamation by the Mayor.

In the event the Mayor independently recommends to the Council a phase of conservation different from that recommended by the Department, the Mayor shall include detailed supporting data and the reasons for the independent recommendation in the notification to the Council of the Mayor's determination as to the appropriate phase of conservation to be implemented.

C. Phase Termination

1. At such time as the Department reports an April 1 forecast of annual Owens Valley and Mono Basin Runoff equal to or exceeding 110 percent of normal and the Metropolitan Water District of Southern California officially states that the sum of its Colorado River and State Water Project supplies exceeds 100 percent of projected demand, the Mayor shall forthwith recommend to the Council the termination of any Customer curtailment phase then in effect. Said recommendation to terminate shall take effect upon concurrence of the Council.

2. The provisions of Subsection C1 above shall not preclude the Department on the basis of information available to it from recommending to the Mayor the termination of a water conservation phase then in effect. The Mayor shall forward said recommendation to the Council and it shall take effect upon concurrence by the Council.

**SEC. 121.08. WATER CONSERVATION PHASES.**

**A. PHASE I**

**Prohibited Uses Applicable To All Customers.**

1. No Customer of the Department shall use a water hose to wash any paved surfaces including, but not limited to, sidewalks, walkways, driveways, and parking areas, except to alleviate immediate safety or sanitation hazards. This Section shall not apply to Department-approved water-conserving spray cleaning devices. Use of water-pressure devices for graffiti removal is exempt. A simple spray nozzle does not qualify as a water-conserving spray cleaning device.

2. No Customer of the Department shall use water to clean, fill, or maintain levels in decorative fountains, ponds, lakes, or similar structures used for aesthetic purposes unless such water is part of a recirculating system.

3. No restaurant, hotel, café, cafeteria, or other public place where food is sold, served or offered for-sale, shall serve drinking water to any person unless expressly requested.

4. No Customer of the Department shall permit water to leak from any pipe or fixture on the Customer's premises; failure or refusal to effect a timely repair of any leak of which the Customer knows or has reason to know shall subject said Customer to all penalties provided herein for a prohibited use of water.

5. No Customer of the Department shall wash a vehicle with a hose if the hose does not have a self-closing water shut-off or device attached to it, or otherwise allow a hose to run continuously while washing a vehicle.

6. No Customer of the Department shall irrigate during periods of rain.

7. No Customer of the Department shall water or irrigate lawn, landscape, or other vegetated areas between the hours of 9:00 a.m. and 4:00 p.m. During these hours, public and private golf course greens and tees and professional sports fields may be irrigated in order to maintain play areas and accommodate event schedules. Supervised testing or repairing of irrigation systems is allowed anytime with proper signage.

8. All irrigating of landscape with potable water using spray head sprinklers and bubblers shall be limited to no more than ten (10) minutes per watering day per station. All irrigating of landscape with potable water using standard rotors and multi-stream rotary heads shall be limited to no more than fifteen (15) minutes per cycle and up to two (2) cycles per watering day per station. Exempt from these landscape irrigation restrictions are irrigation systems using very low-flow drip-type irrigation when no emitter produces more than four (4) gallons of water per hour and micro-sprinklers using less than fourteen (14) gallons per hour. This provision does not apply to Schedule F water Customers or water service that has been granted the General Provision M rate adjustment under the City's Water Rates Ordinance, subject to the Customer having complied with best management practices for irrigation approved by the Department. The 9:00 a.m. to 4:00 p.m. irrigation restriction shall apply unless specifically exempt as stated in subsection 7 above.

9. No Customer of the Department shall water or irrigate any lawn, landscape, or other vegetated area in a manner that causes or allows excess or continuous water flow or runoff onto an adjoining sidewalk, driveway, street, gutter or ditch.

10. No installation of single pass cooling systems shall be permitted in buildings requesting new water service.

11. No installation of non-recirculating systems shall be permitted in new conveyor car wash and new commercial laundry systems.

12. Operators of hotels and motels shall provide guests with the option of choosing not to have towels and linens laundered daily. The hotel or motel shall prominently display notice of this option in each bathroom using clear and easily understood language. The Department shall make suitable displays available.

13. No Large Landscape Areas shall have irrigation systems without rain sensors that shut off the irrigation systems. Large Landscape Areas with approved weather-based irrigation controllers registered with the Department are in compliance with this requirement.

## B. PHASE II

1. **Prohibited Uses Applicable To All Customers.** Should Phase II be implemented, uses applicable to Phase I of this Section shall continue to be applicable, except as specifically provided below.

2. Non-Watering Days. No landscape irrigation shall be permitted on any day other than Monday, Wednesday, or Friday for odd-numbered street addresses and Tuesday, Thursday , or Sunday for even-numbered street addresses. Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address. Watering times shall be limited to:

(a) Non-conserving nozzles (spray head sprinklers and bubblers) – no more than eight (8) minutes per watering day per station for a total of 24 minutes per week.

(b) Conserving nozzles (standard rotors and multi-stream rotary heads) – no more than fifteen (15) minutes per cycle and up to two (2) cycles per watering day per station for a total of 90 minutes per week.

(With the above watering times, water consumption used for both types of nozzles is essentially equal.)

3. Upon written Notice to the Department, irrigation of Sports Fields may deviate from the non-watering days to maintain play areas and accommodate event schedules; however, to be eligible for this means of compliance, a Customer must reduce his overall monthly water use by the Department's Board of Water and Power Commissioners (Board)-adopted

degree of shortage plus an additional five percent from the Customer Baseline Water Usage within 30 days.

4. Upon written Notice to the Department, Large Landscape Areas may deviate from the non-watering days by meeting the following requirements: 1) must have approved weather-based irrigation controllers registered with the Department (eligible weather-based irrigation controllers are those approved by the Metropolitan Water District of Southern California or the Irrigation Association Smart Water Application Technologies [SWAT] initiative); 2) must reduce overall monthly water use by the Department's Board-adopted degree of shortage plus an additional five percent from the Customer Baseline Water Usage within 30 days; and 3) must use recycled water if it is available from the Department.

5. These provisions do not apply to drip irrigation supplying water to a food source or to hand-held hose watering of vegetation, if the hose is equipped with a self-closing water shut-off device, which is allowed everyday during Phase II except between the hours of 9:00 am and 4:00 pm.

## C. PHASE III

1. **Prohibited Uses Applicable to All Customers.** Should Phase III be implemented, uses applicable to Phase I of this Section shall continue to be applicable, except as specifically provided below.

2. Non-Watering Days. No landscape irrigation shall be permitted on any day other than Monday for odd-numbered street addresses and Tuesday for even-numbered street addresses. Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address.

3. No washing of vehicles allowed except at commercial car wash facilities.

4. No filling of residential swimming pools and spas with potable water.

5. Upon written Notice to the Department, irrigation of Sports Fields may deviate from the specific non-watering days and be granted one additional watering day (for a total of 2 days allowed). To be eligible for this means of compliance, a Customer must reduce overall monthly water use by the Department's Board-adopted degree of shortage plus an additional ten percent from the Customer Baseline Water Usage within 30 days.

6. Upon written Notice to the Department, Large Landscape Areas may deviate from the specific non-watering days and be granted one additional watering day (for a total of 2 days allowed) by meeting the following requirements: 1) must have approved weather-based irrigation controllers

registered with the Department (eligible weather-based irrigation controllers are those approved by the Metropolitan Water District of Southern California or the Irrigation Association Smart Water Application Technologies [SWAT] initiative); 2) must reduce overall monthly water use by the Department's Board-adopted degree of shortage plus an additional ten percent from the Customer Baseline Water Usage within 30 days; and 3) must use recycled water if it is available from the Department.

7. These provisions do not apply to drip irrigation supplying water to a food source or to hand-held hose watering of vegetation, if the hose is equipped with a self-closing water shut-off device, which is allowed everyday during Phase IV except between the hours of 9:00 a.m. and 4:00 p.m.

**D. PHASE IV**

1. **Prohibited Uses Applicable To All Customers**. Should Phase IV be implemented, uses applicable to Phases I, II, and III of this Section shall continue to be applicable, except as specifically provided below.

2. Non-Watering Days. No landscape irrigation allowed.

**E. PHASE V**

1. **Prohibited Uses Applicable To All Customers.** Phases I, II, III, and IV of Section 121.08 shall continue to remain in effect.

2. Additional Prohibited Uses - The Board is hereby authorized to implement additional prohibited uses of water based on the water supply situation. Any additional prohibition shall be published at least once in a daily newspaper of general circulation and shall become effective immediately upon such publication and shall remain in effect until cancelled.

**F. EXCEPTION**. The prohibited uses of water provided for by Subsections A, B, C, D, and E of this Section are not applicable to the uses of water necessary for public health and safety or for essential government services such as police, fire, and other similar emergency services.

**G. VARIANCE.** If, due to unique circumstances, a specific requirement of this Section would result in undue hardship to a Customer using water or to property upon which water is used, that is disproportionate to the impacts to water users generally or to similar property or classes of water uses, then the Customer may apply for a variance from the requirements. Unique circumstances include, but are not limited to, physical disabilities which prevent compliance with the Water Conservation Plan. The Department shall adopt procedures for variance applications, review, and decision.

**SEC. 121.09 FAILURE TO COMPLY.**

**A. Penalties – Water Meters Smaller Than Two Inches (2").** It shall be unlawful for any Customer of the Department to fail to comply with any of the provisions of this Article. Notwithstanding any other provision of the Los Angeles Municipal Code, the penalties set forth herein shall be exclusive and not cumulative with any other provisions of this Code. The penalties for failure to comply with any of the provisions of this Article shall be as follows:

1. For the first violation by any Customer of any of the provisions of Subsection A, B, C and D of Section 121.08, the Department shall issue a written notice of the fact of such violation to the Customer.

2. For a second violation by any Customer of any of the provisions of Subsection A, B, C and D of Section 121.08 within the preceding twelve (12) calendar months, a surcharge in the amount of One Hundred Dollars ($100.00) shall be added to the Customer's water bill.

3. For a third violation by any Customer of any of the provisions of Subsection A, B, C and D of Section 121.08 within the preceding twelve (12) calendar months, a surcharge in the amount of Two Hundred Dollars ($200.00) shall be added to the Customer's water bill.

4. For a fourth and any subsequent violation by a Customer of any of the provisions of Subsection A, B, C and D of Section 121.08 within the preceding twelve (12) calendar months, a surcharge in the amount of Three Hundred Dollars ($300.00) shall be added to the Customer's water bill.

5. After a fifth or subsequent violation, the Department may install a flow-restricting device of one-gallon-per-minute (1 GPM) capacity for services up to one and one-half inch (1-1/2") size and comparatively sized restrictors for larger services or terminate a Customer's service, in addition to the financial surcharges provided for herein. Such action shall be taken only after a hearing held by the Department where the Customer has an opportunity to respond to the Department's information or evidence that the Customer has repeatedly violated this Article or Department rules regarding the conservation of water and that such action is reasonably necessary to assure compliance with this Article and Department rules regarding the conservation of water.

Any such restricted or terminated service may be restored upon application of the Customer made not less than forty-eight (48) hours after the implementation of the action restricting or terminating service and only upon a showing by the Customer that the Customer is ready, willing and able to comply with the provisions of this Article and Department rules regarding the conservation of water. Prior to any restoration of service, the Customer shall pay all Department charges for any restriction or termination of service and its restoration as provided for in the Department's rules governing water service, including but not limited to payment of all past due bills and fines.

**B. Penalties – Water Meters Two Inches (2") and Larger**. It shall be unlawful for any Customer of the Department to fail to comply with any of the provisions of this Article. Notwithstanding any other provision of the Los Angeles Municipal Code, the penalties set forth herein shall be exclusive and not cumulative with any other provisions of this Code. The penalties for failure to comply with any of the provisions of this Article shall be as follows:

1. For the first violation by any Customer of any of the provisions of Subsection A, B, C and D of Section 121.08, the Department shall issue a written notice of the fact of such violation to the commercial or industrial Customer.

2. For a second violation by any Customer of any of the provisions of Subsection A, B, C and D of Section 121.08 within the preceding twelve (12) calendar months, a surcharge in the amount of Two Hundred Dollars ($200.00) shall be added to the Customer's water bill.

3. For a third violation by any Customer of any of the provisions of Subsection A, B, C and D of Section 121.08 within the preceding twelve (12) calendar months, a surcharge in the amount of Four Hundred Dollars ($400.00) shall be added to the Customer's water bill.

4. For a fourth and any subsequent violation by a Customer of any of the provisions of Subsection A, B, C and D of Section 121.08 within the preceding twelve (12) calendar months, a surcharge in the amount of Six Hundred Dollars ($600.00) shall be added to the Customer's water bill.

5. After a fifth or subsequent violation, the Department may install a flow-restricting device or terminate a Customer's service, in addition to the financial surcharges provided for herein. Such action shall be taken only after a hearing held by the Department where the Customer has an opportunity to respond to the Department's information or evidence that the Customer has repeatedly violated this Article or Department rules regarding the conservation of water and that such action is reasonably necessary to assure compliance with this Article and Department rules regarding the conservation of water.

Any such restricted or terminated service may be restored upon application of the Customer made not less than forty-eight (48) hours after the implementation of the action restricting or terminating service and only upon a showing by the Customer that the Customer is ready, willing and able to comply with the provisions of this Article and Department rules regarding the conservation of water. Prior to any restoration of service, the Customer shall pay all Department charges for any restriction or termination of service and its restoration as provided for in the Department's rules governing water service, including but not limited to payment of all past due bills and fines.

**C. Notice**. The Department shall give notice of each violation to the Customer committing such violation as follows:

1. For any violation of the provisions of Section 121.08, the Department may give written notice of the fact of such violation to the Customer personally, by posting a notice at a conspicuous place on the Customer's premises, or by United States mail, First-Class, postage prepaid addressed to the Customer's billing address.

2. If the penalty assessed is, or includes, the installation of a flow restrictor or the termination of water service to the Customer, notice of the violation shall be given in the following manner:

(a) By giving written notice thereof to the Customer personally; or

(b) If the Customer is absent from or unavailable at either his place of residence or his place of business, by leaving a copy with some person of suitable age and discretion at either place, and sending a copy through the United States mail, First-Class postage prepaid, addressed to the Customer at his place of business, residence, or such other address provided by the Customer for bills for water or electric service if such can be ascertained; or

(c) If such place of residence, business or other address cannot be ascertained, or a person of suitable age or discretion at any such place cannot be found, then by affixing a copy in a conspicuous place on the property where the failure to comply is occurring and also by delivering a copy to a person of suitable age and discretion there residing, or employed, if such person can be found, and also sending a copy through the United States mail, First-Class, postage prepaid, addressed to the Customer at the place where the property is situated as well as such other address provided by the Customer for bills for water or electric service if such can be ascertained.

Said notice shall contain, in addition to the facts of the violation, a statement of the possible penalties for each violation and statement informing the Customer of his right to a hearing on the violation.

D. **Hearing**. Any Customer who disputes any penalty levied pursuant to this Section shall have a right to a dispute determination conducted pursuant to the Department's Rules Governing Water and Electric Service. Any Customer dissatisfied with the Department's dispute determination may appeal that determination within 15 days of issuance to the Board, or to a designated hearing officer at the election of the Board. The provisions of Sections 19.24, 19.25, 19.26 and Sections 19.29 through 19.39 of the Los Angeles Administrative Code shall apply to such appeals. All defenses, both equitable and legal, may be asserted by a Customer in the appeal process. The decisions of the Board shall become final at the expiration of 45 calendar days, unless the Council acts within that time by a majority vote to bring the action before it or to waive review of the action. If the Council timely asserts jurisdiction, the Council may, by a majority vote, amend, veto or approve the action of the Board within 21 calendar days of voting to bring the matter before it, or the action of the Board shall become final. If the City Council asserts jurisdiction over the matter and acts within 21 calendar days of voting to bring the matter before it, the City Council's action shall be the final decision.

**E. Reservation of Rights.** The rights of the Department hereunder shall be cumulative to any other right of the Department to discontinue service. All monies collected by the Department pursuant to any of the surcharge provisions of this Article shall be deposited in the Water Revenue Fund as reimbursement for the Department's costs and expenses of administering and enforcing this Article.

**SEC. 121.10. GENERAL PROVISIONS.**

**A. Enforcement.** The Department of Water and Power shall enforce the provisions of this Article.

**B. Department to Give Effect to Legislative Intent.** The Department shall provide water to its Customers in accordance with the provisions of this Article, and in a manner reasonably calculated to effectuate the intent hereof.

**C. Public Health and Safety Not to be Affected.** Nothing contained in this Article shall be construed to require the Department to curtail the supply of water to any Customer when, in the discretion of the Department, such water is required by that Customer to maintain an adequate level of public health and safety; provided further that a Customer's use of water to wash the Customer's property immediately following the aerial application of a pesticide, such as Malathion, shall not constitute a violation of this Article.

D. **Recycled Water and Gray Water.** The provisions of this Article shall not apply to the use of Recycled Water or Gray Water, provided that such use does not result in excess water flow or runoff onto the adjoining sidewalk, driveway, street, gutter, or ditch. This provision shall not be construed to authorize the use of Gray Water if such use is otherwise prohibited by law.

**E. Large Landscape Areas.** Large Landscape Areas that have multiple irrigation system stations can deviate from prescribed non-watering days if their systems include weather-based irrigation controllers, and each irrigation station is limited to the number of days prescribed in this ordinance.

**F. Hillside Burn Areas.** The provisions of this Article shall not apply to hillside areas recovering from fire that have been replanted for erosion control. To qualify for this exemption, a Customer must obtain verification from the agency requiring erosion control measures. The duration of the exemption is limited to, either, one growing cycle, one year, or establishment of the vegetation, whichever is the lesser time period.

**SEC. 121.11. SEVERABILITY.**

If any section, subsection, clause or phrase in this Article or the application thereof to any person or circumstances is for any reason held invalid, the validity of the remainder of the Article or the application of such provision to other persons or circumstances shall not be affected thereby. The City Council hereby declares that it would have passed this Article and each section, subsection, sentence, clause, or phrase thereof, irrespective of the fact that one or more sections, subsections, sentences, clauses, or phrases or the application thereof to any person or circumstance be held invalid.

Sec. 2. **URGENCY CLAUSE.**

The Council of the City of Los Angeles hereby finds and declares that there exists within this City a current water shortage and the likelihood of a continuing water shortage into the immediate future and that as a result there is an urgent necessity to take legislative action through the exercise of the police power to protect the public peace, health, and safety of this City from a public disaster or calamity. Therefore, this Ordinance shall take effect immediately upon publication.

Sec. 3. The City Clerk shall certify to the passage of this ordinance and have it published in accordance with Council policy, either in a daily newspaper circulated in the City of Los Angeles or by posting for ten days in three public places in the City of Los Angeles: one copy on the bulletin board located at the Main Street entrance to the Los Angeles City Hall; one copy on the bulletin board located at the Main Street entrance to the Los Angeles City Hall East; and one copy on the bulletin board located at the Temple Street entrance to the Los Angeles County Hall of Records.

**I hereby certify that the foregoing ordinance was introduced at the meeting of the Council of the City of Los Angeles AUG 1 1 2010, and passed at it's meeting of AUG 1 8 2010.**

JUNE LAGMAY, City Clerk

By ______________ Deputy

Approved AUG 2 3 2010

______________ Mayor

Approved as to Form and Legality

CARMEN A. TRUTANICH, City Attorney

By *Victor Sofelkanik (VBE)*
VICTOR SOFELKANIK
Deputy City Attorney)

Date *8/4/10*

File No. *09-0369-S9*

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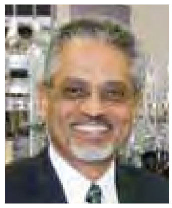
Los Angeles Department of Water & Power

# 2011 Drinking Water Quality Report

# Quality in Every Drop

**James B. McDaniel**
Senior Assistant General Manager - Water



**Dr. Pankaj Parekh**
Director of Water Quality

For over 100 years, LADWP has been the steward of our City's water system and supply. It's a responsibility we take very seriously. Every day, we import raw water, purify it and deliver it to your tap 24-hours a day—all for less than a penny per gallon. It's our duty to maintain the value of this precious resource, and to comply with increasingly stringent state and federal water quality mandates that protect every drop of the water we deliver.

In 2011, every drop of the more than 200 billion gallons of water that LADWP delivered to over 4 million residents met or surpassed all health-based drinking water standards. To maintain such a high level of water quality, LADWP collected over 25,000 water samples across the city, and performed more than 240,000 water quality tests—not just for regulation compliance, but also for research and operational improvements. Throughout the year, we tested for over 200 different contaminants, including both regulated contaminants, such as arsenic, chromium, lead, and disinfection by-products, as well as unregulated contaminants of interest such as sodium and boron.

To continue to comply with newer more stringent water quality regulations into the future, LADWP is undertaking the most significant capital investments in water quality history, totaling $1.1 billion in capital costs in the next five years. Thanks to a recently approved adjustment to our water rates, we can ensure funding for several of these critical water quality projects. Approved on February 1, 2012, the 35-cent per billing unit increase to water rates, discussed later in this report, will provide much-needed funding for major water quality investments.

As we continue to uphold the safety and quality of LA's drinking water, LADWP is also working to make it more sustainable and protect its affordability.

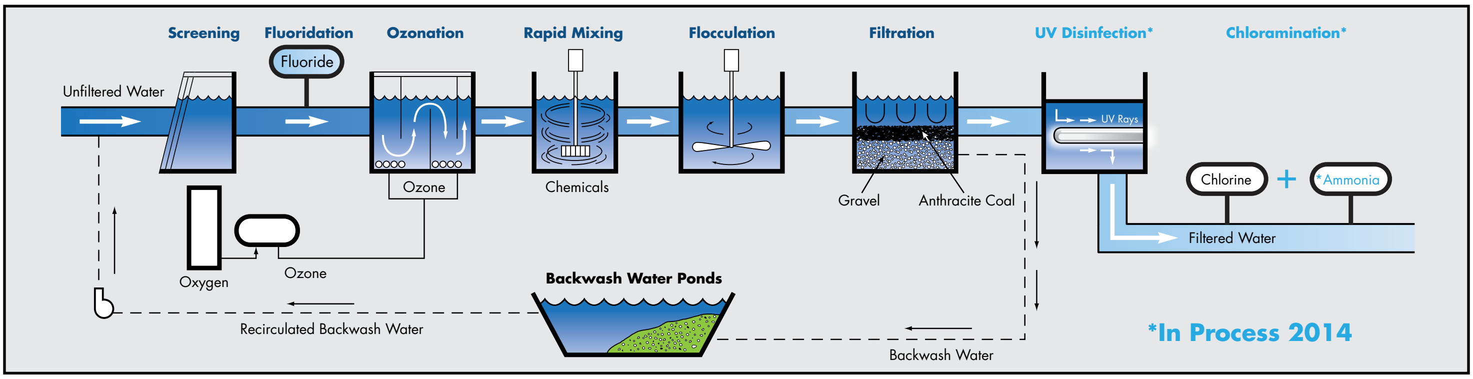
*It's our duty to maintain the value of this precious resource, and to comply with increasingly stringent state and federal water quality mandates that protect every drop of the water we deliver.*

The amount of water imported has rapidly increased throughout the years, accounting for more than 80% of our water supply today. Changing climate conditions and regulatory restrictions have severely limited these imported sources and are driving costs up. To protect our customers from rising costs of imported water, LADWP is aggressively working on developing our local water supply.

Long-term investments in water conservation, stormwater capture, water recycling, and groundwater cleanup will reduce our reliance on imported water and will provide greater stability in the price of water for the future. Investments to develop local water supplies and uphold water quality, in addition to needed investments in replacing aging pipeline, will enable LADWP to maintain Los Angeles' water system and ensure the availability and affordability of clean, reliable drinking water for future generations. These efforts will ensure that LADWP can continue to provide reliable high quality water at an affordable price for another 100 years.

## Table of Contents

# Water Treatment Processes




## Surface Water Treatment

LADWP water comes from four very different water sources—three are from surface water sources like lakes and rivers, and the other is groundwater from local wells and springs. The taste and appearance of surface water can vary seasonally and groundwater generally contains more minerals. All these factors make for different tasting water. Despite these variations, LADWP water meets all drinking water standards for health and aesthetics.

All water coming from the Los Angeles Aqueducts, the California Aqueduct (a.k.a. State Water Project), and the Colorado River Aqueduct is filtered and treated to ensure a safe drinking water supply. At the Los Angeles Aqueduct Filtration Plant, water is treated as follows:

Water flows into the filtration plant by gravity and travels through screens to remove environmental debris such as twigs and dead leaves. Ozone, a super-charged oxygen molecule and a powerful disinfecting agent is injected into the water to destroy bacteria and other impurities that affect taste, odor and color. Treatment chemicals are quickly dispersed into the water to make fine particles called floc. A six-foot-deep filter (crushed coal over gravel) removes the floc and previously added chemicals. Chlorine added during the final step ensures lasting disinfection and protects the water as it travels through the City's distribution system to your tap. Fluoride is optimized to promote oral health by strengthening tooth enamel.

## Groundwater Treatment

The City's vast groundwater supply in the San Fernando and Central Basins are generally clean. LADWP pumps from the clean parts of the basins and disinfects this groundwater with chlorine as a safeguard against microorganisms. In December, 2009, the federal Ground Water Rule went into effect. This regulation now requires all water agencies across the country to disinfect groundwater sources, a standard practice that LADWP has had for decades. Because of man-made contaminants found in San Fernando Valley groundwater wells, LADWP continuously monitors and ensures that all well water meets water quality standards and results are far below the maximum contaminant levels permitted by federal or state regulations. LADWP is formulating a comprehensive long term groundwater treatment plan for the San Fernando Basin that will allow us to extract more water and treat it so we can safely increase our local supply of water.

## Expanding Use of Chloramine

LADWP continually strives to improve water quality. In an ongoing effort to reduce the level of disinfection by-products in drinking water, LADWP is gradually expanding the use of monochloramine (also known as chloramine) to provide the necessary protection to water as it travels through miles of pipe to reach your tap. While both chlorine and chloramine are effective killers of bacteria and other microorganisms, chloramine lasts longer, forms fewer byproducts of disinfection and does not have a chlorinous odor.

A new drinking water regulation that further reduces the allowable level of disinfection by-products will take effect April 2012. In order to comply with the new regulation, LADWP must complete construction of critical facilities before a complete change to chloramine can happen. The LADWP entered into a Compliance Agreement (Agreement) with the California Department of Public Health (CDPH) that allows us to complete the necessary construction projects while allowing us to stay in compliance. While most of the distribution system meets the new compliance requirements, there are some areas that may not on a consistent basis without the use of chloramine. To obtain the Agreement, LADWP demonstrated to CDPH and US Environmental Protection Agency (USEPA) that compliance with the new requirement would be achievable within two additional years and that with the time extension further public health protection from waterborne diseases caused by microorganisms such as Cryptosporidium and viruses will be provided. For more information on the new Disinfection By-Products regulation, please turn to page 4 of this report.

Customers in the Harbor area of the City have received water treated with chloramine for more than 25 years with complete satisfaction. Customers in Eastern Los Angeles and the Sunland-

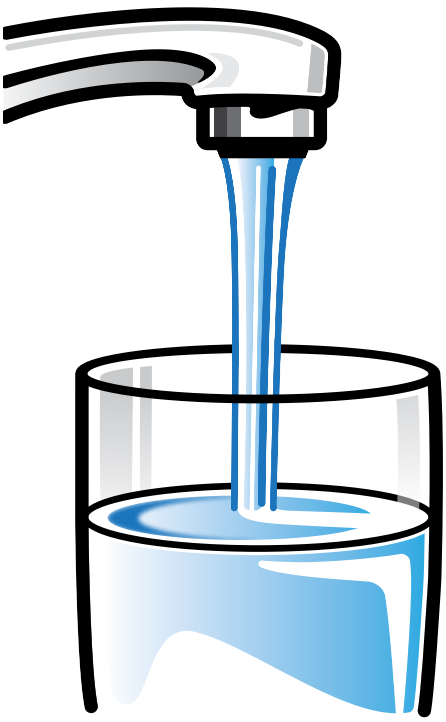
Tujunga areas also receive water treated with chloramine and have reported improved taste.

Since chlorine and chloramine are different chemicals, adjustments to existing treatment must be made for certain types of water uses. Operators of kidney dialysis machines should monitor their equipment more frequently for both "free" and "total" chlorine. The Southern California Renal Disease Council supports this recommendation. Customers who maintain fish ponds, tanks, or aquaria should also make necessary adjustments in water quality treatment, as both chlorine and chloramine are toxic to fish.

Complete expansion to chloramine will continue for a few more years but should be completed by early 2014. Meanwhile, all LADWP customers should expect to receive either type of disinfectant in the water at any time. For more information on chloramine please visit www.ladwp.com, or call Water Quality Customer Service at (213) 367-3182.

## What determines the cost of tap water?

1) The cost of transporting raw water to Los Angeles
2) Treating and cleaning the water to make it drinkable, and
3) Delivering the clean water to your tap.



# Water Quality News & Updates

## New Disinfection By-Products Regulation

The latest drinking water standard for disinfection by-products (DBPs) is the Stage 2 Disinfectants/Disinfection By-Products Rule (Stage 2) which took effect April 1, 2012. The allowable levels of 80 micrograms per liter (µg/L) for total trihalomethanes (TTHMs) and 60 µg/L for total haloacetic acids (HAA5) remain unchanged. The changes to the current DBP regulation are few but significant.

Under Stage 2, all compliance locations used to monitor disinfection by-products (DBPs) must represent maximum values in the distribution system. In anticipation of Stage 2, LADWP's current monitoring plan already represents all maximum values. Under Stage 2, compliance will no longer be based on a system-wide running annual average of all locations. Instead, each location must now meet the standard for TTHMs and HAA5 on a running annual average. This new requirement will result in a system-wide reduction of DBPs levels in the drinking water. LADWP's strategy to achieve compliance is the expansion of the use of chloramine. LADWP submitted a request to State Health for a two year extension to complete a critical project that will allow complete use of chloramine in the distribution system. This extension is allowed under a provision of the federal Safe Drinking Water Act (1996 amendments). As a condition of the extension, LADWP will begin monitoring Stage 2 locations, but will continue to base compliance on a system-wide running annual average. After April 2014, LADWP will begin reporting and complying with Stage 2 compliance calculations, of which we expect to full comply. If at any time the running annual average at any location exceeds the allowable levels for TTHMs or HAA5, public notification is required, with specific health-effects language, to customers in the area represented by the compliance location. The cost of compliance with this regulation is anticipated to exceed $240 million.

## Further Protecting Our Distribution System

The Surface Water Treatment Rule (SWTR), administered by CDPH, is a drinking water regulation that safeguards reservoir supplies from microbiological contamination that may occur when rain runoff from nearby hillsides and slopes enters the water. In Los Angeles, SWTR applied to four open water reservoirs – Lower Stone Canyon, Encino, and Upper and Lower Hollywood. LADWP successfully met the compliance deadlines and treatment requirements for all four open reservoirs that were subject to SWTR. Upper and Lower Hollywood Reservoirs were successfully removed in July 2001 and replaced with two 30 million gallon buried tanks. New support facilities were successfully commissioned to serve filtered water from Encino Reservoir in January 2006 and Lower Stone Canyon Reservoir in September 2008.

The latest drinking water regulation related to the treatment of surface water is the Long Term 2 Enhanced Surface Water Treatment Rule (LT2). This rule requires that LADWP cover or remove from service the remaining six uncovered distribution reservoirs, or provide additional treatment to achieve prescribed inactivation or removal of viruses, Cryptosporidium and Giardia by April 1, 2009 or be in compliance with a state-approved schedule to meet the same requirements. The six reservoirs are Los Angeles, Upper Stone Canyon, Santa Ynez, Ivanhoe, Silver Lake, and Elysian Reservoirs.

On April 1, 2008, LADWP notified CDPH that it is fully committed to complying with the new regulations and requested an extension of the April 1, 2009 deadline. LADWP submitted an interim operations plan, a schedule for the required reservoir improvements, and executed a Compliance Agreement with CDPH on March 31, 2009. LADWP is working diligently to bring all reservoirs into compliance as quickly as possible, but no later than the dates specified in the Compliance Agreement.

Santa Ynez Reservoir was removed from service in November 2010 for the installation of a floating cover, and was placed back into service as a covered reservoir in May 2011. The Final EIR for Elysian Reservoir Water Quality Improvement Project was completed in September of 2011. The Final EIR for Upper Stone Canyon Reservoir WQIP was completed in January of 2012. Both EIRs were submitted to the Board of Water and Power Commissioners for approval in the first quarter of 2012. The Silver Lake Reservoir Bypass Tunnel construction contract will be advertised in the middle of 2012 while LADWP continues to work with the Silver Lake community on environmental concerns. A new 110 MG Headworks Reservoir will be designed and constructed to replace the storage capacity lost when Ivanhoe Reservoir is removed from service. A construction contract should be awarded in mid 2012. Lastly, an Ultraviolet Disinfection Treatment facility is currently in development to treat water leaving LA Reservoir. In addition, LA Reservoir will have shade balls installed beginning in Summer, 2012. The estimated cost to bring the six reservoirs into compliance is $1.1 billion.

To meet strict compliance deadlines, LADWP must award nearly $600 million in project contracts in 2012. While the contracts will spread the cost over the next 5 to 7 years, LADWP must be prepared to fund projects in a timely manner. To ensure sufficient funding for water quality compliance activities, LADWP proposed a one-time increase to the Water Quality Factor of 35 cents per billing unit, or one hundred cubic feet (HCF), which was approved on February 1, 2012. In preparation for compliance with LT2, LADWP has been routinely monitoring its water sources for microbial pathogens since 2005. Cryptosporidium and

In May 2011, LADWP completed the installation of a floating cover on Santa Ynez Reservoir.

As state and federal drinking water quality standards have become more stringent, LADWP is required to invest in over 100 water quality improvement projects, the most significant of which require LADWP to cover, bypass or remove from service all 10 water reservoirs in the Los Angeles basin. Five reservoirs have been covered or bypassed, including Santa Ynez Reservoir, and there are five more to go.

# Sources of Water for City Areas

### San Fernando Valley Communities

Sources: Los Angeles Aqueduct, local groundwater, and MWD State Water Project.

Arleta
Canoga Park
Chatsworth
Encino
Granada Hills
Hollywood Hills
Lake View
Terrace
Mission Hills
North Hills
North Hollywood
Northridge
Olive View
Pacoima
Panorama City
Porter Ranch
Reseda
Sherman Oaks
Studio City
Sun Valley
Sunland
Sylmar
Tarzana
Toluca Lake
Tujunga
Valley Village
Van Nuys
Warner Center
West Hills
Winnetka
Woodland Hills

### Western Los Angeles Communities

Sources: Los Angeles Aqueduct and MWD State Water Project.

Bel Air Estates
Beverly Glen
Brentwood
Castellamare
Century City
Cheviot Hills
Culver City*
Mar Vista
Pacific Palisades
Palisades Highlands
Palms
Playa del Rey
Sawtelle
Venice
West Los Angeles
Westchester
Westwood

### Eastern Los Angeles Communities

Sources: MWD State Water Project and Colorado River Aqueduct.

Atwater Village
Boyle Heights
Cypress Park
Eagle Rock
Echo Park
El Sereno
Glassell Park
Highland Park
Lincoln Heights
Montecito Heights
Monterey Hills
Mt. Washington

### Central Los Angeles Communities

Sources: Los Angeles Aqueduct, MWD State Water Project, and local groundwater.

Baldwin Hills
Chinatown
Country Club Park
Crenshaw
Griffith Park
Hancock Park
Hollywood
Hyde Park
Koreatown
L.A. City Strip*
Little Tokyo
Los Feliz
Mid City
Mt. Olympus
Park La Brea
Rancho Park
Silverlake
Watts
West Hollywood*
Westlake

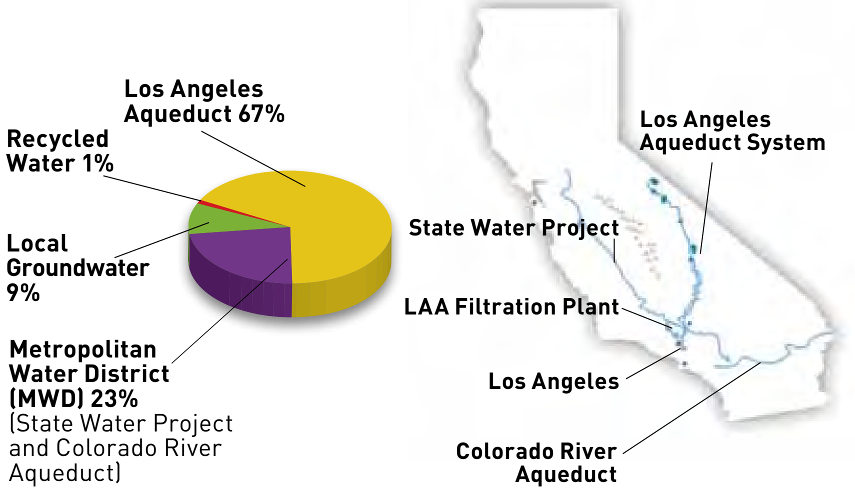
### Harbor Communities

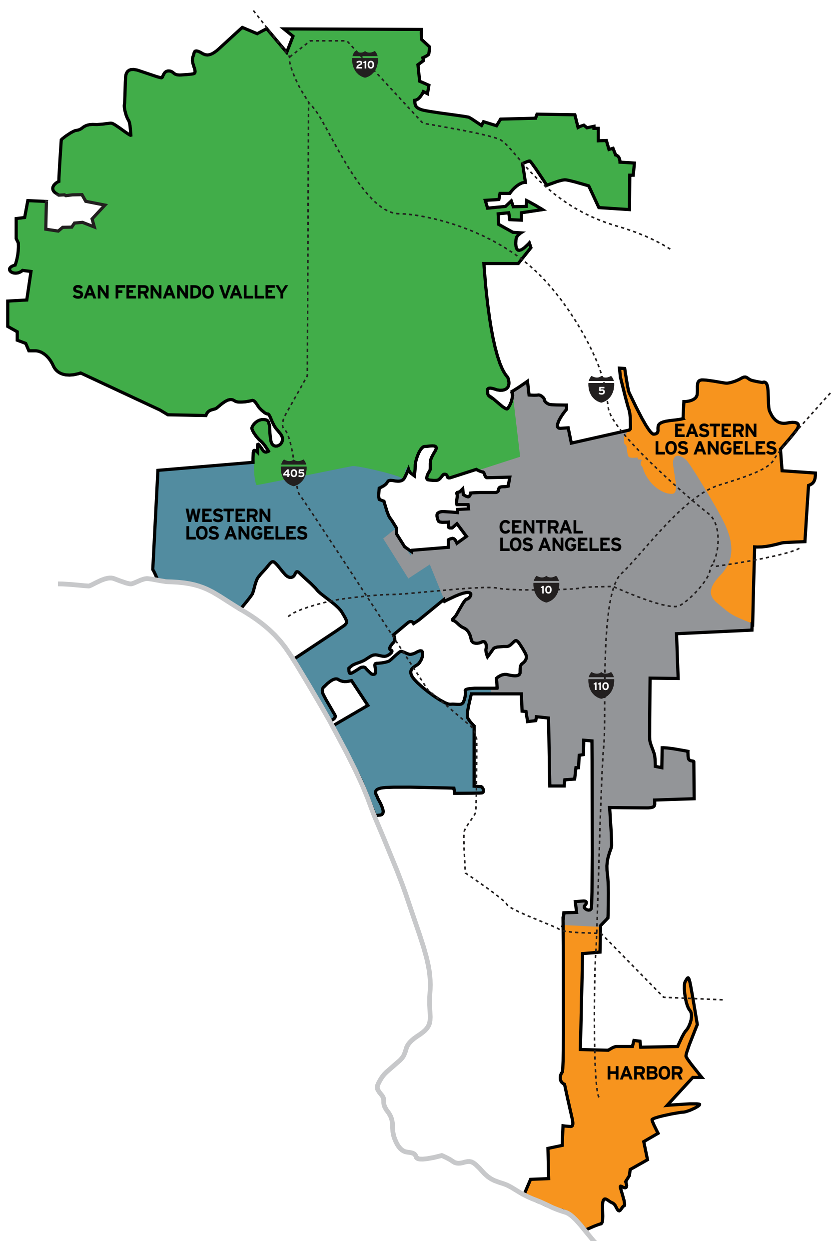
Sources: MWD State Water Project and Colorado River Aqueduct.

East San Pedro (Terminal Island)
Harbor City
Harbor Gateway*
L.A. City Strip*
San Pedro
Wilmington

* parts of

## FY 2011 / 2012 Sources



Giardia are occasionally detected in very low numbers. To further inform our customers on this topic, below is a standard statement from CDPH regarding Cryptosporidium.

"Cryptosporidium is a microbial pathogen found in surface water throughout the U.S. Although filtration removes Cryptosporidium, the most commonly used filtration methods cannot guarantee 100 percent removal. Our monitoring indicates the presence of these organisms in our source water and finished water. Current test methods do not allow us to determine if the organisms are dead or if they are capable of causing disease. Ingestion of Cryptosporidium may cause cryptosporidiosis, an abdominal infection. Symptoms of infection include nausea, diarrhea, and abdominal cramps. Most healthy individuals can overcome the disease within a few weeks. However, immunocompromised persons are at greater risk of developing life threatening illness. We encourage immunocompromised individuals to consult their doctor regarding appropriate precautions to take to avoid infection. Cryptosporidium must be ingested to cause disease, and it may be spread through means other than drinking water."

## Special Population Precautions

There are certain health conditions for which customers may need specially treated water. For example, customers with weakened immune systems, who may have undergone chemotherapy treatment, received organ transplants, suffer from HIV/AIDS, or other immune system disorders. Some elderly and infants can be particularly at risk from infection. Customers with these types of health challenges should seek advice about drinking water from their health care providers. Contact the EPA's Safe Drinking Water Hotline at (800) 426-4791, or visit www.epa.gov, for free guidelines on how to lessen the risk of infection by Cryptosporidium and other microbial contaminants.

continued on page 9

> *To continue to comply with newer more stringent water quality regulations, LADWP is undertaking the most significant capital investments in water quality history, totaling $1.1 billion in capital costs over the next five years.*

## WeTap App

Looking for a refreshing drink of water while you're on the go? Don't waste your money on bottled water, find the closest drinking water fountain by downloading the WeTap drinking water fountain finder application to your smart phone or mobile device.

# 2011 Drinking Water Quality Monitoring Results

Tables I-IV list the results of water tests performed by LADWP and MWD from January to December 2011. LADWP tests for over 200 contaminants. These tables include only contaminants with values that are detected.

### How to Read the Tables

The constituents/contaminants found in the water served in your area are listed as follows:

- For **San Fernando Valley Area** – water test results are under the Los Angeles Aqueduct Filtration Plant, the Northern Combined Wells, and MWD Jensen Filtration Plant columns
- For **Western Los Angeles Area** – water test results are under the Los Angeles Aqueduct Filtration Plant column
- For **Central Los Angeles Area** – water test results are under the Los Angeles Aqueduct Filtration Plant and the Southern Combined Wells columns
- For **Harbor/Eastern Los Angeles Area** – water test results are under the MWD Jensen, Weymouth, and Diemer Filtration Plants columns

Some constituents/contaminants are reported on a citywide basis as required by the California Department of Public Health.

The unregulated contaminants reported on an area-wide basis are included for additional information on the water served in your area.

## Table I

### Calendar Year 2011 Water Quality Monitoring Results

**Health-Based Primary Drinking Water Standards (MCLs) Constituents/Contaminants Detected in Treated Water**

| Constituents / Contaminants | Units | Los Angeles Aqueduct Filtration Plant | | Northern Combined Wells | | Southern Combined Wells | | MWD Weymouth Plant | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Range | Average | Range | Average | Range | Average | Range |
| Aluminum | µg/L | < 50 | < 50 | < 50 | < 50 - 52 | < 50 | < 50 | 110 (a) | < 50 - 220 |
| Arsenic | µg/L | 4 (a) | < 2 – 4 | 2 | < 2 - 4 | 2 | < 2 - 3 | < 2 | < 2 |
| Barium | µg/L | < 100 | < 100 | < 100 | < 100 | < 100 | < 100 - 117 | < 100 | < 100 |
| Bromate (b) | µg/L | < 5 | < 5 | NA | NA | NA | NA | NA | NA |
| Gross Alpha Particle Activity (c) | pCi/L | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 - 3 |
| Gross Beta Particle Activity (c) | pCi/L | < 4 | < 4 | < 4 | < 4 - 5 | < 4 | < 4 - 5 | 4 | < 4 - 6 |
| Nitrate (as $NO_3$) | mg/L | < 2 | < 2 | 5 | < 2 - 18 | 5 | < 2 - 14 | < 2 | < 2 - 2 |
| Nitrate + Nitrite (as N) | mg/L | < 0.4 | < 0.4 | 1 | < 0.4 - 4 | 1 | < 0.4 - 3 | < 0.4 | < 0.4 - 0.4 |
| Tetrachloroethylene (PCE) | µg/L | < 0.5 | < 0.5 | < 0.5 | < 0.5 - 0.6 | < 0.5 | < 0.5 | < 0.5 | < 0.5 |
| Trichloroethene (TCE) | µg/L | < 0.5 | < 0.5 | < 0.5 | < 0.5 | < 0.5 | < 0.5 - 0.8 | < 0.5 | < 0.5 |
| Turbidity (d) | NTU | 100% | 0.58 | NA | NA | NA | NA | 100% | 0.07 |
| Uranium | pCi/L | 3 | < 1 - 4 | 3 | < 1 - 4 | 3 | < 1 - 5 | 2 | 1 - 2 |

**Health-Based Primary Drinking Water Standards (MCLs) Constituents/Contaminants Detected in Treated Water and Reported on City-wide Basis**

| Constituents / Contaminants | Units | Average | Range |
|---|---|---|---|
| Chlorine Residual, Total | mg/L | HRAA = 1.7 (a) | Range = 1.6 – 1.8 |
| Copper (at-the-tap) AL = 1300 (e) | µg/L | 90th Percentile value = 576 | number of samples exceeding AL = 0 out of 110 |
| Cryptosporidium spp (f) | oocysts/sample | Number of positive samples = 0 out of 126 (g) | |
| Escherichia coli Bacteria | CFU/sample | Number of positive samples = 2 (h) | |
| Fecal Coliform Bacteria | CFU/sample | Number of positive samples = 2 (h) | |
| Fluoride | mg/L | Average = 0.7 | Range = 0.7 – 0.8 |
| Giardia spp (f) | cysts/sample | Number of positive samples = 0 out of 126 (g) | |
| Haloacetic Acids (Five) (HAA5) | µg/L | HRAA = 28 (a) | Range = 6 – 68 |
| Lead (at-the-tap) AL = 15 (e) | µg/L | 90th Percentile value = 5.6 | number of samples exceeding AL = 3 out of 110 |
| Total Coliform Bacteria | % Positives | Highest monthly % positive samples = 0.7% | Range = 0 – 0.7% positive samples |
| Total Trihalomethanes (TTHM) | µg/L | HRAA = 45 (a) | Range = 13 - 104 |

continued from page 7

## A Better Understanding of Radon

Radon is a naturally occurring radioactive gas that is not a significant issue in most of California. Last tested in 2010, very low levels of radon were detected in some of our ground water supplies (see Table III on page 12). There is no established drinking water standard or monitoring requirement for radon. In general, radon entering a home through tap water is a very small contributor to radon in indoor air. Although the radon levels were well below what the EPA is currently considering for a standard, the EPA has asked us to share the following general information with you to help you better understand radon.

"Radon is a radioactive gas that you can't see, taste, or smell. It is found throughout the U.S. Radon can move up through the ground and into a home through cracks and holes in the foundation. Radon can build up to high levels in all types of homes. Radon can also get into indoor air when released from tap water from showering, washing dishes, and other household activities. Compared to radon entering the home through soil, radon entering the home through tap water is, in most cases, a small source of radon in indoor air. Radon is a known human carcinogen. Breathing air containing radon can lead to lung cancer. Drinking water containing radon may also cause increased risk of stomach cancer. If you are concerned about radon in your home, test the air in your home. Testing is inexpensive and easy. Fix your home if the level of radon in your air is 4 picoCuries per liter of air (pCi/L) or higher. There are simple ways to fix a radon problem that aren't too costly. For additional information, call your State radon program or call EPA's Radon Hotline (800-SOS-RADON)."

| MWD Diemer Plant | | MWD Jensen Plant | | State Primary Standard (MCL) or [MRDL] | Meet Primary Standard? (Yes/No) | State PHG or Federal (MCLG) | Major Sources in Our Drinking Water |
|---|---|---|---|---|---|---|---|
| Average | Range | Average | Range | | | | |
| 140 (a) | < 50 - 240 | 86 (a) | 61 - 99 | 1000 | YES | 600 | Erosion of natural deposits; residue from surface water treatment processes |
| < 2 | < 2 | 2 | 2 | 10 | YES | 0.004 | Erosion of natural deposits; runoff from orchards; glass and electronics production wastes |
| < 100 | <100 | <100 | <100 | 1000 | YES | 2000 | Erosion of natural deposits |
| NA | NA | 6 (a) | < 5 - 9 | 10 | YES | 0.1 | By-product of ozone disinfection; formed under sunlight |
| 3 | < 3 - 3 | < 3 | < 3 | 15 | YES | (0) | Naturally present in environment |
| < 4 | < 4 - 4 | < 4 | < 4 - 4 | 50 | YES | (0) | Naturally present in environment |
| < 2 | < 2 - 2 | < 2 | < 2 - 2 | 45 | YES | 45 | Erosion of natural deposits; runoff and leaching from fertilizer use |
| < 0.4 | < 0.4 - 0.4 | 0.4 | 0.4 - 0.5 | 10 | YES | 10 | Erosion of natural deposits; runoff and leaching from fertilizer use |
| < 0.5 | < 0.5 | < 0.5 | < 0.5 | 5 | YES | 0.06 | Discharge from factories, dry cleaners, auto shops (metal degreaser) |
| < 0.5 | < 0.5 | < 0.5 | < 0.5 | 5 | YES | 1.7 | Discharge from metal degreasing sites and other factories |
| 100% | 0.08 | 100% | 0.05 | TT | YES | none | Soil runoff |
| 2 | 2 | 1 | < 1 - 2 | 20 | YES | 0.5 | Erosion of natural deposits |

| State Primary Standard (MCL) or [MRDL] | Meet Primary Standard ? | State PHG/ [MRDLG] or Federal (MCLG) | Major Sources in Our Drinking Water |
|---|---|---|---|
| [4] | YES | [4] | Drinking water disinfectant added for treatment |
| TT | YES | 300 | Internal corrosion of household water plumbing systems |
| TT | YES | (0) | Naturally present in the environment |
| 0 | YES | (0) | Naturally present in the environment |
| TT | YES | (0) | Naturally present in the environment |
| 2 | YES | 1 | Erosion of natural deposits; water additive that promotes strong teeth |
| TT | YES | (0) | Naturally present in the environment |
| 60 | YES | none | By-product of drinking water disinfection |
| TT | YES | 0.2 | Internal corrosion of household water plumbing systems |
| 5% of monthly samples are coliform positive | YES | (0) | Naturally present in the environment |
| 80 | YES | none | By-product of drinking water chlorination |

# Table II

## Calendar Year 2011 Water Quality Monitoring Results

### Aesthetic-Based Secondary Drinking Water Standards (SMCLs) Constituents/Contaminants Detected in Treated Water

| Constituents / Contaminants | Units | Los Angeles Aqueduct Filtration Plant | | Northern Combined Wells | | Southern Combined Wells | | MWD Weymouth Plant | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Range | Average | Range | Average | Range | Average | Range |
| Aluminum | μg/L | < 50 | < 50 | < 50 | < 50 - 52 | < 50 | < 50 | 110 (a) | < 50 - 220 |
| Chloride | mg/L | 26 | 18 - 33 | 38 | 23 - 62 | 38 | 28 - 61 | 70 | 63 - 76 |
| Color, Apparent | ACU | 4 | 3 - 4 | 4 | 3 - 5 | 4 | 3 - 5 | 2 | 1 - 2 |
| Foaming Agents (as MBAS) | μg/L | < 50 | < 50 | < 50 | < 50 | < 50 | < 50 - 55 | < 50 | < 50 |
| Manganese NL = 500 | μg/L | < 20 | < 20 | < 20 | < 20 | < 20 | < 20 - 41 | < 20 | < 20 |
| Odor | TON | < 1 | < 1 | < 1 | < 1 - 1 | < 1 | < 1 | 2 | 2 |
| Specific Conductance | μS/cm | 310 | 214 - 427 | 456 | 279 - 640 | 456 | 385 - 693 | 630 | 320 - 870 |
| Sulfate (as $SO_4$) | mg/L | 23 | 13 - 29 | 53 | 19 - 96 | 53 | 22 - 100 | 150 | 120 - 170 |
| Total Dissolved Solids (TDS) | mg/L | 168 | 101 - 202 | 258 | 144 - 394 | 258 | 194 - 468 | 440 | 390 - 480 |
| Turbidity (i) | NTU | < 0.1 | < 0.1 - 0.1 | 0.16 | < 0.1 - 0.3 | 0.16 | 0.1 - 0.3 | 0.05 | 0.02 - 0.07 |
| Zinc | μg/L | < 50 | < 50 | < 50 | < 50 | < 50 | < 50 - 1170 | < 50 | < 50 |

## Abbreviations and Footnotes

**mg/L** = milligrams per liter (equivalent to ppm)
**μg/L** = micrograms per liter (equivalent to ppb)
**ng/L** = nanograms per liter (equivalent to ppt)
**pCi/L** = picoCuries per liter
**%** = percentage
**μS/cm** = microSiemens per centimeter
**NTU** = nephelometric turbidity units
**TON** = threshold odor number
**CFU** = colony-forming unit
**ACU** = apparent color unit
**<** = less than
**NA** = not applicable
**NR** = not reported
**NT** = not tested
**HRAA** = highest running annual average

(a)Values reflect Highest Running Annual Average (HRAA). HRAA is the highest of all Running Annual Averages (RAAs). RAA is a calculated average of all the samples collected within one calendar year period that often includes test data from previous year. HRAA may be higher than the range which is based on the test data in the current calendar year.

(b)Bromate is tested in water treated with ozone. Bromate has also been found in chlorinated treated water of some LADWP reservoirs exposed to sunlight. Metropolitan Water District of Southern California (MWD) only tests bromate at Jensen Filtration Plant.

(c)Radiological monitoring is performed in cycles of various periods of time. LADWP performed testing of Gross Alpha Particle Activity, Radium-226 and Radium-228 in 2009, testing of Gross Beta Particle Activity, Strontium-90 and Tritium in 2011, as well as testing of Radon in 2010 for samples collected at Los Angeles Aqueduct Filtration Plant, Northern Combined Wells blend points, and Southern Combined Wells blend points. MWD performed all radiological testing in 2011 for samples collected at Weymouth, Diemer, and Jensen Plants.

(d)Turbidity is a measure of the cloudiness of the water and is a good indicator of water quality and

## Great Value: Tap Water

On average, one gallon of LA's tap water costs a half-penny or $0.005.
In comparison:

- a gallon of bottled water is $1.00
- a gallon of gasoline is $4
- a gallon of milk is $3

| MWD Diemer Plant | | MWD Jensen Plant | | State Secondary MCL | Meet Secondary Standard? | Major Sources in Our Drinking Water |
|---|---|---|---|---|---|---|
| Average | Range | Average | Range | | | |
| 140 (a) | < 50 - 240 | 86 (a) | 61 - 99 | 200 | YES | Erosion of natural deposits; residue from some surface water treatment process |
| 72 | 70 - 75 | 64 | 59 - 69 | 500 | YES | Runoff/leaching from natural deposits; seawater influence |
| 1 | 1 | 1 | 1 | 15 | YES | Naturally-occurring organic materials |
| < 50 | < 50 | < 50 | < 50 | 500 | YES | Municipal and industrial waste discharges |
| < 20 | < 20 | < 20 | < 20 | 50 | YES | Leaching from natural deposits |
| 2 | 2 | 2 | 2 | 3 | YES | Naturally-occurring organic materials |
| 690 | 320 - 960 | 500 | 420 - 530 | 1600 | YES | Substances that form ions when in water; seawater influence |
| 160 | 150 - 170 | 56 | 54 - 58 | 500 | YES | Runoff/leaching from natural deposits |
| 470 | 440 - 490 | 280 | 280 - 290 | 1000 | YES | Runoff/leaching from natural deposits |
| 0.05 | 0.03 - 0.25 | 0.03 | 0.03 - 0.09 | 5 | YES | Soil runoff |
| < 50 | < 50 | < 50 | < 50 | 5000 | YES | Run off/leaching from natural deposit |

filtration performance. High turbidity can hinder the effectiveness of disinfectants.

The Primary Drinking Water Standard for turbidity level at water filtration plants is less than or equal to 0.3 NTU in at least 95% of the measurements taken in any month and shall not exceed 1.0 NTU at any time. The reporting requirement for treatment plant turbidity is: report the highest single measurement in the calendar year and the lowest monthly percentage of measurements that are less than or equal to 0.3 NTU.

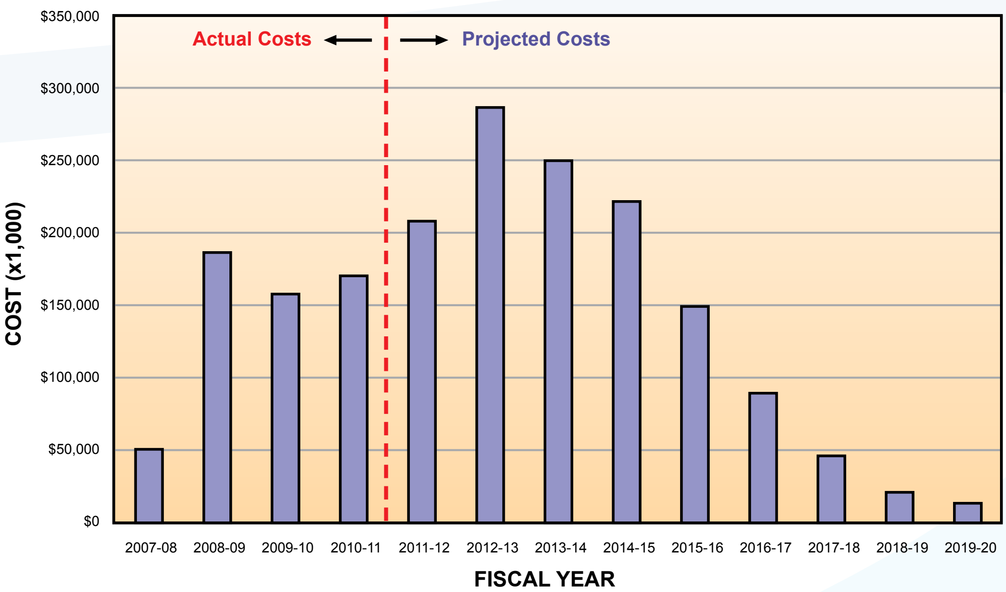
(e)At-the-tap monitoring of lead and copper is conducted every three years as required by the Lead and Copper Rule. A system is out of compliance if the Regulatory Action Level is exceeded in the 90th percentile of all samples at the customers' tap. The most recent monitoring was conducted in 2009. Although the City's treated water has little, if any, detectable lead, studies were conducted and corrosion control has been implemented in Western Los Angeles area in 2010.

(f)Values reflect annual range and average of samples collected from six uncovered reservoirs: Elysian, Ivanhoe, Los Angeles, Santa Ynez, Silver Lake, and Upper Stone Canyon.

(g)The primary standards for Cryptosporidium spp and Giardia spp are established for treated water sources. The filtered water effluents stored in the uncovered reservoirs are further treated to regulatory standards.

(h)The Total Coliform Rule states that the MCL for Escherichia Coli Bacteria or Fecal Coliform Bacteria is exceeded when a routine sample and a repeat sample are Total Coliform positive, and one of these is also E. coli or Fecal Coliform positive. The two positive test results here did not match this criterion.

(i)Values reflect testing at entry to the distribution system.




Drinking Water Quality Improvements total $1.1 billion over the next 5 years - the largest water quality capital costs in LADWP history.

## Water Quality Investments

Compliance with newer water quality regulations requires major investment in LADWP's water distribution system, including $600 million in major new contracts that must be awarded in 2012, and $1.1 billion in capital costs over the next five years to comply with these standards.

# Table III Calendar Year 2011 Water Quality Monitoring Results

## Unregulated Drinking Water Constituents/Contaminants Detected in Treated Water

| Constituents/Contaminants | Units | Los Angeles Aqueduct Filtration Plant | | Northern Combined Wells | | Southern Combined Wells | |
|---|---|---|---|---|---|---|---|
| | | Average | Range | Average | Range | Average | Range |
| Alkalinity, Total (as $CaCO_3$) | mg/L | 87 | 50 - 106 | 108 | 64 - 193 | 108 | 98 - 199 |
| Bicarbonate Alkalinity (as $CaCO_3$) | mg/L | 87 | 50 - 106 | 108 | 64 - 193 | 108 | 98 - 199 |
| Boron NL = 1000 | µg/L | 378 | 158 - 529 | 328 | 122 - 533 | 328 | 97 - 460 |
| Bromide | µg/L | < 20 | < 20 | < 20 | < 20 - 50 | < 20 | < 20 - 60 |
| Calcium | mg/L | 21 | 16 - 25 | 36 | 23 - 78 | 36 | 26 - 83 |
| Chromium, Hexavalent | µg/L | < 1 | < 1 | < 1 | < 1 - 4 | < 1 | < 1 - 4 |
| Hardness, Total (as $CaCO_3$) | mg/L | 76 | 52 - 90 | 131 | 77 - 261 | 131 | 90 - 285 |
| Heterotrophic Plate Count Bacteria (HPC) | CFU/mL | < 1 | < 1 | NA | NA | NA | NA |
| Magnesium | mg/L | 6 | 3 - 7 | 10 | 5 - 16 | 10 | 6 - 19 |
| N-Nitrosodimethylamine (NDMA) NL=10 | ng/L | NT | NT | NT | NT | NT | NT |
| pH | Unit | 7.5 | 7.2 - 7.7 | 7.6 | 7.1 - 7.8 | 7.6 | 7.1 - 7.8 |
| Phosphate (as $PO_4$) | µg/L | < 31 | < 31 | 100 | 50 - 200 | 100 | 50 - 1300 |
| Potassium | mg/L | 4 | 2 - 4 | 4 | 3 - 5 | 4 | 3 - 4 |
| Radon (c) | pCi/L | < 100 | < 100 | < 100 | < 100 | < 100 | < 100 - 150 |
| Silica (as $SiO_2$) | mg/L | 17 | 12 - 19 | 18 | 14 - 24 | 18 | 16 - 23 |
| Sodium | mg/L | 31 | 16 - 38 | 37 | 17 - 47 | 37 | 31 - 47 |
| Total Organic Carbon (TOC) | mg/L | 1.3 | 0.9 - 1.5 | 1.0 | < 0.3 - 1.3 | 1.0 | < 0.3 - 1.4 |
| Vanadium NL = 50 | µg/L | < 3 | < 3 | < 3 | < 3 - 7 | < 3 | < 3 - 3 |

## Terms Used In The Tables

**Compliance:** A drinking water standard based on the health risk (primary standards) and aesthetic (secondary standards) exposure of a contaminant to consumers. For example, bacteria and nitrate have strict limits that must be met at all times due to the acute effects they can cause. Other standards, like small amounts of disinfection by-products and man-made chemicals, have standards that are based on a lifetime of exposure because the risk to consumers is very low. Compliance with most standards is based on an average of samples collected within a year. This allows for some fluctuation above and below the numerical standard, while still protecting public health.

**Detection Limit for Reporting Purpose (DLR):** DLR means the designated minimum level at or above which any analytical finding of a contaminant in drinking water resulting from monitoring required under Title 22 Code of Regulations shall be reported to the California Department of Public Health (CDPH).

**Maximum Contaminant Level (MCL):** MCL is the highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the Public Health Goals (PHGs) or Maximum Contaminant Level Goals (MCLGs) as is economically and technologically feasible. Secondary MCLs are set to protect odor, taste, and appearance of drinking water. For certain contaminants, compliance with the MCL is based on the average of all samples collected throughout the year.

**Maximum Contaminant Level Goal (MCLG):** MCLG is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (USEPA).

**Maximum Residual Disinfectant Level (MRDL):** MRDL is the highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

**Maximum Residual Disinfectant Level Goal (MRDLG):** MRDLG is the level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants. MRDLGs are set by the USEPA.

**Notification Level (NL):** NL is the Health-based advisory levels established by CDPH for chemicals in drinking water that lack maximum contaminant levels (MCLs).

**Primary Drinking Water Standard (PDWS):** MCLs and MRDLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

**Public Health Goal (PHG):** PHG is the level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA).

**Regulatory Action Level (AL):** AL is the concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow. ALs are set by the USEPA.

**Secondary Drinking Water Standard (SDWS):** SMCLs for contaminants that may affect the taste, odor or appearance for drinking water.

**Treatment Technique (TT):** TT is a required process intended to reduce the level of a contaminant in drinking water. For example, the filtration process is a treatment technique used to reduce turbidity (the cloudiness in water) and microbial contaminants from surface water. High turbidities may be indicative of poor or inadequate filtration.

| MWD Weymouth Plant | | MWD Diemer Plant | | MWD Jensen Plant | | Major Sources in Our Drinking Water |
|---|---|---|---|---|---|---|
| Average | Range | Average | Range | Average | Range | |
| 82 | 43 - 110 | 90 | 48 - 120 | 85 | 76 - 93 | Erosion of natural deposits |
| NT | NT | NT | NT | NT | NT | Naturally-occurring dissolved gas; erosion of natural deposits |
| 130 | 130 | 130 | 130 | 190 | 190 | Erosion of natural deposits |
| NT | NT | NT | NT | NT | NT | Runoff/leaching from natural deposits; seawater influence |
| 48 | 41 - 54 | 51 | 47 - 55 | 27 | 26 - 28 | Erosion of natural deposits; natural hot springs |
| < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | Industrial discharge; erosion of natural deposits |
| 170 | 60 - 250 | 190 | 57 - 270 | 110 | 100 - 120 | Erosion of natural deposits |
| < 1 | < 1 - 1 | < 1 | < 1 - 1 | < 1 | < 1 - 1 | Naturally present in the environment |
| 18 | 16 - 21 | 20 | 19 - 21 | 12 | 12 | Erosion of natural deposits |
| < 2 | < 2 | < 2 | < 2 | NR | < 2 - 6 | By-product of chloramination |
| 8.1 | 7.8 – 8.8 | 8.0 | 7.0 - 8.6 | 8.2 | 8.1 - 8.4 | Naturally-occurring dissolved gases and minerals |
| NT | NT | NT | NT | NT | NT | Erosion of natural deposits, agricultural run-off |
| 4 | 3 - 4 | 4 | 4 | 3 | 3 | Erosion of natural deposits |
| < 100 | < 100 | < 100 | < 100 | < 100 | < 100 | Decay of natural deposits |
| NT | NT | NT | NT | NT | NT | Erosion of natural deposits |
| 69 | 62 - 76 | 72 | 67 - 77 | 54 | 52 - 57 | Erosion of natural deposits |
| 2.3 (a) | 1.7 - 2.9 | 2.4 (a) | 1.7 - 3.0 | 1.9 (a) | 1.6 - 2.1 | Erosion of natural deposits |
| < 3 | < 3 | < 3 | < 3 | 3 | 3 | Erosion of natural deposits |

# Table IV

## Calendar Year 2011 Water Quality Monitoring Results

### Drinking Water Disinfection By-Products Reported on Area-Wide Basis

| Constituents/ Contaminants | Units | San Fernando Valley | | Central Los Angeles | | Western Los Angeles | | Harbor / Eastern Los Angeles | | Major Sources in Our Drinking Water |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Average | Range | Average | Range | Average | Range | Average | Range | |
| Bromodichloromethane (BDCM) | µg/L | 9 | 5 - 19 | 11 | 3 - 21 | 14 | 2 - 26 | 13 | 3 - 24 | By-product of chlorine/ chloramine disinfection |
| Bromoform | µg/L | 2 | < 1 - 13 | 2 | < 1 - 6 | 1 | < 1 - 10 | 4 | < 1 - 10 | By-product of chlorine/ chloramine disinfection |
| Chlorate NL = 800 | µg/L | 368 | 61 - 992 | 202 | 27 - 877 | 234 | 39 - 614 | 39 | 26 - 48 | By-product of chlorine disinfection |
| Chloroform | µg/L | 13 | 5 - 37 | 17 | 1 - 46 | 29 | 1 - 80 | 20 | 3 - 56 | By-product of chlorine/ chloramine disinfection |
| Dibromoacetic Acid (DBAA) | µg/L | 7 | 2 - 24 | 8 | 4 - 16 | 8 | < 1 - 27 | 9 | 5 - 19 | By-product of chlorine/ chloramine disinfection |
| Dibromochloromethane (DBCM) | µg/L | 2 | < 1 - 7 | 3 | 1 - 6 | 3 | <1 - 11 | 3 | 1 - 6 | By-product of chlorine/ chloramine disinfection |
| Dichloroacetic Acid (DCAA) | µg/L | 11 | 2 - 38 | 14 | <1 - 32 | 24 | < 1 - 46 | 10 | 2 - 25 | By-product of chlorine/ chloramine disinfection |
| Monobromoacetic Acid (MBAA) | µg/L | < 1 | < 1 - 2 | < 1 | < 1 - 3 | < 1 | < 1 - 3 | < 1 | < 1 - 2 | By-product of chlorine/ chloramine disinfection |
| Monochloroacetic Acid (MCAA) | µg/L | 4 | < 2 - 10 | 5 | < 2 - 10 | 6 | < 2 - 10 | 3 | < 2 - 9 | By-product of chlorine/ chloramine disinfection |
| Trichloroacetic acid (TCAA) | µg/L | 5 | 1 - 16 | 7 | < 1 - 23 | 9 | < 1 - 21 | 8 | < 1 - 24 | By-product of chlorine/ chloramine disinfection |

# Next Century Water

Over the last century, LADWP has built and maintained a water system that transports, treats, and delivers daily hundreds of millions of gallons of water to the City of Los Angeles. Our customers rely on us to provide water to their taps when they need it, keeping our system in operation every day of the week and every hour of the day. Protecting and maintaining our distribution system into the future requires significant investments, not only for the mandated investments in water quality, but also to develop local water supplies and replace aging infrastructure.

Much of the water we serve to our customers travels hundreds of miles from the Eastern Sierra Nevada, Sacramento-San Joaquin Delta, and the Colorado River to reach Los Angeles. These imported supplies supplement our local water supplies and serve a population of nearly 4 million people. As imported supplies are increasingly limited by climatic conditions and regulatory restrictions, they also become more expensive. To reduce our reliance on imported supplies, LADWP is pursuing investments in water conservation, recycled water, stormwater capture, and groundwater clean-up.

Los Angeles has been a leader in water conservation for several decades, showing the rest of the country how to do more with less. In 2011, Los Angeles recorded per capita water use at 123 gallons daily – the lowest of any U.S. city with a population over one million. The installation of water-saving devices and acceptance of water-conserving behaviors have proven to be highly effective and permanent solutions in the fight against water waste in the last several decades. As we move into the next century of water service, increases in the amount and availability of customer rebates and other financial incentives for water-efficient devices, water-saving projects and landscape irrigation efficiency measures will help reduce the amount of water needed to serve Los Angeles.

Another method of reducing the demand for potable water is through the increased use of recycled water. Water recycling is one of the least expensive and most feasible sources of additional water, allowing customers to utilize recycled water for non-potable uses such as irrigation and other industrial purposes. Future investments in recycled water will allow LADWP to expand the purple pipe network, increase the number of recycled water users in the City, and ultimately, increase the local potable water supply through the use of highly treated recycled water to replenish groundwater supplies.

Similarly, investments in stormwater capture are also aimed at replenishing local groundwater supplies. When it rains in Los Angeles, millions of gallons of stormwater runs off into storm drains, collects in flood control channels, and flows out to the ocean. Stormwater capture projects would allow that rainfall to be collected, seep into the ground, and increase the amount of groundwater in the San Fernando Basin.

The San Fernando Basin is a major component to the successful development of our local water supplies. Many of our customers may not realize that Los Angeles' greatest local water resource is contained in an aquifer that lies below the San Fernando Valley. This groundwater resource, known as the San Fernando Basin, was Los Angeles' original source for water years ago. Today, it holds the key to our future water supply.

Over the course of history, industrial pollution caused significant contamination to the groundwater in San Fernando Basin, cutting the availability of that local supply by more than half. Because LADWP will only serve high quality water that meets or exceeds federal and state water quality regulations, several groundwater pumping wells in LADWP's system were removed from service. By investing in a facility to purify our groundwater, we can place those wells back in service and maximize the benefits of stormwater capture and recycled water to replenish our groundwater supply.

Providing water service also requires ongoing investments in replacing aging pipes, valves, pumping stations, and other infrastructure that ensures that water is delivered to our customers' tap without fail. Much of our water system, our pipes in particular, are aging rapidly and are at or exceeding their expected life. We need to invest in our system to accelerate replacement cycles and to keep it strong and robust.

There are over 7,200 miles of pipe in the water distribution system. Our current pipe replacement levels are at 95,000 feet per year. While not all of our pipes need immediate replacement, the current rate of replacement only allows pipes to be replaced once every 400 years. This makes our system vulnerable to leaks and breaks that can interrupt service, and potentially compromise water quality depending on the severity of the interruption.

These long-term water system investments will ensure that high-quality water continues to reach our customers in a reliable manner just as it has for the last century. As we work to make the water system more reliable and sustainable, LADWP remains committed to providing Los Angeles with reliable high-quality water at an affordable price today and into the next century.

## Take the Water Quality Online Survey

What's important to you?
Please take a few moments to take our online survey about water quality.
www.ladwpnews.com/go/survey/1475/10323

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# About This Report

The Drinking Water Quality Report is prepared by the Los Angeles Department of Water and Power (LADWP) every year. This report is required by the California Department of Public Health (CDPH) and is prepared in accordance with CDPH guidelines. It is prepared, printed and mailed to you at a cost of 38 cents.

## Contact Information

LADWP, the largest municipal utility in the nation, was established more than 100 years ago to provide a reliable and safe water and electric supply to the City's 4 million residents and businesses.

LADWP is governed by a five-member Board of Water and Power Commissioners, appointed by the Mayor and confirmed by the City Council. The Board meets regularly on the first and third Tuesdays of each month at 1:30 p.m. Meetings are held at:

Los Angeles Department of Water and Power
111 North Hope Street, Room 1555H
Los Angeles, CA 90012-2694

The meeting agenda is available to the public on the Thursday prior to the week of the meeting. You can access the Board agenda at www.ladwp.com or by calling (213) 367-1351.

For general information about LADWP, call 1-800-DIAL DWP (1-800-342-5397) or visit www.ladwp.com.

For questions regarding water quality, call the LADWP Water Quality Customer Services Group at (213) 367-3182.

For questions regarding this report, please call Mr. Nathan Aguayo at (213) 367-4941 or email at Nathan.Aguayo@ladwp.com.

## Want to know more about your drinking water and related regulations?

Los Angeles Department of Water and Power
www.ladwp.com

California Department of Public Health (CDPH)
www.cdph.ca.gov

U.S. Environmental Protection Agency (USEPA)
www.epa.gov

LADWP's website has a wealth of information specific to improving water quality in your home. If you have specific water quality questions or problems, you should call (213) 367-3182 Monday through Friday 8 – 4 p.m., or anytime at 1-800- DIAL-DWP or contact us on the web at www.ladwp.com.

Here are some useful links for more information on home water filters:

http://www.consumerreports.org/cro/home-garden/kitchen/water-filters/index.htm

http://www.nrdc.org/water/drinking/gfilters.asp

For more information about the NSF certification, call (800) 673-8010 or visit www.nsf.org.

For more information about CDPH certification, call (916) 499-5600 or visit www.cdph.ca.gov.

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Los Angeles Department of Water & Power

# 2011 Drinking Water Quality Report

## This Message for Non-English Speaking Customers

This report contains important information about your drinking water. If you have any questions regarding this report, please contact us at (800) 342-5397.

### Spanish

Este informe contiene información importante sobre su agua potable. Si tiene alguna pregunta sobre este informe, por favor comuníquese con nosotros llamando al (800) 342-5397.

### Russian

**В этом отчете содержится важная информация о вашей питьевой воде. Если у вас есть вопросы по этому отчету, вы можете позвонить по телефону (800) 342-5397.**

### Farsi

این گزارش حاوی اطلاعات مهمی در مورد آب آشامیدنی شماست. چنانچه سؤالی در مورد این گزارش دارید لطفا با شماره تلفن 5397-342(800) با ما تماس بگیرید.

### Japanese

この報告書には皆さんの飲料水に関する重要な情報が含まれています。この報告書に関して何かご質問があれば(800) 342–5397 までお問い合わせください。

### Armenian

Այս զեկոյցը պարունակում է կարեւոր տեղեկութիւններ ձեր խմելու ջուրի մասին: Այս խնդրի մասին որեւէ հարցում ունենալու պարագային կարող էք հեռաձայնել մեզ՝ **(800) 342-5397** հեռախօսահամարով:

### Arabic

يحتوي هذا التقرير على معلومات هامة عن مياه الشرب في لوس انجلوس.
إذا كان لديك أسئلة عن هذا التقرير نرجو الاتصال بنا
على الرقم 342-5397 (800).

### Korean

이 보고서는 여러분의 수돗물에 관한 중요한 정보를 포함하고 있습니다. 이 보고서에 관해 질문이 있으시면, **(800) 342-5397** 로 연락 주십시오.

### Chinese

本報告包含有關您的飲用水的重要資訊，您對本報告如有任何疑問，請致電：(800) 342-5397。

### Vietnamese

**Báo cáo này có tin tức quan trọng về nguồn nước uống của quý vị. Nếu quý vị có thắc mắc về báo cáo này, xin liên lạc với chúng tôi tại số (800) 342-5397.**

### Thai

**รายงานนี้ประกอบด้วยข้อมูลสำคัญเกี่ยวกับน้ำดื่มของท่าน ถ้าหากท่านมีคำถามใดๆเกี่ยวกับรายงานนี้ กรุณาติดต่อเราได้ที่ (800) 342-5397**

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2011 Drinking Water Quality Report
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# Trash Total Maximum Daily Loads

# for the

# Los Angeles River Watershed

August 9, 2007

California Regional Water Quality Control Board
Los Angeles Region
320 West Fourth Street, Suite 200
Los Angeles, California 90013

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## I. Introduction – Legal Background

The California Regional Water Quality Control Board, Los Angeles Region (hereinafter referred to as the "Regional Board") has developed this total maximum daily load (TMDL) designed to attain the water quality standards for trash in the Los Angeles River. The TMDL has been prepared pursuant to state and federal requirements to preserve and enhance water quality in the Los Angeles Basin River Watershed.

*The California Water Quality Control Plan, Los Angeles Region*, also known as the *Basin Plan*, sets standards for surface waters and ground waters in the regions. These standards are comprised of designated beneficial uses for surface and ground water, and numeric and narrative objectives necessary to support beneficial uses and the state's antidegradation policy. Such standards are mandated for all waterbodies within the state under the Porter-Cologne Water Quality Act. In addition, the Basin Plan describes implementation programs to protect all waters in the region. The Basin Plan implements the Porter-Cologne Water Quality Act (also known as the "California Water Code") and serves as the State Water Quality Control Plan applicable to the Los Angles River, as required pursuant to the federal Clean Water Act (CWA).

Section 305(b) of the CWA mandates biennial assessment of the nation's water resources, and these water quality assessments are used to identify and list impaired waters. The resulting list is referred to as the 303(d) list. The CWA also requires states to establish a priority ranking for impaired waters and to develop and implement TMDLs. A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and allocates pollutant loadings to point and non-point sources.

The United States Environmental Protection Agency (USEPA) has oversight authority for the 303(d) program and must approve or disapprove the state's 303(d) lists and each specific TMDL. USEPA is ultimately responsible for issuing a TMDL, if the state fails to do so in a timely manner.

As part of California's 1996 and 1998 303(d) list submittals, the Regional Board identified the reaches of the Los Angeles River at the Sepulveda Flood Basin and downstream as being impaired due to trash.

A consent decree between the USEPA, the Santa Monica BayKeeper and Heal the Bay Inc., represented by the Natural Resources Defense Council (NRDC), was signed on March 22, 1999. This consent decree requires that all TMDLs for the Los Angeles Region be adopted within 13 years. The consent decree also prescribed schedules for certain TMDLs. According to this schedule, a Trash TMDL for the Los Angeles River watershed had to be approved before March 2001.

On September 19, 2001, the Regional Board adopted a Trash TMDL for the Los Angeles River Watershed. The TMDL was subsequently approved by the State Water Resources Control Board on February 19, 2002 and by the Office of Administrative Law on July 16, 2002. The United States Environmental Protection Agency approved the Los Angeles River Trash TMDL on August 1, 2002.

The City of Los Angeles and the County of Los Angeles both filed petitions and complaints in Los Angeles Superior Court challenging the Los Angeles River Trash TMDL. Subsequent negotiations led to a settlement agreement, which became effective on September 23, 2003. Twenty-two other cities[1] ("Cities") sued the Regional Board and State Water Resources Control Board (State Water Board) to set aside the TMDL, on several grounds. The trial court entered an order deciding some claims in favor of the Los Angeles Water Board and State Water Board (collectively "California Water Boards"), and some in favor of the Cities. Both sides appealed, and on January 26, 2006, the Court of Appeal decided every one of the Cities' claims in favor of the California Water Boards, except with respect to CEQA compliance. (*City of Arcadia et al., Los Angeles Regional Water Quality Control Board et al.* (2006) 135 Cal.App.4th 1392.) The Cities filed a petition for review by the California Supreme Court, but on April 19, 2006, the Supreme Court declined to hear any of the Cities' claims.

The Appellate Court found that the California Water Boards did not adequately complete the environmental checklist, and that evidence of a "fair argument" of significant impacts existed such that the California Water Boards should have performed an EIR level of analysis through an EIR or its functional equivalent. (135 Cal.App.4th at 1420-26.) The Court therefore affirmed a writ of mandate issued by the trial court, which orders the California Water Boards to set aside and not implement the TMDL, until it has been brought into compliance with California Environmental Quality Act (CEQA).

On June 8, 2006 the Regional Board set aside the trash TMDL and resolution # 01-013 which established it, pursuant to the writ of mandate and to sections 13240 and 13242 of the Water Code. Setting aside the TMDL was not deemed a repudiation of the settlement agreement entered into between the Los Angeles Regional Water Quality Control Board and the City of Los Angeles and the County of Los Angeles, which was executed on September 24, 2003, and the Los Angeles Water Board expressed its continued intent to be bound by that agreement. The Regional Board also directed staff to revise the CEQA documentation as directed by the writ of mandate, and to prepare and submit for the Regional Board's reconsideration, a TMDL for Trash in the Los Angeles River Watershed, consistent with the requirements of the writ. Staff was also directed to incorporate into its proposed revised TMDL the changes agreed upon in the settlement with the City of Los Angeles, Los Angeles County and the Los Angeles County Flood Control District.

This TMDL staff report and accompanying Basin Plan Amendment incorporate, the changes agreed upon in the settlement with the City of Los Angeles, Los Angeles County and the Los Angeles County Flood Control District. Additional revisions have been made to the TMDL to update the Implementation and Compliance schedules and include city-specific baseline waste load allocations derived from results of the baseline monitoring program

[1] The cities include Arcadia, Baldwin Park, Bellflower, Cerritos, Commerce, Diamond Bar, Downey, Irwindale, Lawndale, Monrovia, Montebello, Monterey Park, Pico Rivera, Rosemead, San Gabriel, Santa Fe Springs, Sierra Madre, Signal Hill, South Pasadena, Vernon, West Covina, and Whittier. They are members of a group that refers to itself as "The Coalition for Practical Regulation."

conducted by the Los Angeles County Department of Public Works (LACDPW). In addition, the CEQA checklist has been revised as directed by the writ of mandate.

The Los Angeles River Trash TMDL is a Basin Plan Amendment and is therefore subject to the 2001 provision of the Public Resources Code Section 21083.9 that requires a CEQA Scoping to be conducted for Regional Projects. CEQA Scoping involves identifying a range of project/program related actions, alternatives, mitigation measures, and significant effects to be analyzed in an EIR or its functionally equivalent document. On June 28, 2006 a CEQA Scoping hearing was held to present and discuss the foreseeable potential environmental impacts of compliance with the Los Angeles River Trash TMDL. A notice of the CEQA Scoping hearing was sent to interested parties including cities and/or counties with jurisdiction in or bordering the Los Angeles River watershed. Input from all stakeholders and interested parties was solicited for consideration in the development of the CEQA document

This Trash TMDL is based on existing, readily available information concerning the conditions in the Los Angeles River watershed and other watersheds in Southern California, as well as TMDLs previously developed by the State and USEPA.

## II. Definitions

The definitions of terms as used in this TMDL are provided as follows:

<u>Baseline Waste Load Allocation</u>. The Baseline Waste Load Allocation is the Waste Load Allocation assigned to a permittee before reductions are required. The progressive reductions in the Waste Load Allocations will be based on a percentage of the Baseline Waste Load Allocation. The Baseline Waste Load Allocation was calculated based on the annual average amount of trash discharged to the storm drain system from a representative sampling of land use areas, as determined during the Baseline Monitoring Program.

<u>Daily Generation Rate (DGR).</u> The DGR is the average amount of litter deposited to land or surface water during a 24-hour period, as measured in a specified drainage area.

<u>Full Capture System</u>. A full capture system is any single device or series of devices that traps all particles retained by a 5 mm mesh screen and has a design treatment capacity of not less than the peak flow rate Q resulting from a one-year, one-hour, storm in the subdrainage area. Rational equation is used to compute the peak flow rate: $Q = C \times I \times A$, where Q = design flow rate (cubic feet per second, cfs); C = runoff coefficient (dimensionless); I = design rainfall intensity (inches per hour, as determined per the rainfall isohyetal map in Figure A),[2] and A= subdrainage area (acres).

[2] The isohyetal map may be updated annually by the Los Angeles County hydrologist to reflect additional rain data gathered during the previous year. Annual updates published by the Los Angeles County Department of Public Works are prospectively incorporated by reference into this TMDL and accompanying Basin Plan amendment.

Monitoring Entity. The Monitoring Entity is the permittee or one of multiple permittees and/or co-permittees that has been authorized by all the other affected permittees or co-permittees to conduct baseline monitoring on their behalf.

Permittee. The term "permittee" refers to any permittee or co-permittee of a stormwater permit.

Trash. In this document, we are defining "trash" as man-made litter, as defined in California Government Code Section 68055.1(g):

> "Litter means all improperly discarded waste material, including, but not limited to, convenience food, beverage, and other product packages or containers constructed of steel, aluminum, glass, paper, plastic, and other natural and synthetic materials, thrown or deposited on the lands and waters of the state, but not including the properly discarded waste of the primary processing of agriculture, mining, logging, sawmilling or manufacturing."

For purposes of this TMDL, we will consider trash to consist of litter and particles of litter, including cigarette butts. These particles of litter are referred to as "gross pollutants" in European and Australian scientific literature. This definition excludes sediments, and it also excludes oil and grease, and vegetation, except for yard waste that is illegally disposed of in the storm drain system. Additional TMDLs for sediments[3] and oil and grease may be required at a later date.

Urbanized Portion of the Watershed. For the purposes of this TMDL, the urban portion of the watershed includes the sum total area of the incorporated cities and the unincorporated portion of Los Angeles County which are located on the Los Angeles River watershed.[4] The estimated area of the "urbanized" portion of the watershed is 609 square miles[5]. The remainder of the watershed is made up of the Los Angeles National Forest and other open space.

[3] Sediments which may be addressed in a separate TMDL are natural particulate matters such as silt and sand. Sediments result from erosion and are deposited at the bottom of a stream. Sediments do not refer to the decomposition of settleable litter into small particulate matters, which this TMDL is trying to prevent.
[4] The Regional Board recognizes that some areas within the unincorporated sections of Los Angeles County are actually suburban or rural.
[5] As determined by the Regional Board from GIS mapping. (Other minor differences in figures are due to rounding.)

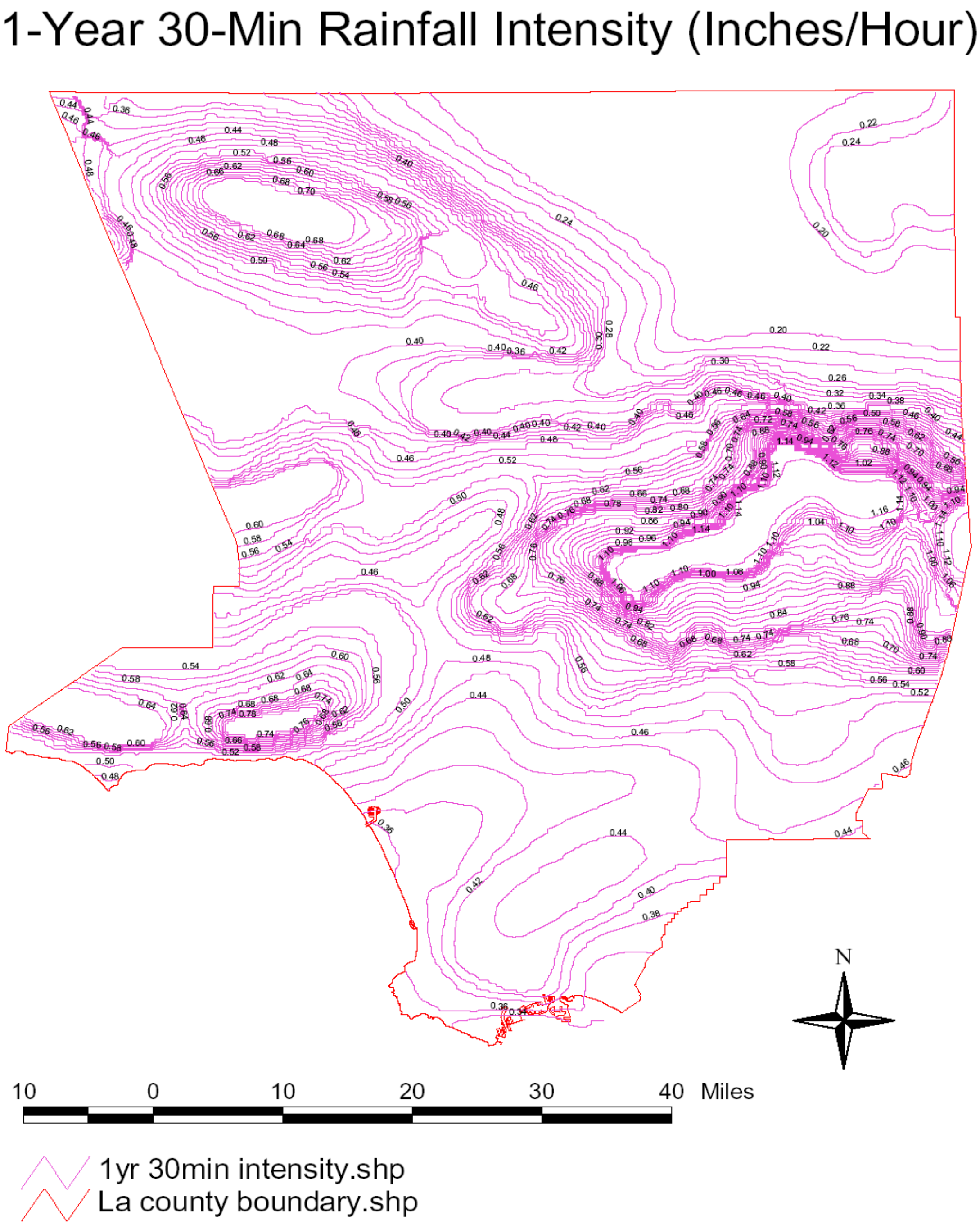


Figure A: Isohyethal Map of Rainfall Intensities in Portions of Los Angeles County (LADPW, 2003).

## III. Problem Statement

The problem statement consists of a description of the watershed, beneficial uses, water quality objectives, and a description of the impairment to the watershed caused by trash.

### A. Description of the Watershed

The Los Angeles River flows 51 miles from the western end of the San Fernando Valley to the Queensway Bay and Pacific Ocean at Long Beach (see Figure B). The headwaters are at the confluence of Arroyo Calabasas and Bell Creek. Arroyo Calabasas drains Woodland Hills, Calabasas, and Hidden Hills in the Santa Monica Mountains. Bell Creek drains the Simi Hills and receives flows from Chatsworth Creek. From the confluence of Arroyo Calabasas and Bell Creek, the Los Angeles River flows east through the southern portion of the San Fernando Valley, bends around the Hollywood Hills before it turns south onto the broad coastal plain of the Los Angeles Basin, eventually discharging into Queensway Bay and thence into San Pedro Bay West of Long Beach Harbor. Together with its several major tributaries, notably the Tujunga Wash, Burbank Western Channel, Arroyo Seco, Rio Hondo, and Compton Creek, the Los Angeles River drains an area of about 834[6] square miles. Of this area, the incorporated cities and unincorporated portion of Los Angeles County comprise 599 square miles. The remaining acreage consists of the Los Angeles National Forest and other uses.

In the San Fernando Valley, the river flows east for approximately 16 miles along the base of the Santa Monica Mountains. Most of the Los Angeles River channel was lined with concrete between 1935 and 1959 for flood control purposes[7]. This reach is lined in concrete except for a section of the river with a soft bottom at the Sepulveda Flood Control Basin. The Sepulveda Basin is a 2,150-acre open space, located upstream of the Sepulveda Dam. It is designed to collect flood waters during major storms. Because the area is periodically inundated, it remains in natural or semi-natural conditions and supports a variety of low-intensity uses. The US Army Corps of Engineers owns the entire basin and leases most of the area to the City of Los Angeles Department of Recreation and Parks, which has developed a multi-use recreational area that includes a golf course, playing fields, hiking trails, and bicycle paths.

The river is again lined in concrete for most of its course except for a seven-mile soft-bottomed segment between the confluence of the Burbank/Western Channel near Riverside Drive and north of the Arroyo Seco confluence. Three miles of this segment border Griffith Park (encompassing 4,217 acres). Four miles downstream, the river flows parallel to Elysian Park (585 acres in size). The original Pueblo de Los Angeles was founded just east of the river "to take advantage of the river's dependable supply of water."[8] Early this century, the progressive pumping of ground water, together with major diversions of water for irrigation and other uses throughout the watershed, contributed to a decreased flow in the River. From

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[6] As determined by the Regional Board from GIS mapping.
[7] Gumprecht, Blake (1999) *The Los Angeles River: Its Life, Death, And Possible Rebirth*, p. 206.
[8] Los Angeles River Master Plan, June 1996, p. 211.

Willow Street all the way through the estuary, the river is soft bottomed with areas of riparian vegetation. This unlined section is about three miles long. Also part of the watershed are a number of lakes including Peck Road Park Lake, Echo Park Lake, and Lincoln Park Lake.

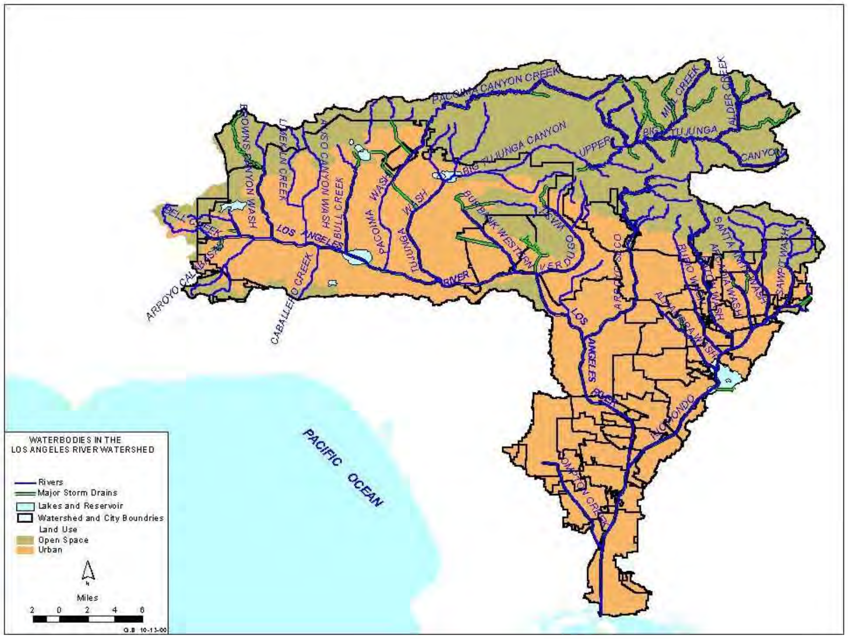


Figure B. Waterbodies in the Los Angeles River Watershed.

## B. Beneficial Uses of the Watershed

A brief description of the beneficial uses most likely to be impaired due to trash in the Los Angeles River is provided in this section.

The upper reaches of the Los Angeles River include Sepulveda Basin, a soft-bottomed area that is designed as a flood control basin. Designated beneficial uses for the upper reaches are Municipal and Domestic Supply (MUN) (although most reaches only have conditional MUN designations), Ground Water Recharge (GWR), Water Contact Recreation (REC1), Non-Contact Water Recreation (REC2), Warm Freshwater Habitat (WARM), Wildlife Habitat (WILD), and Wetland Habitat (WET). The arroyo chub is also found in the Sepulveda Basin area, and cannot survive on the flat surfaces on the concrete-lined portions of the Los Angeles River. The thick growth of riparian plants in this area provides habitat for a variety of wildlife. Native oaks grow along stretches of Valleyheart Drive in Studio City and Sherman Oaks. The river levees along this reach are accessible and neighborhood residents use them for walking and jogging.

Three native species of fish (the south coast minnow-sucker community) are found in Big Tujunga Creek from Big Tujunga Dam downstream to upper Hansen Dam. These are the Santa Ana sucker (Catastomus santaanae), which is listed as a federally endangered species, the Santa Ana speckled dace (Rhinichthys osculus) and the arroyo chub (Gila orcutti), both of which are State Species of Special Concern. They thrive in the moderate to fast cool or cold flows in gravelly and rocky riffles (suckers and dace), alternating with slower pools (chubs)[9].

Glendale Narrows, from Riverside Drive to Arroyo Seco (Figueroa Street), with the longest soft-bottomed segment (seven miles), supports many beneficial uses and is designated accordingly in the Basin Plan. This portion of the Los Angeles River is designated as open space in the various community general plans. Dense riparian vegetation provides habitat for wildlife including birds, ducks, frogs and turtles. Several small pocket parks are found along this section of the River, many of which were designed by North East Trees (NET), sometimes in partnership with the Mountains Recreation and Conservation Authority (MRCA), such as a small park South and North of Los Feliz Boulevard sometimes referred to as the "Los Angeles RiverWalk"[10] and Sunnynook park on the Atwater side, and Rattlesnake Park and Zanja Madre Park on the Silver Lake side. Another example of a pocket park, designed by MRCA, is Knox Park[11], at the end of Knox Avenue. The riparian vegetation closely mimics the historical "willow sloughs" that once dotted the basin[12]. The relatively lush environment in this reach attracts people who enjoy many forms of recreation including walking, jogging, horseback riding, bicycling, bird watching, photography and crayfishing. There are several access points in this reach, including the pedestrian bridge over the Golden State Freeway from Griffith Park near Los Feliz Boulevard (Sunnynook Bridge). This whole section is lined with a maintained bike path, and many bicyclists use the path, which is cooled in places by the riparian trees. In addition, cut fences provide easy access for the many people who use this section of the river, including the homeless who have set up camp under some of the bridges within this reach or on the vacant land between Highway 5 and the fence to the river.

Figure C. Fletcher Drive: Great Egret, October 26, 1999.

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[9] Camm Swift, Emeritus Natural History Museum of Los Angeles County, California Academy of Sciences, May 20, 2000.
[10] Nishith Dhandha, North East Trees, August 24, 2000.
[11] Ibid.
[12] Dan Cooper, Audubon Society, California Academy of Sciences, May 20, 2000.

From Figueroa Street to Washington Boulevard, the river supports several beneficial uses, including the Downtown Channel, which is used by many for recreation and bathing, in particular by homeless people who seek shelter there.

The mid-cities reach (11½ miles from Washington Boulevard to Atlantic Avenue), has several beneficial uses. The western levee is available for trail use from Atlantic Boulevard in Vernon to Firestone Boulevard in South Gate. There is a county bike path on the eastern levee (the Lario Trail) and a county equestrian and hiking trail adjacent to the levee. Continuous access to the Lario Trail is provided below each street bridge crossing. Several parks have been developed adjacent to the river on the east side, some of which provide access to the river trail (Cudahy Park). In Vernon, the channel invert is used for lunchtime soccer games, and people walk or jog on the river maintenance roads mostly during the week at lunchtime. The utility easement in Bell is used partly for small, informal vegetable gardening.[13] South of the confluence of the Los Angeles River and the Rio Hondo Channel in South Gate, increasing numbers of birds can be seen using the channel and adjacent lands.[14]

The nine-mile reach from Atlantic Avenue to the ocean supports some of the most abundant bird life found on the Los Angeles River. The parks, spreading grounds, utility easements and vacant land adjacent to the river provide roosting and feeding habitat. Many species of birds also feed in the concrete channel, where algae grow in the warm, shallow water, and in the estuary South of Willow Street, including fish-eaters like waders (herons, egrets, occidental bitterns and rails), terns, osprey (a fish-eating hawk), pelicans and cormorants. California Brown Pelican and California Least Tern are Federally Endangered Species.[15]

The water in the estuary pools is deep and slow enough to support an abundant fish community as well. In addition to gobies and tilapia (mostly *Tilapia mozambica*)[16], which are very abundant in the Los Angeles River, especially South of Willow Street, many species of fish are found in the estuary of the Los Angeles River. As an example, the following species have been found between the Ocean boulevard bridge and Queensway Bay bridge: California tonguefish, California halibut, specklefin midshipman, California lizardfish, diamond turbot, barcheek pipefish, and Pacific staghorn sculpin (bottom feeders), as well as white croaker, queenfish, deepbody anchovy, white seaperch, slough anchovy, barred sand bass, shiner perch, California grunion, and striped mullet (midwater feeders, often associated with bottom environment). This area also has harbored some pelagic fish, some of which will venture up an undetermined portion of the estuary: northern anchovy, Pacific sardine, Pacific pompano, Pacific barracuda, topsmelt, jacksmelt, white seabass, barred pipefish, giant kelpfish, and bay pipefish.[17]

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[13] Los Angeles River Master Plan, p. 99.
[14] At the confluence there is a ten-acre site (approx.) owned by the City of South Gate that contains an abandoned landfill which is vegetated with grasses, shrubs and trees (Los Angeles River Master Plan).
[15] Dan Cooper, California Audubon Society, December 17, 1999.
[16] Charles Mitchell, MBC Applied Environmental Sciences, December 19, 1999.
[17] Marine Biological Baseline Study of Queensway Bay, Long Beach Harbor, MBC Applied Environmental Sciences, 1994.

Beneficial uses of the Los Angeles River watershed are summarized in Table 1, excerpted from the 1994 Basin Plan. These are the designated beneficial uses that must be protected.[18]

Table 1. Beneficial Uses of Surface Waters of the Los Angeles River.

| **Surface Waters** | **Hydro Unit** | **MUN** | **IND** | **PROC** | **GWR** | **NAV** | **REC1** | **REC2** | **COMM** | **WARM** | **COLD** | **EST** | **MAR** | **WILD** | **RARE** | **MIGR** | **SPWN** | **SHELL** | **WET** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles River Estuary | 405.12 | | E | | | E | E | E | E | | | E | E | E | E | E | E | P | E |
| Los Angeles River to Estuary | 405.12 | P* | P | P | E | | E | E | | E | | | E | E | E | P | P | P | |
| Los Angeles River | 405.15 | P* | P | | E | | E | E | | E | | | | P | | | | | |
| Los Angeles River | 405.21 | P* | P | | E | | E | E | | E | | | | E | | | | | E |
| Compton Creek | 405.15 | P* | | | E | | E | E | | E | | | | E | | | | | E |
| Rio Hondo downstream Spreading Grounds | 405.15 | P* | | | I | | P | E | | P | | | | I | | | | | |
| Rio Hondo | 405.41 | P* | | | I | | I | E | | P | | | | I | E | | | | E |
| Alhambra Wash | 405.41 | P* | | | I | | P | I | | P | | | | P | E | | | | |
| Rubio Wash | 405.41 | P* | | | I | | I | I | | I | | | | E | P | | | | |
| Rubio Canyon | 405.31 | P* | | | E | | I | I | | I | | | | E | E | | | | E |
| Eaton Wash | 405.41 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Eaton Wash (downstream dam) | 405.31 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Eaton Wash (upstream dam) | 405.31 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Eaton Dam and Reservoir | 405.31 | P* | | | I | | P | I | | I | | | | E | | | | | |
| Eaton Canyon Creek | 405.31 | P* | | | E | | E | E | | E | | | | E | E | | E | | E |
| Arcadia Wash (lower) | 405.41 | P* | | | I | | P | I | | P | | | | P | | | | | |
| Arcadia Wash (upper) | 405.33 | P* | | | I | | P | I | | P | | | | P | | | | | |
| Santa Anita Wash (lower) | 405.41 | P* | | | I | | P | E | | P | | | | P | E | | | | |
| Santa Anita Wash (upper) | 405.33 | P* | | | E | | E | E | | E | | | | E | E | | | | |
| Little Santa Anita Canyon Creek | 405.33 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Big Santa Anita Reservoir | 405.33 | P* | | | E | | P | E | | E | E | | | E | | | | | |

[18] Water Quality Control Plan, Los Angeles Region, California Regional Water Quality Control Board, Los Angeles Region, 1994, p. 2-10.

Table 1. Beneficial Uses of Surface Waters of the Los Angeles River, continued.

| Surface Waters | Hydro Unit | MUN | IND | PROC | GWR | NAV | REC1 | REC2 | COMM | WARM | COLD | EST | MAR | WILD | RARE | MIGR | SPWN | SHELL | WET |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | |
| Santa Anita Canyon Creek | 405.33 | E* | | | E | | E | E | | E | E | | | E | E | | E | | E |
| Winter Creek | 405.33 | P* | | | I | | I | E | | I | | | | E | | | | | E |
| East Fork Santa Anita Canyon | 405.33 | P* | | | E | | E | E | | E | E | | | E | | | E | | E |
| Sawpit Wash | 405.41 | I | | | I | | I | I | | I | | | | E | | | | | |
| Sawpit Canyon Creek | 405.41 | P* | | | I | | I | I | | I | | | | E | E | | | | |
| Sawpit Dam and Reservoir | 405.41 | P* | | | I | | P | I | | I | | | | E | | | | | |
| Monrovia Canyon Creek | 405.41 | I | | | I | | I | I | | I | | | | E | | | | | E |
| Arroyo Seco downstream Devil's Gate R. (L) | 405.15 | P* | | | | | I | I | | P | | | | P | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| Arroyo Seco downstream Devil's Gate R. (U) | 405.31 | P* | | | | | I | I | | P | | | | P | E | | | | |
| Devil's Gate Reservoir (L) | 405.31 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Devil's Gate Reservoir (U) | 405.32 | I* | | | I | | I | I | | I | | | | E | | | | | |
| Arroyo Seco upstream Devil's Gate R. | 405.32 | E | E | E | E | | E | E | | E | E | | | E | | | | | E |
| Millard Canyon Creek | 405.32 | E* | E | E | E | | E | E | | E | | | | E | E | | | | E |
| El Prieto Canyon Creek | 405.32 | I | I | I | I | | I | I | | I | | | | E | | | | | |
| Little Bear Canyon Creek | 405.32 | P* | | | I | | I | I | | I | I | | | E | | | | | E |
| Verdugo Wash | 405.24 | P* | | | I | | P | I | | P | | | | P | | | | | |
| Halls Canyon Channel | 405.24 | P* | I | I | I | | I | I | | I | | | | E | | | | | |
| Snover Canyon | 405.32 | I | I | I | I | | I | I | | I | | | | E | | | | | |
| Pickens Canyon | 405.24 | I* | | | I | | I | I | | I | | | | E | | | | | |
| Shields Canyon | 405.24 | I | I | I | I | | I | I | | I | | | | E | | | | | |
| Dunsmore Canyon Creek | 405.24 | I | I | I | I | | I | I | | I | | | | E | | | | | |

Table 1. Beneficial Uses of Surface Waters of the Los Angeles River, continued.

| Surface Waters | Hydro Unit | MUN | IND | PROC | GWR | NAV | REC1 | REC2 | COMM | WARM | COLD | EST | MAR | WILD | RARE | MIGR | SPWN | SHELL | WET |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Burbank Western Channel | 405.21 | P* | | | | | P | I | | P | | | | P | | | | | |
| La Tuna Canyon Creek | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Tujunga Wash | 405.21 | P* | | | I | | P | I | | P | P | | | P | | | | | |
| Hansen Flood Control Basin & Lakes | 405.23 | P* | | | E | | E | E | | E | E | | | E | E | | | | |
| Lopez Canyon Creek | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Little Tujunga Canyon Creek | 405.23 | P* | | | I | | I | E | | I | I | | | E | E | | | | |
| Kagel Canyon Creek | 405.23 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Big Tujunga Canyon Creek | 405.23 | P* | | | E | | E | E | | E | E | | | E | E | | E | | E |
| Upper Big Tujunga Canyon Creek | 405.23 | P* | | | E | | E | E | | I | P | | | E | | | | | E |
| Haines Canyon Creek | 405.23 | P* | | | I | | I | I | | I | | | | E | E | | | | |
| Vasquez Creek | 405.23 | P* | | | E | | E | E | | P | P | | | E | | | | | E |
| Clear Creek | 405.23 | P* | | | E | | E | E | | E | E | | | E | | | | | E |
| Big Tujunga Reservoir | 405.23 | P* | | | E | | P | E | | E | P | | | E | | | E | | |
| Mill Creek | 405.23 | P* | | | E | | E | E | | E | E | | | E | | | | | E |
| Pacoima Wash | 405.21 | P* | | | E | | P | E | | E | | | | E | E | | | | |
| Pacoima Reservoir | 405.22 | P* | | | E | | E | E | | E | | | | E | | | | | |
| Pacoima Canyon Creek | 405.22 | P* | | | E | | E | E | | E | E | | | E | E | | E | | E |
| Stetson Canyon Creek | 405.22 | P* | | | I | | P | E | | P | | | | P | | | | | |
| Wilson Canyon Creek | 405.22 | P* | | | I | | E | E | | I | | | | E | | | | | |
| May Canyon Creek | 405.22 | P* | | | I | | I | E | | I | | | | E | | | | | |
| Sepulveda Flood Control Basin | 405.21 | P* | | | E | | E | E | | E | | | | E | | | | | E |
| Bull Creek | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Los Angeles Reservoir | 405.21 | E | E | E | P | | P | E | | E | | | | E | E | | | | |
| Lower Van Norman Reservoir | 405.21 | E* | E | E | E | | E | E | | E | | | | E | E | | | | |
| Solano Reservoir | 405.21 | E* | | | | | P | | | P | | | | E | | | | | |
| Caballero Creek | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Aliso Canyon Wash and Creek | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Limeklin Canyon Wash | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |

Table 1. Beneficial Uses of Surface Waters of the Los Angeles River, concluded.

| **Surface Waters** | **Hydro Unit** | **MUN** | **IND** | **PROC** | **GWR** | **NAV** | **REC1** | **REC2** | **COMM** | **WARM** | **COLD** | **EST** | **MAR** | **WILD** | **RARE** | **MIGR** | **SPWN** | **SHELL** | **WET** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Browns Canyon Wash and Creek | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Arroyo Calabasas | 405.21 | P* | | | | | P | I | | P | | | | P | | | | | |
| McCoy Canyon Creek | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Dry Canyon Creek | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Bell Creek | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Chatsworth Reservoir | 405.21 | E | E | E | | | P | E | | E | | | | E | | | | | |
| Dayton Canyon Creek | 405.21 | P* | | | I | | I | I | | I | | | | E | | | | | |
| Echo Lake | 405.15 | P* | | | | | P | E | | P | | | | E | | | | | |
| Lincoln Park Lake | 405.15 | P* | | | | | P | E | | P | | | | E | | | | | |

E: Existing beneficial use
P: Potential beneficial use
I: Intermittent beneficial use

**BENEFICIAL USE CODES (see Basin Plan for more details):**
MUN - Municipal and Domestic Water Supply
IND - Industrial Service Supply
PROC - Industrial Process Supply
GWR - Ground Water Recharge
REC1 - Water Contact Recreation
REC2 - Non-Contact Water Recreation
COMM - Commercial and Sport Fishing

*: Conditional designation: the waters designated with an "*" in the table do not have MUN as a designated use until such time as the Basin Plan is modified based on additional study. In the interim, no new effluent limitations will be placed in Waste Discharge Requirements as a result of these designations until the Regional Board adopts an amendment that identifies those waters in the Region that should be excepted from the MUN designation.

WARM - Warm Freshwater Habitat
COLD - Cold Freshwater Habitat
EST - Estuarine Habitat
MAR - Marine Habitat
WILD - Wildlife Habitat
RARE - Rare, Threatened or Endangered Species
SPWN - Spawning, Reproduction, and/or Early Development
SHELL - Shellfish Harvesting
WET - Wetland Habitat

## C. Water Quality Objectives

Water quality standards consist of a combination of beneficial uses, water quality objectives and the State's Antidegradation Policy. The Regional Board has determined that the narrative water quality objectives applicable to this TMDL are **floating materials***: "Waters shall not contain floating materials, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses*"[19] and **solid, suspended, or settleable materials:** "*Waters shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses*."[20] The States' Antidegradation Policy is formally referred to as the *Statement of Policy with Respect to Maintaining High Quality Waters in California* (State Board Resolution No. 68-16).

## D. Impairment of Beneficial Uses

Existing beneficial uses impaired by trash in the Los Angeles River are contact recreation (REC 1) (contact sports: swimmers are spotted regularly in the Los Angeles River at Glendale Narrows and also at Willow Street in Long Beach) and non-contact recreation such as fishing (REC 2) (trash is aesthetically displeasing and deters recreational use and tourism); warm fresh water habitat (WARM); wildlife habitat (WILD); estuarine habitat (EST) and marine habitat (MAR); rare, threatened or endangered species (RARE); migration of aquatic organisms (MIGR) and spawning, reproduction and early development of fish (SPWN); Commercial and sport fishing (COMM); Wetland Habitat (WET), and Cold freshwater habitat (COLD). These beneficial uses in the Los Angeles River are impaired by large accumulations of suspended and settled debris throughout the river system. The problem is even more acute in Long Beach where debris flushed down from the upper reaches of the river collects. Common items that have been observed by Regional Board staff include Styrofoam cups, Styrofoam food containers, glass and plastic bottles, toys, balls, motor oil containers, antifreeze containers, construction materials, plastic bags, and cans. Heavier debris can be transported during storms as well.

Reaches of the Los Angeles River that are impaired by trash, and listed on the 303(d) list for such, are Tujunga Wash (downstream Hansen Dam to Los Angeles River), Los Angeles River Reach 5 (within Sepulveda Basin), Los Angeles River Reach 4 (Sepulveda Dam to Riverside Dr.), Los Angeles River Reach 3 (Riverside Dr. to Figueroa St.), Los Angeles River Reach 2 (Figueroa St. to upstream Carson St.), Los Angeles River Reach 1 (upstream Carson St. to estuary), Burbank Western Channel, Verdugo Wash (Reaches 1 & 2), Arroyo Seco Reach 1 (downstream Devil's Gate Dam) & Reach 2 (W. Holly Ave. to Devil's Gate), and Rio Hondo Reach 1 (Santa Ana Fwy to Los Angeles River). In addition, Peck Road Lake, Echo Park Lake and Lincoln Park Lake are listed as impaired for trash.

Trash in waterways causes significant water quality problems. Small and large floatables can inhibit the growth of aquatic vegetation, decreasing spawning areas and habitats for fish and other living organisms. Wildlife living in rivers and in riparian areas can be harmed by ingesting or becoming entangled in floating trash. Except for large items such as shopping carts, settleables are not always obvious to the eye. They include glass, cigarette butts, rubber,

[19] Water Quality Control Plan ("Basin Plan"), p. 3-9.
[20] Ibid., pp. 3-16.

construction debris and more. Settleables can be a problem for bottom feeders and can contribute to sediment contamination. Some debris (e.g. diapers, medical and household waste, and chemicals) are a source of bacteria and toxic substances. Floating debris that is not trapped and removed will eventually end up on the beaches or in the open ocean, repelling visitors away from our beaches and degrading coastal waters.

A major trash problem experienced in the Los Angeles River Watershed contributes to a broader phenomena that affects ocean waters, as small pieces of plastic called "nurdles" (defined as pre-production virgin material from plastic parts manufacturers, as well as post-production discards that are occasionally recycled) float at various depths in the ocean and affect organisms at all levels of the food chain. As sunlight and UV radiation render plastic brittle, wave energy pulverizes the brittle material, with a subsequent chain of nefarious effects on the various filter feeding organisms found near the ocean's surface. Studies in the North Pacific indicate that both large floating plastic and smaller fragments are increasing. As a result of increased reports of resin pellet ingestion by aquatic wildlife and evidence that the ingested pellets are harming wildlife, the Interagency Task Force on Persistent Marine Debris (ITF) identified resin pellets, also know as plastic pellets, as a debris of special concern.[21] When released into the environment, these pellets either may float on or near the water surface, may become suspended at mid-depths, or may sink to the bottom of a water body. Whether a specific pellet floats or sinks depends on the type of polymer used to create the pellet, on additives used to modify the characteristics of the resin, and on the density of the receiving water.

A 1999 study of Marine Debris in the Mid-Pacific Gyre in an attempt to assess the potential effects of ocean particles on filter feeding marine organisms, collected plankton samples at various locations throughout the gyre. The results were stunning: the mass of plastic particles collected was six times higher than the mass of plankton (841 g/km$^2$), although the number of planktonic organisms (1,837,342/km$^2$) was five times the number of plastic pieces. The distribution of the sampling points allows one to assume that this number can be safely extrapolated to the breadth of the Mid-Pacific Gyre. A remarkable finding was that the number of particles did not increase in successively smaller size classes as expected, indicating there may be non-selective removal by mucus web-feeding jellies and salp. In this study, the most common type of identifiable particle, thin plastic film, accounted for 29% of the total. Many birds will die from ingesting this non-nutritive plastic.[22]

The prevention and removal of trash in the Los Angeles River ultimately will lead to improved water quality and protection of aquatic life and habitat, expansion of opportunities for public recreational access, enhancement of public interest in the rivers and public participation in restoration activities, and propagation of the vision of the river as a whole and enhancement of the quality of life of riparian residents.

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[21] US Environmental Protection Agency (US EPA) (1992) **Plastic Pellets in the Aquatic Environment: Sources and Recommendations.**

[22] Moore, C.J. et al. **Marine Debris in the North Pacific Gyre, 1999, with a Biomass Comparison of Neustonic Plastic and Plankton**. (in preparation)

## E. Extent of the Trash Problem in the Los Angeles River

Trash is a water quality problem throughout the Los Angeles River. The Regional Board has determined that current levels of trash exceed the existing Water Quality Objectives necessary to protect the beneficial uses of the river.

For many years, Los Angeles County and other cities have recognized that trash is a problem.[23] The Los Angeles County Department of Public Works is reporting a "30% decrease in roadway trash on unincorporated County roads and a 50% decrease in trash entering catchbasins since adoption of the current National Pollutant Discharge Elimination System (NPDES) Permit".[24] However, trash in the Los Angeles River continues to be a serious problem.

Every city in the watershed agrees that the amount of trash found in the waterways is excessive, and that trash is found in all reaches of the river from Calabasas to Long Beach, and in all tributaries. Although the Regional Board has not yet received the data that the Los Angeles County Department of Public Works used for its findings, Regional Board staff regularly observe trash in the waterways of this watershed. Non-profit organizations such as Heal the Bay, Friends of the Los Angeles River (FoLAR) and others, organize volunteer clean-ups periodically, and document the amount of trash that was removed on such days, but these data do not indicate how long the trash had been accumulating at that particular site, only the amount that was picked up by the volunteers on a given day.

For example, at Coastal Clean-up Day in 1996, 26,300 lbs of trash were collected in Los Angeles County. During the September 18, 1999, California Coastal Clean up organized by Heal the Bay, a total of 60,711 lbs of trash were collected.[25]

At a clean-up organized during the Sacred Music Festival on Saturday, October 16, 1999, between Los Feliz Boulevard and Fletcher Drive over a distance of slightly under 1.5 miles, eleven shopping carts and six 40-gallon bags of trash were removed (see Figure D). However, this was not the total amount of trash on site, as Regional Board staff noticed more shopping carts and more trash on the same site the very next afternoon.[26] Meanwhile, the purpose of volunteer clean-ups is to visibly clean the river and its banks, not to quantify debris. As a result, it is likely that some of the debris collected during those events are not recorded. In

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[23]See comments from Los Angeles County, Agoura Hills, Artesia, Beverly Hills, Hermosa Beach, Hidden Hills, Carson, Diamond Bar, La Habra Heights, La Mirada, La Puente, Monrovia, Norwalk, Rancho Palos Verdes, Rolling Hills, San Fernando, San Marino, West Hollywood, Westlake Village, and the Executive Advisory Committee (Stormwater Program - Los Angeles County) on behalf of all the Los Angeles County cities, submitted in response to the first draft of this Trash TMDL for the Los Angeles River Watershed.

[24]Comment letter from County of Los Angeles, Department of Public Works, May 15, 2000, p. 1.

[25] Alix Gerosa, Heal the Bay, November 22, 1999.

[26] Trash observed by Regional Board staff on October 17, 1999, included mixed polystyrene waste (cups, plates and others), plastic bags, cement, sound boards, large clusters of cigarette butts, disposable plastic glass lids, aluminum wrappers, balloons, medications, plastic bottles, clothing, books, and aerosol paint cans.

addition, volunteers traditionally focus on larger, more visible debris to the exclusion of smaller debris which are commonly encountered, such as cigarette butts.

Figure D. Trash waiting for pick-up at Los Feliz Boulevard after the Sunday, October 16, 1999 river clean-up.

Several studies which attempted to quantify trash generated from discreet areas have been completed, but they concern relatively small areas, or relatively short periods, or both. The findings of some of these studies are discussed below.

The City of Calabasas cleaned out the Continuous Deflective Separation (CDS) Unit they had installed in December of 1998, on September 28, 1999. This CDS unit, located in Calabasas at the intersection of Las Virgenes Road and Agoura Road, collects trash from the runoff of a small storm drain, as well as part of the runoff from Calabasas Park Hills (Santa Monica Mountains), and eventually empties to Las Virgenes Creek. It is assumed that this CDS unit prevented all trash from passing through. The calculated area drained by this CDS Unit, as provided to the Regional Board by Los Angeles County Department of Public Works staff, amounts to 12.8 square miles. The urbanized area was estimated by Regional Board staff to amount to 0.10 square miles of the total area. The result of this clean-out, which represents approximately half of the 1998-1999 rainy season, was 2,000 gallons of sludgy water and a 64-gallon bag about two-third full of plastic food wrappers. It is assumed that part of the trash that accumulated in the CDS unit over roughly half of the rainy season had decomposed in the unit, hence the absence of paper products. Given the CDS unit was cleaned out after slightly more than nine months of use, it was assumed that this 0.10 square mile urbanized area produced a volume of 64 gallons of trash over one year. This datum will be used as the default value for the implementation plan. Although other studies are informative, studies currently available to the Regional Board provide insufficient data and could not be applied directly to establishing trash generation rates.

The City of Los Angeles conducted an Enhanced Catch Basin Cleaning Pilot Project in compliance with a consent decree between the United States Environmental Protection Agency, the State of California, and the City of Los Angeles. The project goals were to determine debris loading rates, characterize the debris, and find an optimal cleaning schedule through enhancing catch basin cleaning. The project evaluated trash loading at two drainage basins:

-The Hollywood Basin (1,366 acres and 793 catch basins) includes much of Hancock Park and is mostly residential with some commercial and open space, and no industrial land;

-The Sawtelle Basin (2,267 acres and 502 catch basins) includes residential areas with some commercial, industrial and transportation-related uses, and some open space.

The catch basins are inlet structures without a sump below the level of the outlet pipe to capture solids and trash washed down by the stormwater.[27] These inlets also collect trash, grass clippings and animal wastes during dry weather. Catch basins were cleaned 3-4 times from March 1992 to December 1994 and yielded approximately 0.79 $yd^3$ (160 Gal) of debris per cleaning (Sawtelle – 1.04 $yd^3$ (210 Gal) and Hollywood – 0.61 $yd^3$ (123 Gal)), characterized as paper (26%), plastic wastes (10%), soil (33%), and yard trimmings (31%).

The study also observed that the amount of plastic waste was less in residential areas and greater in non-residential areas, that paper waste was greater in commercial areas, and that soil and yard waste was greater in residential areas and open spaces.[28]

Long Beach collects large amounts of trash at the mouth of the Los Angeles River, as much of the trash carried down the Los Angeles River ends up at the river's mouth in Long Beach. Debris tonnage at the mouth of the Los Angeles River is listed in Table 2.

Table 2. Storm Debris Collection Summary for Long Beach: Debris is measured in Tonnage.[29]

| Storm Year | First Quarter (July-Sept.) | Second Quarter (Oct.-Dec.) | Third Quarter (Jan.-March) | Fourth Quarter (April-June) | Total |
|---|---|---|---|---|---|
| 1994-95 | 436 | 509 | 3,576 | 702 | 5,224 |
| 1995-96 | 504 | 344 | 3,100 | 645 | 4,593 |
| 1996-97 | 350 | 2,361 | 601 | 681 | 3,993 |
| 1997-98 | 647 | 3,650 | 4,016 | 977 | 9,290 |
| 1998-99 | 565 | 720 | 532 | 1,274 | 3,091 |
| 1999-00 | 781 | 176 | 1,664 | 1,223 | 3,844 |
| 2000-01 | 757 | 581 | 2,625 | 474 | 4,437 |
| 2001-02 | 424 | 739 | 288 | 407 | 1,858 |
| 2002-03 | 430 | 752 | 2,564 | 884 | 4,630 |
| 2003-04 | 299 | 779 | 607 | 951 | 2,636 |

[27] Such structures are usually termed *catchments*, but the term *catch basin* is used throughout Southern California. The absence of flow during dry weather allows trash to collect at the inlet. (Phone conversation with Wing Tam, City of Los Angeles, November 10, 1999.)

[28] This information and all of the above concerning the City of Los Angeles Enhanced Catch Basin Cleaning was found in: City of Los Angeles Department of Public Works, Bureau of Sanitation: Consent Decree Report, Enhanced Catch Basin Cleaning, April 1999. (Unpublished report.)

[29] City of Long Beach *L.A. River Debris Summary* (as of June 2006).

| Storm Year | First Quarter (July-Sept.) | Second Quarter (Oct.-Dec.) | Third Quarter (Jan.-March) | Fourth Quarter (April-June) | Total |
|---|---|---|---|---|---|
| 2004-05 | 273 | 4,390 | 6,176 | 1,416 | 12,255 |
| 2005-06 | 561 | 495 | 862 | 670 | 2,591 |

## IV. Numeric Target

The numeric target for this TMDL is 0 (zero) trash in the water. The numeric target is derived from the narrative water quality objectives, including an implicit margin of safety. Although a substantial number of comments were received in response to the March 17, 2000 Draft TMDL, no information was provided to justify any other number for the final TMDL target that would fully support the designated beneficial uses. The numeric target was used to calculate the Waste Load Allocations as described in the Implementation Plan (see Section VIII.)

## V. Source Analysis

The major source of trash in the river results from litter, which is intentionally or accidentally discarded in watershed drainage areas. Transport mechanisms include the following:

1. Storm drains: trash is deposited throughout the watershed and is carried to the various reaches of the river and its tributaries during and after significant rainstorms through storm drains.

2. Wind action: trash can also blow into the waterways directly.

3. Direct disposal: direct dumping also occurs.

Extensive research has not been done on trash generation or the precise relationship between rainfall and its deposition in waterways. However, it has been found that the amount of gross pollutants entering the stormwater system is rainfall dependent but does not necessarily depend on the source (Walker and Wong, December 1999). The amount of trash which enters the stormwater system depends on the energy available to re-mobilize and transport deposited gross pollutants on street surfaces rather than on the amount of available gross pollutants deposited on street surfaces. The exception to this finding of course would be in the event that there is zero gross pollutants deposited on the street surfaces or other drainages tributary to the storm drain. Where gross pollutants exist, a clear relationship between the gross pollutant load in the stormwater system and the magnitude of the storm event has been established. The limiting mechanism affecting the transport of gross pollutants, in the majority of cases, appears to be re-mobilization and transport processes (i.e., stormwater rates and velocities).

Several studies conclude that urban runoff is the dominant source of trash. The large amounts of trash conveyed by urban storm water to the Los Angeles River is evidenced by the amount of as trash that accumulates at the base of storm drains. The amount and type of trash that is washed into the storm drain system appears to be a function of the surrounding land use.

A number of studies (Walker and Wong, 1999, Allison, 1995), have shown that commercial land-use catchments generate more pollutants than residential land use catchments, and as much as three times the amount generated from light industrial land use catchment. It is generally accepted that commercial land uses tend to contribute larger loads of gross pollutants per area compared to residential and mixed land-use areas. This is in spite of daily street sweeping in the commercial sub-catchment compared to once every two weeks in residential and mixed land use areas.

## VI. Waste Load Allocations

Storm drains have been identified as a major source of trash in the Los Angeles River. The strategy for meeting the water quality objective will focus on reducing the trash discharged via municipal storm drains.

Waste Load Allocations are assigned to the Permittees and Co-permittees of the Los Angeles County Municipal Stormwater Permit (hereinafter referred to as Permittees) and Caltrans. In addition, Waste Load Allocations may be issued to additional facilities in the future under Phase II of the US EPA Stormwater Permitting Program. Waste Load Allocations assigned under the MS4 permit and the Caltrans permit will be based on a phased reduction from the estimated current discharge (i.e., baseline) over a 9-year period until the final Waste Load Allocation (currently set at zero) is met. Permittees under the Phase II Stormwater Permitting Program will also be assigned a final WLSA of zero trash discharge. The baseline allocation for the MS4 Permittees and Co-permittees (referred to hereinafter as the "Permittees") is derived from data collected during the Baseline Monitoring Program.

### A. Reconsideration and Refinement Provision

The baseline Waste Load Allocations for the MS4 Permittees and Co-permittees have been modified from that assigned in the earlier trash TMDL. The Regional Board will review and reconsider the final Waste Load Allocations once a reduction of 50% of the Baseline Waste Load Allocation has been achieved. This means that the final Waste Load Allocation will be reviewed only after substantial reductions are achieved. This reconsideration of the Waste Load Allocation will be based on the findings of future studies regarding the threshold levels needed for protecting beneficial uses.

### B. Default Baseline Waste Load Allocation

The Default Baseline Waste Load Allocation for the municipal stormwater permittees, in the earlier version of the trash TMDL was equal to 640 gallons of uncompressed trash per square mile per year. No differentiation was applied for different land uses in the Default Baseline Waste Load Allocation.

## C. Refined Baseline Waste Load Allocations

The municipal stormwater permittees opted to seek refinement of the Default Baseline Waste Load Allocation by implementing a "Baseline Monitoring Plan." The goal of the Baseline Monitoring program was to derive a representative trash generation rate for various land uses from across the Los Angeles River watershed. The Baseline Waste Load Allocation for any single city is the sum of the products of each land use area multiplied by the Waste Load Allocation for the land use area, as shown below:

$$LA = \sum \textit{for each city}\left(\textit{area by land uses} \bullet \textit{allocations for this land use}\right)$$

The urban portion of the Los Angeles River watershed was divided into twelve types of land uses for every city and unincorporated area in the watershed. Similar land use classifications already exist on the land use maps used by L.A. County Department of Public Works to assess the generation of certain pollutants by land use.[30] The land use categories are: (1) high density residential[31], (2) low density residential[32], (3) commercial and services, (4) industrial, (5) public facilities[33], (6) educational institutions[34], (7) military installations, (8) transportation[35], (9) mixed urban[36], (10) open space and recreation[37], (11) agriculture[38], and (12) water[39]. Given that the minimum mapping resolution is 2.5 acres, a non-critical land use unit may not be mapped if it is less than 2.5 acres in size[40].

The appendix contains a table which shows the square mileage for each land use for each city and unincorporated areas in the watershed, and a list of maps showing land uses for each city. Unincorporated areas include areas such as Altadena, East Compton, East Los

[30] The land use classification was developed by Aerial Information Systems as a modified Anderson Land Use Classification and originally included 104 categories. The land use coverages were donated for GIS library use by Southern California Association of Governments (SCAG), and show land use for 1990 and for 1993. The coverages were map-joined into a single coverage by Teale Data Center. The Regional Board layers were aggregated from the TDC coverage into the land uses shown above.

[31] High Density Residential includes High Density Single Family Residential and all Multi Family Residential, Mobile Homes, Trailer Parks and Rural Residential High Density.

[32] Under 2 units per acre.

[33] These include government centers, police and sheriff stations, fire stations, medical health care facilities, religious facilities large enough to be distinguished on an aerial photograph, libraries, museums, community centers, public auditoriums, observatories, live indoor and outdoor theaters, convention centers which were built prior to 1990, communication facilities, and utility facilities (electrical, solid waste, liquid waste, water storage and water transfer, natural gas and petroleum).

[34] Preschools and daycare centers, elementary schools, high schools, colleges and universities, and trade schools, including police academies and fire fighting training schools.

[35] Airports, railroads, freeways and major roads (that meet the minimum mapping resolution of 2.5 acres), park and ride lots, bus terminals and yards, truck terminals, harbor facilities, mixed transportation and mixed transportation and utility.

[36] Mixed commercial, industrial and/or residential, and areas under construction or vacant in 1990.

[37] Golf courses, local and regional parks and recreation, cemeteries, wildlife preserves and sanctuaries, botanical gardens, beach parks.

[38] Orchards and vineyards, nurseries, animal intensive operations, horse ranches.

[39] Open water bodies, open reservoirs larger than 5 acres, golf course ponds, lakes, estuaries, channels, detention ponds, percolation basins, flood control and debris dams.

[40] Critical land uses were mapped regardless of resolution limits. Critical land use units below 1 acre in size were mapped as 1-acre units.

Angeles, East Pasadena, East San Gabriel, Florence, La Crescenta, Mayflower Village, North El Monte, South San Gabriel, Walnut Park, Westmount and Willowbrook. For cities that are only partially located in the watershed, the square mileage indicated is for the part of this city that is in the watershed only.

Land uses that are not under municipal jurisdiction, such as military installations, will be dealt with through separate permits, and were thus not included in the calculation of the baseline Waste Load Allocations.

Each permittee will be allowed 60% of their baseline Waste Load Allocation during the first year of implementation, and subsequent annual reductions of 10% of from the baseline will be required through every year of implementation.

## D. Baseline Waste Load Allocations for Caltrans

A Litter Management Pilot Study (LMPS)[41] was conducted to evaluate the effectiveness of several litter management practices in reducing litter that is discharged from Caltrans storm water conveyance systems. The LMPS employed four field study sites, each of which was used to test a separate BMP. Each site included three replicate testing pairs, consisting of one site designed to measure the amount of trash produced when treatment was applied, and one control with no treatment site. The LMPS averages the data collected at the control outfalls in order to obtain the annual litter loads. The average combined total loads for the three control outfalls at each site normalized by the total area of control catchments is presented in the following table, adapted from the LMPS report[42]:

Table 3. Average Combined Total Loads for Control Outfalls at 3 Litter Management Pilot Study (LMPS) Sites.

| Site | Weight lbs/sq mi | Volume cu ft/sq mi |
|---|---|---|
| 1E | 10584.00 | 1312.97 |
| 1W | 7479.36 | 971.73 |
| 6 | 7479.36 | 881.34 |
| 8 | 4374.72 | 404.51 |

The baseline Waste Load Allocation for weight and volume load generation for freeways is arrived at by averaging weight and volume columns. (see Table 4.) It is to be noted that control site 1E already had one BMP in place before testing of the other BMPs, as it was cleaned monthly through an "Adopt a Highway" program.

[41] California Department of Transportation District 7 Litter Management Pilot Study, June 2000. This study defined litter in stormwater as "manufactured items that can be retained by ¼-inch mesh made from paper, plastic, cardboard, etc.", and "that are not of natural origin (i.e. does not include sand, soil, gravel, vegetation, etc.)" (p. 1-2).
[42] Ibid., Table 6-8.

Table 4. A Preliminary Baseline Waste Load Allocation for Weight and Volume for Freeways.

| Weight lbs/sq mi | Volume cu ft/sq mi |
|---|---|
| 7479.36 | 892.64 |

Average Annual Daily Traffic (AADT) for all control sites in the study ranged from 216,000 to 238,000.[43] Considering AADT on Los Angeles County freeways may be close to 300,000 on some sections[44], the chosen sites, although typical freeway outfalls, are not distributed throughout the whole AADT range. As the purpose of the study was to assess the effectiveness of specific BMPs, not to assess a trash generation factor, sites were chosen with similar characteristics.

## E. Baseline Waste Load Allocations for Municipal Permittees

Baseline Monitoring was conducted by the Los Angeles County Department of Public Works, as prescribed in the September 19, 2001 Los Angeles River Trash TMDL. The goal of the Baseline Monitoring Program was to collect representative data from across the watershed to refine the default Waste Load Allocations presented in the 2001 Los Angeles River Trash TMDL. Monitoring data was used to establish specific trash generation rates per land use. The land use categories that were monitored by the LACDPW baseline monitoring group (to determine land use based generation rates) were:

- High density residential,
- Low density residential,
- Commercial and services,
- Industrial, and
- Open space and recreation.

Public facilities-, Educational Institutions-, Mixed urban-, Agricultural-, and Water- land uses were exempt from monitoring.

In the analysis of the monitoring results provided by LACDPW, staff assumed the litter generation rate from public facilities and mixed urban landuse to be equivalent to that from the industrial land use. The transportation land use was equated with industrial land use, and agricultural land use was equated to open space. Water was assigned a litter generation rate of zero since it is not considered a generator of trash. The portion of the transportation land use that is under Caltrans' jurisdiction will be covered under Caltrans' permit. Major boulevards that are currently under Caltrans' jurisdiction, but are affected by trash generated on municipal sites, such as Santa Monica Boulevard, will be addressed by the cities concerned.

Military Installations were not included in the Waste Load Allocations of the cities that had this land use. Under EPA Phase II of the Storm Water Regulations, separate permits will be written for these facilities. While public educational institutions will also be covered under separate permits under Phase II, the analysis did not differentiate between public and private

[43] Ibid., Table 6-8.
[44] Information on AADT on select freeways can be found on Caltrans' website: http://www.caltrans.ca.gov/.

educational facilities under this landuse. Therefore, the cities have the option of providing information on the acreage of such land uses within their jurisdiction in order that contributions from these facilities be removed from their assigned baseline waste load allocations.

The baseline Waste Load Allocations for the municipal permittees is presented on a city by city basis in Table 5. A more detailed breakdown along land uses is provided in Appendix II. The Waste Load allocations for the first year of compliance will be a 40% reduction in the baseline Waste Load Allocation. The subsequent annual Waste Load Allocations will be a progressive 10% reduction in the baseline Waste Load Allocations over a period of 6 years, and apply except in areas serviced by Full Capture Systems. The values shown, in gallons, are in uncompressed volumes.

**Table 5. Los Angeles River Trash TMDL Baseline Waste Load Allocations (gallons and lbs of trash)** *Military Installations were not included in calculation of Baseline WLA

| City | WLA (gals) | WLA (lbs) |
|---|---|---|
| Alhambra | 39903 | 68761 |
| Arcadia | 50108 | 93036 |
| Bell* | 16026 | 25337 |
| Bell Gardens | 13500 | 23371 |
| Bradbury | 4277 | 12160 |
| Burbank* | 92590 | 170389 |
| Calabasas | 22505 | 52230 |
| Carson | 6832 | 10208 |
| Commerce | 58733 | 85481 |
| Compton* | 53191 | 86356 |
| Cudahy | 5935 | 10061 |
| Downey | 39063 | 68507 |
| Duarte | 12210 | 23687 |
| El Monte | 42208 | 68267 |
| Glendale* | 140314 | 293498 |
| Hidden Hills | 3663 | 10821 |
| Huntington Park | 19159 | 30929 |
| Irwindale | 12352 | 17911 |
| La Cañada Flintridge | 33496 | 73747 |
| Long Beach* | 87135 | 149759 |
| Los Angeles* | 1374845 | 2572500 |
| Los Angeles County* | 310223 | 651806 |
| Lynwood | 28201 | 46467 |
| Maywood | 6129 | 10549 |
| Monrovia | 46687 | 100988 |
| Montebello | 50369 | 83707 |
| Monterey Park | 38899 | 70456 |
| Paramount | 27452 | 44490 |
| Pasadena* | 111998 | 207514 |
| Pico Rivera | 13953 | 22549 |
| Rosemead | 27305 | 47378 |
| San Fernando | 13947 | 23077 |
| San Gabriel | 20343 | 36437 |
| San Marino | 14391 | 29147 |
| Santa Clarita | 901 | 2326 |
| Sierra Madre | 11611 | 25192 |
| Signal Hill | 9434 | 14220 |
| Simi Valley | 137 | 344 |
| South El Monte | 15999 | 24319 |
| South Gate | 43904 | 72333 |
| South Pasadena | 14907 | 28357 |
| Temple City | 17572 | 31819 |
| Vernon | 47203 | 66814 |
| Caltrans | 59421 | 66566 |

## VII. Implementation and Compliance

As required by the Clean Water Act, discharges of pollutants to surface waters from storm water are prohibited, unless the discharges are in compliance with a National Pollutant Discharge Elimination System (NPDES) Permit. Discharge of trash to the Los Angeles River will be regulated via the Municipal NPDES Storm Water Permits and the Caltrans stormwater permit. In addition, USEPA Phase II stormwater permits, general permits, and industrial permits may also be used to regulate discharges of trash to the river.

In June 1990, the first Municipal NPDES Storm Water Permit was issued jointly to Los Angeles County and 84 cities as co-permittees. A separate NPDES Storm Water Permit was issued to the City of Long Beach on June 30, 1999. Storm water municipal permits will be one of the implementation tools of this Trash TMDL, and will include the allocations as effluent limits or other permit requirements. Thus, future storm water permits will be modified to incorporate the Waste Load Allocations and to address monitoring and implementation of this TMDL.

The implementation and compliance schedule is designed to accommodate trash reduction efforts that have been conducted by several cities and the county throughout the Los Angeles River Watershed, in response to the previously adopted trash TMDL. The calculated baseline waste load allocations are derived from data collected during the 2002/03 and 2003/04 storm years. The initial compliance requirement of a 40% reduction from baseline trash levels assumes a 10% reduction per year in trash discharges from the end of the baseline monitoring period. Flexibility is provided by determining compliance based on a 2-year average in the second year and 3-year rolling averages in subsequent years until the numeric target of a zero discharge is attained. The purpose of the rolling averages is to account for fluctuations in trash discharge rates that may occur as a result of variations in annual rainfall patterns and/or littering and trash removal. This approach ensures that measurable reductions to the trash impairment will be achieved in a timely manner, while flexibility in implementation is provided for the responsible agencies

### A. Compliance Determination

For those areas not covered by Full Capture Systems, compliance with the Waste Load Allocations will be calculated as follows:

The first compliance date during the Implementation Phase will be September 30, 2007. Compliance will be evaluated based on the total load discharged to the river during the period October 1, 2007 through September 30, 2008. The second compliance date will be based on the average annual load discharged to the river from October1 2007 through September 30, 2009. Compliance thereafter will be evaluated at the end of each successive storm season and will be based on a rolling three-year average (see Table 6). This method will provide allowances for variability due to rainfall. Exceedance of the allowable discharges will subject the permittee to enforcement action. A summary of the schedule for determining compliance with the Waste Load Allocations is presented in Table 6.

The final waste load allocation will be considered complied with when the Executive Officer finds that devices or systems and/or institutional controls have removed effectively 100% of the trash from the storm drain system discharge to Los Angeles River or its listed tributaries.

Table 6. Los Angeles River Trash TMDL: Implementation Schedule.[45]
(Required percent reductions based on initial baseline wasteload allocation of each city)

| Year | Implementation | Waste Load Allocation | Compliance Point |
|---|---|---|---|
| ***1*** Sept 2008 | Implementation: Year 1 | 60% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans | Compliance is 60% of the baseline load |
| ***2*** Sept 2009 | Implementation: Year 2 | 50% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans | Compliance is 55% of the baseline load calculated as a 2-year annual average |
| ***3*** Sept 2010 | ***Implementation: Year 3***[46] | 40% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans | Compliance is 50% of the baseline load calculated as a rolling 3-year annual average |
| 4 Sept 2011 | ***Implementation: Year 4*** | 30% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans | Compliance is 40% of the baseline load calculated as a rolling 3-year annual average |
| 5 Sept 2012 | ***Implementation: Year 5*** | 20% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans | Compliance is 30% of the baseline load calculated as a rolling 3-year annual average |
| 6 Sept 2013 | Implementation: Year 6 | 10% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans | Compliance is 20% of the baseline load calculated as a rolling 3-year annual average |
| 7 Sept 2014 | Implementation: Year 7 | 0% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans | Compliance is 10% of the baseline load calculated as a rolling 3-year annual average |
| 8 Sept 2015 | Implementation: Year 8 | 0% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans | Compliance is 3.3% of the baseline load calculated as a rolling 3-year annual average |
| 9 Sept 2016 | Implementation: Year 9 | 0% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans | Compliance is 0% of the baseline load calculated as a rolling 3-year annual average |

[45] "Notwithstanding the zero trash target and the baseline waste load allocations shown in Table 5, a Permittee will be deemed in compliance with the Trash TMDL in areas served by a Full Capture System within the Los Angeles River Watershed."
[46] As specified in Section VI.A., the Regional Board will review and reconsider the final Waste Load Allocations once a reduction of 50% has been achieved and sustained in the watershed.

## B. Compliance Strategies

Permittees may employ a variety of strategies to meet the progressive reductions in their Waste Load Allocations. These strategies may be broadly classified as either:

- Full capture systems or
- Partial capture control systems and/or
- Institutional controls.

A permittee could comply with the successive reduction in Waste Load Allocations by installing Full Capture Systems progressively throughout the watershed until all of the outlets to the Los Angeles River system are covered. This approach may be best suited for open space areas, where low levels of trash may accumulate over large vegetated drainage areas. However, in more urban settings, institutional controls including enforcement of litter laws and more frequent street sweeping may be preferred.

It is to be noted that ordinances that prohibit litter are already in place in most cities. For example, the Los Angeles City Code of Regulations recognizes that trash becomes a pollutant in the storm drain system when exposed to storm water or any runoff and prohibits the disposal of trash on public land:

> No person shall throw, deposit, leave, cause or permit to be thrown, deposited, placed, or left, any refuse, rubbish, garbage, or other discarded or abandoned objects, articles, and accumulations, in or upon any street, gutter, alley, sidewalk, storm drain, inlet, catch basin, conduit or other drainage structures, business place, or upon any public or private lot of land in the City so that such materials, when exposed to storm water or any runoff, become a pollutant in the storm drain system. (City Code of Regulations, §64.70.02.C.1(a).)

Institutional controls provide several advantages over structural full capture systems. Foremost, institutional controls offer other societal benefits associated with reducing litter in our city streets, parks and other public areas. The capital investment required to implement institutional controls is generally less than for full capture systems. However, the labor costs associated with institutional controls may be higher, and institutional controls may be more costly in the long-term.

There have been a number of discussions as to how permittees may best implement the gradual reductions required by this Trash TMDL, and as to the types of devices or best management practices they should elect. The permittees will be free to implement trash reduction in any manner that they choose.

A discussion of the means for determining compliance for various implementation strategies is presented in the following subsections.

## 1. Full Capture Treatment Systems

The amount of trash discharged to the river by an area serviced by a full-capture system will be considered to be in compliance with the final Waste Load Allocation for the drainage area, provided that the Full Capture Systems are adequately sized, maintained and maintenance records are available for inspection by the Regional Board. Compliance with the final Waste Load Allocation will be assumed wherever Full Capture Systems are installed in the Los Angeles River Watershed. The installation of a Full Capture System by a discharger does not establish any presumption that the system is adequately sized, and the Regional Board reserves the right to review sizing and other data in the future to validate that a system satisfies the criteria established in this TMDL for a Full Capture System.

## 2. Partial Capture Treatment Systems and Institutional Controls

Measuring the effectiveness of partial-capture systems and institutional controls is more complicated. The discharge resulting from an area addressed by partial capture and/or institutional controls will be estimated using a mass balance approach, based on the daily generation rate (DGR) for the specific area. [Note: The DGR should not be confused with the trash generation rates obtained during baseline monitoring. The baseline monitoring program is designed to obtain "typical" trash generation rates for a given land use. Those values are then used to calculate a Permittee's baseline load allocation. The DGR is the average amount of trash deposited within a specified drainage area over a 24-hour period. The DGR will be used in a mass balance equation to estimate the amount of trash discharged during a rain event.] (See Example 1.)

Annual re-calculation of the DGR will serve as a measure of the effectiveness of source reduction measures including public education, enforcement of litter laws, etc. Source reduction measures will be accredited based on an annual recalculation of the DGR to allow for progressive improvement and/or to account for backsliding.

The DGR will be determined from direct measurement of trash deposited in the drainage area during any 30-day period from June 22$^{nd}$ to September 22$^{nd}$ of a given year[47], and re-calculated every year thereafter. This three-month period was assumed to be a time characterized by high outdoor activity when trash is most likely to be deposited on the ground. The recommended method for measuring trash during this time period is to close the catch basins in a manner that prevents trash from being swept into the catch basins and then to collect trash on the ground via street sweeping, manual pickup, or other comparable means. The DGR will be calculated as the total amount of trash collected divided by 30 (the required duration of trash collection ).

[47] Provided no special events are schedule that may affect the representative nature of this period.

Accounting of DGR and trash removal via street sweeping, catch basin clean outs, etc. will be tracked in a central spreadsheet or database to facilitate the calculation of discharge for each rain event. The spreadsheet and/or database will be available to the Regional Board for inspection during normal working hours. The database/spreadsheet system will allow for the computation of calculated discharges and can be coordinated with enforcement. This database will be developed by cities or groups of cities.

The Executive Officer may approve alternative compliance monitoring programs other than those described above, upon finding that the program will provide a scientifically-based estimate of the amount of trash discharged from the storm drain system.

## 3. Examples of Implementation Strategies

Two example control strategies for municipal stormwater discharges are described in this section.

**Example 1.**

A permittee installs catch basin inserts and "dry weather trash door" devices of the type that maintains the catch basin shut during dry weather, and implements regular street sweeping. After each storm of 0.25 inch or greater, the catch basin inserts are emptied. In this case, the DGR was calculated during the month of July as follows:[48]

DGR = (Volume of trash collected via street sweeping during the month of July / 31 days.)

The stormwater discharge for a given rain event then would be calculated by multiplying the number of days since the last street sweeping by the DGR and subtracting the volume of trash recovered in the catch basin inserts.

Stormwater Discharge = [(Days since last street sweeping) (DGR)] –
[Volume of trash recovered from catch basin inserts]

**Example 2.**

City X is comprised of three land use areas (Land Uses A, B, and C). The city has adopted an implementation strategy using a combination of full capture structural and institutional controls. As of year five, the city has installed full capture systems in Area A and institutional controls in Area B. City X has not yet taken any action to control trash in Area C. The watershed-wide baseline Waste Load Allocation have been established at 100 lbs per square mile for Land Uses A and B, and at 200 lbs per square mile for landuse C. The full capture system is assumed to meet the final Waste Load Allocation. The city's mass balance calculations show that 100 lbs of trash was discharged from Land Use Area B. The discharge from Land Use Area C is assumed to be the base load allocation since no controls were

[48] In the event that trash generation rates differ between weekday and weekends, a distinction in the DGRs may be warranted.

implemented and the daily generation rate has not been established. As shown in Figure E City X's discharge for the year was 1,100 lbs, and the 3-year rolling average discharge was less than the 5-Year Waste Load Allocation. Therefore the city was found to be in compliance with its discharge loading unit.

## 4. Potential Environmental Impact of Implementation Strategies

An accompanying CEQA Checklist document analyses the potential negative environmental impacts of compliance with the trash TMDL based on the implementation strategies discussed above. The previous Los Angeles River Trash TMDL became effective in 2002 and several municipalities have completed projects in which storm sewer catchment basins were retrofitted with inserts and vortex separation devices were installed within storm drain systems. The most significant environmental impacts have proved to be construction activities associated with the installation of these devices, and maintenance activities. Construction impacts from structural measures are similar to those of small scale public works projects that are sited in previously developed areas. The major construction activities appear to be concrete and electrical work, and in some areas, earth work associated with structural improvements. The environmental impacts and mitigation methods for these types of activities are well known. The environmental impacts from maintenance of the structural measures are associated with removing and disposing trash collected from the structural devices.

Regarding cumulative impacts, it is noted that both the construction and maintenance activities are in small, discrete, discontinuous areas over a short duration. Consequently, cumulative impacts are not significantly exacerbated from the sum of individual project impacts. Project level environmental analysis, by municipalities and responsible agencies for implementation of structural methods, were conducted under notices of exemption. Categorical exemptions were based on the nature of the projects including:

-Minor alteration of existing public structures involving negligible expansion of an existing facility.
-Modifications of existing storm drain system and addition of environmental protection devices in existing structures with negligible or no expansion of use.
-Modifications to sewers constructed to alleviate a high potential or existing public health hazard.

The analysis concludes that the implementation of this TMDL will result in improved water quality in the Los Angeles River Watershed, but may result in temporary or permanent localized significant adverse impacts to the environment. While specific projects employed to implement the TMDL may have significant impacts, these impacts are expected to be limited, short-term or may be mitigated through careful design and scheduling. Furthermore, to the extent the alternatives, mitigation measures, or both, are not deemed feasible by those agencies, the necessity of implementing the federally required TMDL and removing the trash impairment from the Los Angeles River the Watershed (an action required to achieve the express, national policy of the Clean Water Act) outweigh the unavoidable adverse environmental effects, as they will be minimal because project level planning, construction, and operation methods are available to mitigate foreseeable environmental impacts from implementing the TMDL as described in the CEQA checklist.

Figure E. Example 2, City X After Year 5.

| | |
|---|---|
| Land Use A:<br>10 sq miles treated by a full capture system<br><br>Baseline Waste Load Allocation:<br><br>100 lbs/sq mi/year | Land Use B:<br>5 sq miles treated via institutional controls and partial capture<br><br>Baseline Waste Load Allocation:<br>100 lbs/sq mi/year |
| | Land Use C:<br>5 sq miles - No treatment applied<br><br>Baseline Waste Load Allocation:<br>200 lbs/sq mi/year |

<u>Baseline Waste Load Allocation for each land use in City X</u>:
A=(100 lbs/sq mi/yr) (10 sq mi)=1000 lbs
B=(100 lbs/sq mi/yr) (5 sq mi)=500 lbs
C=(200 lbs/sq mi/yr) (5 sq mi)=1000 lbs
Total baseline Waste Load Allocation = 2,500 lbs
Year 5 Waste Load Allocation = 2,000 lbs*
*An 80% reduction based on a 3-year rolling average.

<u>Previous Years' Discharge:</u>
Year 3 = 2,400 lbs
Year 4 = 2,000 lbs

Trash Discharge for Year 5:
A=0
B=100 lbs (Determined by mass balance)
C=1,000 lbs (No reduction)
Total Discharge (Year 5) = 1,100 lbs

Three-Year Rolling Average Discharge
Year 3 = 2,400 lbs
Year 4 = 2,000 lbs
Year 5 = 1,100 lbs
3-year rolling average discharge = 1,833 lbs

Compliance is achieved: Discharge (1,833 lbs) < Waste Load Allocation (2,000 lbs).

A summary of implementation strategies and compliance assurance methods is provided in Table 7.

Table7. Summary of Possible Trash Reduction Implementation Measures.

| Treatment Applied | Measure of Effectiveness | Compliance Determination |
|---|---|---|
| Source Control:<br>Public education, enforcement of litter laws, container redemption programs, etc. | Daily Generation Rate:<br>Amount of trash collected via street sweeping and or from catch basin inserts divided by the number of days provides a measure of source control measure effectiveness | DGR used in mass balance calculation of discharge:<br>Discharge = [DGR (x) Days since last street sweeping] (-) [Catch basin cleanouts] |
| Partial Capture:<br>(Catch basin inserts, trash excluder doors, etc.) | Mass Balance:<br>Discharge =<br>[DGR (x) Days since last street sweeping] (-) [Catch basin cleanouts]<br>OR<br>Downstream Monitoring w/ Full Capture System | Discharge based on mass balance calculation:<br>Discharge =<br>[DGR (x) Days since last street sweeping] (-) [Catch basin cleanouts]<br>OR<br>Monitoring Results |
| Full Capture System:<br>Any single device or series of devices that traps all particles retained by a 5 mm mesh screen and has a design treatment capacity of not less than the peak flow rate Q resulting from a one-year, one-hour storm in a sub drainage area. Rational equation is used to compute the peak flow rate:<br>$Q = C \times I \times A$, where Q = design flow rate (cubic feet per second, cfs); C = runoff coefficient (dimensionless); I = design rainfall intensity (inches per hour, as determined per the rainfall isohyetal map in Figure A),* and A= subdrainage area (acres). | Effectiveness verified by literature | Final Waste Load Allocation Achieved:<br>Provided system is adequately sized, maintained and maintenance records are available for Regional Board inspection |

* The isohyethal map may be updated annually by the Los Angeles County hydrologist to reflect additional rain data gathered during the previous year. Annual updates published by the Los Angeles County Department of Public Works are prospectively incorporated by reference into this TMDL and accompanying Basin Plan amendment.

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## VIII. Cost Considerations

The Porter-Cologne Section 13241(d), requires staff to "consider costs" associated with the establishment of water quality objectives. The TMDL does not establish water quality objectives, but is merely a plan for achieving existing water quality objectives. Therefore cost considerations required in Section 13241 are not required for this TMDL.

The purpose of this cost analysis is to provide the Regional Board with information concerning the potential cost of implementing this TMDL and to addresses concerns about costs that have been raised by stakeholders. This section takes into account a reasonable range of economic factors in fulfillment of the applicable provisions of the California Environmental Quality Act (Public Resources Code Section 21159.)

An evaluation of the costs of implementing this Trash TMDL amounts to evaluating the costs of preventing trash from getting from the storm drains to the river. This brief report gives a summary overview of the costs associated with the most likely ways the permittees will achieve the required reduction in discharges to the storm drain system. Such an analysis would be incomplete if it failed to consider the existing cost that presently is transferred to "innocent" downstream communities. Approximately 1,620 tons of litter are estimated to be discharged to the Los Angeles River annually, requiring costly removal measures. In addition there is an unquantified cost to aquatic life within the River and the Ocean.

The Regional Board has some information about various facets of the costs of preventing trash from getting into the storm drains. However, exact information on infrastructure currently in place and current structural projects being undertaken is currently not available to the Board. Furthermore, lack of complete information on existing costs precludes a comparison between costs of compliance with existing costs.

### A. Cost of Trash Clean-Ups

Cleaning up the river, its tributaries and the beaches is a costly endeavor. The Los Angeles County Department of Public Works contracts out the cleaning of over 75,000 catchments (catch basins) for a total cost of slightly over $1 million per year, billed to 42 municipalities. Each catch basin is cleaned once a year before the rainy season, except for 1,700 priority catch basins that fill faster and have to be cleaned out more frequently.

Over 4,000 tons of trash is collected from Los Angeles County beaches annually, at a cost of $3.6 million to Santa Monica Bay communities in fiscal year 1988-89 alone. In 1994 the annual cost to clean the 31 miles of beaches (19 beaches) along Los Angeles County was $4,157,388.

Long Beach bears a large part of the financial burden for cleaning up trash from the Los Angeles River watershed, which is disproportionate to the amount actually produced by this city.[49] The costs of gathering and disposing of trash at the mouth of the Los Angeles River during the rainy season are listed on Table 8.

Table 8. Storm Debris Summary for Long Beach: Billings.[50]

| | First Quarter (July-Sept.) | Second Quarter (Oct.-Dec.) | Third Quarter (Jan.-March) | Fourth Quarter (April-June) | Total |
|---|---|---|---|---|---|
| 1995-96 | $44,152[51] | $130,986 | $224,023 | $126,416 | $525,577 |
| 1996-97 | $102,055 | $187,344 | $88,180 | $122,416 | $499,995 |
| 1997-98 | $158,612 | $268,594 | $282,988 | $169,340 | $879,534 |
| 1998-99 | $247,986 | $198,147 | $185,179 | $246,950 | $878,262 |

## B. Cost of Implementing Trash TMDL

The cost of implementing this TMDL will range widely, depending on the method that the Permittees select to meet the Waste Load Allocations. Arguably, enforcement of existing litter ordinances could be used to achieve the final Waste Load Allocations at minimal or no additional cost. The most costly approach in the short-term is the installation of full capture systems on all discharges to the river. However, in the long term this approach would result in lower labor costs and may be less expensive than some other approaches.

Most of the information presented herein consists of catch basin inserts, structural vortex separation devices and end of pipe nets. We are considering the costs associated with preventing the disposal of trash into the storm drain system over the whole watershed. For all calculations, the urbanized portion of the Los Angeles River watershed is estimated to span an area of 599 square miles[52].

Regardless of the method(s) used, costs associated with the gradual decrease of the amount of trash in the waterways, and the maintenance of the Los Angeles River and its tributaries free of trash include monitoring and implementation costs. Any device chosen for monitoring trash or removing trash from storm drain, regardless of its installation costs, will also be associated with labor costs.

We are looking at several methods separately, from retrofitting all the catch basins in the urbanized portion of the watershed, to using solely structural full capture methods.

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[49] However, the cost to the City of Long Beach is offset somewhat by an annual reimbursement from Los Angeles County in the amount of $500,000. (Written comment from The City of Los Angeles, June 23, 2000.)
[50] Memorandum from Geoffrey Hall; City of Long Beach; Parks and Recreation.
[51] 9/95 only.
[52] Although the urbanized portion of the watershed is 609 square miles, about 10 square miles are covered with water.

## 1. Catch Basin Inserts

At a cost of around $800 per insert, catch basin inserts are the least expensive structural treatment device in the short term. However, if they are not a full capture method, they must be monitored frequently and must be used in conjunction with frequent street sweeping. We assumed that approximately 150,000 catch basins would have to be retrofitted with inserts to cover 574 square miles of the watershed. A summary of estimated costs for using catch basin inserts across the entire watershed is provided in Table 9.

The analysis includes capital costs for catch basin improvements and increases to the annual operating costs for additional street sweeping that may be incurred to ensure that catch basins are kept free from debris. It is assumed that the current annual street sweeping in the Los Angeles River watershed is on a monthly basis and will be increased to twice per month to implement the trash TMDL. Costs for street sweeping are estimated from a range of costs derived from a nationwide study of seven municipalities that are normalized to a "curb-mile" basis. The low and high costs range from $12 to $60 per curb-mile with a median cost of $20 per curb-mile (SWRCB NPDES Stormwater Cost Survey (Cal State Sacramento), www.owp.csus.edu/research/npdes/costsurvey.pdf)

The curb-miles of the Los Angeles River watershed are estimated from the area of the developed portion of the Los Angeles River watershed. Based on an estimated area of 589 square miles, and an assumption that streets are spaced an average of 300-feet apart, and there are two curbs per street, the estimated number of curb-miles is approximately 440,000. On an annual basis, it is assumed that the streets are swept on a monthly basis to yield a total of 5,280,000 curb miles annually. For TMDL implementation, it is assumed that street sweeping will be increased to semi-monthly. It is assumed that the number of curb miles subject to increased street sweeping will increase on an annual basis of 10% as more catch basin improvements are installed. Finally, the annual costs are normalized to an estimated 2 million households in the Los Angeles River watershed.

Table 9. Costs of retrofitting the urban portion of the watershed with catch basin inserts. (amounts in millions)

| Number of years into the program | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital costs (yearly) | $12 | $12 | $12 | $12 | $12 | $12 | $12 | $12 | $12 | $12 | $00 | $00 |
| Operation & Maintenance costs (yearly, cumulative) | $5.1 | $10.2 | $15.4 | $20.5 | $25.6 | $30.1 | $35.9 | $41.0 | $46.2 | $51.3 | $51.3 | $51.3 |
| Costs per year (servicing + capital costs) | $17.1 | $22.2 | $27.4 | $32.5 | $37.6 | $42.1 | $47.9 | $53 | $58.2 | $51.3 | $51.3 | $51.3 |

The total capital costs required for retrofitting the whole watershed would be $120 million, while the yearly maintenance costs after full implementation would be $51.3 million.

## 2. Full Capture Vortex Separation Systems (VSS)

Permanent structural devices can be used to trap gross pollutants for monitoring purposes as well as implementation. Among those "litter control devices" are structural vortex separation systems (VSS), floating debris traps, end-of-pipe nets and trash racks. VSS units appear to be among the best alternatives to evaluate or remove the amount of trash generated throughout a particular drainage area.

An ideal way to capture trash deposited into a storm drain system would be to install a VSS unit. This device diverts the incoming flow of storm water and pollutants into a pollutant separation and containment chamber. Solids within the separation chamber are kept in continuous motion, and are prevented from blocking the screen so that water can pass through the screen and flow downstream. This is a permanent device that can be retrofitted for oil separation as well. Studies have shown that VSS systems remove virtually all of the trash contained in the treated water. The cost of installing a VSS is assumed to be high, so limited funds will place a cap on the number of units which can be installed during any single fiscal year.

Table 10 shows estimated costs associated with retrofitting the watershed with low capacity vortex separation systems progressively over ten years.

Table 10. Costs Associated with Low Capacity Vortex Gross Pollutant Separation Systems.
(amounts in millions)

| Number of years into the program | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Operations and Maintenance (yearly, cumulative) | $14.8 | $29.5 | $44.3 | 59.1 | $73.9 | $88.6 | $103.4 | 118.2 | $132.9 | $147.7 | $147.7 | $147.7 |
| Capital costs (yearly) | $94.5 | $94.5 | $94.5 | $94.5 | $94.5 | $94.5 | $94.5 | $94.5 | $94.5 | $94.5 | $0.0 | $0.0 |
| Annual costs per year (capital costs + Operation and Maintenance) | $109.3 | $124.1 | $138.8 | $153.6 | $168.4 | $183.2 | $197.9 | $212.7 | $227.5 | $242.2 | $147.7 | $147.7 |

Similarly, Table 11 provides estimates of costs associated with the installation of large capacity VSS systems.

Table 11. Costs Associated with Large Capacity Vortex Gross Pollutant Separation Systems. (amounts in millions)

| Number of years into the program | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Operations and Maintenance (yearly, cumulative) | $0.7 | $1.5 | $2.2 | $3.0 | $3.7 | $4.4 | $5.2 | $5.9 | $6.6 | $7.4 | $7.4 | $7.4 |
| Capital costs (yearly) | $33.2 | $33.2 | $33.2 | $33.2 | $33.2 | $33.2 | $33.2 | $33.2 | $33.2 | $33.2 | $0.0 | $0.0 |
| Annual costs per year (capital costs + Operation and Maintenance) | $34.0 | $34.7 | $35.5 | $36.2 | $36.9 | $37.7 | $38.4 | $39.1 | $39.9 | $40.6 | $7.4 | $7.4 |

As shown in Table 12, outfitting a large drainage with a number of large VSS systems may be less costly than using a larger number of small VSS systems. Maintenance costs decrease dramatically as the size of the system increases. Topographical and geotechnical considerations also should come into play when choosing VSS systems or other structural systems or devices.

Table 12. Costs Associated with VSS.

| Capacity | Acres (average) | Number of devices needed on urban portion of watershed | Capital costs | Yearly costs for servicing all devices |
|---|---|---|---|---|
| 1 to 2 cfs | 5 | 73,856 | $945,356,800 | $147,712,000 |
| 6 to 8 cfs | 30 | 12,309 | $553,920,000 | $24,618,000 |
| 19 to 24 cfs | 100 | 3,693 | $332,352,000 | $7,386,000 |

For this table, we have assumed the cost of yearly servicing of a VSS unit to be $2000 per year.

## 3. End of Pipe Nets

"Release nets" are a relatively economical way to monitor trash loads from municipal drainage systems. However, in general, they can only be used to monitor or intercept trash at the end of a pipe and are considered to be partial capture systems, as the nets are usually sized at a 1/2" to 1" mesh. These nets are attached to the end of pipe systems. The nets remain in place on the end of the drains until water levels upstream of the net rise sufficiently to release a catch that holds the net in place. The water level may rise from either the bag being too full to allow sufficient water to pass, or from a disturbance during very high flows. When the nets release they are attached to the side of the pipe by a steel cable and as they are washed downstream (a yard or so) are tethered off so that no pollutants from within the bags are washed out.

Preliminary observations suggest that the nets rarely fill sufficiently to cause the bags to release. And therefore, if they are cleaned after a storm event, the entire quantity of material is captured and can be measured for monitoring purposes using two bags per trap. This makes it easy to replace the full or partially full bag with an empty one, so that the first bag can be taken to a laboratory for analysis without manual handling of the material it contains.

The nets are valid devices because of the ease of maintenance and also because the devices can be relocated after a set period at one location (provided the pipe diameters are the same). With limited funding, installation could be spread over several land uses and lead to valuable monitoring results.

Because the devices require attachment to the end of a pipe, this can severely reduce the number of locations within a drainage system that can be monitored. In addition, these nets cannot be installed on very large channels (7 feet in diameter is the maximum), while the largest outlets into the Los Angeles River are 10 feet in diameter. Thus costs shown in Table 13 are given per pipe, and no drainage coverage is given.

Table 13. Sample Costs for End of Pipe Nets.

| Pipe Size | Release nets (cost estimates) |
|---|---|
| End of 3 ft pipe | $10,000 |
| End of 4 ft pipe | $15,000 |
| End of 5 ft pipe | $20,000 |
| In 3 ft pipe network | $40,000 |
| In 4 ft pipe network | $60,000 |
| In 5 ft pipe network | $80,000 |

## 4. Cost Comparison

A comparison of costs between strategies based on catch basin inserts (CBIs), low capacity VSS, high capacity VSS systems, and enforcement of litter laws is presented in Table 14.

Table 14. Cost Comparison (amounts in millions)

| | CBI only | Low capacity VSS Units | Large capacity VSS Units | Enforcement of Litter Laws[53] |
|---|---|---|---|---|
| Cumulative capital costs over 10 years | $120 | $945 | $332 | <$1 |
| Cumulative maintenance and capital costs after 10 years | $450 | $1,758 | $373 | <$1 |
| Annual servicing costs after full implementation | $51.3 | $148 | $7.4 | <$1 |

Costs to implement the Los Angeles River trash TMDL will depend on the BMPs selected by the permittees.

## 5. Implementation Costs per Household

In order to estimate the magnitude of fiscal impact that may be incurred to households in the Los Angeles River watershed, the estimated capital, operation and maintenance costs for implementation of the trash TMDL are normalized on an annual per household basis. This analysis of household costs is based on the capital costs for catch basin improvements, and annual operation and maintenance costs, estimated above. The analysis assumes that 50% of the costs of installing, operating and maintaining catch basins improvements will be incurred by households in the Los Angeles River watershed. The remaining costs are estimated to be incurred by commercial, industrial, municipal and public agencies. The methodology for the household cost analysis is to normalize the estimated annual costs of TMDL compliance to the number of households in the Los Angeles River watershed.

It is assumed that there are approximately 3.3 million households in Los Angeles County (SCAG -2000 Census Data) and 2 million households in the Los Angeles River watershed. It is also assumed that household fees will fund approximately 50% of the trash TMDL costs. Based on these assumptions, the costs for implementing the trash TMDL initially are on the order of $3.00 per year per household and increases to approximately $14.55 per year per household.

53 Revenues from fines assessed to offset increased law enforcement cost. The cost of a database system used to calculate trash discharges estimated to be less than $250,000.

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## Appendix I

This table shows the square mileage for "high density residential", "low density residential", "commercial and services", "industrial", "public facilities", "educational institutions", "military institutions", "transportation and utilities", "mixed urban", "open space", "agriculture", "water" and "recreation" land uses for every city and incorporated areas in the watershed. The "water" land use of water is not in itself a source of trash, and will therefore not receive an allocation. For cities that are only partially located on the watershed, the square mileage indicated is for the portion located in the watershed.

**SQUARE MILEAGE ESTIMATED FOR EACH LAND USE FOR CITIES IN THE WATERSHED, AND FOR UNINCORPORATED AREAS.**

| Jurisdiction | High Density Residential | Low Density Residential | Commercial | Industrial | Public Facilities | Educational Institutions | Military | Transportation | Mixed Urban | Open Space | Agriculture | Water | Recreation | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alhambra | 5.12 | 0.01 | 0.89 | 0.29 | 0.23 | 0.32 | 0.00 | 0.39 | 0.01 | 0.04 | 0.00 | 0.02 | 0.29 | **7.61** |
| Arcadia | 6.55 | 0.97 | 1.28 | 0.23 | 0.23 | 0.22 | 0.00 | 0.23 | 0.01 | 0.34 | 0.00 | 0.19 | 0.68 | **10.94** |
| Bell | 1.21 | 0.00 | 0.27 | 0.45 | 0.20 | 0.08 | 0.04 | 0.20 | 0.00 | 0.02 | 0.00 | 0.27 | 0.01 | **2.74** |
| Bell Gardens | 1.41 | 0.00 | 0.32 | 0.26 | 0.03 | 0.16 | 0.00 | 0.02 | 0.00 | 0.03 | 0.09 | 0.05 | 0.12 | **2.49** |
| Bradbury | 0.03 | 0.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.59 | 0.18 | 0.02 | 0.01 | **1.41** |
| Burbank | 8.03 | 0.01 | 1.56 | 1.27 | 0.43 | 0.35 | 0.01 | 1.28 | 0.07 | 3.72 | 0.01 | 0.06 | 0.56 | **17.36** |
| Calabasas | 2.05 | 0.12 | 0.21 | 0.00 | 0.02 | 0.12 | 0.00 | 0.04 | 0.02 | 2.59 | 0.03 | 0.03 | 0.35 | **5.58** |
| Carson | 0.26 | 0.00 | 0.01 | 0.51 | 0.00 | 0.02 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | **0.88** |
| Commerce | 0.65 | 0.00 | 0.55 | 3.73 | 0.26 | 0.04 | 0.00 | 1.09 | 0.03 | 0.07 | 0.01 | 0.02 | 0.11 | **6.57** |
| Compton | 4.43 | 0.01 | 0.73 | 1.58 | 0.16 | 0.71 | 0.01 | 0.53 | 0.03 | 0.14 | 0.06 | 0.09 | 0.12 | **8.60** |
| Cudahy | 0.76 | 0.00 | 0.09 | 0.16 | 0.01 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | **1.12** |
| Downey | 5.29 | 0.02 | 0.76 | 0.16 | 0.47 | 0.39 | 0.00 | 0.15 | 0.00 | 0.02 | 0.00 | 0.11 | 0.43 | **7.80** |
| Duarte | 0.74 | 0.01 | 0.21 | 0.11 | 0.18 | 0.06 | 0.00 | 0.09 | 0.01 | 0.85 | 0.00 | 0.01 | 0.05 | **2.30** |
| El Monte | 3.74 | 0.00 | 1.06 | 0.98 | 0.15 | 0.31 | 0.00 | 0.43 | 0.03 | 0.03 | 0.00 | 0.18 | 0.07 | **6.97** |
| Glendale | 12.54 | 0.13 | 1.87 | 0.72 | 1.08 | 0.44 | 0.00 | 0.67 | 0.12 | 11.99 | 0.01 | 0.10 | 0.95 | **30.63** |
| Hidden Hills | 0.01 | 1.29 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.23 | 0.01 | 0.00 | 0.00 | **1.57** |
| Huntington Park | 1.60 | 0.00 | 0.53 | 0.50 | 0.05 | 0.16 | 0.00 | 0.11 | 0.03 | 0.00 | 0.00 | 0.00 | 0.06 | **3.03** |
| Irwindale | 0.02 | 0.00 | 0.06 | 1.00 | 0.07 | 0.00 | 0.00 | 0.09 | 0.01 | 0.08 | 0.00 | 0.57 | 0.00 | **1.89** |

### SQUARE MILEAGE ESTIMATED FOR EACH LAND USE FOR CITIES IN THE WATERSHED, AND FOR UNINCORPORATED AREAS, CONTINUED.

| Jurisdiction | High Density Residential | Low Density Residential | Commercial | Industrial | Public Facilities | Educational Institutions | Military | Transportation | Mixed Urban | Open Space | Agriculture | Water | Recreation | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| La Cañada Flintridge | 2.94 | 2.03 | 0.18 | 0.15 | 0.23 | 0.17 | 0.00 | 0.25 | 0.00 | 2.16 | 0.06 | 0.04 | 0.37 | **8.58** |
| Long Beach | 9.56 | 0.02 | 1.76 | 1.08 | 0.41 | 0.53 | 0.00 | 1.16 | 0.08 | 0.32 | 0.26 | 0.81 | 0.69 | **16.67** |
| Los Angeles | 146.95 | 6.86 | 17.04 | 16.81 | 8.83 | 7.72 | 0.13 | 11.66 | 2.16 | 45.85 | 2.61 | 5.11 | 9.77 | **281.49** |
| Los Angeles County | 24.75 | 2.20 | 2.35 | 4.39 | 1.39 | 1.01 | 0.02 | 1.88 | 0.18 | 25.59 | 0.76 | 0.66 | 2.99 | **68.16** |
| Lynwood | 2.99 | 0.00 | 0.49 | 0.44 | 0.09 | 0.24 | 0.00 | 0.47 | 0.05 | 0.03 | 0.00 | 0.00 | 0.05 | **4.86** |
| Maywood | 0.85 | 0.00 | 0.15 | 0.08 | 0.01 | 0.04 | 0.00 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | **1.19** |
| Monrovia | 3.26 | 0.30 | 0.57 | 0.56 | 0.11 | 0.16 | 0.00 | 0.16 | 0.03 | 4.94 | 0.00 | 0.08 | 0.16 | **10.34** |
| Montebello | 3.86 | 0.00 | 0.71 | 1.68 | 0.40 | 0.33 | 0.00 | 0.31 | 0.01 | 0.22 | 0.12 | 0.21 | 0.51 | **8.37** |
| Monterey Park | 4.63 | 0.00 | 0.64 | 0.22 | 0.52 | 0.28 | 0.00 | 0.20 | 0.03 | 0.81 | 0.14 | 0.01 | 0.18 | **7.67** |
| Paramount | 1.89 | 0.00 | 0.44 | 0.99 | 0.08 | 0.22 | 0.00 | 0.24 | 0.04 | 0.06 | 0.17 | 0.14 | 0.08 | **4.35** |
| Pasadena | 11.93 | 1.19 | 2.28 | 0.30 | 1.02 | 0.98 | 0.02 | 0.89 | 0.06 | 2.63 | 0.09 | 0.25 | 1.06 | **22.71** |
| Pico Rivera | 1.17 | 0.02 | 0.21 | 0.54 | 0.02 | 0.06 | 0.00 | 0.12 | 0.02 | 0.01 | 0.02 | 0.89 | 0.04 | **3.13** |
| Rosemead | 3.31 | 0.00 | 0.73 | 0.15 | 0.13 | 0.28 | 0.00 | 0.19 | 0.02 | 0.07 | 0.11 | 0.01 | 0.15 | **5.14** |
| San Fernando | 1.43 | 0.00 | 0.42 | 0.30 | 0.06 | 0.08 | 0.00 | 0.03 | 0.01 | 0.01 | 0.00 | 0.03 | 0.04 | **2.42** |
| San Gabriel | 2.86 | 0.01 | 0.54 | 0.09 | 0.09 | 0.14 | 0.00 | 0.05 | 0.02 | 0.02 | 0.07 | 0.00 | 0.23 | **4.12** |
| San Marino | 2.21 | 0.87 | 0.07 | 0.00 | 0.12 | 0.11 | 0.00 | 0.08 | 0.00 | 0.01 | 0.00 | 0.00 | 0.30 | **3.77** |
| Santa Clarita | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | **0.21** |
| Sierra Madre | 1.71 | 0.06 | 0.05 | 0.01 | 0.05 | 0.06 | 0.00 | 0.00 | 0.00 | 0.93 | 0.01 | 0.06 | 0.04 | **3.00** |
| Signal Hill | 0.19 | 0.00 | 0.18 | 0.55 | 0.02 | 0.03 | 0.00 | 0.05 | 0.04 | 0.04 | 0.00 | 0.00 | 0.04 | **1.14** |
| Simi Valley | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | **0.03** |
| South El Monte | 0.58 | 0.00 | 0.15 | 1.14 | 0.03 | 0.04 | 0.00 | 0.01 | 0.02 | 0.05 | 0.03 | 0.02 | 0.02 | **2.10** |
| South Gate | 3.92 | 0.00 | 0.78 | 1.25 | 0.18 | 0.26 | 0.00 | 0.40 | 0.07 | 0.04 | 0.10 | 0.22 | 0.27 | **7.48** |
| South Pasadena | 2.43 | 0.13 | 0.20 | 0.00 | 0.06 | 0.10 | 0.00 | 0.09 | 0.02 | 0.24 | 0.01 | 0.01 | 0.13 | **3.43** |
| Temple City | 3.44 | 0.00 | 0.27 | 0.08 | 0.07 | 0.12 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | **4.02** |
| Vernon | 0.00 | 0.00 | 0.02 | 3.85 | 0.09 | 0.00 | 0.00 | 0.82 | 0.01 | 0.06 | 0.00 | 0.23 | 0.00 | **5.09** |
| **Totals** | **291.54** | **18.09** | **40.62** | **46.86** | **17.58** | **16.39** | **0.22** | **24.52** | **3.28** | **113.46** | **5.01** | **10.52** | **21.02** | **598.95** |

## Appendix II

This table shows the Waste Load Allocations for trash per land use in each city base on square mileage. The "water" land use of water is not in itself a source of trash, and therefore did not receive an allocation. Contributions from Military Installations were not included in the Waste Load Allocations of the cities that had this land use. For cities that are only partially located on the watershed, the square mileage indicated is for the portion located in the watershed.

### WASTE LOAD ALLOCATIONS FOR TRASH PER LAND USE IN EACH CITY (GALLONS OF UNCOMPRESSED VOLUME)

| City | High Density Residential | Low Density Residential | Commercial Services | Industrial | Public Facilities | Educational Institutions | Military Institutions | Transportation | Mixed Urban | Open Space | Agriculture | Water | Recreation | Total for all classes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alhambra | 18264 | 23 | 8380 | 2816 | 2262 | 2983 | 0 | 3865 | 92.2 | 135 | 15 | 0 | 1067 | 39903 |
| Arcadia | 23362 | 1879 | 12106 | 2265 | 2243 | 2113 | 0 | 2274 | 64.8 | 1266 | 0 | 0 | 2535 | 50108 |
| Bell | 4305 | 0 | 2508 | 4396 | 1993 | 740 | 0 | 1953 | 3.9 | 71 | 0 | 0 | 55 | 16026 |
| Bell Gardens | 5024 | 0 | 3033 | 2503 | 323 | 1502 | 0 | 235 | 0.0 | 108 | 343 | 0 | 429 | 13500 |
| Bradbury | 99 | 1102 | 0 | 0 | 39 | 0 | 0 | 0 | 137 | 2198 | 659 | 0 | 42 | 4277 |
| Burbank | 28637 | 12 | 14703 | 12477 | 4187 | 3305 | 0 | 12592 | 707 | 13850 | 44 | 0 | 2077 | 92590 |
| Calabasas | 7323 | 232 | 1964 | 0 | 211 | 1169 | 0 | 411 | 163 | 9643 | 105 | 0 | 1284 | 22505 |
| Carson | 940 | 0 | 108 | 5019 | 0 | 157 | 0 | 563 | 0 | 0 | 0 | 0 | 44 | 6832 |
| Commerce | 2320 | 0 | 5178 | 36590 | 2505 | 371 | 0 | 10717 | 319 | 268 | 52 | 0 | 415 | 58733 |
| Compton | 15810 | 25 | 6919 | 15462 | 1545 | 6727 | 0 | 5218 | 273 | 527 | 239 | 0 | 447 | 53191 |
| Cudahy | 2718 | 0 | 831 | 1531 | 85 | 613 | 0 | 47 | 25 | 0 | 0 | 0 | 85 | 5935 |
| Downey | 18865 | 46 | 7187 | 1548 | 4599 | 3657 | 0 | 1519 | 0 | 57 | 0 | 0 | 1586 | 39063 |
| Duarte | 2625 | 25 | 1944 | 1059 | 1745 | 523 | 0 | 864 | 83 | 3158 | 0 | 0 | 183 | 12210 |
| El Monte | 13332 | 2 | 10050 | 9568 | 1501 | 2904 | 0 | 4199 | 270 | 121 | 0 | 0 | 261 | 42208 |
| Glendale | 44697 | 250 | 17678 | 7088 | 10552 | 4131 | 0 | 6560 | 1171 | 44593 | 52 | 0 | 3544 | 140314 |
| Hidden Hills | 40 | 2511 | 9 | 0 | 0 | 122 | 0 | 70 | 0 | 857 | 55 | 0 | 0 | 3663 |
| Huntington Park | 5692 | 0 | 5004 | 4880 | 504 | 1481 | 0 | 1060 | 309 | 0 | 0 | 0 | 229 | 19159 |
| Irwindale | 58 | 0 | 550 | 9771 | 676 | 0 | 0 | 900 | 90 | 307 | 0 | 0 | 0 | 12352 |

## WASTE LOAD ALLOCATIONS FOR TRASH PER LAND USE IN EACH CITY (GALLONS OF UNCOMPRESSED VOLUME) - CONTINUED

| City | High Density Residential | Low Density Residential | Commercial Services | Industrial | Public Facilities | Educational Institutions | Military Institutions | Transportation | Mixed Urban | Open Space | Agriculture | Water | Recreation | Total for all classes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| La Canada Flintridge | 10494 | 3943 | 1685 | 1502 | 2273 | 1565 | 0 | 2409 | 0 | 8027 | 210 | 0 | 1387 | 33496 |
| Long Beach | 34085 | 36 | 16609 | 10563 | 4009 | 4973 | 0 | 11355 | 757 | 1207 | 964 | 0 | 2577 | 87135 |
| Los Angeles | 523851 | 13302 | 161072 | 164951 | 86603 | 72974 | 0 | 114426 | 21170 | 170494 | 9692 | 0 | 36310 | 1374845 |
| Los Angeles County | 88236 | 4265 | 22185 | 43081 | 13654 | 9511 | 0 | 18407 | 1799 | 95145 | 2840 | 0 | 11100 | 310223 |
| Lynwood | 10671 | 0 | 4612 | 4347 | 859 | 2290 | 0 | 4587 | 529 | 118 | 0 | 0 | 187 | 28201 |
| Maywood | 3023 | 0 | 1401 | 771 | 96 | 367 | 0 | 225 | 146 | 55 | 0 | 0 | 45 | 6129 |
| Monrovia | 11624 | 577 | 5432 | 5526 | 1097 | 1522 | 0 | 1616 | 323 | 18375 | 13 | 0 | 584 | 46687 |
| Montebello | 13743 | 0 | 6751 | 16486 | 3935 | 3121 | 0 | 3071 | 105 | 811 | 441 | 0 | 1905 | 50369 |
| Monterey Park | 16521 | 4 | 6067 | 2157 | 5071 | 2609 | 0 | 1957 | 310 | 3011 | 511 | 0 | 680 | 38899 |
| Paramount | 6729 | 0 | 4157 | 9705 | 832 | 2072 | 0 | 2397 | 392 | 239 | 631 | 0 | 297 | 27452 |
| Pasadena | 42519 | 2315 | 21595 | 2929 | 9970 | 9281 | 0 | 8694 | 616 | 9783 | 339 | 0 | 3957 | 111998 |
| Pico Rivera | 4154 | 48 | 1998 | 5317 | 224 | 596 | 0 | 1146 | 214 | 22 | 75 | 0 | 159 | 13953 |
| Rosemead | 11814 | 0 | 6859 | 1442 | 1279 | 2673 | 0 | 1842 | 175 | 249 | 419 | 0 | 552 | 27305 |
| San Fernando | 5093 | 9 | 3933 | 2979 | 598 | 796 | 0 | 289 | 57 | 54 | 0 | 0 | 140 | 13947 |
| San Gabriel | 10178 | 14 | 5139 | 893 | 868 | 1327 | 0 | 530 | 183 | 79 | 262 | 0 | 870 | 20343 |
| San Marino | 7863 | 1690 | 621 | 0 | 1205 | 1054 | 0 | 830 | 0 | 26 | 0 | 0 | 1101 | 14391 |
| Santa Clarita | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 158 | 0 | 731 | 0 | 0 | 0 | 901 |
| Sierra Madre | 6112 | 121 | 500 | 132 | 523 | 529 | 0 | 5 | 39 | 3471 | 27 | 0 | 151 | 11611 |
| Signal Hill | 679 | 0 | 1659 | 5379 | 207 | 313 | 0 | 513 | 407 | 136 | 0 | 0 | 140 | 9434 |
| Simi Valley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 0 | 105 | 0 | 0 | 0 | 137 |
| South El Monte | 2084 | 0 | 1410 | 11161 | 332 | 340 | 0 | 130 | 178 | 177 | 105 | 0 | 82 | 15999 |
| South Gate | 13965 | 0 | 7367 | 12284 | 1724 | 2424 | 0 | 3941 | 693 | 147 | 363 | 0 | 997 | 43904 |
| South Pasadena | 8670 | 254 | 1897 | 39 | 616 | 939 | 0 | 847 | 232 | 897 | 38 | 0 | 479 | 14907 |
| Temple City | 12256 | 5 | 2595 | 770 | 639 | 1104 | 0 | 74 | 0 | 0 | 15 | 0 | 114 | 17572 |
| Vernon | 12 | 0 | 145 | 37816 | 881 | 45 | 0 | 8004 | 63 | 234 | 3 | 0 | 0 | 47203 |

# Appendix III

## CALCULATION OF LITTER GENERATION RATE PER LAND USE

| Land Use | Drainage Area* (acres) | Litter (gallons) | | | LGR (gals/acre) | LGR (gals/sq mi) |
|---|---|---|---|---|---|---|
| | | 2002-03* | 2003-04* | Average (gallons) | | |
| Commenrcial | 104.46 | 1591.92 | 1494.09 | 1543 | 14.77 | 9453 |
| High Density Single Family Residential | 113.98 | 423.07 | 846.85 | 635 | 5.57 | 3565 |
| Industrial | 119.88 | 2159.82 | 1517.7 | 1839 | 15.33 | 9811 |
| Low Density Single Family Residential | 164.36 | 173 | 822.75 | 498 | 3.03 | 1939 |
| Open Space & Parks | 128.89 | 509.55 | 988.15 | 749 | 5.81 | 3718 |
| Total | 631.56 | 4857.36 | 5669.54 | 5263 | 8.33 | 5334 |

| Land Use | Drainage Area* (acres) | Litter (lbs) | | | LGR (lbs/acre) | LGR (lbs/sq mi) |
|---|---|---|---|---|---|---|
| | | 2002-03* | 2003-04* | Average (lbs) | | |
| Commenrcial | 104.46 | 1924.96 | 2697.04 | 2311 | 22.12 | 14157 |
| High Density Single Family Residential | 113.98 | 480.20 | 1986.3 | 1233 | 10.82 | 6925 |
| Industrial | 119.88 | 2586.60 | 2586.96 | 2587 | 21.58 | 13811 |
| Low Density Single Family Residential | 164.36 | 124.08 | 2989.71 | 1557 | 9.47 | 6061 |
| Open Space & Parks | 128.89 | 549.79 | 3723.72 | 2137 | 16.58 | 10611 |
| Total | 631.56 | 5665.63 | 13983.73 | 9825 | 15.56 | 9956 |

*Data provided by the Los Angeles County Department of Public Works - Baseline Monitoring Program

LGR: Litter Generation Rate

Baseline Waste Load Allocation per City = $\sum$ Landuse Area X Litter Generation Rate

# Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants Total Maximum Daily Loads


PREPARED BY
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION
AND

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 9

MAY 5, 2011

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## LIST OF ACRONYMS

| | |
|---|---|
| µg/g | Micrograms per Gram |
| µg/kg | Micrograms per Kilogram |
| µg/L | Micrograms per Liter |
| BPTCP | Bay Protection and Toxic Cleanup Program |
| Caltrans | California Department of Transportation |
| CEQA | California Environmental Quality Act |
| City BOS | City of Los Angeles Bureau of Sanitation |
| CFR | Code of Federal Regulations |
| COMM | Commercial and Sport Fishing |
| CTR | California Toxics Rule |
| CWA | Clean Water Act |
| DDT | dichlorodiphenyltrichloroethane |
| DL | Detection Limit |
| EMCs | Event Mean Concentrations |
| ERL | Effects Range-Low |
| ERM | Effects Range-Median |
| EST | Estuarine Habitat |
| FR | Federal Register |
| kg | Kilograms |
| LACDPW | Los Angeles County Department of Public Works |
| LARWQCB | Los Angeles Regional Water Quality Control Board |
| LACSD | Los Angeles County Sanitation District |
| LAR | Los Angeles River |
| LSPC | Loading Simulation Program in C++ |
| MAR | Marine Habitat |
| mg/kg | Milligrams per Kilogram |
| MS4 | Municipal Separate Storm Sewer System |
| MTRL | Maximum Tissue Residue Level |
| NAV | Navigation |
| ng/L | Nanograms per Liter |
| NPDES | National Pollutant Discharge Elimination System |
| OEHHA | Office of Environmental Health Hazard Assessment |
| PAHs | Polyaromatic hydrocarbons |
| PCBs | Polychlorinated biphenyls |
| PEL | Probable Effects Level |
| POLA | Port of Los Angeles |
| POLB | Port of Long Beach |
| pg/L | Picograms per Liter |
| ppb | Parts per Billion |
| ppt | Parts per Thousand |
| RARE | Rare, Threatened, or Endangered Species |
| REC1 | Water Contact Recreation |
| REC2 | Non-Contact Water Recreation |
| SGR | San Gabriel River |
| SHELL | Shellfish Harvesting |

| | |
|---|---|
| SQOs | Sediment Quality Objectives |
| TEL | Threshold Effects Level |
| TMDL | Total Maximum Daily Load |
| TSMP | Toxic Substances Monitoring Program |
| USACE | United States Army Corps of Engineers |
| USEPA | United States Environmental Protection Agency |
| WDRs | Waste Discharge Requirements |
| WILD | Wildlife Habitat |
| WLAs | Waste Load Allocations |
| WQA | Water Quality Assessment |
| WQOs | Water Quality Objectives |

# 1 INTRODUCTION AND REGULATORY BACKGROUND

The waters of the Dominguez Channel and the Ports of Los Angeles and Long Beach in the San Pedro Bay have enormous economic, recreational and habitat value and fail to meet water quality standards. The California Regional Water Quality Control Board, Los Angeles Region (Regional Board) has developed this total maximum daily load (TMDL) to attain the water quality standards for the Dominguez Channel and greater Los Angeles and Long Beach Harbors waters. The TMDL has been prepared pursuant to state and federal requirements.

The California Water Quality Control Plan, Los Angeles Region (Basin Plan) sets standards for surface waters and ground waters in the Coastal Watersheds of Los Angeles and Ventura Counties. These standards are comprised of designated beneficial uses for surface and ground water, numeric and narrative objectives necessary to support beneficial uses, and the state's antidegradation policy. Such standards are mandated for all waterbodies within the state under the Porter-Cologne Water Quality Act and the Federal Clean Water Act. In addition, the Basin Plan describes implementation programs to protect all waters in the region. The Basin Plan implements the Porter-Cologne Water Quality Act (also known as the "California Water Code") and serves as the State Water Quality Control Plan as required pursuant to the federal Clean Water Act (CWA).

Section 305(b) of the CWA mandates biennial assessment of the nation's water resources, and these water quality assessments are used to identify and list impaired waters. CWA requires that each State "shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality objective applicable to such waters." The resulting list is referred to as the 303(d) list. The CWA also requires states to establish a priority ranking for impaired waters and to develop and implement Total Maximum Daily Loads (TMDL). A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and allocates pollutant loadings to point and non-point sources. The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in the USEPA guidance (USEPA, 2000a). A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (USEPA, 2000a).

States must develop water quality management plans to implement the TMDL (40 CFR 130.6). The USEPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. The State submits TMDLs to USEPA for review and approval pursuant to CWA section 303(d), and section 303(c) as appropriate. In California, the State Water Resources Control Board (State Board) and the nine Regional Water Quality Control Boards are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to USEPA approval. If USEPA disapproves a TMDL submitted by a state, USEPA is required to establish a TMDL for that water body. The Regional Boards also hold regulatory authority for many of the instruments used to implement the TMDLs, such as the National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs).

A consent decree between the USEPA, the Santa Monica BayKeeper and Heal the Bay Inc., represented by the Natural Resources Defense Council (NRDC), was signed on March 22, 1999 (consent decree). This consent decree requires that all TMDLs, as required by the 1998 303(d) list, for the Los Angeles Region be adopted within 13 years. For the purpose of scheduling TMDL development, the consent decree combined the more than 700 water body-pollutant combinations into 92 TMDL analytical units and also prescribed schedules for certain TMDLs.

Specific water body-pollutant combinations for Dominguez Channel and greater Los Angeles and Long Beach Harbor waters were identified as impaired on the 1996, 1998, 2002, 2006 and 2008/2010 California 303(d) lists (LA RWQCB, 1996, 1998, 2002, 2007, 2010). The final 2008/2010 list of impaired water body-pollutant combinations for Dominguez Channel and greater Los Angeles and Long Beach Harbor waters is contained in Table 2-7.

On Sept. 2, 2010, the U.S. District Court approved a modification to the consent decree which added and removed certain pollutants from certain Analytical Units from the consent decree-required TMDLs for the Harbor waters. Analytical units (AU) 73, 74, 75 and 78 are addressed via these Harbor Toxics TMDLs. However, parts of two AUs are not addressed in this TMDL project - Copper and lead in Wilmington Drain which is part of AU 75 and Chlordane, DDT and PCBs in Machado Lake which is part of AU 73. A separate TMDL for Chlordane, DDT and PCBs in Machado Lake was approved by the Regional Board in September of 2010. The September 2010 modification of the consent decree included a finding of non-impairment for copper and lead in Wilmington Drain; these impairments will also be removed from the 303(d) list when sufficient data is available to de-list in accordance with the State Listing Policy.

The TMDLs for Dominguez Channel and greater Los Angeles/Long Beach Harbor waters will be established in a Basin Plan Amendment and are therefore subject to Public Resources Code Section 21083.9 that requires California Environmental Quality Act (CEQA) Scoping and Analysis to be conducted for Regional Projects. CEQA Scoping involves identifying a range of project/program related actions, alternatives, mitigation measures, and significant effects to be analyzed in an EIR or its Substitute Environmental Documents (SEDs). On September 21, 2006 a CEQA Scoping meeting was held to present and discuss the foreseeable potential environmental impacts of compliance with the TMDLs for Dominguez Channel and greater Los Angeles/Long Beach Harbor waters at the Los Angeles Regional Water Quality Control Board. Input from all stakeholders and interested parties were solicited for consideration in the development of the CEQA environmental analysis.

Metals TMDLs have already been completed for Los Angeles River, San Gabriel River and Los Cerritos Channel; therefore, metal pollutant allocations have been defined to restore beneficial uses in these watersheds. These three watersheds also contribute freshwater to the greater LA/LB Harbor waters, primarily the LA River Estuary and eastern San Pedro Bay.

# 2 Problem Statement

The waters of Dominguez Channel, Dominguez Channel estuary, Torrance Lateral Channel (sometimes referred to as Torrance Carson Channel), Los Angeles and Long Beach Harbors (including Inner and Outer Harbor, Main Channel, Consolidated Slip, Southwest Slip, Fish

Harbor, Cabrillo Marina, Inner Cabrillo Beach), San Pedro Bay and Los Angeles River Estuary are impaired by heavy metals and organic pollutants. More specifically, each of these water bodies are included on the 303(d) list for one or more of the following pollutants: cadmium, chromium, copper, mercury, lead, zinc, chlordane, dieldrin, toxaphene, DDT, PCBs, and certain PAH compounds. These impairments may exist in one or more environmental media—water, sediments or tissue. This section provides an overview of water quality criteria and guidelines applicable to the above waterbodies and reviews the fish tissue, and sediment and water quality data compiled for the purpose of these TMDLs.

## 2.1 Environmental Setting

This report addresses water quality in Dominguez Channel and waters associated with greater Los Angeles and Long Beach Harbor ("greater Los Angeles and Long Beach Harbor waters"). Specifically, the greater Los Angeles/Long Beach Harbor waters include Inner and Outer Harbor, Consolidated Slip, Fish Harbor, Cabrillo Marina, Inner Cabrillo Beach, Los Angeles River estuary, and San Pedro Bay (Figure 2-1). Dominguez Channel includes the Dominguez Channel Estuary and Torrance Lateral Channel (Figure 2-2).

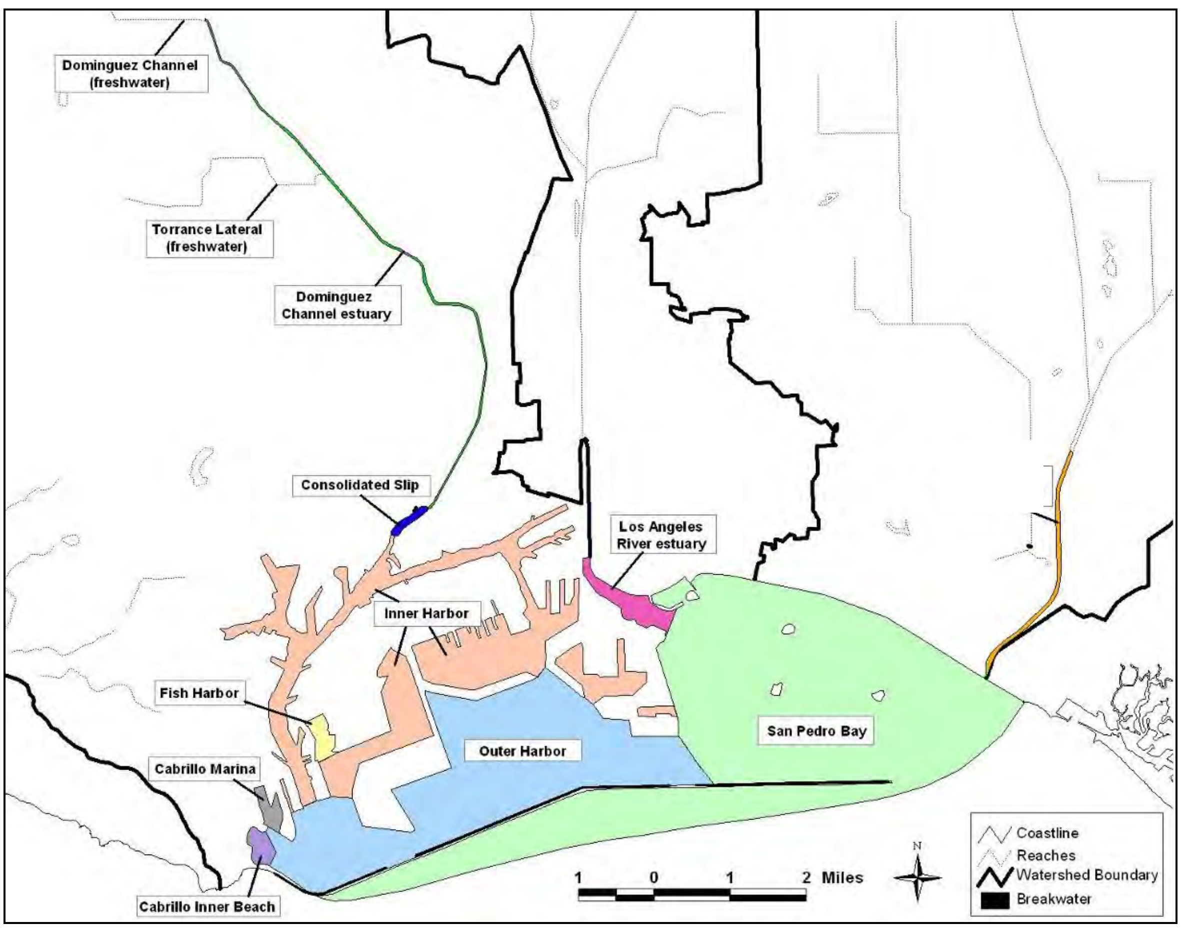



**Figure 2-1. Dominguez Channel and greater Los Angeles and Long Beach Harbor waters.**

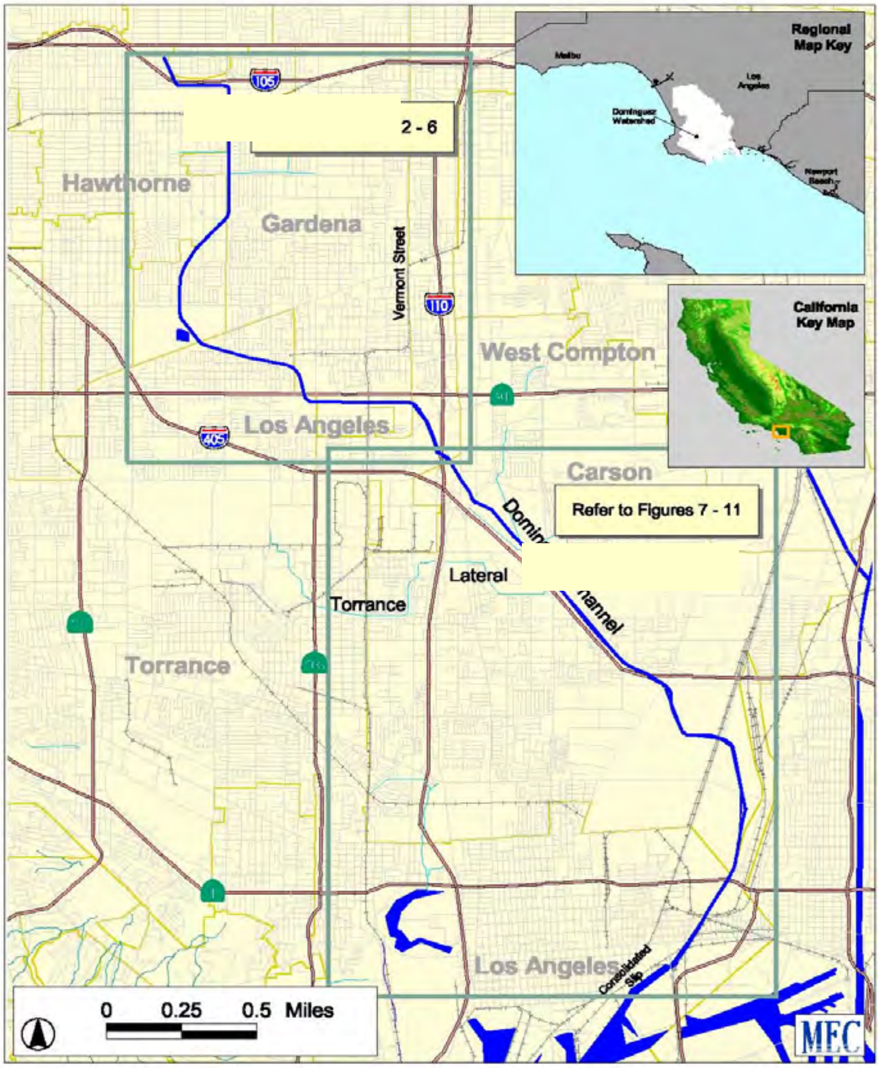



**Figure 1. Dominguez Channel Vicinity Map.**

**Figure 2-2. Dominguez Channel sub-watershed areas**
(Source: MEC Analytical; note: boxes in the figure refer to additional figures within the original MEC Analytical report)

### *2.1.1 Watersheds and Land Use*

The watershed of the Dominguez Channel and the Los Angeles and Long Beach Harbors is an important industrial, commercial and residential area with unique and important historical and environmental resources. The area includes 21 municipalities within and including Los Angeles County and roughly 1 million residents. Prior to its development, the area was largely marshland and now almost no wetland or original coastline exists. Water quality decreased with increased development in the 1970s. Since then, the water quality has improved but there are still significant water quality and sediment quality challenges.

The ports of Los Angeles and Long Beach occupy over 10,500 acres of land and water. The Inner Harbors contain piers for ship loading and unloading and several marinas. The outer part of both harbors (the greater San Pedro Bay) has been less disrupted than the inner areas and supports a great diversity of marine life. It is open to the ocean at its eastern end and receives much greater ocean flushing than inner harbor areas.

San Pedro Bay receives the discharges of the Dominguez Channel, Los Angeles and San Gabriel Rivers, although the latter two watersheds are not the focus of these TMDLs. (Machado Lake also may contribute intermittent flows to the Inner Harbor and is also not a focus of this TMDL.) The Los Angeles River is largely treated wastewater flow and the watershed is 834 square miles, 66% developed. The San Gabriel River is 689 square miles (including the Los Cerritos Channel and Alamitos Bay) and is largely developed in the downstream end.

The Dominguez Channel Watershed drains an area of approximately 133 square miles in southwestern Los Angeles. The watershed is composed of two hydrologic subunits. The two subunits drain primarily via an extensive network of underground storm drains. The northern subunit drains into the Dominguez Channel while the southern subunit drains directly into the Los Angeles and Long Beach Harbor Area. The headwaters of the Dominguez Channel consist of an underground storm drain system which daylights approximately 0.25 miles north of the Hawthorne Municipal Airport. The Dominguez Channel drains approximately 62 percent of the watershed before discharging to Los Angeles Harbor. Land use for Dominguez Channel is shown in Table 2-1.

As documented in the Los Angeles County Department of Public and Work (LA Co DPW) Integrated Report (1994-2005), the Dominguez Channel watershed is dominated by urban land uses such as residential, industrial, commercial and transportation, which comprise as much as 85% of the land area. Very little vacant and open space areas are present in the watershed. The watershed is approximately 60% impervious based on assumptions of impervious areas in each land use type. The highest population density in the watershed appears to be in communities of Inglewood and Hawthorne.

The Dominguez Channel and the Los Angeles and Long Beach Harbors watershed has a Mediterranean climate with an average of approximately 14 inches of rain per year, most of it during the winter season. LA Co DPW maintains a water sampling mass emission station, S28, in the Dominguez Channel near the center of the watershed area. At this station in 2004-2005 all daily rainfall totals were below 2.5 inches. The wettest period was in late December and early January.

There are many permitted discharges to the watershed. There are approximately 60 active, individual NPDES permitted discharges to the Dominguez Channel and to the Los Angeles and Long Beach Harbors. These include four refineries that discharge to the Dominguez Channel, two generating stations that discharge to the inner harbor areas and the Terminal Island Water Reclamation Plant (TIWRP). The Terminal Island Treatment Plant discharges secondary-treated effluent to the Outer Harbor and this POTW is under a time schedule order to eliminate their discharge into surface waters. In addition, there are approximately 50 active, general NPDES permitted discharges to the watershed.

**Table 2-1. Land Use by Subwatershed Area for Dominguez Channel Watershed**

| Land Use Type* | Area |
|---|---|
| Agricultural | 1% |
| Industrial | 17% |
| Mixed Use | 1% |
| Open Space/Recreation | 3% |
| Residential | 41% |
| Retail/Commercial | 14% |
| Transportation | 13% |
| Vacant | 4% |
| Water | 6% |
| Total | 100% |

* source: LACDPW integrated 1994-2005 report.

**Habitats:**
A number of fresh and marine habitat types are included in the TMDL area.

The Freshwater habitat areas of Upper Dominguez Channel are concrete lined and offer minimal habitat value at this time. The Torrance Lateral and other tributary channels, 132nd and 135th Street Drains, Del Amo Laterals, and Victoria Creek, are also freshwater and concrete-lined.

From Vermont Street downstream to Los Angeles Harbor, Dominguez Channel has a soft-bottom with riprap banks, and is estuarine.

Within the Harbor areas and San Pedro Bay the habitats are marine and include shallow water habitat, deeper habitat, some beach areas and small wetland areas. A small, man-made wetland (approx. 5 acres), “Salinas de San Pedro” extends about 650 feet north along waterfront on northern Cabrillo Beach.

Shallow water habitat, some man-made during 1999-2000 as part of the Port of Los Angeles’ Outer Harbor Channel Deepening and Pier 400 Construction Project occurs within the outer harbor and supports some kelp habitat. The Harbors also include extensive soft bottom areas and eelgrass beds. The ship channels in the Harbors are deeper and maintained by dredging.

**Birds:**
Over 100 species of birds occupy habitats in the Port of Los Angeles and Port of Long Beach, including three species that are listed as Threatened or Endangered by either the State or federal government [California least tern (*Sterna antillerum browni*), Western Snowy Plover (*Charadrius alexandrinus nivosus*) and Peregrine Falcon (*Falco pereginus anatum*)]. At least 18 bird species nest in the Port area. Birds that use Inner Cabrillo Beach include gulls and pigeons

as well as seasonal snowy plovers, Caspian terns, least terns, black skimmers, Forster's terns, brown pelicans, great blue herons, sanderlings, western and least sandpipers, willets western, Clark's, and eared grebes, cormorants, occasional loons and ducks (S. Vogel, Cabrillo Marine Aquarium, personal communication).

**Fish:**
Over 70 species of fish have been noted in the Harbor. From 1993 to 2001 trawls for fish in the Los Angeles Harbor by the City of Los Angeles Environmental Monitoring Division, typically found 20 or 30 fish species, dominated by white croaker (*Genyonemus lineatus*), queenfish (*Seriphus politus*), California tonguefish (*Symphurus atricauda*), and Pacific sanddab (*Citharichthys stigmaeus*) (City of Los Angeles, 2002; 2001; 2000; 1999a; 1998; 1997; 1996). Ports Biological Baseline Study (2000) reported the following fish by mass abundance: Northern anchovy, white croaker, queenfish, topsmelt, specklefin midshipman, speckled sanddab, Pacific sardine, shiner surfperch, white surfperch, and salema. California halibut and barred sandbass had moderate abundance. In beach seines on Inner Cabrillo Beach, commonly caught fish include surfperch, topsmelt, jacksmelt, pipefish and flatfish. In addition, there are grunion runs on the Inner and Outer Cabrillo Beaches from March through July (S. Vogel, Cabrillo Marine Aquarium, personal communication).

**Invertebrates:**
Over 400 species of invertebrates have been noted in the Harbor. From 1993 to 2001 trawls for invertebrates in the Los Angeles Harbor by the City of Los Angeles Environmental Monitoring Division, were dominated by blackspotted bay shrimp (*Crangdon nigromaculata*), American spider crab (*Pyromaia tuberculata*) and New Zealand cephlaspidian (*Philine auriformis*) (City of Los Angeles, 2002; 2001; 2000; 1999a; 1998; 1997; 1996).

**Mammals:**
Los Angeles Harbor is used by California sea lions (*Zalophus californianus*) and occasionally harbor seals, elephant seals, dolphins and gray whale calves (S. Vogel, Cabrillo Marine Aquarium, personal communication).

## 2.2 **Water Quality Standards**

California state water quality standards consist of the following elements: 1) beneficial uses; 2) narrative and/or numeric water quality objective (WQOs); and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Boards in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are also specified in each region's Basin Plan. The objectives are set to be protective of the beneficial uses in each water body in the region and/or to protect against degradation. Numeric objectives for toxics in water can be found in the California Toxics Rule (40 CFR §131.38).

### ***2.2.1 Beneficial Uses***

The first part of California water quality standards is beneficial uses. The Basin Plan for the Los Angeles Regional Board (1994) defines beneficial uses for Dominguez Channel and greater Los Angeles/Long Beach Harbor waters (Table 2-2).

**Table 2-2. Beneficial Uses of Dominguez Channel and greater Los Angeles/Long Beach Harbor waters (LARWQCB, 1994)**

| 303(d) list waterbody | Basin Plan waterbody (Hydo # 405.12) | MUN | NAV | IND | REC1 | REC2 | COMM | WARM | EST | MAR | WILD | RARE | MIGR | SPWN | SHELL | WET |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dominguez Channel fresh<br>Torrance Lateral | Dominguez Channel to Estuary | P | | | Ps | E | | P | | | P | E | | | | |
| Dominguez Channel Estuary | Dominguez Channel Estuary | | P | | Es | E | E | | E | E | E | Ee | Ef | Ef | | |
| Consolidated Slip<br>Inner Harbor<br>Fish Harbor | Los Angeles Long Beach Harbor All Other Inner areas | | E | E | E | E | E | | | E | | Ee | | | P | |
| Cabrillo Marina | Los Angeles Long Beach Harbor Marinas | | E | E | E | E | E | | | E | | E | | | P | |
| Inner Cabrillo Beach | Los Angeles Long Beach Harbor Public Beach areas | | E | | E | E | E | | | E | E | E | | E | E | |
| Los Angeles River Estuary | Los Angeles River Estuary | | E | E | E | E | E | | E | E | E | Ee | Ef | Ef | P | E |
| Outer Harbor<br>San Pedro Bay | Los Angeles Long Beach Harbor Outer Harbor | | E | | E | E | E | | | E | | E | | | P | |

Beneficial use designations apply to all tributaries to the indicated water body, if not listed separately.
E: Existing beneficial use
P: Potential beneficial use
e: One or more rare species utilize all oceans, bays, estuaries, and wetlands for foraging and/or nesting.
f: Aquatic organisms utilize all bays, estuaries, lagoons, and coastal wetlands, to a certain extent, for spawning and early development. This may include migration into areas that are heavily influenced by freshwater inputs.
s: Access prohibited by Los Angeles County Department of Public Works

Greater Los Angeles and Long Beach Harbor waters have designated uses to protect aquatic life including the marine (MAR) and rare, threatened or endangered species habitat (RARE). There are also beneficial uses associated with human use of these waters, including recreational use for water contact (REC1), non-contact water recreation (REC2), navigation (NAV), industrial service supply (IND), commercial and sport fishing (COMM), and shellfish harvesting (SHELL). The estuaries (EST) are recognized as areas for spawning, reproduction and/or early development (SPWN), migration of aquatic organisms (MIGR) and wildlife habitat (WILD). Dominguez Channel also has an existing designated use of warm freshwater habitat (WARM) and the Los Angeles River estuary has the designated use of wetland habitat (WET).

### *2.2.2 Water Quality Objectives (WQOs)*

The second part of California water quality standards is water quality objectives. As stated in the Basin Plan, water quality objectives (WQOs) are intended to protect the public health and welfare and to maintain or enhance water quality in relation to the designated existing and potential beneficial uses of the water. The Basin Plan specifies both narrative and numeric water quality objectives. The following narrative water quality objectives are the most pertinent to this TMDL. These narrative WQOs may be applied to both the water column and the sediments.

> Chemical Constituents: *Surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use.*
>
> Bioaccumulation: *Toxic pollutants shall not be present at levels that will bioaccumulate in aquatic life to levels, which are harmful to aquatic life or human health.*
>
> Pesticides: *No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.*
>
> Toxicity: *All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.*

The Regional Board's narrative toxicity objective reflects and implements national policy set by Congress. The Clean Water Act states that, "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited." (33 U.S.C. 1251(a)(3).) In 2000, USEPA established numeric water quality objectives for several pollutants addressed in this TMDL in the California Toxics Rule (CTR) (USEPA, 2000b). The CTR establishes numeric aquatic life criteria for 23 priority toxic pollutants and numeric human health criteria for 92 priority toxic pollutants. These criteria are established to protect human health and the environment and are applicable to inland surface waters, enclosed bays and estuaries.

For the protection of aquatic life, the CTR establishes short-term (acute) and long-term (chronic) criteria in both freshwater and saltwater. The acute criterion equals the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects. The chronic criterion equals the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects. Freshwater criteria apply to waters in which the salinity is equal to or less than 1 part per thousand (ppt) 95 percent or more of the time. Saltwater criteria apply to waters in which salinity is equal to or greater than 10 ppt, 95 percent or more of the time. For waters in which the salinity is between 1 and 10 ppt, the more stringent of the two criteria apply.

In the CTR, freshwater and saltwater criteria for metals are expressed in terms of the dissolved fraction of the metal in the water column. These criteria were calculated based on methods in USEPA's *Summary of Revisions to Guidelines for Deriving Numerical National Water Quality* *dCriteria for the Protection of Aquatic Organisms and Their Uses* (50 FR 30792, July 29, 1985), developed under Section 304(a) of the CWA. This methodology is used to calculate the total recoverable fraction of metals in the water column and then appropriate conversion factors, included in the CTR are applied, to calculate the dissolved criteria.

The human health criteria are established to protect the general population from priority toxic pollutants regulated as carcinogens (cancer-causing substances) and are based on the consumption of water and aquatic organisms or aquatic organisms only, assuming a typical consumption of 6.5 grams per day of fish and shellfish and drinking 2.0 liters per day of water. Table 2-3 summarizes the aquatic life, and human health criteria for metals and organic constituents, covered under this TMDL.

**Table 2-3. Water quality standards established in the CTR for metals and organic compounds**

| Pollutant | Criteria for the Protection of Aquatic Life | | Criteria for the Protection of Human Health | |
|---|---|---|---|---|
| | Saltwater | | | |
| | Acute (µg/L) | Chronic (µg/L) | Water & Organisms (µg/L) | Organisms only (µg/L) |
| Cadmium | 42 | 9.3 | | |
| Copper | 4.8 | 3.1 | 1300 | |
| Chromium VI | 1100 | 50 | | |
| Lead | 210 | 8.1 | | |
| Nickel | 74 | 8.2 | 610 | 4600 |
| Selenium | 290 | 71 | | |
| Silver | 1.9 | n/a | | |
| Zinc | 90 | 81 | | |
| Chlordane | 0.09 | 0.004 | 0.00057 | 0.00059 |
| Dieldrin | 0.71 | 0.0019 | 0.00014 | 0.00014 |
| 4,4'-DDT[1] | 0.13 | 0.001 | 0.00059 | 0.00059 |
| Total PCBs[2] | | 0.014 | 0.00017 | 0.00017 |
| Benzo[a]pyrene | | | 0.0044 | 0.049 |

[1]Based on total DDT, the sum of all isomer analyses.
[2]Based on total PCBs, the sum of all congener or isomer or homolog or aroclor analyses.

For PCBs, the aquatic life values in the Basin Plan are the same as in the CTR. For PCBs, the human health values are not the same. The Basin Plan human health value for PCBs is based only on the sum of Aroclor analyses; however the CTR human health value (0.17 ng/L) is for total PCBs and is applicable and more stringent since it is calculated as sum of all congener, or isomer, or homolog or Aroclor analyses.

There are no numeric standards for fish tissue in the Basin Plan or CTR. However, the human health criteria in the CTR were developed to ensure that bioaccumulative substances do not concentrate in fish tissue at levels that could impact human health.

There are no sediment quality objectives in the Basin Plan or CTR. The Regional Board applied best professional judgment to define elevated values for metals in sediment during the water quality assessments conducted in 1996, 1998, and 2002. During the water quality assessments for 2006, assessments of sediments for metals and organics followed the sediment quality guidelines in the Functional Equivalent Document for the California Listing policy "Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List." These guidelines were also used in the assessment of sediment quality for this TMDL (Table 2-4).

**Table 2-4. Sediment quality guidelines used for determination of impairment for metals and organic compounds**

| Pollutant | Marine and Estuarine Sediments | | | Freshwater Sediments |
|---|---|---|---|---|
| | Effects Range Median[1] | Probable Effects Level[2] | Other Sediment Quality Guideline | Probable Effect Concentration[3] |
| **METALS** | | | | |
| Cadmium | | 4.21 µg/g dw | | 4.98 mg/kg dw |
| Copper | 270 µg/g dw | | | 149 mg/kg dw |
| Chromium | 370 µg/g dw | | | 111 mg/kg dw |
| Lead | | 112.18 µg/g dw | | 128 mg/kg dw |
| Nickel | | | | 48.6 mg/kg dw |
| Selenium | | | | |
| Silver | | 1.77 µg/g dw | | |
| Zinc | 410 µg/g dw | | | 459 mg/kg dw |
| **ORGANICS** | | | | |
| Chlordane | 6 ng/g dw[4] | | | 17.6 µg/kg dw |
| Dieldrin | 8 ng/g dw | | | 61.8 µg/kg dw |
| Total DDT | | | 590* | 572 µg/kg dw |
| Total PCBs | 180 ng/g dw | | 400 ng/g[5] | 676 µg/kg dw |
| Total PAHs | | | 180,000(µg/kg)[8] | 22,800(µg/kg) |
| Benzo[a]pyrene | | 763.22 ng/g | | 1450 µg/kg dw |
| 2-methyl-napthalene | | 201.28 ng/g dw | | |
| Phenanthrene | | 543.53 ng/g dw | | 1170 ug/kg dw |
| Lo MW PAHs | | 1442 ng/g dw | | |
| Benza[a]anthracene | | 692.53 ng/g dw | | 1050 ug/kg dw |

[1]Long et al. 1995 dw = Dry Weight
[2]MacDonald et al., 1996
[3]MacDonald et al., 2000a
[4]Long and Morgan, 1990
[5]MacDonald et al., 2000b
[8]Fairey et al., 2001
Freshwater and saltwater SQG values from CA listing policy, FED pg. 122-123
*marine DDT value from EPA Superfund Risk Assessment (1994)

The California Water Quality Control Board has set a State policy, *The State Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality* (SQO Part 1), for evaluation of sediments by the interpretation and integration of multiple lines of evidence called the sediment "triad": Application of the SQO Part 1 results in assessed sediments being categorized as Unimpacted, Likely Unimpacted, Inconclusive, Possibly Impacted, Likely

Impacted, or Clearly Impacted. The sediment categories of **Unimpacted** and **Likely Unimpacted** are the protective conditions and meet the narrative objective.

### *2.2.3 <u>Antidegradation</u>*

The third part of California water quality standards is antidegradation. State Board Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality Water" in California, known as the "Antidegradation Policy," protects surface and ground waters from degradation. Any actions that can adversely affect water quality in all surface and ground waters must be consistent with the maximum benefit to the people of the state, must not unreasonably affect present and anticipated beneficial use of such water, and must not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the federal Antidegradation Policy (40 CFR 131.12).

## 2.3 **Impairments Identified in 303(d) lists**

The waters of the Dominguez Channel and the Ports of Los Angeles and Long Beach in the San Pedro Bay, addressed by this TMDL, are impaired due to a variety of toxic pollutants, including metals, organic compounds, and sediment toxicity. In addition, certain waterbodies show impairment to the benthic community.

This section reviews the 303(d) lists issued by the State of California and USEPA in 1998 (the list to which the consent decree refers) (Table 2-5), 2002, 2006 (Table 2-6) and 2008/2010 (Table 2-7) which establish the impairments.

The consent decree provides that TMDLs need not be completed for specific water body by pollutant combinations if the State or EPA determines that TMDLs are not needed for these combinations, consistent with the requirements of Section 303(d). The consent decree provides that this determination may be made either through a formal decision to remove a combination from the State Section 303(d) list or through a separate determination that the specific TMDLs are not needed. The September 2010 modification of the consent decree included a finding of non-impairment for copper and lead in Wilmington Drain; these impairments will also be removed from the 303(d) list when sufficient data is available to de-list in accordance with the State Listing Policy

For the 2006 303(d) list, the State of California made several changes in water body-pollutant listings for water in Dominguez Channel and greater Los Angeles and Long Beach Harbor waters. Clarification was provided such that individual PAH compounds were listed as opposed to the general category of polyaromatic hydrocarbons (PAHs). Some areas changes also occurred. In addition, EPA proposed some additions to the State's 2006 list. Table 2-6 provides the waterbody-pollutant combinations for the 2006 list.

**Table 2-5. 1998 303(d) list of metal and organic compound impairments, shown here by analytical units as defined in consent decree.**

| Water body name | Tissue | Sediment |
|---|---|---|
| **Analytical Unit #73** | | |
| Dominguez Channel freshwater | Aldrin*, Chem A*<br>Chlordane*, Dieldrin*<br>DDT*, PCBs* | |
| Dominguez Channel estuary | Aldrin*, Chem A*<br>Chlordane, Dieldrin<br>DDT, PCBs | Benthic community effects |
| Consolidated Slip | Chlordane, Dieldrin<br>DDT, PCBs, | Toxicity, benthic community effects |
| Inner Harbor | DDT, PCBs | Toxicity |
| Main Channel | DDT, PCBs | Toxicity |
| SouthWest Slip | DDT, PCBs | Toxicity |
| Fish Harbor | DDT, PCBs | Toxicity |
| Long Beach Harbor | DDT, PCBs | Toxicity, benthic community effects |
| Cabrillo Beach-Inner | DDT, PCBs | Toxicity |
| San Pedro Bay | DDT, PCBs | Toxicity |
| Los Angeles River Estuary | DDT, PCBs | Toxicity |
| Machado Lake ** | DDT, PCBs | |
| **Analytical Unit #74** | | |
| Dominguez Channel freshwater | | PAHs |
| Dominguez Channel estuary | | PAHs |
| Consolidated Slip | | PAHs |
| Inner Harbor | | PAHs |
| Main Channel | | PAHs |
| Fish Harbor | | PAHs |
| Long Beach Harbor | | PAHs |
| San Pedro Bay | | PAHs |
| **Analytical Unit #75** | | |
| Torrance Lateral Channel | | Cu, Pb |
| Wilmington Drain * | | Cu, Pb |
| Dominguez Channel freshwater | | Cr, Cu, Pb, Zn |
| Dominguez Channel estuary | | Cr, Cu, Pb, Zn |
| Consolidated Slip | | Cr, Pb, Zn |
| Inner Harbor | | Cu, Zn |
| Main Channel | | Cu, Zn |
| Fish Harbor | | Cu, Zn |
| **Analytical Unit #78** | | |
| San Pedro Bay | | Cr*, Cu*, Zn* |

* Pollutants marked are removed from the 303(d) list. Therefore, this TMDL will not address these.
** Machado Lake and Wilmington Drain will not be addressed in these TMDLs.

**Table 2-6. 2006 final 303(d) list of individual pollutant impairments by water body.**

| Water body name | Tissue | Sediment |
|---|---|---|
| Dominguez Channel freshwater | Pb, Dieldrin | Zn, Cu<br>Toxicity |
| Torrance Lateral | | Cu, Pb |
| Dominguez Channel estuary | Chlordane, Dieldrin<br>DDT, Pb | DDT, PCBs, Zn<br>benthic community effects<br>Benzo[a]anthracene,<br>Benzo[a]pyrene,<br>Chrysene,<br>Phenanthrene,<br>Pyrene |
| Consolidated Slip | Chlordane, Dieldrin<br>DDT, PCBs,<br>toxaphene | Chlordane, DDT, PCBs<br>Cd, Cr, Cu, Hg, Pb, Zn<br>Toxicity, benthic community effects<br>Benzo[a]anthracene,<br>Benzo[a]pyrene,<br>Chrysene,<br>Phenanthrene,<br>Pyrene,<br>2-methylnaphthalene |
| Inner Harbor* | DDT, PCBs | Cu, Zn, Toxicity, benthic community effects |
| Fish Harbor | DDT, PCBs | Cu, Hg, Pb, Zn<br>Chlordane, DDT, PCBs<br>Benzo[a]anthracene, Benzo[a]pyrene<br>Chrysene,<br>Dibenz[a,h]anthracene,<br>Phenanthrene,<br>Pyrene, PAHs, Toxicity |
| LA Harbor—Cabrillo Marina | DDT, PCBs | |
| LA Harbor—Inner Cabrillo Beach | DDT, PCBs | Cu |
| Outer Harbor* | DDT, PCBs | Toxicity |
| San Pedro Bay | DDT, PCBs | Chlordane, PAHs,<br>Cr, Cu, Zn,<br>Toxicity |
| Los Angeles River Estuary | -- | Chlordane, toxicity<br>DDT, PCBs,<br>Pb, Zn |

*Inner Harbor area changes made in 2006, includes Southwest Slip and portions of Main Channel, as well as portions of Los Angeles and Long Beach Harbor. Also Long Beach Harbor area changes were made in 2006, redefined into Inner and Outer Harbor (see Figure 2-1).

The final 2008/2010 303(d) list was approved by EPA on November 12, 2010. Several additional additions and deletions were made based on newer data. Table 2-7 provides the waterbody-pollutant combinations for the 2008/2010 list.

**Table 2-7. 2008/10 final 303(d) list of individual pollutant impairments by water body.**

| Water body name | Tissue | Sediment |
|---|---|---|
| Dominguez Channel freshwater | | Cu, Pb, Zn<br>Diazinon |
| Torrance Lateral | | Cu, Pb |
| Dominguez Channel Estuary | Chlordane, Dieldrin<br>DDT, Pb | DDT, PCBs, Zn,<br>benthic community effects<br>Benzo[a]anthracene<br>Benzo(a)pyrene<br>Chrysene<br>Phenanthrene<br>Pyrene<br>Toxicity |
| Consolidated Slip | Chlordane, Dieldrin<br>DDT, PCBs<br>Toxaphene | Chlordane DDT PCBs<br>Cd, Cr, Cu, Hg, Pb, Zn,<br>Toxicity, Benthic Community Effects<br>Benzo[a]anthracene<br>Benzo(a)pyrene<br>Chrysene<br>Phenanthrene<br>Pyrene<br>2-Methylnapthalene |
| Inner Harbor | DDT, PCBs | Cu, Zn, Toxicity<br>Benthic Community Effects<br>Benzo(a)pyrene<br>Chrysene |
| Fish Harbor | DDT, PCBs | Cu, Hg, Pb, Zn<br>Chlordane, DDT, PCBs<br>Benzo[a]anthracene<br>Benzo(a)pyrene<br>Chrysene<br>Dibenz[a,h]anthracene<br>Phenanthrene<br>*PAHs (Polycyclic Aromatic Hydrocarbons)*<br>Phenanthrene<br>Pyrene, Toxicity |
| Los Angeles Harbor – Cabrillo Marina | DDT, PCBs | Benzo(a)pyrene |
| Los Angeles Harbor –Inner Cabrillo Beach | DDT, PCBs | |
| Outer Harbor | DDT, PCBs | toxicity |
| San Pedro Bay Near/Off Shore Zones | DDT, PCBs | Chlordane<br>Toxicity |
| Los Angeles River Estuary | | Chlordane, Toxicity, DDT, PCBs |

## 2.4 **Data Review/Impairments identified for this TMDL**

This section summarizes available monitoring data for Dominguez Channel and greater Los Angeles and Long Beach Harbor waters for the listed pollutants in water, fish and sediments. This section includes more recent data than the listing data, in some instances, and provides more detail in terms of whether impairments are in water, tissue or sediment. The summary includes water quality, fish tissue, and sediment quality data from various monitoring sources, for the period of 1992 to 2010. Thus, the assessment and problem statement sections of this document more accurately reflect current water quality conditions in Dominguez Channel and greater Los Angeles and Long Beach Harbor waters.

### *2.4.1 Assessment methodology*

In general, the protocols used for this assessment are consistent with those outlined in the State's 303(d) listing policy (SWRCB 2004). The benchmarks used in this assessment are consistent with those identified in the policy's supporting Functional Equivalency Document (FED) document. The state's policy was developed by the State for purposes of water quality assessments, and the State applied this policy to develop its decisions for the 2006 and 2008/2010 303(d) lists. In addition, EPA added waterbodies and pollutants to the State's list in 2006.

This assessment builds on the data record evaluated by the State and compiled in the 2006 and 2008/2010 303(d) list factsheets; it also includes more recent information. This more detailed analysis is consistent with procedures provided in the State's Impaired Waters Guidance (SWRCB, 2005) to produce an assessment more accurately reflecting current water conditions.

As described above, this assessment is generally consistent with protocols and benchmarks provided in the State's 303(d) listing policy and supporting (FED) document. For example, this assessment used the same benchmarks for comparison to determine exceedences; e.g., water quality objectives from CTR, sediment quality guideline values and OEHHA fish tissue screening values from the policy's FED. One exception (discussed below) is that this assessment used a sediment chemistry benchmark for DDT, whereas the listing policy did not include a media-pollutant specific value.

Important sources of new data include: Bight 2003 study, recent Los Angeles County MS4 monitoring, City of Los Angeles (TIWRP) Harbor monitoring, Port of Los Angeles (POLA) Prop 13 studies, Port of Long Beach (POLB) water monitoring and POLA/POLB TMDL monitoring of 2006 and some SCCWRP studies. The complete list of data reviewed is provided in Table 2-8. All recent data are final and have received some QA/QC review, thus data are viable for assessment.

**Table 2-8. Water Quality, sediment and fish data reviewed for this assessment.**

| ID | Data Source | Data record | Spatial scope | Sample media |
|---|---|---|---|---|
| 5 | POLA/POLB Sediment survey | 2006 | Greater Los Angeles/Long Beach Harbor waters | Sediment, porewater, overlying water |
| 3 | POLB water data | 2006 | Inner Harbor | Water |
| 8 | SCCWRP | 2006 | Consolidated Slip | Sediment, porewater, overlying water |
| | | 2006 | Dominguez Channel estuary | Air |
| 4 | POLA Prop. 13<br>POLA water data | 2004—2006 | Dominguez Channel estuary, Consolidated Slip, Inner Harbor | Water |
| | | 2004—2006 | Consolidated Slip, Inner Harbor | Water |
| 11 | Bight '03 | 2003 | greater Los Angeles/Long Beach Harbor waters | Sediment |
| 21 | LA RWQCB SWAMP | 2003 | Dominguez Channel freshwater | Water |
| 7 | SCCWRP DDE Inventory | 2003 | So. Calif. Bight and LA Harbor | Water |
| 18 | SCCWRP | 2002-03 | Dominguez Channel freshwater | Water |
| 10 | POLA/AMEC | 2002 | Consolidated Slip | Fish |
| 13 | USEPA Superfund Montrose site | 2002 and 1994 | Stormwater pathway from site downstream to Consolidated Slip | Sediment DDT |
| 17 | POLA Biological baseline | 2002 and 2008 | Inner & Outer Harbor;<br>San Pedro Bay | Biology |
| 1 | LACDPW<br>NPDES MS4 | 2002—2010 | Dominguez Channel freshwater | Water |
| 19 | ACTA 2001 | 2000-01 | Dominguez Channel estuary | Mussels |
| 6 | City of LA BOS TIWRP | 1999-2004 | Outer Harbor | Sediment, Fish;<br>Water in 2002-03 |
| 16 | Oil Refineries NPDES | 1998-2004 | Dominguez Channel estuary | Sediment |
| 2 | POLB stormwater NPDES data | 1996—2005 | LB Harbor | Water |
| 20 | LACSD | 1995—2004 | San Gabriel River Estuary | Water, Sediments |
| 9 | CSTF sediment database | 1988-2001 | greater Los Angeles/Long Beach Harbor waters | Sediment, Fish |
| 14 | NOAA status & trends data | 1986—1998 | Outer Harbor and San Pedro Bay | Mussels |
| 15 | TSMP | 1978—2000 | Dominguez Channel estuary | Fish |
| 14 | SMW | 1977—2000 | Inner & Outer Harbor | Mussels |
| 12 | OEHHA | 1991 | So. Calif. Bight | Fish |
| | OEHHA/CFCP | 1999 & 2000 | San Pedro Bay, Belmont Pier | Fish |

note: numbered data sources are discussed further below.
POLA – Port of Los Angeles, POLB – Port of Long Beach

### *2.4.2 Water Column*

#### *2.4.2.1 1. LACDPW NPDES MS4 Los Angeles County Department of Public Works - Freshwater Dominguez Channel*

Los Angeles County Department of Public Works (LACDPW) collects samples at the Dominguez Channel mass emissions monitoring station (S28), which is above tidal influence. The upper portion of Dominguez Channel contains freshwater down to Artesia Blvd. S28 is in a concrete-lined, rectangular channel. LACDPW monitoring results from this site provides data for both wet and dry weather.

Metals data was reviewed for both wet and dry weather. All metal data were compared to sample-specific hardness adjusted CTR standards. From 2002 to 2010, CTR criteria for dissolved metals were exceeded in wet weather for copper, lead and zinc: Cu, 29 exceedances out of 35wet weather samples; Pb: 16 exceedances of 35 and Zn: 27 exceedances out of 35. While pre-2005 Pb results contain some uncertainty because the lab reporting limit (5 ug/L) was occasionally above the hardness specific Pb criteria, Pb results as of 2004 -2010 were reliably assessed, since the method detection limit was lowered to 0.5 ug/L at that time. In dry weather, no dissolved exceedences were observed for these three metals. In addition, no exceedences were observed for dissolved cadmium, chromium, mercury, nickel, selenium and silver in wet or dry weather.

Also, water column toxicity was repeatedly observed at S28 monitoring station from 2002 to 2010. Chronic ***Ceriodaphnia dubia*** tests showed inhibited survival during wet weather events in 2002, 2003 and 2005. *C. dubia* tests also showed inhibited reproductive success in the same timeframe. Toxic responses occurred in 6 of 14 wet weather sampling events during this timeframe. Dry weather results showed only one toxic result in 14 sampling events. Few water toxicity identification evaluation (TIE) studies have been performed to identify the category of causative agent(s). TIEs in 2003-04 indicated some volatile organic compounds may have caused toxicity; whereas 2002-03 TIEs indicated toxicity may be due to one or more non-polar organic compounds, cationic metals, and/or metabolically-activated organophosphates.

Five of 21 samples collected as part of the Los Angeles County Stormwater monitoring program exceeded the chronic DFG fresh water hazard assessment criteria for diazinon (three of which also exceeded the acute criteria) for the protection of aquatic life. Trend analysis of sample results collected over 8 years, showed that diazinon levels were below the DFG criteria after 2005, this is concurrent with EPA's deadline to ban on urban use of this pesticide. While toxicity is apparent in Dominguez Channel freshwater after 2005, it does not appear attributable to elevated diazinon.

*Torrance Lateral*

Torrance Lateral is a sub-watershed within the larger Dominguez Channel watershed that flows directly into Dominguez Channel Estuary (approx. 2 miles below S28). Recently Los Angeles County DPW completed more monitoring within Torrance Lateral as part of the Dominguez Channel tributary study (LAC DPW, 2009; 2010). Torrance Lateral refers to waters upstream of confluence with Dominguez Channel, consistent with LAC DPW sampling site TS19. Available water column results (2008 & 2009) reveal exceedences of dissolved copper (8 of 10) and zinc (9 of 10) CTR criteria during wet weather conditions. Dissolved lead was below the criteria in wet weather conditions and no dry weather exceedences occurred for any of these three metals. Currently there is no flow gauge associated with stream flows within Torrance Lateral, thus the daily storm volume or load duration approach can not apply.

#### *2.4.2.2 2. POLB stormwater NPDES data Port of Long Beach—Inner Harbor (mid-water column)*

Port of Long Beach has collected ambient samples from one site (3RW) within Long Beach Harbor. Available data from 1996 to 2005, include only total recoverable metals. Careful review of these ambient results, revealed some possible QA/QC concerns that require further clarification prior to assessment. Most notably, results from dates prior to and including 2002 are much higher than those reported from 2003 to present. These results will not be included in the assessment of Inner Harbor waters until the QA issues have been resolved.

#### *2.4.2.3 3. POLB water data*

In 2006, POLB performed one sampling event with numerous sites within the Inner Harbor. All samples were below criteria. Results are summarized in Table 2-9.

**Table 2-9. Water column dissolved metal results from Port of Long Beach—Inner Harbor (2006).**

| Pollutant | Detection Limit | # of detections | Conc. Range (ug/L) | CTR chronic saltwater objective (ug/L) |
|---|---|---|---|---|
| Cadmium | 0.005 | 14 | 0.01 – 0.06 | 9.3 |
| Copper | 0.01 | 14 | 0.28 – 1.41 | 3.1 |
| Lead | 0.005 | 14 | 0.10 – 0.07 | 8.1 |
| Mercury | 0.005 | 14 | <0.01 | 0.05¥ |
| Nickel | 0.005 | 14 | 0.19 – 0.39 | 8.2 |
| Silver | 0.02 | 14 | <0.02 | 1.9* |
| Zinc | 0.005 | 14 | 0.58 – 3.81 | 81 |

*silver value is acute criterion; ¥mercury value is human health criterion

#### *2.4.2.4 4. POLA water data Port of Los Angeles—various Harbor waters (mid-water column)*

Port of Los Angeles (POLA) currently has a monitoring program which obtains monthly samples for conventional parameters (DO, pH, TSS) at fixed stations which began in 2003. In 2005, POLA collected extra samples for an enhanced suite of analytes; i.e., metals and priority organics during two sampling events. Waterbodies sampled included Inner and Outer Harbor, Fish Harbor, Consolidated Slip, Cabrillo Marina and Inner Cabrillo Beach. Results for the two enhanced suite events are presented in Table 2-10 and compared with CTR chronic criteria.

**Table 2-10. Water column data (2005) for POLA Inner, Fish and Outer Harbor.**

| Pollutant | Detection Limit | # of sites | Conc. Range (ug/L) | CTR chronic saltwater objective (ug/L) |
|---|---|---|---|---|
| Cadmium* | 0.005 | 22 | 0.015 – 0.104 | 9.3 |
| Copper* | 0.01 | 22 | 0.28 – 3.16 | 3.1 |
| Lead* | 0.005 | 22 | 0.02 – 0.834 | 8.1 |
| Mercury* | 0.005 | 22 | 0.0005 – 0.0046 | 0.05¥ |
| Nickel* | 0.005 | 22 | 0.27 – 0.71 | 8.2 |
| Silver * | 0.02 | 22 | 0.007 – 0.11 | 1.9* |
| Zinc* | 0.005 | 22 | 3.28 – 58.8 | 81 |
| totDDT | 0.01 | 22 | ND | 0.001 |
| totPAHs | 0.01 | 22 | 0.09 – 0.28 | 0.049** |
| totPCBs | 0.01 | 22 | ND | 0.03 |

*silver value is acute criterion; ¥mercury value is human health criterion;
** total PAHs CTR criterion is for benzo[a]pyrene, protection of human health (consumption of organisms only).
Dissolved results for metals; unfiltered total results for organics.

POLA has also collected freshwater samples in Dominguez Channel at Artesia, the same site as the mass emission station (S28) maintained by LACDPW. Pollutograph samples were collected by capturing samples at distinct time intervals to evaluate concentration changes over short time frame such as one day. POLA has also collected some Dominguez Channel estuary water samples during wet and dry weather to support hydrodynamic and water quality modeling for the estuary. Results are pending.

#### *2.4.2.5 5. POLA/POLB Sediment survey Ports of Long Beach and Los Angeles—Inner and Outer Harbor (waters overlying sediments)*

In fall 2006, POLB and POLA performed a joint monitoring survey of sediments and overlying waters at 60 sites within greater Los Angeles/Long Beach Harbor waters. More description of this survey is provided in the section describing sediment monitoring results. Analytical results for total, unfiltered samples of waters overlying the sediment are summarized in Table 2-11.

**Table 2-11. Overlying Water data (2006) for Ports—Inner and Outer Harbor.**

| Pollutant | Detection Limit | # of detections | Conc. Range (ug/L) | CTR chronic saltwater objective (ug/L) |
|---|---|---|---|---|
| Cadmium* | 0.005 | 43 | | 9.3 |
| Copper* | 0.01 | 43 | 0.3 – 3.9 | 3.1 |
| Lead* | 0.005 | 43 | <0.005 – 1 | 8.1 |
| Mercury* | 0.005 | 43 | <0.005 | 0.05¥ |
| Silver * | 0.02 | 43 | <0.02 | 1.9* |
| Zinc* | 0.005 | 43 | 0.4 – 7.1 | 81 |
| totDDT | | 43 | ND— 0.0043 | 0.001 |
| totPAHs | | 43 | 0.0046 – 0.42 | |
| totPCBs | | 43 | ND | 0.03 |

*silver value is acute criterion; ¥mercury value is human health criterion
All results are total unfiltered samples collected one foot above sediment-water interface.

### *2.4.2.6 6. City of LA BOS TIWRP- Outer Harbor*

City of Los Angeles, Bureau of Sanitation, collects ambient samples in compliance with an NPDES permit for TIWRP. Some water samples were collected as part of the Interim Monitoring Program (IMP) in 2002-03, from station HW50 in the Outer Harbor. The vast majority of these water column results are below the detection limits, however, the detection limits are above the water quality criteria. The metal results have some detections for (presumably) total recoverable metal analytes. Some exceedences of water quality criteria are noted for copper (5-31.5 ppb), lead (11-58 ppb) and silver (6.7-11.6 ppb).
NOTE: These results may require additional investigation regarding appropriate QA/QC for saltwater matrices and potential confounding interferences for accurate instrumental analysis.

### *2.4.2.7 7. SCCWRP DDE Inventory SCCWRP – Inner & Outer Harbor, San Pedro Bay*

SCCWRP has utilized special analytical techniques to obtain measurements of priority organics in the water column at various sites along the Southern California Bight. Special, highly sensitive, solid phase microextraction (SPME) devices were deployed into the water column for sufficient time periods as to yield actual ambient results for DDT and PCBs with extremely low detection levels (sub-ng/L). The initial research efforts measured dissolved phase DDE (metabolite form of parent DDT compound) throughout the Bight (Zeng et al. 2005). Results from four stations within Inner and Outer Harbor waters show elevated levels of DDE in comparison to CTR human health numeric criteria. Total PCB measurements also exceed the CTR human health numeric criteria at these stations. Concentrations of DDE and total PCBs were higher at surface (2 m sub-surface) than those measured in water overlying (2m above) contaminated sediments.

### *2.4.2.8 8. SCCWRP – Consolidated Slip*

In fall 2006, SCCWRP performed repeated sampling at one site in Consolidated Slip. The sampling was designed to obtain chemical measurements of priority organics from sediment, porewater and overlying water to characterize the sediment flux values for the pollutants of concern in the Consolidated Slip. During each of three sampling events, the overlying waters were sampled via in-situ high volume pump to obtain high sample volumes (e.g., 1000+ L) for chemical extraction via PUF methods and to generate lower detection limits. Average results showed elevated levels of total DDT (0.47 ng/L) and total PCBs (0.45 ng/L) in comparison to CTR human health criteria ($10^{-6}$) for consumption of organisms only. Measured concentration ranges for listed organic compounds are provided in Table 2-12, along with CTR human health criteria.

**Table 2-12. SCCWRP (2006) overlying water data for Consolidated Slip.**

| Pollutant | Detection Limit | # of detections | Conc. Range (ng/L) | CTR Human health (ng/L) |
|---|---|---|---|---|
| Chlordane total | 0.010 | 3 | 0.055 – 0.07 | 0.59 |
| Dieldrin | 0.020 | 3 | <0.020 | 0.59 |
| p,p-DDE* | 0.050 | 3 | 0.15 – 0.23 | 0.59 |
| DDT total | 0.050 | 3 | 0.41 – 0.47 | 0.59[¥] |
| PCBs total | 0.020 | 3 | 0.37 – 0.43 | 0.17 |
| Benzo[a]pyrene | 0.020 | 3 | 0.147 – 0.827 | 49 |
| Benzo[a]anthracene | 0.050 | 3 | 0.743 – 1.006 | 49 |
| Chrysene | 0.050 | 3 | 0.747 – 1.319 | 49 |
| Phenanthrene | 0.050 | 3 | 5.772 – 12.169 | n/a |
| Pyrene | 0.050 | 3 | 8.670 – 11.173 | 11,000 |

### *2.4.3 Sediment*

Several sources provide sediment results for both sediment chemistry as well as sediment toxicity. Data were compiled through the Contaminated Sediments Task Force (CSTF), representing the data record from 1992 to 2001. For Consolidated Slip, there are also sediment results from the EPA Superfund sampling event in 2002, with added analyses by AMEC in contract with the Port of Los Angeles. In addition, for Dominguez Channel freshwater, NPDES-collected data from LA County DPW were analyzed and for Dominguez Channel estuary NPDES-collected data from oil refineries were analyzed.

To assess impacts to sediments, sediment results from the 2006 303(d) list as well as more recent additional data for the waterbodies of concern in these TMDLs were reviewed. The more recent data includes: Bight 2003 study, TIWRP NPDES samples, Los Angeles and Long Beach Harbor’s 2006 survey and the SCCWRP sediment flux study in 2006. Below is a brief discussion of each sediment data set to provide general spatial and temporal information.

#### *2.4.3.1 Consolidated Sediment Task Force database (CSTF)*

Numerous sediment results have been compiled by SCCWRP into one database (CSTF 2001). The database contains records from numerous sampling events by various monitoring groups/studies. Records from 1992 to 2001, including results from Bay Protection Toxic Cleanup Program (1992, 1994, 1996, 1997), Bight 1998, Western EMAP 1999 and dredge studies were reviewed.

#### *2.4.3.2 Refineries (NPDES)*

Oil refineries that discharge process waters into Dominguez Channel are required to collect receiving water samples from within the Channel as part of their NPDES permits. Most years, however, the refineries do not discharge. Sampling sites are located within Dominguez Channel estuary. From 1994 to 2004, sampling frequency has decreased and now occurs only in years when there is a discharge, such as 2005. Analytical detection limits for DDT, PCBs and PAHs were not sufficiently sensitive to allow assessment in comparison to sediment quality guidelines.

For example, results for individual PAH compounds in sediments were expressed as "<0.8mg/kg" in 2003; whereas the State's Listing Policy has identified sediment quality guidelines values (all in dry wt.) for 2-methylnaphthalene (201 µg/kg), phenanthrene (543.5 µg/kg), benzo[a]pryrene (763.2 µg/kg), benzo[a]anthracene (692.5 µg/kg), chrysene (845.9 µg/kg), pyrene (1397.4 µg/kg). Future monitoring efforts will benefit significantly from lower detection limits for comparison with these and other relevant sediment quality guidelines.

##### *2.4.3.3 Terminal Island Water Reclamation Plant (NPDES)*

City of Los Angeles Terminal Island Water Reclamation Plant monitors sediment in five locations in Outer Harbor. Sediment chemistry results from 1999-2004 were reviewed.

##### *2.4.3.4 Bight 03—Southern California Bight Regional Monitoring Project*

Bight 03 provides an integrated assessment of Southern California coastal estuaries (SCCWRP 2004, 2006). Multiple agencies coordinated to collect samples in summer 2003 which were analyzed for sediment chemistry, toxicity, and benthic community response. The sediment toxicity and bulk chemistry results for stations in the greater Harbor waterbodies have been included in this assessment report relevant to these TMDLs. These sediment chemistry results supplement the sediment data record provided by CSTF and provide review of more recent ambient sediment concentrations.

##### *2.4.3.5 PORTs (POLB & POLA)—sediment survey 2006*

In fall 2006, the Ports of Los Angeles and Long Beach performed a monitoring survey of 60 sites in greater Los Angeles/Long Beach Harbor waters. The sampling approach was discussed by both Ports, Regional Board staff, USEPA, SCCWRP and Weston Solutions, and agreed upon as part of a more comprehensive data collection plan to support the TMDL development process. One goal was to characterize contaminant concentrations in sediment, porewater and overlying water. Physical parameters, such as grain size and percent moisture, were also measured to provide ancillary data. Another goal was to reduce uncertainty associated with spatial variability thus sampling occurred at 30 randomly selected sites within each of the Port's jurisdictional areas. A complementary study by SCCWRP (see immediately below) provided additional data at co-located sites. These studies were designed to help characterize site-specific sediment-water flux rates within these greater Los Angeles/Long Beach Harbor waters. To ensure compatibility of all data, both Weston and SCCWRP used the same analytical laboratory, therefore analytical methods and method detection limits were consistent across both programs.

##### *2.4.3.6 SCCWRP—Sediment flux study 2006*

In fall 2006, SCCWRP, under separate contract with the Regional Board, performed complementary monitoring to the Port's study described above. One goal was to perform similar matrix sampling of sediment, porewater, overlying waters at one site in the Consolidated Slip and to collect samples at three different times to evaluate individual site variability. Another goal was to co-locate solid phase microextraction (SPME) devices at 11 stations with the Ports' sites to measure organics in waters overlying sediments via a different analytical approach. As mentioned above, the overall goal was to obtain site-specific data for generating sediment-water flux estimates of organochlorines and PAHs at the Consolidated Slip site and then extrapolate this information to other Harbor sites using other chemical data collected by Ports at the 60 other sites.

### *2.4.4 Fish and Shellfish Tissue*

While fish tissue data are limited, analysis of fish tissue for chemical contaminants provides a good measure of water quality since this media represents a long term integrator of bioaccumulation of pollutants and more reliable indication of water quality impacts. The following summary discusses the existing fish advisory and then presents more recent results along with some older data for perspective.

#### *2.4.4.1 OEHHA—LA Harbor, Cabrillo Marina, Inner Cabrillo Beach, San Pedro Bay*

In 1991, OEHHA issued a fish consumption advisory for various waters along the coastline between Point Dume and Dana Point, including waters in the Harbor area. High levels of DDT and PCBs were measured in sportfish representing a human health risk. Samples collected inside the Harbor breakwater, at Pier J and at Belmont Pier clearly showed elevated total DDT and PCBs in comparison to risk-based values. Total chlordane levels (ranged from 0 to 53 ppb) in these same samples were not above risk values so chlordane was not included in the advisory.

As part of the Coastal Fish Contamination Project (CFCP), OEHHA collected more fish tissue samples off Belmont Pier in 1999 and 2000. Results are summarized in Table 2-13.

**Table 2-13. Fish tissue composite results from OEHHA/CFCP (1999 & 2000) (µg/kg, wet weight).**

| Pollutant | White Croaker (n=2) | Queenfish (n=1) | Spotted Turbot (n=1) | Total # of exceedences | OEHHA screening value |
|---|---|---|---|---|---|
| Chlordane | 5.4 – 17.5 | 12.4 | 2.3 | 0 | 30 |
| DDT total | 92.4 – 254.0 | 396.6 | 104.0 | 3 | 100 |
| PCBs total | 98.0 – 294 | 207 | 116 | 4 | 20 |

Composite results shown for filets only, organics reported for skin-on filets

#### *2.4.4.2 Terminal Island Water Reclamation Plant–LA Harbor*

City of Los Angeles Terminal Island Water Reclamation Plant monitoring program has also collected fish tissue samples within the Outer Harbor. Results for 2000-2004 are summarized in Table 2-14. These results indicate non-impairment of fish tissue for arsenic, cadmium, mercury, selenium and chlordane, based on samples lower than Listing Policy screening values. The continued presence of high DDT and PCB levels indicates these pollutants are still creating adverse impacts and provide corroborating evidence for the consumption advisory in these waters.

**Table 2-14. Fish tissue data from Terminal Island Water Reclamation Plant (1999-2004) (ppb = ug/kg, wet weight).**

| Pollutant | Count | Fish Tissue (conc. range) | Total # of exceedences | OEHHA screening value |
|---|---|---|---|---|
| As | 30 | 0.46 – 1.14 | 1 | 1.0 |
| Cd | 30 | <0.4 | 0 | 3.0 |
| Hg | 30 | 0.01 – 0.11 | 0 | 0.3 |
| Se | 30 | 0.10 – 0.46 | 0 | 1* |
| Chlordane | 30 | 0.30 – <3.0 | 0 | 30 |
| DDT total | 40 | 22 – 6514 | 36 | 100 |
| PCBs total | 40 | 19 – 1000 | 36 | 20 |

*Se tissue value from USFWS for protecting birds. Dieldrin in fish tissue was not reported.

### *2.4.4.3 USEPA Superfund (and POLA)*

In 2002, USEPA Superfund Division collected fish samples via separate projects in various waters of concern to these TMDLs. The Consolidated Slip was sampled to determine DDT levels in fish tissue. POLA coordinated with EPA to have these samples analyzed by AMEC for other parameters. Two fish species were collected and four individuals of each species (halibut and white croaker) were analyzed. Various sample preparation methods were used and yielded different analytical results consistent with each approach. Analytical results for fish filets are presented in Table 2-15 below. In general, tissue levels were below Listing Policy tissue screening values for arsenic, cadmium, mercury, selenium and chlordane. DDT and PCB total levels exceeded Listing Policy values in several samples indicating impairment due to these pollutants.

**Table 2-15. Fish tissue data from Consolidated Slip (ppb = ug/kg, wet weight; EPA Superfund & POLA/AMEC).**

| | White Croaker (n=4) | Halibut (n=4) | | |
|---|---|---|---|---|
| Pollutant | Conc. Range | Conc. Range | Total # of exceedences | OEHHA screening value |
| As | 0.42—0.63 | 0.19—0.56 | 0 | 1.0 |
| Cd | 0.01 | 0.01—0.07 | 0 | 3.0 |
| Hg | 0.08—0.13 | 0.05—0.11 | 0 | 0.3 |
| Se | 0.31—1 | 0.23—0.41 | 1 | 1* |
| Chlordane | 1—8.2 | 1 | 0 | 30 |
| Dieldrin | n/a | n/a | -- | 2.0 |
| DDT total | 399—569 | 6—15 | 4 | 100 |
| PCBs total | 131—888 | 47 | 3 | 20 |

Metals reported for filets only, organics reported for skin-on filets
*Se value from USFWS (not OEHHA) for protecting birds

As part of Montrose Settlement Restoration Program, USEPA (Superfund Division) and other federal agencies collected fish samples from Point Dume to Dana Pt. in 2002. The objective of this project was to measure DDT and PCB contamination in fish tissue. Over 1000 individual fish from 123 species were collected in Santa Monica Bay, around Palos Verde peninsula, San

Pedro Bay, Huntington Harbor, Newport Harbor, etc. Tissue results from three "segments" are pertinent to waterbodies within the scope of these TMDLs (EPA 2007). These segments are all inside the San Pedro Bay breakwater ranging from Cabrillo fishing pier in the west (segment #16) to Pier J/Finger Piers (segment #17) to Belmont Pier/Seaport Village in the east (segment #18). Fish tissue results for these segments are summarized in Table 2-16 below.

**Table 2-16. Individual Fish tissue results from inside breakwater of Outer Harbor and eastern San Pedro Bay. (EPA /NMFS/OEHHA, 2002) (ppb = µg/kg, wet weight).**

| | Cabrillo Pier-inside bkwtr (Segment 16) | | Pier J/Fingers Pier (Segment 17) | | Belmont Pier/Seaport Village (Segment 18) | |
|---|---|---|---|---|---|---|
| **Pollutant** | **Conc. range** | **# exceeds/total** | **Conc. range** | **# exceeds/total** | **Conc. range** | **# exceeds/total** |
| Chlordane | 3 – 23 | 0 / 80 | 2 – 63 | 5 / 68 | 3 – 33 | 3 / 69 |
| Dieldrin | 0.4 – 1.4 | 0 / 74 | 0.4 – 7.9 | 8 / 65 | 0.5 – 1.5 | 0 / 69 |
| DDT total | 9 – 2522 | 27 / 80 | 0.4 – 764 | 13 / 68 | 1.4 – 206 | 12 / 69 |
| PCBs total | 0.5 – 278 | 50 / 80 | 46 – 188 | 46 / 68 | 4.1 – 190 | 50 / 69 |

organics reported for skin-on filets

In 1994, to demonstrate DDT contamination in the stormwater pathway coming off the Montrose Chemical plant site, USEPA Superfund Division collected biota samples in waterbodies downstream of the Montrose site in the Dominguez Channel watershed and into Consolidated Slip. Various tissue samples were obtained ranging from mosquito fish (in freshwater Torrance Lateral) to mussels, whole crabs and mallard eggs (in Dominguez Channel estuary) to whole topsmelt and black surfperch filets (in Consolidated Slip). Total DDT results for majority of these samples exceeded the OEHHA screening value (100 ppb wet wt.). No chlordane, dieldrin or PCB results were determined for these samples.

#### *2.4.4.4 Mussel Watch data—greater Los Angeles/Long Beach Harbor waters*

Both NOAA and SWRCB have monitoring programs of mussels in bay, harbor and coastal waters. Given the nature of this program which is to transplant mussels to specific sites on annual basis, these analytical results can be used for evaluating long term trends. State Mussel Watch (SMW) results for Consolidated Slip in 1982-2000 showed declining trends for chlordane, DDT, and PCBs. SMW chlordane results did not exceed the OEHHA value, and DDT results were often below the corresponding OEHHA value, whereas, PCB results were never below the OEHHA PCB value. SMW results for dieldrin and toxaphene were the basis for listing Consolidated Slip in 1996; dieldrin had one exceedence (1/20) above the OEHHA value, whereas toxaphene had more exceedences, (5/10) in ten years.

#### *2.4.4.5 CSTF database—Inner Harbor, Outer Harbor, Inner Cabrillo Beach, San Pedro Bay*

The CSTF database contains fish tissue results from BPTCP 1997 and Bight 1998. Composite results were presented for whole fish, mostly small forage species such as goby. No metal results were reported in the database. There were exceedances of Listing Policy tissue guidelines for DDT and PCBs: total DDT = 4 exceedance of 18 detections, and total PCBs = 7 exceedances of 18 detections. Chlordane, detected 13 times, showed no exceedances.

#### *2.4.4.6 Toxic Substances Monitoring Program—Dominguez Channel*

In 1992, Toxic Substances Monitoring Program (TSMP) collected one fish sample (white croaker) in Dominguez Channel. The 1998 and 2002 303(d) lists utilized this data to indicate the freshwater portion of Dominguez Channel as impaired due to high levels of organics in fish tissue. For the 2006 303(d) list, the State of California concluded that the conclusion of impairment within Dominguez Channel freshwater segment were inaccurate because the actual sampling site for the one fish was collected in the estuary. The 2006 303(d) list analysis stated the TSMP sampling report verifies that the white croaker was caught downstream of Vermont Ave., in the estuary segment of Dominguez Channel. Thus there is no impairment due to dieldrin within Dominguez Channel; no TMDL will be developed for this specific waterbody-pollutant combination. Table 2-17 is a summary of the TSMP data.

**Table 2-17. Fish tissue data (1992) from Dominguez Channel estuary (ppb, wet weight).**

| **Program** | **TSMP** | **SWRCB** | **SWRCB** |
|---|---|---|---|
| **Date** | **1992** | **Maximum Tissue Residue Level (MTRL)** | **Screening Value (µg/kg)** |
| **Species** | **White Croaker (n=1)** | | |
| Cd | n/d | -- | 3 |
| Hg | 0.09 | -- | 0.3 |
| Se | 0.68 | -- | 1* |
| Chlordane | 164 | 8.3 | 30 |
| Dieldrin | 5.3 | 0.7 | 2.0 |
| Total DDTs | 6487 | -- | 100 |
| Total PCBs | 1780 | 5.3 | 20 |

Note: MTRLs are not used for assessment purposes , but provided for perspective.
*Se value from USFWS for protecting birds

## 2.5 **Summary of data on pollutant basis**

### ***2.5.1 <u>Metals</u>***

Copper, lead and zinc were most commonly above numeric criteria for various waterbodies. Elevated levels of these three metals were observed in the freshwaters of Dominguez Channel, and Torrance Lateral. Dissolved copper occasionally exceeds in Inner and Fish Harbor. Elevated copper, lead and zinc levels in sediments were evident within Dominguez Channel estuary, Consolidated Slip, Inner Harbor, and Fish Harbor. Cadmium and chromium were elevated in sediments of Consolidated Slip or Dominguez Channel estuary but do not exceed in sediments elsewhere in the watershed or receiving waters. Mercury levels in fish tissue were not above Listing Policy screening values for any water body. Mercury sediment levels were high only in Consolidated Slip and Fish Harbor. Some water bodies appeared to show non-impairment for metals, Cabrillo Beach, Outer Harbor, Los Angeles River estuary and San Pedro Bay. Arsenic did not exceed water or sediment numeric criteria in any waters.

### *2.5.2 PAHs*

Individual PAH results exceeded numeric sediment guidelines most frequently in Dominguez Channel estuary, Consolidated Slip, Inner Harbor and Fish Harbor. A few sediment exceedences for benzo[a]pyrene were also observed in Cabrillo Marina and Los Angeles River Estuary. Measurements of PAH compounds in water were not reliable for assessment due to inadequate method detection limits in comparison to numeric criteria. Fish tissue results for PAHs were either non-existent or do not provide sufficient information to be utilized for assessment with screening values.

### *2.5.3 Organochlorines*

Chlordane sediment levels were observed above sediment guidelines in Dominguez Channel estuary, Consolidated Slip, Fish Harbor and Los Angeles River Estuary. The vast majority of fish tissue results of chlordane were below Listing Policy screening values in all waterbodies. Mussel results show declining trend for chlordane at two locations in receiving waters.

Dieldrin tissue and sediment results were elevated and isolated to Dominguez Channel estuary and Consolidated Slip. Toxaphene is elevated in tissue in Consolidated Slip only.

DDT and PCB fish results were elevated above Listing Policy screening values in nearly all receiving waters. This does not include Dominguez Channel freshwater; although DDT has been detected in stormwater samples collected in Torrance Lateral (SCCWRP 2002-03). The more recent (1999-2004) tissue results corroborated the previously established consumption advisory in these greater Los Angeles/Long Beach Harbor waters (OEHHA 1991; 2009). Sediment results for DDT and PCBs were elevated in transitional waters; e.g., Dominguez Channel estuary, Consolidated Slip and Los Angeles River Estuary.

### *2.5.4 Sediment Toxicity*

Water toxicity was repeatedly observed in Dominguez Channel freshwaters. Sediment toxicity was observed in Dominguez Channel estuary, Consolidated Slip, Inner and Outer Harbor, Fish Harbor, Los Angeles River estuary and San Pablo Bay. The Bight 03 and Ports' 2008 BioBaseline studies provided the most recent sediment toxicity results.

### *2.5.5 Benthic Community Effects*

The Dominguez Channel estuary, Consolidated Slip and Inner Harbor were previously listed for degraded benthic communities (infauna population and species composition). The recent survey of benthic infauna (Bight 2003; Ports' 2006 and 2008) provided results in more current conditions; whereas previous studies provided historical information (BPTCP 1992-97, Bight 1998). While certain areas in the Inner Harbor have shown dramatic improvement, most notably the Cabrillo and Pier 400 Shallow Water Habitat areas, the 2003-08 results did not change the overall assessment conclusion of impairment for three waterbodies mentioned above.

## 2.6 **Assessment Findings for each water body**

### ***2.6.1 Dominguez Channel freshwaters***

Dissolved copper, lead and zinc exceeded numeric hardness-specific CTR criteria during wet weather events. No exceedences for these three metals occurred during dry weather conditions. Results for other metals or organochlorine compounds did not exceed criteria or detection limits were too high for adequate assessment determinations. Water toxicity has been repeatedly observed in the freshwater at the mass emissions station during wet weather conditions, only one exceedence was observed during dry conditions. Whereas elevated diazinon levels had been observed concurrently with toxicity in 2002-2005 wet weather samples and therefore diazinon was presumed to be contributing to adverse toxicity results; post-2005 results show no diazinon concentrations above the freshwater guideline. Therefore, it is appropriate to develop freshwater metals and toxicity TMDLs for wet weather; however, the more recent toxicity results are not attributable to diazinon and therefore no diazinon TMDLs have been developed for Dominguez Channel.

### ***2.6.2 Torrance Lateral***

Torrance Lateral contains freshwater and is currently included on the State's 2008/2010 CWA 303(d) list as impaired due to copper and lead. Sediment results for copper and lead were above the State listing policy sediment quality values for these heavy metals (POLA/AMEC 2002). Recently Los Angeles County DPW completed water column monitoring within Torrance Lateral as part of the Dominguez Channel tributary study (LAC DPW, 2009; 2010). Available water column results reveal exceedences of dissolved copper (8 of 10) and zinc (9 of 10) CTR criteria during wet weather conditions. Dissolved lead was below the criteria in wet weather conditions and no dry weather exceedences occurred for any of these three metals. Based on this information, we conclude water column impairments for copper and zinc.

### ***2.6.3 Dominguez Channel estuary***

Sediment toxicity has been observed in 4 of 7 results, including 3 of 6 highly toxic results in Bight 03. In recent sediment triad studies, bulk levels of Cd, Cu, Pb and Zn were above sediment guidelines (Bight 03). Historical sediment results showed elevated levels of these metals, also. PAH sediment data showed levels of five individual compounds were above guidelines and maybe contributing to sediment toxicity. Elevated DDT and PCBs occurred in fish tissue and some sediment samples. Chlordane was elevated in recent sediment samples and historical fish tissue results. Dieldrin was not measured in sediments and was observed at slightly elevated levels in the individual fish sample reported in 1992. Degraded benthic community effects were observed in BPTCP 96 & 97 and confirmed in Bight 03 (3 of 5 in poor condition).

### ***2.6.4 Los Angeles Harbor - Consolidated Slip***

Water results showed elevated levels of DDT and PCBs (SCCWRP, 2006). Sediment toxicity has been observed in 12 of 13 historical samples, including one highly toxic result in Bight 03. In recent sediment triad studies, bulk levels of Hg, Pb and Zn were above sediment guidelines (Bight 03). Historical sediment results showed elevated levels of these metals and Cd, Cr, Cu, also. PAH sediment data showed that levels of six individual compounds were above guidelines and may be contributing to sediment toxicity. Chlordane and dieldrin have not been measured in recent sediment samples. Tissue results were mixed. Elevated DDT and PCBs occurred in fish tissue and nearly all sediment samples. Toxaphene was originally listed due to elevated levels in mussels and remains impaired until new data shows significant decreases. Benthic community effects were observed in BPTCP 96 & 97 and moderate degradation observed in the Bight 03 results.

### *2.6.5 Los Angeles and Long Beach Inner Harbor*

A fish consumption advisory for certain DDT and PCBs in certain fish species is currently in place and is corroborated by recent fish tissue results (OEHHA 2009).

Sediment toxicity has been observed in 10 of 23 samples, including 3 of 8 toxicity samples in Bight 03. Historical sediment data (pre- 1996) showed elevated levels of metals, PAHs and PCBs. In sediment triad studies, individual PAH levels were above PAH sediment guidelines (BPTCP 96 & 97, Bight 98). PAH sediment data showed sufficient exceedences of benzo[a]pyrene and chrysene (8/80) as to be impaired. There are fewer exceedences of benzo[a]anthracene, pyrene and phenanthrene (2/72) so these PAH compounds appear to not contributing to sediment toxicity. PCB sediment results from two older studies were also above sediment guidelines (BPTCP 96 & 97, Bight 98). More recent triad studies did not show such elevated (nor threatening) levels of PCBs; however, Pb and Zn were above guidelines (Bight 03). There are some reliable measurements of metals in water and only copper exceedences were evident (POLA 2005-06, Ports 2006). DDT and PCBs in water column have been detected via solid phase microextraction (SPME) devices; DDE results showed exceedences of CTR human health criteria (Zeng, et al. 2005). Benthic community effects were observed in BPTCP 96 & 97, Bight 98 & 03 and a few in Biobaseline 08.

### *2.6.6 Outer Harbor*

A fish consumption advisory for DDT and PCBs in certain fish species is currently in place and is corroborated by recent fish tissue results (OEHHA 2009). Additional support is provided by 2004 -06 fish tissue results (TIWRP). Sediment toxicity has been observed in 7 of 26 samples, including 3 of 7 moderately toxic samples in Bight 03. No individual contaminants were above sediment guidelines in more recent studies (Bight 98, WEMAP 99, Bight 03). Individual PAH levels were above pollutant sediment guidelines only in historical results; e.g., BPTCP 1997 and earlier. Trend analyses of NOAA mussel data for PAHs were inconclusive. There are a few reliable measurements of metals, PAHs, DDT and PCBs in the water column. DDE measured in water column showed 2 of 4 exceedences of CTR criteria (Zeng, et al. 2005). Benthic community effects were observed in Bight 98 & 03 and a few in Biobaseline 08.

### *2.6.7 Los Angeles Fish Harbor*

A fish consumption advisory for DDT and PCBs in certain fish species is currently in place and is corroborated by recent fish tissue results (OEHHA 2009). Sediment toxicity has been observed in 2 of 4 results, including 1 of 1 moderate toxicity result in Bight 03. In recent sediment triad studies, bulk levels of Cu, Pb and Zn were above sediment guidelines (Bight 03). Historical sediment results showed elevated levels of chlordane, mercury, and six individual PAH compounds. There are a few reliable measurements of aqueous metals or organics in this waterbody.

#### ***2.6.8 Cabrillo Marina***

A fish consumption advisory for DDT and PCBs in certain fish species is currently in place and is corroborated by recent fish tissue results (OEHHA 2009). Only one sediment toxicity result (Bight 03) exists and showed moderate to high toxicity, with corresponding and repeatedly elevated results for benzo[a]pyrene (5 of 26 exceedences of sediment quality guideline). Historical sediment results showed elevated levels of chlordane and chrysene in comparison to sediment guidelines, yet these do not correspond with sediment toxicity results, so impairment is not associated with these two compounds. Sediment results did not show elevated levels of metals or other organic compounds. There are a few reliable measurements of aqueous metals or organics exist in this waterbody; no exceedences have been recorded.

#### ***2.6.9 Cabrillo Beach - Inner***

A fish consumption advisory for DDT and PCBs in certain fish species is currently in place and is corroborated by recent fish tissue results (OEHHA 2009). Only historical sediment toxicity results exist for this segment; however no corresponding elevated levels of individual PAHs, total PAHs or organochlorine compounds were associated with the one toxic result. Sediment metal results are not elevated values relative to sediment quality guidelines, except for copper (2 of 16 in BPTCP 1994). More recent sediment results do not show any exceedences for any metal or organic compounds (PORTs 2006). There are a few reliable measurements of aqueous metals or organics exist in this waterbody; no exceedences have been recorded, including copper 0 of 4 dissolved (POLA 2005-06). Based on available data in this pre-TMDL assessment, this waterbody is not impaired for copper, although it is on 2006 303(d) list.

#### ***2.6.10 Los Angeles River Estuary***

A fish consumption advisory for DDT and PCBs in certain fish species is currently in place and extends into the estuary based on recent fish results collected at Pier J/Fingers Pier, both near the estuary mouth (OEHHA 2009). Sediment toxicity has been observed in 4 of 7 results, including 2 of 5 moderate toxicity results in Bight 03. Historical sediment results showed elevated levels of chlordane. In recent sediment triad studies, bulk levels of chlordane, PCBs, and benzo[a]pyrene were above sediment guidelines (Bight 03). A few reliable measurements of aqueous metals or organics exist in this waterbody; no exceedences have been recorded. Based on available data in this pre-TMDL assessment, this waterbody is not impaired for lead and zinc.

#### ***2.6.11 San Pedro Bay***

A fish consumption advisory for DDT and PCBs in certain fish species is currently in place and is corroborated by recent fish tissue results (OEHHA 2009). Chlordane in fish tissue did not appear to be elevated above OEHHA screening values. Sediment toxicity has been observed in 4 of 18 results, including 1 of 2 moderate toxicity results in Bight 03. Elevated levels of chlordane have been repeatedly occurring (6 of 19) and are associated with sediment toxicity. Other sediment results do not show exceedences for metals nor PCBs, nor other organics. A few reliable measurements of aqueous metals or organics exist in this waterbody (Ports 2006, SCCWRP 2006). Based on available data, this waterbody is not impaired for chromium, copper, zinc, and total PAHs and these listings have been removed from the 2008/2010 303(d) list.

## 2.7 **Assessment changes**

### ***2.7.1 New findings of impairment***

In the course of this assessment, some waterbodies were identified as impaired due to pollutants not identified on previous 303d lists. Please note that previous "PAHs" listings have been clarified, where feasible, for individual PAH compounds; these may be construed as new listings.

- Dominguez Channel for water toxicity.
- Dominguez Channel Estuary for cadmium and copper.
- Torrance Lateral for zinc.

### ***2.7.2 Assessment findings of non-impairment***

This assessment has identified some water body-pollutant combinations as non-impaired. Even though this combination is on the 2010 303(d) list, based on review of available data, the pollutant levels are not elevated relative to water quality benchmarks, therefore, the assessment conclusion yields the water body is attaining standards for this particular pollutant.

- Dominguez Channel for Diazinon

## 2.8 **Conclusions**

Based on review of available data, including information with 2008-2010 303(d) list factsheets and more recent monitoring information, the water-quality limited segments are identified in Table 2-18 below. Each waterbody-pollutant combination will require TMDL development.

Using available sediment triad results (Bight 98, 03; WEMAP 99,05; BioBaseline 2008), we performed an assessment for each saline waterbody using SQO Part I-Direct Effects methodology. An exceedence of SQO Part I was considered for Possibly Impacted, Likely Impacted or Clearly Impacted at each station. Following the CA 303(d) Listing Policy procedures, including those outlined in Table 3-1 of that document, two or more exceedences per waterbody was interpreted as impaired. These assessment results confirmed impairment within the estuaries and and greater LA/LB Harbor waters identified in Table 2-18. See Appendix III.9 for sediment triad results compiled per waterbody.

**Table 2-18. Assessment Findings for each water body**

| Waterbody | Metals | PAHs | PCBs, DDT, etc | Toxicity | Benthic Community | SQO Impaired |
|---|---|---|---|---|---|---|
| Dominguez Channel fresh | Cu, Pb, Zn | | | **Water (diazinon)** | | |
| Torrance Lateral | Cu, Pb, **Zn** | | | | | |
| Dominguez Channel estuary | **Cd**, Cu, Pb, Zn | Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, Pyrene, Phenanthrene | DDT, PCBs, Chlordane, Dieldrin | sediment | X | X |
| Consolidated Slip | Cd, Cr, **Cu**, Hg, Pb, Zn | Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, Pyrene, Phenanthrene, 2-methylnapthalene | DDT, PCBs, Chlordane, Dieldrin, Toxaphene | sediment | X | X |
| Inner Harbor | Cu, Zn | Benzo[a]pyrene, Chrysene | DDT, PCBs | sediment | X | X |
| Outer Harbor | | | DDT, PCBs | sediment | | X |
| Fish Harbor | Cu, Pb, Zn, Hg | Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, Pyrene, Phenanthrene, Dibenzoanthracene | DDT, PCBs, Chlordane | sediment | | X |
| Cabrillo Marina | | Benzo[a]pyrene, | DDT, PCBs, | | | X |
| Inner Cabrillo Beach | | | DDT, PCBs | | | |
| LA River Estuary | | | DDT, PCBs, Chlordane | sediment | | X |
| San Pedro Bay | | | DDT, PCBs, Chlordane | sediment | | X |

**Bold** indicates impairment although not included on 2008/2010 303(d) list
No impairment due to diazinon in freshwaters of Dominguez Channel

# 3 Numeric Targets

Numeric targets were developed for all toxic pollutants identified in Section 2, above. Metal, chlordane and individual PAH compound target values are provided for water and sediment (Tables 3-1 and 3-7). DDT and PCBs and toxaphene targets are provided for water and sediment (Tables 3-1 and 3-7) as well as for fish tissue and tissue residues (Table 3-8 and 3-9). Also, ambient water toxicity and sediment toxicity targets are included since TMDLs will be developed for these impairments, which may not be alleviated by attainment of water quality standards for metals, PAHs, or organochlorine compounds. Both freshwater and saltwater targets are provided in this section.

## 3.1 **Water**

Numeric water targets are established in this TMDL for metals, organics and toxicity. Water targets are guided by the Basin Plan and the California Toxics Rule (CTR).

### ***3.1.1 Water: Metals and Organics***

Numeric water targets for metals and organics, consistent with CTR water quality criteria for protecting aquatic life, are established in Table 3-1. All metal water targets are for dissolved forms of the metals and are hardness dependent, except mercury which is for total mercury and is not hardness dependent.

The human health target was determined using the "organism only" values from the CTR versus the "organism and water" values because the waters of the Harbors are not drinking waters.

**Table 3-1. Water quality criteria established in CTR for metals and organics.**

| Pollutant | Criteria for the Protection of Aquatic Life | | | | Human Health |
|---|---|---|---|---|---|
| | Freshwater | | Saltwater | | Organism only |
| | Acute (µg/L) | Chronic (µg/L) | Acute (µg/L) | Chronic (µg/L) | (ug/L) |
| Copper | 6.99* | 4.95* | 4.8 | 3.1 | n/a |
| Lead | 30.14* | 1.17* | 210 | 8.1 | n/a |
| Zinc | 65.13* | 65.66* | 90 | 81 | n/a |
| Mercury | n/a | n/a | n/a | n/a | 0.051 |
| Chlordane | 2.4 | 0.0043 | 0.09 | 0.004 | 0.00059 |
| Dieldrin | 0.24 | 0.056 | 0.71 | 0.0019 | 0.00014 |
| 4,4'-DDT | 1.1 | 0.001 | 0.13 | 0.001 | 0.00059 |
| Total PCBs | n/a | 0.014 | n/a | 0.03 | 0.00017 |
| Benzo[a]pyrene | n/a | n/a | n/a | n/a | 0.049** |

* Freshwater aquatic life criteria for Cd, Cu, Pb, Zn are expressed as a function of total hardness (mg/L) in the water body. Values presented correspond to average hardness from/to 2002-2010 of 50 mg/L (n=35).

** CTR criteria for individual PAH of benzo(a)anthracene, benzo(a)pyrene, and chrysene equals 0.049 µg/L. CTR criteria for pyrene is 11,000 ug/L.

n/a = no criteria available in CTR

### ***3.1.2 Water: Total metals***

Wet weather monitoring results were evaluated for the potential use of site-specific wet-weather factors to converting the acute CTR criteria from dissolved metals concentrations to total recoverable concentrations. LAC DPW stormwater data collected at Vermont Ave (MES site# S28, 2002 to 2010), included hardness, TSS, dissolved and total metals.

Staff used EPA Guidance *The Metals Translator: Guidance For Calculating A Total Recoverable Permit Limit From A Dissolved Criterion* (USEPA, 1996) on developing metal translators, to evaluate the potential for site-specific wet weather conversion factors for copper, lead and zinc. CTR identifies default translators which were compared to the USEPA guidance on three options for deriving a site-specific translator:

- Direct Measurement - Assuming no Relationship to Total Suspended Solids (TSS), uses descriptive statistics and may be developed directly as the ratio of dissolved to total recoverable metal;
- Direct Measurement - Based upon Relationship to TSS, uses regression equations to evaluate correlations and yield $r^2$ values, which indicate the strength of the relationship with TSS and fraction of particulate metals;
- Partition coefficient – Based on relationship to TSS and is functionally related to the number of metal binding sites on the particulate surfaces in the water column (i.e., concentrations of TSS, TOC, or humic substances), and $r^2$ values also indicate the strength of the relationships and the conversion factor (fraction of particulate metals).

Option 1 (“percentile method”) was selected as viable for estimating site-specific wet weather hardness specific conversion factors for each metal (Table 3-2). For translation of acute metals criteria, the 90% value was determined, which is consistent with the State’s Implementation Policy (SIP) for CTR (SWRCB, 2005). Analysis via Options 2 and 3 revealed a very poor correlation of particulate metals fractions with TSS ($r^2$ values ranged from 0.345 - 0.378). Without any reliable relationship with TSS, translators derived from Options 2 and 3 were disregarded.

**Table 3-2. Freshwater wet weather dissolved/total metals targets (ug/L) – using different translators**

| Metal | Diss. CTR Criteria* | CTR default translator | Total metals w/ CTR | Site specific Conv. Factor* | Total metals w/ Site Sp. Conv. Factor |
|---|---|---|---|---|---|
| Copper | 6.99 | 0.96 | 7.3 | 0.722 | 9.7 |
| Lead | 30.14 | 0.895 | 33.8 | 0.706 | 42.7 |
| Zinc | 65.13 | 0.978 | 66.6 | 0.935 | 69.7 |

*LAC DPW results at S28, data record 2002-2010, median hardness – 50 mg/L; sample size = 35

### *3.1.3 Water: Toxicity*

The Basin Plan includes a narrative toxicity objective which states, in part: “All Waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in, human, plant, animal, or aquatic life.” This objective does not allow acute toxicity in any receiving waters or chronic toxicity outside designated mixing zones.

A numeric toxicity target of 1 chronic toxicity unit (1 TUc) is established for this TMDL to allow evaluation of the narrative toxicity objective. The 1 TUc target maybe replaced by an equivalent toxicity target based upon any Statewide Toxicity Policy. A chronic toxicity target was selected because it addresses the potential adverse effects of long term exposure to lower concentrations of a pollutant and is therefore more protective than an acute toxicity target that may not address potential effects of longer term exposures. Equation 1 describes the calculation of a TUc.

**Equation 1** $TU_c$ = Toxicity Unit Chronic = 100/NOEC (no observable effects concentration).

Or: TUc = 100% ÷ the sample concentration, derived using hypothesis testing, to cause no observable effect, with the sample concentration expressed as a percentage.

The numeric toxicity target is set at no observable toxicity with water samples defined as toxic by toxicity testing if the following two criteria are met: 1) there is a significant difference ($p<0.05$) in mean organism response (e.g., percent survival) between a sample and the control as determined using a separate-variance t-test, and 2) the mean organism response in the toxicity test (expressed as a percent of the laboratory control) was less than the threshold based on the 90th percentile Minimum Significant Difference (MSD) value expressed as a percent of the control value.

The 90$^{th}$ percentile MSD value is specific for each specific toxicity test protocol and is determined by identifying the magnitude of difference that can be detected 90% of the time by a specific test method. The following is a description of MSDs and how a toxic effect would be identified (SWRCB, 1996): "In toxicity tests, the MSD represents the smallest difference between the control mean and a treatment mean (the effect size) that leads to the statistical rejection of the null hypothesis ($H^o$: no difference). Any effect size equal to or larger than the MSD would result in a finding of statistically significant difference. For example, if the control mean for mysid growth were 80 ug/mysid and the MSD were 20, any treatment with mean mysid weight less than or equal to 60 ug would be significantly different from the control and considered toxic."

## 3.2 **Sediment**

Numeric sediment targets are established in this TMDL for metals, PAHs, and some priority organic compounds. Sediment targets are guided by the Basin Plan and the State Board Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (SQO Part 1) which include descriptive narrative goals and methods for integrating sediment triad results. The numeric sediment quality guidelines of Long and MacDonald (Long et al., 1995; MacDonald et al., 2000) are recommended by the State Listing Policy. In this section, the Sediment Quality Plan is discussed first, as it guides sediment conditions for restoration and protection of benthic infauna (or sediment dwelling organisms) Consistent with SQO Part I, the sediment quality condition for direct effects is based on interpreting multiple lines of evidence using sediment triad results. Later, Section 3.3 presents sediment targets related to fish tissue values using an indirect effects approach.

### ***3.2.1 Sediment: Applicability of the State Board Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality***

California recently adopted the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (SQO Part 1) which applies to sediments within enclosed bays and estuaries. EPA approved the Sediment Quality Plan on September 25, 2009. Part 1 of the Sediment Quality Plan establishes a method to assess sediment quality which integrates chemical and biological measures to determine if the aquatic life within ambient sediment are protected or degraded by exposure to toxic pollutants in sediment. The Sediment Quality Plan establishes sediment quality objectives (SQO) based on three lines of evidence including sediment chemistry, sediment toxicity and benthic community condition. These three lines of evidence are referred to as the sediment triad.

The Sediment Quality Plan-Part 1 describes a method of using the three lines of evidence to categorize a sediment as “Unimpacted,” “Likely unimpacted,” “Inconclusive,” “Possibly impacted,” Likely impacted,” or “Clearly impacted.” The categories -“Unimpacted,” and “Likely unimpacted” - are considered as achieving the protective condition for aquatic life in ambient sediment; these categories integrate three lines of evidence to define the TMDL targets for impaired sediments. Possibly Impacted, Likely Impacted and Clearly Impacted indicate impaired conditions; while Inconclusive is not impaired. T hese target conditions - “Unimpacted,” and “Likely unimpacted” are the goal conditions, however TMDLs and allocations need to be numeric according to federal regulations. Both the narrative and numeric target are described in more detail below.

The SQOs for the protection of aquatic life and human health are described below:

a. Aquatic Life – Benthic Community Protection

   Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries of California. This narrative objective shall be implemented using the integration of multiple lines of evidence. The assessment of sediment quality consists of the measurement and integration of three lines of evidence (LOE). The LOE are:

- Sediment Toxicity: Sediment toxicity is a measure of the response of invertebrates exposed to surficial sediments under controlled laboratory conditions. The sediment toxicity LOE is used to assess both pollutant related biological effects and exposure. Sediment toxicity tests are of short durations and may not duplicate exposure conditions in natural systems. This LOE provides a measure of exposure to all pollutants present, including non-traditional or unmeasured chemicals.
- Benthic Community Condition: Benthic community condition is a measure of the species composition, abundance and diversity of the sediment-dwelling invertebrates inhabiting surficial sediments. The benthic community LOE is used to assess impacts to the primary receptors targeted for protection of aquatic life. Benthic community composition is a measure of the biological effects of both natural and anthropogenic stressors.
- Sediment Chemistry: Sediment chemistry is the measurement of the concentration of chemicals of concern in surficial sediments. The chemistry LOE is used to assess the potential risk to benthic organisms from toxic pollutants in surficial sediments. The sediment chemistry LOE is intended only to evaluate overall exposure risk from chemical pollutants. This LOE does not establish causality associated with specific chemicals.

b. Human Health

> Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health. The narrative human health objective shall be implemented on a case-by-case basis, based upon a human health risk assessment. In conducting a risk assessment, the Water Boards shall consider any applicable and relevant information, including California Environmental Protection Agency's (Cal/EPA), Office of Environmental Health Hazard Assessment (OEHHA) policies for fish consumption and risk assessment, Cal/EPA's Department of Toxic Substances Control (DTSC) Risk Assessment, and USEPA Human Health Risk Assessment policies.

Each line of evidence produces specific information that, when integrated with the other lines of evidence provides a more confident assessment of sediment quality relative to sediment chemistry alone. When the exposure (chemistry) and effects (toxicity and benthic community assessment) are integrated, the approach can quantify protection through effects measures and also provide predictive capability through the exposure measure.

### *3.2.2 Benthic community effects*

This TMDL establishes benthic community targets based on the Sediment Quality Plan. Benthic community condition is a measure of the species composition, abundance and diversity of the sediment-dwelling invertebrates inhabiting surficial sediments. The narrative SQOs in the Sediment Quality Plan are designed to protect the biological organisms within marine sediments and provide a direct measure of impact to these communities.

The Sediment Quality Plan identifies methods to evaluate a waterbody's benthic community condition and its alteration from reference conditions. Four different benthic indices are provided in the Sediment Quality Plan each using the same benthic community data: the Benthic Response Index (BRI); the Index of Biological Integrity as adapted for California bays and estuaries (IBI); the Relative Benthic Index (RBI); and the River Invertebrate Prediction and Classification System (RIVPACS) which was adapted for use in California bays and estuaries.

Categorical thresholds for each of the four biological indices (BRI, IBI, RBI, RIVPACS) were developed based in comparison to reference condition and categorized into four levels of biological disturbance:

> Reference: Equivalent to least affected or unaffected site
> Low Disturbance: Some indication of stress is present, but within measurement error of unaffected condition
> Moderate Disturbance: clear evidence of stress
> High Disturbance: high magnitude of stress

The combination of the four benthic indices provides more information than any single index (Ranasinghe, et al., 2007). These benthic-response categories are integrated by taking the median value, rounding up when the median falls midway between two benthic-response categories.

Because the SQOs were developed in part based on a local reference condition specific to Southern California marine bays, benthic assessments can rely on these published indices in a weight of evidence approach. The target for benthic community effects are either reference or low disturbance condition for any of the four biological indices included in the SQOs (Table 3-3, shaded boxes).

**Table 3-3. Benthic Index Categorization Values (Recreated from Sediment Quality Plan Part 1 Table 5)**

| Index | 1. Reference | 2. Low Disturbance | 3. Moderate Disturbance | 4. High Disturbance |
|---|---|---|---|---|
| **Southern California Marine Bays** | | | | |
| **BRI** | **<39.96** | **39.96 to 49.14** | **49.15 to 73.26** | **>73.26** |
| **IBI** | **0** | **1** | **2** | **3 or 4** |
| **RBI** | **>0.27** | **0.17 to 0.27** | **0.09 to 0.16** | **<0.09** |
| **RIVPACS** | **>0.90 to <1.10** | **0.75 to 0.90 or 1.10 to 1.25** | **0.33 to 0.74 or >1.25** | **<0.33** |

### *3.2.3 Sediment toxicity*

This TMDL establishes sediment toxicity targets based on the Sediment Quality Plan. Sediment toxicity is a measure of the response of invertebrates exposed to surficial sediments under controlled laboratory conditions. This provides a measure of exposure to all pollutants present in the sediment, including non-traditional or unmeasured chemicals.

Application of SQOs per the Sediment Quality Plan requires a minimum of two sediment toxicity tests—at least one short-term survival test and at least one sub-lethal test.

For the short-term survival tests, the acceptable species are all amphipods species (*Eohaustorius estuarius, Leptocheirus plumulosus, and Rhepoxynius abronius*). For these species, toxicity is defined by tests that are statistically significant (from reference sediment sample) and exhibit more than 10% mortality. Thus the target conditions for short-term survival tests are less than or equal to 10% toxicity in comparison to a reference sediment sample. The thresholds established in the Sediment Quality Plan are based on statistical significance and magnitude of the toxic effect. Acceptable test organisms and methods are summarized in Table 3-4.

**Table 3-4. Acceptable Short Term Survival Sediment Toxicity Test Methods.**

| Test Organism | Exposure Type | Duration | Endpoint |
|---|---|---|---|
| *Eohaustorius estuarius* | Whole Sediment | 10 days | Survival |
| *Leptocheirus plumulosus* | Whole Sediment | 10 days | Survival |
| *Rhepoxynius abronius* | Whole Sediment | 10 days | Survival |

The sub-lethal sediment toxicity tests, growth or development tests are required by the SQOs. For the acute sub-lethal tests, the selection of test organisms is constrained to two organisms—Neanthes for juvenile growth or Mytillus embryo for reproductive development. The target conditions for sub-lethal sediment toxicity tests are less than or equal to 10% toxicity for juvenile growth and 20% for reproductive development in comparison to a reference sediment sample. Acceptable test organisms and methods are summarized in Table 3-5.

**Table 3-5. Acceptable Sublethal Sediment Toxicity Test Methods.**

| Test Organism | Exposure Type | Duration | Endpoint |
|---|---|---|---|
| *Neanthes arenaceodentata* | Whole Sediment | 28 days | Growth |
| *Mytilus gallopprovincialis* | Sediment-water Interface | 48 hours | Embryo Development |

Because the SQOs require both toxicity tests, the desired condition for a waterbody is a non-toxic category from each type of toxicity test as shaded in Table 3-6, Disturbance Category 1.

**Table 3-6. Sediment toxicity categorization values (Sediment Quality Plan Part 1. Table 4).**

| Test Species/ Endpoint | Statistical Significance | Score (Disturbance Category) | | | |
|---|---|---|---|---|---|
| | | 1 Nontoxic (Percent) | 2 Low Toxicity (Percent of Control) | 3 Moderate toxicity (Percent of Control) | 4 High Toxicity (Percent of Control) |
| Eohaustorius Survival | Significant | 90 to 100 | 82 to 89 | 59 to 81 | <59 |
| Eohaustorius Survival | Not Significant | 82 to 100 | 59 to 81 | | <59 |
| Leptocheirus Survival | Significant | 90 to 100 | 78 to 89 | 56 to 77 | <56 |
| Leptocheirus Survival | Not Significant | 78 to 100 | 56 to 77 | | <56 |
| Rhepoxynius Survival | Significant | 90 to 100 | 83 to 89 | 70 to 82 | <70 |
| Rhepoxynius Survival | Not Significant | 83 to 100 | 70 to 82 | | <70 |
| Neanthes Growth | Significant | 90 to 100* | 68 to 90 | 46 to 67 | <46 |
| Neanthes Growth | Not Significant | 68 to 100 | 46 to 67 | | <46 |
| *Mytilus* Normal | Significant | 80 to 100 | 77 to 79 | 42 to 76 | <42 |
| *Mytilus* Normal | Not Significant | 77 to 79 | 42 to 76 | | <42 |

*Expressed as a percentage of the control

### *3.2.4 Sediment Chemistry: Metals and organics*

Sediment targets are the desired surface sediment concentrations for specific toxic pollutants to protect human health, aquatic organisms and wildlife as well as to restore all beneficial uses. Sediment targets represent longer term goals than water quality targets.

This TMDL establishes numeric targets that are protective of aquatic life beneficial uses for organochlorine pesticides, PCBs, PAHs, and metals in sediments. While chlordane, dieldrin, toxaphene, DDT, and PCB impairments have been documented in fish tissue only, sediment targets are necessary as these fish tissue contaminants are directly associated with sediments which are the transport mechanism of these compounds to the fish.

The Sediment Quality Objectives (SQOs) established by the Sediment Quality Plan provide objectives based on multiple lines of evidence that can be applied to sediments but does not provide individual numeric targets for sediment chemistry. To develop a TMDL, it is necessary to translate the narrative objectives in the Basin Plan and the lines of evidences in the SQOs into numeric targets that identify the measurable endpoint or goal of the TMDL and represent attainment of applicable numeric and narrative sediment and water quality standards.

The sediment quality guidelines of Long and MacDonald (Long et al., 1995; MacDonald et al., 2000) provide applicable numeric sediment targets because the impairments and the 303(d) listings for PAHs, metals, toxicity and benthic community effects - are primarily based on sediment quality data for the Dominguez Channel estuary, Consolidated Slip, Fish Harbor, Inner and Outer Harbor, Cabrillo Beach-Inner, San Pedro Bay, and Los Angeles River Estuary. In addition, the pollutants being addressed have a high affinity for particles and the delivery of these pollutants is generally associated with the transport of suspended solids from the watershed or from sediments via porewater diffusion within the estuaries and greater Los Angeles/Long Beach Harbor waters.

The sediment quality guidelines of Effect Range Low (Long et al., 1995) and Threshold Effects Concentrations (MacDonald et al., 2000) are used to establish the numeric targets for freshwater sediment for Dominguez Channel, and marine sediment for the greater Los Angeles/Long Beach Harbor waters, as shown in Table 3-7. The State Board listing policy recommends the use of the Effect Range Medians (ERMs), Probable Effect Levels (PELs), and other sediment quality guidelines as a threshold for 303d listing decisions. ERM and PEL values are interpreted as levels above which the adverse biological effects are expected, which make them applicable in the determination of impairment. The Threshold Effects Concentration (TEC) for freshwater sediment and Effect Range Low (ERL) for marine sediment values, on the other hand, represent the levels below which adverse biological effects are not expected to occur, and are more applicable to the prevention of impairment. The goal of the TMDL is to remove impairment and to restore beneficial uses; therefore, the TEC for freshwater sediment and ERLs for marine sediment are selected as numeric targets over the ERMs and PELs to limit adverse effects to aquatic life.

Sediment targets must also be established at levels which will be protective of fish tissue contaminant levels. The organic pollutants addressed by this TMDL (e.g. Chlordane, Dieldrin, Toxaphene, DDT, and PCBs) have the potential to bioaccumulate. To account for bioaccumulation, these TMDLs will rely on the simplified assumption that reduced sediment pollutants will correspond to reduced fish tissue levels. This is reasonable based on the observation that white croaker is a bottom feeding fish and DDT and PCB levels in this fish species are contributing to the fish advisory throughout the greater Los Angeles/Long Beach Harbor waters. The Chlordane, Dieldrin, Toxaphene, DDT and PCBs sediment targets presented in section 3.2.1 may need to be revised in the future to attain the fish tissue targets. Assessment of indirect impacts of sediment contamination via bioaccumulation is currently under development by State Board and SCCWRP, as part of the State's Sediment Quality Plan –Part II. Scientific information from such studies, based on local fish species and biogeochemistry specific to Southern California will be helpful in evaluating possible revision of sediment quality targets.

**Table 3-7. Targets for sediment chemistry in fresh and saline waters (conc. in dry wt.)**

| Metals | Freshwater Sediment (mg/kg) | Marine Sediment (mg/kg) |
|---|---|---|
| Cadmium | n/a | 1.2 |
| Chromium | n/a | 81 |
| Copper | 31.6 | 34 |
| Lead | 35.8 | 46.7 |
| Mercury | n/a | 0.15 |
| Zinc | 121 | 150 |
| **Organics** | **Marine Sediment (ug/kg)** | |
| Chlordane, total | 0.5 | |
| Dieldrin | 0.02 | |
| Toxaphene | 0.10* | |
| Total PCBs | 22.7 | |
| Benzo[a]anthracene | 261 | |
| Benzo[a]pyrene | 430 | |
| Chrysene | 384 | |
| Pyrene | 665 | |
| 2-methylnaphthalene | 201 | |
| Dibenz[a,h]anthracene | 260 | |
| Phenanthrene | 240 | |
| Hi MW PAHs | 1700 | |
| Lo MW PAHs | 552 | |
| Total PAHs | 4,022 | |
| Total DDT | 1.58 | |

n/a = not applicable since target not needed for this pollutant in freshwater sediment
*Toxaphene value from New York DEP (1999), assumes 1% TOC

Sediment targets, defined in Table 3-7 or 3-8, are not intended to be used as ~~necessarily~~ 'clean-up standards' for navigational, capital or maintenance dredging or capping activities; rather they are long-term sediment concentrations that should be attained after reduction of external loads, targeted actions addressing internal reservoirs of contaminants, and environmental decay of contaminants in sediment.

## 3.3 Fish Tissue for the protection of Human Health

Fish tissue targets for DDT and PCBs are selected from "Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene", which are recently developed by OEHHA in June 2008 to assist other agencies to develop fish tissue-based criteria with a goal toward pollution mitigation or elimination and to protect humans from consumption of contaminated fish or other aquatic organisms (OEHHA 2008). Use of fish tissue targets is appropriate to account for uncertainty in the relationship between pollutant loadings and beneficial use effects (USEPA, 2002) and directly addresses potential human health impacts from consumption of contaminated fish or other aquatic organisms. Use of fish tissue targets also allows the TMDL analysis to more completely use site-specific data where limited water column data are available, consistent with the provisions of 40 CFR 130.7(c)(1)(i). Thus, use of Fish Contaminant Goals (FCGs) provides an effective method for accurately quantifying achievement of the water quality objectives/standards (Table 3-8). Associated sediment targets are not provided for Dieldrin and PAHs because the relationship between sediment and fish tissue is not sufficiently well established to determine an associated sediment target.

**Table 3-8. Targets for bioaccumulatives in fish tissue.**

| Pollutant | Fish Tissue target (ug/kg wet) | Associated sediment target (ug/kg dry) |
|---|---|---|
| Chlordane | **5.6** | **1.3** [b] |
| Dieldrin | **0.46** | **n/a** |
| Total DDT | **21** | **1.9** [b] |
| Total PCBs | **3.6** | **3.2** [c] |
| PAHs – total | **5.47**[a] | **n/a** |
| Toxaphene | **6.1** | **0.1** [d] |

[a] PAHs –total in fish is EPA screening value (EPA 2000c)
[b] Chlordane and total DDT associated sediment values from Newport Bay Indirect Effects draft report (SFEI, 2007)
[c] PCBs-total associated sediment target from SF Bay bioaccumulation study (Gobas & Arnot, 2010)
[d] Toxaphene value from New York DEP (1999), assumes 1%TOC
n/a indicates that a target is not established in this TMDL for this constituent.

### 3.4 Tissue residues for the protection of Wildlife

Tissue residue goals are identified for protection of wildlife habitat (WILD) and preservation of rare and endangered species (RARE) can also be achieved through tissue/residue levels for DDT and PCBs (Table 3-9). Reducing pollutant loads to attain human health targets will yield progress toward restoring all beneficial uses, yet additional wildlife specific goals must be considered to address possible impairments to reproductive success (birds) or immune system suppression (seals).

**Table 3-9. Goals for DDT and PCBs in tissue residues for protecting wildlife habitat and rare and endangered species.**

| Pollutant | Birds | Harbor Seals |
|---|---|---|
| Total DDT | n/a | 0.3 ug/g lipid* |
| Total PCBs | 2.2 ug/g in eggs** | 5.2 ug/g lipid* |

*Barron et al (2003; citations therein) no-effect level for total DDT and total PCBs in harbor seals from Europe.
**Muir et al (1999) no-effect level for total PCBs in Forster's Tern eggs.

## 4 SOURCE ASSESSMENT

This section identifies the potential sources of OC Pesticides, PCBs, sediment toxicity, PAHs and metals compounds to Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters including discharges directly to these waterbodies and also through the Los Angeles River above the estuary (Los Angeles River estuary, itself, is included in "Greater Los Angeles and Long Beach Harbor Waters") and the San Gabriel River and estuary. As introduced in Section 2, Environmental Setting, the Los Angeles River Watershed and San Gabriel River watershed are not focus of these TMDLs. Detailed discussion of sources of OC Pesticides, PCBs, sediment toxicity, PAHs and metals *within* the Los Angeles and San Gabriel River watershed will not be provided in this section. However, a discussion of the Los Angeles River above the estuary and the San Gabriel River and estuary as a source to the Harbors on the whole, is included.

Briefly, there are two categories of pollutant sources to the waters of concern in these TMDLs. Point source discharges are regulated through National Pollutant Discharge Elimination System (NPDES) permits. Point sources include stormwater and urban runoff (MS4) and other NPDES discharges, including but not limited to the Terminal Island Water Reclamation Plant, refineries (5), and power generating plants (2), etc. Non-point sources, by definition, include pollutants that reach waters from a number of diffuse land uses and are not regulated through NPDES permits. Non-point sources include existing contaminated sediments within these waters and direct (air) deposition to the waterbody surface.

Metals and PAHs are currently generated or deposited in the watersheds and are then washed into storm drains and channels that discharge to the Dominguez Channel and greater Harbor waters. PCBs, DDT, dieldrin, toxaphene, and chlordane are legacy pollutants for the most part, yet, they remain ubiquitous in the environment, bound to fine-grained particles. When these particles become waterborne, the chemicals are often transported downstream and deposited within estuarine or marine waters. Urban runoff and rainfall higher in the watersheds mobilize the particles, which are then washed into storm drains and channels that discharge to the Dominguez Channel and greater Harbor waters.

Monitoring data from NPDES discharges, land use runoff coefficients, and air deposition studies were used to estimate the magnitude of metals, organo-chlorine pesticides, PCBs, and PAHs loads to Dominguez Channel and Greater Los Angeles and Long Beach Harbor waters.

## 4.1 **Point Sources**

A point source, according to 40 CFR 122.3, is defined as “any discernable, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged.” The NPDES program, under CWA Sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources.

The NPDES permits in the Dominguez Channel watershed, Los Angeles River Watershed, San Gabriel Watershed, and Greater Los Angeles and Long Beach Harbor Waters include the MS4 and Caltrans Storm Water Permits, general construction storm water permits, general industrial storm water permits, individual NPDES permits, minor NPDES permits, and general NPDES permits (Table 4-1).

**Table 4-1. Summary of Active NPDES Permits in the Dominguez Channel and Greater Harbor Waters and the Los Angeles River, and San Gabriel River (Summer 2010)**

| Order Title | Number of Permits | | |
|---|---|---|---|
| | Dominguez Channel and Greater Harbor Waters | Los Angeles River | San Gabriel River |
| **Municipal Stormwater Permits:** | | | |
| ▪ Municipal Stormwater Permit (number of municipalities in the Los Angeles County MS4) | 24 | 32 | 34 |
| ▪ California Department of Transportation Storm Water | 1 | 1 | 1 |
| ▪ Municipal Storm Water Permit for the City of Long Beach | 1 | 1 | 1 |
| **Individual NPDES Permits** | | | |
| Individual NPDES Permits (Major including POTW, refineries, and generating stations) | 6 | 3 | 8 |
| Individual NPDES Permits (Minors) | 12 | 13 | 16 |
| **General Permits:** | | | |
| ▪ Statewide Industrial storm water permits | 207 | | |
| ▪ Statewide Construction storm water permits | 90 | | |
| ▪ Statewide Discharges of Aquatic Pesticides for Vector and Aquatic Weed Control permits | | 2 | |
| ▪ Statewide Permit for discharges from utility vaults and underground structures | | 3 | |
| ▪ Specified discharges to groundwater in Santa Clara River and Los Angeles River Basins | | 1 | |
| ▪ Treated Groundwater from Construction and Project Dewatering to Surface Waters | | 2 | |
| ▪ Groundwater from Construction and Project Dewatering to Surface Waters | | 2 | |
| ▪ Waste Discharge Requirements for discharges of groundwater from potable water supply wells to surface waters | 13 | 33 | 26 |
| ▪ Waste Discharge Requirements for discharges of nonprocess wastewater to surface waters in coastal watersheds | 1 | 8 | 3 |
| ▪ Waste Discharge Requirements for discharges of low threat hydrostatic test water to surface waters in coastal waters | 2 | 12 | 3 |
| ▪ Waste Discharge Requirements for discharges of groundwater from construction and project dewatering to surface waters in coastal watersheds | 1 | 32 | 12 |
| ▪ Waste Discharge Requirements for treated groundwater and other wastewaters from investigation and/or cleanup of petroleum fuel-contaminated sites to surface waters in coastal watersheds | | 2 | 2 |
| ▪ Waste Discharge Requirements for discharges of treated groundwater from investigation and/or cleanup of volatile organic compound Contaminated-sites to surface waters in coastal watersheds | | 5 | 5 |
| **Total** | **358** | **155** | **110** |

### *4.1.1 Stormwater Permits in Dominguez Channel Watershed and Greater Harbor Waters Nearshore Watershed*

Storm water runoff in the Dominguez Channel watershed and in the nearshore watershed to the greater harbor waters is regulated through a number of permits including:

1) The municipal separate storm sewer system (MS4) permit issued to the County of Los Angeles and the incorporated jurisdictions therein (except the City of Long Beach);
2) The municipal separate storm sewer system (MS4) permit issued to the City of Long Beach;
3) A separate statewide storm water permit specifically for the California Department of Transportation (Caltrans);
4) The statewide Construction Activities Storm Water General Permit; and
5) The statewide Industrial Activities Storm Water General Permit.

These discharges are point sources because the storm water discharges from the end of a storm water conveyance system.

#### *4.1.1.1 MS4 Storm Water Permits*

A. Regulation under MS4 Permit

Federal regulations for controlling pollutants in storm water discharges were issued by the USEPA on November 16, 1990 (40 Code of Federal Regulations [CFR] Parts 122, 123, and 124). As part of these regulations, USEPA developed rules establishing Phase I of the 'Municipal Separate Storm Sewer System' storm water program, designed to prevent harmful pollutants from being washed by storm water runoff into MS4s (or from being discharged directly into the MS4s) and then discharged from the MS4s into local waterbodies. Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or more) to implement a storm water management program as a means to control polluted discharges from the MS4s. (Phase II of the MS4 program will focuses on smaller municipalities.) Approved storm water management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipally owned operations, and hazardous waste treatment. Large and medium MS4 operators are required to develop and implement Storm Water Management Plans that address, at a minimum, the following elements:

- Structural control maintenance
- Areas of significant development or redevelopment
- Roadway runoff management
- Flood control related to water quality issues
- Municipally owned operations such as landfills, and wastewater treatment plants
- Municipally owned hazardous waste treatment, storage, or disposal sites
- Application of pesticides, herbicides, and fertilizers
- Illicit discharge detection and elimination
- Regulation of sites classified as associated with industrial activity

- Construction site and post-construction site runoff control
- Public education and outreach

The municipalities in Los Angeles County are covered by Phase I MS4 permits. The current County of Los Angeles MS4 permit was issued to the Los Angeles County Flood Control District, County of Los Angeles, and 84 incorporated cities on December 13, 2001 (Order No. 01-182, NPDES No. CAS004001) and was amended on amended on September 14, 2006 by Order R4-2006-0074, on August 9, 2007 by Order R4-2007-0042, on December 10, 2009 by Order No. R4-2009-0130, and on October 19, 2010, pursuant to a Preemptory Writ of Mandate.

The permittees in the Dominguez Channel or Greater Harbors waters watersheds include the following:

- City of Bellflower
- City of Carson
- City of Compton
- City of El Segundo
- City of Gardena
- City of Hawthorne
- City of Inglewood
- City of Lakewood
- City of Lawndale
- City of Long Beach
- ~~City of Lomita~~
- City of Los Angeles
- City of Manhattan Beach
- City of Paramount
- City of Rancho Palos Verdes
- City of Redondo Beach
- City of Rolling Hills
- City of Rolling Hills Estates
- City of Signal Hill
- City of Torrance
- County of Los Angeles
- County of Los Angeles, Flood Control District

The current City of Long Beach MS4 Permit was issued on June 30, 1999 (Order No. 99-060, NPDES No. CAS004003).

Both the County of Los Angeles and City of Long Beach MS4 permits were scheduled to expire five years after they were issued but remain in effect until new MS4 permits are issued and these rescinded.

B. Summary of Los Angeles County MS4 Stormwater Monitoring

As part of the Los Angeles County MS4 Permit Core Monitoring Program, flow and water quality are measured in Dominguez Channel at station, S28 (mass emission station) which is located near the center of the watershed. Data from the mass emission station has been used for flow data in Dominguez Channel.

In addition, as part of the Los Angeles County MS4 Permit Core Monitoring Program, tributary monitoring is conducted in specific subwatersheds each year. Tributary monitoring was conducted at six locations in the Dominguez Channel watershed in 2008-2009. Automatic flow weighted composite samples and grab samples were taken from each tributary location; five wet-weather and three dry-weather events were monitored for each location. The samples were analyzed for OC pesticides and PCBs, although only non-detect results were reported (Los Angeles County Stormwater Monitoring Report, 2008-09). Based on insufficient sensitivity of analytical methods and difficulty with accurately interpreting these results, current stormwater discharge from the Dominguez Channel watershed appears to be an uncertain load of contaminants to the Dominguez Channel and Greater Harbor Waters. However, detections have been measured by other parties within these waters (SCCWRP, 2003), thus it is possible for small amounts of contaminated sediment to transport downstream, become bioavailable and accumulate in tissue to levels that cause impairment.

#### *4.1.1.2 Caltrans Storm Water Permit*

Caltrans is regulated by a statewide storm water discharge permit that covers all municipal storm water activities and construction activities (State Board Order No. 99-06-DWQ, NPDES No. CAS000003). The Caltrans storm water permit authorizes storm water discharges from Caltrans properties such as the state highway system, park and ride facilities, and maintenance yards.

The storm water discharges from most of these Caltrans properties and facilities eventually end up in either a city or county storm drain. The metals loading specifically from Caltrans properties have not been determined in the Greater Harbors and Dominguez Channel watershed. A conservative estimate of the percentage of the Greater Harbors and Dominguez Channel watershed covered by state highways is 2.4% (approximately 618 acres). This area represents Caltrans' right-of-way that drains to Dominguez Channel. This percentage does not represent all the watershed area that Caltrans is responsible for under the storm water permit. For example, the park and ride facilities and the maintenance yards were not included in the estimate.

#### *4.1.1.3 General Storm Water Permits*

The federal Phase I stormwater regulations for controlling pollutants in storm water issued by the USEPA in 1990, require operators of facilities where discharges of storm water associated with industrial activity occur to obtain an NPDES permit and to implement Best Available Technology Economically Achievable (BAT) to reduce or prevent pollutants associated with industrial activity in storm water discharges and authorized non-storm discharges. The regulations also require discharges of storm water associated with construction activity including clearing, grading, and excavation activities (except operations that result in disturbance of less than five acres of total land area) to obtain an NPDES permit and to implement BAT to reduce or eliminate storm water pollution.

The federal Phase II stormwater rules promulgated by USEPA on December 8, 1999, (40CFR Parts 122, 123, and 124) expanded the NPDES storm water program to include storm water discharges from construction sites that resulted in land disturbances equal to or greater than one acre but less than five acres. Now, under Phase II, any construction site that is greater than one acre must obtain a storm water permit.

On April 17, 1997, State Board issued a statewide general NPDES permit for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities Permit (Order No. 97-03-DWQ). This Order regulates storm water discharges and authorized non-storm water discharges from ten specific categories of industrial facilities, including but not limited to manufacturing facilities, oil and gas mining facilities, landfills, and transportation facilities. Under Order No. 97-03-DWQ, non-storm water discharges are authorized only when they do not contain significant quantities of pollutants, where BMPs are in place to minimize contact with significant materials and to reduce flow, and when they are in compliance with Regional Board and local agency requirements.

As of summer 2010, there are 207 discharges enrolled under the general industrial storm water permit within the Dominguez Channel watershed and Greater Harbor Waters.

Potential pollutants from an industrial site will depend on the type of facility and operations that take place at that facility. There is a potential for metals loadings from these types of facilities, especially transportation, recycling and manufacturing facilities. During wet weather, runoff from industrial sites has the potential to contribute metals loadings to the Dominguez channel. This finding is supported by Stenstrom et al. in their final report (2005) on the industrial storm water monitoring program under the existing general permit. In the summary of existing data, the report found that although the data collected by the monitoring program were highly variable, the mean values for copper, lead and zinc were 1010, 2960, and 4960 µg/L, respectively (Stenstrom et al., 2005). During dry weather, the potential contribution of metals loadings from industrial storm water is low.

On August 19, 1999, State Board issued a statewide general NPDES permit for Discharges of Storm Water Runoff Associated with Construction Activities (Order No. 99-08-DQW, NPDES NO. CAS000002). On September 2, 2009 the State Board updated the permit (Order No. 2009-009-DWQ). There are 90 construction sites enrolled under the general construction storm water permit within the Dominguez Channel watershed and Greater Harbor Waters.

Potential pollutants from construction sites include sediment, which may contain metals as well as metals from construction materials and the heavy equipment used on construction sites. During wet weather, runoff from construction sites has the potential to contribute metals loadings to the channel. During dry weather, the potential contribution of metals loadings is low. Under Order No. 99-08-DWQ, discharges of non-storm water are authorized only where they do not cause or contribute to a violation of any water quality standard and are controlled through implementation of appropriate BMPs for elimination or reduction of pollutants.

#### *4.1.2 <u>Other General and Individual NPDES Permits</u>*

An individual NPDES permit may be classified as either a major or a minor permit. The discharge flows associated with minor individual NPDES permits and general NPDES permits are typically less than 1 million gallons per day (MGD). There are six major NPDES discharges in Dominguez Channel watershed: one POTW, two generating stations, and three refineries. Other than the major NPDES discharges, there are total of 12 minor NPDES discharges and 17 discharges covered by general NPDES permits. General NPDES permits often regulate episodic discharges (e.g. dewatering operations) rather than continuous flows. The minor NPDES permits issued within the Dominguez Channel watershed are also for episodic discharges.

- Major and Minor Individual NPDES Permits

  Terminal Island Water Reclamation Plant (TIWRP) (NPDES No. CA005386) is the only Publically-Owned Treatment Works (POTW) that discharges to Dominguez Channel watershed or Greater Harbor Waters. The TIWRP discharges tertiary-treated effluent to the Outer Harbor and is under a time schedule order to remove the discharge. The discharger's plan consists of achieving full reclamation (mostly for industrial reuse purposes) by 2020 which would eliminate the effluent discharge completely.

  The Harbor Generating Station and Long Beach Generating Station discharge to the Inner Harbor area. Several oil refineries discharge to Dominguez Channel Estuary. Exxon Mobil discharges to Torrance Lateral.

| **Facility** | **NPDES NO.** | **Regional Board Order No.** |
|---|---|---|
| Conoco Phillips (Los Angeles Refinery) | CA0000051 | R4-2006-0082 |
| BP Carson Refinery | CA0000680 | R4-2007-0015 |
| Tesoro (Los Angeles Refinery) | CA0003778 | R4-2010-0179 |
| Exxon Mobil Torrance Refinery | CA0055387 | R4-2007-0049 |
| Shell/Equilon Carson Terminal | CA0000809 | R4-2007-0026 |
| Long Beach Generating Station | CA0001171 | R4-2009-0112 |
| Harbor Generating Station | CA000361 | R4-2003-0101 |

  Many smaller, non-process waste discharges also occur into the harbors.

- General NPDES Permits

  Pursuant to 40 CFR parts 122 and 123, the State Board and the Regional Boards have the authority to issue general NPDES permits to regulate a category of point sources if the sources: involve the same or substantially similar types of operations; discharge the same type of waste; require the same type of effluent limitations; and require similar monitoring. The Regional Board has issued general NPDES permits for six categories of discharges: construction and project dewatering; petroleum fuel cleanup sites; volatile organic compounds (VOCs) cleanup sites; potable water; non-process wastewater; and hydrostatic test water.

  The general NPDES permit for Discharges of Groundwater from Potable Water Supply Wells to Surface Waters (Order No. R4-2003-0108) covers discharges of groundwater from potable supply wells generated during well purging, well rehabilitation and redevelopment, and well drilling, construction and development. As of summer 2010, there are 13 dischargers enrolled under this Order in the Dominguez Channel watershed for a combined total discharge flow of 21.7 MGD.

The general NPDES permit for Discharges of Nonprocess Wastewater to Surface Waters (Order No. R4-2004-0058) covers waste discharges, including but not limited to, noncontact cooling water, boiler blowdown, air conditioning condensate, water treatment plant filter backwash, filter backwash, swimming pool drainage, and/or groundwater seepage. Currently, there is only one discharger enrolled under this Order. The facility discharges only up to 5,000 gallons per day of wastewater into a nearby storm drain that flows into Dominguez Channel.

The general NPDES permits for Discharges of Low Threat Hydrostatic Test Water to Surface Waters (Order No. R4-2009-0068) covers waste discharges from hydrostatic testing of pipes, tanks, and storage vessels using domestic/potable water. Currently, there is only one discharger enrolled under this Order in the Dominguez Channel watershed with design flow of 2.5 MGD.

The general NPDES permit for Discharges of groundwater from construction and project dewatering to surface waters in coastal watersheds of Los Angeles and Ventura Counties (Order No. R4-2008-0032) covers wastewater discharges, including but not limited to, treated or untreated groundwater generated from permanent or temporary dewatering operations. Currently, there is one discharger enrolled under this Order in the Dominguez Channel watershed with design flow of 0.6 MGD.

#### *4.1.3 Superfund Sites within Torrance Lateral subwatershed*

Two Superfund sites are located in the watershed: the Montrose Superfund site (DDT) and the Del Amo Superfund site (benzene). Montrose Superfund site includes multiple operable units, which are identified as investigation areas potentially contributing site-related contamination. Both sites are located in the Kenwood Drain subwatershed, which discharges stormwater into Torrance Lateral and flows downstream into saline waters of Dominguez Channel Estuary and Consolidated Slip. Torrance Lateral, Dominguez Channel Estuary and Consolidated Slp (OU2) contain sediments contaminated with multiple pollutants including DDT (potentially from various sources). In 1994 and 2002, USEPA performed a sediment transect study by measuring DDT levels in sediments at numerous sites throughout OU2. Individual grab samples were collected at each site and a comparative analysis was performed on 1994 vs. 2002 results at each site. Briefly, average DDT levels within Kenwood Drain were considerably lower in 2002 when compared to 1994 levels. DDT levels in Consolidated Slip were somewhat higher in 2002 than 1994. Given the ‘snapshot’ nature of these results, one might infer that DDT contaminated sediments in waters of OU2 have moved to more downstream locations in this stormwater pathway (CH2M Hill, 2003).

#### *4.1.4 Point Sources Summary*

Dominguez Channel drains a highly industrialized area and also contains remnants of persistent legacy pesticides as well as PCBs which results in poor sediment quality both within the Channel and in adjacent Inner Harbor areas. The total loading of OC pesticides, PCBs, PAHs, and metals reflects the sum of inputs from urban runoff and multiple NPDES permits within the watershed (Table 4-2). In the Dominguez Channel Watershed storm water discharges are regulated under the MS4 permit, the Caltrans permit, the general industrial storm water permit and the general construction storm water permit.

**Table 4-2. Summary of permits in Dominguez Channel Watershed**

| Type of NPDES Permit | Number of Permits | Permitted Volume (MGD) | Screening for pollutants? | Potential for significant contribution? |
|---|---|---|---|---|
| Municipal Storm Water | 24 | NA | Yes | High |
| Caltrans Storm Water | 1 | NA | Yes | High |
| Municipal Storm Water Permit for the City of Long Beach | 1 | NA | Yes | High |
| General Construction Storm Water | 90 | NA | Yes | High |
| General Industrial Storm Water | 207 | NA | Yes | High |
| POTW | 1 | 16 | Yes | Medium |
| Individual NPDES Permits (majors) (incl refineries) | 6 | 24.8 | Yes | Medium |
| Individual NPDES Permits (minors) | 12 | 4.1 | Yes | Medium |
| General Permits | 17 | 24.3 | Yes | Low |

"Potential for significant contribution" is based on professional judgment on type of discharges and associated potential pollutants maybe carried by the discharges."

## 4.2 Non-point Sources

A nonpoint source is a source that discharges to water of the US or State via sheet flow or natural processes. Surface water runoff within the watershed occurs as sheet flow near the shores. Additional non-point sources include air deposition and contaminant fluxes from existing sediments within the receiving waters into porewater and overlying water.

### *4.2.1 Air Deposition*

Nonpoint source inputs not only occur from the runoff of precipitation, but also from precipitation falling directly onto the land surface or the harbors. Precipitation occurs as wet deposition of rain droplets, and dry deposition of particulate matter. In the atmosphere, the mixture of gases, water vapor, particulate matter, and wind currents form a dynamic environment in which changes in chemical composition of precipitation can frequently occur. Precipitation can carry significant amounts of inorganic contaminants and sediments to the harbors. Atmospheric deposition is a nonpoint source of metals to the watershed through both direct deposition onto waterbody surface and indirect deposition onto land and then urban runoff carries into the waterbody.

*Atmospheric Deposition Loads of Metals in Los Angeles Area Study* (Atmospheric Deposition Report) completed by the Regional Board in 2009, summarizes the findings of previous studies on the air deposition loads of metals resulting from direct sources of major facilities in Los Angeles area including Los Angeles River watershed, San Gabriel River watershed, Dominguez Channel and Los Angeles and Long Beach Harbors Watershed, Santa Monica Bay Watershed, and Ballona Creek Watershed. The study also uses the existing information of the previous studies to estimate the indirect atmospheric deposition loads of metals in the Los Angeles area. The study is referenced in this section to provide estimated loadings from direct and indirect atmospheric deposition.

Direct atmospheric deposition of metals to Los Angeles River, San Gabriel River, and Dominguez Channel watersheds was calculated using monitoring data. The estimates are shown in Table 4-3. In general, direct atmospheric deposition from Los Angeles River and San Gabriel River watersheds is smaller in comparison to the deposition from Dominguez Channel and Harbors watershed because the actual surface area of the river systems themselves are smaller than surface areas of the Harbors and Dominguez Channel.

**Table 4-3 Direct Atmospheric Deposition of Metals Provided by Dischargers**

| Constituent | Direct Source | Los Angeles River Watershed | San Gabriel River Watershed | Dominguez Channel and LA/LB Harbors Watershed |
|---|---|---|---|---|
| **Copper** (g/year) | | | | |
| | WSPA | | | 43 |
| | Rangers Die Casting | 21,909 | | |
| | **Total** | **21,909** | | **43** |
| **Lead** (g/year) | | | | |
| | WSPA | | | 32 |
| | Exide Tech | 11,340 | | |
| | Trojan Battery | | 83 | |
| | **Total** | **11,340** | **83** | **32** |
| **Zinc** (g/year) | | | | |
| | WSPA | | | 490 |
| | Bandag Licensing | 454 | | |
| | Quemetco | | 222 | |
| | US Borax | | | 3,112 |
| | Western Tube and Conduit | 907 | | 454 |
| | **Total** | **1,361** | **222** | **4,056** |

Direct atmospheric deposition rates used in this TMDL are based on the most recent study performed by the Southern California Coastal Water Research Project (SCCWRP): *Metals Dry Deposition Rates along a Coastal Transect in Southern California study* performed by Sabin et al. in 2007. Differences in metal dry deposition flux rates observed between sites were dominated by proximity to urban areas and/or other nearby sources, with the highest metal fluxes observed near the Los Angeles Harbor and San Diego Bay sites. Compared with data from the 1970s, lead fluxes were typically one to two orders of magnitude lower in the present study (2007), indicating atmospheric sources of these metals have decreased over the past three decades. The median dry deposition fluxes for all metals measured at the Los Angeles Harbor site were comparable to measurements in other studies in Los Angeles and Chicago and provided in Table 4-4.

**Table 4-4. Comparison of metal dry deposition flux rates (Sabin et al. 2007)**

| Air Deposition Study | Constituents (µg/m$^2$-day) | | | |
|---|---|---|---|---|
| | Chromium | Copper | Lead | Zinc |
| **Lim et al., 2006 Urban Sites in Los Angeles and Orange County, CA USA** | | | | |
| Los Angeles River -1 | 6 | 21 | 15 | 130 |
| Los Angeles River -2 | 2.3 | 30 | 31 | 160 |
| Los Angeles River -3 | 9 | 16 | 32 | 110 |
| Ballona Creek | 2.7 | 18 | 20 | 77 |
| Dominguez Channel | 3.3 | 12 | 11 | 74 |
| Santa Ana River | 4.3 | 30 | 10 | 180 |
| **Yi et al., 2001** | | | | |
| Chicago, IL USA | 5.7 | 63 | 38 | 120 |
| South Haven, MI USA | 0.7 | 31 | 23 | 51 |
| Sleeping Bear Dunes, MI USA | 1.6 | 79 | 35 | 68 |
| **Sabin et al., 2007** | | | | |
| Santa Barbara | 0.34 | 2.0 | 1.3 | 14 |
| Oxnard | 0.23 | 0.89 | 0.52 | 4.8 |
| Malibu | 0.29 | 1.9 | 1.0 | 12 |
| Hyperion | 0.39 | 3.9 | 1.0 | 16 |
| Los Angeles Harbor (a.k.a Wilmington) | 3.6 | 22 | 14 | 160 |
| Newport | 0.64 | 5.1 | 1.8 | 22 |
| Oceanside | 0.48 | 4.2 | 1.4 | 40 |
| San Diego Bay | 0.99 | 29 | 3.3 | 63 |

Note: Shaded rows indicate inland monitoring sites

The SCCWRP study (2006) collected air deposition samples at a Los Angeles Harbor air monitoring site, also known as 'Wilmington' site, (located 3 km inland) and these results are more comparable to other inland sites (shaded sites in Table 4-4). Therefore, the deposition rate for LA Harbor is applied to calculate the estimated current air deposition loads for certain waterbodies: Dominguez Channel Estuary, Consolidated Slip, Inner Harbor and LA River Estuary. The average of six coastal site values (underlined in table immediately above) are applied to the following waterbodies: Fish Harbor, Cabrillo Marina, Inner Cabrillo Beach, Outer Harbor and San Pedro Bay. The estimates of copper, lead, zinc, DDT, and PAHs loading from atmospheric deposition are presented in Table 4-5. See also Appendix III, Part 6.

**Table 4-5. Estimated Atmospheric Deposition of Copper, Lead, Zinc, and PAHs in Dominguez Channel Estuary and Greater Harbor Waters based on monitoring results from Sabin & Schiff (2007).**

| | | Wilmington site ($\mu g/m^2$-day) | | | Coastal sites (n= 6) ($\mu g/m^2$-day) | | | ($ng/m^2$-day) |
|---|---|---|---|---|---|---|---|---|
| | | **Cu** | **Pb** | **Zn** | **Cu** | **Pb** | **Zn** | **PAHs** |
| **Water Bodies** | **Area ($m^2$)** | **22** | **14** | **160** | **3** | **1.17** | **18.1** | **244** |
| Dominguez Channel | 567,900 | 4.56 | 2.90 | 33.2 | | | | 0.051 |
| Consolidated Slip | 147,103 | 1.18 | 0.75 | 8.59 | | | | 0.013 |
| Inner Harbor | 12,154,560 | 97.6 | 62.1 | 709.8 | | | | 1.08 |
| LA River Estuary | 837,873 | 6.73 | 4.28 | 48.93 | | | | 0.075 |
| Fish Harbor | 368,524 | | | | 0.40 | 0.16 | 2.43 | 0.033 |
| Cabrillo Marina | 310,259 | | | | 0.34 | 0.13 | 2.05 | 0.028 |
| Cabrillo Inner Beach | 331,799 | | | | 0.36 | 0.14 | 2.19 | 0.03 |
| Outer Harbor | 16,358,366 | | | | 17.9 | 6.99 | 108.1 | 1.46 |
| San Pedro Bay | 33,073,517 | | | | 36.2 | 14.1 | 218.5 | 2.95 |

Shaded rows indicate monitoring results from Wilmington (inland) site; other rows based on average of six coastal sites from Sabin et al., 2007 in Table 4-4 above.

Indirect deposition of metals is generally associated with the accumulation and wash-off of metals on the land surface during rain events. Metals washed off the land surface are delivered to the river through creeks and stormwater collection systems. As such, indirect loading varies depending on the amount of rainfall and size of storms in a given year.

Indirect atmospheric deposition is the amount of airborne metals deposited on land surface that may be washed into a water body during storm events. The amount of deposited metals available for transport to Los Angeles area (i.e., not infiltrated) is unknown.

Indirect atmospheric deposition reflects the process by which metals deposited on the land surface may be washed off during rain events and be delivered to the river and tributaries. Not all the metals deposited on the land from the atmosphere are loaded to the river. Estimates of metals deposited on land are much higher than estimates of loadings to the river system. The loadings of metals associated with indirect atmospheric deposition are accounted for in the estimates of the stormwater loadings.

## 4.3 Model Estimated Loads from Point and Non Point Sources

### ***4.3.1 Existing Loads within Dominguez Channel freshwater***

Current loads of metals into Dominguez Channel freshwater were estimated using Loading Simulation Program in C++ (LSPC) model output from simulated flows for 1995-2005. Monitoring data from NPDES discharges and land use runoff coefficients were analyzed along with Channel stream flow rates to estimate the magnitude of metal loadings. The PAH loads were calculated using simulated flow and PAH Event Mean Concentrations (EMC), while the DDT and PBC loads were calculated by applying observed sediment concentrations to the LSPC simulated sediment concentrations (see Appendix II). In recognition of the wide variety of stream flow rates generated by various rainfall conditions, flow duration curves were utilized to analyze the metals loading during wet weather.

The LSPC model was also updated for freshwater inputs from Los Angeles River and San Gabriel River. These models were previously developed by Tetra Tech to support metals TMDLs in those watersheds. The nearshore areas were also modeled using LSPC. These nearshore areas refer to freshwater inputs that discharge either directly into the saline TMDL receiving waters or to the Channels, Rivers, or Bays that ultimately discharge to the saline TMDL receiving waters. More discussion of the LSPC model and results are provided in the Linkage Analysis section of this document. Additional information is provided in Appendix II and III.

### *4.3.2 Existing Pollutants in in Dominguez Channel Estuary and Greater Harbor Waters*

A variety of activities in the past decades in Dominguez Estuary, Los Angeles and Long Beach Harbors, and surrounding areas contributed to contamination of existing sediment bed. The sediment bed is represented by multiple layers with internal transport of contaminants by pore water advection and diffusion. Sediment and water is exchanged between the water column and bed by deposition, erosion and re-suspension, with corresponding exchange of adsorbed and dissolved contaminants. Re-suspension may occur via natural processes and/or anthropogenic activities including (ship) propeller wash. Dissolved phase contaminants are also exchanged by diffusion between bed pore water and the overlying water column. Sediment bed conditions are persistent with changes in bed sediment composition and contamination levels occurring slowly at annual scales and longer. Sediment conditions influence both sediment transport dynamics and the phase distribution and mobility of contaminants in the bed.

Existing sediment loading for metals, PAHs, DDT, and PCBs for Dominguez Channel Estuary and greater Harbor waters were estimated via Environment Fluid Dynamics Code (EFDC) model for 2002-2005. (Summary information for the EFDC model used for these TMDLs are included in Linkage Analysis, Section 5. Detailed model reports are included in Appendices I, II and III.) This involved using the existing average sediment concentration predicted by the EFDC model for 2002-2005 in the top 5 cm and the total sediment deposition rate per waterbody (see Appendix III, Part 1). Table 4-6 presents the modeled existing sediment bed pollutant loads in Dominguez Channel Estuary and Greater Harbor waters.

**Table 4-6. Estimated pollutant loadings in existing sediment bed based on average EFDC model output for 2002-2005 (deposition rate * existing concentration in top 5 cm = total existing load).**

| Waterbody | Pollutants (g/yr) | | | | | |
|---|---|---|---|---|---|---|
| | Cu | Pb | Zn | DDT | PAH | PCB |
| Dominguez Channel Estuary | 327,600 | 457,905 | 1,799,038 | 54 | 28,082 | 57 |
| Consolidated Slip | 92,143 | 127,260 | 398,941 | 49 | 11,510 | 84 |
| Inner Harbor | 178,444 | 105,916 | 542,093 | 22 | 3,524 | 30 |
| Outer Harbor | 118,991 | 66,725 | 403,429 | 31 | 626 | 35 |
| Fish Harbor | 1,434 | 600 | 4,209 | 0.17 | 3 | 0.08 |
| Los Angeles River Estuary | 1,611,961 | 2,641,274 | 20,096,108 | 232 | 8,722 | 402 |
| Cabrillo Inner Beach | 2,980 | 655 | 4,518 | 1.0 | 24 | 0.3 |
| Cabrillo Marina | 9,164 | 2,307 | 9,144 | 1.7 | 236 | 1.1 |
| San Pedro Bay | 1,250,794 | 1,737,044 | 8,166,507 | 205 | 3,634 | 111 |

## 4.4 Sources Summary

**Dominguez Channel freshwater waters:** The major pollutant sources of metals into Dominguez Channel and Torrance Lateral freshwaters are stormwater and urban runoff discharges. Nonpoint sources include atmospheric deposition.

Current loads of metals into Dominguez Channel were estimated using Loading Simulation Program in C++ (LSPC) model output from simulated flows for 1995-2005. Monitoring data from NPDES discharges and land use runoff coefficients were analyzed along with Channel stream flow rates to estimate the magnitude of metal loadings. In recognition of the wide variety of stream flow rates generated by various rainfall conditions, flow duration curves were utilized to analyze the metals loading during wet weather.

**Dominguez Channel Estuary and Greater Los Angeles and Long Beach Harbor waters:** A variety of activities over the past decades in the four contributing watersheds (Dominguez Channel, Los Angeles River, San Gabriel River and the nearshore watershed) and in the Harbors themselves have contributed to the sediment contamination. The contaminated sediments are a reservoir of historically deposited pollutants. Stormwater runoff from manufacturing, military facilities, fish processing plants, wastewater treatment plants, oil production facilities, and shipbuilding or repair yards in both Ports discharged untreated or partially treated wastes into Harbor waters. Current activities also contribute pollutants to Harbor sediments including, stormwater runoff from upstream sources and port sources, commercial vessels (ocean going vessels and harbor craft), recreational vessels, and the re-suspension of contaminated sediments from propeller wash within Ports' slips and unmaintained areas also contributes to transport of pollutants within the Harbors. Loadings from the four contributing watersheds and intermittent overflows from Machado Lake are also potential sources of metals, pesticides, PCBs, and PAHs to the Harbors.

The pollutants of concern in Machado Lake (a.k.a. Harbor Lake) are similar to those in this TMDL. Some intermittent overflows from Machado Lake reach LA Inner Harbor via storm channel; however, there is a paucity of available data and information for chemical concentrations and flow rates from Machado Lake overflows. For this TMDL, the freshwater hydrologic model incorporated pollutant loads into Machado Lake, treating it as a sink, but we did not have sufficient data to quantify loadings that may occur in intermittent overflows reaching the Inner Harbor. (See Appendix II for additional discussion.) A Toxics TMDL has been developed and approved for Machado Lake and implementation is planned (and funded) to occur through Prop O project which includes dredging contaminated sediment in the Lake.

Another nonpoint source of pesticides and PCBs to the greater Harbor waters are fluxes from currently contaminated sediments into the overlying water. The re-suspension of these sediments as well as desorption of pollutants into the water column contributes to the fish tissue impairments. In addition, atmospheric deposition appears to be a potentially significant nonpoint source of metals, DDT and PAHs to the watershed, through either direct deposition or indirect deposition.

Current loading of metals, PAHs, DDT and PCBs to the Dominguez Channel Estuary and Greater Harbor waters were calculated by adding the stormwater runoff and other point source contributions (including TIWRP into Outer Harbor) and the nonpoint sources – existing sediment loads and direct deposition to each waterbody surface. The total current load for each water body-pollutant combination is included in Section 6, Tables 6-9 and 6-11 along with required percent reductions.

# 5 LINKAGE ANALYSIS

The linkage analysis connects pollutant loads to the numeric targets and protection of beneficial uses of the listed waterbodies. The numeric targets selected for pollutants in fish tissue, water, and sediments define acceptable levels to restore habitat conditions and protect benthic infauna, other aquatic organisms including fish and marine mammals, wildlife and human health.

For direct effects, the linkage between pollutants and sediment dwelling organisms is presented in Figure 5-1. Benthic organisms are exposed to pollutants via ingestion of sediment, intake of sediment porewater or overlying water, and possible consumption of other bottom dwelling organisms, algae or detritus. Furthermore benthic organisms reside in these sediments and are relatively immobile so they endure continual exposure to pollutants in sediments, porewater or overlying water.

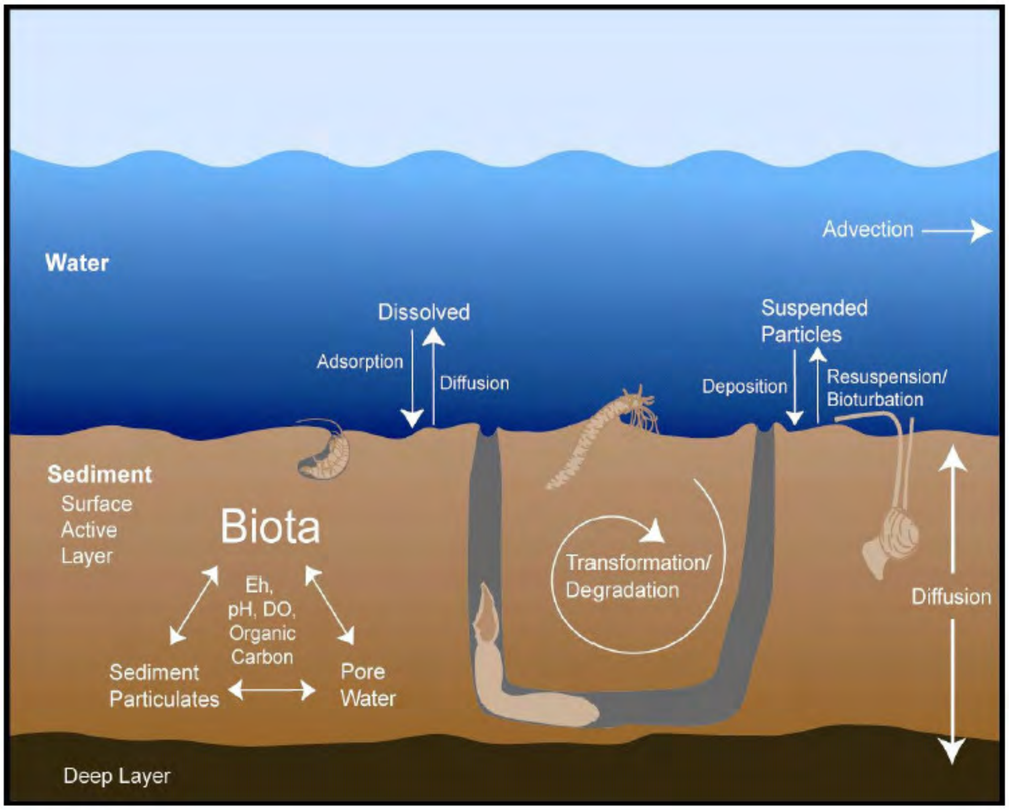



**Figure 5-1. Sediment processes affecting the distribution and form of contaminants to benthic and aquatic organisms. (Source: SWRCB, 2008; Figure 2-2)**

A food web diagram is presented in Figure 5-2 to describe linkage between bioaccumulative pollutants in water and sediment and transfer across trophic levels. This conceptual model represents organisms in various trophic levels or guilds in the San Francisco Bay food web bioaccumulation model (Gobas and Arnot 2010). The organisms and pollutant transfer pathways closely resemble those within greater Harbor waters, namely: phytoplankton and algae; zooplankton; filter-feeding invertebrates (bivalves and amphipods); sediment detritovores (shrimp and mysids); juvenile and adult fish; fish-eating birds; juvenile and adult marine mammals and humans (not shown). The biological species with empirical data used in S.F Bay bioaccumulation study are also residents of greater Harbor waters, including Pacific oysters, California mussels, shiner surfperch, jack smelt, white croaker, double-crested cormorant and harbor seals. The Newport Bay bioaccumulation study has similar trophic guilds and has included many fish species that also reside in greater Harbor waters, e.g., striped anchovy, topsmelt, halibut, sandbass, corbina and croaker. Again, once such studies are completed in local waters with corresponding empirical data to revise food web models, then site-specific sediment and tissue targets may be reconsidered.

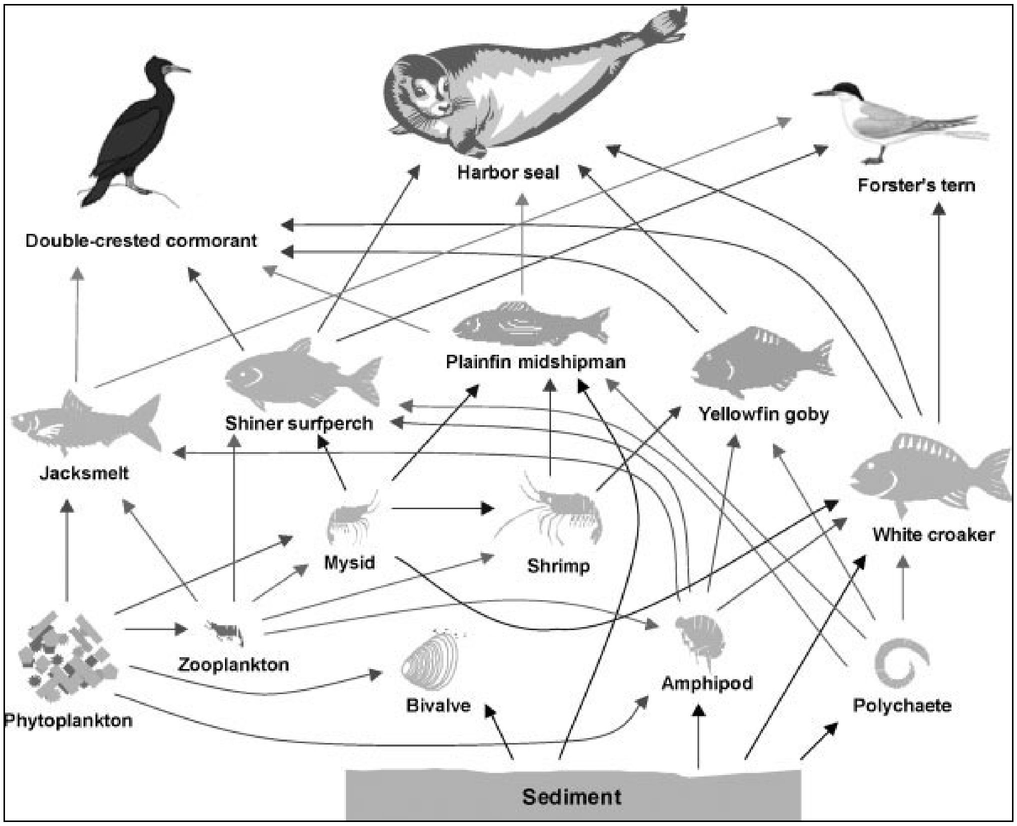
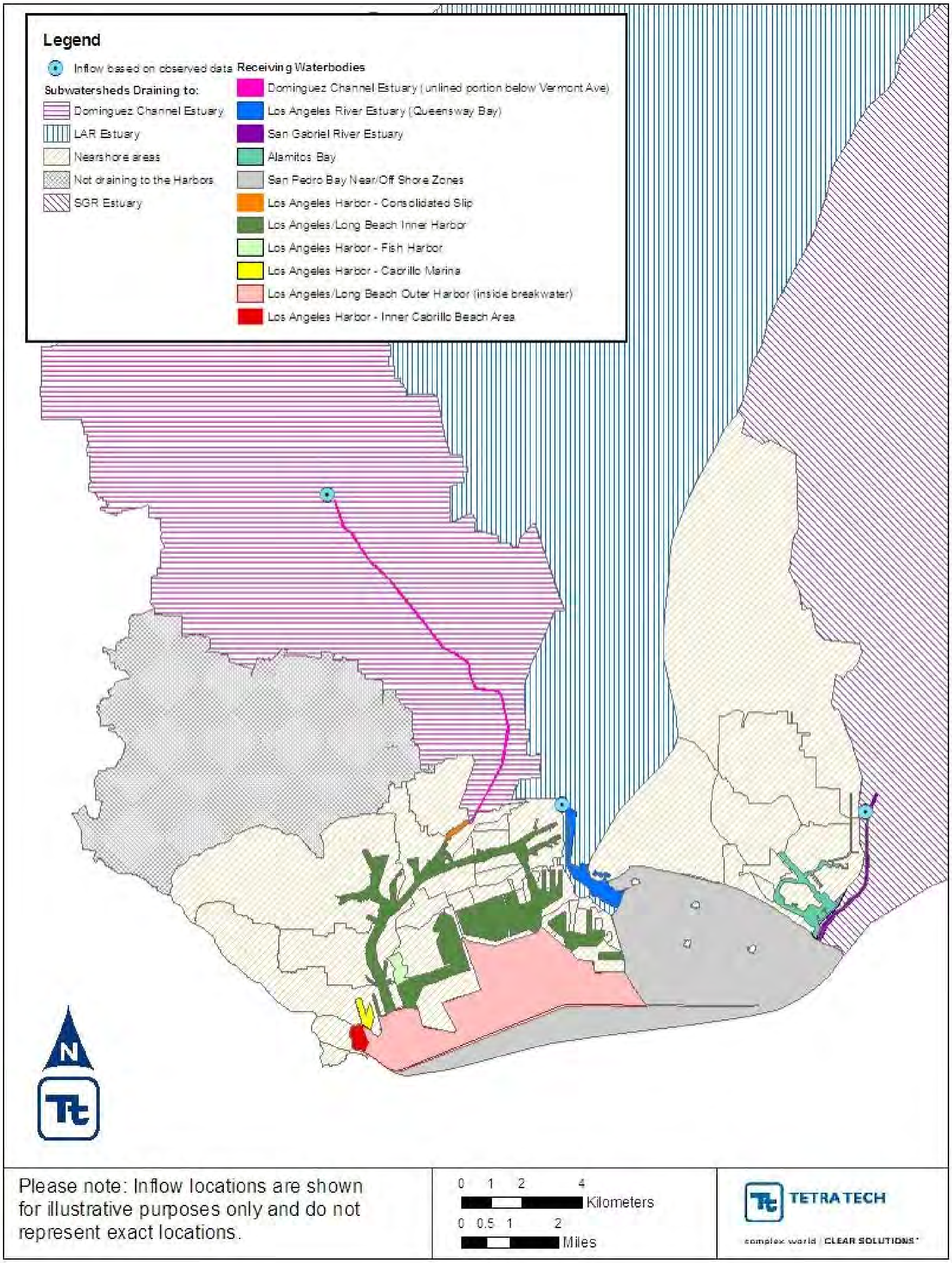



**Figure 5-2. Conceptual model of food web in S.F Bay bioaccumulation study, used for this TMDL to set sediment PCBs targets. (Reproduced from Gobas and Arnot, 2010).**

## 5.1 Model Development

This section will also describe model development for use in the area of the Los Angeles and Long Beach Harbors and San Pedro Bay, including their tributaries, the Los Angeles and San Gabriel Rivers and Dominguez Channel (Figure 5-3), which will be used to evaluate the results of different input scenarios for the TMDL allocation plan in the following Section.

To represent the linkage between source contributions and in receiving water response, a dynamic water quality model was developed to simulate source loadings and transport of the listed pollutants in the greater harbor water area. Hydrodynamic and sediment and contaminant transport models provide an important tool to evaluate existing conditions, including identifying point and non-point source load contributions, source controls, and TMDL allocation alternatives. A modeling system that includes hydrodynamic, sediment transport, and contaminant transport and fate is necessary to estimate current conditions and potential load reduction scenarios for the listed waterbodies.




5.2 **Figure 5-3. Watershed associated with each receiving waterbody.**

Three appendices are included with the Staff Report to fully document the modeling approach.

Appendix I, *The Los Angeles-Long Beach Harbors and San Pedro Bay Hydrodynamic and Sediment- Contaminant Transport Model Report* describes the estimation of metals and organic pollutant concentrations using Environmental Fluid Dynamics Code (EFDC) in the Dominguez Channel Estuary and Greater Los Angeles and Long Beach Harbor Waters. Appendix I gives a complete description of the hydrodynamic, water quality, and sediment transport developed to simulate the dynamic interactions in saline waters of the greater harbor system.

Appendix II, *The Watershed Model Development for Simulation of Loadings to the Los Angeles/Long Beach Harbors Report* describes the approach used to estimate metals and organic pollutant loads from the Los Angeles River, the San Gabriel River, and nearshore watershed areas. These models, based on the Loading Simulation Program in C++ (LSPC) watershed model, and in addition to the Dominguez Channel model, were used to determine the pollutant loadings into Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters.

Appendix III includes additional material developed by Tetra Tech including: TMDL Loading Calculations for Saltwater Waterbodies; Dominguez Channel Freshwater Loading Calculations; Initial Conditions for EFDC Model; Applicable Maps; SCCWRP Flux Monitoring Study; Metals Aerial Deposition Rates; Justification for Addition of Waterbody-Pollutant Combinations (in addition to 2006 303(d) list); Tetra Tech Memo on TMDL Scenarios.

**Dominguez Channel and other freshwater**
The LSPC model was used to estimate freshwater loadings of total metals and totals of PAHs, DDT, and PCBs from the four contributing watersheds (Dominguez Channel, Los Angeles River (LAR) , San Gabriel River (SGR), and the nearshore watersheds) (see Appendix II for more information). An LSPC model developed for the Dominguez Channel watershed was based on information initially provided by SCCWRP. LAR and SGR models were updated from earlier versions used for metals TMDLs in those two watersheds. The nearshore watershed was analyzed and modeled using LSPC by breaking it into 67 subwatersheds that discharge directly to the Greater Los Angeles and Long Beach Harbor waters. These sub-watersheds were then aggregated by receiving waterbody; e.g. nearshore contributions to Inner Harbor consisted of stormdrains and surface (sheet) flows that discharge directly into the Inner Harbor. See Figure 5-5 at the end of this section for nearshore watersheds and associated neighboring waters.

Model development throughout Los Angeles waters relies on regionally-calibrated metals parameters, stormwater event mean concentrations (EMCs) for PAHs, predicted sediment loads and receiving water sediment concentrations for DDT and PCBs as well as simulated (and LAR hourly observed) flows to estimate pollutant loadings. The simulation time frames for the LSPC watershed model were expanded to 1995-2005 to generate temporally consistent model output from each contributing watershed. A separate approach was used to estimate dry weather loads, as described in Appendix II, Section 2. These were combined with the wet weather loads and the resulting loads from all contributing watersheds were applied to the estuarine and marine receiving waters.

Detailed model results are presented in Appendix II. This modeling approach relied on a regional modeling approach using regionally-calibrated parameter values, consistent with other TMDLs in the Los Angeles Region. While the watershed model results did not always predict the observed values, they generally captured the range of observations; however, deviations from the observed values did occur (see Appendix II). Given the limited data available for model calibration and validation, there were not enough data to justify refinement of the calibrated and validated parameter values associated with the regional modeling approach (which were developed using significantly larger datasets). Overall, the TMDL model made use of the best available data at the time of modeling.

Table 5-1 below shows total loads from the four contributing watersheds to the Greater Harbor waters by comparing them to one another. Overall, the Los Angeles River is the largest freshwater contributor of pollutants to the greater Harbor waters; LA River flows primarily impact water quality in eastern San Pedro Bay. The Inner Harbor receives the bulk of the loading from the nearshore watershed, which is expected since this waterbody has the largest nearshore drainage areas and acts as a pollutant sink. See Table 5-2. For Dominguez Channel, Los Angeles River, and San Gabriel River, all of their loadings are directly received by their downstream estuaries (Dominguez Channel Estuary, Los Angeles River Estuary, and San Gabriel River Estuary, respectively).

**Table 5-1. Comparative Watershed Loadings to Greater Harbor Waters.**

| | LSPC Modeled Existing Loading by Watershed (1995-2005) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dominguez Channel | | Los Angeles River | | San Gabriel River | | Nearshore Watershed | |
| Contaminant | Percent of Total Loading | Average Daily Load (kg/day) | Percent of Total Loading | Average Daily Load (kg/day) | Percent of Total Loading | Average Daily Load (kg/day) | Percent of Total Loading | Average Daily Load (kg/day) |
| **Wet Conditions** | | | | | | | | |
| Sediment | 5.6% | 1.88E+05 | 72.0% | 2.79E+06 | 20.4% | 4.90E+05 | 1.9% | 6.54E+04 |
| Total Copper | 4.3% | 3.58E+01 | 81.1% | 7.85E+02 | 12.5% | 7.51E+01 | 2.1% | 1.78E+01 |
| Total Lead | 3.0% | 2.08E+01 | 71.5% | 5.67E+02 | 23.3% | 1.15E+02 | 2.2% | 1.53E+01 |
| Total Zinc | 5.0% | 3.56E+02 | 72.2% | 5.89E+03 | 20.2% | 1.02E+03 | 2.6% | 1.84E+02 |
| Total DDT | 9.2% | 2.20E-02 | 89.5% | 2.46E-01 | 0.7% | 1.15E-03 | 0.7% | 1.59E-03 |
| Total PAH | 8.0% | 2.04E+00 | 70.2% | 2.07E+01 | 16.1% | 2.95E+00 | 5.8% | 1.50E+00 |
| Total PCB | 2.3% | 1.38E-02 | 97.5% | 6.86E-01 | 0.1% | 3.11E-04 | 0.2% | 9.92E-04 |
| **Dry Conditions** | | | | | | | | |
| Sediment | 0.7% | 8.57E+01 | 19.0% | 2.27E+03 | 80.1% | 1.01E+04 | 0.1% | 1.54E+01 |
| Total Copper | 2.6% | 2.56E-01 | 48.7% | 4.69E+00 | 40.8% | 4.18E+00 | 8.0% | 7.78E-01 |
| Total Lead | 0.9% | 3.48E-02 | 19.8% | 7.86E-01 | 72.9% | 3.07E+00 | 6.5% | 2.59E-01 |
| Total Zinc | 0.9% | 5.65E-01 | 30.4% | 1.90E+01 | 62.6% | 4.15E+01 | 6.2% | 3.89E+00 |
| Total DDT | 7.7% | 1.90E-05 | 83.0% | 2.01E-04 | 9.3% | 2.38E-05 | 0.0% | 2.88E-10 |
| Total PAH | 6.8% | 7.06E-02 | 62.7% | 6.39E-01 | 30.4% | 3.29E-01 | 0.0% | 4.18E-05 |
| Total PCB | 1.8% | 1.06E-05 | 97.1% | 5.59E-04 | 1.1% | 6.43E-06 | 0.0% | 1.45E-10 |

**Table 5-2. Receiving Waterbody and Contaminant Loading from the Near Shore Watershed (based on LSPC model output).**

| Contaminant | | Alamitos Bay | Los Angeles Harbor - Cabrillo Marina | Los Angeles Harbor - Consolidated Slip | Los Angeles Harbor - Fish Harbor | Los Angeles Harbor - Inner Cabrillo Beach Area | Los Angeles River Estuary | Los Angeles/Long Beach Inner Harbor | Los Angeles/ Long Beach Outer Harbor (inside breakwater) | San Pedro Bay Near/Off Shore Zones |
|---|---|---|---|---|---|---|---|---|---|---|
| Total Copper | Percent of Total Loading | 54.9% | 3.1% | 0.1% | 1.2% | 0.8% | 0.6% | 28.2% | 4.9% | 6.2% |
| | Average Daily Load (kg/day) | 1.36E+00 | 7.74E-02 | 1.50E-03 | 3.04E-02 | 1.97E-02 | 1.52E-02 | 6.97E-01 | 1.21E-01 | 1.54E-01 |
| Total Lead | Percent of Total Loading | 59.9% | 2.8% | 0.1% | 1.1% | 0.7% | 0.5% | 25.0% | 4.0% | 5.9% |
| | Average Daily Load (kg/day) | 1.05E+00 | 4.95E-02 | 9.29E-04 | 2.02E-02 | 1.20E-02 | 9.03E-03 | 4.39E-01 | 7.12E-02 | 1.04E-01 |
| Total Zinc | Percent of Total Loading | 59.5% | 2.7% | 0.1% | 1.0% | 0.6% | 0.6% | 25.2% | 4.3% | 5.9% |
| | Average Daily Load (kg/day) | 1.30E+01 | 6.00E-01 | 1.23E-02 | 2.28E-01 | 1.40E-01 | 1.31E-01 | 5.51E+00 | 9.41E-01 | 1.30E+00 |
| Total DDT | Percent of Total Loading | 15.5% | 3.0% | 0.1% | 2.2% | 0.7% | 2.4% | 66.9% | 7.3% | 2.0% |
| | Average Daily Load (kg/day) | 2.46E-05 | 4.81E-06 | 9.93E-08 | 3.43E-06 | 1.11E-06 | 3.78E-06 | 1.06E-04 | 1.16E-05 | 3.25E-06 |
| Total PAH | Percent of Total Loading | 53.5% | 2.9% | 0.1% | 1.3% | 0.7% | 0.6% | 29.1% | 4.2% | 7.6% |
| | Average Daily Load (kg/day) | 8.04E-02 | 4.32E-03 | 1.32E-04 | 1.97E-03 | 1.13E-03 | 9.16E-04 | 4.37E-02 | 6.27E-03 | 1.14E-02 |
| Total PCB | Percent of Total Loading | 11.0% | 2.5% | 0.0% | 2.5% | 0.6% | 2.7% | 71.4% | 7.7% | 1.5% |
| | Average Daily Load (kg/day) | 1.10E-05 | 2.45E-06 | 4.46E-08 | 2.47E-06 | 5.69E-07 | 2.68E-06 | 7.08E-05 | 7.68E-06 | 1.53E-06 |

**Dominguez Channel Estuary and Greater Los Angeles and Long Beach Harbor waters**
The EFDC model was used to simulate hydrodynamics and water and sediment quality of Dominguez Channel Estuary and the Greater LA/LB Harbor waters (see Appendix I for more details). The EFDC model applied a simulated time period of 2002-2005. The model was calibrated with numerous sediment monitoring studies, and it benefitted significantly from POLA/POLB sediment characterization study (2006) which yielded sediment, porewater and overlying water concentrations as well as results from highly sensitive monitoring (SPME) devices for detecting DDT, PCBs, and PAHs in the water column (SCCWRP 2007). The EFDC model also considered ocean water (outside breakwater) conditions as well as fine and course sediment transport and deposition within this hydrologically connected system of fresh and saline waters. While a grid was used to represent Dominguez Channel Estuary and the Greater LA/LB Harbor waters, it is important to note that the grid was not modeled as a closed system. Specifically, water, sediment, and associated pollutant loads can be exchanged both in and out of the model grid through the open ocean boundary.

Ultimately the EFDC model was integrated with LSPC output – hourly for three watersheds, daily for nearshore watersheds – to model total metals, PAHs, PCBs, and DDT (total) concentrations in the receiving waters. The EFDC model was used to quantify fine and coarse sediment deposition rates associated with each waterbody. These rates were summed, yielding the total deposition rate for each waterbody multiplied by the corresponding average modeled existing sediment concentration (in the top 5 cm of active sediment layer) or the target concentration to estimate the existing and target pollutant loads, respectively, within each waterbody (Table 5-3). The sediment flux is dependent on watershed inputs as well as tidal movements between waterbodies.

**Table 5-3. Sediment Deposition Rates per Waterbody**

| Waterbody Name | TMDL Zone | Area (acres)[1] | Area ($m^2$)[1] | Total Deposition (kg/yr)[2] |
|---|---|---|---|---|
| Dominguez Channel Estuary | 01 | 140 | 567,900 | 2,470,201 |
| Consolidated Slip | 02 | 36 | 147,103 | 355,560 |
| Inner Harbor - POLA | 03 | 1,539 | 6,228,431 | 1,580,809 |
| Inner Harbor - POLB | 08 | 1,464 | 5,926,130 | 674,604 |
| Fish Harbor | 04 | 91 | 368,524 | 30,593 |
| Cabrillo Marina | 05 | 77 | 310,259 | 38,859 |
| Cabrillo Beach | 06 | 82 | 331,799 | 27,089 |
| Outer Harbor - POLA | 07 | 1,454 | 5,885,626 | 572,349 |
| Outer Harbor - POLB | 09 | 2,588 | 10,472,741 | 1,828,407 |
| Los Angeles River Estuary | 10 | 207 | 837,873 | 21,610,283 |
| San Pedro Bay | 11 | 8,173 | 33,073,517 | 19,056,271 |

[1] Area obtained from GIS layer of the 2006 303(d) list. Available at: http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_lists2006_gis.shtml

[2] Sediment deposition rates were calculated by approximating the average mass of total sediment (fine and coarse particles) deposited in each waterbody annually based on 2002-2005 EFDC output. Sediment flux for each grid cell, which is dependent on watershed inputs as well as tidal movements between waterbodies, was obtained from the EFDC model output. These values were summarized across each TMDL zone, resulting in the average deposition of both sediment fines and sand by waterbody. The total deposition rate is simply the sum of the rates for fines and sand and this value is the waterbody-specific average annual (clean) sediment deposition rate.

EFDC is a multidimensional (i.e., 1-D, 2-D, or 3-D) hydrodynamic and water quality model that has been used by EPA for TMDL development in river, lake, estuary, wetland, and coastal regions throughout the United States. The model has three primary components (hydrodynamics, sediment-toxic transport and fate, and water quality) integrated into a single model. The hydrodynamic component is dynamically coupled to salinity and temperature transport as well as to sediment-toxic transport and water quality components.

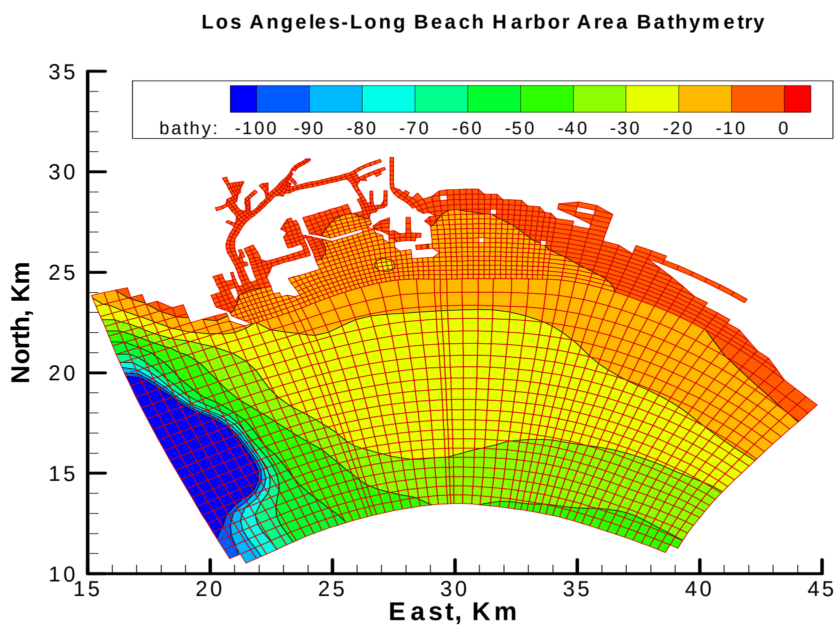
The water quality component of EFDC simulates eutrophication and sediment biogeochemical (diagenesis) processes. The eutrophication kinetics and sediment processes are similar to those in the USACE CE-QUAL-ICM or Chesapeake Bay water quality model. EFDC can simulate multiple classes of sediment such as suspended loads and bed loads as well as sediment deposition and re-suspension. The sediment transport is linked to toxic or contaminant transport and fate components. EFDC is capable of simulating any number of contaminants, including metals and hydrophobic organics, adsorbed to any sediment size class.

A brief overview of the hydrodynamic simulation model including grid set-up and model parameters are presented in the next section (additional details are provided in Appendix I).

### *5.2.1 Hydrodynamic Model*

**Computational Grid Setup and Boundary Conditions**

A multi-resolution, curvilinear spatial grid of the greater Los Angeles and Long Beach Harbor waters and San Pedro Bay was constructed using the Visual Orthogonal Grid Generation (VOGG) grid generation system (Tetra Tech, 2002). Shoreline boundaries for the grid were based on the NOAA/NOS electronic navigation charts in GIS format. The Dominguez Channel grid from a previous study was incorporated into the model (Everest, 2006). The grid system uses a multi-domain mapping, unique to the EFDC model, which allow a course resolution outside the breakwater in San Pedro Bay and a finer resolution in the harbors system. Bathymetric data were interpolated on to the model grid using an average of the bathymetric data points falling within a cell. The primary bathymetric data set used was the NOAA High Resolution Coastal Relief Data, which has a horizontal resolution of approximately 90 meters. Model grid and bathymetry are shown in Figure 5-4, except the Dominguez Channel estuary area.




Note: Elevation in meters relative to local mean sea level.
The portion of the grid in Dominguez Channel extending to Vermont Avenue is not shown. The grid for this area was represented by a previous study (Everest, 2006)

**Figure 5-4. EFDC Model Grid System and bathymetry for Los Angeles-Long Beach Harbor and San Pedro Bay.**

Boundary conditions for velocity and water elevations were specified for every grid cell in the model region. Salinity and temperature open boundary conditions were specified as spatially constant and temporally varying along the open boundary. The hydrodynamic and transport model was configured for a four-year historical simulation period from January 2002 through December 2005, since this period encompasses the greatest amount of observational data for model calibration and overlaps with the available watershed model output (see Appendix I for more details).

### *5.2.2 Sediment and Contaminant Transport Model*

**Sediment and Contaminant Transport Model Parameters**

The EFDC model simulates transport and fate in both the water column and sediment bed. Both fine, cohesive behaving sediment and noncohesive sand were simulated. Particulate organic material was assumed to be associated with the fine sediment class. Contaminants modeled included three metals; copper, lead, and zinc and three organics; DDT, PAH, and PCB. See Appendix I for more EFDC details). Two-phase equilibrium partitioning was used to represent for the Los Angeles and Long Beach Harbor adsorption of the metals and organics to the fine sediment class.

Water column transport included advection, diffusion, and settling for sediment and sediment adsorbed contaminates. The sediment bed was represented by multiple layers with internal transport of contaminants by pore water advection and diffusion. Sediment and water was exchanged between the water column and bed by deposition and erosion, with corresponding exchange of adsorbed and dissolved contaminants. Dissolved phase contaminants were also exchanged by diffusion between bed pore water and the overlying water column.

Initial water column conditions, based on available monitoring results were integrated into the model. However it is important to note that aqueous pollutant concentrations often wash out or rapidly respond to external sources and open boundary conditions. In contrast, initial bed sediment conditions are persistent and contamination levels change more slowly at annual scales and longer. Parameters used for hydrodynamic model development included salinity and bathymetry to reproduce observed water elevation and velocity patterns and magnitudes.

Equilibrium partition coefficients for three metals based on the 2006 POLA-POLB sediment and overlying water data are listed in Table 5-4. Both sets of values are within the literature range summarized by USEPA (2005). Water column partition coefficients for metal adsorption to dilute sediment (concentrations in the 1 to 100's mg/L) are typically larger than bed values.

**Table 5-4. Sediment Bed and Water Column Equilibrium Partition Coefficients and Particulate to Dissolved Concentration Ratios for Metals.**

| Contaminant | Average Bed Partition Coefficient Based on Total Solids (L/mg)[1] | Visual Best Fit Bed Partition Coefficient Based on Total Solids (L/mg)[1] | Water Column Particulate to Dissolved Concentration Ratio[2] | Estimated Water Column Partition Coefficient, 5 Times Column 3 (L/mg)[3] |
|---|---|---|---|---|
| Copper | 0.09 | 0.05 | 0.51 | 0.25 |
| Lead | 0.54 | 0.25 | 7.12 | 1.25 |
| Zinc | 0.02 | 0.01 | 0.20 | 0.05 |

[1] Based on POLA/POLB 2006 sediment bed and overlying water data.

[2] Based on POLA 2005 and 2006 mid-water data.

[3] Calculated based on POLA/POLB 2006 sediment bed and overlying water data.

Sediment initial conditions influence both sediment transport dynamics and the phase distribution and mobility of contaminants in the bed. Physical parameters for setting sediment initial conditions included: porosity, density, and grain size from numerous studies in the greater Los Angeles and Long Beach Harbor waters (Bight 98, WEMAP 99, Bight 03 and various POLA and POLB sediment analysis post-1997, n= 200). Available sediment bed grain size data suggested that a mean sand diameter between 0.125 and 0.250 mm would be appropriate. Sediment contaminant concentrations as well as particulate or total organic carbon (POC or TOC) data were interpolated into the model based on post 2000 available sediment chemistry results. See Appendix III.3 for monitoring results used to set up EFDC model initial conditions.

Equilibrium partition coefficients based on the 2006 POLA-POLB data for DDT, PAH, and PCB, as a function of bed sediment concentration and bed total organic carbon concentration. Since no functional dependence of the partition coefficients on sediment concentration and organic carbon is observed, average values were estimated for use in the modeling. Table 5-5 summarizes the estimated average equilibrium partition coefficients for the three organic contaminants based on the data.

**Table 5-5. Sediment Bed Equilibrium Partition Coefficients for Organics.**

| Contaminant | Bed Solids Based (L/mg)[1] | Bed TOC Based (L/mg)[1] | TOC Based Low Range (L/mg)[2] | TOC Based High Range (L/mg)[2] |
|---|---|---|---|---|
| DDT | 0.0002 | 0.02 | 0.0002 | 0.2 |
| PAH | 0.0004 | 0.04 | 0.01 | 2.0 |
| PCB | 0.0002 | 0.02 | 0.005 | 0.5 |

[1] Based on POLA-POLB 2006 sediment bed and overlying water data.

[2] Based on Chapra, 1997.

## 5.3 EFDC Model Calibration

### *5.3.1 Calibration of the Hydrodynamic Model*

After the model was set-up or configured, model calibration was performed. This is generally a two-phase process, with hydrodynamic calibration completed before repeating the process for water quality. Upon completion of the calibration at selected locations, a calibrated dataset containing parameter values (salinity, etc.) was developed.

Hydrodynamics was the first model calibration component because simulation of water quality loading relies heavily on flow prediction. The hydrodynamic calibration involves a comparison of model results to water elevation and velocity observations at selected locations. After comparing the results, key hydrodynamic parameters were adjusted and additional model simulations were performed. This iterative process was repeated until the simulated results closely represented the system and reproduced observed water elevation and velocity patterns and magnitudes.

The parameters that need to be calibrated for tidal elevation and velocity were the amplitude and phase of the incoming tidal constituent waves along the open boundary. The amplitude and phase along the three open boundaries were determined using a proprietary optimization procedure to minimize the difference between the observed and predicted complex amplitudes (cosine and sine amplitudes). Figure 5-5 shows a visual comparison of tidal frequency water surface elevation at the NOAA Gauge. As shown in this figure, agreement between observed and predicted tidal water surface elevations is reasonably good for the NOAA tide gauge station (note: additional details are provided in Appendix I).

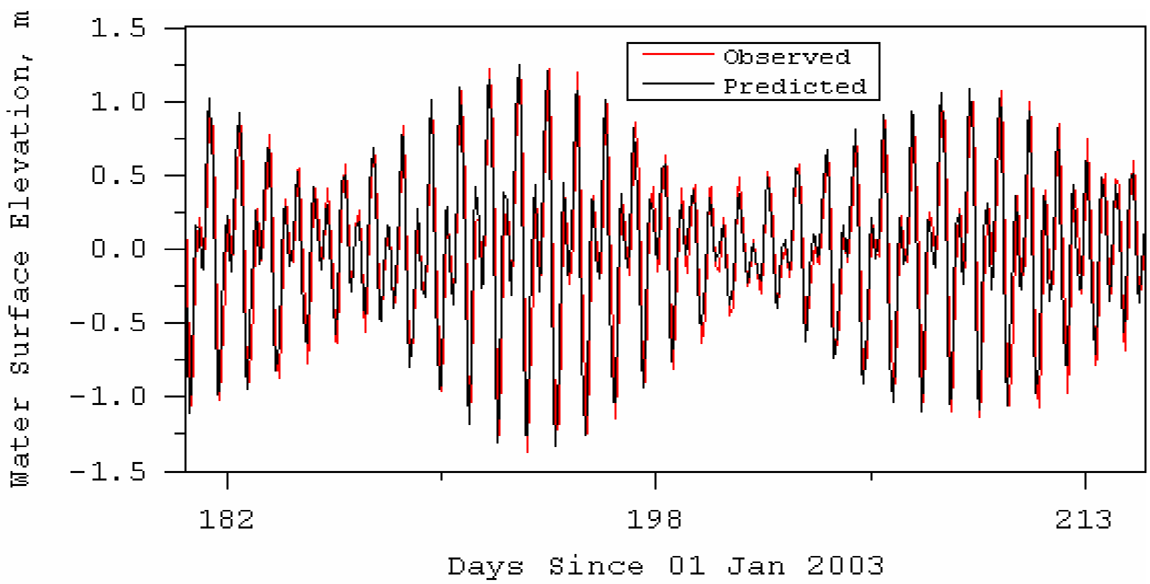



**Figure 5-5. Tidal water surface elevation comparison at NOAA tide gauge in Los Angeles Harbor**

Figure 5-6 shows a scatter plot comparing predicted and observed data for the 20 station locations for four sampling times from December 2004 to March 2005. The surface and bottom notation corresponds to averages over the upper and lower halves of the water column. Predicted salinities over the lower half of the water column agree reasonably well with observations although there are clusters of over and under prediction. Predicted salinities for the upper half of the water column agree reasonably well at most stations although the model tends to under predict surface salinity which the exception of a number of stations having over prediction. The solid lines represent linear regression fits. The lower range of variability of the bottom values yields a slope that is overly influenced by extreme values. The fit for the surface values yields a near unity slope.

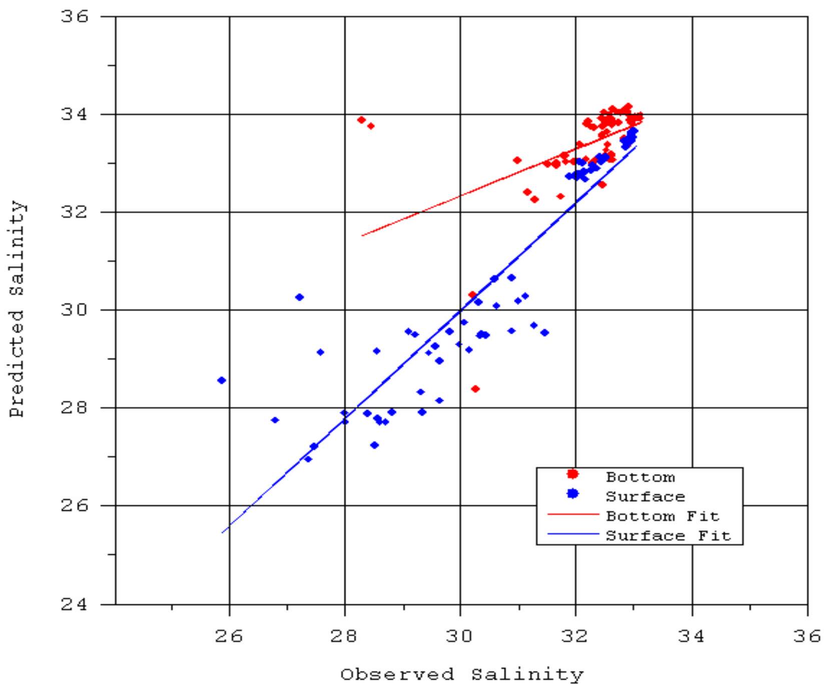


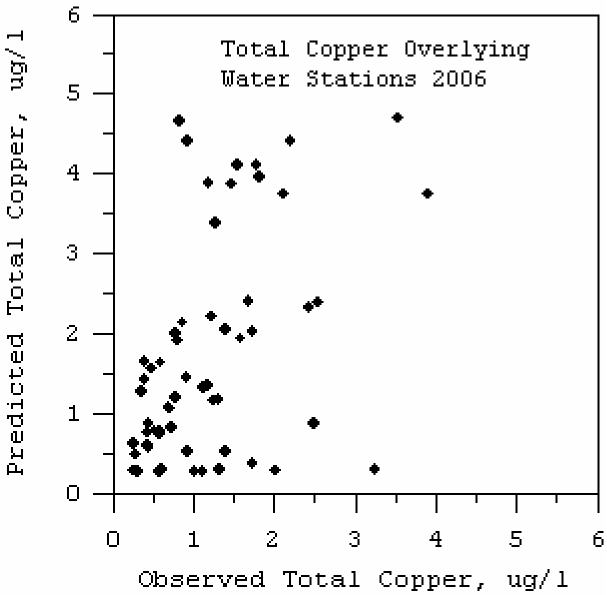

**Figure 5-6. Comparison of EFDC predicted and observed salinity at 20 stations for four sampling times during the December 2004 to March 2005 period using NOAA Port wind fields**

As can be seen from the comparisons indicated in the above figures, the hydrodynamic model provides a good foundation for the simulation of sediment and contaminant transport modeling in the greater harbor water system (see Appendix I for more details, especially Appendix A embedded within Appendix I, which presents time series plots of the modeled and observed salinity illustrating the model's response to high freshwater inflows).

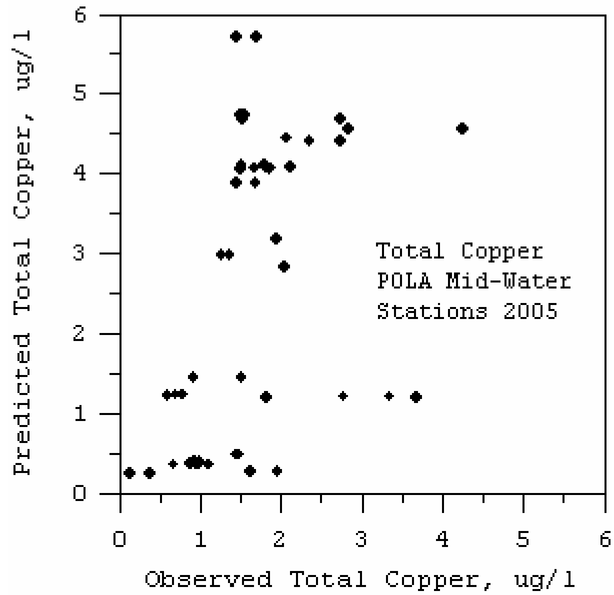
### ***5.3.2 Calibration of the Sediment and Contaminant Transport Model***

The observational data available for sediment and contaminant transport model calibration and validation is sparse. Due to these data limitations, only a calibration effort was undertaken, as an independent set of data was not available to perform model validation. As mentioned in the preceding section, observational data defining conditions in the sediment bed were used for model initialization and are not appropriate for use in calibration. The calibration approach taken in this study was to use observational data in the water column for model calibration. Observational data in the water column included sediment and contaminant concentrations measured near the bottom of the water column during fall 2006.

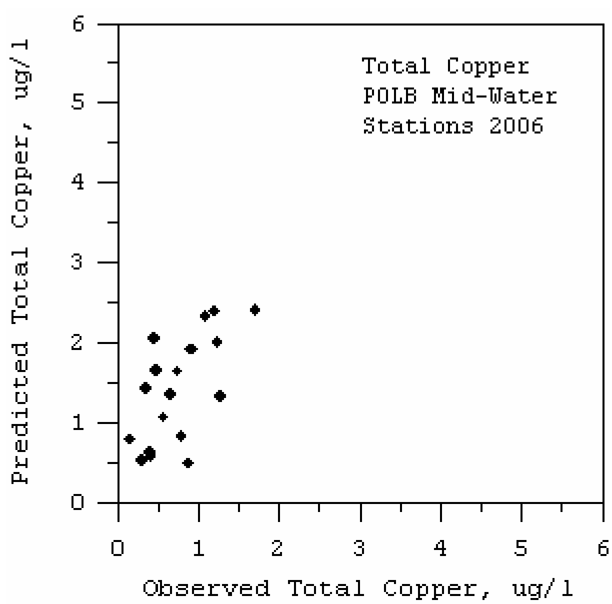
The degree of calibration of the sediment and contaminant transport model is evaluated using sediment and contaminant concentrations at the 60 fall 2006 overlying water sites and the 2005 and fall 2006 mid-water column sites. As previously noted, the mid-water column sites only have data for the three metals. Overlying water sites failed to provide detectable concentrations of PCB, resulting in no calibration results being presented for PCB other than confirmation that the model predicted water column PCB levels were below detection limits. As was done for the sediment comparison, contaminant concentrations were averaged over the six-month dry season period from May to October 2005 for comparison with instantaneous observations taken during dry fall conditions (mostly in 2006). Results for copper simulations are shown as an example (Figure 5-7). Appendix I provides additional details and calibrations results associated with the EFDC model.




(a)




(b)




(c)

**Figure 5-7. Comparison of model predicted and observed copper concentration at the overlying water and mid-water column sites (Appendix I, Figure 43)**

Overall, there were extremely limited data available for model calibration and the best available data and information were incorporated into the models. While the model results did not always match the observed values, it generally captured the range of observations using the data and information available at the time of model development. Appendix I provides extensive detail on the model calibration efforts and results.

## 5.4 Summary of Linkage Analysis

The LSPC model was developed and applied to TSS and pollutant loads from freshwaters, including Dominguez Channel, Los Angeles River, San Gabriel River and nearshore areas. Comparison of LSPC model output based on 1995-2005 simulation period, shows the Los Angeles River contains the highest pollutant load of any of the four fresh watersheds. Output (2002-2005) from these watersheds was integrated into the EFDC receiving water model. Figure 5-8 below illustrates the TMDL zones simulated by EFDC as well as the nearshore watersheds draining to those zones.

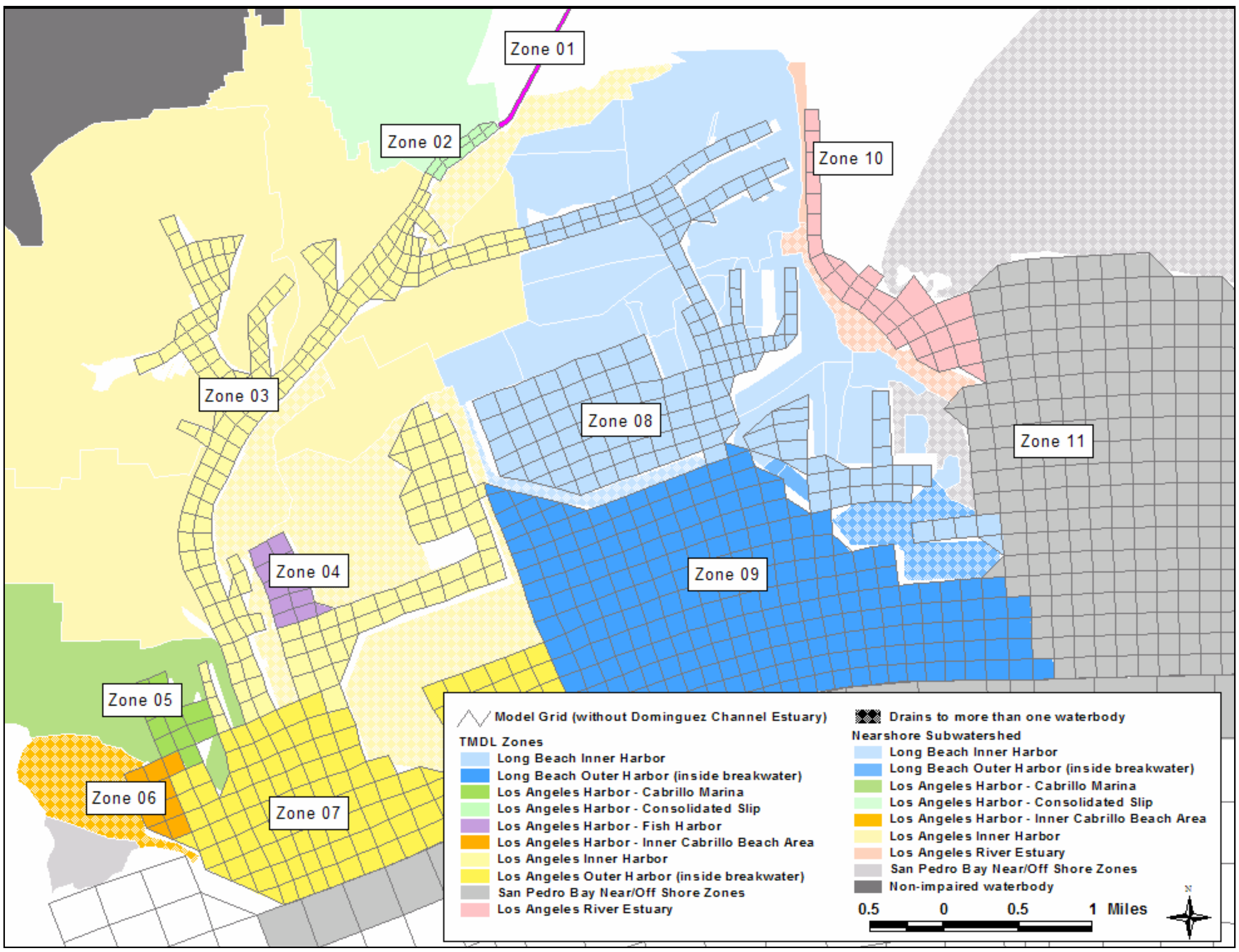



**Figure 5-8. Nearshore subwatersheds (LSPC model) associated with TMDL (EFDC) model zones**

The EFDC based hydrodynamic, sediment transport, and contaminant transport and fate model for the greater Los Angeles and Long Beach Harbors and adjacent region of San Pedro Bay has been calibrated and demonstrated to be suitable for use in TMDL development.

The EFDC model was used to generate a baseline as well as several other management scenarios and to evaluate relative contributions from various inputs to support water quality management decisions in these waters. The baseline scenario started with the initial conditions and then simulated four years ahead to determine average water and sediment conditions if no implementation occurs (see Appendix III, section 8) to characterize existing contaminant loads. Pollutant load reduction scenarios were performed to support allocation analyses and implementation alternatives. Appendix III, Part 8 provides details on all of these scenarios. The "no upland sources" scenario, which simulates conditions assuming no upland (watershed) contaminant loads, was used to support allocation of the TMDL loads.

Results of the "no upland sources" scenario were compared with results from the baseline scenario to quantify the relative contributions from the watersheds. Specifically, the model was run for 2002-2005 for these two scenarios and the resulting average sediment bed concentrations in each waterbody were quantified. The waterbody-specific values from each scenario were compared and the difference between them was represented as a percentage. This percentage was interpreted as the waterbody-specific percent contribution of the contaminant to the bed sediments from the upstream watersheds. These percentages were ultimately applied to both the TMDLs and the existing conditions to determine the wasteload allocation and existing load, respectively, associated with watershed inputs. The resulting WLAs were further distributed among MS4 permits based on the area draining to each waterbody (see Appendix III, Part 1).

Preliminary results for these two scenarios indicate that reducing freshwater input loads may not be sufficient to achieve target concentrations in water and sediments; thus decreasing contaminated pollutant levels in bed sediments may be required.

# 6 TMDLs and Allocations

This section explains the development of the loading capacities (i.e., TMDLs) and allocations for toxicants in the Dominguez Channel watershed and greater Harbor waters. EPA regulations require that a TMDL include waste load allocations (WLAs), which identify the portion of the loading capacity allocated to existing and future point sources (40 CFR 130.2(h)) and load allocations (LAs), which identify the portion of the loading capacity allocated to nonpoint sources (40 CFR 130.2(g)). As appropriate waste load allocations are assigned to point sources, such as wastewater treatment plants, storm water discharges, power generating stations, and other NPDES discharges. Load allocations are assigned to existing sediments and atmospheric deposition. As discussed in previous sections, the flows, sources, and the relative magnitude of inputs vary between pollutant types as well as seasonal conditions. Separate TMDLs have been developed for freshwaters in Dominguez Channel and Torrance Lateral; these apply during wet weather conditions only. TMDLs for impaired sediment chemistry, sediment quality conditions (benthic communities) and bioaccumulation (elevated fish tissue levels) apply year-round in Dominguez Channel Estuary and all other greater Harbor waterbodies.

Interim WLA and LA are to not allow any decrease in current facility performance. Interim allocations shall be met upon the effective date of the TMDL. As allocation-specific data are collected, interim targets for other pollutants and waterbodies may be identified.

## 6.1 Freshwater toxicity TMDLs in Dominguez Channel

The Basin Plan narrative toxicity objective does not allow acute or chronic toxicity in any receiving waters. To meet the narrative toxicity objective, a numeric toxicity target of 1 chronic toxicity unit (1 TUc) is established. Equation 1 describes the calculation of a TUc.

TUc – Toxicity Unit Chronic = 100/NOEC (no observable effects concentration) (Eq. 1)

To calculate the TUc: TUc = 100% divided by the sample concentration, derived using hypothesis testing, to cause no observable effect, with the sample concentration expressed as a percentage. For example, if the NOEC is estimated to 25% using hypothesis testing, then the TUc equals 100/25 = 4 toxic units.

An updated Toxicity Policy is now in development by the State Water Resources Control Board and may establish new toxicity criteria. Targets that are based on new criteria that achieve the narrative objective of Chapter 3 of the Basin Plan may substitute for the TUc of 1, when those new criteria are adopted and in effect.

As discussed in the Problem Statement section, whereas toxicity results are re-occurring (6 of 14 over 7 years), diazinon does not appear to be elevated and thus is probably not the causative agent. Recent City of Los Angeles monitoring data show diazinon exceedences from 2002-2005, but none from 2006-2010 (zero of 34 samples). This timing is consistent with the EPA ban on urban use of diazinon, effective Dec. 31, 2005. Based on available monitoring results, no diazinon TMDLs have been developed at this time. The Regional Board may revisit the potential for diazinon TMDLs in the future or if the data record continues to show no exceedences the Board may pursue delisting this pollutant in future 303(d) Listing cycles.

### *6.1.1 Toxicity Allocations – Wasteload and Load Allocation*

To address toxicity occurring in freshwaters of Dominguez Channel, the allocations will equal the numeric target and loading capacity. Therefore the allocation of 1 TUc applies to each source, including all point sources and non-point sources (Table 6-1). Similar toxicity allocations have been applied to other freshwater TMDLs including Calleguas Creek Watershed Toxicity TMDL. The fresh water interim allocation shall be implemented as a trigger for initiation of the TRE/TIE process as outlined in USEPA's "Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination System Program" (2000) and current NPDES permits. The fresh water interim allocation shall be implemented in accordance with US EPA, State Board and Regional Board resolutions, guidance and policy at the time of permit issuance, modification or renewal.

**Table 6-1. Wasteload and Load Allocations for dischargers into Dominguez Channel freshwaters.**

| Allocations | Interim* | Final |
|---|---|---|
| Waste load Allocations | | |
| MS4 – LA County | 2 TUc | 1 TUc |
| CalTrans | 2 TUc | 1 TUc |
| Other permittees** | 2 TUc | 1 TUc |
| *Load Allocations* | | |
| non-point sources | 2 TUc | 1 TUc |

* LACDPW results are currently <2 TUc so this interim should be easily achieved.
** 'Other permittees' includes General Construction and General Industrial permittees as well as minor permittees with irregular discharges during wet weather.

### *6.1.2 Freshwater Toxicity – Margin of Safety*

An implicit margin of safety is included in these toxicity TMDLs. Chronic Toxicity unit allocations will be protective of both acute and chronic exposures. No explicit margin of safety is required as meeting the final allocation will attain the applicable narrative objective; i.e., "no toxics in toxic amounts."

## 6.2 **Freshwater wet weather metals TMDLs in Dominguez Channel**

Freshwater metals TMDLs within Dominguez Channel are based on repeated exceedences of CTR criteria for dissolved copper, lead and zinc in wet weather. No exceedence has been observed in dry weather; therefore no dry weather metals TMDLs are required for this waterbody. These freshwater metal TMDLs utilize a similar approach to other Regional Board metals TMDLs; that it, the targets are set for acute conditions, hardness dependent, and expressed in total metals concentrations. See Table 3-2 to review total metal targets.

Mass-based WLAs have been developed for combined stormwater sources, that is, MS4, Caltrans sources, and flow data will rely on approximate daily storm volume.

Concentration-based WLAs have been developed for General Construction and General Industrial; (and) non-stormwater discharges; e.g., minor, general and future minor NPDES permits.

### *6.2.1 Wet Weather TMDLs*

Wet-weather TMDLs apply when the maximum daily flow in the Dominguez Channel is equal to or greater than 63 cfs as measured at LACDPW flow gauge S-28. This gauge is located in Dominguez Channel at Vermont Ave. and represents only freshwater flows.

During wet weather, the allowable load is a function of the volume of water in the Channel and the total metal target concentration. See Equation 2. Given the variability in wet-weather flows, the concept of a single critical flow is not justified. Instead, a load duration curve approach was used to establish the wet-weather loading capacity. In brief, a load duration curve is developed by multiplying the wet-weather flows by the in-stream numeric target. The result is a curve, which identifies the allowable load for any given flow. The wet-weather loading capacity applies to any day when the maximum daily flow measured at a location within the Dominguez Channel is equal to or greater than 62.7 cfs, which is the 90$^{th}$ percentile of annual flow rates from the estimated modeled flow rates. The wet-weather freshwater metals TMDLs were defined by these load-duration curves and are presented in Table 6-2.

TMDL (g/day) = loading capacity = daily storm volume (liters) X numeric target (µg/L) / 1,000,000 (Eq. 2)

**Table 6-2. Wet-weather loading capacities (TMDLs) for metals (total recoverable metals).**

| Reach | Copper (kg/day) | Lead (kg/day) | Zinc (kg/day) |
|---|---|---|---|
| Dominguez Channel (freshwater) | Daily storm volume x 9.7 g/L | Daily storm volume x 42.7 g/L | Daily storm volume x 69.7 g/L |

The daily storm volume is equal to the total daily flow in Dominguez Channel measured at site S28.
Metal specific values are hardness dependent (50 mg/L) and site-specific conversion factors are applied.

The LSPC model was used to simulate flows and metals concentrations in Dominguez Channel from 1995-2005, providing daily flow volume and estimates of existing metals loads during wet days. By including all storm flows over the 1995-2005 period (an eleven-year period), analysis of critical conditions was included. Allowable loads were calculated by multiplying the daily flow volume (when Dominguez Channel maximum streamflow rate is greater than or equal to 62.7 cfs) by the appropriate numeric water quality target.

Based on modeling of the average annual loading capacity for each metal during only wet weather days, Table 6-3 compares the annual predicted existing load to the allowable load determined using the numeric targets. (Source: Tetra Tech spreadsheet, April 2011). The loads presented in Table 6-3 are based the load duration curves; therefore, the numbers used in these calculations are from the bars in the load duration curves presented for each metal or the total loads under the loading capacity curves (Appendix III, Figures III.2-2 to III.2-4).

Specifically, for the existing loads, the loads associated with all bars in the load duration curves are summed, but for the average annual allowable loads, the total possible loads below the loading capacity curve are summed. These total existing loads or total allowable loads (which are based solely on wet days over the eleven-year modeling period) were divided by eleven to yield average annual wet weather loads. It is important to note that these “annual” loads are only based on the wet days. If they are converted to average daily loads for comparison with the TMDL loads in Table 6-4, they should be divided by an average of 28 wet days per year (in the eleven-year simulation period, there were a total of 307 wet days). The percent reductions in Table 6-3 are estimates to provide readers with an approximate level of pollutant reductions during wet weather on daily basis.

**Table 6-3. Dominguez Channel freshwater model-predicted average annual loads (kg) and percent reduction required.**

| Metal[1] | Allowable load (kg) | Existing load (kg) | Percent reduction required |
|---|---|---|---|
| Total Copper[2] | 245 | 776 | 72.0% |
| Total Lead[3] | 1080 | 440 | 3.1% |
| Total Zinc[2] | 1763 | 6747 | 76.4% |

[1] The numeric targets presented in Table 3-2 (based on CTR) were used to determine allowable loads for all three metals in the watershed model.
[2] Copper and zinc average annual and daily existing loads were consistently above the allowable load (based on wet days in the eleven-year modeling period), requiring 72% and 76% reductions, respectively.
[3] Although the average annual existing load of Pb is below the average annual allowable load (based on wet days in the eleven-year modeling period), there are a few exceedances of the allowable daily load in the modeled Load Duration Curve, thus a small percent reduction is required.

Wet-weather load-duration curves for each metal, along with the 1995-2005 wet weather modeled existing loads are presented in Appendix III, Part - 2. For practical purposes of comparing stormwater data to the TMDLs, the wet-weather load for a day is calculated based on the stormwater event mean concentration (EMC) from a flow-weighted composite.

Model results for lead are different from results for copper and zinc since the average annual existing lead loads are less than the average annual allowable load (based on wet days in the eleven-year modeling period). Given that this is an average condition; some daily loads are expected to be above this load, while others will fall below, as illustrated by the lead load duration curves in Appendix III.2 (Figure III.2-3). When comparing the sum of the daily exceedance loads with the sum of the total lead existing loads in the load duration curves, a 3.1 percent load reduction is required to achieve the loading capacity.

### *6.2.2 <u>Wet-weather Allocations</u>*

Wet-weather allocations are assigned to all upstream reaches and tributaries of Dominguez Channel (above Vermont Avenue) because they potentially drain to these impaired freshwater reaches during wet weather. Allocations are assigned to both point (WLA) and nonpoint sources (LA). A mass-based LA has been developed for direct atmospheric deposition. A mass-based waste load allocation (WLA) is divided between the MS4 permittees and Caltrans under its NPDES stormwater permit by subtracting the other stormwater or NPDES waste load allocations, air deposition and the margin of safety from the total loading capacity. Individual MS4 waste load allocations are further defined for Los Angeles County MS4 Permittees and Caltrans based on land use percentages within the Dominguez Channel watershed. Concentration-based WLAs are assigned for the other point sources including but not limited to General Construction, General Industrial, Power Generating stations, minor permits and irregular dischargers, and other NPDES dischargers.

#### *6.2.2.1 Wet-Weather Load Allocations*

An estimate of direct atmospheric deposition is developed based on the percent area of surface water in the watershed. Approximately 0.3% of the watershed area draining to the freshwater portion of Dominguez Channel is comprised of surface water. The load allocation (LA) for atmospheric deposition is calculated by multiplying this percentage by the difference of total loading capacity (TMDL) and margin of safety (MOS), according to the following equation:

$$LA_{\text{Direct Atmospheric Deposition}} = 0.03 \times (TMDL - MOS)$$

#### *6.2.2.2 Wet-Weather Waste Load Allocation for Stormwater*

Wet-weather waste load allocations for the LA County and CalTrans stormwater permittees are calculated in the same manner as other metals TMDLs in Los Angeles region. Since the direct atmospheric deposition is calculated as a percentage of the TMDL, the equation becomes:

$$WLA_{\text{Stormwater permittees}} = TMDL - MOS - LA_{\text{Direct Atmospheric Deposition}}$$

Wet weather mass-based allocations for direct air deposition and stormwater permittees are presented in Table 6-4.

#### *6.2.2.3 Wet-Weather Waste Load Allocation for other NPDES Permits*

Concentration-based waste load allocations are established for General Construction and General Industrial stormwater and other minor NPDES permittees that discharge to Dominguez Channel to ensure that these point sources do not contribute to exceedances of the CTR criteria. The concentration-based waste load allocations are equal to the wet-weather numeric targets for each total recoverable metal expressed as an average daily concentration, identified as "other stormwater/NPDES" in Table 6-4. Any future minor NPDES permits or enrollees under a general non-stormwater NPDES permit will also be subject to the concentration-based waste load allocations.

**Table 6-4. Wet-weather TMDLs and Allocations for copper, lead and zinc (g/d) in Dominguez Channel. Allocation values presented here are based on daily volume associated with stream flow rate = 62.7 cfs at monitoring station S28.**

| Dominguez Channel | Percent area | Total Copper | Total Lead | Total Zinc |
|---|---|---|---|---|
| TMDL | 100% | 1485.1 | 6548.8 | 10,685.5 |
| Waste Load Allocations | | | | |
| Municipal Stormwater | 97.3% | 1300.3 | 5733.7 | 9355.5 |
| CalTrans Stormwater | 2.4% | 32.3 | 142.6 | 232.6 |
| Other stormwater/NPDES | N/A | [9.7 µg/L] | [42.7 µg/L] | [69.7 µg/L] |
| Load Allocations | | | | |
| Air Deposition | 0.3% | 4.0 | 17.7 | 28.9 |
| Margin of Safety | | | | |
| MOS (10%) | N/A | 148.5 | 654.9 | 1069.6 |

Mass-based stormwater values were based on total recoverable metal targets, a hardness of 50 mg/L and a flow of 62.7 cfs (daily volume = $1.5 \times 10^8$ liters).
Recalculated mass-based allocations using ambient hardness and flow rate at the time of sampling are considered consistent with the assumptions and requirements of these waste load allocations. In addition, samples collected during flow conditions less than the 90th percentile of annual flow rates must demonstrate that the acute and chronic hardness dependent water quality criteria provided in the CTR are achieved. Other Stormwater/NPDES allocations are shown in total recoverable concentration.

Interim water allocations are assigned to stormwater dischargers, (MS4, general construction and general industrial stormwater dischargers) and other NPDES dischargers. Interim water allocations listed in Table 6-5 are based on the 95th percentile of total metals concentrations collected from January 2006 to January 2010 using a log-normal distribution. The use of 95th percentile values to develop interim allocations is consistent with NPDES permitting methodology. Regardless of the interim allocations below, permitted dischargers shall ensure that effluent concentrations and mass discharges do not exceed levels that can be attained by performance of the facility's treatment technologies existing at the time of permit issuance, reissuance or modification.

**Table 6-5. Wet-weather Concentration-based Dominguez Channel and Torrance Lateral freshwater interim metal allocations (ug/L)**

| Allocation | Copper | Lead | Zinc |
|---|---|---|---|
| **Interim water allocation** | 207.5 | 122.9 | 898.9 |

Based on hardness of 50 mg/L.
Recalculated concentration-based allocations using ambient hardness at the time of sampling are considered consistent with the assumptions and requirements of these waste load allocations. In addition, samples collected during flow conditions less than the 90th percentile of annual flow rates must demonstrate that the acute and chronic hardness dependent water quality criteria provided in the CTR are achieved.

### *6.2.3 Margin of Safety-Dominguez Channel freshwater*

The federal statute and regulations require that TMDLs include a margin of safety (MOS) to account for any lack of knowledge concerning the relationships between effluent limitations and water quality. To account for any additional uncertainty in the wet-weather freshwater TMDLs, an explicit MOS equal to 10% of the loading capacity or existing load available for wet-weather allocations has been included. The 10% MOS was subtracted from the loading capacity or existing load, whichever is smaller. Applying an explicit margin of safety is reasonable because a number of uncertain estimates are offset by the explicit margin of safety. While the observed dissolved-to-total metals ratios are not similar to CTR default conversion values, there appears to be very poor correlation between the fraction of particulate metals and TSS. Also, there is added uncertainty of stream flow rates during wet weather conditions, when the highest metal loads occur, thus an explicit margin of safety is justified.

## 6.3 **Freshwater wet weather metals TMDLs in Torrance Lateral**

Torrance Lateral is a sub-watershed within the larger Dominguez Channel watershed that flows directly into Dominguez Channel Estuary (approx. 2 miles below S28). Torrance Lateral refers to waters upstream of confluence with Dominguez Channel Estuary, consistent with LAC DPW sampling site TS19. Currently there is no flow gauge associated with stream flows within Torrance Lateral, thus the daily storm volume or load duration approach can not be applied.

### *6.3.1 Wet weather metals TMDLs in Torrance Lateral*

Recent monitoring results provide only 10 wet weather samples and no flow data within Torrance Lateral, thus the TMDL approach has been modified from that taken for freshwater metals in Dominguez Channel. For Torrance Lateral freshwaters, concentration-based TMDLs and allocations for the water column were developed; these are consistent with total metal targets identified for Dominguez Channel freshwaters. To address impaired sediments, sediment waste load allocations are assigned to all other dischargers to Torrance Lateral equal to the concentration-based sediment targets.

### *6.3.2 Wet-weather Allocations*

Until more robust results exist for waters sampled within the Torrance Lateral sub-watershed, the water column allocations are set equal to total metal concentration-based targets provided for Dominguez Channel. See Table 6-6. These allocations apply during all wet weather conditions; i.e., no base flow level has been identified. If future studies within Torrance Lateral provide sufficient flow data, then water column allocations maybe refined to apply above a designated stream flow rate.

These allocations apply to Los Angeles County MS4 Permittees. Non-point sources do not exist within this sub-watershed. Sediment concentration-based allocations are included here.

**Table 6-6. Water and Sediment Allocations for Torrance Lateral sub-watershed.**

| Media | Copper | Lead | Zinc |
|---|---|---|---|
| Water (unfiltered) | 9.7 µg/L | 42.7 µg/L | 69.7 µg/L |
| Sediment (TECs) | 31.6 mg/kg dry | 35.8 mg/kg dry | 121 mg/kg dry |

Hardness = 50 mg/L based on Dominguez Channel monitoring site S28.
Recalculated concentration-based allocations using ambient hardness at the time of sampling are considered consistent with the assumptions and requirements of these waste load allocations. In addition, samples collected during flow conditions less than the $90^{th}$ percentile of annual flow rates must demonstrate that the acute and chronic hardness dependent water quality criteria provided in the CTR are achieved. Other Stormwater/NPDES allocations are shown in total recoverable concentration.

#### *6.3.2.1 Wet weather wasteload allocations for ExxonMobil Refinery*

Exxon Mobil retains stormwater for its facility and part of the City of Torrance. Typically this stormwater is retained on-site and then preferentially diverted to a local wastewater treatment system; however there are rare times when the facility must discharge stormwater into Torrance Lateral. ExxonMobil has provided monitoring results and flow data, from 2000-2010, for two discharge events during this timeframe, both occurred during water year 2005 (very large rainfall year). These allocations assume that Refinery stormwater discharges will continue to be rare in the future; that is, these facilities will continue to maximize storage and divert large stormwater volumes into POTWs prior to discharging into Torrance Lateral or Dominguez Channel Estuary. ExxonMobil anticipates discharging stormwater once every seven years on average (ExxonMobil 2007). If, due to an increase in discharge frequency or volumes, it appears that the allocations are not supportive of the TMDL, these allocations may be revised. Based on this information as well as the total recoverable metals targets, the mass-based allocations for copper, lead and zinc for stormwater discharges from this NPDES permittee are shown in Table 6-7. No explicit allocations for PAHs are identified for ExxonMobil; however, discharges should not exceed existing water quality criteria for these individual compounds and continued monitoring should occur.

**Table 6-7. Waste Load Allocations for ExxonMobil refinery into Torrance Lateral.**

| Media | Copper | Lead | Zinc |
|---|---|---|---|
| Water (unfiltered) | 1.36 kg/yr | 5.98 kg/yr | 9.75 kg/yr |

Values are based on Q = 3.7 MGD for 7 days/year and total metal targets; assumes discharge events are irregular; e.g., once every seven years on average.

Compliance with the freshwater metals allocations for Dominguez Channel and Torrance Lateral may be demonstrated via any one of three different means:

a. Final allocations are met.
b. CTR total metals criteria are met instream.
c. CTR total metals criteria are met in the discharge.

### *6.3.3 Margin of Safety-Torrance Lateral*

An implicit margin of safety exists in the final wasteload allocations. The implicit margin of safety is based on multiple targets (for water and sediment). Currently no explicit margin of safety is applied to these TMDLs to address impaired conditions within the sediments; however, if any chemical-specific freshwater sediment quality value(s) is revised or updated contingent on future sediment quality studies, then an explicit margin of safety may be considered and may be applied.

## 6.4 **Impaired Sediment Quality Objective – Direct Effects TMDLs in Dominguez Channel Estuary and Greater Harbor waters**

Based on monitoring studies with sediment triad results, impaired sediment conditions exist and TMDLs are required for the following waterbodies: Dominguez Channel Estuary, Consolidated Slip, Inner, Outer and Fish Harbors, Los Angeles River estuary, eastern San Pedro Bay and Cabrillo Marina. The goal is to restore the beneficial uses of aquatic life within sediments of these waterbodies.

The categories designated in the State Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (SQO Part 1) as Unimpacted and Likely Unimpacted by the interpretation of multiple lines of evidence shall be considered as the protective narrative objective. Evaluation of achieving these desired categories relies on multiple lines of evidence, integrating sediment chemistry, sediment toxicity and benthic community index results. Numeric TMDLs and allocations are presented below and are expected to attain the narrative objective.

### *6.4.1 Interim Allocations for Sediment*

Interim sediment allocations are assigned to stormwater dischargers, (MS4, general construction and general industrial stormwater dischargers) and other NPDES dischargers. Interim sediment allocations are based on the 95$^{th}$ percentile of sediment data collected from 1998-2006 (Table 6-8). The use of 95$^{th}$ percentile values to develop interim allocations is consistent with NPDES permitting methodology. For waterbodies where the 95$^{th}$ percentile value has been equal to, or lower than, the numeric target, then the interim allocation is set equal to the final allocation. Regardless of the allocation, permitted dischargers shall ensure that effluent concentrations and mass discharges do not exceed levels that can be attained by performance of the facility's treatment technologies existing at the time of permit issuance, reissuance or modification.

Compliance with the interim concentration-based sediment allocations may be demonstrated via any one of three different means:

1. Demonstrate that the sediment quality condition of **Unimpacted** or **Likely Unimpacted** via the interpretation and integration of multiple lines of evidence as defined in the SQO Part 1, is met; or
2. Meet the interim allocations in bed sediment over a three-year averaging period; or
3. Meet the interim allocations in the discharge over a three-year averaging period.

**Table 6-8. Sediment, Interim Concentration-based Allocations**

| Waterbody | Pollutant (mg/kg sediment) | | | | | |
|---|---|---|---|---|---|---|
| | Copper | Lead | Zinc | DDT | PAHs | PCBs |
| Dominguez Channel Estuary | 220.0 | 510.0 | 789.0 | 1.727 | 31.60 | 1.490 |
| Long Beach Inner Harbor | 142.3 | 50.4 | 240.6 | 0.070 | 4.58 | 0.060 |
| Los Angeles Inner Harbor | 154.1 | 145.5 | 362.0 | 0.341 | 90.30 | 2.107 |
| Long Beach Outer Harbor (inside breakwater) | 67.3 | **46.7** | **150** | 0.075 | **4.022** | 0.248 |
| Los Angeles Outer Harbor (inside breakwater) | 104.1 | **46.7** | **150** | 0.097 | **4.022** | 0.310 |
| Los Angeles River Estuary | 53.0 | **46.7** | 183.5 | 0.254 | 4.36 | 0.683 |
| San Pedro Bay Near/Off Shore Zones | 76.9 | 66.6 | 263.1 | 0.057 | **4.022** | 0.193 |
| Los Angeles Harbor - Cabrillo Marina | 367.6 | 72.6 | 281.8 | 0.186 | 36.12 | 0.199 |
| Los Angeles Harbor - Consolidated Slip | 1470.0 | 1100.0 | 1705.0 | 1.724 | 386.00 | 1.920 |
| Los Angeles Harbor - Inner Cabrillo Beach Area | 129.7 | **46.7** | 163.1 | 0.145 | **4.022** | 0.033 |
| Fish Harbor | 558.6 | 116.5 | 430.5 | 40.5 | 2102.7 | 36.6 |

Numbers in **bold** are also the final allocation.

### *6.4.2 TMDL – Direct Effects*

The narrative objective provides two qualitative conditions that satisfy the support of aquatic life in sediments. These two qualitative conditions are either 'unimpacted' or 'likely unimpacted' which must be interpreted via evaluation multiple lines of evidence as described above. For these TMDLs, an alternative, quantitative expression, defined as meeting the sediment quality value (SQV) for each chemical[1] identified within the applicable Sediment Quality Plan, Part I – Direct Effects is included. The SQV for each chemical is initially set equal to the chemical-specific ERL values. However, the SQV may be modified or replaced based on future sediment quality studies, such as site-specific (toxicity or benthic impact) studies or stressor identification studies. Such special sediment studies may test for sediment toxicity (survival and sub-lethal effects) as well as benthic community response index. Also, plans for sediment special studies will be reviewed by the Regional Board and EPA in order to provide the basis for replacing an ERL as the SQV.

Attainment of the narrative sediment quality objective may occur either through demonstrating the waterbody has achieved the desired qualitative condition [clearly unimpacted or likely unimpacted] or the quantitative condition; i.e., if the ambient sediment chemistry levels within a waterbody are equal to or below the sediment quality values.

The direct effects TMDLs were calculated using annual average sediment deposition rates (Table 5-3) from the EFDC model output for each TMDL zone. These deposition rates were multiplied by the applicable numeric targets and a conversion factor to determine the loading capacities for each pollutant in each TMDL waterbody. See Appendix III, Part 1 for more information on the TMDL calculations. The loading capacities are presented in Table 6-10. This table also includes estimates of existing loads, which are consistent with the values presented in Table 4-6 and are based on the total deposition rate multiplied by the applicable existing sediment concentration and a conversion factor (the existing sediment concentrations are based on the average simulated sediment concentration from 2002-2005 in the top 5 cm of sediment).

### 6.4.3 *Allocations – Direct Effects*

These allocations apply to pollutant sources discharging into the waterbody as well as to existing sediments within each waterbody. To comply with Federal Regulations, wasteload and load allocations must be express in numeric form within TMDLs. See 40 C.F.R. § 130.2(h) & (i). For these TMDLs, the allocations are based on chemical specific sediment quality value (SQV), referring to the chemical concentration in the bulk sediments. The initial SQV value is equal to the ERL value. As described below, mass-based allocations were defined for some sources where sufficient data was available, whereas concentration-based allocations were identified for others.

#### *6.4.3.1 Waste Load Allocations – Direct Effects*

Wasteload Allocations are provided by waterbody and source-type in Table 6-9 and 6-10. Mass-based WLAs are identified for TIWRP and other point sources that have provided discharge flow data. (Refineries which have provided discharge flow data along with monitoring results receive mass-based allocations, whereas other refineries receive concentration-based allocations because no discharge flow data has been provided to Regional Board staff.) Stormwater sources,

[1] Sediment Quality Plan, Part I identifies the following specific contaminants of concern: Cu, Pb, Hg, Zn, PAHs (18 compounds), Dieldrin, Chlordane (3 isomers), DDT (6 isomers), total PCBs (18 congeners), TOC, % fines. Here the approach is simplified by developing TMDLs for total PAHs, total Chlordane, total DDT and total PCBs.

including Los Angeles County MS4 Permittees, City of Long Beach and Caltrans, have received individual, mass-based allocations by permit within each watershed. Stormwater discharges from the Port of Los Angeles (POLA) and Port of Long Beach (POLB) are grouped with the MS4 dischargers. Mass-based WLAs are applied as annual limits. Individual mass-based WLAs for an individual MS4 Permittee will be calculated based on its share, on an area basis, of the mass-based WLA or other approved approach available at the time final mass-based WLAs are in effect and incorporated into the permit.

As described above in Section 5.3, the relative difference between the baseline and "no upland sources" scenarios were interpreted as the waterbody-specific percent contribution of the contaminant to the bed sediments from the upstream watersheds. These percentages were applied to the TMDLs to determine the mass-based WLAs for the stormwater sources. These overall WLAs were further divided to individual, mass-based allocations by permit based on the percent area draining to each waterbody (see Appendix III, Part 1).

Concentration-based WLAs are identified for other sources, such as General Construction, General Industrial, Power Generating stations, minor permits and irregular dischargers into Dominguez Channel Estuary. Any future minor NPDES permits or enrollees under a general non-stormwater NPDES permit will also be subject to the concentration-based waste load allocations. Concentration-based limits are applied as daily limits.

Non-MS4 point sources such as General Construction, General Industrial, individual industrial permittees, including power generating stations, minor permits and irregular dischargers into Dominguez Channel Estuary and greater Harbor waters are assigned concentration-based allocations. Any future minor NPDES permits or enrollees under a general NPDES permit are also assigned the concentration-based waste load allocations. The allocations are set equal to the saltwater targets for metals and equal to the human health targets for the organic compounds in CTR. The averaging period for the concentration-based WLAs shall be consistent with that specified in the regulation establishing the criterion or objective or relevant implementation guidance published by the establishing agency.

**Table 6-9. Receiving (salt) Water Column Concentration-Based Waste Load Allocations**

| Constituents | Copper* (µg/L) | Lead* (µg/L) | Zinc* (µg/L) | PAHs (µg/L) | Chlordane (µg/L) | 4,4'-DDT (µg/L) | Dieldrin (µg/L) | Total PCBs (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **Dominguez Channel Estuary** | 3.73 | 8.52 | 85.6 | 0.049** | 0.00059 | 0.00059 | 0.00014 | 0.00017 |
| **Inner Harbor** | 3.73 | 8.52 | 85.6 | | | 0.00059 | | 0.00017 |

***** Total Concentration-based WLAs for metals are converted from saltwater dissolved CTR criteria using CTR saltwater default translators.

****** CTR human health criteria were not established for total PAHs. Therefore, the CTR criteria for individual PAHs of 0.049 µg/L are applied individually to benzo[a]anthracene, benzo[a]pyrene, and chrysene. The CTR criterion for pyrene of 11,000 µg/L is assigned as an individual WLA. Other PAHs compounds in the CTR shall be screened as part of the TMDL monitoring.

Calculations for the allocations shown here include MS4 discharges from the Seal Beach area (Orange County) to San Pedro Bay. The Orange County MS4 is issued by the Santa Ana Regional Board. Allocations for the Orange County MS4 will not be assigned in the Basin Plan

Amendment. If later monitoring demonstrates that the Seal Beach MS4 discharges do not support the goals of the TMDL, a revision to this TMDL in conjunction with the Sana Ana Region may be developed.

TIWRP discharges into Outer Harbor. Effluent flow from 1988 to 2009 showed the following range of average annual discharge rates – 21.0 to 16.0 MGD, with general declining trend. The target pollutant concentrations multiplied by 15.6 MGD (annual average flow rate in 2009) was used to calculate mass-based allocations for this point source. This yields allocation quantities for metals and bioaccumulatives that exceed the loading capacity. A reduction in the flow from TIWRP is planned and may allow for a revision of the WLA in future TMDL re-considerations.

#### *6.4.3.2 Load Allocations – Direct Effects*

Load Allocations apply to non-point sources; e.g., existing sediments and direct air deposition, and are also presented in Table 6-10. Direct air deposition allocations are included for Cu, Zn and PAHs based on estimates of current atmospheric loading rates presented in Source Analysis section, Table 4-6 based on monitoring results cited by Sabin & Schiff (2007) or Sabin et al., (2010). Future changes to Cu, Zn and PAH air quality criteria, other regulation such as brake pad requirements, or other improvement in air quality may allow for re-calculations of air deposition allocations in future revisions to the TMDL. Mass-based LAs are applied as annual limits.

For Lead (Pb), the direct air deposition allocation was calculated using information from EPA's revision to the National Ambient Air Quality Standard (EPA, 2008) as well as recent rule making by South Coast Air Quality Management District (SCAQMD, 2010). SCAQMD will be implementing EPA's Pb ambient air standard (0.15 ug/m$^3$) in forthcoming years. The load allocation for direct deposition of Pb onto surface waters is based on this revised air quality standard and the surface area of each waterbody, converted to mass/year. These mass-based direct air deposition allocations apply as annual limits.

Air deposition allocations for copper and zinc are based on existing loads; assuming no direct deposition reductions this consumes or partially consumes the available loading capacity. Copper and zinc load allocations for bed sediments are negative values, in Inner and Outer Harbor, indicating that copper and zinc loads must be reduced. (Each negative copper and zinc bed sediment allocation may alternatively be interpreted as zero, or not adversely affecting benthic organisms.) The amount of copper and zinc load reduction may be revised based on future monitoring results. For example, if future air deposition studies show lower existing air deposition copper and zinc loads or, if future copper and zinc sediment characterization studies show lower existing bed sediment copper and zinc loads, then copper and zinc allocations may be adjusted (presumably higher).

If, at some point in the future, a non-point source is considered subject to NPDES or WDR regulations, then the corresponding load allocation (numeric value) may switch to wasteload allocation columns.

*6.4.3.3 Allocations for other sediment pollutants*

Consolidated Slip and Fish Harbor are impaired for mercury in sediments and the average sediment concentration (1.1 mg/kg dry) is significantly higher than the target concentration (0.15 mg/kg dry). Consolidated Slip is also impaired for cadmium and chromium in sediments. Dominguez Channel Estuary is impaired for cadmium in sediments. While mercury is a compound that often bioaccumulates, there are no associated tissue listings for mercury in these waters, so it does not appear to be bioaccumulating to excessive levels and no fish tissue-supporting sediment target or allocation is assigned. See Table 6-11 for applicable WLAs.

### *6.4.4 Margin of Safety – Direct Effects*

An implicit margin of safety exists in the final allocations. Implicit margin of safety is based on the selection of multiple numeric targets, including targets for water, fish tissue and sediment. Currently no explicit margin of safety is applied to these TMDLs to address impaired conditions within the sediments; however, an explicit margin of safety must be considered and may be applied if any chemical-specific sediment quality value is revised or updated contingent on future sediment quality studies.

**Table 6-10. TMDLs and Allocations (kg/yr) – Metals and PAHs Compounds by waterbody/source. Sediment values are based on active sediment layer = 5cm depth.**

| *Waterbody/source* | *Total Cu* | *Total Pb* | *Total Zn* | *PAHs total* |
|---|---|---|---|---|
| ***DomCh Estuary - TMDL*** | 84 | 115.4 | 370.5 | 9.94 |
| ***WLAs*** | | | | |
| ***MS4- LA County et al.*** | 22.4 | 54.2 | 271.8 | 0.134 |
| ***MS4- City of Long Beach*** | 0.6 | 1.52 | 7.6 | 0.0038 |
| ***MS4- CalTrans*** | 0.384 | 0.93 | 4.7 | 0.0023 |
| ***LAs*** | | | | |
| ***Air deposition*** | 4.6 | 0.031 | 33.2 | 0.051 |
| ***Bed sediments*** | 56.0 | 58.7 | 53.3 | 9.7 |
| ***Current Load (Table 4-6)*** | 327.6 | 457.9 | 1799.0 | 28.1 |
| ***Overall reduction*** | 74% | 75% | 79% | 65% |
| ***Consolidated Slip - TMDL*** | 12.1 | 16.6 | 53.3 | 1.43 |
| ***WLAs*** | | | | |
| ***MS4- LA County et al*** | 2.73 | 3.63 | 28.7 | 0.0058 |
| ***MS4 CalTrans*** | 0.043 | 0.058 | 0.5 | 0.00009 |
| ***LAs*** | | | | |
| ***Air deposition*** | 1.2 | 0.008 | 8.6 | 0.013 |
| ***Bed sediments*** | 8.13 | 12.9 | 15.57 | 1.41 |
| ***Current Load (Table 4-6)*** | 92.1 | 127.3 | 398.9 | 11.5 |
| ***Overall reduction*** | ***87%*** | ***87%*** | ***87%*** | ***88%*** |
| ***Inner Harbor - TMDL*** | 76.7 | 105.3 | 338.3 | 9.1 |
| ***WLAs*** | | | | |
| ***MS4- LA County et al*** | 1.7 | 34.0 | 115.9 | 0.088 |

| Waterbody/source | Total Cu | Total Pb | Total Zn | PAHs total |
|---|---|---|---|---|
| MS4 City of Long Beach | 0.463 | 9.31 | 31.71 | 0.024 |
| MS4 CalTrans | 0.032 | 0.641 | 2.18 | 0.0017 |
| **LAs** | | | | |
| Air deposition<br>Bed sediments | 97.6<br>(23.1) | 0.67<br>60.7 | 710<br>(521.3) | 1.08<br>7.88 |
| Current Load (Table 4-6) | 178.4 | 105.9 | 542.1 | 3.524 |
| Overall reduction | 57% | 1% | 38% | 0% |
| **Outer Harbor - TMDL** | 81.6 | 112.1 | 360.1 | 9.7 |
| **WLAs** | | | | |
| MS4- LA County et al | 0.91 | 26.1 | 81.5 | 0.105 |
| MS4 City of Long Beach | 0.63 | 18.1 | 56.4 | 0.073 |
| MS4 CalTrans | 0.0018 | 0.052 | 0.162 | 0.00021 |
| TIWRP = POTW (CTR & MGD***) | 80.4 | 183.6 | 1845 | 1.056 |
| **LAs** | | | | |
| Air deposition<br>Bed sediments | 17.9<br>(18.2) | 0.9<br>(116) | 108.1<br>(1731) | 1.5<br>6.964 |
| Current Load (Table 4-6) | 119.0 | 66.7 | 403.4 | 0.626 |
| Overall reduction | 31% | 0% | 11% | 0% |
| **Fish Harbor - TMDL** | 1.04 | 1.43 | 4.59 | 0.123 |
| **WLAs** | | | | |
| MS4- LA County et al (POLA) | 0.00017 | 0.54 | 1.62 | 0.007 |
| MS4 CalTrans | 0.0000005 | 0.00175 | 0.0053 | 0.000021 |
| **LAs** | | | | |
| Air deposition<br>Bed sediments | 0.4<br>0.636 | 0.02<br>0.87 | 2.4<br>0.5 | 0.033<br>0.084 |
| Current Load (Table 4-6) | 1.43 | 0.60 | 4.2 | 0.003 |
| Overall reduction | 27% | 0% | 0% | 0% |
| **Cabrillo Marina -TMDL** | 1.32 | 1.81 | 5.8 | 0.156 |
| **WLAs** | | | | |
| MS4- LA County et al (POLA) | 0.0196 | 0.289 | 0.74 | 0.00016 |
| MS4 CalTrans | 0.00019 | 0.0028 | 0.007 | 0.0000016 |
| **LAs** | | | | |
| Air deposition<br>Bed sediments | 0.34<br>1.0 | 0.017<br>1.506 | 2.05<br>3.03 | 0.028<br>0.1285 |
| Current Load (Table 4-6) | 9.2 | 2.3 | 9.14 | 0.236 |
| Overall reduction | 86% | 21% | 36% | 34% |
| **San Pedro Bay - TMDL** | 648 | 890 | 2858 | 76.6 |
| **WLAs** | | | | |

| *Waterbody/source* | *Total Cu* | *Total Pb* | *Total Zn* | *PAHs total* |
|---|---|---|---|---|
| ***MS4- LA County et al*** | 20.3 | 54.7 | 213.1 | 1.76 |
| ***MS4 City of Long Beach*** | 137.9 | 372.2 | 1449.7 | 12.0 |
| ***MS4 CalTrans*** | 0.88 | 2.39 | 9.29 | 0.077 |
| **MS4 Orange County**** | *9.8* | *26.4* | *102.9* | *0.85* |
| ***LAs*** | | | | |
| ***Air deposition*** | 36 | 1.8 | 219 | 2.9 |
| ***Bed sediments*** | 442.9 | 432 | 865 | 59.0 |
| ***Current Load (Table 4-6)*** | 1251 | 1737 | 8167 | 3.63 |
| ***Overall reduction*** | 48% | 49% | 65% | 0% |
| ***LA River Estuary - TMDL*** | 735 | 1009 | 3242 | 86.9 |
| ***WLAs*** | | | | |
| ***LAR Estuary dischargers**** | [Cu SQV] | [Pb SQV] | [Zn SQV] | [PAH SQV] |
| ***MS4- LA County et al*** | 35.3 | 65.7 | 242.0 | 2.31 |
| ***MS4 City of Long Beach*** | 375.8 | 698.9 | 2572.7 | 24.56 |
| ***MS4 CalTrans*** | 5.1 | 9.5 | 34.8 | 0.333 |
| ***LAs*** | | | | |
| ***Air deposition*** | 6.7 | 0.046 | 48.9 | 0.075 |
| ***Bed sediments*** | 311.8 | 235.0 | 343.0 | 59.6 |
| ***Current Load (Table 4-6)*** | 1612 | 2641 | 20096 | 8.72 |
| ***Overall reduction*** | 54% | 62% | 84% | 0% |

Note: Cu, Zn & PAHs air dep allocation = existing load, no reductions anticipated. MS4 and bed sediments are expected to reduce loads. Negative values for bed sediments indicates loads are expected to be reduced – the amount of reduction may be revised with additional monitoring results. See discussion in Section 6.4.3.2.
Individual MS4 permits based on land percentage within that individual watershed.
Pb air dep allocation = reduction based on new SCAQMD ambient air standard proposed November 2010.
*SQV values are currently set at ERLs as discussed in section 6.4.1.
**Orange County MS4 permit is issued by the Santa Ana Regional Board. The allocations included, here, for the Seal Beach nearshore area, are for TMDL calculation purposes only, and an allocation is not assigned in the Basin Plan Amendment.
***For TIWRP, the discharge volume at the time of permit modification or reissuance shall be used to calculate the mass-based effluent limitations consistent with the assumptions and requirements of these WLAs. Studies may be conducted to determine the portion of the discharged pollutants that is deposited on bedded sediment. The results of any such Executive Officer approved studies shall be evaluated at the TMDL reconsideration to modify these WLAs as appropriate.

**Table 6-11. Final Concentration-Based Sediment WLAs for metals.**

| Concentration-based Sediment WLAs (mg/kg dry sediment) | | |
|---|---|---|
| **Cadmium** | **Chromium** | **Mercury** |
| 1.2 | 81 | 0.15 |

Mercury applies to both Consolidated Slip and Fish Harbor; Cd applies to Dominguez Estuary and Consolidated Slip; Cr applies to Consolidated Slip only.

### *6.4.5 Compliance with TMDL – Direct Effects*

These TMDLs are designed to protect the benthic organisms in sediments of these waterbodies. Attainment of these Direct Effects TMDLs may be achieved any one of three different means:

- Meet final sediment allocations in Table 6-10, are met.
- The qualitative sediment condition of Unimpacted or Likely Unimpacted via the interpretation and integration of multiple lines of evidence as defined in the SQO Part 1 is met, with exception of Cr which is not included in SQO Part 1.
- Sediment numeric targets are met in bed sediments over a three-year averaging period.

Compliance with mass-based limits will be measured at designated discharge points. Compliance with concentration-based WLA for existing sediment shall be determined by pollutant concentrations in ambient sediment in each waterbody. The average ambient bulk sediment level within a waterbody at or below the sediment quality value is considered attainment with these TMDLs. Implementation Section 7.5 provides more details on compliance for these Direct Effects TMDLs.

Interim WLAs are based on the 95$^{th}$ percentile of sediment data collected from 1998-2006. The use of 95$^{th}$ percentile values to develop interim limits is consistent with NPDES permitting methodology. If the 95$^{th}$ percentile is equal to or lower than the numeric target, then the interim limit is equal to the final WLA. Interim and final WLAs will be included in MS4 permits in accordance with NPDES regulations and guidance (40 CFR 144.22(d)(1)(vii)(B); US EPA Memorandum "Revisions to the November 22, 2002 Memorandum 'Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs'" (November 12, 2010)).

The allocations were designed to achieve the following specific goals:

1 Reduction of sediment toxicity (as measured by both lethal and sub-lethal tests),
2 Improvement of benthic organism communities,
3 Minimization of the negative impact of sediment chemicals,
4 Reduction of pollutant loads.

Whereas certain chemicals are identified in these TMDLs as pollutants of concern, future site specific studies may yield results that point to other toxicants as causative agents. The SQO – Direct Effects Policy provides for sediment stressor ID studies, which may be pursued as long as stakeholders/responsible parties are concurrently pursuing activities supporting these TMDLs and the goals defined above. Demonstrable improvement in the SQO lines of evidence must be provided along with progress in stressor ID studies. Progress solely in stressor ID studies is not an acceptable substitute; thus sediment quality improvements must be concurrent.

## 6.5 Bioaccumulative/Organochlorine compounds TMDLs in Dominguez Channel Estuary and greater Harbor waters

### *6.5.1 TMDL – Bioaccumulatives*[2]

[2] Total DDT, total PCBs, total chlordane, dieldrin, and toxaphene.

Fish tissue levels of certain bioaccumulative compounds are above desired numeric targets (OEHHA Fish Contaminant Goals). DDT and PCBs (total) apply to all estuarine and marine waters in greater Harbor area, including Cabrillo Beach Inner, Los Angeles River estuary and eastern San Pedro Bay. Chlordane TMDLs apply to Dominguez Channel estuary, Consolidated Slip, Fish Harbors, Los Angeles River estuary and eastern San Pedro Bay. Dieldrin applies to Dominguez Channel estuary and Consolidated Slip. Toxaphene applies to Consolidated Slip only.

To address these impairments, the TMDLs have been designed to reduce contaminated sediment levels which will result in lower corresponding pollutant levels in fish tissue. This approach has been utilized in other Los Angeles Region TMDLs. (Ballona Estuary TMDLs, 2007, Calleguas Creek Organochlorine Compounds TMDLs, 2005). Here, the active sediment layer approach to quantify the mass of allowable sediment-bound loads has been used. More specifically, the average mass of total sediment (fine and coarse particles) deposited in each waterbody annually based on average EFDC model output (using water years 2002-2005) was approximated. This value is the average annual (clean) sediment deposition rate per waterbody (Table 5-3). Then the more protective sediment quality value of either ERLs or biota-sediment accumulation factor (BSAF) was selected to determine desired sediment concentrations to attain specific fish tissue levels. The loading capacity of contaminated sediments within each waterbody was calculated from multiplying the sediment quality target by the average annual sediment deposition rate (Equation 3; See also Appendix III, Part 1).

TMDL = total sediment deposition rate x SQV or BSAF; (Eq. 3)

where sediment deposition rate = average annual mass of sediment deposited per waterbody

The loading capacities are presented in Table 6-12. This table also includes estimates of existing loads, which are consistent with the values presented in Table 4-6 and are based on the total deposition rate multiplied by the applicable existing sediment concentration and a conversion factor (the existing sediment concentrations are based on the average simulated sediment concentration from 2002-2005 in the top 5 cm of sediment).

The biota-sediment accumulation factor (BSAF) accounts for the sediment concentration, the associated food web and the desired fish tissue level to protect wildlife or human health consumption. The Basin Plan does not contain BSAFs, nor has State Board have approved any; however, the current development of Sediment Quality Plan,Part 2 – Indirect Effects is using a foodweb spreadsheet model to determine sediment concentrations (BSAFs) that correspond to specific fish tissue levels. As described above the more protective value between BSAF or ERL was used for determining TMDLs for bioaccumulative compounds. For chlordane and dieldrin, the ERL value is lower and more protective than BSAF values. The DDT sediment values are nearly equal (ERL = 1.58, BSAF = 1.9); the more stringent one was used for calculation. The PCBs sediment value associated with fish tissue is more stringent than the ERL sediment value for PCBs (3.2 vs. 22.7).

The active sediment layer is a generic term for the depth of contaminated sediments that benthic infauna consume or mix up via their physical movements. The sediment volume is approximately equal to the product of waterbody surface area and active sediment layer or depth. The issue of active sediment layer is contingent on the burrowing depth of benthic organisms within the bioaccumulation foodweb. Studies of benthic infauna in sediment show that 95% of benthic organisms exist within top 5 cm, yet some benthic organisms (such as ghost shrimp) burrow deeper down (~ 20 cm) and are also contained within the bioaccumulative foodweb. Here the active sediment layer is defined as 5 cm depth[3].

Chlordane, Dieldrin and Toxaphene TMDLs and allocations are concentration-based for all sources. Available monitoring data for these particular bioaccumulative pollutants does not provide sufficient detection levels to adequately estimate the current loads. Some detections of chlordane has been reported for a few waterbodies, however it is highly erratic and less frequent for Dieldrin and Toxaphene. To simplify, allocations for these pollutants within the impaired waters are concentration-based.

### *6.5.2 Allocations – Bioaccumulatives*

#### *6.5.2.1 Wasteload Allocations – Bioaccumulatives*

Wasteload Allocations are provided by waterbody and source-type in Table 6-9 or 6-12. Mass-based WLAs were developed for TIWRP and other point sources that have provided discharge flow data. (Refineries that have provided discharge flow data along with monitoring results receive mass-based allocations, where as other refineries receive concentration-based allocations because no discharge flow data has been provided to Regional Board staff.) Stormwater sources, including Los Angeles County MS4 Permittees, City of Long Beach and Caltrans, have received individual mass-based allocations, by permitted land area. Mass-based WLAs are applied as annual limits. Individual mass-based WLAs for an individual MS4 Permittee will be calculated based on its share, on an area basis, of the mass based WLA or other approved approach available at the time final mass-based WLAs are in effect and incorporated into the permit.

As described above in Section 5.3, the relative difference between the baseline and "no upland sources" scenarios were interpreted as the waterbody-specific percent contribution of the contaminant to the bed sediments from the upstream watersheds. These percentages were applied to the TMDLs to determine the mass-based WLAs for the stormwater sources. These overall WLAs were further divided to individual, mass-based allocations by permit based on the percent area draining to each waterbody (see Appendix III, Part 1).

Concentration-based WLAs are identified for other sources, such as General Construction, General Industrial, Power Generating stations, minor permits and irregular dischargers into Dominguez Channel Estuary. Any future minor NPDES permits or enrollees under a general non-stormwater NPDES permit will also be subject to the concentration-based waste load allocations. Concentration-based limits are applied as daily limits.

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[3] The Sediment Quality Plan – Direct Effects describes 5 cm for monitoring purposes however it does not intend to constrain or limit the sediment depth of applicability (person. commun., C. Beegan, SWRCB). Sediment Quality Plan –Indirect Effects is still in development and has not indicated a definite number for active sediment layer.

The calculations for the allocations shown here included MS4 discharges from the Seal Beach area (Orange County) to San Pedro Bay. The Orange County MS4 is issued by the Santa Ana Regional Board. Allocations for the Orange County MS4 will not be assigned in the Basin Plan Amendment. If later monitoring demonstrates that the Seal Beach MS4 discharges do not support the goals of the TMDL, a revision to this TMDL in conjunction with the Sana Ana Region may be developed.

#### *6.5.2.2 Load Allocations – Bioaccumulatives*

Load Allocations are provided by waterbody and source-type in Table 6-12. Mass-based LAs are identified for non-point sources, existing sediments and direct air deposition. Direct air deposition allocations are included for total DDT based on atmospheric monitoring results collected close to Los Angeles/Long Beach Harbor at SCAQMD Wilmington station in 2006 (SCCWRP presentation, 2007). Chemical-specific air deposition values (DDT = 29 ng/m$^2$/day) were multiplied by the surface area of each waterbody to produce direct deposition allocations. Direct deposition allocations for PCBs are not included since air deposition (air to water) has been measured to be less than water to air fluxes. Chlordane and dieldrin were not measured in the 2006 air deposition study. Mass-based WLAs will be applied as annual limits.

Air deposition allocations for DDT are based on existing loads; with no reductions anticipated this consumes the available loading capacity. DDT load allocations for bed sediments are negative values, with exception of those for the Los Angeles River Estuary, indicating that DDT loads must be reduced. (Each negative DDT bed sediment allocation may alternatively be interpreted as zero, or interpreted as minimal bioaccumulation into the food web.) The amount of DDT load reduction may be revised based on future monitoring results. For example, if future air deposition studies show lower existing air deposition DDT loads or, if future DDT sediment characterization studies show lower existing bed sediment DDT loads, then DDT allocations may be adjusted.

Note: If, at some point in the future, a non-point source is considered subject to NPDES or WDR regulations, then the corresponding load allocation (numeric value) may switch to wasteload allocation columns.

**Table 6-12. TMDLs and Allocations (g/yr) – Bioaccumulative Compounds by waterbody/source. Sediment values are based on active sediment layer = 5cm depth.**

| *Waterbody/source* | *DDT total* | *PCBs total* |
|---|---|---|
| ***DomCh Estuary – TMDL*** | 3.90 | 7.90 |
| ***WLAs*** | | |
| ***MS4- LA County et al*** | 0.250 | 0.207 |
| ***MS4 City of Long Beach*** | 0.007 | 0.006 |
| ***MS4 CalTrans*** | 0.004 | 0.004 |
| ***LAs*** | | |
| ***Air deposition*** | 6.01 | n/a |
| ***Bed sediments*** | (2.4) | 7.7 |

| ***Waterbody/source*** | ***DDT total*** | ***PCBs total*** |
|---|---|---|
| ***Current Load (Table 4-6)*** | 54.0 | 57.5 |
| ***Overall reduction*** | 93% | 86% |
| ***Consolidated Slip - TMDL*** | 0.56 | 1.14 |
| ***WLAs*** | | |
| ***MS4- LA County et al*** | 0.009 | 0.004 |
| ***MS4 CalTrans*** | 0.00014 | 0.00006 |
| ***LAs*** | | |
| ***Air deposition***<br>***Bed sediments*** | 1.56<br>(1.00) | n/a<br>1.13 |
| ***Current Load (Table 4-6)*** | 49.0 | 83.9 |
| ***Overall reduction*** | 99% | 99% |
| ***Inner Harbor - TMDL*** | 3.56 | 7.22 |
| ***WLAs*** | | |
| ***MS4- LA County et al*** | 0.051 | 0.059 |
| ***MS4 City of Long Beach*** | 0.014 | 0.016 |
| ***MS4 CalTrans*** | 0.0010 | 0.0011 |
| ***LAs*** | | |
| ***Air deposition***<br>***Bed sediments*** | 129<br>(125) | n/a<br>7.14 |
| ***Current Load (Table 4-6)*** | 21.67 | 29.51 |
| ***Overall reduction*** | 84% | 76% |
| ***Outer Harbor - TMDL*** | 3.79 | 7.68 |
| ***WLAs*** | | |
| ***MS4- LA County et al*** | 0.005 | 0.020 |
| ***MS4 City of Long Beach*** | 0.004 | 0.014 |
| ***MS4 CalTrans*** | 0.000010 | 0.00004 |
| ***TIWRP = POTW***<br>***(CTR & MGD***)*** | 12.7 | 0.37 |
| ***LAs*** | | |
| ***Air deposition***<br>***Bed sediments*** | 173<br>(182) | n/a<br>7.28 |
| ***Current Load (Table 4-6)*** | 30.8 | 34.7 |
| ***Overall reduction*** | 88% | 78% |
| ***Fish Harbor - TMDL*** | 0.048 | 0.098 |
| ***WLAs*** | | |
| ***MS4- LA County et al*** | 0.0003 | 0.0019 |
| ***MS4 CalTrans*** | 0.0000010 | 0.000006 |
| ***LAs*** | | |
| ***Air deposition*** | 3.9 | n/a |

| *Waterbody/source* | *DDT total* | *PCBs total* |
|---|---|---|
| ***Bed sediments*** | (3.85) | 0.10 |
| ***Current Load (Table 4-6)*** | 0.168 | 0.075 |
| ***Overall reduction*** | 71% | 0% |
| ***Cabrillo Marina -TMDL*** | 0.061 | 0.124 |
| ***WLAs*** | | |
| ***MS4 LAC DPW*** | 0.000028 | 0.000025 |
| ***MS4 CalTrans*** | 0.00000028 | 0.00000024 |
| ***LAs*** | | |
| ***Air deposition***<br>***Bed sediments*** | 3.3<br>(3.22) | n/a<br>0.12 |
| ***Current Load (Table 4-6)*** | 1.66 | 1.06 |
| ***Overall reduction*** | 96% | 88% |
| ***Inner Cabrillo Beach - TMDL*** | 0.04 | 0.09 |
| ***WLAs*** | | |
| ***MS4- LA County et al*** | 0.0001 | 0.0003 |
| ***LAs*** | | |
| ***Air deposition***<br>***Bed sediments*** | 3.5<br>(3.5) | n/a<br>0.09 |
| ***Current Load (Table 4-6)*** | 0.98 | 0.31 |
| ***Overall reduction*** | 96% | 72% |
| ***San Pedro Bay - TMDL*** | 30.1 | 61.0 |
| ***WLAs*** | | |
| ***MS4- LA County et al*** | 0.049 | 0.44 |
| ***MS4 City of Long Beach*** | 0.333 | 3.01 |
| ***MS4 CalTrans*** | 0.002 | 0.019 |
| ***MS4 Orange County***** | 0.024 | 0.213 |
| ***LAs*** | | |
| ***Air deposition***<br>***Bed sediments*** | 350<br>(320) | n/a<br>57.3 |
| ***Current Load (Table 4-6)*** | 205.2 | 110.7 |
| ***Overall reduction*** | 85% | 45% |
| ***LA River Estuary - TMDL*** | 34.1 | 69.2 |
| ***WLAs*** | | |
| ***MS4- LA County et al*** | 0.100 | 0.324 |
| ***MS4 City of Long Beach*** | 1.067 | 3.441 |
| ***MS4 CalTrans*** | 0.014 | 0.047 |
| ***LAR Estuary dischargers**** | [DDT SQV] | [PCB SQV] |
| ***LAs*** | | |

| *Waterbody/source* | *DDT total* | *PCBs total* |
|---|---|---|
| ***Air deposition*** | 8.9 | n/a |
| ***Bed sediments*** | 24.09 | 65.3 |
| ***Current Load (Table 4-6)*** | 231.6 | 402.2 |
| ***Overall reduction*** | 85% | 83% |

Note: DDT air dep allocation = existing load, no reductions anticipated. Negative values for bed sediments indicate DDT loads are expected to be reduced-the amount of reduction may be revised with additional monitoring results. See discussion in Section 6.5.2.2.
Individual MS4's based on land percentage within that individual watershed.
PCBs air dep value n/a since monitoring results show flux from water to air.
*SQV values are currently set at the more protective of ERLs or BSAFs as discussed in section 6.5.1.
**Orange County MS4 is issued by the Santa Ana Regional Board. The allocations included, here, for the Seal Beach nearshore area, are for TMDL calculation purposes, only and an allocation is not assigned in Basin Plan Amendment.
***For TIWRP, the discharge volume at the time of permit modification or reissuance shall be used to calculate the mass-based effluent limitations consistent with the assumptions and requirements of these WLAs. Studies may be conducted to determine the portion of the discharged pollutants that is deposited on bedded sediment. The results of any such Executive Officer approved studies shall be evaluated at the TMDL reconsideration to modify these WLAs as appropriate.

Bed sediment concentration-based allocations are assigned for chlordane in Dominguez Channel Estuary, Consolidated Slip, Fish Harbor, Los Angeles River Estuary and Eastern San Pedro Bay. Bed sediment concentration-based allocations are also assigned for dieldrin in Dominguez Channel Estuary and Consolidated Slip. Bed sediment concentration allocations are also assigned for toxaphene in Consolidated Slip. The TMDLs and allocations are set at target sediment concentrations; see Table 6-13.

**Table 6-13. Final Concentration-Based Sediment WLAs for other bioaccumulative compounds.**

| Concentration-based Sediment WLAs (µg/kg dry sediment) | | |
|---|---|---|
| **Chlordane** | **Dieldrin** | **Toxaphene** |
| 0.5 | 0.02 | 0.10 |

### *6.5.3 MOS – Bioaccumulatives*

An implicit margin of safety exists in the final allocations to Dominguez Channel estuary and greater Harbor waters. The implicit margin of safety is based on the selection of multiple numeric targets, including targets for water, fish tissue and sediment among other conservative assumptions. An explicit margin of safety must be considered and may be applied if any chemical-specific sediment quality value is revised or updated contingent on future sediment quality studies. That is, there may be uncertainty associated with revised sediment quality values that may warrant including an explicit margin of safety.

### *6.5.4 Compliance with TMDL – Bioaccumulatives*

Compliance with these bioaccumulative TMDLs may be achieved via any of four different means:

- Fish tissue targets are met in species resident to the TMDL waterbodies[4].
- Final sediment allocations, presented in Table 6-12, are met.
- Sediment numeric targets to protect fish tissue are met in bed sediment over a three-year averaging period.
- Demonstrate that the sediment quality objective protective of fish tissue is achieved per the Statewide Enclosed Bays and Estuaries Plan, as amended to address contaminants in finfish and wildlife.

Implementation Section 7.5 provides more details on compliance for these bioaccumulative TMDLs.

## 6.6 Summary of TMDLs

The freshwater TMDLs within Dominguez Channel are based on water column pollutants. The loading capacity is based on meeting CTR criteria for metals in freshwaters for both Dominguez Channel and Torrance Lateral. For downstream saline receiving waters – Dominguez Estuary and greater Harbor waters, the loading capacity for metals, organochlorine and PAH TMDLs are based on an estimate of annual pollutant loads that can be delivered to sediments and still meet the sediment targets. These TMDLs acknowledge that pollutant load reductions are required by watershed (stormwater) sources as well as existing bed sediments to attain the allowable loading capacity. Water column concentration-based allocations are also included for receiving waters; these allocations are equal to existing CTR criteria for protection of aquatic life or human health. Reductions in air deposition are expected only for Pb, otherwise load allocations for the other pollutants are equal to current estimates of direct deposition. As a general rule of thumb, reductions necessary to meet target Cu levels will also attain Pb, Zn and PAHs allocations. Necessary copper reductions range from 25 – 87%. Likewise, necessary reductions to meet DDT or PCB levels, up to 99%, will also attain the other bioaccumulative compound allocations.

Direct Effects targets are presented in flexible manner; that is, future stressor identification site-specific studies may yield different sediment quality values that correlate with desired sediment toxicity and benthic community goals. These TMDLs will need to be revisited and modified if toxic pollutants outside the scope of these TMDLs are identified as causative agents. Bioaccumulative compound TMDLs are designed to achieve fish tissue targets through contaminated sediment reductions and meeting saltwater column criteria.

## 6.7 Critical Condition

TMDLs must include consideration of critical conditions and seasonal factors. Pesticides, PCBs, PAHs, and metals are a concern in Dominguez Channel Estuary and Greater Harbor waters due to long-term loading and bioaccumulation effects. Wet weather events are likely to transport sediments and therefore produce extensive sediment redistribution into the harbors. In concert with aqueous pollutant transfer and contaminant diffusion properties the CTR-based water column targets are protective of this condition. This would be considered the critical condition

[4] A site-specific study to determine resident species shall be submitted to the Executive Officer for approval.

for loading. The effects of pollutants in sediment and fish tissue are manifested over long time periods. As an example, the half-life of PCBs in some sediment is estimated to be 20 years, whereas the PCBs half-life in fish is closer to 100 days, according to Gobas & Arnot (2010) and references therein. For this reason, short term variations (e.g., annual wet and dry seasons) in pollutant loadings are not likely to cause significant variations in impairment in fish tissue or sediments. In addition, no correlation with flow or seasonality (wet vs. dry season) was found to exist in sediment or tissue data. Given that allocations for this TMDL are expressed in terms of pesticides, PCBs, PAHs, and metals levels in sediment, a critical condition is not identified based upon flow or seasonality.

# 7 IMPLEMENTATION

California Water Code section 13360 precludes the Regional Board from specifying the method of compliance with waste discharge requirements; however California Water Code section 13242 requires that the Basin Plan include an implementation plan to describe the nature of actions to be taken to achieve water quality objectives and a time schedule for action. This section describes the proposed implementation plan to meet numeric targets for toxic pollutants in the Dominguez Channel and greater Los Angeles and Long Beach Harbor Waters.

Compliance with the TMDL for metals and PAHs is based on achieving the load and waste load allocations and/or demonstrating attainment of the sediment quality objectives (SQO Part 1) as multiple lines of evidence. Compliance with the TMDLs for bioaccumulative compounds shall be based on achieving the assigned loads and waste load allocations or, alternatively, by meeting fish tissue targets. Compliance will require the elimination of toxic pollutants being loaded into Dominguez Channel and the harbors, and clean up of contaminated sediments lying at the bottom of greater Los Angeles and Long Beach Harbors. Dischargers and responsible parties may implement structural and or non-structural BMPs and work collaboratively to achieve the numeric targets and allocations.

As discussed in the source analysis and allocations section of this TMDL, in most areas of the harbors, contaminant concentrations in sediment are above numeric targets for sediment. WLAs and LAs may not be attainable without reducing loadings from storm water discharges, near-shore and on water discharges, and river influences, and removal of contaminated sediment within hotspots of the Dominguez Channel Estuary and the Los Angeles and Long Beach Harbors. SWRCB (1999b, 2003) has prioritized hotspots in these waters, including: Consolidated Slip, and areas of Inner and Outer Harbors. This implementation section includes discussion of implementation actions to address these TMDLs. The implementation section describes the following implementation processes.

1. Implement (and evaluate effectiveness of) best management practices (BMPs) and source control in conjunction with the remediation actions to remove contaminated sediment as necessary;
2. Evaluate effectiveness of controlling sediment loading from Los Angeles River, San Gabriel River, and Machado Lake through implementation of effective TMDLs.
3. Conduct monitoring to evaluate compliance with targets during implementation and after

implementation actions are in place.

4. Determine if reductions in loadings from controllable sources from Los Angeles River and San Gabriel River will be required and addressed through revision of the TMDL.
5. Re-evaluate the WLAs and LAs, if necessary.

This implementation section also includes a schedule for conducting the activities listed above, a discussion of monitoring activities, and consideration of an economic analysis.

## 7.1 **Regulation by the Regional Board**

The Porter-Cologne Water Quality Control Act provides that "All discharges of waste into the waters of the State are privileges, not rights." Furthermore, all discharges are subject to regulation under the Porter-Cologne Act including both point and nonpoint source discharges.[5] In obligating the State Board and Regional Boards to address all discharges of waste that can affect water quality, the legislature provided the State Board and Regional Boards with authority in the form of administrative tools (waste discharge requirements (WDRs), waivers of WDRs, and Basin Plan waste discharge prohibitions) to address ongoing and proposed waste discharges. Hence, all current and proposed discharges must be regulated under WDRs, waivers of WDRs, a prohibition, or some combination of these or other administrative tools (e.g. Statewide Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program). Since the USEPA delegated responsibility to the State and Regional Boards for implementation of the National Pollutant Discharge Elimination System (NPDES) program, WDRs for discharges to surface waters also serve as NPDES permits

The regulatory mechanisms to implement the TMDL include, but are not limited to, general NPDES permits, individual NPDES permits, MS4 Permits covering jurisdictions and flood control districts within these waters, the Statewide Industrial Storm Water General Permit, the Statewide Construction Activity Storm Water General Permit, the Statewide Stormwater Permit for Caltrans Activities, and the authority contained in Sections 13263, 13267 and 13383 of the Cal. Water Code. For each discharger assigned a WLA, the appropriate Regional Board Order shall be reopened or amended when the order is reissued, in accordance with applicable laws, to incorporate the applicable WLA(s) as a permit requirement consistent with federal regulation and related guidance (40 CFR 144.22(d)(1)(vii)(B); US EPA Memorandum "Revisions to the November 22, 2002 Memorandum 'Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs'" (November 12, 2010)).

The MS4 Permits, Caltrans Storm Water Permit, general NPDES permits, general industrial storm water permits, general construction storm water permits, and minor NPDES permits shall be allowed a phased implementation schedule to achieve the waste load allocations. A phased implementation approach, using a combination of non-structural and structural BMPs could be

[5] See CWC sections 13260 and 13376.

used to achieve compliance with the waste load allocations. The administrative record and the fact sheets for the permits must provide reasonable assurance that the BMPs selected will be sufficient to implement the WLAs in the TMDL.

MS4 permittees, Caltrans, and other NPDES dischargers will be required to meet the WLAs at the designated compliance locations as defined in the TMDL monitoring plan. To achieve the necessary reductions to meet the allowable waste load allocations, permittees could balance short-term capital investments directed to addressing this and other TMDLs in the Dominguez Channel watershed and greater Los Angeles and Long Beach Harbor waters with long-term planning activities for stormwater management in the region as a whole. It should be emphasized that the potential implementation strategies discussed below may contribute to the implementation of other TMDL for Dominguez Channel watershed and greater Los Angeles and Long Beach Harbor waters. Likewise, implementation of other TMDLs in the watershed may contribute to the implementation of this TMDL.

Implementation by assigned responsible parties is required in three waterbody areas:

1. Dominguez Channel, Torrance Lateral, and Dominguez Channel Estuary
2. Greater Los Angeles and Long Beach Harbor waters (including Consolidated Slip)
3. Los Angeles River and San Gabriel River

The sediment targets are not intended to be used as ~~necessarily~~ 'clean-up standards' for navigational, capital or maintenance or dredging or capping activities; rather they are long-term sediment concentrations that should be attained after reduction of external loads, targeted actions addressing internal reservoirs of contaminants, and environmental decay of contaminants in sediment. Sediment remediation or dredging activities are reviewed in different regulatory processes (e.g., CWA Section 404; Marine Protection, Research, and Sanctuaries Act; Rivers and Harbors Act) and often take into account numerous factors, including yet not limited to: depth and volume of dredge materials, cost, disposal options, navigation and potential redistribution.

## 7.2 Responsible Parties and Potential Implementation Strategy

TMDL implementation will be carried out by responsible parties including, but not limited to:

1. Dominguez Channel Responsible Parties

- Dominguez Channel, Torrance Lateral, and Dominguez Channel Estuary MS4 Permittees
    - Los Angeles County
    - Los Angeles County Flood Control District
    - Caltrans
    - City of Carson
    - City of Compton
    - City of El Segundo
    - City of Gardena
    - City of Hawthorne
    - City of Inglewood
    - City of Lawndale
    - ~~City of Lomita~~

- City of Long Beach
- City of Los Angeles
- City of Manhattan Beach
- City of Redondo Beach
- City of Torrance

- Individual and General Stormwater Permit Enrollees
- Other Non-stormwater Permittees
- Dominguez Channel Estuary Subgroup for bed sediment and fish:
    - Los Angeles County
    - Los Angeles County Flood Control District
    - Caltrans
    - City of Carson
    - City of Compton
    - City of Gardena
    - City of Los Angeles
    - City of Long Beach
    - City of Torrance

2. Greater Los Angeles and Long Beach Harbors Waters Responsible Parties

- Greater Los Angeles and Long Beach Harbor Waters MS4 Permittees
    - Los Angeles County
    - Los Angeles County Flood Control District
    - Caltrans
    - City of Bellflower
    - City of Lakewood
    - City of Long Beach
    - City of Los Angeles
    - City of Paramount
    - City of Signal Hill
    - City of Rolling Hills
    - City of Rolling Hills Estates
    - City of Rancho Palos Verdes
- City of Los Angeles (including the Port of Los Angeles)
- City of Long Beach (including the Port of Long Beach)
- State Lands Commission
- Individual and General Stormwater Permit Enrollees
- Other Non-stormwater Permittees, including City of Los Angeles (TIWRP)
- <u>Los Angeles River Estuary Subgroup for bed sediment and fish:</u>
    - Los Angeles County
    - Los Angeles County Flood Control District
    - City of Long Beach
    - City of Los Angeles
    - City of Signal Hill
    - Caltrans
- Consolidated Slip Responsible Parties subgroup
    - Consolidated Slip MS4 Permittees[6]

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[6] US EPA is the regulatory oversight agency pursuant to CERCLA with respect to the Superfund site within the Dominguez Channel Estuary and Consolidated Slip subarea, but is not identified as a Responsible Party under the TMDL. As the regulatory oversight agency, US EPA is

- Los Angeles County
- Los Angeles County Flood Control District
- City of Los Angeles

3. Los Angeles River and San Gabriel River Watershed TMDLs Responsible Parties
   - Los Angeles River and San Gabriel River metals TMDLs responsible parties

## 7.3 Phased Implementation by Waterbody Area

The implementation actions described in this implementation section represent a range of activities that could be conducted to achieve final allocations. The specific actions taken to achieve the final allocations may vary to some degree from the elements presented here based on this evaluation and future analyses of the most cost effective and beneficial mechanisms for achieving the final allocations. To the extent possible, all ideas being considered as mechanisms for implementing the TMDL have been included in this implementation plan. Future considerations may result in other actions being implemented rather than the options presented.

Reductions to be achieved by each BMP will be documented and sufficient monitoring will be put in place to verify that the required reductions are achieved. When permits for responsible parties are revised, the permits should provide mechanisms to make adjustments to the required BMPs as necessary to ensure their adequate performance. If proposed structural and non-structural BMPs adequately implement the waste load allocations then additional controls will not be necessary. Alternatively, if the proposed structural and non-structural BMPs selected prove to be inadequate then additional structural and non-structural BMPs or additional controls may be required.

Implementation actions to achieve WLA and LA will be implemented via an iterative process, whereby information from each phase being used to inform the implementation of the next phase. The project will be adjusted as necessary based on information gained during each implementation phase.

Phase I Implementation includes elements to reduce the amount of sediment transport from point sources that directly or indirectly discharge to Dominguez Channel and the harbors. An important component of Phase I will be to secure the relationships and agreements between cooperating parties and to develop a detailed scope of work with priorities.

Phase I includes the following elements:

- Incorporate interim limits into WDRs and NPDES permits
- Implementation of Structural and Non-Structural BMPs throughout Dominguez Watershed and nearshore areas of greater LA/LB Harbor waters
- Implementation of effective TMDLs in Los Angeles River, San Gabriel River, and Machado Lake

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responsible for choosing an appropriate remedy for these sites. Furthermore, under CERCLA, US EPA is responsible for assuring that the CERCLA PRPs clean up the site in compliance with CERCLA and applicable or relevant and appropriate requirements (ARARs) (CERCLA section 121(d))

- o Develop and initiate monitoring program

Phase II will include the implementation of site-specific cleanup actions for areas identified as high-priority in Phase I according to prioritization assessment completed by responsible parties and approved by the Regional Board in Phase I. Phase II will also include implementation of additional BMPs and site remedial actions upstream and in the Los Angeles and Long Beach Harbors, as determined to be effective based on the success of upstream source control, TMDL monitoring data evaluations, and WRAP and Sediment Management Plan-directed activities implemented during Phase I. Responsible parties will develop, prioritize, and implement Phase II elements based on data from the TMDL monitoring program and other information from special studies. Possible actions include additional structural and non-structural BMPs throughout the watershed by municipalities, counties, Caltrans, and others. It is expected that Phase II will include the majority of any necessary sediment removal activities.

Phase II should be designed by responsible parties to achieve all allocations by the end of Phase II. Phase III is provided to allow for any necessary follow-on activities due to the scope and complexity of the TMDL goals.

Phase III will includes implementation of secondary and addition remediation actions as necessary to be incompliance with final load allocations by end of implementation period.

### *7.3.1 Dominguez Channel, Torrance Lateral, and Dominguez Channel Estuary*

Responsible parties can implement a variety of implementation strategies to meet the required WLAs and LAs, such as non-structural and structural BMPs, diversion and treatment to reduce sediment transport from the watershed to Dominguez Channel and Greater Harbor waters, and sediment removal activities.

Nonpoint source elements include legacy sediments and air deposition across Dominguez Channel and Harbor waters. The sediment load allocations for the contaminated bed sediments are assigned to the Cities of Long Beach and Los Angeles and the State Lands Commission, which have responsibility for remediation of the contaminated sediments.

- Phase I

The purpose of the Phase I implementation is to reduce the amount of sediment transport from point sources that directly or indirectly discharge to Dominguez Channel and the Harbor waters. Phase I should include watershed-wide implementation actions. Important components of Phase I should be to secure the relationships and agreements between cooperating parties and to develop a detailed scope of work with priorities.

Potential watershed-wide non-structural BMPs include more frequent and appropriately timed storm drain catch basin cleaning, improved street cleaning by upgrading to vacuum type sweepers, and educating residents and industries about good housekeeping practices. Structural BMPs may include the placement of stormwater treatment devices designed to reduce sediment loading, such as infiltration trenches, vegetated swales, and/or filter strips at critical points in the watershed. Structural BMPs may also include diversion and treatment facilities to divert runoff directly, or provide capture and storage of runoff and then diversion to a location for treatment. Treatment options to reduce sediment could include sand or media filters.

The Los Angeles County Flood Control District (District) owns and operates Dominguez Channel; therefore, the District and the cities that discharge to Dominguez Channel shall each be responsible for conducting implementation actions to address contaminated sediments in Dominguez Channel. Responsible parties in Dominguez Channel shall develop a Sediment Management Plan to address contaminated sediment in Dominguez Channel and Dominguez Channel Estuary.

Sediment conditions shall be evaluated through the Sediment Quality Objective (SQO) process detailed in the SQO Part 1. If chemicals within sediments are contributing to an impaired benthic community or toxicity, then causative agent(s) shall be determined using SQO recommended procedures, SQO Part 1 (VII.F.). Impacted sediments shall be included in the list of sites to be managed.

- Phase II

Phase II should include the implementation of additional BMPs and site remedial actions, as determined to be effective based on the success of upstream source control, evaluation of TMDL monitoring data collected during Phase I, and targeted source reduction activities as identified in Phase I. Regional responsible parties should develop, prioritize, and implement Phase II elements based on data from the TMDL monitoring program and other available information from special studies. Possible actions include implementation of additional structural and non-structural BMPs throughout the watershed by municipalities, LA County, Caltrans, and others. Phase II should include the implementation of site-specific cleanup actions for areas identified as high priority in the Dominguez Channel Estuary and in accordance with the Sediment Management Plan.

- As management actions are planned for a contaminated site, site-specific cleanup criteria should be determined following protocols that are consistent with state and national guidance. The site improvements should be confirmed through a sediment monitoring program.
- There are two Superfund sites located within Dominguez Channel Watershed: the Montrose Superfund Site and the Del Amo Superfund Site. The US EPA has not yet reached a final remedial decision with respect to certain of the Montrose Superfund Site Operable Units (OUs) that remain contaminated with DDT, including the on- and near-property soils (OU1), the current storm water pathway (OU2), and the "Neighborhood Areas" (OU4 and OU6). The TMDL, its waste load and load allocations, and other regulatory provisions of this TMDL may be applicable or relevant and appropriate requirements (ARARs) as set forth in Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. §§ 9621(d)) for those OUs. The TMDL for DDT should be taken into account in the course of the remedial decision-making process. The City of Los Angeles and/or Los Angeles County, should they decide to take action that impacts

one of the OUs, shall consult with US EPA's Superfund Division in advance of such action.

Detection of DDT compounds in water or sediment samples collected within Torrance Lateral shall trigger additional monitoring, by parties to be determined by the Executive Officer, in coordination with EPA, to evaluate potential contribution from contaminated soils related to upstream Montrose operable units discharging via the Kenwood storm drain. Upon reconsideration of the TMDL, all monitoring results for DDT compounds collected by responsible parties or other entities shall be considered as part of source analysis and to determine potential future allocation(s) that may be necessary to minimize impacts to downstream waters and restore beneficial uses in TMDL waterbodies.

- Phase III

Phase III should include implementation of secondary and additional remediation actions as necessary to be in compliance with final allocations by the end of the implementation period. TMDLs to allocate additional contaminant loads between dischargers in the Dominguez Channel, Torrance Lateral and Dominguez Channel Estuary subwatersheds may also be developed, if necessary.

### *7.3.2 Greater Los Angeles and Long Beach Harbor Waters (including Consolidated Slip)*

Responsible parties can implement a variety of implementation strategies to meet the required WLAs, such as non-structural and structural BMPs, and/or diversion and treatment to reduce sediment transport from the nearshore watershed to the Greater Harbor waters.

- Phase I

The purpose of Phase I implementation is to reduce the amount of sediment transport from point sources that directly or indirectly discharge to the Harbor waters. Phase I should include actions to be implemented throughout the nearshore watershed and specific implementation actions at the Ports. Important components of Phase I should be to secure the relationships and agreements between cooperating parties and to develop a detailed scope of work with priorities.

Potential watershed-wide non-structural BMPs include more frequent and appropriately timed storm drain catch basin cleaning, improved street cleaning by upgrading to vacuum type sweepers, and educating residents and industries about good housekeeping practices. Structural BMPs may include the placement of stormwater treatment devices designed to reduce sediment loading, such as infiltration trenches, vegetated swales, and/or filter strips at critical points in the watershed. Structural BMPs may also include diversion and treatment facilities to divert runoff directly, or provide capture and storage of runoff and then diversion to a location for treatment. Treatment options to reduce sediment could include sand or media filters.

Implementation actions at the Ports should be developed to address different sources that contribute loading to the Harbors such as Port-wide activities and associated control measures for water and sediment, control measures to reduce the discharges from various land uses in the Harbors, nearshore discharges, and on-water discharges. The implementation actions described in the *Water Resources Action Plan* (WRAP) adopted by the Port of Los Angeles and the Port of Long Beach represent a range of activities that could be conducted to control discharges of polluted stormwater and contaminated sediments to the Harbors.

To meet necessary reductions in sediment bed loads, a Sediment Management Plan shall be developed by the dischargers assigned a sediment bed load LA, the Cities of Los Angeles and Long Beach and the State Lands Commission. Phase I implementation elements for the improvement of the Harbors' sediment quality should be conducted through the continuation of source reduction, source control, and sediment management. Below are proposed implementations actions that may be implemented in Phase I or Phase II to improve sediment quality at the ports:

- *Removal of Contaminated Sediment within Areas of Known Concern*. Planned removal programs are in place for IR Site 7 (former Navy facility in the Port of Long Beach) and Berth 240 (former Southwest Marine facility in the Port of Los Angeles). Contaminated sediment will be removed by Port of Long Beach and Port of Los Angeles.

- *Sediment Management Plan, Prioritization Assessment for Contaminated Sediment Management.* Sediment will be evaluated through the Sediment Quality Objective (SQO) process detailed in the Enclosed Bays and Estuaries Plan (i.e., SQO Part 1 as amended). If chemicals within sediments are contributing to an impaired benthic community or toxicity or fish tissue, then causative agent(s) will be determined using SQO recommended procedures, including SQO Part I (VII. F.). Impacted sediments will be included in the list of sites to be managed. The sites to be managed by the responsible parties will be prioritized for management and coupled with other planned projects when feasible. Prioritized sites shall include known hot spots, including but not limited to Consolidated Slip and Fish Harbor. For these prioritized sites, the sediment management plan shall include concrete actions and milestones, including numeric estimate of load reductions or removal, to remediate the priority areas and shall demonstrate the atcitons to address prioritized hot spots will be initiated and completed as early as possible during the 20-year TMDL implementation period. This process will prioritize management efforts on sites that have the greatest impact to the overall health of the benthic community and fish tissue and allow sites with lower risks to be addressed in later phases when opportunities can be coupled to capital projects. As management actions are planned for a contaminated site, site-specific cleanup criteria will be determined following established protocols that are consistent with state and national policy and guidance. The site will then be managed and the improvements confirmed through a sediment monitoring program. A flow chart showing a potential sediment monitoring and priority assessment program is included in Figure 7-1.

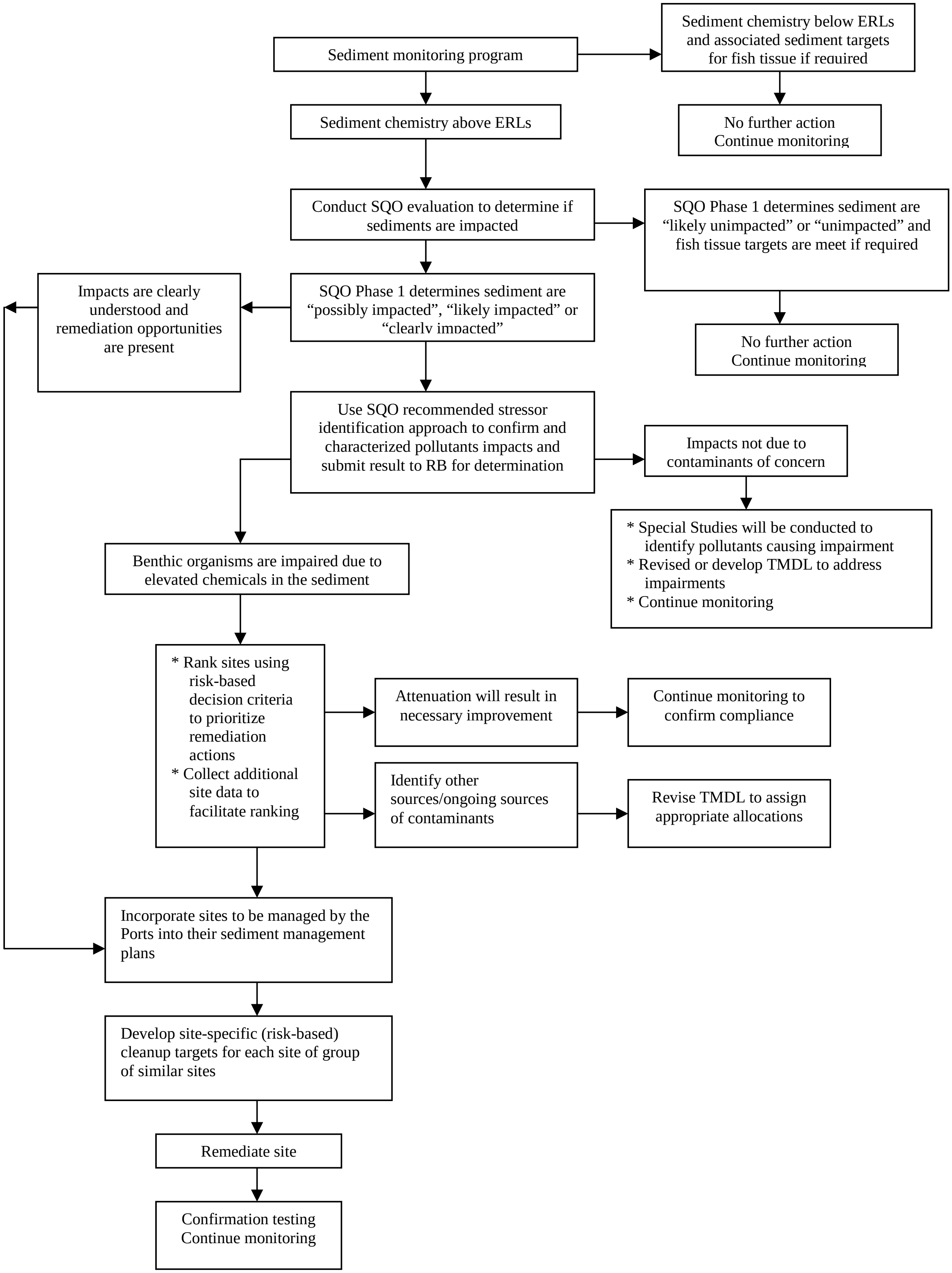


**Figure 7-1. Proposed Sediment Monitoring Program and Priority Assessment Flowchart.**

- *Superfund Sites.* Two Superfund sites are located in Dominguez Channel Watershed: the Montrose Superfund Site (DDT) and the Del Amo Superfund Site (benzene). Montrose Superfund Site includes multiple operable units (OUs), which are identified as investigation areas potentially containing site-related contamination. These Superfund Sites are located in a community known as Harbor Gateway, which is situated mostly in the City of Los Angeles and partially in unincorporated land in Los Angeles County. Harbor Gateway lies within the Kenwood Drain subwatershed, which discharges stormwater into Torrance Lateral which flows downstream into saline waters of Dominguez Channel Estuary and Consolidated Slip. The Torrance Lateral, Dominguez Channel Estuary and Consolidated Slip (OU2) contain sediments contaminated with multiple pollutants including DDT (potentially from various sources). The US Environmental Protection Agency (US EPA) has been working with other government agencies and local agencies including the City of Los Angeles and Los Angeles County to ensure the protection of both the environment and public health in the areas surrounding these Superfund sites.

  The US EPA has not yet reached a final remedial decision with respect to certain of the Montrose Superfund Site Operable Units (OUs) that remain contaminated with DDT, including the on- and near-property soils (OU1), the current storm water pathway (OU2), and the "Neighborhood Areas" (OU4 and OU6). The TMDL, its waste load and load allocations, and other regulatory provisions of this TMDL may be applicable or relevant and appropriate requirements (ARARs) as set forth in Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. §§ 9621(d)) for those OUs. The TMDL for DDT should be taken into account in the course of the remedial decision-making process.

  In August 1999, USEPA and the State of California, which includes the Regional Board, entered into a consent decree concerning the Montrose Superfund site in a case entitled *United States of America and State of California v. Montrose Chemical Corporation of California, et al*., United States District Court Central District of California, Case No. CV 90-3122-AAH (JRx)."

  Also, US EPA Superfund does not need to make a remedial decision prior to individual or collective action (by City of LA and/or County of LA) to clean up sediments within the OU2 stormwater pathway. The City of Los Angeles and/or Los Angeles County, should they decide to take action that impacts one of the OUs, shall consult with US EPA's Superfund Division in advance of such action. The goal of consultation is to ensure the proposed sediment cleanup will not aggravate the situation or further interfere with the site. The Montrose surrounding area is shown in Figure 7-2.

  Detection of DDT compounds in water or sediment samples collected within Torrance Lateral shall trigger additional monitoring, by parties to be determined by the Executive Officer, in coordination with EPA, to evaluate potential contribution from contaminated soils related to upstream Montrose operable units discharging via the Kenwood storm drain. Upon reconsideration of the TMDL, all monitoring results for DDT compounds collected by responsible parties or other entities shall be considered as part of source analysis and to determine potential future allocation(s) that may be necessary to minimize impacts to downstream waters and restore beneficial uses in TMDL waterbodies.

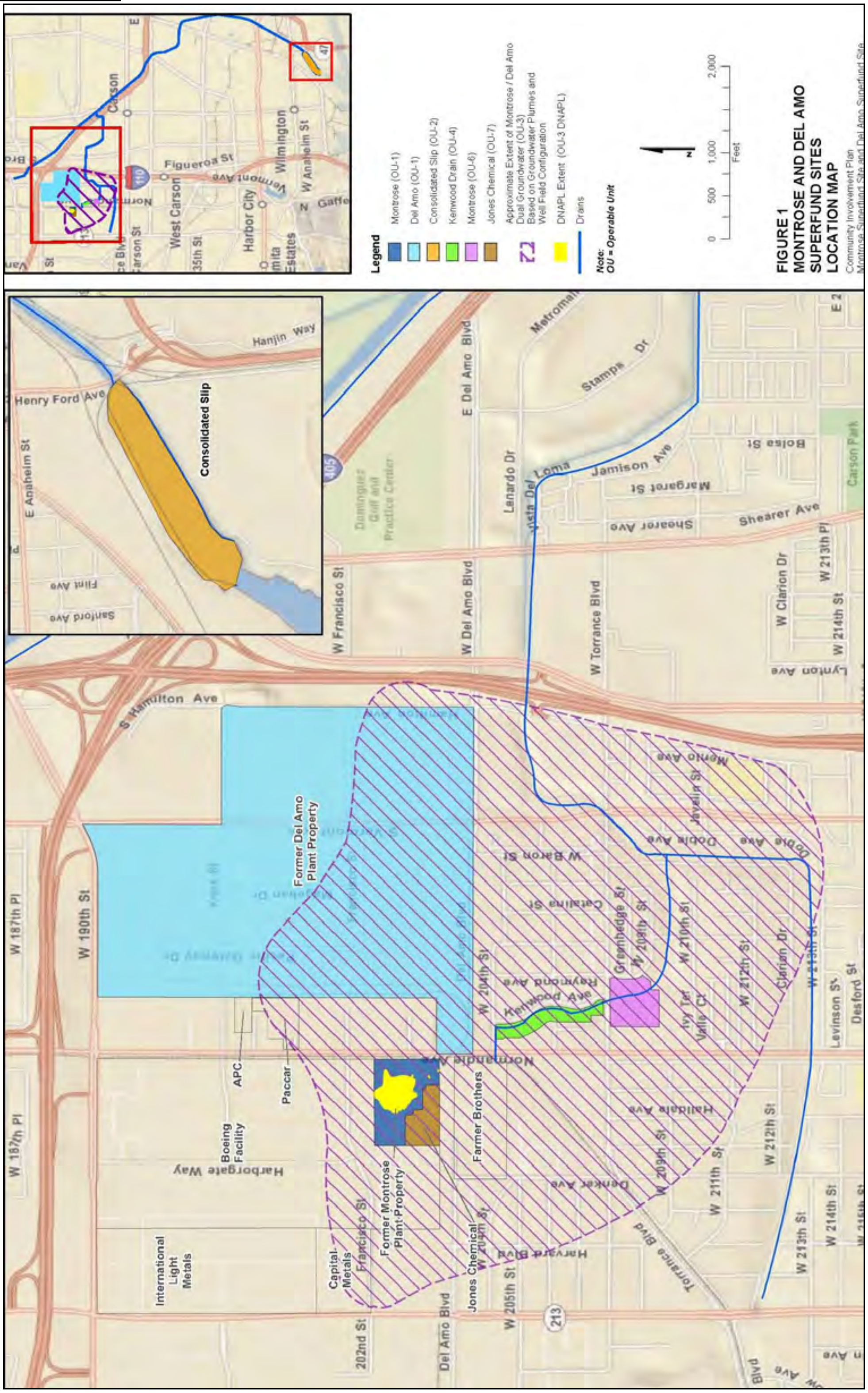

**Figure 7-2 Montrose Superfund Site and the Del Amo Superfund Site Area Map**

- Phase II

Phase II should include the implementation of additional BMPs and site remedial actions including sediment removal in the nearshore watershed and in the Harbors, as determined to be effective based on the success of upstream source control, TMDL monitoring data evaluations, WRAP activities implemented during Phase I, and targeted source reduction activities as identified in Phase I. Responsible parties should develop, prioritize, and implement Phase II elements based on data from the TMDL monitoring program and other available information from special studies. Possible actions include additional structural and non-structural BMPs throughout the watershed.

Phase II should include the implementation of site-specific cleanup actions for areas identified as high priority in the Harbor waters and per the Sediment Management Plan.

- Phase III

The purpose of Phase III is to implement secondary and additional remediation actions as necessary to be in compliance with final waste load and load allocations by the end of the TMDL implementation period.

#### *7.3.3 Los Angeles River and San Gabriel River*

Responsible parties in these watersheds are implementing other TMDLs, which will directly or indirectly support the goals of this TMDL.

- Phase I

Responsible parties for each watershed shall submit a Report of Implementation to describe how current activities support the downstream TMDL.

- Phases II and III

Implementation actions may be developed and required in Phases II and III as necessary to meet the targets in the Greater Harbor waters. TMDLs to allocate contaminant loads between dischargers in the Los Angeles and San Gabriel Rivers watersheds may also be developed, if necessary.

### 7.4 **Special Studies and Reconsiderations**

Special studies may be used to refine source assessments, assign appropriate allocation based on updated information from the results of implementation actions and monitoring program, and help focus implementation efforts. Regional Board staff also recognize that the TMDL targets, allocations, and proposed implementation actions to reach those targets and allocations will change due to changes in policies anticipated SQO Part II. In addition, improved air deposition studies may be used to refine air deposition allocations. The results of special studies submitted to the Regional Board’s EO will be considered during subsequent TMDL reopeners. In addition, it may be necessary to make adjustments to the TMDL to be responsive to new State policies including, but not limited to, SQO Part II; toxicity policy; possible changes to air quality criteria and other regulations affecting air quality.

If appropriate, the TMDL will be reconsidered by the Regional Board at the end of Phase I to consider completed special studies or policy changes. As allocation-specific data are collected, interim targets for the end of Phase II may be identified.

Below is list of potential optional special studies that may be conducted by responsible parties:

- **Optional Special Study - Stressor Identification Studies**
  Outlined in the Phase I SQOs is a stressor identification (stressor ID) process that is intended to be completed in order to identify the specific constituents causing sediment quality impairments. Given the recent adoption of the Phase I SQOs, stressor IDs have not been completed within the waterbodies addressed by the Harbors TMDLs. As a stressor ID process has not been completed, no individual constituent has been identified as directly causing or contributing to impairment in a manner consistent with the State's sediment quality objectives.

  A stressor ID study consists of the development and implementation of a work plan to: (1) confirm and characterize pollutant-related impacts; (2) identify specific pollutants; and (3) identify pollutant sources. The stressor ID process outlined in Section VII.F of the Phase I SQOs and the NPDES receiving water and effluent limit process outlined in Section VI.B of the Phase I SQOs provide the scientific basis and an approved regulatory process for identifying and addressing specific constituents causing sediment quality impairments. Work plans consistent with the Phase I SQOs stressor ID study approach must be submitted for Regional Board EO approval. The results of this special studies will submitted to the Regional Board and maybe used to revised the targets and allocation if determine by the Regional Board to be sufficient and appropriate.

- **Optional Special Study – Further characterization of direct air deposition loadings for heavy metals and legacy pesticides**
  Allocations of certain pollutants in certain waterbodies are confounded by preliminary estimates of pollutant loading via direct deposition onto waterbody surface area. Additional monitoring of these pollutants at air sampling sites more closely resembling the respective waterbody will help characterize these loadings. Limited data exist for dry deposition so this could be extended over longer timeframes. Measurements of wet deposition for each pollutant may also be appropriate to estimate air deposition more completely. Results could provide data to reconsider pollutant-specific allocations in this TMDL.

  Detection of DDT compounds in water or sediment samples collected within Torrance Lateral shall trigger additional monitoring, by parties to be determined by the Executive Officer, in coordination with EPA, to evaluate potential contribution from contaminated soils related to upstream Montrose operable units discharging via the Kenwood storm drain. Upon reconsideration of the TMDL, all monitoring results for DDT compounds collected by responsible parties or other entities shall be considered as part of source analysis and to determine potential future allocation(s) that may be necessary to minimize impacts to downstream waters and restore beneficial uses in TMDL waterbodies.

- **Optional Special Study - Evaluation of Los Angeles River and San Gabriel River Loadings to the Harbors**
  This special study will evaluate whether or not the loading from Los Angeles River and San Gabriel have the potential to re-contaminate the Harbors and the results from this study will be used to determine if reductions in loadings from controllable sources from Los Angeles River and San Gabriel River will be required and addressed through revision of the TMDL.

- **Optional Special Study - Sediment and Fish Tissue Linkage Studies**
  A relationship between sediment pollutant concentrations, depth of sediment contamination and fish tissue pollutant concentrations exists; however, the quantification of that relationship (i.e., what concentrations in sediment lead to levels of concern in fish) is not well understood in the waterbodies addressed in the Harbors TMDLs. Performing special studies to develop a more comprehensive understanding of the link between sediment constituent concentrations and fish constituent concentrations may affect allocations associated with bioaccumulative pollutants addressed in the TMDL. Additionally, determining the range and habitat of specific fish populations within the receiving waterbodies can help guide implementation actions and the attainment of targets. That is, if a specific fish populations' range and habitats are known, then the fish tissue quality can be compared to the sediment quality for areas within the fish populations' range and habitats. These investigations may also be based on applying Phase II SQOs (currently being developed) for an understanding of the continuing level of impairment.

  Completion of studies linking sediment pollutant concentrations with fish tissue pollutant concentrations and evaluating the range and habitat of specific fish populations may be used to evaluate the attainment of targets, guide future implementation actions, and may lead to changes in TMDL targets, WLAs and LAs. Work plans to complete such studies must be submitted for Regional Board EO approval.

- **Optional Special Study – Additional monitoring results within Dominguez Channel and greater Harbor waters**
  Any additional monitoring data or information may be used to refine the existing watershed and/or receiving water models relevant to the TMDL.

## 7.5 **Compliance with Allocations and Attainment of Numeric Targets**

The goal of the TMDL is to restore all of the beneficial uses of Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters through attainment of water and sediment quality objectives.

Compliance with the TMDL shall be determined through water, sediment, and fish tissue monitoring and comparison with the TMDL waste load and load allocations and numeric targets. Compliance with the sediment TMDL for metals and PAH compounds shall be based on achieving the loads and waste load allocations or, alternatively, demonstrating attainment of the SQO Part 1 through the sediment triad/multiple lines of evidence approach outlined therein. Compliance with the TMDLs for bioaccumulative compounds shall be based on achieving the assigned loads and waste load allocations in water and sediment or, alternatively, by meeting fish tissue targets. If at any point during the implementation plan, monitoring data or special studies indicate that WLAs or LAs will be attained but fish tissue targets may not be achieved, the Regional Board shall reconsider the TMDL to modify WLAs and LAs to ensure that the fish tissue targets are attained.

The compliance point for the stormwater WLAs shall be at the storm drain outfall of the permittee’s drainage area. Alternatively, if stormwater dischargers select a coordinated compliance monitoring option, the compliance point for the stormwater WLA may be at storm drain outfalls or at a point in the receiving water, which suitably represents the combined discharge of cooperating parties discharging to Dominguez Channel and Greater Los Angeles and Long Beach Harbor waters. Depending on potential BMPs implemented, alternative stormwater compliance points may be proposed by responsible parties subject to approval by the Regional Board Executive Officer. The compliance point(s) for responsible parties receiving load allocations shall be in the receiving waters or the bed sediments of the Dominguez Channel and the Greater Los Angeles and Long Beach waters.

## 7.6 **Monitoring**

Monitoring is required to measure the progress of pollutant load reductions and improvements in water and sediment quality and fish tissue. The information presented in this section is intended to be a brief overview of the goals of the monitoring. Special studies may be planned to improve understanding of key aspects related to achievement of WLAs and LAs, restore the beneficial uses, and to assist in the modification of structural and non-structural BMPs if necessary. The goals of monitoring include:

- To determine compliance with the assigned waste load and load allocations.
- To monitor the effect of implementation actions proposed by responsible parties to improve water and sediment quality including proposed structural and non-structural BMP to reduce storm water run-off and sediment loading, and remediation actions to remove contaminated sediment.
- To monitor contaminated sediment level in the harbors and determine if additional implementation action should be required.
- To implement the monitoring in a manner consistent with other TMDL implementation plans and regulatory actions within the Dominguez Channel watershed.

Monitoring by assigned responsible parties is required in three waterbody areas:

1. Dominguez Channel, Torrance Lateral, and Dominguez Channel Estuary
2. Greater Los Angeles and Long Beach Harbor Waters (including Consolidated Slip)

3. Los Angeles River and San Gabriel River

Monitoring shall be conducted under technically appropriate Monitoring and Reporting Plans (MRPs) and Quality Assurance Project Plans (QAPPs). The MRPs shall include a requirement that the responsible parties report compliance and non-compliance with waste load and load allocations as part of annual reports submitted to the Regional Board. The QAPPs shall include protocols for sample collection, standard analytical procedures, and laboratory certification. All samples shall be collected in accordance with SWAMP protocols. Monitoring Plans shall be submitted twenty (20) months after the effective date of the TMDL for public review and, subsequently, Executive Officer approval.

Monitoring shall begin six months after the monitoring plan is approved by the Executive Officer. Responsible parties assigned both WLAs and LAs may submit one document that addresses the monitoring requirements (as described below) and implementation activities for both WLAs and LAs. Responsible parties shall submit annual monitoring reports.

The Regional Board Executive Officer may reduce, increase, or modify monitoring and reporting requirements, as necessary, based on the results of the TMDL monitoring program. Currently, several of the constituents of concern have numeric targets that are lower than the readily available detection limits. As analytical methods and detection limits continue to improve (i.e., development of lower detection limits) and become more environmentally relevant, responsible parties shall incorporate new method detection limits in the MRP and QAPP.

### *7.6.1 Dominguez Channel Freshwater, Torrance Lateral, and Dominguez Channel Estuary Compliance Monitoring Program*

For Dominguez Channel, Dominguez Channel Estuary, and Torrance Lateral, water and total suspended solids samples shall be collected at the outlet of the storm drains discharging to the channel and the estuary. Fish tissue samples shall be collected in receiving waters of the Dominguez Channel Estuary. Sediment samples shall be collected in the estuary.

Responsible parties listed above for Dominguez Channel, Torrance Lateral, and Dominguez Channel Estuary are each responsible for conducting water, sediment, and fish tissue monitoring. However, they are encouraged to collaborate or coordinate their efforts to avoid duplication and reduce associated costs. Stormwater dischargers may coordinate compliance with the TMDL. Compliance with the TMDL may be based on a coordinated MRP. Dischargers interested in coordinated compliance shall submit a coordinated MRP that identifies stormwater BMPs and monitoring to be implemented by the responsible parties. Under the coordinated compliance option, the compliance point for the stormwater WLAs shall be storm drain outfalls which suitably represent the combined discharge of cooperating parties.

Water samples and total suspended solids samples will be collected during two wet weather and one dry weather events each year. The first large storm event of the season shall be included as one of the wet weather monitoring events. Water samples and total suspended solid samples will be analyzed for metals, DDT, PCBs, Benzo[a]anthrancene, Benzo[a]pyrene, Chrysene, Phenanthrene, and Pyrene. Sampling shall be designed to collected sufficient volumes of suspended solids to allow for analysis of the listed pollutants in the bulk sediment.

In addition to TMDL constituents, general water chemistry (temperature, dissolved oxygen, pH, and electrical conductivity) and a flow measurement will be required at each sampling event. General chemistry measurements may be taken in the laboratory immediately following sample collection, if auto samplers are used for sample collection or if weather conditions are unsuitable for field measurements.

Sediment monitoring program shall be developed in agreement with the selected method for compliance and all samples shall be collected in accordance with SWAMP protocols.

a) If ERLs compliance method is selected, sediment chemistry samples will be collected every two years for analysis of general sediment quality constituent and full chemical suite as specified in SQO Part 1. In addition, benthic community effects shall be assessed in the Dominguez Channel estuary.

b) If SQO compliance method is selected, sediment chemistry samples shall also be collected every five years (in addition to, and in between, the sediment triad sampling events as described below), beginning after the first sediment triad event to evaluate trends in general sediment quality constituents and listed constituents relative to sediment quality targets. Chemistry data without accompanying sediment triad data shall be used to assess sediment chemistry trends and shall not be used to determine compliance.

Sediment quality objective evaluation as detailed in the SQO Part 1 (sediment triad sampling) shall be performed every five years in coordination with the Biological Baseline and Bight regional monitoring programs, if possible. Sampling and analysis for the full chemical suite, two toxicity tests and four benthic indices as specified in SQO Part 1 shall be conducted and evaluated. If moderate toxicity as defined in the SQO Part 1 is observed, results shall be highlighted in annual reports and further analysis and evaluation to determine causes and remedies shall be required in accordance with the EO approved monitoring plan. Locations for sediment triad assessment and the methodology for combining result from sampling locations to determine sediment conditions shall be specified in the MRP to be approved by the Executive Officer. The sampling design shall be in compliance with the SQO Part 1 Sediment Monitoring section (VII.E.).

Fish tissue samples will be collected every two years and analyzed for chlordane, dieldrin, toxaphene, DDT, and PCBs. The target species in the Dominguez Channel estuary shall be selected based on the local abundance and fish size at the time of field collection. Tissues analyzed will be based on most common preparation for the selected fish species.

### *7.6.2 Greater Harbor Waters Compliance Monitoring Program*

Responsible parties listed above for Greater Harbor Waters, Eastern San Pedro Bay are jointly responsible for implementing the monitoring program. At a minimum, monitoring shall be conducted at the locations and constituents listed in Table 7-1 for water column, total suspended solid, and sediment. The exact location of monitoring sites shall be specified in the monitoring plan to be approved by the Executive Officer. During aspects of the remedial action(s) for the Montrose Superfund Site that may mobilize sediments and associated pollutants from the on- or near-property soils or “Neighborhood Areas”, it is recommended that US EPA, as the regulatory oversight agency, require that Potentially Responsible Parties (PRP) implement monitoring to evaluate pollutant loads and concentrations leaving the site and surrounding area, as well as pollutant concentrations in the bed sediments of Dominguez Channel Estuary and Consolidated Slip and coordinate such monitoring with other TMDL compliance monitoring.

Sediment quality objective evaluation as detailed in the SQO Part 1 (sediment triad sampling) will be performed every five years for compliance; concurrently with the Biological Baseline and Bight programs. Full chemical suite, two toxicity tests and four benthic indices will be conducted and evaluated. If moderate toxicity as defined in the SQO Part 1 is observed, results shall be highlighted in annual reports and further analysis and evaluation to determine causes and remedies shall be required in accordance with the EO approved monitoring plan. Locations for sediment triad assessment and the methodology for combining results from sampling locations to determine sediment conditions in the waterbody shall be specified in the MRP to be approved by the EO. The sampling design shall be in compliance with the SQO Part I Sediment Monitoring section (VII.E).

Sediment chemistry samples will also be collected in between every five year of the sediment quality objective evaluation for analysis of general sediment quality constituents (GSQC) and listed constituents in Table 7-1. The chemistry analysis shall be used to assess sediment chemistry trend and will not be used to determine compliance. All samples will be collected in accordance with SWAMP protocols.

Water samples and total suspended solids samples will be collected during two wet weather and one dry weather event each year. The first large storm event of the season shall be included as one of the wet weather monitoring events. General water chemistry (temperature, dissolved oxygen, pH, and electrical conductivity), flow measurement, and listed constituent in Table 7-1 will be required at each sampling event.

**Table 7-1. List of Constituents for Analysis and Required Monitoring Sites and for Water Column and Sediment Chemistry**

<table>
<tr><th rowspan="2">Water Body Name</th><th rowspan="2">Station Id</th><th rowspan="2">Station Location</th><th colspan="2">Sample Media</th></tr>
<tr><th>WATER/TSS</th><th>SEDIMENT</th></tr>
<tr><td>Consolidated Slip</td><td>01</td><td>Center of Consolidated Slip</td><td>Metals, PCBs, DDT</td><td>Metals, Chlordane, DDT PCBs, Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, Phenanthrene, Pyrene, 2-methylnaphthalene</td></tr>
<tr><td>Los Angeles Inner Harbor</td><td>02</td><td>East Turning Basin</td><td>Metals, PCBs, DDT</td><td rowspan="3">Metals, Toxicity, Benthic Community Effect</td></tr>
<tr><td></td><td>03</td><td>Center of the POLA West Basin</td><td>Metals, PCBs, DDT</td></tr>
<tr><td></td><td>04</td><td>Main Turning Basin north of Vincent Thomas Bridge</td><td>Metals, PCBs, DDT</td></tr>
<tr><td></td><td>05</td><td>Between Pier 300 and Pier 400</td><td>Metals, PCBs, DDT</td><td>Metals, Toxicity, Benthic Community Effect</td></tr>
</table>

| Water Body Name | Station Id | Station Location | Sample Media | |
|---|---|---|---|---|
| | | | WATER/TSS | SEDIMENT |
| | 06 | Main Channel south of Port O'Call | Metals, PCBs, DDT | Metals, Toxicity, Benthic Community Effect |
| Fish Harbor | 07 | Center of inner portion of Fish Harbor | Metals, PCBs, DDT | Metals, Toxicity, PCBs, DDT, Chlordane, Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, Dibenz[a,h]anthracene, Phenanthrene, Pyrene |
| Los Angeles Outer Harbor | 08 | Los Angeles Outer Harbor between Pier 400 and middle breakwater | Metals, PCBs, DDT | Toxicity |
| | 09 | Los Angeles Outer Harbor between the southern end of the reservation point and the San Pedro breakwater | Metals, PCBs, DDT | Toxicity |
| Cabrillo Marina | 10 | Center of west Channel | Metals, PCBs, DDT | |
| Inner Cabrillo Beach | 11 | Center of Inner Cabrillo Beach | Metals, PCBs, DDT | Metals |
| Long Beach Inner Harbor | 12 | Cerritos Channel between the Heim Bridge and the Turning Basin | Metals, PCBs, DDT | Metals, Toxicity, Benthic Community Effect |
| | 13 | Back Channel between Turning Basin and West Basin | Metals, PCBs, DDT | Metals, Toxicity, Benthic Community Effect |
| | 14 | Center of West Basin | Metals, PCBs, DDT | Metals, Toxicity, Benthic Community Effect |
| | 15 | Center of Southeast Basin | Metals, PCBs, DDT | Metals, Toxicity, Benthic Community Effect |
| Long Beach Outer Harbor | 16 | Center of Long Beach Outer Harbor | Metals, PCBs, DDT | Toxicity |
| | 17 | Between the southern end of Pier J and the Queens Gate | Metals, PCBs, DDT | Toxicity |
| San Pedro Bay | 18 | Northwest of San Pedro Bay near Los Angeles River Estuary | Metals, PCBs, DDT | Metals, Chlordane, PAHs, Toxicity |
| | 19 | East of San Pedro Bay | Metals, PCBs, DDT | Metals, Chlordane, PAHs, Toxicity |
| | 20 | South of San Pedro Bay inside breakwater | Metals, PCBs, DDT | Metals, Chlordane, PAHs, Toxicity |
| Los Angeles River Estuary | 21 | Los Angeles River Estuary Queensway | Metals, PCBs, DDT | Metals, Chlordane, DDT, PCBs |

| Water Body Name | Station Id | Station Location | Sample Media | |
|---|---|---|---|---|
| | | | WATER/TSS | SEDIMENT |
| | | Bay | | |
| | 22 | Los Angeles River Estuary | Metals, PCBs, DDT | Metals, Chlordane, DDT, PCBs |

Fish tissue samples will be collected annually in San Pedro Bay, Los Angeles Harbor, and Long Beach Harbor, and analyzed for Chlordane, Dieldrin, Toxaphene, DDT, PCBs. Fish targeted to evaluate potential impacts to human health will be limited to species more commonly consumed by humans. White croaker, a sport fish, and a prey fish shall be collected and analyze to capture contaminant concentrations in species that pose the biggest risk to human health if consumed.

## 7.7 Implementation Schedule

The TMDL Implementation Schedule (Table 7-2) is designed to provide responsible parties flexibility to implement BMPs and management strategies to address toxicity pollutant impairments in Dominguez Channel and Greater Harbor waters. Implementation consists of development of monitoring/management plans by responsible parties, implementation of BMPs to address contaminant loading to the Dominguez Channel and Greater Harbor waters, and the ports management activities to remediate the sediment contamination and protect aquatic life.

**Table 7-2. Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants TMDL: Implementation Schedule**

| Task Number | Task | Responsible Party | Deadline |
|---|---|---|---|
| 1 | Interim allocations are met. | All Responsible Parties | Effective date of the TMDL |
| 2 | Submit a Monitoring Plan to the Los Angeles Regional Board for Executive Officer approval. | Dominguez Channel Responsible parties; Greater Harbors Responsible Parties; Consolidated Slip Responsible Parties subgroup; Los Angeles and San Gabriel River Responsible Parties | 20 months after effective date of the TMDL |
| 3 | Implement Monitoring Plan | Dominguez Channel Responsible parties; Greater Harbors Responsible Parties; Consolidated Slip Responsible Parties subgroup; Los Angeles and San Gabriel River Responsible Parties | 6 months after monitoring plan approved by Executive Officer. |
| 4 | Submit annual monitoring reports to the Los Angeles Regional Board. | All Responsible parties | 15 months after monitoring starts and annually thereafter |
| 5 | Submit an Implementation Plan and Contaminated Sediment Management Plan (CSMP). The Implementation Plan and CSMP shall be circulated for public review for 30 days. The CSMP shall include concrete milestones with numeric estimates of load reductions or removal, including milestones for remediating hot spots, including but no limited to Dominguez Channel Estuary, Consolidated Slip and Fish Harbor, for Executive Officer approval. The Executive Officer shall consider the consent decree for the Montrose Superfund site in determining whether to approve the CSMPs. | Dominguez Channel Responsible parties; Greater Harbors Responsible Parties; Consolidated Slip Responsible Parties subgroup | 2 years after effective date of the TMDL |
| 6 | Submit Report of Implementation to the Los Angeles Regional Board for Executive Officer approval. | Los Angeles and San Gabriel River Responsible Parties | 2 years after effective date of the TMDL |
| 7 | Submit annual implementation reports to the Los Angeles Regional Board. Report on implementation progress and demonstrate progress toward meeting the assigned LAs and WLAs. | All Responsible parties | 3 years after effective date of the TMDL and annually thereafter |
| 8 | Complete Phase I of TMDL Implementation Plan and Sediment Management Plan. | Dominguez Channel Responsible parties; Greater Harbors Responsible Parties; Consolidated Slip Responsible Parties subgroup | 5 years after effective date of the TMDL |
| 9 | Submit updated Implementation Plan and | Dominguez Channel | 5 years after |

| Task Number | Task | Responsible Party | Deadline |
|---|---|---|---|
| | Contaminated Sediment Management Plan. | Responsible parties; Greater Harbors Responsible Parties; Consolidated Slip Responsible Parties subgroup | effective date of the TMDL |
| 10 | Regional Board will reconsider targets, WLAs, and LAs based on new policies, data or special studies. Regional Board will consider requirements for additional implementation or TMDLs for Los Angeles and San Gabriel Rivers and interim targets and allocations for the end of Phase II. | Regional Board | 6 years after the effective date of the TMDL |
| 11 | Report on status of implementation and scope and schedule of remaining Phase II implementation actions to Regional Board | All responsible parties | 10 years after the effective date of the TMDL. |
| 12 | Complete Phase II of TMDL Implementation Plan and Sediment Management Plan. | Dominguez Channel Responsible parties; Greater Harbors Responsible Parties; Consolidated Slip Responsible Parties subgroup | 15 years after effective date of the TMDL |
| 13 | Complete Phase III of TMDL Implementation Plan and Sediment Management Plan. | Dominguez Channel Responsible parties; Greater Harbors Responsible Parties; Consolidated Slip Responsible Parties subgroup | 20 years after effective date of the TMDL |
| 14 | ~~Final LAs and WLAs are achieved~~. Demonstrate attainment of WLAs and LAs using the mean identified under WLAs and LAs in Table 7-40.1 in the Basin Plan. | All Responsible parties | 20 years after effective date of the TMDL |

## 7.8 Cost Consideration

Porter-Cologne Section 13241(d) requires staff to consider costs associated with the establishment of water quality objectives. This TMDL does not establish water quality objectives, but is merely a plan for achieving existing water quality objectives. Therefore, cost considerations required in Section 13241 are not required for this TMDL.

The purpose of this cost analysis is to provide the Regional Board with information concerning the potential cost of implementing this TMDL, and to address concerns about costs that may be raised by responsible parties. An evaluation of the costs of implementing this toxic pollutant TMDL amounts to evaluating the costs of remediating toxic pollutant levels in the Dominguez Channel and Los Angeles and Long Beach Harbors and preventing toxic pollutant loading to these waters from stormwater discharge. This section provides an overview of the costs associated with the typical toxic pollutant cleanup and toxic pollutant reduction implementation methods.

### *7.8.1 Cost of Implementing Toxic Pollutant TMDL*

The cost of implementing this TMDL will range widely, depending on methods that the responsible parties select to meet the Waste Load and Load Allocations. Based on the implementation measures discussed previously, approaches can be categorized as Harbor management and stormwater treatment prior to discharging into Harbor. Harbor management strategies may be relatively more effective in reducing toxic pollutant concentrations in harbors, since some methods can remove the long accumulated sediment, which is a large source of toxic pollutants. Attainment of the WLA and LA in Harbor by only treating incoming stormwater would require more time. However, stakeholders may determine the compliance approach by considering the possible time needed in conjunction with the expense.

#### *7.8.1.1 Harbor Management Implementation Options*

**Sediment Removal/Dredging**

The depth of Harbor ranges from 30 to 60 feet (10-20 meters) with shallower bottom near outlet of Dominguez Channel and inner side of Pier 300 at Port of Los Angeles (< 20 feet), and deeper water at the entrance to Port of Long Beach (> 60 feet). Both Los Angeles and Long Beach Harbors are dredged periodically for navigation purposes. Staff finds it may be feasible to dredge Harbors for contaminated sediment removal as part of the existing practices.

Factors that possibly influence the dredging cost include dredging methodology, depth to the bottom of harbor, distance from shoreline, composition (silt, clay, sands with different grain sizes) of the sediments, transport of dredged materials, disposal methods and locations, and subaqueous capping for off-shore disposal. Based on a feasibility study conducted in 1998 for sediment contamination mitigation at the mouth of Ballona Creek and Marina del Rey, the dredging cost ranges from \$10.95 per cubic yard ($yd^3$) to \$74.4 per cubic yard (Moffatt & Nichol Engineers, 1998). The less expensive estimate was the results of choosing off-shore disposal, and economic capping. Since most of cost driving factors are undetermined, the average of estimates is used to predict the most probable dredging unit cost of \$42.68 per cubic yard (1998 dollars). Assuming an inflation rate of 3% each year, the unit cost adjusted to the current value (year 2010) becomes \$60.84 per cubic yard. This cost includes delivery of equipment, setup, operating equipment, pumping, dewatering process or sludge/sediment management, cleaning, labor associated with the above activities, and transporting waste.

Based on the draft memorandum to Regional Board staff on December 10, 2010, prepared by Ports of Long Beach and Los Angeles, and its associated discussion, areas where dredging activities may be necessary to remove contaminated sediment to fulfill requirements of Effect Range Low (ERL) or Sediment Quality Objective (SQO) were analyzed. Multiple literatures including Southern California Bight Monitoring (1998, 2003 and 2008) and the Ports Biobaseline Monitoring in 2008, indicated that the sediments at five primary locations which are Fish Harbor, Cabrillo Marina, Consolidated Slip, and Inner Cabrillo Beach of Los Angeles Harbor, Inner and Outer Harbors of Los Angeles/Long Beach have concentrations exceeding ERLs, and may have caused or contributed to benthic community impairment.

In accordance with the SQO procedure, multiple lines of evidences for sediment chemistry, toxicity, and benthic community may be used to determine the levels of impact which indirectly may interpolate the areas and depth of necessary dredging activities. Approximately 1889 acres where classified either possible, likely or clearly impacted, with varying depths with a range of 2-8 feet may be dredged. Table 7-3 summarizes the total volume of dredged materials that may fulfill requirements of SQO and ERLs.

**Table 7-3. Estimated volume of dredged materials with respect to SQO and ERL, prepared by Anchor QEA for Port of Los Angeles and Long Beach December 2010.**

| | Estimated Volume of Dredged materials Cubic Yard ($yd^3$) | |
|---|---|---|
| **Waterbody** | **SQO** | **ERL** |
| Fish Harbor | 1,120 | 1,111,701 |
| Los Angeles Harbor Cabrillo Marina | 1,156,131 | 1,159,768 |
| Los Angeles Harbor Consolidated Slip | 475,910 | 478,294 |
| Los Angeles Harbor Inner Cabrillo Beach Area | 196,560 | 238,138 |
| Los Angeles Harbor Beach Inner Harbor | 6,692,551 | 21,864,948 |
| Los Angeles Harbor Beach Outer Harbor | 2,645,954 | 10,669,544 |
| San Pedro Bay outside Harbors Outlet of Los Angeles River* | 4,840* | 4,840* |
| Total | 11,173,066 | 35,527,233 |

*Additional estimate provided by Regional Board Staff.

The memo referenced above did not address any areas outside of Los Angeles and Long Beach Harbors. Based on a study conducted by Southern California Coast Water Research Project (SCCWRP) in 2008 and Regional Board staff's analysis, several locations with total area of 73 acres were identified as impacted. By the typical protocol of dredging, the minimal dredging depths are in a range of 2-3 feet. Therefore, the total volume to be dredged per SQO is approximately 11,173,066 cubic yards.

The total cost to dredging at Harbors is estimated $679.8 million dollars. Given a compliance schedule of 20 years, and the annual interest rate of 6%, the amortized cost for each year would be $59.3 million dollars (Table 7-4).

**Table 7-4. Summary of estimated cost for dredging**

| | Volume (cubic yards) | Unit Cost | Total Cost |
|---|---|---|---|
| Dredging | 11,173,066 | $60.84/cubic yard | $679,788,860 |
| Amortized over 20 years (6% interest rate) | | | $59,277,589 per year |

(Wastewater Engineering Treatment, disposal and Reuse, 3rd edition, Chap 12, Metcalf & Eddy).

### *7.8.1.2 Stormwater Treatment Implementation Options*

**Sand/Organic Filters**

A typical sand/organic filter system contains two or more chambers. The first is the sedimentation chamber for removing floatables and heavy sediments. The second is the filtration chamber, which removes additional pollutants by filtering the runoff through a sand bed. Properly designed sand/organic filters are effective methods to remove suspended solids, biochemical oxygen demand (BOD), total phosphorus, fecal coliform bacteria, metals and toxic pollutants from stormwater. The effectiveness of a sand/organic filter system is greatly influenced by the pollutant loadings, and the characteristics of the drainage areas.

The construction cost of a sand/organic filter system depends on the drainage areas, expected efficiency and other design parameters. Case studies conducted in 1997 indicate cost ranges from $2,360 dollars/acre for areas greater than 30 acres to $18,500 dollars per acre (EPA, 1999). With considerations of inflation rate of 3% to bring the monetary value to current, and the vast areas, the unit price of constructing filter system is assumed $3,000 dollars per acre. The Dominguez Channel subwatershed is approximately 75,144 acres, which results in the overall cost of $ 225 million dollars for sand/organic filter system construction (Table 7-5). Amortized with interest rate of 6% annually and into 20 years based on the implementation schedule, and with the average annual maintenance rate of 5%, the total cost is 20.64 million dollars.

**Table 7-5. Summary of estimated cost for stormwater treatment filters**

| Items | Unit Price | Total Cost |
|---|---|---|
| Construction cost | $3,000/acre of drainage area Total 75,144 acres in the Dominguez Channel Subwatershed. | $225,432,000 $19.6 million annually if amortized with an interest rate of 6% for 20 years. |
| Maintenance | 5% of the construction cost, annually | $982,884 annually |
| Total Cost | | $20,640,554 annually |

**Vegetated Swales**

Vegetated swales are constructed along drainage ways where stormwater runoff conveyed. Vegetation in swales and strips allows for the filtering of pollutants, and infiltration of runoff into groundwater. Densely vegetated swales can be designed to add visual interest to a site or to screen unsightly views. They reduce runoff velocities, which allow sediment and other pollutants to settle out.

The effectiveness of vegetated swales depends on slopes of swales, soil permeability, grass cover density, contact time of stormwater runoff and intensity of storm events. Vegetated swales, based on case studies, are capable of managing runoff from small drainage areas with approximate sizes of 10 acres.

Construction of swales begins with site clearing, grubbing, excavation, leveling and tilling, thereafter followed with seeding and vegetation planting. The cost of developing a swale unit is estimated in the range of $6,000 to $17,000 (CASQA, 2003). Routine maintenance activities include keeping up the hydraulic and removal efficiency of the channel, periodic mowing, weed control, watering, reseeding and clearing of debris and blockages for a dense, healthy grass cover.

With considerations of inflation rate of 3% to bring the monetary value to current, and the vast areas, the unit price of constructing a vegetated swale is assumed to be $7,200 dollars each. Acreage of the Dominguez Channel subwatershed requires approximately 7,514 units of vegetated swales, which results in the overall cost of $54.1 million dollars (Table 7-6). Amortized with interest rate of 6% annually and into 20 years based on the implementation schedule, and with the average annual maintenance rate of 5%, the total cost is $4.95 million dollars.

**Table 7-6. Summary of estimated cost for vegetative swales**

| Items | Unit Cost | Total cost |
|---|---|---|
| Construction | $7,200 per unit swale for each 10-acre drainage area | $54,103,680<br>$4.7 million annually if amortized with an interest rate of 6% for 20 years. |
| Maintenance | 5% of construction cost annually | $235,892 annually |
| Total Cost | | $4,953,733 annually |

### *7.8.1.3 Cost Comparison*

Water quality improvement at the Harbors can be achieved through harbor management which mitigates the toxic pollutant problem in harbors water and by reducing toxic pollutant loading from stormwater discharge. The following table summarizes the estimated total costs as results of implementing this TMDL (Table 7-7). The overall project costs arising from dredging the contaminated sediment in harbors and pollutant loading reduction in stormwater could be in a range of 733 million dollars to 905 million dollars. With consideration of the maintenance cost to structural BMPs such as infiltration system and vegetated swales, this overall cost may amortized, at a interest rate of 6%, to become as low as 64 million dollars per year during implementation of this TMDL.

Both the Port of Los Angeles and Port of Long Beach dredge the harbors and channels periodically or upon request to maintain proper navigation. The quantity of dredged materials for purposes other than removing contaminated sediment was not accounted, and may further reduce the cost for implementing this TMDL.

**Table 7-7. Cost summary for stormwater treatment implementation alternatives**

| Implementation Alternatives | Harbor Dredging and Sand/Organic Filters | Harbor Dredging and Vegetated Swale |
|---|---|---|
| Total Project Cost (current value) | $905,220,860 | $733,892,540 |
| Amortized annual Cost (Interest rate 6% over 20 years) | $79,918,143 | $64,231,322 |

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# TOTAL MAXIMUM DAILY LOADS FOR NITROGEN COMPOUNDS AND RELATED EFFECTS

## LOS ANGELES RIVER AND TRIBUTARIES


California Regional Water Quality Control Board

Los Angeles Region



May 2, 2003

Revised: July 10, 2003

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# 1 INTRODUCTION

Many segments of the Los Angeles River and its tributaries contain elevated levels of nutrients that adversely impact the water and contribute to algae, odors, scum, foam, and toxicity. These impaired segments exceed water quality objectives (WQOs) for ammonia, pH, nutrients (including nitrogen compounds such as nitrite and nitrate), algae, odors, scum/foam and toxicity, which appears to be primarily related to ammonia. Impaired segments (i.e. reaches) of the Los Angeles River were included on the 1998 California 303(d) list of impaired waterbodies (LARWQCB, 1998a). To address these impairments, the Clean Water Act requires a Total Maximum Daily Load (TMDL) be developed to restore impaired waterbodies, including the Los Angeles River, to their full beneficial uses. Table 1 summarizes the segments of the Los Angeles River included on the 1998 California 303(d) list for ammonia, nutrients, algae, odors, scum/foam, and pH.

Ammonia, pH, nutrients (including nitrogen compounds such as nitrite and nitrate), algae, odors, scum/foam can be addressed through limitations on nitrogen compounds. The goal of this TMDL is to develop wasteload allocations for nitrogen compounds and an implementation plan to meet the water quality objectives in the Los Angeles River. Attaining the nitrogen compound objectives is intended to address impairments caused by pH, scum/foam, and algae as these effects are related to the presence of nitrogen in the waterbody. The TMDL implementation plan requires continued studies to verify this assumption, including special studies to assess the effectiveness of the nitrogen compound wasteload allocations established by this TMDL in eliminating pH, algae, odor, scum and foam impairments. The implementation plan includes a provision to revise nitrogen compound targets and wasteload allocations to address the nutrient, algae, foam, scum/odor and pH impairments, if required.

**TABLE 1. SEGMENTS OF THE LOS ANGELES RIVER AND TRIBUTARIES LISTED AS IMPAIRED FOR NITROGEN, PH, OR EUTROPHIC EFFECTS (U.S. EPA, 1998)**

| Listed Waterbody Segment | Hydro Unit No | Miles of Impairment for Each Type of Nitrogen-Related Impairment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ammonia | Nutrients | Algae | Odors | Scum/ Foam | pH |
| Los Angeles River (at Sepulveda Basin) | 405.21 | 1.9 | 1.9 | NL | 1.9 | 1.9 | NL |
| Los Angeles River (from Sepulveda Dam to Sepulveda Blvd.) | 405.21 | 11.8 | 11.8 | NL | 11.8 | 11.8 | NL |
| Los Angeles River (from Riverside Dr. to Figueroa St.) | 405.21 | 7.2 | 7.2 | NL | 7.2 | 7.2 | NL |
| Tujunga Wash (from Hansen Dam to Los Angeles River) | 405.21 | 9.7 | NL | NL | 9.7 | 9.7 | NL |
| Burbank Western Channel | 405.21 | 6.4 | NL | 6.4 | 6.4 | 6.4 | NL |
| Verdugo Wash (from Verdugo Rd. to Los Angeles River) | 405.24 | NL | NL | 3.4 | NL | NL | NL |
| Arroyo Seco (from West Holly Ave. to Los Angeles River) | 405.15 | NL | NL | 7.0 | NL | NL | NL |
| Los Angeles River (from Figueroa St. to Carson St.) | 405.15 | 19.4 | 19.4 | NL | 19.4 | 19.4 | NL |
| Rio Hondo (at the Spreading Grounds) | 405.15 | 2.7 | NL | NL | NL | NL | NL |
| Rio Hondo (from the Santa Ana Fwy. to Los Angeles River) | 405.15 | 4.2 | NL | NL | NL | NL | 4.2 |
| Compton Creek | 405.15 | NL | NL | NL | NL | NL | 8.5 |
| Los Angeles River (From Carson St. to estuary) | 405.12 | 2.0 | 2.0 | NL | NL | 2.0 | 2.0 |
| Total miles affected | | 65.3 | 42.4 | 16.8 | 56.4 | 58.4 | 14.7 |

NL: Not listed as impaired

This TMDL addresses the requirements prescribed by Section 303(d) of the Clean Water Act, 40 CFR 130.2 and 130.7, and U.S. Environmental Protection Agency guidance (U.S. EPA, 2000a). This TMDL is based on the analysis provided by the U.S. EPA of nitrogen sources in the Los Angeles River watershed. The Modeling Analysis for the Development of TMDLs for Nitrogen Compounds in the Los Angeles River and Tributaries by Tetra Tech, Inc. was used to analyze the assimilative capacity, seasonality, critical conditions and the linkage of nitrogen sources to in-stream water quality. These analyses formed the basis of the wasteload allocations to be established by this TMDL.

The Implementation Plan of this TMDL is designed to attain water quality objectives for oxidized nitrogen, and ammonia (collectively the nitrogen compound objectives) in the Los Angeles River. Attaining the nitrogen compound objectives will likely address ancillary nutrient effects, including dissolved oxygen and algal growth. The implementation plan requires continued studies to verify this assumption. The Implementation Plan includes special studies to assess both wet-weather and dry-weather runoff loads in the watershed, including residential, commercial, and industrial land uses and other sources. Should these studies demonstrate that eutrophic impairments would not be eliminated through attainment of the nitrogen targets proposed in this TMDL, the California Regional Water Quality Control Board, Los Angeles Region (Regional Board) may revise targets and reallocate loads through a reevaluation included in the Implementation Plan. Additional discussion is provided in the Implementation Plan of this document.

## 1.1 REGULATORY BACKGROUND

Section 303(d) of the Clean Water Act (CWA) requires that each State "shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality objective applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters.

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in the U.S. Environmental Protection Agency guidance (U.S. EPA, 2000a). A TMDL is defined as the "sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the waterbody to assimilate pollutant loads (the loading capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (U.S. EPA, 2000).

States must develop water quality management plans to implement TMDLs (40 CFR 130.6). The Environmental Protection Agency has oversight authority for the 303(d) program and is required to review and either approve or disapprove TMDLs submitted by states. In California, the State Water Resources Control Board (State Board) and the nine Regional Water Quality Control Boards are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to U.S. EPA approval. If U.S. EPA disapproves a TMDL submitted by a state, U.S. EPA is required to establish a TMDL for that waterbody. The Regional Boards also hold regulatory authority for many of the instruments used to implement the TMDLs, such as the National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs).

The Regional Board identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWCQB, 1996, 1998a). These are referred to as “listed” or “303(d) listed” waterbodies or waterbody segments. A schedule for development of TMDLs in the Los Angeles Region was established in a consent decree (Consent Decree) approved on March 22, 1999 (Heal the Bay Inc., et al. v. Browner, C 98-4825 SBA). For the purpose of scheduling TMDL development, the decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units.

This TMDL addresses Analytical Unit 11 of the Consent Decree. Analytical Unit 11 consists of segments of the Los Angeles River and tributaries with impairments from ammonia, nutrients, algae, pH values outside of the allowable range, odors, foam and scum. Table 1 identifies the listed waterbodies, the nitrogen-related impairments for which each is listed, and the number of miles of waterbody impaired by each. This TMDL also addresses oxidized nitrogen compounds (*i.e.*. nitrite and nitrate) because these compounds are related to the other nitrogen impairments and can be formed by oxidation of ammonia in the environment. Moreover the oxidized nitrogen compounds exceed the Water Quality Control Plan for the Coastal Watersheds of Los Angeles and

Ventura Counties (Basin Plan) objectives in certain reaches of the Los Angeles River. The Consent Decree schedule requires that U.S. EPA establish this TMDL by March 22, 2004. This report presents the TMDL for nitrogen and summarizes the analyses performed by U.S. EPA and the Regional Board to develop this TMDL.

The Basin Plan includes an ammonia objective and a criterion specific compliance schedule provision that requires publicly owned treatment works (POTWs) that discharge to inland surface waters until June 13, 2002 to: 1) make the necessary adjustments and improvements to meet the water quality objectives for ammonia or 2) conduct studies leading to an approved site-specific objective for ammonia.

At public hearings on January 11, 2001 and May 31, 2001, the Regional Board heard status reports on "Publicly Owned Treatment Works' (POTWs') Progress toward Compliance with Inland Surface Water Ammonia Objectives" from Regional Board staff. The status report indicated that two of the major POTWs that discharge to the Los Angeles River, the Donald C. Tillman Water Reclamation Plant and the Los Angeles-Glendale Water Reclamation Plant, have initiated pilot tests with a target compliance date of 2005. The City of Los Angeles Bureau of Sanitation (City) reported that it could not meet the 2002 target compliance date because completion of a downstream relief sewer, scheduled for November 2005, is required to account for the anticipated derating of the Donald C. Tillman and Los Angeles-Glendale POTWs. The treatment capacity of these two POTWs will be reduced due to implementation of nitrification/denitrification processes to meet the ammonia objective. The target compliance date for the Burbank POTW is 2003.

The Regional Board approved a Basin Plan amendment to update the ammonia objectives in inland surface waters on April 25, 2002. The revised ammonia objectives apply to waters with beneficial uses pertaining to aquatic life such as wildlife habitat (WILD) or warm freshwater habitat (WARM). This update was based on the U.S. EPA "1999 Update of Ambient Water Quality Criteria for Ammonia" (U.S. EPA, 1999). The revised objectives will be finalized once the State Board, the Office of Administrative

Law, and U.S. EPA approve the amendment. This TMDL has been developed to be consistent with the updated objectives.

## 1.2 ENVIRONMENTAL SETTING: THE LOS ANGELES RIVER

This TMDL addresses the loading of nitrogen compounds to five reaches and twelve tributaries to the Los Angeles River. The Los Angeles River flows for 55 miles from the Santa Monica Mountains at the western end of the San Fernando Valley to the Pacific Ocean at San Pedro Bay. It drains a watershed with an area of 834 square miles. Figure 1 shows the location of the waterbodies addressed by this TMDL. The main stem of the Los Angeles River runs from the upstream end of the Sepulveda Basin downstream to the beginning of San Pedro Bay, a total of five reaches. The seven listed reaches of tributaries are: Tujunga Wash below Hansen Dam; Burbank Western Channel Verdugo Wash from Verdugo Road to the Los Angeles River confluence; Arroyo Seco below Devils Gate Dam; Rio Hondo at the spreading grounds; Rio Hondo downstream of the spreading grounds, from the Santa Ana Freeway to the Los Angeles River confluence; and Compton Creek.

Approximately 44% of the watershed area can be classified as forest or open space. These areas are primarily within the headwaters of the Los Angeles River in the Santa Monica, Santa Susana, and San Gabriel Mountains. There is little agricultural activity in these areas. Approximately 36% of the land use can be categorized as residential, 10% as industrial, 7.5% as retail commercial, and 3% as other. Most of the area devoted to these more urban uses is found in the lower portions of the watershed.

The natural hydrology of the river and many of its tributaries have been altered for flood control purposes. Many stretches of the river and its tributaries have been channelized and flood control reservoirs have been constructed. Most of the main stem of the Los Angeles River is lined with concrete, and most tributaries are lined with concrete for most or all of their lengths. However, soft-bottomed segments of the river occur where groundwater upwelling prevented armoring of the river bottom. These areas support riparian habitat in many areas this habitat is quite extensive.

The main stem of the Los Angeles River begins by definition at the confluence of Arroyo Calabasas (which drains northeastern portion of the Santa Monica Mountains) and Bell Creek (which drains the Simi Hills) at mile 55 (*i.e.* 55 miles upstream of San Pedro Bay). The river flows east from its origin along the southern edge of the San FernandoValley. In this region, the Los Angeles River receives flow from Browns Canyon, Aliso Creek and Bull Creek, non-listed tributaries that drain the Santa Susana Mountains. The lower portions of Arroyo Calabasas and Bell Creek are channelized. Browns Canyon, Aliso Creek and Bull Creek are completely channelized. This portion of the Los Angeles River is not listed for nitrogen compounds or related effects.

The river enters the Sepulveda Basin at mile 41. Sepulveda Basin is a 2,150-acre open space designed to collect floodwaters during major storms. Because the area is periodically inundated, it remains in natural or semi-natural conditions and supports a variety of low-intensity land uses. Sepulveda Basin and Glendale Narrows supports various beneficial uses. The wildlife habitat (WILD) beneficial use applies to the Sepulveda Basin and Glendale Narrows. The water contact recreation (REC1) beneficial use applies to the Sepulveda Basin. The Donald C. Tillman Wastewater Reclamation Plant, a POTW operated by the City of Los Angeles, discharges directly to the Los Angeles River within the basin and also via two lakes in the Sepulveda Basin that are used for recreational and wildlife habitat. The POTW has a capacity of 80 million gallons per day (mgd) and contributes a substantial flow to the Los Angeles River. The average monthly flow for the period 1995 to 2000 was approximately 53 mgd (*i.e.*. 80 cubic feet per second ($ft^3/s$)). During storm runoff, POTW effluent accounts for 15-40% of the total flow in the river at this point. During dry weather, the discharge from Donald C. Tillman constitutes a large proportion of the flow in the river.

Below the Sepulveda Basin, Pacoima Wash and Tujunga Wash enter the Los Angeles River. Both tributaries drain portions of the Angeles National Forest in the San Gabriel

Mountains. Pacoima Wash is channelized below Lopez Dam to the Los Angeles River; that reach is listed for nitrogen or related effects. Tujunga Wash is listed for the 10-mile reach below Hansen Dam. It is entirely channelized in this reach. Some of the discharge from Hansen Dam is diverted to spreading grounds for groundwater recharge, but most of the flow enters the channelized portion of the stream.

Further downstream, where the Los Angeles River continues flowing east in the San Fernando Valley, Burbank Western Channel and Verdugo Wash enter at mile 30 and mile 28 respectively. Both are channelized streams that drain the Verdugo Mountains. Verdugo Wash is listed for algae. The Western Channel is listed for multiple nitrogen-related effects below the point where it receives flow from the Burbank Water Reclamation Plant, a POTW with a design capacity of 9 mgd. Average monthly flows from this POTW in the period 1995 to 2000 were about 4 mgd, or about 6 $ft^3/s$. During the periods of wet weather when the flow exceeds the Los Angles Zoo's wastewater retention basin capacity, excess flow from the wastewater facility is discharged through North and/or South bypasses to a paved channel adjacent to Golden State Freeway (I-5), which is tributary to Los Angeles River at Colorado Street in Glendale.

At the eastern end of the San Fernando Valley, the Los Angeles River turns south at the eastern end of the Hollywood Hills and flows through Griffith Park and Elysian Park in an area known as the Glendale Narrows. This area is fed by natural springs during periods of high groundwater. This potential source was analyzed and found to have a negligible contribution of nitrogen compounds during critical conditions. The river is channelized and the sides are lined with concrete, but the river bottom in this area is unlined because the water table is high and groundwater routinely discharges into the channel, in varying volumes depending on the varying water table. The Los Angeles/Glendale Water Reclamation Plant, operated by the City of Los Angeles, is a 20-mgd POTW, which discharges to the Los Angeles River in the Narrows (at mile 29). The monthly average effluent discharge in the period 1995 to 2000 from this plant area was approximately 13 mgd, or 19 $ft^3/s$.

Another factor affecting hydrologic conditions in the Los Angeles River Narrows has been the increasing releases of reclaimed water. Reclaimed water releases from the Los Angeles-Glendale WRP were started in 1976-1977 and from the Donald C. Tillman WRP in 1985-1986. These year-round releases tend to keep the alluvium of the Los Angeles River Narrows saturated, even in dry years. Also there is up to 3,000 acre-feet of recharge from delivered water within the Los Angeles Narrows-Pollock Well Field area that adds to the rising groundwater. Rising groundwater also occurs above the Verdugo Narrows and in the reach upgradient from Gage F-57C-R (Figure 2). During dry periods, conditions in the unlined reach are stabilized with regard to percolation and rising water by releases of treated wastewater. In wet periods, rising groundwater above Gage F-57C-R has been related to the increase of rising groundwater above the Verdugo Narrows. For 2000-01 the total rising groundwater flow at Gage F-57C-R and F-252-R was estimated at 3,900 acre-feet (ULARA Watermaster Report, 2000-2001 Water Year, May 2002).

The first major tributary below the Narrows is Arroyo Seco (mile 24), which drains areas of Pasadena and portions of the Angeles National Forest in the San Gabriel Mountains. The 10-mile length of the Arroyo below Devils Gate Dam to the Los Angeles River is channelized, and is listed for algae.

The Rio Hondo is a channelized tributary and joins the Los Angeles River at mile 10. The Rio Hondo and its tributaries drain a large area in the eastern portion of the watershed. Flow in the Rio Hondo is managed by the County Sanitation Districts of Los Angeles County (CSDLAC). At the Whittier Narrows the Rio Hondo and the adjacent San Gabriel River both enter a large spreading grounds, managed by the CSDLAC. Flow from the two rivers intermingles during storm events, producing substantial flows in the Los Angeles River downstream of the spreading grounds. During other periods, especially during dry weather, virtually all the water in Rio Hondo goes to groundwater recharge, so little or no flow exits the spreading grounds into the Los Angeles River. Rio Hondo is listed for ammonia both at the spreading grounds and downstream, in the reach from the Santa Ana Freeway to the Los Angeles River confluence.

Compton Creek is the last large tributary to the system, entering the Los Angeles River at mile 6. Compton Creek is channelized for most of its 8.5-mile length. Impairments to Compton are related to pH that is outside of the allowable range in the Basin Plan.

The tidal portion of the Los Angeles River begins in Long Beach at Willow Street (mile 3) and runs approximately three miles before joining with Queensway Bay located between the Port of Long Beach and the City of Long Beach. In this reach, the channel has a soft bottom with concrete-lined sides. Sandbars accumulate in the portion of the river where tidal influence is limited. Compton Creek receives up to 720 mgd of hydrotest and stormwater from Southern California Edison Company on an intermittent basis. The wastewater then flows to the Los Angeles River about ¼-mile downstream from Del Amo Boulevard, above the tidal prism. This discharge is not a significant source of nitrogen compounds discharged to Compton Creek. The ammonia load from Compton Creek was analyzed and found to be negligible.

During dry weather, most of the flow in the Los Angeles River is comprised of wastewater effluent from three POTWs in the Los Angeles River watershed: The Donald C. Tillman Water Reclamation Plant, the Los Angeles-Glendale Water Reclamation Plant, and the Burbank Water Reclamation Plant. In most months the mean monthly discharge in the river is approximately equal to the sum of the measured effluent from the Donald C. Tillman, Los Angeles-Glendale, and Burbank POTWs. During periods of storm runoff, however, the river's flow is much greater, by as much as two to three orders of magnitude. The river's mean monthly discharge greatly exceeds the POTW effluent volume during months with substantial rainfall, such as December 1996; January, November, and December 1997; February through May 1998; and others. In dry-weather months such as February through October 1997, POTW mean monthly discharges totaled 70% to 100% of the monthly average flow in the river. In months with major rain events, such as February through May 1998, POTW monthly average discharges together was less than 20% of the monthly average flow in the river.

The high flows in the wet season originate as storm runoff both from the large areas of undeveloped open space in the mountains of the tributaries' headwaters, and from the equally large urban land uses in the flat low-lying areas of the watershed. Rainfall in the headwaters flows rapidly because the watershed and stream channels for the most part are steep. In the urban areas, about 5,000 miles of storm drains in the watershed convey urban runoff to the Los Angeles River. Those storm drains are designed to convey stormwater flows rapidly through the system. Altogether, the watershed produces storm flow in the river with a sharply peaked hydrographic, where flow increases quite rapidly after the beginning of rain events in the watershed, and declines rapidly after rainfall ceases. The Los Angeles River TMDL therefore needs to account for differences in flow between wet and dry seasons; for differences between storm runoff and periods of no runoff, both during wet seasons and dry seasons; and also for differences in the relative contributions from point sources and urban runoff.

## 1.3 ELEMENTS OF A TMDL; ORGANIZATION OF THIS DOCUMENT

Guidance from U.S. EPA (1991) identifies seven elements of a TMDL. Sections 2 through 8 of this document are organized such that each section describes one of the elements, with the analysis and findings of this TMDL for that element. Section 9 includes an analysis of costs that may be incurred to meet the TMDL. The elements are:

- Section 2: Problem Identification. This section reviews the data used to add the waterbody to the 303(d) list, and summarizes existing conditions using that evidence along with any new information acquired since the listing. For this TMDL, the problem encompasses nitrogen compounds (ammonia, nitrite and nitrate), and effects which may be caused by nitrogen loading: pH outside of the allowable range, algae, foam/scum, and odors. This element identifies those reaches that fail to support all designated beneficial uses; the beneficial uses that are not supported for each reach; the water quality objectives (WQOs) designed to protect those beneficial uses; and, in summary, the evidence supporting the decision to list each reach, such as the number and severity of excellencies observed.

- Section 3: Numeric Targets. For this TMDL, the numeric targets consist of WQOs described in the Basin Plan. The implementation Plan includes studies to verify that attainment of the WQOs for constituents having numeric criteria will address impairments by constituents having narrative objectives, such as algae, scum/foam, and odors.
- Section 4: Source Assessment. This section develops the quantitative estimate of nitrogen loadings from point sources and non-point sources into the Los Angeles River.
- Section 5: Linkage Analysis. This analysis shows how the sources of nitrogen compounds into the waterbody are linked to the observed conditions in the impaired waterbody. The linkage analysis addresses the critical conditions of stream flow, loading, and water quality parameters.
- Section 6: Pollutant Allocation. Each pollutant source is allocated a quantitative load of nitrogen compounds that it can discharge to meet the numeric targets. Allocations are designed such that the waterbody will not exceed numeric targets for the nitrogen compounds or related effects. Allocations are based on critical conditions, so that the allocated pollutant loads may be expected to remove the impairments at all times.
- Section 7: Implementation. This section describes the plans, regulatory tools, or other mechanisms by which the wasteload allocations and load allocations are to be achieved. This section contains a cost analysis. The TMDL provides cost estimates to implement effluent treatment (nitrification/denitrification) at the major Publicly Owned Treatment Works (POTWs) discharging to the Los Angeles River. The cost estimates were developed by stakeholders.
- Section 8: Monitoring. This TMDL includes a requirement for monitoring the waterbody to ensure that the water quality standards for nitrogen compounds are attained and that related impairments such as pH, algae, odor, and foam/scum also are removed. If the monitoring results demonstrate the TMDL has not succeeded in removing the impairments, then revised allocations will be developed.

# 2 PROBLEM IDENTIFICATION

This section provides an overview of water quality standards for the Los Angeles River and reviews water quality data used in the 1998 water quality assessment and additional data used to analyze sources in this TMDL.

## 2.1 WATER QUALITY STANDARDS

California state water quality standards consist of the following elements: 1) beneficial uses; 2) narrative and/or numeric water quality objectives; and 3) an antidegradation policy. For inland surface waters in the Los Angeles Region, beneficial uses are identified in the Basin Plans. Numeric and narrative objectives are specified in the Basin Plan, designed to be protective of the beneficial uses in each waterbody in the region or State Water Quality Control Plans. The Basin Plan for the Los Angeles Regional (1994) defines 13 beneficial uses for the Los Angeles River. Table 2 summarizes these beneficial uses. Other waterbodies within the watershed have a conditional designation for MUN. These waterbodies are indicated with an asterisk in the Basin Plan. Conditional designations are not recognized are under federal law and are not considered water quality standards requiring TMDL development to protect at this time. (See Letter from Alexis Strauss [U.S. EPA] to Celeste Cantú [State Board], Feb. 15, 2002.)

**TABLE 2. BENEFICIAL USES IN 303 (D) LISTED REACHES OF THE LOS ANGELES RIVER (LARWQCB, 1994.)**

| STREAM REACH | Hydro Unit No. | MUN | GWR | REC1 | REC2 | WILD | WARM | SHELL | RARE | MIGR | SPWN | WET | MAR | IND | PROC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles River to Estuary | 405.12 | P* | E | Es | E | E | E | Ps | E | P | P | | E | P | P |
| Los Angeles River | 405.15 | P* | E | Es | E | P | E | | | | | | | P | |
| Los Angeles River | 405.21 | P* | E | E | E | E | E | | | | | | | P | |
| Compton Creek | 405.15 | P* | E | Es | E | E | E | | | | | E | | | |
| Rio Hondo Spreading Grounds and below | 405.15 | P* | I | Pm | E | I | P | | | | | | | | |
| Rio Hondo | 405.41 | P* | I | Im | E | I | P | | E | | | E | | | |
| Arroyo Seco S. of Devils Gate (L) | 405.15 | P* | | I | I | P | P | | | | | | | | |
| Arroyo Seco S. of Devils Gate (U) | 405.31 | P* | | Im | I | P | P | | E | | | | | | |
| Verdugo Wash | 405.24 | P* | I | Pm | I | P | P | | | | | | | | |
| Burbank Western Channel | 405.21 | P* | | Pm | I | P | P | | | | | | | | |
| Tujunga Wash | 405.21 | P* | I | Pm | I | P | P | | | | | | | | |

E: Existing beneficial use
P: Potential beneficial use
I: Intermittent beneficial use
s: Access prohibited by Los Angeles County DPW
m: Access prohibited by Los Angeles County DPW in the concrete-channelized area
*  Conditional designation which may be considered for exemption at a later date

### 2.1.1 Beneficial Uses

Nitrogen loadings to the Los Angeles River may result in impairments of beneficial uses associated with aquatic life (WILD[1], WARM[2], RARE[3], WET[4], MAR[5]), recreation (REC1[6] and REC2[7]) and water supply (GWR[8]). The Basin Plan (1994) identifies beneficial uses as existing (E), potential (P), or intermittent (I) uses. Several potential beneficial uses could be impacted, including SHELL[9], MIGR[10], SPWN[11], IND[12], and PROC[13]. Concentration of ammonia, a nitrogen compound, often exceeds water quality objectives for chronic and acute toxicity to aquatic life. Nitrate and nitrite, two oxidized nitrogen compounds, have, on infrequent occasions, been present in concentrations exceeding water quality objectives in the Basin Plan. All three of these nitrogen compounds may stimulate the production of algae that can impair aquatic life, water supply and recreational beneficial uses. Algal growth in some instances has produced algal mats in the waterbody that can result in eutrophic conditions where low dissolved oxygen concentration can harm aquatic life. The decay of these mats may also cause impairments by scum, odors, and foam that affect recreational uses of the river.

Analysis indicates that six of the beneficial uses are the most sensitive to nitrogen compounds and related effects such that protecting those uses will serve to protect all related beneficial uses. Therefore, this document focuses on key beneficial use designations, including WARM, WILD, WET, RARE, GWR, REC1, and REC2.

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[1] WILD: wildlife habitat
[2] WARM: warm freshwater habitat
[3] RARE: rare, threatened, or endangered species
[4] WET: wetland habitat
[5] MAR: marine habitat
[6] REC-1: water contact recreation
[7] REC-2: non-contact water recreation
[8] GWR: ground water recharge
[9] SHELL: shellfish harvesting
[10] MIGR: migration of aquatic organisms
[11] SPWN: spawning, reproduction, and/or early development
[12] IND: industrial service supply
[13] PROC: Industrial service supply

Existing use designations for warm freshwater, wildlife, wetland, and rare, threatened or endangered species (WARM, WILD, WET, and RARE) habitats apply over much of the main stem and Compton Creek in the lower part of the watershed. The WARM designation applies as a potential use to the remaining listed tributaries. The Wildlife use designation (WILD) is for the protection of fish and wildlife. This use applies to most of the main stem of the Los Angeles River, as an intermittent use in Rio Hondo, and as potential use in the remainder of the tributaries. Water quality objectives developed for the protection of fish and wildlife are applicable to the reaches with the WARM, WILD, WET and RARE designations.

The municipal supply (MUN) use designation applies to several tributaries to the Los Angeles River and all groundwater in the Los Angeles River watershed. Other waterbodies within Region 4 also have a conditional designation for MUN. These waterbodies are indicated with an asterisk in the Basin Plan. However, conditional designations are not recognized are under federal law and are not water quality standards requiring TMDL development at this time. (See Letter from Alexis Strauss [U.S. EPA] to Celeste Cantú [State Board], Feb. 15, 2002.)

The ground water recharge (GWR) use designation applies to the Los Angeles River and its tributaries as either an existing or intermittent beneficial use. The Basin Plan provides a nitrogen (nitrate, nitrite) objective for groundwater: "Ground waters shall not exceed 10 mg/L nitrogen as nitrate-nitrogen plus nitrite-nitrogen ($NO_3$-N + $NO_2$-N), 45 mg/L as nitrate ($NO_3$), 10 mg/L as nitrate-nitrogen ($NO_3$-N), or 1 mg/L as nitrate-nitrogen ($NO_2$-N)."

Recreational uses for body contact (REC1) and secondary contact (REC2) apply to almost all the listed river segments and tributaries as either existing, potential or intermittent. Although access to the Los Angeles River and the concrete-channelized areas of Tujunga, Verdugo, Burbank Western Channel, Arroyo Seco, and Rio Hondo is limited by Los Angeles County Department of Public Works, people are still observed using the Los Angeles River for recreational purposes. Recreational activities have been observed along the Los Angeles River include bird watching, jogging, hiking, soccer playing, and bicycling. Currently, public access is restricted along most of the main stems of the Los Angles River. This restriction is for public safety reasons. Water flows in the concrete channel can be 20 to 40 cubic feet per second (CFAs) and are able to sweep away people who are in close proximity. In spite of the posted prohibition signs, homeless people and others come in direct contact with the river's water for wading, bathing or other purposes. In 1990, it was estimated that 150 homeless individuals lived along the downtown portion of the river (Beneficial Uses of the LA and San Gabriel Rivers – May 2001). Objectives designed to protect human health (*e.g.*, bacterial objectives), and the aesthetic quality of the resource (*e.g.*, visual, tastes and odors) is appropriate to protect recreational uses of the river.

### 2.1.2 Water Quality Objectives (WQOs)

The Basin Plan provides WQOs for nitrogen compounds and their related effects, including numeric and narrative objectives discussed below. Both types of objectives are used in developing numeric targets and wasteload allocations.

#### 2.1.2.1 Objectives for Ammonia

Water quality objectives for ammonia are based on the "U.S. EPA 1999 Update of Ambient Water Quality Criteria for Ammonia (U.S. EPA 1999). Although the updated EPA criteria have not yet been incorporated into the Basin Plan, these criteria have been adopted by the Regional Board. The Resolution adopted by the Regional Board that amended the Basin Plan to include the updated ammonia objective is currently under review by the State Board.

#### 2.1.2.1.1 Basic for evaluation and proposed ammonia objective for Los Angeles River

The neutral, un-ionized ammonia species ($NH_3$) is highly toxic to fish and other aquatic life. The ratio of toxic $NH_3$ to total ammonia ($NH_4^+$ + $NH_3$) is primarily a function of pH, but is also affected by temperature and other factors. Additional impacts can occur as the oxidation of ammonia lowers the dissolved oxygen content of the water, further stressing aquatic organisms. Ammonia also combines with chlorine (often both are present) to form chloramines – persistent toxic compounds that extend the effects of ammonia and chlorine downstream.

Oxidation of ammonia to nitrate may lead to groundwater impacts in the area of recharge.

*In order to protect aquatic life, ammonia concentrations in receiving waters shall not exceed the values listed for the corresponding in-stream conditions in Tables 3-1 to 3-4 of the Basin Plan.*

In order to protect underlying groundwater basins, ammonia shall not be present at levels that, when oxidized to nitrate, pose a threat to groundwater.

On April 25, 2002 the Los Angeles Regional Water Quality Control Board approved a basin plan amendment to update the ammonia objectives in inland surface waters (Resolution No. 2002-011). This update was based on the U.S. EPA "1999 Update of Ambient Water Quality Criteria for Ammonia" (U.S. EPA 1999). The revised objectives will be finalized once the Office of Administrative Law has approved them. This TMDL has been developed to be consistent with these updated objectives.

The U.S. EPA's revised ammonia criteria reflect research and data analyzed since 1985, and represent a revision of several elements in the 1984 guidance, including the relationship between ammonia toxicity, pH and temperature, and the recognition of increased sensitivity of early life stage forms of fish to ammonia toxicity. The 1984 criteria were based on un-ionized ammonia ($NH_3$), while the 1999 criteria are expressed only as total (un-ionized plus ionized or $NH_3$ + $NH_4^+$) ammonia. The criteria apply to freshwater and do not impact the Ammonia Water Quality Objectives contained in the California Ocean Plan.

The most significant differences in the 1999 U.S. EPA guidance relative to the existing Basin Plan objectives for ammonia are:

1. Acute criteria are no longer temperature-dependent but remain dependent on pH and fish species present.
2. A greater recognition of the temperature dependence of the chronic criteria, especially at low temperatures.
3. An Early Life Stage (ELS) chronic criterion was introduced.
4. Chronic criteria are no longer dependent on the presence or absence of specified fish species, but remain dependent on pH and temperature.
5. A 30-day averaging period for the ammonia chronic criteria replaced the 4-day averaging period.

Additional information about the updated criteria, including technical rationale and comparisons to existing objectives, is found in the RWQCB Draft Staff Report, "Proposed Amendment of the Water Quality Control Plan, Los Angeles Region, to Revise Ammonia Objectives, April 24, 2002," which is provided in Appendix 1.

The revised objectives are not yet approved by the Office of Administrative Law (OAL), but the TMDL has been developed to be consistent with the updated objectives. Further, the Regional Board's resolution adopting the TMDL will specify that the TMDL will take effect following the approval of the revised criteria by OAL. Reaches listed for ammonia are: several reaches of the Los Angeles River main stem; the Burbank Western Channel; Tujunga Wash; and Rio Hondo at and below the spreading grounds.

Calculation of ammonia objectives as reflected in the April 25, 2002, Basin Plan amendment approved by the Regional Board:

1 The one-hour average concentration of total ammonia as nitrogen (in mg N/L) does not exceed (more than once every three years on average) the CMC (acute criteria) calculated using the following equations.

*Where salmonid fish are present:*

$$CMC = \left( \frac{0.275}{1+10^{7.204-pH}} \right) + \left( \frac{39.0}{1+10^{pH-7.204}} \right) \quad \text{(Equation 1a)}$$

*Or where salmonid fish are not present:*

$$CMC = \left( \frac{0.411}{1+10^{7.204-pH}} \right) + \left( \frac{58.4}{1+10^{pH-7.204}} \right) \quad \text{(Equation 1b)}$$

2 The thirty-day average concentration of total ammonia nitrogen (in mg N/L) does not exceed (more than once every three years on the average) the CCC (chronic criteria) calculated using the following equations.

*Where early life stage fish are present:*

$$CCC = \left( \frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}} \right) * MIN\left(2.85, 1.45*10^{0.028*(25-T)}\right) \quad \text{(Equation 2a)}$$

where MIN indicates use of the lesser of the two values contained within the parentheses.

*Or where early life stage fish are not present:*

$$CCC = \left( \frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}} \right) * 1.45*10^{0.028*(25-MAX(T,7))} \quad \text{(Equation 2b)}$$

where MAX indicates use of the greater of the two values contained within the parentheses and,

T = temperature expressed in °C.

The highest four-day average within the 30-day period should not exceed 2.5 times the CCC.

In addition to the ammonia objectives for surface waters, the Basin Plan states, "ammonia shall not be present at levels that, when oxidized to nitrate, pose a threat to groundwater" (LARWQCB, 1994). The primary drinking water Maximum Contaminant Level (MCL) is 45 mg/L for nitrate ($NO_3$), 10 mg/L for nitrite-nitrogen ($NO_3$ -N), and 1 mg/L for nitrite-nitrogen ($NO_2$-N). These MCLs are relevant to the extent that portions of the Los Angeles River recharge underlying groundwater.

Currently, the City of Los Angeles, City of Burbank, and the County Sanitation Districts of Los Angeles County are conducting a water effects ratio (WER) study for ammonia in the Los Angeles River. The objective of the study is to support development of a site-specific objective for ammonia in the Los Angeles River. If the WER study results in a revised ammonia objective, this TMDL will need to be revised to reflect the new ammonia target. A change in the levels of ammonia will require a reevaluation of the wasteload allocation for all of the nitrogen compounds because ammonia is converted to nitrite and nitrate in the Los Angeles River. Similarly, nitrate, nitrite, and organic nitrogen are converted to ammonia.

2.1.2.1.2 Alternatives Considered

Two alternatives were considered for developing of an appropriate water quality objective for ammonia in the Los Angeles River: 1) Using existing Basin Plan objectives; 2) Applying the "1999 Update of Ambient Water Quality Criteria for Ammonia" developed by U.S. EPA in developing ammonia objectives for Los Angeles River. The criteria used for selecting the recommended alternative included:

- consistency with State and federal water quality laws and policies;
- level of beneficial use protection; and
- consistency with the current science regarding water quality necessary to reasonably protect the beneficial uses.

a) Alternative 1 – Using existing Basin Plan objectives
   Under this alternative the existing Basin Plan water quality objective for ammonia would remain unchanged and would continue to apply to Los Angeles River without consideration of the updated criteria for ammonia.
b) Alternative 2 – Applying the "1999 Update of Ambient Water Quality Criteria for Ammonia"

Under this alternative the 1999 Update of Ambient Water Quality Criteria for Ammonia would be applied to Los Angeles River as a water quality objective.

2.1.2.1.3 Recommended Alternative

Alternative 2 is the recommended alternative since the action would:

a) be consistent with State and federal water quality laws and policies;
b) facilitate development of an objective that would be protective of Los Angeles River's beneficial uses; and
c) improve the scientific basis upon which the water quality objective is based.

Adoption of Alternative 1 (Using existing Basin Plan objectives) would be inconsistent with the updated objectives

2.1.2.2 Objectives for nitrate, nitrite, and total nitrogen

Nitrate, nitrite, and total nitrogen are considered nutrients that are known to promote plant and algae growth. This TMDL proposes a numeric target for oxidized nitrogen compounds that is based on existing objectives in the Basin Plan. For the main stem of the Los Angeles River and the Rio Hondo, the Basin Plan provides objectives for nitrate-nitrogen + nitrite-nitrogen ($NO_3$-N+$NO_2$-N) of 8 mg/L above Figueroa Street, between Figueroa Street and Los Angles River Estuary including Rio Hondo below Santa Ana Freeway, and Rio Hondo above Santa Ana Freeway, and 10 mg/L for other tributary reaches including Santa Anita Creek, Eaton Canyon Creek, Arroyo Seco, Big Tujunga

Creek, and Pacoima Wash. Also, the Basin Plan designates ground water recharge (GWR) as a beneficial use of the main stem of the Los Angeles River. The Basin Plan designates municipal supply (MUN) as a beneficial use for ground waters of the San Fernando Basin and Central Basin that underlie the Los Angeles River. The following objective applies to all ground waters of the Region: "Ground waters shall not exceed 10 mg/L nitrogen as nitrate-nitrogen plus nitrite-nitrogen ($NO_3$-N+$NO_2$-N), 45 mg/L as nitrate ($NO_3$), 10 mg/L as nitrate-nitrogen (NO3-N), or 1 mg/L as nitrite-nitrogen (NO2-N)."

2.1.2.3 Objective for pH

The Basin Plan specifies a numeric objective for pH, stating that pH "shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges" and a narrative objective, stating that ambient pH levels "shall not be changed more than 0.5 units from natural conditions as a result of waste discharge." The pH of the impaired waterbody relates to this TMDL in a number of other ways. High pH may be due to respiration of algae which is a reflection of nuisance biomass, as noted below. pH also has a major effect on ammonia toxicity. As reflected in Appendix 1, increasing pH greatly increases ammonia toxicity, so the numeric objective for ammonia sharply declines with increasing pH.

2.1.2.4 Objective for Toxicity

For toxicity, the Basin Plan specifies that all waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in, human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organism, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration or other appropriate methods as specified by the Regional Board. The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that of the same waterbody in areas unaffected by the waste discharge, or when necessary, other control water.

The acute toxicity objective for discharges indicates that the average survival in undiluted effluent for any three consecutive 96-hour static or continuous flow bioassay tests shall be at least 90%, with no single test having less than 70% survival when using an established U.S. EPA, State Board, or other protocol authorized by the Regional Board. To determine compliance with chronic toxicity, critical life stage tests for at least three species with approved testing protocols shall be used to screen for the most sensitive species. The test species used for screening shall include a vertebrate, an invertebrate, and an aquatic plant. The sensitive species shall then be used for routine monitoring.

#### 2.1.2.5 Objectives for nutrients, algae, odors, foam and scum

The Basin Plan addresses provides narrative objectives for biostimulatory substances, color, solid, suspended, or settleable materials, taste and odor, and floating material which applies to nutrients, algae, odor, scum, and foam. The objective for biostimulatory substances specifies, "*waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.*" The Basin Plan also recognizes that such excessive growth can cause water quality problems (*e.g.* pH altered beyond the acceptable range) and aesthetic problems (*e.g.*, odor, scum). Other problems associated with excessive algae growth include decreased flow velocity and reduction of recreation uses. The narrative objective for scum requires that the waters should be free of foams and scum "in concentrations that cause nuisance or adversely affect beneficial uses."

### 2.1.3 Antidegradation

State Board Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality Water" in California, known as the "Antidegradation Policy," protects surface and ground waters from degradation. Any actions that can adversely affect water quality in all surface and ground waters must be consistent with the maximum benefit to the people of the state, must not unreasonably affect present and anticipated beneficial use of such water, and must not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect waters of the United States are also subject to the federal Antidegradation Policy (40 CFR 131.12). The proposed TMDL will not degrade water quality, and will in fact improve water quality as it is designed to achieve compliance with existing water quality standards.

## 2.2 Water Quality Data Summary

This section summarizes water quality data for the Los Angeles River pertaining to nitrogen compounds and their effects. The summary includes data considered by the Regional Board and U.S. EPA in developing the 1998 303(d) list for nitrogen compounds and their effects in addition to more recent data that was used to develop the source assessment and linkage analysis for this TMDL.

### 2.2.1 Ammonia

The ammonia data used in the Regional Board's water quality assessment of the Los Angeles River are summarized in Table 3. These data are from Regional Board studies and data collected by the Los Angeles Department of Public Works between 1988 and 1994. For the purpose of the 303(d) listing, a reach was considered to be non-supporting if greater than 10% of the samples exceeded the criterion.

For Tujunga Wash, the maximum reported ammonia concentration was 2.4 mg/L, and the variation of the ammonia concentration data did not suggest ammonia concentration routinely exceeded the standard. Recent data for Rio Hondo reflected the changes in the major source for this reach. The Whittier Narrows Wastewater Reclamation Facility (WNWRRF) implemented a nitrification-denitrification process in 1997. Concentration of ammonia in the WNWRRF effluent has decreased; the mean concentration prior to

1997 was about 13 mg/L, and since 1997 is about 2.4 mg/L. The State Board has recommended that the Rio Hondo be delisted for ammonia and placed on the enforceable program list. Additional investigation and monitoring will be conducted during the implementation of this TMDL to more accurately quantify ammonia sources and instream concentrations in Tujunga Wash. Therefore, this TMDL does not provide ammonia wasteload allocations in Tujunga Wash or Rio Hondo. If the results from the monitoring program show that wasteload allocations are required to meet water quality standards, establishment of wasteload allocations will be considered by the Regional Board through a revision of the TMDL.

**TABLE 3. SUMMARY OF AMMONIA DATA USED IN LISTING PROCESS.**

| Waterbody Name | Number of Samples | Mean (Std Dev) (mg/L) | Range (mg/L) | Listed for Ammonia |
|---|---|---|---|---|
| Los Angeles River (at Sepulveda Basin) | 10 | 8.8 (6.0) | 2.2 – 20.1 | yes |
| Los Angeles River (Dam to Riverside Dr.) | 95 | 10.7 (4.8) | ND – 34.9 | yes |
| Los Angeles River (Riverside Dr. to Figueroa St.) | 20 | 9.1 (2.7) | 2.2 – 14.9 | yes |
| Tujunga Wash (up to Hansen Dam) | 7 | 0.6 (0.8) | ND – 2.4 | yes |
| Burbank Western Channel | 11 | 12.0 (2.7) | 8.3 – 16.3 | yes |
| Verdugo Wash (up to Verdugo Rd.) | 8 | 0.3 (0.4) | ND – 1.3 | no |
| Arroyo Seco (up to Devils Gate Dam) | 10 | 0.5 (0.9) | ND – 3.0 | no |
| Los Angeles River (Figueroa St. to Carson St.) | 162 | 6.0 (4.5) | ND – 29.8 | yes |
| Rio Hondo (at Spreading Grounds) | 65 | 4.4 (4.6) | ND – 18.2 | yes |
| Rio Hondo (below spreading grounds, to Santa Ana Fwy) | 57 | 0.3 (0.5) | ND – 2.6 | yes |
| Compton Creek | 58 | 0.7 (1.7) | ND – 12.1 | no |
| Los Angeles River (Carson St. to Estuary) | 94 | 6.0 (4.5) | ND – 29.8 | yes |

Table 4 displays more recent data on ammonia for six monitoring locations, four in the Los Angeles River and two in the Burbank Western Channel. These data were collected by the three major POTWs discharging to the Los Angeles River, whose NPDES permits specify quarterly sampling of the receiving water upstream and downstream of the treatment plant discharge points. These data were compared to the updated ammonia objective in the Basin Plan after adjusting for pH and temperature. The adjustments were made using the pH and temperature data collected concomitantly with the ammonia data. Most of these data exceeded the 30-day chronic objective (bolded in Table 4). A subset of these values also exceeds the 1-hour acute objective (underlined in Table 4).

**Table 4. Ammonia Concentrations (mg/L) in Los Angeles River Relative to Major POTWs (Sources: City of Burbank 1998-2000; City of Los Angeles 1998a-2000a, 1999b-2000b.)**

| Sample date | Burbank Western Channel: headwaters | Burbank Western Channel: below Burbank WRP | Los Angeles River headwaters (entering Sepulveda Basin) | Los Angeles River: exiting Sepulveda Basin | Los Angeles River: Glendale Narrows | Los Angeles River: below Glendale WRP |
|---|---|---|---|---|---|---|
| Feb. 98 | <0.1 | **10** | NA | NA | **10.3** | NA |
| May 98 | <0.1 | **4.0** | NA | NA | **3.0** | NA |
| Aug. 98 | 0.1 | **11** | NA | NA | **4.3** | NA |
| Nov. 98 | <0.1 | **11** | <dl | **5.4** | **3.5** | 2.2 |
| Feb. 99 | 0.2 | **16** | <dl | **6.9** | **7.2** | **6.7** |
| May 99 | 0.2 | **19** | <dl | **5.8** | **7.6** | **5.6** |
| Aug. 99 | 0.2 | **13** | 0.1 | **8.0** | **7.5** | **5.7** |
| Nov. 99 | 0.1 | **16** | 0.3 | **10.4** | **7.8** | **5.6** |
| Feb. 00 | **≤5** | **15** | 0.8 | **11.8** | **7.7** | **7.5** |
| May 00 | **<1** | **19** | 0.5 | **9.5** | **9.5** | **7.6** |
| Aug. 00 | **0.8** | **10** | 0.5 | **10.9** | **9.6** | **9.0** |
| Nov. 00 | 0.1 | **21** | <dl | **10.9** | **7.1** | **8.5** |
| Feb. 01 | 0.3 | **22** | 1.9 | **17.4** | **11.4** | **11.8** |
| May. 01 | 0.2 | **13** | ND | **12.3** | **8.2** | **8.3** |
| Aug. 01 | 0.32 | **11** | 0.3 | **6.2** | **4.8** | **3.5** |
| Nov. 01 | 0.09 | **18** | ND | **4.5** | **3.1** | **3.6** |

Samples in bold exceeded 30-day chronic criterion for ammonia in the "1999 Update of Ambient Water Quality Criteria for Ammonia"; samples underlined exceeded both chronic and 1-day acute criterion; dl: detection limit, NA: not available

The POTW effluent data indicate that the treatment plants are a significant source of ammonia, one of the primary causes of impairment in the Los Angeles River. Table 5 summarizes ammonia concentration data for POTW effluent and the Los Angeles River in locations upstream and downstream of the POTWs' discharge points.

**TABLE 5. AMMONIA CONCENTRATIONS (MG/L) IN LOS ANGELES RIVER RELATIVE TO POTWS (SOURCES: CITY OF BURBANK 1998-2000; CITY OF LOS ANGELES 1998A-2000A, 1999B-2000B.)**

| | Tillman Upstream | Tillman WRP Effluent | Tillman Downstream | Burbank Upstream | Burbank WRP Effluent | Burbank Downstream | Glendale Upstream | Glendale WRP Effluent | Glendale Downstream |
|---|---|---|---|---|---|---|---|---|---|
| Feb-98 | NA | **2.2** | NA | <0.1 | **13.0** | **10.0** | **10.3** | **13.7** | NA |
| May-98 | NA | **6.1** | NA | <0.1 | **12.0** | **4.0** | **3.0** | **7.7** | NA |
| Aug-98 | NA | **5.0** | NA | 0.1 | **15.0** | **11.0** | **4.3** | **9.2** | NA |
| Nov-98 | <dl | 0.5 | **5.4** | <0.1 | **12.0** | **11.0** | **3.5** | **4.5** | 2.2 |
| Feb-99 | <dl | **2.8** | **6.9** | 0.2 | **20.0** | **16.0** | **7.2** | **9.4** | **6.7** |
| May-99 | <dl | 0.3 | **5.8** | 0.2 | **22.0** | **19.0** | **7.6** | **9.1** | **5.6** |
| Aug-99 | 0.1 | **3.5** | **8.0** | 0.2 | **14.0** | **13.0** | **7.5** | **8.1** | **5.7** |
| Nov-99 | 0.3 | **5.9** | **10.4** | 0.1 | 1.8 | **16.0** | **7.8** | **7.2** | **5.6** |
| Feb-00 | 0.8 | **5.0** | **11.8** | ≤5 | **13.8** | **15** | **7.7** | **8.2** | **7.5** |
| May-00 | 0.5 | **7.5** | **9.5** | **<1** | **18** | **19** | **9.5** | **9.0** | **7.6** |
| Aug-00 | 0.5 | **8.1** | **10.9** | **0.8** | **15** | **10** | **9.6** | **8.9** | **9.0** |
| Nov-00 | <dl | **3.8** | **10.9** | 0.1 | **25** | **21** | **7.1** | **9.5** | **8.5** |
| Feb. 01 | 1.9 | **11.9** | **17.4** | 0.3 | **25** | **22** | 11.4 | **14.7** | **11.8** |
| May. 01 | ND | **7.3** | **12.3** | 0.2 | **17** | **13** | 8.2 | **10.3** | **8.3** |
| Aug. 01 | 0.3 | **2.1** | **6.2** | 0.32 | **15** | **11** | 4.8 | **5.3** | **3.5** |
| Nov. 01 | ND | 0.9 | **4.5** | 0.09 | **16** | **18** | 3.1 | **6.5** | **3.6** |

Samples in bold exceeded 30-day chronic criterion for ammonia in the "1999 Update of Ambient Water Quality Criteria for Ammonia"; samples underlined exceeded both chronic and 1-day acute criterion; dl: detection limit, NA: not available

Ammonia concentrations in the POTW effluent are often as much as 10 times greater than the WQO for chronic toxicity, and in many cases exceeds the WQO for acute toxicity. Ammonia concentration in the receiving water shows similar exceedances. In some cases, ammonia concentration downstream of the Donald C. Tillman POTW is greater than the upstream concentration and effluent concentration. The data also show the ammonia concentration in the effluent of the Los Angeles-Glendale POTW is in some cases greater than the upstream concentration while the downstream concentration is less than the upstream concentration. These data may result from sampling and analytical variability or may suggest the presence of some other influence, such as additional ammonia sources and transformation of other substances in the POTW effluent, such as organic nitrogen, into ammonia. This issue is further addressed in the Linkage Analysis. The ammonia problem appears to be limited to the main stem of the Los Angeles River and the Burbank Western Channel. Therefore this TMDL addresses those reaches for ammonia.

### 2.2.2 Toxicity

Toxicity tests performed by the POTWs indicated chronic toxicity in the Los Angeles River and Burbank Western Channel both upstream and downstream of these treatment plants (Table 6). There was also acute toxicity in a smaller number of samples. Effluent toxicity tests performed by the POTWs as part of their NPDES monitoring requirements indicated both acute and chronic toxicity in the effluent, and results of a Toxic Identification Evaluation (TIE) showed that the toxicity was caused by ammonia. Additionally, results from the Los Angeles River Toxicity Testing Project (UC Davis, 2002.) indicate that ammonia was the cause or a contributor to the toxicity in the majority of samples from Reaches 3, 4, and 5. Therefore it is reasonable to assume the toxicity in receiving water may be related to ammonia concentrations in the river. Table 6 compares the toxicity data from the Los Angeles River upstream and downstream of the POTWs and the POTW effluent toxicity data. The presence of toxicity upstream of the POTWs in some of the samples suggests that additional factors may also be contributing to the observed toxicity.

**TABLE 6. TOXICITY IN LOS ANGELES RIVER (SOURCES: CITY OF BURBANK 1998-2000; CITY OF LOS ANGELES 1998A-2000A, 1999B-2000B.)**

**Chronic toxicity (TUc).**

| | Tillman Upstream | Tillman POTW Effluent | Tillman Downstream | Burbank Upstream | Burbank POTW Effluent | Burbank Downstream | Glendale Upstream | Glendale POTW Effluent | Glendale Downstream |
|---|---|---|---|---|---|---|---|---|---|
| Feb-98 | NA | NA | NA | 1.0 | 1.0 | 1.0 | **>10** | **>10** | **1.3** |
| May-98 | NA | NA | NA | **5.6** | 1.0 | **1.8** | **10** | **10** | **10** |
| Aug-98 | NA | NA | NA | 1.0 | **1.8** | 1.0 | **4.0** | **10** | **10** |
| Nov-98 | **10** | <1.0 | **4.0** | 1.0 | 1.0 | 1.0 | **>10** | **>10** | **>10** |
| Feb-99 | **>10** | <1.0 | **4.0** | 1.0 | 1.0 | 1.0 | **10** | **>10** | **10** |
| May-99 | **10** | **1.3** | **2.0** | 1.0 | 1.0 | 1.0 | **2.0** | **1.3** | <1.0 |
| Aug-99 | **>10** | **>10** | **4.0** | 1.0 | 1.0 | 1.0 | **1.3** | **1.3** | **1.3** |
| Nov-99 | **4.0** | **4.0** | **1.3** | **3.1** | 1.0 | **5.6** | **1.3** | <1.0 | <1.0 |
| Feb-00 | **10** | **4.0** | **4.0** | **1.8** | **1.8** | **1.8** | **>10** | **4.0** | **>10** |
| May-00 | **2** | **>10** | **>10** | **5.6** | **1.8** | 1.0 | 1.0 | 1.0 | 1.0 |
| Aug-00 | NA | NA | NA | **5.6** | 1.0 | 1.0 | **10** | 2.0 | 2.0 |
| Nov-00 | **7.0** | **7.0** | **7.0** | 1.0 | 1.0 | 1.0 | **>10** | **10** | **10** |
| Feb. 01 | **>10** | **>10** | **4** | 1 | **1.8** | **3.13** | **10** | **10** | **4** |
| May. 01 | **>16** | **>16** | **>16** | 1 | 1 | 1 | **>10** | **>10** | **>10** |
| Aug. 01 | **>16** | **>16** | **16** | 1 | **1.8** | **1.8** | **16** | **16** | **16** |
| Nov. 01 | **>16** | **>16** | **>16** | 1 | **1.8** | **1.8** | **2** | **4** | **4** |

* Samples in bold exceeded 30-day chronic criterion; TUc: toxicity units for chronic toxicity; NA: not available

**Acute toxicity (% Survival).**

| | Tillman Upstream | Tillman POTW | Tillman Downstream | Burbank Upstream | Burbank POTW | Burbank Downstream | Glendale Upstream | Glendale POTW | Glendale Downstream |
|---|---|---|---|---|---|---|---|---|---|
| Feb-98 | NA | NA | NA | 100 | 100 | 100 | 100 | 100 | 100 |
| May-98 | NA | NA | NA | 100 | 100 | **50** | NA | NA | NA |
| Nov-98 | NA | NA | NA | NA | NA | NA | 100 | **5** | 100 |
| Dec-98 | NA | NA | NA | NA | NA | NA | 100 | 95 | 100 |
| Jan-99 | NA | NA | NA | NA | NA | NA | 100 | 90 | 95 |
| Feb-99 | NA | NA | NA | 100 | **0** | **0** | 85 | 100 | 100 |
| May-99 | NA | NA | NA | 75 | **0** | **0** | 90 | 100 | 95 |
| Aug-99 | NA | NA | NA | 100 | 90 | 100 | **0** | **0** | **0** |
| Nov-99 | NA | NA | NA | 100 | 100 | **0** | 100 | 100 | 100 |
| Feb-00 | NA | NA | NA | 80 | **70** | **70** | **40** | **30** | 85 |

| **Chronic toxicity (TUc).** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Tillman Upstream | Tillman POTW Effluent | Tillman Downstream | Burbank Upstream | Burbank POTW Effluent | Burbank Downstream | Glendale Upstream | Glendale POTW Effluent | Glendale Downstream |
| May-00 | NA | NA | NA | 80 | **0** | **0** | **70** | 95 | 95 |
| Aug-00 | NA | NA | NA | 85 | **0** | **0** | 93 | 98 | 93 |
| Nov-00 | NA | NA | NA | 100 | **0** | **0** | **55** | **65** | 88 |
| Feb. 01 | NA | NA | NA | 95 | 95 | 95 | **60** | **15** | **55** |
| May. 01 | NA | NA | NA | 100 | **0** | 0 | 88 | 95 | 98 |
| Aug. 01 | NA | NA | NA | 100 | **0** | 0 | 98 | 100 | 98 |
| Nov. 01 | NA | NA | NA | **47.5** | **0** | **12.5** | **70** | **40** | **43** |

* Exceedances in bold type

### 2.2.3 Oxidized Nitrogen Compounds: nitrate and nitrite

The $NO_3$-N + $NO_2$-N data used in the Regional Board's water quality assessment of the Los Angeles River are summarized in Table 7. The ranges of reported data indicate that water quality concentrations in the Los Angeles River, Burbank Western Channel, and Rio Hondo (at the spreading grounds) exceed the objective (8mg/L for most of the Los Angeles River) for nitrite + nitrate.

**TABLE 7. SUMMARY OF $NO_3$-N+$NO_2$-N DATA (MG/L) USED IN LISTING PROCESS**

| Waterbody Name | Number of Samples | Mean (Std Dev) | Range | Listed for Nutrients |
|---|---|---|---|---|
| Los Angeles River (at Sepulveda Basin)[1] | 10 | 3.8 (4.1) | 0.5 – 15.7 | yes |
| Los Angeles River (Dam to Riverside Dr.)[1] | 92 | 4.7 (3.9) | 0.03 – 20.42 | yes |
| Los Angeles River (Riverside Dr. to Figueroa St.)[1] | 20 | 4.5 (1.1) | 3.1 – 7.6 | yes |
| Tujunga Wash (up to Hansen Dam) | 7 | 0.1 (0.1) | ND – 0.22 | no |
| Burbank Western Channel | 11 | 3.9 (3.0) | 0.4 – 11.7 | no |
| Verdugo Wash (up to Verdugo Rd.) | 8 | 2.6 (0.8) | 1.1 –3.8 | no |
| Arroyo Seco (up to Devil Gates Dam) | 10 | 3.7 (1.5) | 1.8 – 6.5 | no |
| Los Angeles River (Figueroa St. to Carson St.)[1] | 160 | 6.2 (3.8) | 0 – 19.2 | yes |
| Rio Hondo (at Spreading Grounds)[1] | 64 | 2.7 (3.2) | 0.2 – 14.5 | no |
| Rio Hondo (up to Santa Ana Fwy)[1] | 57 | 0.7 (1.1) | ND - 5 | no |
| Compton Creek | 57 | 0.4 (1.1) | ND – 7.6 | no |
| Los Angeles River (Carson St. to Estuary)[1] | 94 | 4.6 (2.4) | 0.01 – 13.16 | yes |

[1]Objective for nitrate-nitrite in these reaches is 8 mg/L.

These data were analyzed relative to the WQOs for nitrate and for nitrite at four locations in the Los Angeles River, where the WQO for $NO_3$-N is 8 mg/L and the WQO for $NO_2$-N is 1 mg/L. Table 8 shows results. Approximately 20% of the samples at Tujunga and Arroyo Seco exceeded the nitrate objective. The percentage of exceedances was lower further down the river near Firestone Blvd (5%) and Wardlow Rd (1%). The mean $NO_2$-N concentration exceeded the 1 mg/L objective in about 40% of the samples, and did not change appreciably with distance down the river. The Tujunga Wash appears to have a nitrate and nitrite loading to the Los Angeles River. The Monitoring Program proposed by this TMDL includes further studies to investigate nitrogen compounds in Tujunga Wash.

**TABLE 8. STATISTICAL SUMMARY OF NITRATE AND NITRITE DATA FOR LOS ANGELES RIVER 1988-95 (LACDPW) AS COMPARED TO THE BASIN PLAN OBJECTIVES**

| **Nitrate-N (mg/L)** | | | | |
|---|---|---|---|---|
| Station | Los Angeles River at Tujunga | Los Angeles River at Arroyo Seco | Los Angeles River at Firestone Blvd | Los Angeles River at Wardlow Rd |
| No. of Samples | 82 | 85 | 109 | 108 |
| Ave. (SD) | 4.65 (4.37) | 6.41 (4.28) | 3.79 (3.36) | 3.15 (2.32) |
| Range | 0.00 – 16.02 | 0.00 – 17.61 | 0.00 – 24.61 | 0.00 – 10.60 |
| %>10 mg/L | 17% | 20% | 5% | 1% |
| Nitrite-N (mg/L) | | | | |
| Station | Los Angeles River at Tujunga | Los Angeles River at Arroyo Seco | Los Angeles River at Firestone | Los Angeles River at Wardlow |
| No. of samples | 82 | 83 | 107 | 106 |
| Ave. (SD) | 1.01 (1.30) | 1.09 (1.36) | 1.00 (1.35) | 1.07 (1.35) |
| Range | 0.00 – 7.68 | 0.00 – 8.70 | 0.00 – 6.33 | 0.00 – 7.41 |
| %>1mg/L | 38% | 42% | 38% | 42% |

More recent data from the wastewater treatment plant NPDES monitoring programs (Table 9) show that, although the POTWs contribute nitrite and nitrate to the receiving water, the concentrations in the effluent are generally not in exceedance of the 8 mg/L objective for $NO_3$-N + $NO_2$-N; however, nitrite and nitrate are also loaded to the Los Angeles River by conversion of ammonia and organic nitrogen that is discharged by the POTWs.

**TABLE 9. NITRATE-N PLUS NITRITE-N CONCENTRATIONS IN THE LOS ANGELES RIVER (MG/L) RELATIVE TO MAJOR POTWS (SOURCES: CITY OF BURBANK 1998-2000; CITY OF LOS ANGELES 1998A-2000A, 1999B-2000B.)**

| | Tillman Upstream | Tillman POTW Effluent | Tillman Downstream | Burbank Upstream | Burbank POTW Effluent | Burbank Downstream | Glendale Upstream | Glendale POTW Effluent | Glendale Downstream |
|---|---|---|---|---|---|---|---|---|---|
| Feb-98 | NA | 2.5 | NA | 3.9 | 3.2 | 3.3 | 2.4 | 2 | NA |
| May-98 | NA | 3.8 | NA | **20.0** | 3.6 | 4.8 | 2.7 | 2.6 | NA |
| Aug-98 | NA | 1.2 | NA | 1.9 | 4.36 | 2.7 | 3.0 | 2.4 | NA |
| Nov-98 | NA | 7.7 | NA | 7.3 | 3.3 | 3.1 | **10.6** | 5.4 | 5.4 |
| Feb-99 | 6.0 | 6.1 | 4.7 | 5.3 | 1.26 | 1.67 | 5 | 4.1 | 5.5 |
| May-99 | 4.0 | 7.9 | 5.9 | 2.4 | 0.49 | 1.22 | 5.4 | 4.1 | 5.7 |
| Aug-99 | 4.2 | 3.7 | 2.5 | 2.0 | 2.32 | 3.85 | 2.6 | 3.4 | 4.0 |
| Nov-99 | 4.0 | 5.0 | 3.7 | 4.2 | 1.59 | 4.18 | 4.6 | 3.8 | 5.7 |
| Feb-00 | 5.1 | 5.8 | 3.6 | 2.0 | 5.6 | 5.5 | 4.0 | 3.3 | 4.3 |
| May-00 | 4.1 | 2.3 | 1.8 | 0.5 | 2.4 | 1.9 | 2.9 | 3.3 | 4.2 |
| Aug-00 | 2.3 | 1.8 | 2.0 | 0.6 | 3.9 | 6.5 | 2.8 | 2.4 | 3.2 |
| Nov-00 | 5.2 | 6.0 | 3.3 | 2.1 | 0.6 | 1.0 | 4.9 | 3.7 | 4.7 |
| Feb. 01 | 5.8 | 2.7 | 2.1 | 3 | 0.7 | 0.9 | 3.8 | 3.3 | 4.6 |
| May. 01 | 4.7 | 2.3 | 1.7 | 1.5 | 0.8 | 1.8 | 3.4 | 3.4 | 4.2 |
| Aug. 01 | 2.7 | 4.2 | 3.1 | 1.8 | 2.2 | 2.4 | 3.7 | 3.5 | 4.1 |
| Nov. 01 | 3.9 | 6 | 6.4 | 3.2 | 4.7 | 0.7 | 6.6 | 4.7 | 5.9 |

Values greater than 8 mg/L are in bold; NA: not available

### 2.2.4 pH

The water column pH data reviewed by the Regional Board in the listing process suggest impairments in the lower portion of the Los Angeles River, Compton Creek and the lower portion of the Rio Hondo (Table 10). The fact that high pH values co-occur with high ammonia levels in the Los Angeles River and Rio Hondo suggest that ammonia toxicity is a problem in these areas.

**TABLE 10. SUMMARY OF PH DATA REVIEWED USED IN THE LISTING PROCESS**

| Waterbody Name | Number of Samples | Range | Mean (Std Dev) | Listed for pH |
|---|---|---|---|---|
| Rio Hondo (up to Santa Ana Fwy) | 57 | 7.3 – 9.9 | 8.1 (0.6) | yes |
| Compton Creek | 59 | 6.9 – 9.9 | 8.1 (0.6) | yes |
| Los Angeles River (Carson St. to Estuary) | 148 | 7.0 – 10.6 | 9.2 (0.9) | yes |

A review of more recent pH data from the receiving water programs for the three large wastewater reclamation plants indicated several pH values greater than 8.5. The pH values tended to be higher upstream of the plants (Table 11). The pH values in effluent from the three wastewater plants were consistently around 7.2, lower than the ambient pH. Although the source of the elevated pH is not determined, nitrate and nitrite loading can result in increased algae photosynthesis that might cause the pH level to increase. The Implementation Plan includes a monitoring program to assure that the nitrogen wasteload allocations will result in attainment of the pH objectives.

**TABLE 11. SUMMARY OF PH DATA IN THE LOS ANGELES RIVER (MG/L) RELATIVE TO MAJOR POTWS (SOURCES: CITY OF BURBANK 1998-2000; CITY OF LOS ANGELES 1998A-2000A, 1999B-2000B.)**

| | Tillman Upstream | Tillman POTW | Tillman Downstream | Burbank Upstream | Burbank POTW | Burbank Downstream | Los Angeles-Glendale Upstream | Glendale POTW | Los Angeles-Glendale Downstream |
|---|---|---|---|---|---|---|---|---|---|
| 50th percentile | 8.2 | 8.1 | 8.0 | 8.4 | 7.7 | 8.0 | 8.0 | 7.7 | 7.6 |
| 90th percentile | 8.4 | 8.4 | 8.5 | 8.7 | 8.0 | 8.3 | 8.3 | 8.0 | 7.8 |

### 2.2.5 Nuisance effects: algae, odors, foam, and scum

The listings for algae, odors, foam and scum were based primarily on visual observations made by Regional Board staff during the 1996 listing process. To further investigate the 1996 listings, a survey of the algal biomass in the Los Angeles River was conducted in September 2000 (Characterization of Water Quality in the Los Angeles River, Ackerman, D., SCCWRP, 2000). The investigation provides some limited data on the distribution and abundance of algae along 30-m transects at four locations along the River and at two tributaries (Bell Creek and Arroyo Seco). Biomass measurements ranged from 0 to 3 $kg/m^2$. Values were lowest at Bell Creek and highest at the bottom of Arroyo Seco. There were essentially two types of algae observed in the river. One type was the long filamentous algae (*Rhizoclonium spp.*) that forms thick mats and is considered to be nuisance algae. The other type was the blue-green algae (*Cyanobacteria*) that forms a thin film on hard substrate. *Rhizoclonium spp.* was observed at high densities at the bottom of Arroyo Seco, its distribution was patchier in the River at Bell/Calabasas and at the Sepulveda Dam. This species was virtually absent at Bell Creek, near the Burbank Western Channel and above Arroyo Seco. Table 12 summarizes the data regarding algae distribution in the Los Angeles River watershed. Bell Creek and Los Angeles River at Bell Creek are above the Donald C. Tillman WRP. Sepulveda Dam is below the Donald C. Tillman WRP. Los Angeles River at Burbank Western Channel is below Burbank WRP. Los Angeles River above Arroyo Seco and Bottom of Arroyo Seco are below LA Glendale WRP.

**TABLE 12. DISTRIBUTION AND ABUNDANCE OF ALGAL BIOMASS IN THE LOS ANGELES RIVER (SEPTEMBER 2000) (BIOMASS VALUES ARE EXPRESSED AS GRAMS/M2 WET WEIGHT (AND GRAMS /M2 DRY WEIGHT))**

| Station/ Transect number | Bell Creek | Los Angeles River at Bell/ Calabasas | Los Angeles River at Sepulveda Dam | Los Angeles River at Burbank Western Channel | Los Angeles River above Arroyo Seco | Bottom of Arroyo Seco |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 303 (2) | BG film* | BG film | 1156 (191) |
| 2 | 0 | 0 | 2 (0) | BG film | BG film | 1450 (124) |
| 3 | 0 | 0 | 77 (11) | BG film | BG film | 1894 (301) |
| 4 | 0 | 1425 ( 94) | 207 (0) | BG film | BG film | 2981 (367) |
| 5 | 0 | 2339 (120) | 0 | BG film | 243 (4) | 2034 (225) |
| Average | --- | 753 (43) | 118 (3) | --- | --- | 1903 (242) |

* BG film: Blue green algae film

Although this data set is limited, there appears to be a high degree of variability among stations (compare Los Angeles River above Arroyo Seco to the values at the bottom of Arroyo Seco) and within stations (*e.g.*, Los Angeles River at Bell Calabasas or Los Angeles River at Sepulveda Dam).

In summary, the data reviewed as part of this TMDL confirms the listings made by the Regional Board in 1998. Water quality concentrations around the POTWs exceed the chronic water quality criteria for ammonia and to a lesser extent the acute water quality criteria. Toxicity tests also indicate both acute and chronic toxicity that appears to be related to ammonia. There are exceedances of the nitrate and nitrite objectives in the ambient waters of the Los Angeles River. The percentage of these exceedances appeared to be higher in the upper reaches of the River than in the lower reaches of the river. More monitoring surveys are needed to evaluate the extent and magnitude of the algae in the reaches listed for algae.

# 3 NUMERIC TARGETS

Numeric targets for this TMDL are the target conditions in the waterbody necessary to support the beneficial uses. Numeric targets for this TMDL are have been selected based on the water quality objectives in the Basin Plan discussed in Section 2 and listed in Table 13.

For this TMDL, the ammonia targets are based on the criteria developed by U.S. EPA, in the "1999 Update of Ambient Water Quality Criteria for Ammonia," December 1999 and adopted by the Regional Board in 2002. The 1999 Update contains U.S. EPA's most recent freshwater aquatic life criteria for ammonia and supersedes all previous freshwater aquatic life criteria for ammonia. In this revision the acute criteria is dependent on pH and the chronic criteria is based on pH and temperature of the receiving water. A review of pH data does not show evidence of a seasonal signal. However, dischargers have noted that there may be a seasonal variation in temperature. This effect will be subject of a special study by the dischargers to determine ammonia targets. The 1999 U.S. EPA Ambient Water Quality for Ammonia acknowledges that ammonia toxicity may be dependent on the ionic composition of the waterbody. This issue can be addressed by performing a water effects ratio (WER) study or other site-specific approaches, if approved by the Regional Board through the Basin Plan amendment process. The Basin Plan outlines the requirements for development of a Site-Specific Objective (SSO). At this time, stakeholders have initiated a WER study for ammonia in the Los Angeles River in conformance with a workplan that has been approved by Regional Board staff. It is anticipated that the WER study will serve as the basis for development of a proposed SSO and revised effluent limits, as appropriate, for Regional Board approval. A SSO based on a WER for ammonia would be implemented as a Basin Plan Amendment that, if approved, would amend both the Basin Plan and this TMDL.

The SSO would be required to demonstrate that both the ammonia objectives would be in conformance with the Antidegradation Policy (State Board Resolution 68-16) and that any increase in ammonia effluent limits would not cause exceedances of the water quality objectives for nitrate or nitrite + nitrate.

For ammonia, numeric targets that are pH and temperature dependent will be applied to protect water quality criteria for aquatic life. Numeric targets for this TMDL are concentration based. Since most of Los Angeles River watershed listed segments are not designated in the Basin Plan as "COLD," "MIGR," and "SPWN," it is assumed that salmonids are absent and early life stages needing special protection are not present in Los Angles watershed. The acute numeric target and chronic numeric target for ammonia will be calculated using the equations set forth in Resolution No. 2002-11before the interim effluent limits set forth in the implementation Plan of this TMDL expire (Section 7).

However, for illustrative purposes, based on the pH and temperature data downstream of the POTW outfalls from the last five years, one-hour ammonia targets range from 2.65 mg/L to 22.97 mg/L for the Donald C. Tillman WRP; 3.88 mg/L to 22.97 mg/L for the Burbank WRP; and 0.61 mg/L to 3.71 mg/L the Los Angeles-Glendale WRP. Thirty-day ammonia targets range from 0.47 mg/L to 2.87 mg/L for the Donald C. Tillman WRP; 1.01 mg/L to 2.12 mg/L for the Burbank WRP; and 0.61 mg/L to 3.71 mg/L for the Los Angeles-Glendale WRP. These numeric targets do not assume application of an ammonia water effects ratio.

The numeric targets for nitrate, nitrite, and nitrate + nitrite are based on the water quality objectives provided in the Basin Plan for the Los Angeles River. Dischargers have expressed concerns regarding several issues with the numeric targets for nitrate, nitrite, and nitrate + nitrite, including the appropriateness of an averaging period and establishment of a mixing zone downstream of the POTWs for compliance purposes. These issues will be addressed through special studies to be conducted by the Dischargers during the Implementation period at which time interim effluent limits apply. The

Regional Board will consider the results of those studies to determine if water quality objective modifications and site specific objectives are appropriate.

**TABLE 13. SUMMARY OF NUMERIC TARGETS FOR THE LOS ANGELES RIVER NITROGEN TMDL**

| Parameter | Beneficial uses/ Basin Plan | Numeric target |
|---|---|---|
| Ammonia-nitrogen ($NH_3$-N) | WILD, WARM | Temp and pH dependent<br>Based on the last two years of temperature and pH data provided by the dischargers, the ammonia numeric targets for the major POTWs are provided below:<br><br>POTWs — One-hour average (mg/L) — Thirty-day average (mg/L)<br>D.C. Tillman — 4.7 — 1.6<br>Los Angeles-Glendale — 8.7 — 2.4<br>Burbank — 10.1 — 2.3 |
| Nitrate-nitrogen ($NO_3$-N) | Basin Plan | 8 mg/L |
| Nitrite-nitrogen ($NO_{2}$ - N) | GWR | 1 mg/L |
| (NO $_3$ N + NO $_2$ N) | Basin Plan | 8 mg/L above Figueroa Street, between Figueroa Street and Los Angles River Estuary including Rio Hondo below Santa Ana Freeway, and Rio Hondo above Santa Ana Freeway<br>10 mg/L in other tributaries |

Targets are also required for constituents with narrative objectives, and those also are addressed below to the extent feasible. The numeric targets in this TMDL reflect the total pollutant loading capacity of the water body for the nitrogen compounds, accounting for seasonal variations, future growth and margin of safety.

The Basin Plan contains narrative objectives for color, exotic vegetation, floating material, solid, suspended, or settleable materials, and taste and odor that apply to algae, foam/scum, and odor. These narrative objectives prohibit materials that cause nuisance or adversely affect beneficial uses. One mechanism by which excess algal biomass can adversely impact beneficial uses is through eutrophication that results in low dissolved oxygen (DO) concentrations. Another mechanism of impairment of REC-1 and REC-2 occurs when excess algal biomass results in unpleasant odors and scum.

Numeric targets for algae, scum/foam, and odor are not readily definable. The specific quantity of algal biomass that produces scum and odors varies with many factors including algal type, season, consumption by other organisms, and other factors not widely measured or quantified. There is literature from other parts of the U.S. to suggest a target for nuisance algae at 100 to 200 $mg/m^2$ for chlorophyll a (Biggs, 2000, Dodds and Welch, 2000); Dodds et al., 1997). No such data relating chlorophyll-a concentrations to nuisance conditions are known for the Los Angeles River, and the relevance of values reported in other parts of the U.S. is unknown.

Because data are not sufficient to develop and implement a target for algae in this TMDL, algal biomass and DO concentrations will be measured as part of the TMDL monitoring plan, and observations will be recorded of odors and scum during monitoring. It is anticipated that reductions in nitrogen compounds implemented as part of this TMDL will reduce algal biomass. If those measures serve to ameliorate problems with scums and odors, then the impairment will be considered to be removed. That approach is a reasonable alternative to a specific numeric target in this case.

# 4 SOURCE ASSESSMENT

Pollutant sources include two categories: point sources and nonpoint sources. Point sources typically include discharges for which there are defined outfalls such as wastewater treatment plants and industrial discharges. These discharges are regulated through a permit such as the federal National Pollution Discharge Elimination System (NPDES) permit or the State of California issued Waste Discharge Requirements (WDRs). Stormwater runoff in the Los Angeles River watershed is regulated as a point source under the municipal separate stormwater sewer system (MS4) permit. Nonpoint sources include pollutants that reach waters from a number of land uses and source activities, but that are not conveyed through a storm sewer system. During dry weather, nitrogen sources conveyed to the Los Angeles River through the stormwater system can also be significant.

Urban runoff in Los Angeles County is regulated under two stormwater NPDES permits. The first is the Los Angeles County Municipal Storm Water NPDES permit which the Regional Board has recently renewed. There are 86 co-permittees covered under this permit including 85 cities and the County of Los Angeles. The second is a separate storm water permit for the California Department of Transportation (Caltrans). Runoff from industrial facilities is subject to a statewide NPDES permit for industry. The permitting process defines these discharges as point sources because the storm water discharges from the end of a storm water conveyance system. Because stormwater discharges are permitted under NPDES permits, they are treated as point sources in this TMDL. Data from the stormwater programs are used, to the extent possible, to estimate loadings associated with urban runoff. There are also a large number of small industrial wastewater dischargers with NPDES and WDR permits throughout the watershed. These are individual point sources, but together make up such a small proportion of the total load of nitrogen compounds that they are considered here in the aggregate as a single source category.

## 4.1 POINT SOURCES

The Regional Board's Characterization of the Los Angeles River Watershed (LARWQCB, 1998) identified six major point source discharges and 145 minor point source discharges permitted under the National Pollutant Discharges Elimination System (NPDES). There are six wastewater reclamation plants that either discharge, or have the potential to discharge into the Los Angeles River or its tributaries. Five are POTWs: Donald C. Tillman Water Reclamation Plant (WRP), Los Angeles-Glendale WRP, Burbank WRP, Tapia Water Reclamation Facility (TWRF), and Whittier Narrows WRP. The other is a wastewater reclamation plant located at the Los Angeles Zoo and operated by the City of Los Angeles Department of Parks.

### 4.1.1 Major nitrogen sources

The three largest POTWs (Donald C. Tillman Water Reclamation Plant, Los Angeles-Glendale Water Reclamation Plant, and Burbank Water Treatment Plant) constitute the major sources of nitrogen in the watershed.

- Donald C. Tillman is a tertiary treatment plant with a design capacity of 80 mgd. Most of the flow is discharged directly into the Los Angeles River. However, a portion of the flow goes into a recreation lake, which then drains into Bull Creek and Hayvenhurst Channel and back into the Los Angeles River. Another portion of the flow goes to a wildlife lake, which then drains into Haskel Channel and ultimately back into the Los Angeles River. The Donald C. Tillman plant discharges around 53 mgd to the Los Angeles River.
- Burbank has a design capacity of 9 mgd. Around 4 mgd is discharged directly into the Burbank Western Channel. The City of Burbank and CalTrans reclaim a portion of the effluent for irrigation (freeway landscapes, golf courses, parks etc.). Treated water from the plant is also used as cooling water for the Burbank Steam Power Plant.
- The Los Angeles-Glendale POTW is a 20 mgd plant that discharges around 13 mgd directly into the Los Angeles River in the Glendale Narrows. Around 4 mgd of the treated wastewater is used for irrigation and industrial uses.

Table 14 summarizes nitrogen loading from the major POTWs. The loads from the Donald C. Tillman, Burbank and Glendale POTWs were estimated using monthly flow and effluent concentration data provided as part of the annual self monitoring reports (City of Los Angeles, 2000a, 2000b, 1999a, 1999b, 1998a, 1998b, 1997a, 1997b, 1996a, 1996b, 1995a, 1995b; City of Burbank, 2000, 1999, 1998, 1997, 1996, 1995). The total annual nitrogen load from these three POTWs was 2,140 MT/yr in 2000. The total nitrogen load averaged 2,243 MT/yr from 1995 – 2000.

**TABLE 14. NITROGEN LOADINGS FROM MAJOR POINT SOURCES (MT/YR).**

| Source | Constituent | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|
| **Donald C. Tillman POTW** | Ammonia-N | 1426 | 1191 | 1401 | 1421 | 1134 | 1530 |
| | Nitrate-N | 190 | 278 | 152 | 95 | 81 | 33 |
| | Nitrite-N | 47 | 53 | 63 | 62 | 28 | 50 |
| | Organic-N | 177 | 212 | 200 | 179 | 149 | 141 |
| | **TOTAL-N** | **1840** | **1734** | **1817** | **1758** | **1392** | **1754** |
| **Burbank POTW** | Ammonia-N | 169 | 92 | 126 | 144 | 117 | 115 |
| | Nitrate-N +Nitrite-N | 20 | 46 | 29 | 19 | 16 | 24 |
| | Organic-N | 34 | 39 | 35 | 15 | 13 | 43 |
| | **TOTAL-N** | **223** | **178** | **190** | **178** | **147** | **181** |
| **Los Angeles - Glendale POTW** | Ammonia-N | 286 | 296 | 333 | 300 | 161 | 137 |
| | Nitrate-N | 45 | 79 | 53 | 37 | 25 | 29 |
| | Nitrite-N | 15 | 11 | 12 | 9 | 11 | 11 |
| | Organic-N | 40 | 39 | 39 | 52 | 31 | 28 |
| | **TOTAL –N** | **386** | **426** | **436** | **397** | **228** | **205** |
| **TOTAL POTW** | **TOTAL-N** | **2449** | **2338** | **2433** | **2333** | **1767** | **2140** |

### 4.1.2 Minor nitrogen sources

Minor nitrogen sources include other POTWs, permitted dischargers, tributaries and urban runoff. Three POTWs listed below are considered minor sources of nitrogen compounds:

- Tapia Water Reclamation Facility: Most of the effluent from the Tapia WRF is either reclaimed or discharged into Malibu Creek. However, due to a discharge prohibition in Malibu Creek from April 15 to November 15, the permittee is allowed to discharge up to 2 mgd of wastewater to the Los Angeles River. However, this discharge is infrequent. Because the permitted flow from Tapia is less than 2% of the mean flows from the major POTWs discharging to the Los Angeles River, the nitrogen compound loads are considered minor.

- Whittier Narrows WRP: Treated wastewater from this WRP discharges to the Rio Hondo above the Whittier Narrows Dam, into spreading grounds where most of the effluent enters the groundwater. It has been estimated that less than 1% (0.1mgd) of Whittier Narrows WRP effluent remains in the channel downstream of the spreading grounds. Further, the Whittier Narrows WRP has implemented nitrification and denitrification and nitrogen compound loadings from this facility are considered minor.
- Los Angeles Zoo WRP: The Los Angeles Zoo WRP has a 1.8 million-gallon retention basin, and discharges into the Los Angeles River near the Glendale Narrows only during wet weather when the retention capacity is exceeded. Consequently, the nitrogen compound loads are considered minor during critical conditions for this TMDL.

The contribution of these plants to the overall nitrogen loadings in the Los Angeles River is minimal, so the quantification of sources addresses the loadings of the major largest POTWs. The Monitoring program of this TMDL will include data collection to quantify loadings from these sources, if necessary.

Other minor sources of nitrogen are storm water and urban runoff from municipal separate storm sewer systems (MS4s) and 145 minor dischargers listed with NPDES or WDR permits in the Los Angeles River Watershed Characterization Report (LARWQCB, 1998), including:

- 63 permits to discharge miscellaneous wastes. These include waste from dewatering, recreational lake overflow, swimming pool wastes, water ride wastewater, ground water seepage, and others
- 34 permits to discharge treated contaminated ground water with hazardous materials
- 23 permits to discharge non-contact cooling water
- 12 permits to discharge stormwater
- 5 permits to discharge contaminated ground water

- 3 permits to discharge contact cooling water
- 2 permits to discharge process waste water
- 2 permits to discharge product wash water waste
- 1 permit to discharge filter backwash brine waters

These permitted discharges are not considered major sources of nitrogen to the Los Angeles River for the following reasons. First, the discharge flows associated with these permits are generally small. More than half of these permitted discharges are for design flows of less than 0.1 mgd. Second, many of these permits are for episodic discharges rather than continuous flows, so the total annual flow is much less than the permitted design flow. Finally, although there are limited monitoring data to characterize these discharges, none of these are of types that may be expected to contain large loads or high concentrations of nitrogen. The expected small role of these discharges is supported by mass balance approximations described in the Summary to this section. The Monitoring program of this TMDL will include data collection to quantify loadings from these sources, and concentration based wasteload allocations based on water quality objectives will be established for these sources.

#### 4.1.3 Dry-weather loading assessment

During low flow periods the three major POTWs typically account for 60% to 80% of the total volume of discharge in the river. The remaining 20% to 40% of the dry weather flow represents a combination of tributary flows, flows from other permitted NPDES/WDRs discharges within the watershed, and urban dry weather runoff.

To estimate the relative magnitude of loads from these sources during non-storm periods, recent data from the LADPW mass emission station in the LA River as well as previous estimates of stormwater loadings from the Regional Board (Corado, 1998) and from SCCWRP (Characterization of Water Quality in the Los Angeles River, Ackerman, D., SCCWRP, 2000) were evaluated. Additionally, monitoring was undertaken for this TMDL. The monitoring consisted of synoptic sampling within a single day of flow from the three POTWs, the headwaters of the tributaries, and more than 60 storm drains on September 11, 2000. The goal of the monitoring was to quantify the relative contributions from storm drains in dry weather to support the model. This was followed up by another synoptic survey in July 2001 to validate the model. The monitoring reflects one of the most complete efforts to identify and quantify dry weather flows from storm drains in Southern California. The data collected during the two surveys were consistent in terms of flows and nitrogen compound concentrations. The data were also consistent with data collected by LADPW as part of their on-going dry weather monitoring studies and appear to be representative of the dry-weather contributions from storm drains. Results are shown in Table 15.

**TABLE 15. RELATIVE LOADING (%) OF NITROGEN FROM MAJOR POTWS, TRIBUTARIES, AND STORM DRAINS TO THE LOS ANGELES RIVER DURING DRY WEATER CONDITIONS** (CHARACTERIZATION OF WATER QUALITY IN THE LOS ANGELES RIVER, ACKERMAN, D., **SCCWRP, 2000).**

| Constituent | Total load (kg/day) | Percent Loading (%) | | |
|---|---|---|---|---|
| | | Major POTWs | Tributaries | Storm Drains |
| Ammonia-N | 3357 | 85 | 14 | 0 |
| Nitrate-N | 361 | 32 | 35 | 34 |
| Total Organic Nitrogen | 4066 | 82 | 17 | 2 |

The data also show that about 43% of the total dry weather nitrogen load is ammonia, 4.6% of the total dry weather nitrogen load is oxidized nitrogen, and 52% of the total dry weather nitrogen load is total organic nitrogen. The major POTWs contribute 84.1% of the total nitrogen load. The stormwater system contributes a significant portion of the oxidized nitrogen load, 45MT/yr (123 kg/day). Because these estimates are based on a single sampling event, additional monitoring to estimate dry weather inputs from tributaries and the stormwater system may be justified if wasteload allocations to point sources do not succeed in removing the impairments to the listed waterbodies.

### 4.1.4 Loading assessment from runoff for wet and dry weather

The sources of nitrogen compounds, assimilative capacity of the Los Angeles River, and impairment by related effects can be strongly affected by variations between wet and dry weather. More specifically, high-volume flows during storm events (which are typically concentrated in the wet weather season) are very different in character than non-storm flows, which may occur in the wet season as well as the dry season. The nitrogen sources most strongly affected by wet and dry weather variations are runoff from land surfaces. In the Los Angeles River watershed, most of the runoff is conveyed to the Los Angeles River and its tributaries is conveyed through the municipal separate storm systems and are regulated under NPDES permits. Consequently, nitrogen loads conveyed through these systems are considered point sources. This section addresses sources of nitrogen from runoff .

The source assessment from runoff is based on land use data and nitrogen export coefficients. Runoff from various parts of the watershed may vary according to land use type. The Regional Board (1998) estimated total source loadings for total nitrogen to the Los Angeles River watershed, using watershed nitrogen export coefficients for waterbodies in the western United States. Table 16 summarizes results by source type, and shows the estimated total annual loading was 404 metric tons of nitrogen. This analysis suggested that 78% of the loads from the storm drain system was associated with urban runoff, 315 MT/yr. This load includes both dry and wet weather.

**TABLE 16. ESTIMATES OF ANNUAL NITROGEN LOADINGS FROM RUNOFF IN THE LOS ANGELES RIVER WATERSHED BY LAND USE (LARWQCB, 1998)**

| Land Use | Area (sq miles) | Unit area loads (g/m2/y) | Annual Nitrogen Load (Mt/yr) |
|---|---|---|---|
| Urban | 487 | 0.25 | 315 |
| Rural/Agricultural | 2 | 0.2 | 1 |
| Forest | 324 | 0.1 | 84 |
| Atmosphere (receiving water) | 2 | 1 | 4 |
| Estimated total nitrogen annual load | | | 404 |

A second study yielded similar results. SCCWRP (Characterization of Water Quality in the Los Angeles River, Ackerman, D., SCCWRP 2000) estimated nitrogen loads using export coefficients developed specifically for Southern California. That study also used more specific land use designations, and finer resolution for the watershed boundaries. Table 17 shows results, with a comparable estimated total annual load of 417 MT/yr. The study indicated urban sources in the lower part of the watershed, including residential, commercial, and industrial land uses, are the major contributor of the nitrogen loads from stormwater runoff.

**TABLE 17. ESTIMATES OF NITROGEN LOADING (MT/YR) IN THE LOS ANGELES RIVER WATERSHED BY LAND USE (**CHARACTERIZATION OF WATER QUALITY IN THE LOS ANGELES RIVER, ACKERMAN, D., **SCCWRP, 2000)**

| Land Use | $NH_3$-N | $NO_3$-N | $NO_2$-N |
|---|---|---|---|
| Agriculture | 0.5 | 3.0 | 0.0 |
| Commercial | 20.6 | 60.9 | 3.2 |
| Industrial | 14.8 | 72.6 | 2.6 |
| Open | 0.9 | 28.5 | 0.2 |
| Residential | 27.7 | 173.6 | 6.2 |
| Other | 0.3 | 1.6 | 0.1 |
| TOTAL | 64.9 | 340.1 | 12.2 |

More than one thousand industrial facilities in the Los Angeles River watershed are enrolled under the statewide NPDES general industrial stormwater permit. Those facilities are required to sample runoff and report monitoring data twice annually, but the data collected under this program are not of sufficient frequency or quality to be used to estimate loadings (Duke et al., 1998). Therefore those discharges are not quantified individually, but are included among the land use categorizations above. The analysis shows those activities are not major sources of nitrogen to the Los Angeles River and an aggregate assessment of total load is adequate based on review of previous estimates, assessment of dry weather storm system sources, and synoptic surveys.

The Los Angeles County Department of Public Works (LACDPW) estimated nitrogen loads to the Los Angeles River as part of its stormwater monitoring program (LACDPW, 2000). Nitrogen concentrations in samples collected from the Los Angeles River downstream of the POTWs during storm events were used to estimate the annual nitrogen load from 1996-2000 (LADPW, 2000). Table 18 summarizes the annual nitrogen loadings in metric tons (MT) per year that range from 75 MT/yr to 1900 MT/yr (LADPW, 2000). The annual nitrogen load estimate is a function of the total rainfall and runoff in a given year. Therefore, these estimates are subject to verification through continued monitoring and source assessment.

**TABLE 18. ANNUAL NITROGEN LOADINGS (MT/YR).**

| Constituent | 96-97 | 97-98 | 98-99 | 99-00 |
|---|---|---|---|---|
| $NH_3$-N | 38.5 | 332.7 | 10.8 | 3.1 |
| $NO_3$-N | 101.8 | 242.3 | 30.6 | 17.9 |
| $NO_2$-N | 8.0 | 41.5 | 17.0 | 2.9 |
| TKN | 339.5 | 1609.0 | 181.4 | 54.1 |
| TOTAL | 449.3 | 1892.8 | 220 | 74.9 |

Total nitrogen is equal to TKN + Nitrate + Nitrite; TKN = Total Kjeldahl Nitrogen

The effect of storm water loadings on in-stream concentrations of ammonia, nitrate and nitrite during storm discharge may be evaluated using storm water concentration data collected by the Los Angeles Department of Public Works over the five year period 1994 through 1999. Table 19 summarizes those data. The data were collected in storm runoff from a number of monitoring stations at relatively small catchments in Los Angeles selected to represent various types of land uses in the city.

**TABLE 19. SUMMARY OF CONCENTRATION OF NITROGEN COMPOUNDS IN STORMWATER RUNOFF BY LAND USE TYPES.**

| Land Use | $NH_3$-N | $NO_3$-N | $NO_2$-N |
|---|---|---|---|
| Vacant land | 0.2 (0.4) | 0.1 (0.4) | 1.0 (1.6) |
| Education | 0.4 (0.7) | 0.4 (0.7) | 0.4 (0.9) |
| High Density Residential | 0.3 (1.2) | 0.3 (1.2) | 0.7 (0.6) |
| Light Industrial | 0.5 (0.9) | 0.4 (0.9) | 0.9 (1.0) |
| Retail/Commercial | 1.2 (0.5) | 1.0 (0.5) | 0.6 (1.3) |
| Transportation | 0.3 (1.2) | 0.2 (1.2) | 0.6 (0.8) |
| Multi-family Residential | 0.6 (0.8) | 0.5 (0.8) | 0.9 (0.8) |
| Mixed Residential | 0.6 (1.0) | 0.5 (1.0) | 0.4 (1.0) |

Note: Values in tables are in mg/L, showing flow-weighted means and coefficient of variations (in parentheses) of multiple samples over five years.

These data suggest that the concentrations of ammonia, nitrate and nitrite in stormwater runoff from urban land uses are low relative to water quality objectives. The data also suggest that the largest contribution of nitrogen from runoff sources is residential. The MS4 permitees are currently undertaking special studies to address these loadings through Best Management Practices. Although the total load of nitrogen in stormwater discharge might be substantial, the load occurs entirely during periods of storm runoff when the large volume of water greatly increases assimilative capacity. To verify this assumption, additional analyses are required to measure the concentration of nitrogen compounds during storm events. However, since it is known that storm runoff strongly dominates flow during storm periods, and since the above data show concentration in the storm runoff is routinely well below the WQOs, it is reasonable to assume that the WQO is not exceeded during storm discharge in the Los Angeles River or its tributaries.

The relative load of oxidized nitrogen contributed from groundwater flow to surface water should be considered in Verdugo Basin. Groundwater data show the nitrate concentrations in this area exceed the numeric target of 45 mg-$NO_3$/L. Based on the estimated total flow of rising water at Gage F57C-R at 3900 acre-feet (1999-00 to 2000-01) with concentration ranging from 17 to 53 mg-$NO_3$/L, the oxidized nitrogen load from groundwater was estimated at 16.8 tons. The implementation plan addresses this source with special studies to assess if groundwater discharge is responsible for the elevation of the surface water nitrate concentrations.

## 4.2 NONPOINT SOURCES

As discussed in Section 4.1.4, the nitrogen contributions from runoff are mostly conveyed to the Los Angeles River and it's tributaries through the municipal separate storm sewer system and are considered point sources. The magnitude of the nonpoint source nitrogen contributions to the Los Angeles River is minimal.

## 4.3 SOURCE ASSESSMENT OVERVIEW AND SUMMARY

The three major POTWs comprise the largest source of nitrogen to the Los Angeles River, providing an average of 2,243 MT/yr in total nitrogen loadings. Urban runoff contributes a smaller fraction of the total nitrogen loadings. Although estimates to the Los Angeles River vary greatly between years (LADPW, 2000), the nitrogen loadings from the storm drain system in a typical rainfall year appear to be less than 500 MT/yr (LARWQCB, 1998; Characterization of Water Quality in the Los Angeles River, Ackerman, D., SCCWRP, 2000).

# 5 LINKAGE ANALYSIS

Information on sources of pollutants provides one part of the TMDL equation. To determine the effects of these sources on groundwater quality, it is also necessary to determine the carrying capacity of the receiving water, in this case the waterbody's ability to assimilate nitrogen loadings. This section describes the use of a hydrodynamic and water quality model to assess the effects of nitrogen loadings in the Los Angeles River on water quality.

The goal was to develop a model that can link sources of pollutants to in-stream water quality concentrations and impacts. This model will be used to establish the relationship between pollutant loads and the in-stream water quality targets for the listed reaches. The Environmental Fluid Dynamics Code 1-D (EFDC1D) was used to model the hydrodynamic characteristics of the river. The Water Quality Analysis Simulation Program (WASP) was used to model water quality.

## 5.1 MODEL DEVELOPMENT

To support the model development a comprehensive set of in-stream hydrodynamic and water quality data were collected over a two-day period in the late summer of 2000 (September 11-12) by SCCWRP. These data were reflective of low flow/dry weather conditions in the Los Angeles River Basin. This sampling effort was part of an overall program that was to include two additional sampling efforts under low flow conditions. This series of measurements was to be utilized to provide dynamic simulation of dry-weather conditions over a period of 30 to 60- days. Following the first sampling event, weather conditions changed and rain events made further dry weather sampling impossible. Therefore, the model calibrations presented herein were based on comparison of the model to the relatively steady state conditions that existed over the two-day period. These calibrations represent the critical condition for nitrogen related impairments is during the dry weather season.

Two special studies were also conducted in September 2000 to evaluate key processes. The first was a time of travel to evaluate the rate with which water flows through the system (Ackerman et al., In Prep). The second study evaluated the nutrient uptake rates by the algae *Rhizoclonium spp.* (Kamer, In Prep). *Rhizoclonium* was identified as the dominant algal species in the LA River. Studies were undertaken in 2000 and 2001 to quantify the algal biomass at certain locations to support the model. A more extensive monitoring effort was conducted in July 2001 to better understand the distribution and biomass of the algae in various parts of the watershed. The monitoring program recommendations for future studies to better define algae impairments and the relationships between algal biomass and environmental conditions.

The development and calibration of the model system is presented in detail in a report entitled "Modeling Approach and Calibration Report for the Los Angeles River Basin Nutrient and Fecal Coliform TMDLs" (Tetra Tech, 2002). The linkage analysis is briefly summarized below.

The hydrodynamic model (EFDC) was utilized to simulate the flow and temperature within the 303(d) listed segments of the Los Angeles River and tributaries (Table 20) under dry-weather conditions. EFDC1D is a one dimensional variable cross-section model for flow and transport in surface water systems.

**TABLE 20. LOS ANGELES RIVER SEGMENTS MODELED FOR LINKAGE ANALYSIS**

| Los Angeles River Mainstem | Los Angeles River Tributaries |
|---|---|
| Reach 6: above Sepulveda Flood Control Basin | Bell Creek |
| Reach 5: within Sepulveda Basin | Tujunga Wash |
| Reach 4: Sepulveda Dam to Sepulveda Dr | Burbank Western Channel |
| Reach 3: Riverside Drive to Figueroa St | Verdugo Wash |
| Reach 2: Figueroa St to Carson St | Arroyo Seco |
| Reach 1: Carson St to Estuary | Rio Hondo River |
| | Compton Creek |

The river system was divided into a total of 302 grid cells averaging 600 meters in length. Detailed cross-sections of the 303(d) listed rivers and tributaries were input into the model. Typical measured flows at the downstream end of the Los Angeles River range from 100 to 125 $ft^3$/sec. The point source discharges contribute approximately 80 to 100 $ft^3$/sec. For the purpose of the model a non-WRP base flow was established to account for flows from headwaters, storm drains, groundwater discharge near the Glendale Narrows and other unknown sources.

Figures 3-13 and 3-14 in Attachment 1 present comparisons of the measured versus simulated flows at four stations locations along the main stem of the Los Angeles River for the 2000 and 2001 low flow period (April to September). The simulated and measured flows ranged from 15 to 110 $ft^3$/sec at the upper most station to 165 to 200 $ft^3$/sec at the lowest station. The lowest station (designated F319-R) is below the confluence of all tributaries within the Los Angeles River and all simulated point source discharges (Figure 3-4 of Attachment 1). This station reflects the total water "mass balance" within the system under the relatively steady low flow condition. Comparison of the simulated flows shows that the model is simulating the flows relatively well. Above the Arroyo Seco, significant deviations between the model and measured flow values were observed (overestimates as high as 20%, underestimates of 30% not uncommon). It is noted that flow differences on the order of 20% to 30% are not uncommon in water quality models. Some of the factors contributing to accurate flow measurements include stream flow gauges that have large errors at low flow. In general the model predicts the peak flows fairly well.

The EFDC hydrodynamic model was calibrated to the September 2000 data set for flow and velocity. The values utilized for the non-WRP base flows were determined from measurements made throughout the system on September 10-11, 2000 for tributaries and storm drains. The flow data were validated using the July 2001 data set.

For simulation of the water quality within the Los Angeles River, the EFDC model was linked to the Water Quality Analysis Simulation Program (WASP5). Nutrient cycling and algal growth were simulated using the EUTRO5 component of the WASP5 model system which simulates the transport and transformation of the nitrate/nitrite, ammonia, organic nitrogen, organic phosphorus, orthophosphate, carbonaceous oxygen demand, attached algae, and dissolved oxygen. The model considers four interacting systems, algal kinetics (attached algae), the phosphorus cycle, the nitrogen cycle, and the dissolved oxygen balance. Inputs from point sources (mainly POTWs) were obtained directly from the POTWs measurements. Table 21 summarizes in part the parameters used in the model.

**TABLE 21. CONCENTRATIONS AND FLOW FOR POINT SOURCE DISCHARGES LOADED INTO THE MODEL**

| Point Source Discharge | Flows (mgd) | $NH_3$-N (mg/L) | $NO_3$-N+$NO_2$-N (mg/L) | Organic-N (mg/L) | Ortho-phosphate (mg/L) | Organic Phosphorous (mg/L) |
|---|---|---|---|---|---|---|
| Donald C. Tillman POTW | | | | | | |
| Direct Discharge | 34.4 | 13.40 | 0.10 | 1.80 | 1.56 | 0.15 |
| Japanese Gardens | 4.8 | 12.50 | 0.90 | 3.10 | 1.59 | 0.15 |
| Recreation Lake | 17.4 | 4.35 | 7.55 | 4.30 | 0.96 | 0.15 |
| Wildlife Lake | 5.9 | 12.50 | 0.90 | 3.10 | 1.59 | 0.15 |
| Glendale POTW | 9.3 | 3.67 | 2.69 | 1.00 | 1.62 | 0.01 |
| Burbank POTW | 9.2 | 19.00 | 0.50 | 2.00 | 0.50 | 0.50 |

In-stream concentrations and boundary conditions were collected during a field survey. The dry weather water quality model was calibrated using field measurements collected on September 10 and 11, 2000. The storm drain flows and concentration data used in the model are summarized in the Tetra Tech report (Attachment 1.). Table 22 summarizes the nitrogen and phosphorous concentrations and flows for the Los Angeles River tributaries used in the model. The values presented for each of the tributaries reflect the data that was collected in September 2000 to support the model calibration. These data reflect the critical condition of dry weather flows and reflect the concentration within the ranges shown in Tables 3 and 5, except for the Burbank Western Channel, which has implemented nitrification/denitrification and reduced ammonia concentrations discharged.

**TABLE 22. CONCENTRATIONS AND FLOW FOR EACH TRIBUTARY LOADED INTO THE MODEL**

| Tributary | Flows (mgd) | $NH_3$-N | $NO_3$-N+$NO_2$-N | Organic-N | Total P |
|---|---|---|---|---|---|
| Bell Creek | 6.7 | 0.2 | 2.4 | 3.3 | 0.46 |
| Tujunga Wash | 1.0 | 0 | 0 | 2.2 | 0.27 |

| | | | | | |
|---|---|---|---|---|---|
| Burbank Western Channel | 2.2 | 16.3 | 1.5 | 2.0 | 0.94 |
| Verdugo Wash | 4.4 | 0.2 | 1.4 | 0.9 | 0.70 |
| Arroyo Seco | 5.8 | 0.2 | 2.8 | 2.3 | 0.66 |
| Compton Creek | 4.8 | 0.4 | 0.3 | 1.5 | 1.06 |

For the main stem of the Los Angeles River the model shows that total nitrogen increases sharply at Donald C. Tillman plant then decreases slowly downstream with a slight increase in the area near Burbank Western Channel ( 3-34, Attachment 1). Most of the nitrogen is in the form of ammonia. Ammonia concentrations gradually decreased downstream of the treatment plants to values less than 1 mg/L (Figure 3-31, Attachment 1). The linkage analysis suggests that this is largely due to nitrification (*i.e.* the conversion of ammonia to nitrate) and volatilization of un-ionized ammonia. $NO_3$-N + $NO_2$-N concentrations increase at Donald C. Tillman from less than 1 mg/L to around 3 mg/L and continue to increase gradually downstream as a result of nitrification to a maximum concentration of 7 mg/L (Figure 3-32, Attachment 1).

The model predictions of in-stream chemistry can be compared to the range of values (indicated on the charts in Attachment 1 by triangle symbols) measured at the seven in-stream locations (Figures 3-31 through 3-38, Attachment 1). The model is capturing the general pattern but tending to over predict the actual measured concentrations. The range in values from three composite samples collected within an hour of each other also provides perspective on the short-term variability associated with the field measurements. Compared to the maximum concentrations for ammonia, nitrate and nitrite, the model underestimates the levels of ammonia in the Los Angeles River. However, compared to the concentration range, the model generally predicts higher concentrations than were measured in the field and the concentrations predicted by the model are consistent with the values typical of the main stem of the Los Angeles River. The monitoring data collected in September 2000 and July 2001 appear representative data of dry weather conditions.

The modeled concentrations of the different nitrogen species in the river are generally low in the tributaries and similar to the mean concentrations presented in Table 4. The predicted concentrations for Bell Creek, Tujunga Wash, Verdugo Wash, Arroyo Seco and

Compton Creek were low relative to the water quality objectives. Concentrations in Burbank Western Channel were high relative to the targets due to the influence of the Burbank POTW. Rio Hondo was not modeled in the analysis because almost all of the dry-weather flow is diverted to the spreading grounds and there was no measurable flow during the field survey

Total phosphorous concentrations in the Los Angeles River are low upstream of Donald C. Tillman (around 0.2 to 0.3 mg/L). Downstream of Donald C. Tillman, the concentrations increase to around 1.3 mg/L and are relatively stable along the river. The model results are similar to the measured concentrations from the calibration data set with the exception of the lower portion of the River below Rio Hondo where the model appears to be over predicting the actual concentration.

Algal biomass predicted by the model ranged from 40 to around 80 g/m2. The model does not reflect the very patchy distribution of algae in the river. The model shows a general relationship between algal biomass and nutrient concentrations. However, this relationship is difficult to quantify because nutrient concentrations exceed what is generally considered limiting for algae species. There did not appear to be any relationship between algal biomass and nutrient concentrations (total nitrogen or total phosphorous) in either the Los Angeles River of the Burbank Western Channel. The inability of the model to accurately predict algal biomass reflects the limitations in our understanding of the physical and biological processes that control algal biomass in the Los Angeles River and the complexity of other characteristics such as canopy cover, temperature, substrate availability, or turbidity have in controlling algae growth. It is also possible that the reductions in ammonia and phosphate concentrations in the lower portion of the river may be controlled by biological processes that are not well quantified (*e.g.*, bacterial uptake).

The model generally reflects the general patterns and approximates the actual concentration of the different nitrogen compounds in the Los Angeles River and listed tributaries. Recognizing the inherent uncertainties in any water quality model, and the combination of other characteristics in controlling algae growth, the model was used to assess the effectiveness of various load reduction strategies to meet numeric targets for ammonia and nitrate + nitrite. The model allocation scenarios and the process for selecting the preferred allocation scenario used in this TMDL are discussed in the next section.

## 5.2 VALIDATION OF THE MODEL

The linkage analysis was validated by comparing simulation results to measured data. For the low flow simulations the comparisons included the flow rate throughout the system (1997 and 2000), time of travel (2000), and in-stream nitrogen concentrations (2000).

General results of the model comparison verify the model accuracy for hydrodynamics, and flow velocity. The water quality comparison shows that the simulated values are generally greater than the average measured results in the Los Angeles River main stem and tributaries, except for organic nitrogen in the Western Burbank Channel. The simulation adds a degree of conservatism to the load allocation scheme. The implementation plan includes further validation of the model as additional data is collected.

## 5.3 EVALUATION OF POTENTIAL REMEDIES

The model was used to evaluate four potential management options for reducing nitrogen loadings to the system. The first option (Scenario 1) involves nitrification and denitrification (N/DN) at the three major POTWs. Scenario 2 is based on the N/DN of Scenario 1, but evaluates the effect of 10 mgd of water reclamation at the Donald C. Tillman POTW to further reduce nitrogen loadings. Scenario 3 also involves N/DN at the major POTWs, but evaluates the effect treating 30 mgd of effluent through a constructed wetland at the Donald C. Tillman POTW. Scenario 4 is the same as scenario

3 (N/DN at the three POTWs with 30 mgd of constructed wetlands treatment)and also assumes 10 mgd of water reclamation at the Donald C. Tillman POTW.

The flow estimates are based on a reduction of plant capacity by 13% for N/DN facilities. The effluent quality for the N/DN process was based on estimates from pilot testing at the Los Angeles-Glendale POTW provided by the City of Los Angeles. The effluent quality represents water quality that can be met on a monthly average. These concentrations were applied in the model to all three POTWs.

The predicted in-stream concentrations are presented for each of the segments of the river modeled (Table 23). The scenario evaluation assumed an effluent concentration of 2 mg/L for ammonia and 2.2 mg/L for nitrate. It is noted that the scenario evaluation utilized an ammonia load in the POTW effluent that may exceed the ammonia target for the Donald C. Tillman POTW. All four scenarios result in substantial reduction in ammonia, nitrate-nitrite and total nitrogen for the main stem and Burbank Western Channel. Under Scenario 1, total nitrogen loadings would be reduced by approximately 50% (from 4,375 kg/d to 2419 kg/d) over the existing condition and there would be an almost five-fold reduction of ammonia loads (from 3,328 kg/d to 722 kg/d). The 10-mgd of water reclamation would remove an additional 253 kg/d of total nitrogen from the system and the wetland option would remove an additional 602 kg/d of total nitrogen from the system.

The predicted water quality concentrations were evaluated to determine the effectiveness of each management scenario to meet the water quality objectives for ammonia and nitrate-nitrite in the Los Angeles River and tributaries along the entire length of the Los Angeles River. The model also provides output to evaluate changes in total nitrogen, phosphate, and algal biomass.

**TABLE 23. COMPARISON OF FLOWS, NITROGEN CONCENTRATIONS, AND NITROGEN LOADINGS FOR FOUR MANAGEMENT SCENARIOS TO EXISTING CONDITION**

| Existing condition | Flow (mgd) | Concentrations (mg/L) | | | | Loading (kg/d) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Donald C. Tillman | | $NH_3$ | $NO_3$-$NO_2$ | Org-N | Total N | $NH_3$ | $NO_3$-$NO_2$ | Org-N | Total N |
| Direct Discharge | 34.4 | 13.4 | 0.1 | 1.8 | 15.3 | 1745 | 13 | 234 | 1992 |
| Japanese Gardens | 4.8 | 12.5 | 0.9 | 3.1 | 16.5 | 227 | 16 | 56 | 300 |
| Recreation Lake | 17.4 | 4.4 | 7.6 | 4.3 | 16.2 | 286 | 497 | 283 | 1067 |
| Wildlife Lake | 5.9 | 12.5 | 0.9 | 3.1 | 16.5 | 279 | 20 | 69 | 368 |
| Glendale POTW | 9.3 | 3.7 | 2.7 | 1.0 | 7.4 | 129 | 95 | 35 | 259 |
| Burbank POTW | 9.2 | 19.0 | 0.5 | 2.0 | 21.5 | 662 | 17 | 70 | 749 |
| | 81.0 | | | | | 3328 | 659 | 748 | 4735 |
| Scenario 1 | Flow (mgd) | Concentrations (mg/L) | | | | Loadings (kg/d) | | | |
| | | $NH_3$ | $NO_3$-$NO_2$ | Org-N | Total N | $NH_3$ | $NO_3$-$NO_2$ | Org-N | Total N |
| Donald C. Tillman | 70.0 | 2.0 | 2.7 | 2.0 | 6.7 | 530 | 715 | 530 | 1775 |
| Burbank | 8.0 | 2.0 | 2.7 | 2.0 | 6.7 | 61 | 82 | 61 | 203 |
| Glendale | 17.4 | 2.0 | 2.7 | 2.0 | 6.7 | 132 | 178 | 132 | 441 |
| | 95.4 | | | | | 722 | 975 | 722 | 2419 |
| Scenario 2 | Flow (mgd) | Concentrations (mg/L) | | | | Loadings (kg/d) | | | |
| | | $NH_3$ | $NO_3$-$NO_2$ | Org-N | Total N | $NH_3$ | $NO_3$-$NO_2$ | Org-N | Total N |
| Donald C. Tillman | 60.0 | 2.0 | 2.7 | 2.0 | 6.7 | 454 | 613 | 454 | 1522 |
| Burbank | 8.0 | 2.0 | 2.7 | 2.0 | 6.7 | 61 | 82 | 61 | 203 |
| Glendale | 17.4 | 2.0 | 2.7 | 2.0 | 6.7 | 132 | 178 | 132 | 441 |
| | 85.4 | | | | | 646 | 873 | 646 | 2166 |
| Scenario 3 | Flow (mgd) | Concentrations (mg/L) | | | | Loadings (kg/d) | | | |
| | | $NH_3$ | $NO_3$-$NO_2$ | Org-N | Total N | $NH_3$ | $NO_3$-$NO_2$ | Org-N | Total N) |
| Donald C. Tillman | 40.0 | 2.0 | 2.7 | 2.0 | 6.7 | 303 | 409 | 303 | 1014 |
| Tillman Wetland | 30.0 | 1.6 | 2.0 | 0.1 | 1.4 | 182 | 227 | 11 | 159 |
| Burbank | 8.0 | 2.0 | 2.7 | 2.0 | 6.7 | 61 | 82 | 61 | 203 |
| Glendale | 17.4 | 2.0 | 2.7 | 2.0 | 6.7 | 132 | 178 | 132 | 441 |
| | 95.4 | | | | | 677 | 895 | 506 | 1817 |
| Scenario 4 | Flow (mgd) | Concentrations (mg/L) | | | | Loadings (kg/d) | | | |
| | | $NH_3$ | $NO_3$-$NO_2$ | Org-N | Total N | $NH_3$ | $NO_3$-$NO_2$ | Org-N | Total N |
| Donald C. Tillman | 30.0 | 2.0 | 2.7 | 2.0 | 6.7 | 227 | 307 | 227 | 761 |
| Tillman Wetland | 30.0 | 1.6 | 2.0 | 0.1 | 1.4 | 182 | 227 | 11 | 159 |
| Burbank | 8.0 | 2.0 | 2.7 | 2.0 | 6.7 | 61 | 82 | 61 | 203 |
| Glendale | 17.4 | 2.0 | 2.7 | 2.0 | 6.7 | 132 | 178 | 132 | 441 |
| | 85.4 | | | | | 601 | 793 | 431 | 1564 |

Table 24 presents a summary of the modeling results in terms of the extent of the ammonia plume concentration downstream of the Tillman WRP as a function of the ammonia as nitrogen concentration. The model indicates that the maximum instream ammonia concentration is 1.8 mg/L based on a discharge of 2.0 mg/L.

**TABLE 24. MAGNITUDE (MG/L) AND EXTENT (MILES) OF AMMONIA SIGNAL DOWNSTREAM OF DONALD C. TILLMAN WRP UNDER FOUR NITROGEN REDUCTION SCENARIOS**

| NH3-N concentration (mg/L) | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| 1.8 | 0 | 0 | 0 | 0 |
| 1.7 | 1.88 | 0.75 | 0 | 0 |
| 1.6 | 5.26 | 4.13 | 0 | 0 |
| 1.5 | 9.37 | 7.52 | 3.75 | 1.88 |
| 1.4 | 10.81 | 10.11 | 7.89 | 5.26 |
| 1.3 | 14.37 | 13.27 | 10.86 | 9.75 |
| 1.2 | 16.57 | 16.20 | 14.73 | 12.62 |
| 1.1 | 18.41 | 17.51 | 16.94 | 16.20 |
| 1.0 | 19.14 | 19.14 | 18.77 | 18.04 |

In the model, algal biomass in the Los Angeles River was not sensitive to nitrogen reduction scenarios. There was only a slight reduction in algal biomass in Burbank Western Channel. This is consistent with special studies performed by SCCWRP (Kamer, In Prep) that suggest that nitrogen may not be limiting algae in the Los Angeles River. A sensitivity analysis was run to estimate the concentration at which phosphorous became limiting in the model. Phosphorous was not limiting at concentrations as low as 0.3 mg/L. This analysis suggests that algal biomass in the Los Angeles River may be controlled by other processes, such as flow, substrate, turbidity, canopy cover, phosphorous and temperature, in addition to nitrogen concentrations.

Further research is needed to determine whether nitrogen compounds are controlling algal biomass in the river and if so what levels of reductions would be necessary to limit algal biomass. Due to this uncertainty, the implementation plan includes monitoring to observe changes in algae mass. If algal growth is not sufficiently reduced to meet targets, further analysis will be conducted to revise this TMDL for nitrogen compounds and include other pollutants that affect algal growth.

# 6 ALLOCATIONS

In this section, wasteload allocations for nitrogen compounds from point sources, and allocations for nitrogen compounds from nonpoint sources to the Los Angeles River are developed. The wasteload allocations discussed below are based on Scenario 2, which was selected by stakeholders as the preferred scenario.

## 6.1 WASTELOAD ALLOCATIONS

U.S. EPA regulations require that a TMDL include wasteload allocations (WLAs), which identify the portion of the loading capacity allocated to existing and future point sources (40 CFR 130.2(h)). It is not necessary that every individual point source have a portion of the allocation of pollutant loading capacity. It is necessary, however, to allocate the loading capacity among individual point sources as necessary to meet the water quality objective.

This TMDL defines ammonia WLAs in accordance with Resolution No. 2002-11 and the Policy for Implementation of Toxics Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries. The ammonia Waste Load Allocation for this TMDL is equivalent to the Effluent Concentration Allowance (ECA) as defined in the Policy for Implementation of Toxics Objectives. The ECA is based on the ammonia WQOs and provides the basis, along with an analysis of the variability in POTW denitrification performance, for determining effluent limits for ammonia in NPDES permits. Because the dischargers have not yet implemented nitrification at the major POTWs, it is difficult to quantify the variability in nitrification performance that is necessary to determine the ammonia effluent limits. Consequently, the POTW effluent limits for ammonia necessary to implement the WLAs for this TMDL will be specified in the NPDES permit.

### 6.1.1 Wasteload Allocations for Major Point Sources

WLAs have been developed for the Donald C. Tillman, Los Angeles-Glendale and Burbank POTWs because they represent approximately 85% of the total nitrogen loadings to the system. Wasteload allocations for Donald C. Tillman, Los Angeles-Glendale and Burbank POTWs are based on concentrations needed to meet in-stream water quality objectives for ammonia, nitrate-N + nitrite-N, nitrate, and nitrite. The WLAs are set at levels necessary to attain and maintain the applicable narrative and numerical water quality objectives. A 20 percent explicit margin of safety has been included for nitrate, nitrite, and nitrate + nitrite to account for any lack of knowledge concerning the relationships between effluent limitations and water quality.

WLAs for ammonia are based on Resolution No. 2002-11 which establishes the relationship between water quality objectives and the beneficial uses of inland waterbodies. Since most of Los Angeles River listed segments are not designated in the Basin Plan as “COLD,” “MIGR,” and “SPWN,” it is assumed that salmonids are absent and early life stages are not present in Los Angles River. WLAs for ammonia ($NH_3$) include one-hour and thirty day averages and are based on the pH and temperature data downstream from the POTWs for the past five years. The $90^{th}$ percentile of pH data is used to establish the one-hour average WLA, and the medians of pH and temperature data are used to establish the thirty-day average WLA. WLAs for Donald C. Tillman, Los Angeles-Glendale, and Burbank POTWs are provided in Table 25. The ammonia WLA for the Donald C. Tillman WRP has been modified to account for increased assimilative capacity from discharge into the Los Angeles River that passes through the Wildlife and Recreational Lakes where ammonia is converted to oxidized nitrogen. The magnitude of the increased assimilative capacity is based on the product of a ratio of the total effluent to the effluent directly discharged through the Lakes (80 MGD/63 MGD) and an estimate of the magnitude of ammonia conversion from 2001 monitoring data. The estimate of ammonia conversion is based on the average ammonia concentration in the effluent to the average concentration in the Wildlife Lake Receiving Water Station W-3 (16.2 mg/L and 14.7 mg/L, respectively), i.e. 9% conversion. Therefore, WLA for ammonia at the Tillman WRP is adjusted by a factor of 1.05. If the water effect ratio study results in a revised ammonia objective, this TMDL will be revised to reflect the new ammonia target and correspondent WLA.

**TABLE 25. AMMONIA ($NH_3$) WASTELOAD ALLOCATION FOR MAJOR POTWS IN LOS ANGELES RIVER WATERSHED**

| POTWS | One-hour average WLA (mg/L) | Thirty-day average WLA (mg/L) |
|---|---|---|
| Donald C. Tillman WRP | 4.2 | 1.4 |
| Los Angeles-Glendale WRP | 7.8 | 2.2 |
| Burbank WRP | 9.1 | 2.1 |

Table 26 shows the WLAs for nitrate-nitrogen ($NO_3$-N), nitrite-nitrogen ($NO_2$-N), and nitrate-nitrogen plus nitrite-nitrogen ($NO_3$-N + $NO_2$-N) for major POTWs in the Los Angeles River watershed.

**TABLE 26. NITRATE-NITROGEN, NITRITE-NITROGEN, AND NITRATE-NITROGEN + NITRITE-NITROGEN WASTELOAD ALLOCATIONS FOR MAJOR POTWS**

| POTWs | Thirty-day Average WLA* (mg/L) | | |
|---|---|---|---|
| | Nitrate$NO_3$-N | Nitrite$NO_2$-N | Nitrate$NO_3$-N +Nitrite$NO_2$-N |
| Donald C. Tillman WRP | 7.2 | 0.9 | 7.2 |
| Los Angeles-Glendale WRP | 7.2 | 0.9 | 7.2 |
| Burbank WRP | 7.2 | 0.9 | 7.2 |

*Receiving water monitoring is required on a weekly basis to ensure compliance with the water quality objective

These limits will be sufficient to meet the water quality objectives. This assertion is based on two key findings from the Source Analysis and Linkage Analysis. The first finding is that there are no other point sources with sufficient loads to increase nitrogen compound concentrations above the WQO. This finding is reasonable warranted based on the Source Analysis, however it is conceivable that this could change in the future. For this reason it may be prudent to develop wasteload allocations for the minor NPDES dischargers. This will require development of improved monitoring programs to establish the baseline from these sources. The second finding is that there are no sinks in the system that would allow for the accumulation of nitrogen. This also appears to be warranted since most of the river is channelized and sediments that may accumulate in these channels are likely to be flushed out during major storms. The one possible exception would be in the vicinity of the Glendale Narrows where willow trees and other vegetation have taken root. This area is a relatively small portion of the river and the overall effect on the nitrogen budget for the river is probably negligible.

### 6.1.2 Wasteload Allocations for Minor Point Sources

Ammonia WLAs for minor point sources will be set at levels necessary to maintain the applicable water quality objective. WLAs for minor point sources will be established in accordance to the reach into which a minor point source discharges based on instream pH and temperature of the last five years data set. Ammonia WLAs for minor point source discharges are listed in Table 27.

**TABLE 27. AMMONIA WASTE LOAD ALLOCATIONS FOR MINOR POINT SOURCES IN LOS ANGELES WATERSHED**

| Water Body | One-hour average WLA (mg/L) | Thirty-day average WLA (mg/L) |
|---|---|---|
| Los Angeles River above Los Angeles-Glendale WRP | 4.7 | 1.6 |
| Los Angeles River below Los Angeles-Glendale WRP | 8.7 | 2.4 |
| Los Angeles River Tributaries | 10.1 | 2.3 |

WLAs for nitrate-nitrogen, nitrite-nitrogen, and nitrate-nitrogen plus nitrite-nitrogen are set equal to numeric targets as listed in Table 28. Monitoring requirements will be placed on minor NPDES and WDR dischargers to refine the estimates of nitrogen loadings. Wasteload allocations for these minor point sources will be revised and in the future if monitoring data indicates that loads are greater than assumed in this assessment and the prescribed wasteload allocations do not result in attainment of water quality objectives.

**TABLE 28. $NO_3$-N, $NO_2$-N, AND $NO_3$-N + $NO_2$-N WASTE LOAD ALLOCATIONS FOR MINOR POINT SOURCES IN LOS ANGELES WATERSHED**

| Constituent | Thirty-day Average Wasteload allocation |
|---|---|
| $NO_3$-N | 8 mg/L |
| $NO_2$-N | 1 mg/L |
| $NO_3$-N + $NO_2$-N | 8 mg/L |

6.1.3 WLA for municipal storm water and urban runoff from municipal separate storm sewer systems (MS4s)

As discussed in Section 4, Source Assessment, the concentrations of ammonia, nitrate and nitrite in runoff from land uses objectives during both dry and wet weather are low relative to water quality. Table 17 indicates no significant loads of ammonia from runoff sources in the watershed. The dry-weather flows measured from individual storm drains represent 7 to 15% of total nitrogen loadings to the Los Angeles River. It is believed that WLAs for the POTWs, which represent 85% of the total nitrogen loadings and 97% of the ammonia loadings, will result in the attainment of water quality objectives. This assumes that nitrogen loadings estimate associated with runoff flows are accurate and that they will not increase over time. Based on the 1998 Regional Board Staff Report, the estimated annual nitrogen load is 315 MT/year from run off through the stormwater system. The WLAs for ammonia, nitrate, nitrite, and nitrate + nitrite are based on the numeric targets and are listed as WLAs for minor point sources in Tables 27 and 28. Additional source monitoring information is needed to refine the estimates of nitrogen contributions from urban runoff and determine the sources. Measures should also be taken by MS4 permittees to ensure that loadings from nuisance flows do not increase in the future. This might involve best management practices (BMPs) to address dry weather runoff from residential areas (e.g., runoff of fertilizers from lawns). Waste load allocations for MS4s may be revised in the future if monitoring data indicate that loads are higher than assumed in this assessment and the prescribed WLAs for POTWs do not result in attainment.

## 6.2 LOAD ALLOCATIONS

The Source Assessment indicates that nitrogen loads from nonpoint sources are not significant relative to the loads from point sources. Consequently, load allocations will not be developed at this time. Load allocations may be developed if it is determined they are necessary after load reductions are effected through implementation of the wasteload allocations.

## 6.3 CRITICAL CONDITIONS AND SEASONALITY

The critical condition for this TMDL is low flow (dry weather) during summer. Summer reflects the critical condition for nitrogen compounds because the ammonia toxicity objective is lower at higher temperatures. In addition, the combination of warmer temperatures and stable low-flow conditions in the summer is also likely to create conditions conducive for algal growth and the build up of mats in certain portions of the river. The assessment of critical conditions for this TMDL is based on analysis of long-term data reflecting river flow and in-stream measurements of temperature and pH.

During low flow periods wastewater treatment plants make up most of the baseflow to the system (typically 80%) and contribute most of the nitrogen loadings (roughly 85%). Consequently there is minimal dilution during this critical period. Storms may increase total loadings to the system but these periods are not considered to be critical for the following reasons: 1) the magnitude of storm-water contribution is small relative to annual loadings from point sources; 2) there is ample dilution during storm events; and stormwater is rapidly moved through and exported out of the river system.

The major and minor point sources are all expected to be relatively constant throughout the year, so the critical period for impacts on the Los Angeles River and tributaries is times when storm runoff is absent or small because low flow in the river allows less assimilative capacity for pollutants. Periods of low flow are not restricted to a particular season, such as months commonly defined as “dry weather” in southern

California, when virtually no storm runoff occurs for an entire season. The low-flow conditions described in this dry weather mass balance can also occur during months when monthly average rainfall and runoff may be substantial, because low flow commonly occurs at periods between storms in wet seasons.

### 6.4 MARGIN OF SAFETY

The statute and regulations require that a TMDL include a margin of safety to account for any lack of knowledge concerning the relationships between effluent limitations and water quality, and uncertainty in the source and linkage analyses. The margin of safety is largely based on the following factors:

- Use of modified design flows rather than actual flows in the model. Average flows from Donald C. Tillman are around 53 mgd or 76% of the modified design flows (70 mgd). Average flows from Glendale are 13 mgd or 75% of the design flow of 17.4 mgd. Average flows at Burbank were 5 mgd or 63% of the modified design flow of 8 mgd.

- An explicit margin of safety of 10 percent is included for $NH_3$, $NO_3$-N, $NO_2$-N, and $NO_3$-N + $NO_2$-N WLAs provided in Tables 25 and 26 to address uncertainty in the sources and linkage analyses. The target for these nitrogen compounds is based on the WQOs for the Los Angeles River.

### 6.5 SUMMARY OF TMDL

This TMDL sets wasteload allocations for ammonia, nitrite and nitrate + nitrite for the Donald C. Tillman WRP, Los Angeles-Glendale WRP and the Burbank WRP. The WLAs are designed to ensure compliance with the water quality objectives for ammonia based on both the chronic and acute criteria and nitrite and nitrate + nitrite. Under this TMDL the monthly ammonia loadings will be reduced from around 143,500 kg/month to around 19,700 kg/month. This represents an 86% reduction in the total ammonia loads.

This TMDL places a limit and requires a reduction of ammonia and nitrite + nitrate mass discharged from the three major POTWs in the Los Angeles River watershed. Under these allocations the mass emissions for nitrate-nitrite can increase to a limited extent without causing exceedances of water quality objectives for these compounds. However, conversion of the ammonia load in POTWs effluent to nitrate + nitrite through nitrification will likely result in exceedances of nitrate + nitrite water quality objectives unless the nitrified effluent is subsequently denitrified.

The degree of ammonia, nitrate, nitrite, and nitrite + nitrate reduction specified in this TMDL is subject to modification if it is determined that additional reductions in nitrogen concentrations are required to meet algae, foam/scum, odor, pH or DO target. Presently, there are insufficient data for defining such a target.

Available data suggest that the nitrogen loadings from the minor NPDES dischargers and dry-weather nuisance flows are insignificant relative to the major NPDES dischargers. Based on available data, literature, analysis, models, and conservative assumptions built into models, the Regional Board anticipates that implementation of this TMDL will result in compliance with the water quality objectives. Additional WLAs or LAs may be developed or implemented at a future date should the monitoring data indicate non-attainment of water quality objectives or other in-stream targets.

# 7 IMPLEMENTATION

The WLAs established in this TMDL will be established as NPDES permit effluent limits for the three major POTWs and other NPDES dischargers. The renewal of the NPDES permits for the D.C. Tillman and Los Angeles-Glendale POTWs is tentatively scheduled for September 2003. At that time, an updated data set for pH and temperature will be available that can be considered in establishing this TMDL's WLA in the NPDES permits, upon approval by the Regional Board.

The City of Los Angeles reports that additional time is required to implement the nitrification and denitrification facilities required to meet the WLAs. This Implementation Plan provides interim limits for ammonia and nitrate during construction and start-up of nitrification/denitrification processes.

## 7.1 ALTERNATIVES CONSIDERED

Two alternatives were considered for developing an appropriate implementation schedule to meet the ammonia, nitrate, nitrite, nitrate + nitrite objectives. The details are discussed in section 7.2 and 7.3

- Alternative 1 – Waste load allocations would be applied to POTWs on the effective date of the TMDL
- Alternative 2 – Under this alternative, the interim waste load allocation would be considered in interim period before WLAs for nitrate-N, nitrite-N, nitrate-N + nitrite-N apply to POTWs

## 7.2 RECOMMENDED ALTERNATIVE

Alternative 2 is the recommended alternative since this alternative would allow the dischargers to complete the implementation of nitrification/denitrification facilities without increasing current ammonia, nitrate and nitrite loads in the interim period. As the nitrification/denitrification facilities are commissioned, the reductions in ammonia and nitrate loads will reduce impairments caused by nutrient effects. Alternative 1 would not provide time needed for the dischargers to complete implementation of nitrification/denitrification facilities.

## 7.3 EVALUATION AND BASIS FOR THE IMPLEMENTATION PLAN

This TMDL provides the Regional Board discretion to establish interim wasteload allocations for ammonia + nitrite + nitrate for a period not to exceed three years beyond the effective date of the TMDL. These interim wasteload allocations will allow the dischargers to complete implementation of nitrification/denitrification facilities without increasing current ammonia, nitrate and nitrite loads.  After the nitrification/denitrification facilities are in place, it is anticipated that the reductions in ammonia and nitrate loads will reduce impairments caused by nutrient effects, including algae, odor, and scum.  The Implementation Plan includes the following elements:

* nitrification and denitrification process to remove ammonia and oxidized nitrogen from POTW effluent
* interim limits for POTWs implementing nitrification and denitrification processes;
* water effects ratio (WER) studies to determine site-specific objectives for ammonia;
* special studies to address issues pertaining to water quality objectives for nitrate and nitrite
* continued and additional monitoring for nutrients and their effects in Los Angeles River; implementation and evaluation of residential best management practices (BMPs) in the Los Angeles River watershed;
* implementation and evaluation of residential best management practices (BMPs) in the Los Angeles River watershed; and
* additional studies to address issues for which the data is insufficient to assess the nutrient loading from groundwater.

Table 29 provides the Implementation Schedule for this TMDL.

**TABLE 29. LOS ANGELES RIVER NITROGEN TMDL IMPLEMENTATION SCHEDULE**

| **Table 7-8.2. IMPLEMENTATION SCHEDULE**<br><br>**Implementation Tasks** | **Completion Date** |
|---|---|
| 1. Apply interim limits for $NH_3$-N and $NO_3$-N + $NO_2$-N to major Publicly Owned Treatment Works (POTWs).<br>2. Apply Waste Load Allocations (WLAs) to minor point source dischargers and MS4 permittees.<br>3. Include monitoring for nitrogen compounds in NPDES permits for minor NPDES dischargers above 0.1 mgd as permits are renewed. | Effective Date of TMDL |
| 4. Submittal of a Monitoring Work Plan by MS4 permittees to estimate ammonia and nitrogen loadings associated with runoff loads from the storm drain system for approval by the Executive Officer of the Regional Board. The Work Plan will include monitoring for ammonia, nitrate, and nitrite. The Work Plan may include a phased approach wherein the first phase is based on monitoring from the existing mass emission station in the Los Angeles River. The results will be used to calibrate the linkage analysis.<br>The Work Plan will also contain protocol and a schedule for implementing additional monitoring if necessary. The Work Plan will also propose triggers for conducting source identification and implementing BMPs, if necessary. Source identification and BMPs will be in accordance with the requirements of MS4 permits. | 1 year after the Effective Date of TMDL |
| 5. Submittal of a Workplan by major NPDES permittees to evaluate the effectiveness of nitrogen reductions on removing impairments from algae odors, scums, and pH for approval by the Executive Officer of the Regional Board. The monitoring program will include instream monitoring of algae, foam, scum, and odors in the Los Angeles River. A key objective of these studies will be to determine the effectiveness of nitrogen reductions on removing impairments related to algae, foam, odor, scum and pH. In addition, groundwater discharge to Los Angeles River will also be analyzed for nutrients to determine the magnitude of these loadings and the need for load allocations. The Workplan will include protocol and schedule for development of appropriate numeric targets for | 1 year after the Effective Date of TMDL |

| Table 7-8.2. IMPLEMENTATION SCHEDULE<br>Implementation Tasks | Completion Date |
|---|---|
| nutrients and algae in the Los Angeles River. The Workplan will also contain protocol and a schedule for identification of limiting nutrients. | |
| 6. Submission of a special studies Workplan by the City of Los Angeles to evaluate site-specific objectives for ammonia, nitrate, and nitrite, including the following issues: pH and temperature distribution downstream of the D.C. Tillman WRP to determine the point of compliance for ammonia, establishment of ammonia WLAs based on seasonality, and revision of the water quality objectives for nitrate and nitrite based on averaging of the numeric objective. | 1 years after Effective Date of TMDL |
| 7. Submission of results from water effects ratio study for ammonia and special studies by the City of Los Angeles including pH and temperature distribution downstream of D.C. Tillman WRP. | No later than 2.5 years after Effective Date of TMDL. |
| 8. Regional Board considers site-specific objective for ammonia, nitrate, nitrite and nitrite + nitrate and revision of wasteload allocations based on results from Tasks 6 and 7. The site specific objective will consider factors including but not limited to seasonality, averaging periods, and the WER for ammonia. If a site specific objective is adopted by the Regional Board, approved by State Board and Office of Administrative Law and established by US EPA, for ammonia then the WQO are revised and as such the numeric target and waste load allocations would need to be revised to reflect the revised WQO. | No later than 3.5 years after Effective Date of TMDL. |
| 9. Interim limits for ammonia and nitrate + nitrite expire and WLAs for ammonia, nitrate, nitrite, and nitrate + nitrite apply to POTWs. | 3.5 years after Effective Date of TMDL |
| 10. Complete evaluation of monitoring for nutrient effects and determine need for revising wasteload allocations, including but not limited to establishing new WLAs for other nutrient and related effects such as algal growth | 4 years after Effective Date of TMDL |
| 11. Regional Board considers results of Tasks 5 and 10 and revises or establishes WLAs as appropriate. | 5 years after Effective Date of TMDL |

### 7.3.1 Nitrification and Denitrification

This section provides a brief overview of the processes available for the POTWs to achieve the WLAs. Nitrification removes ammonia and a portion of organic nitrogen from wastewater treatment plant effluent by converting these nitrogen compounds to other nitrogen forms, such as nitrite and nitrate. Denitrification converts the oxidized nitrogen forms into gaseous nitrogen that is released from the effluent.

Two different categories of nitrification and denitrification processes can be implemented. The first involves converting existing facilities to provide nitrification and denitrification. The second requires the construction of new facilities for nitrification and denitrification.

Conversion of existing facilities to provide nitrogen removal involves modifying existing activated sludge processes by adjusting the amount of aeration, the types of bacteria present in the sludge, and the solids residence time. The benefit of converting existing facilities relative to constructing new nitrogen removal facilities is that it is cost effective, involves minimal new construction, and does not significantly change existing operations and maintenance costs. However, nitrogen removal processes based on conversion of existing facilities are more difficult to control than new facilities specifically designed to remove nitrogen compounds. If a large amount of ammonia enters the treatment plant unexpectedly, it is possible that the ammonia will pass through the plant without being treated. As such, meeting instantaneous maximum effluent limits with this process could be difficult. Achieving consistent levels of nitrate and nitrite significantly below 10 mg/L-N is difficult in converted facilities. And finally, this process adds some organic nitrogen to the effluent.

The costs for construction of new facilities for nitrification and denitrification are significantly greater than the conversion of existing facilities. However, the new facilities allow significantly more control over the nitrogen removal processes.

Additionally, the new facilities can be designed to achieve significantly more overall nitrogen removal than the converted facilities.

A monitoring program will be developed to assess compliance with in-stream targets identified in Table 13. Monitoring requirements will also be established to evaluate changes (if any) to algal biomass and the presence of scum and odors. Monitoring requirements will also be established to refine source estimates from minor NPDES dischargers, dry-weather flows from storm drains and stormflow. In addition, receiving water quality and algae should be monitored weekly. These data will be reviewed prior to the next permit cycle (5-years) to evaluate the effectiveness of this TMDL and to determine if additional WLAs or LAs are required for other constituents.

7.3.2 Interim Discharge Limit

As POTWs implement nitrification/denitrification processes to comply with the ammonia-nitrogen, nitrate-nitrogen, nitrite-nitrogen, and nitrate-nitrogen + nitrite-nitrogen objectives, implementation of nitrification/denitrification facilities requires time for planning, design, and construction. POTWs in the Los Angeles River watershed may require additional time to meet the ammonia-nitrogen, nitrate-nitrogen, nitrite-nitrogen, and nitrate-nitrogen + nitrite-nitrogen WLAs. To allow time for completion of the nitrification/denitrification facilities which are integral to this TMDL, the amendment to the Basin Plan made by this TMDL provides the authority for the Regional Board to grant compliance schedules, at the Regional Board's discretion, based on higher interim loads which translate as interim effluent limits in Tables 30 and 31 for a period not to exceed three years from the effective date of the TMDL at the discretion of the Regional Board. The thirty-day average and daily maximum interim limits for total ammonia as nitrogen are based on the 95$^{th}$ and 99$^{th}$ percentiles of effluent performance data reported by dischargers from 1998 to 2002. These interim limits will apply to $NH_3$-N, and $NO_3$-N + $NO_2$-N. Effluent limits for the individual compounds $NH_3$-N, $NO_3$-N, and $NO_2$-N are not required during the interim period.

**TABLE 30. INTERIM LIMITS FOR TOTAL AMMONIA AS NITROGEN ($NH_3$-N)**

| POTWs | Daily Maximum Interim Limits (mg/l) | Monthly Average Interim Limits (mg/l) |
|---|---|---|
| Donald C. Tillman WRP | 21.7 | 21.0 |
| Los Angeles-Glendale WRP | 19.4 | 16.5 |
| Burbank WRP | 24.1 | 22.7 |

**TABLE 31. INTERIM LIMITS FOR $NH_3$-N + $NO_3$-N + $NO_2$-N**

| POTWs | Monthly Average Interim Limits (mg/l) |
|---|---|
| Donald C. Tillman WRP | 8.0 |
| Los Angeles-Glendale WRP | 8.0 |
| Burbank WRP | 8.0 |

### 7.3.3 Special Studies

Special studies can be conducted by the dischargers to address concerns regarding water quality objectives, numeric targets, and wasteload allocations. Dischargers have already undertaken WER studies to address the ammonia water quality objective. This study will be augmented by a detailed profile of pH, temperature and mixing of the effluent discharge into the receiving water downstream from the Donald C. Tillman POTW. The Dischargers may also undertake studies to address issues regarding ammonia, nitrate, nitrite, and nitrate+nitrite, including compliance points and averaging periods for interpreting water quality objectives.

These studies will be conducted in accordance with Workplans submitted by the Discharger and approved by the Executive Officer. The results from the special studies will be used as the basis for a Regional Board Staff recommendation for modification of the water quality objectives and wasteload allocations. After consideration and approval by the Regional Board, a water quality objective modification or site specific objective would be established as a Basin Plan Amendment. The Implementation Plan schedules a Regional Board hearing to consider special studies 3 years after the effective date of the TMDL.

### 7.4 COST ANALYSIS

This section summarizes the cost analysis associated with the Los Angeles River Nitrogen TMDL. The cost analysis includes a capital cost estimate for denitrification facilities based on information provided by the City of Los Angeles.

The cost for Nitrification/Denitrification (N/DN) at Donald C. Tillman and Glendale is estimated at $21.3 M and $10.8 M respectively based on communication from the City of Los Angeles City. The cost for N/DN at Burbank is estimated to be $8.5 million. No additional cost is considered for the 10 mgd of water reclamation because significant infrastructure is in place. The total cost for Scenarios 1 and 2 is approximately $40.6 million. The cost estimates were provided by the City of Los Angeles.

Scenarios 3 and 4 require constructed wetlands at Donald C. Tillman. The cost for construction of the 30-acre wetland has been estimated at $56 million. The total cost for scenarios 3 and 4 is $96.6 million. Modeling shows that options listed under Scenario 2 (N/DN with 10 mgd reclamation at Donald C. Tillman) are sufficient to meet the in-stream water quality objectives. Monitoring of the river will be required to determine the need additional level of treatment.

It is noted that the costs for implementation of nitrification/denitrification of the POTW effluent are required by the criterion specific water quality objective for ammonia in the Basin Plan. The costs attributable to this TMDL only include the costs for monitoring and special studies in the Implementation Plan.

## 8 MONITORING

The details of the monitoring plan to measure the effectiveness of the TMDL will be developed by the Regional Board as part of the NPDES permitting process for the POTWs and include the following components: 1) a core compliance monitoring program designed to ensure that effluent limitations and water quality objectives are being met by the POTWs; 2) a source monitoring program to better identify sources and refine loading estimates; and 3) watershed-scale monitoring to ensure compliance at key compliance points along the river and listed tributaries for both nitrogen compounds and effects such as algae, foam, scum, odors, and pH.

## 8.1 COMPLIANCE MONITORING FOR WASTEWATER RECLAMATION PLANTS

Effluent monitoring requirements will be developed for the POTWs to ensure compliance with the daily and monthly limits for nitrogen species (ammonia, nitrate, and nitrite). The frequency of sampling should be on a daily basis until there is sufficient data to statistically demonstrate that some other frequency of monitoring is adequate to ensure that the daily objective is being met. Organic nitrogen should also be measured at these times to keep track of total nitrogen loadings.

Receiving water monitoring requirements should include water column measurements of temperature, pH and DO (on at least a weekly basis) ammonia, nitrate, nitrite, organic nitrogen (on at least a monthly basis) and acute and chronic toxicity (on at least a quarterly basis). Observations for the presence of scum, odors, and the presence and extent of algal mats should be recorded at the same time the receiving waters are sampled.

## 8.2 ADDITIONAL SOURCE MONITORING

Additional monitoring and special studies are needed to refine the source loading estimates. There are uncertainties in the assessment of source loadings from the upstream tributaries to the Los Angeles River, the minor permitted discharges and the non-permitted dry-weather flows from the stormwater system. The following recommendations are designed to address these uncertainties.

A requirement for minor NPDES dischargers above 0.1 mgd to monitor nitrogen loadings on a monthly basis will be considered as the NPDES permits are revised by the Regional Board. The loadings from these sources will be used to re-evaluate the need for additional reductions in the Wasteload Allocations at the time of permit renewal of the large POTWs.

This TMDL will include monitoring to evaluate sources of loadings associated with nonpoint sources, specifically dry weather discharges from urban sources delivered to the Los Angeles River through storm drains. A special study on groundwater in Verdugo Basin should also be conducted to assess if groundwater discharge is responsible for the elevation of the surface water nitrate concentrations in Verdugo Basin.

### 8.2.1 Watershed Monitoring

A watershed scale monitoring program will be implemented through major dischargers' monitoring programs. The watershed monitoring program will include key compliance points along the river and the upstream and downstream ends of the listed tributaries. Sample results should be compared to the numeric in-stream targets identified in Table 13. Data on the extent and distribution of algal mats, scum and odors should also be compiled. The data could also be used to provide further verification of the model and refine the TMDL as appropriate.

A special watershed-wide study should also be conducted to assess extent and magnitude of algae problem within the Los Angeles River Watershed. Should it be determined that algae is indeed a problem, this would trigger additional studies in the Los Angeles River Watershed in the next phase of permit renewal to: 1) define the targets for algal abundance, scum and odors; 2) address factors controlling algal abundances; and 3) develop an implementation process.

## 8.3 SUMMARY OF MONITORING

The TMDL monitoring program is designed to provide information that will assure that water quality objectives are being met throughout the watershed and to refine the source loading estimates.  These efforts will provide information on the success of the TMDL to address the nitrogen related problems in the River and listed tributaries. Information generated by this program may be used to revise the TMDL at the next NPDES permit cycle.

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# Los Angeles River Watershed Bacteria Total Maximum Daily Load

July 15, 2010

California Regional Water Quality Control Board
Los Angeles Region
320 West Fourth Street, Suite 200
Los Angeles, California 90013

# Acronyms

| | |
|---|---|
| 303(d) list | State of California Clean Water Act section 303(d) List of Water Quality Limited Segments |
| BMPs | Best Management Practices |
| BSI | Bacteria Source Identification Study |
| Caltrans | California Department of Transportation |
| CFR | Code of Federal Regulations |
| cfs | Cubic Feet per Second |
| CMP | Coordinated Monitoring Plan |
| CREST | Cleaner Rivers through Effective Stakeholder-led TMDLs |
| CWA | Clean Water Act |
| EO | Executive Officer |
| HFS | High Flow Suspension |
| IRP | Integrated Resources Plan |
| LA | Load Allocation |
| LACDPW | Los Angeles County Department of Public Works |
| LARWQCB | Los Angeles Regional Water Quality Control Board |
| LAX | Los Angeles International Airport |
| LDC | Load Duration Curve |
| LFD | Low Flow Diversion |
| LID | Low Impact Development |
| LRS | Load Reduction Strategy |
| mgd | Million Gallons per Day |
| mL | Milliliter |
| MOS | Margin of Safety |
| MPN | Most Probably Number |
| MS4 | Municipal Separate Storm Sewer System |
| NPDES | National Pollutant Discharge Elimination System |
| OWTS | Onsite Wastewater Treatment Systems |
| O&M | Operation and Maintenance |
| SCCWRP | Southern California Coastal Water Research Project |
| SEA | Significant Ecological Areas |
| SSO | Sanitary Sewer Overflows |
| SWPPP | Storm Water Pollution Prevention Plan |
| SWRCB | State Water Resources Control Board |
| TMDL | Total Maximum Daily Load |
| UAA | Use Attainability Analysis |
| USEPA | United States Environmental Protection Agency |
| WDR | Waste Discharge Requirement |
| WLA | Waste Load Allocation |
| WRP | Water Reclamation Plant |

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# 1 INTRODUCTION

The Los Angeles River is unlike any other river. The natural waterway, so greatly altered that it is now sometimes maligned as mere "concrete ditch", has an important past, present and future. The river is the nearest natural waterbody for many millions of people and the namesake river for the City and County of Los Angeles. Because the mainstem of 55 miles is mostly concrete -and much of the principal tributaries, are concrete- many may see the Los Angeles River only as a flood control channel. And while that use is important, so much more can be, and is, expected from the Los Angeles River. In addition to the beneficial uses identified, below, the River's potential, as identified in the Los Angeles River Revitalization Master Plan (City of Los Angeles, 2007), Los Angeles River Master Plan (County of Los Angeles, 1996), as required by the Clean Water Act and Porter Cologne Water Quality Control Act, and as detailed in this and other TMDLs is such that all parties are compelled to take aggressive action to protect and restore this river.

This Staff Report documents the development of a Total Maximum Daily Load (TMDL) to address impairments of water quality standards for bacteria in the Los Angeles River Watershed (see Figure 1-1). The Staff Report describes the water bodies and their beneficial uses, bacteria objectives for supporting the beneficial uses, water quality data documenting impairments, sources of bacteria and their linkage to water quality, waste load and load allocations, and sets forth an implementation plan to attain water quality standards.

This TMDL and Staff Report are based on the original work conducted by the "Cleaner Rivers through Effective Stakeholder-led TMDLs" (CREST) stakeholder group, a stakeholder effort initiated by the City of Los Angeles for the purpose of developing TMDLs to restore and protect water quality in the Los Angeles River. CREST conducted a groundbreaking study of the dry weather storm drain system inputs to the Los Angeles River referred to in these documents as the "Bacteria Source Identification" study (BSI study). This study sampled every storm drain in selected reaches of the Los Angeles River and documented the bacterial inputs and variability from urban areas in the most complete fashion to date. With stakeholders, the City of Los Angeles's CREST team established reference conditions for dry and wet weather and developed a detailed dry weather implementation plan with a schedule and estimates of costs. CREST held many stakeholder meetings and workshops and wrote a technical report with sections that parallel the TMDL sections upon which most of this staff report depends.

This TMDL considers the entire mainstem of the Los Angeles River from above Sepulveda Basin to the estuary and the tributaries including Bell Creek, Tujunga Wash below Hansen Dam, Verdugo Wash, Arroyo Seco, Rio Hondo, Compton Creek, Bull Creek and Burbank Western Channel.

**Figure 1-1 Map of the Los Angeles River Watershed**

## 1.1 Regulatory Background

The State of California's principal water quality law is the Porter-Cologne Water Quality Control Act (Porter-Cologne Act). The Porter-Cologne Act is implemented in the Los Angeles Region (i.e., Los Angeles and Ventura Counties) by the California Water Quality Control Plan, Los Angeles Region (Basin Plan). The Basin Plan sets water quality standards for the Los Angeles Region, which includes beneficial uses for surface and ground water with numeric and narrative objectives necessary to support those uses, and the state's antidegradation policy. The Basin Plan also describes implementation programs to protect all waters in the region. The Basin Plan lists numeric water quality objectives for indicator bacteria in fresh waters, which apply to the Los Angeles River and its tributaries. These plans are required to comply with the federal Clean Water Act (CWA). Section 303(d)(1)(A) of the CWA requires each state to conduct a biennial assessment of its waters, and identify those waters that are not achieving water quality standards. The resulting list is referred to as the 303(d) list (LARWQCB, 2006b; 2003a). The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and to develop and implement TMDLs for these waters (40 CFR §130.7).

A TMDL is defined as the "sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR §130.2) such that the capacity of the water body to assimilate pollutant loads (the loading capacity) is not exceeded. The elements of a TMDL are described in Code of Federal Regulations, title 40, section 130.2 and section 130.7 (40 CFR §130.2 and §130.7) and Section 303(d) of the CWA, as well as in United States Environmental Protection Agency (USEPA) guidance (USEPA, 1991). TMDLs must take into account seasonal variations and include a margin of safety to address uncertainty in the analysis (40 CFR §130.7(c)(1)). A TMDL allocates pollutant loadings to point and nonpoint sources. Finally, TMDLs must be included or referenced in States' water quality management plans (40 CFR §130.6 (c)(1)).

The USEPA has oversight authority for the 303(d) program and is required to review and either approve or reject the State's 303(d) list and each TMDL developed by the state. If the State fails to develop a TMDL in a timely manner or if the USEPA disapproves a TMDL submitted by a state, EPA is required to establish a TMDL for that water body (40 CFR §130.7(d)(2)).

As part of its 1996 and 1998 regional water quality assessments, the Regional Board identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWQCB, 1996, 1998b). A 13-year schedule for development of TMDLs in the Los Angeles Region was established in a consent decree (*Heal the Bay Inc., et al. v. Browner, et al.* C 98-4825 SBA) approved on March 22, 1999. For the purpose of scheduling TMDL development, the consent decree combined the over 700 waterbody-pollutant combinations into 92 TMDL analytical units. Analytical unit 15 consists of segments of the Los Angeles River and tributaries with impairments related to coliform bacteria.

Bacterial water quality standards protect human health. Monitoring of all potential waterborne pathogens is infeasible, therefore fecal indicator bacteria are used to predict the presence of pathogens and/or fecal sources. Epidemiological studies have been used to develop recreational water quality criteria given an accepted health risk. Recreational water quality criteria are currently based on epidemiological studies that simultaneously measured densities of fecal indicator bacteria (***E. coli***, fecal coliform, total coliform, and/or Enterococcus) and rates of highly-credible gastrointestinal illness and other adverse health effects in swimmers (Cabelli ***et al.***, 1981; Dufour, 1984; Haile ***et al.***, 1999).

Since the 1950s, numerous epidemiological studies have been conducted around the world to investigate the possible links between swimming in fecal-contaminated waters and health risks. However, as shown in several large-scale epidemiological studies of recreational waters, other health outcomes such as skin rashes, respiratory ailments, and eye and ear infections are also associated with swimming in fecal-contaminated water. Many of these studies have been conducted in areas of known human sewage contamination; others have been conducted in areas where the sources of fecal contamination were unknown. A Santa Monica Bay study (Haile et al., 1999) found swimming in urban runoff-contaminated waters resulted in an increased risk of chills, ear discharge, vomiting, coughing with phlegm and significant respiratory diseases. These studies demonstrate that there is a causal relationship between illness and recreational water quality, as measured by fecal indicator bacteria densities.

Los Angeles Regional Water Quality Control Board Staff (Regional Board Staff) proposes to use the reference system, antidegradation approach for this TMDL. The reference system/antidegradation approach recognizes the fact that there are natural sources of bacteria that may cause or contribute to exceedances of bacteria water quality standards as allowed by the Region's implementation for the REC-1 bacteria objectives. This approach allows a certain number of days when the single sample bacteria objectives may be exceeded. The number is based on historic exceedance levels at local reference sites.

In essence, the reference system approach recognizes natural sources and focuses this TMDL to set waste load allocations and load allocations such that anthropogenic sources of bacteria do not cause or contribute to exceedances of bacteria water quality standards.

The reference system approach ensures water quality comparable to that of reference systems while being consistent with state and federal antidegradation policies. This is accomplished by requiring that, if current water quality is better than that of the reference system, then no degradation of existing water quality is permitted.

## 1.2 Environmental Setting

The Los Angeles River Watershed has a varied terrain consisting of mountains, low lying foothills, valleys and coastal plains. The area is bounded on the north by the Santa Susanna and San Gabriel Mountains whose hillside slopes exceed 68% and stream gradients range up to 3,000 feet per mile (57%). From the outwash fans at the northern edge of this alluvial plain to the top of the higher peaks there is a difference in elevation of as much as 4,500 feet (County of Los Angeles, 1996).

Due to major flood events at the beginning of the century, most of the Los Angeles River Watershed was lined with concrete between the 1940s to 1950s. The sections lined with concrete include: Arroyo Calabasas from Valley Circle to Los Angeles River, Bell Creek form Highlander Rd. to Los Angeles River, Caballero Creek, Browns Creek, Aliso Canyon Wash, Bull Creek from San Fernando Rd. to the beginning of the Sepulveda Basin, Tujunga Wash from Hansen Dam to Los Angeles River, Pacoima Wash from Lopez Dam to Los Angeles River, Burbank Western Channel, Verdugo Wash and tributaries, Arroyo Seco from Devils Gate Dam to Los Angeles River, Rio Hondo and tributaries (Alhambra Wash, Rubio Wash, Eaton Wash, Arcadia Wash, Santa Anita Wash, Sawpit Wash), and most of Compton Creek (LARWQCB, 1998a). Only three sections of main channel remain soft-bottom. These sections include the Sepulveda Basin, Glendale Narrows, and the lower reaches of the main channel from Willow Street to the estuary, though this portion still retain concrete-lined sides.

### 1.2.1 Reach Definition

The Los Angeles River flows for 55 miles from the Santa Monica Mountains at the western end of the San Fernando Valley to the Long Beach Harbor and into the Pacific Ocean. The entire watershed includes a total stream length of 837.62 miles and 4.6 square miles of lake area, based on the Regional Board GIS Database (see Figure 1-2 for the detailed reach map).

The headwaters of the Los Angeles River are located in the Santa Monica Mountains at the confluence of Arroyo Calabasas and Bell Creek (LARWQCB, 1998a). From this point the river flows east to the Sepulveda Flood Control Basin at Balboa Blvd and is designated as Los Angeles River Reach 6. Tributaries in this reach include Browns Canyon, Aliso Canyon Wash, and Bull Creek, which drains the Santa Susanna Mountains.

Reach 5 of the Los Angeles River runs from Balboa Blvd through Sepulveda Flood Control Basin to the Sepulveda Dam. The Basin remains one of the few “soft-bottom” portions of the main channel. The Basin is a 2,150-acre open space designed to collect floodwaters during major storms. Because the area is periodically inundated, it remains in natural or semi-natural conditions and supports a variety of low-intensity uses. The U.S. Army Corps of Engineers owns the entire basin and leases most of the area to the City of Los Angeles Department of Recreation and Parks, which has developed a multi-use recreational area that includes a golf course, playing fields, hiking trails and bicycle paths. The Corps has undertaken a riverside re-vegetation program here, and wind-blown seeds have taken root in the river bed sediments and along the stone and mortar banks (LARWQCB, 1998a). The D.C. Tillman Water Reclamation Plant discharges tertiary treated effluent to this section of the watershed.

Reach 4 of the Los Angeles River runs from the Sepulveda Dam to Riverside Drive. Pacoima Wash and Tujunga Wash are the two main tributaries to this reach. Both tributaries drain portions of the Angeles National Forest in the San Gabriel Mountains. Some of the discharge from Hansen Dam is diverted to spreading grounds for groundwater recharge, but most of the flow enters the channelized portion of the stream.

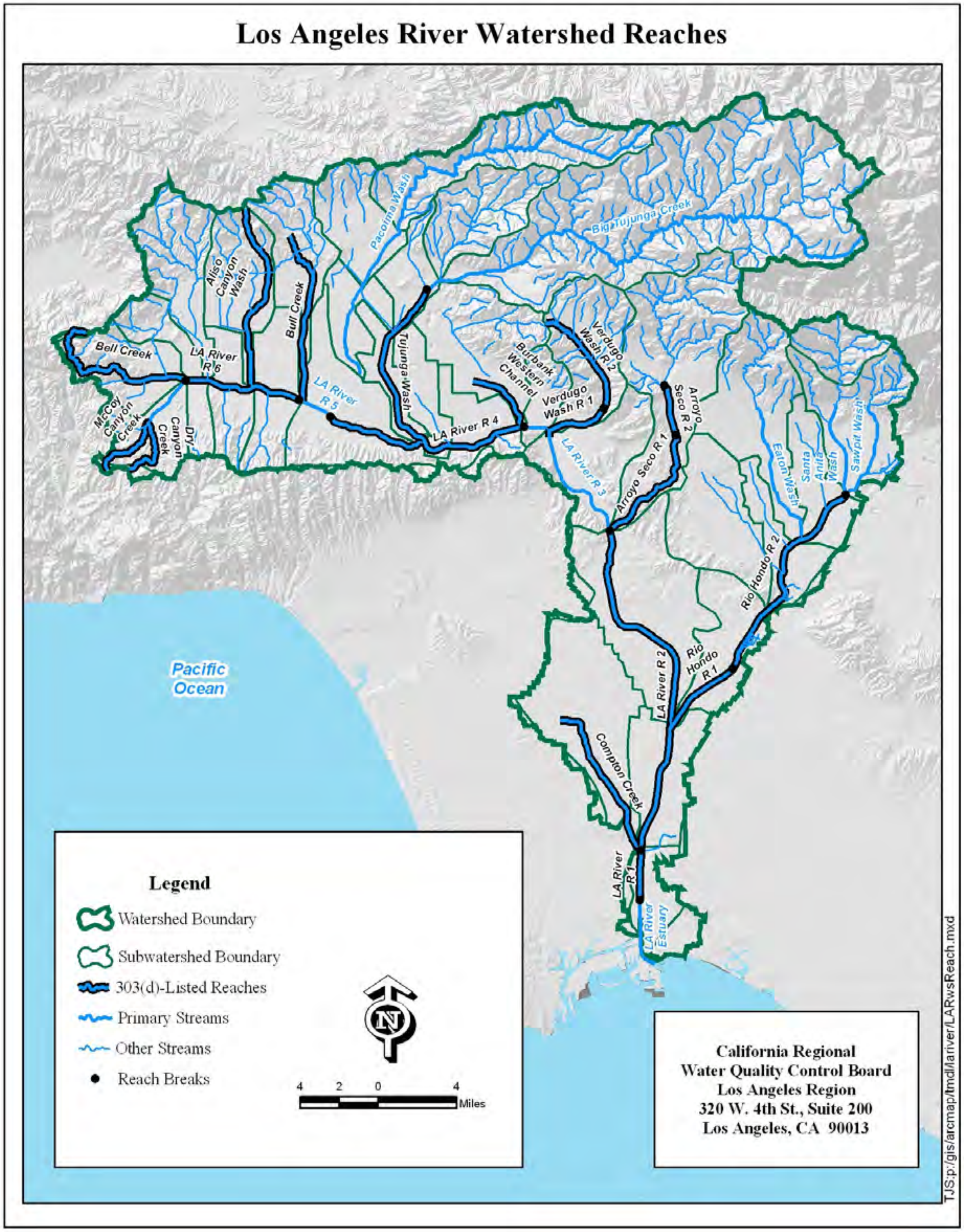
Reach 3 of the Los Angeles River runs from Riverside Drive to Figueroa Street. The two major tributaries to this reach are the Burbank Western Channel and Verdugo Wash, which drains the Verdugo Mountains. Both tributaries are channelized. The Burbank Western Channel receives flow from the Burbank Water Reclamation Plant.

From the eastern end of the San Fernando Valley, the Los Angeles River flows through Griffith Park and Elysian Park, an area known as the Glendale Narrows. This area is fed by natural springs during periods of high groundwater. The river bottom in this area is unlined because historically groundwater routinely discharges into the channel, in varying volumes depending on the height of the water table, maintaining year-long flow at the downstream end of the river. The Los Angeles-Glendale Water Reclamation Plant discharges to the Los Angeles River in the Glendale Narrows.

Reach 2 of the Los Angeles River runs from Figueroa Street to Carson Street. Arroyo Seco is just below Glendale Narrows, which drains areas of Pasadena and portions of the Angeles National Forest in the San Gabriel Mountains. The Rio Hondo and its tributaries drain a large area in the eastern portion of the watershed. At Whittier Narrows, flow from the Rio Hondo can be diverted to the Rio Hondo Spreading Grounds. During dry weather, virtually all the water in the Rio Hondo goes to groundwater recharge, so little or no flow exits the spreading grounds to Reach 1 of the Rio Hondo. During storm events, Rio Hondo flow that is not used for spreading, reaches the Los Angeles River.

Reach 1 of the Los Angeles River, runs from Carson Street to the estuary at Willow St. Major tributaries include Compton Creek. The Los Angeles River Estuary begins at Willow St. where the tidal-influenced portion of the River begins and runs approximately three miles before joining with Queensway Bay located between the Port of Long Beach and the City of Long Beach. In this reach, the channel has a soft bottom with concrete-lined sides. Sandbars accumulate in the portion of the river where tidal influence is limited.

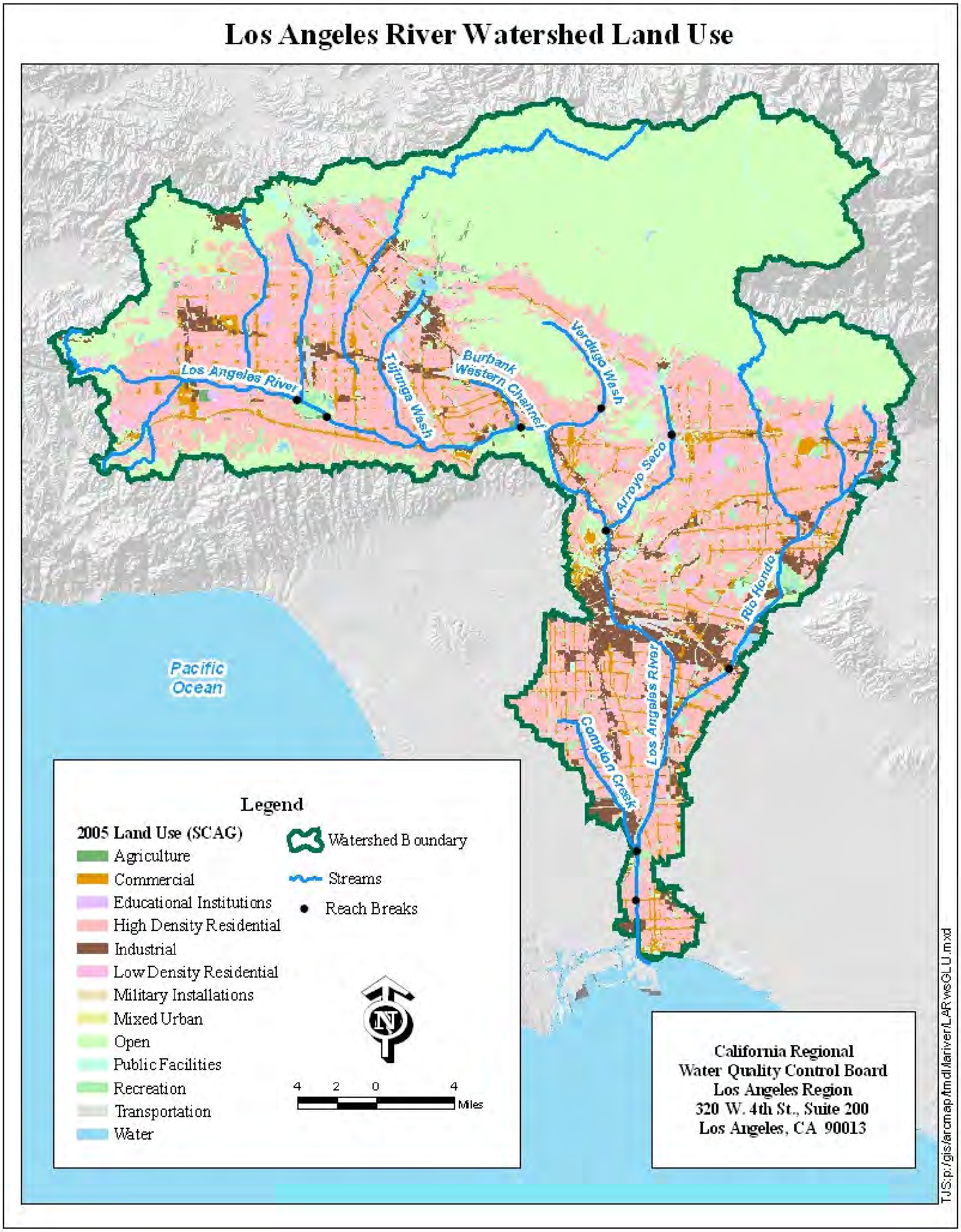
**Figure 1-2 Los Angeles River Reach Map**



### 1.2.2 Land Use

The watershed consists of an area of 834 square miles. The foothill and mountainous portions of the Los Angeles River Watershed comprise 363 square miles or about 43 percent of the watershed, and of this area, 272 square miles are within the boundary of the Angeles National Forest (County of Los Angeles, 1996). Approximately 44% of the watershed area can be classified as forest or open space. These areas are primarily within the headwaters of the Los Angeles River in the Santa Monica, Santa Susana, and San Gabriel Mountains, including the Angeles National Forest. Approximately 36% of the land use can be categorized as residential, 10% as industrial, 8% as commercial, and 3% as agriculture, water and other (see Figure 1-3). The more urban uses are found in the lower portions of the watershed.

**Figure 1-3 Los Angeles River Watershed Land Use Map**



### 1.2.3 Climate/Rainfall

The Los Angeles watershed has a mild, Mediterranean climate, which is characterized by hot dry summers and cool wet winters. Long-term annual rainfall averages vary from 12.2 inches along the coast, 15.5 inches in downtown Los Angeles, to 27.5 inches in the mountains. The maximum-recorded 24-hour rainfall in the Region was 34 inches in the mountains and 9 inches on the coastal plain (Leadership Committee, 2006).

The City's mean monthly high temperature is 74.1 degrees Fahrenheit with a yearly average of 329 days of sunshine.

### 1.2.4 Watershed Habitat

Twenty-five different types of habitat in the Los Angeles River watershed were identified by the Natural History Museum of Los Angeles County (LARWQCB, 1998a).

Based on information from the National Wetland Inventory and the Southern California Mapping Project, Regional Board staff has determined that the Los Angeles River Watershed contains approximately 19.82 square miles of wetland habitat or roughly12,685 acres.

A number of fish species have recently been documented in the Los Angeles River including green sunfish (*Lepomis cyanellus*), tilapia (*Oreochromis sp*), black bullhead (*Ameiurus melas*), Amazon sailfish catfish (*Pterygoplichthys pardalis*), carp (*Cyprinue carpio*), fathead minnow (*Pimephales promelas*) and mosquitofish (*Gambusia affinis*) (FOLAR, 2008). Steelhead trout (*Oncorhynchus mykiss*), were found in the River, historically, but the last steelhead caught in the river was in the 1940s.

The river also supports a number of bird species, including sandpipers, plovers, great blue heron, green heron snowy egret, american coot, black-necked stilt, mallard, cinnamon teal, peregrine falcon and white-tailed kite. The River is an important part of the Pacific Flyway.

#### 1.2.4.1 Special Habitat Areas

Currently there are no areas within the Los Angeles River Watershed listed in California State Water Resources Control Board (State Board), "Areas of Special Biological Significance," or listed by the California Coastal Commission as a Critical Coastal Area.

In 2003, the Coastal Commission designated the Santa Monica Mountains as an Environmentally Sensitive Habitat Area (ESHA) (Dixon, 2003). In addition, the County of Los Angeles has dedicated Significant Ecological Areas throughout the Greater Los Angeles County Region. The Greater Los Angeles County Integrated Regional Water Management Plan includes the following discussion of

Significant Ecological Areas in Los Angeles County (Leadership Committee, 2006).

> Significant Ecological Areas (SEAs) are ecologically important areas that are designated by the County of Los Angeles as having valuable plant or animal communities. Similar to the SEAs are Environmentally Sensitive Habitat Areas which are designated by the Coastal Commission via local coastal programs.

There are a total of 11 designated SEAs in the Los Angeles River watershed. Below is a figure illustrating the location of all the SEAs in the Los Angeles River Watershed.

**Figure 1-4 Map of Significant Ecological Areas in the Los Angeles River Watershed**


1.2.4.2 Threatened and Endangered Species

The Federal Endangered Species Act of 1973 (FESA) defines a threatened species as one that is likely to become endangered within the foreseeable future and an endangered species is defined as one that is considered in danger of becoming extinct throughout all or a significant portion of its range (17USC §1531–§1544). FESA does not include a formal definition for species of concern, also known as 'at-risk' species, however the United States Fish and Wildlife Service maintains a list for these species. Species of concern is typically defined as species that are declining or appear to be in need of conservation. Rare species are defined as species "…existing in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment worsens …" or…"the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and may be considered "threatened" as that term is used in the Federal Endangered Species Act"

The City of Los Angeles Optimization Study lists 8 bird species, 1 amphibian species, 1 fish species, 3 insect species and 2 plant species as endangered, threatened, rare species or as species of concern in the Los Angeles River watershed (City of Los Angeles, 2003).

# 2 Problem Identification

The Los Angeles River is highly contaminated by fecal pollution. Many reaches and tributaries exceed the bacterial water quality standards 80 or 90 or even 100% of the time, that is, most or all of the time. The reaches or tributaries with better water quality exceed the indicator bacteria water quality standards roughly 50% of the time. This severely limits the potential for recreational uses of the river.

Bacterial concentrations in the Los Angeles River and tributaries exceed water quality standards during both dry and wet weather.

## 2.1 CWA Section 303(d) Listed reaches and tributaries

At least 127 miles of Los Angeles River mainstem or tributaries have been included on the State of California's CWA Section 303(d) list as impaired for indicator bacteria.

**Table 2-1 Miles of Los Angeles River and Tributaries Listed for coliform or fecal coliform Bacteria**

| Waterbody Segments Listed | Miles Affected |
|---|---|
| Los Angeles River Reach 1(from the estuary to Carson St.)[1] | 2 |
| Los Angeles River Reach 2 (from Carson St. to Figueroa St.)[1] | 19 |
| Los Angeles River Reach 4 (from Sepulveda Dam to Sepulveda Dr.)[1] | 12 |
| Los Angeles River Reach 6 (above Sepulveda Flood Control Basin)[1] | 6 |
| Aliso Canyon Wash[3] | 10 |
| Arroyo Seco Reach 1 (LA River to West Holly Ave)[1] | 7 |
| Arroyo Seco Reach 2 (Figueroa St. To Riverside Dr.)[1] | 3 |
| Bell Creek[1] | 10 |
| Bull Creek[4] | 2 |
| Burbank Western Channel[4] | 13 |
| Compton Creek[1] | 9 |
| Dry Canyon Creek[2] | 4 |
| McCoy Canyon Creek[2] | 4 |
| Rio Hondo Reach 1 (from the Santa Ana Fwy to LA River)[1] | 4 |
| Rio Hondo Reach 2 (at spreading grounds)[1] | 3 |
| Tujunga Wash (from Hansen Dam to LA River)[1] | 10 |
| Verdugo Wash Reach 1 (from LA River to Verdugo Rd)[1] | 3 |
| Verdugo Wash Reach 2 (above Verdugo Rd)[1] | 6 |
| Total miles affected | 127 |

[1]First listed on the 1998 303(d) and reference Consent Decree thereafter
[2]First listed on the 2002 303(d)
[3]First listed on the 2006 303(d)
[4]Listed in the Regional Board Approved 2008 303(d) List

### 2.1.1 Beneficial Uses

The Basin Plan for the Los Angeles Region (1994) defines 14 beneficial uses for the Los Angeles River and its tributaries. These uses are summarized in Table 2-2. The Basin Plan identifies beneficial uses as existing (E), potential (P), or intermittent (I) uses.

Existing use designations for warm freshwater, wildlife, wetland, and rare, threatened or endangered species habitats (WARM, WILD, WET, and RARE) apply over much of the mainstem and Compton Creek in the lower part of the watershed. The WARM designation applies as either an intermittent or potential use to the remaining listed tributaries. The WILD designation is for the protection of fish and wildlife. This use applies to much of the mainstem of the Los Angeles River, as an intermittent use in Rio Hondo, and as potential use in the remainder of the tributaries. Water quality objectives developed for the protection of fish and wildlife are applicable to the reaches with the WARM, WILD, WET and RARE designations.

The Shellfish Harvesting use designation (SHELL) is for waters that support habitats suitable for the collection of shellfish for human consumption, commercial or sports purposes. This use applies as an existing use in the estuary and as a potential use in the lower portion of the River.

**Table 2-2 Beneficial Uses in Listed Reaches of the Los Angeles River**

| STREAM REACH | MUN | GWR | REC1 | REC2 | WILD | WARM | SHELL | RARE | MIGR | SPWN | WET | MAR | IND | PROC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles River (Reach 6) | P* | E | E | E | E | E | | | | | E | | P | |
| Aliso Canyon Wash | P* | I | I[1] | I | E | I | | | | | | | | |
| Bell Creek | P* | I | I[1] | I | E | I | | | | | | | | |
| Bull Creek | P* | I | I[1] | I | E | I | | | | | | | | |
| Dry Canyon Creek | P* | I | I[1] | I | E | I | | | | | | | | |
| McCoy Canyon Creek | P* | I | I | I | E | I | | | | | | | | |
| Los Angeles River (Reach 4) | P* | E | E | E | E | E | | | | | E | | P | |
| Tujunga Wash | P* | I | P[1] | I | P | P | | | | | | | | |
| Verdugo Wash Reach 1 | P* | I | I[1] | I | P | P | | | | | | | I | I |
| Verdugo Wash Reach 2 | P* | I | I[1] | I | P | P | | | | | | | I | I |
| Burbank Western Channel | P* | | P[1] | I | P | P | | | | | | | | |
| Los Angeles River (Reach 2) | P* | E | E1 | E | P | E | | | | | | | P | |
| Arroyo Seco (Reach 1) | E | E | E | E | E | | | | | | E | | E | E |
| Arroyo Seco (Reach 2) | E | E | E | E | E | | | | | | E | | E | E |
| Rio Hondo (Reach 1) | P* | I | P[1] | E | I | P | | | | | | | | |
| Rio Hondo (Reach 2) | P* | I | P[1] | E | I | P | | | | | | | | |
| Compton Creek | P* | E | E[1] | E | E | E | | | | | E | | | |
| Los Angeles River (Reach 1) | P* | E | E[1] | E | E | E | P[1] | E | P | P | | E | P | P |

(LARWQCB, 1994)

*Municipal designations marked with an asterisk are conditional.
E: Existing beneficial use,
P: Potential beneficial use,
I: Intermittent beneficial use,
[1]: Use restricted by LACDPW in concrete channelized areas

All of the Los Angeles River and its tributaries including all of the Section 303(d) listed waterways have designated recreational beneficial uses which are listed in Table 2-3. While access is prohibited to much of the Los Angeles River and the concrete-channelized areas of Tujunga, Verdugo, Burbank Western Channel, Arroyo Seco, and Rio Hondo, some human use of these reaches does or may exist and the beneficial use is applicable.

**Table 2-3 Recreational Uses in Listed Reaches of the Los Angeles River watershed**

| Stream Reach | REC-1 | REC-2 |
|---|---|---|
| Los Angeles River (Reach 6) | E | E |
| Aliso Canyon Wash | I[1] | I |
| Bell Creek | I[1] | I |
| Bull Creek | I[1] | I |
| Dry Canyon Creek | I[1] | I |
| McCoy Canyon Creek | I | I |
| Los Angeles River (Reach 4) | E | E |
| Tujunga Wash | P[1] | I |
| Verdugo Wash Reach 1 | I[1] | I |
| Verdugo Wash Reach 2 | I[1] | I |
| Burbank Western Channel | P[1] | I |
| Los Angeles River (Reach 2) | E[1] | E |
| Arroyo Seco (Reach 1) | E | E |
| Arroyo Seco (Reach 2) | E | E |
| Rio Hondo (Reach 1) | P[1] | E |
| Rio Hondo (Reach 2) | P[1] | E |
| Compton Creek | E[1] | E |
| Los Angeles River (Reach 1) | E[1] | E |

E: Existing beneficial use
P: Potential beneficial use,
I: Intermittent beneficial use,
[1]: Access may be restricted in part by LACDPW

## 2.2 Water Quality Objectives

The Basin Plan contains bacteria water quality objectives to protect the REC-1 and REC-2 beneficial uses. The objectives include geometric mean limits and single sample bacteria indicator limits for fresh waters: including fecal coliform and *E. coli*.

1. Geometric Mean Limits
    a. *E. coli* density shall not exceed 126/100 mL.
    b. Fecal coliform density shall not exceed 200/100 mL.

2. Single Sample Limits
    a. *E. coli* density shall not exceed 235/100 mL.
    b. Fecal coliform density shall not exceed 400/100 mL.

Regional Board staff is in the process of updating the bacteria objectives for freshwaters designated as REC-1 to remove redundancy and maintain consistency with U.S. EPA's recommended criteria. The update of bacteria objectives will remove the fecal coliform objectives and use *E. coli* objectives as the sole objective for freshwaters. To be consistent with the update of bacteria objectives, the numeric targets will be only the adopted Basin Plan objectives for *E. coli* for REC-1 in freshwaters.

Single sample bacteria exceedances are used to determine impairments. Geometric mean limits are also used to determine impairments. Protecting REC-1 beneficial uses will result in the protection of REC-2 beneficial uses because REC-1 bacteria objectives are more stringent than REC-2 bacteria objectives.

Implementation provisions for the water contact recreation bacteria objectives, defined in the Basin Plan Resolution 2001-018, are listed below (LARWQCB, 2001).

> The geometric mean values should be calculated based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period).
>
> If any of the single sample limits are exceeded, the Regional Board may require repeat sampling on a daily basis until the sample falls below the single sample limit or for five days, which ever is less, in order to determine the persistence of the exceedance.
>
> When repeat sampling is required because of an exceedance of any one single sample limit, values from all samples collected during that 30-day period will be used to calculate the geometric mean.

Implementation provisions for the water contact recreation bacteria objectives, defined in the Basin Plan Resolution 2002-22 are listed below (LARWQCB, 2001).

> The single sample bacteriological objectives shall be strictly applied except when provided for in a Total Maximum Daily Load (TMDL). In all circumstances, including in the context of a TMDL, the geometric mean objectives shall be strictly applied. In the context of a TMDL, the Regional Board may implement the single sample objectives in fresh and marine waters by using a 'reference system/antidegradation approach' or

‘natural sources exclusion’ approach subject to the antidegradation policies as discussed below. A reference system is defined as an area and associated monitoring point that is not impacted by human activities that potentially affect bacteria densities in the receiving water body.

These approaches recognize that there are natural sources of bacteria, which may cause or contribute to exceedances of the single sample objectives for bacterial indicators. They also acknowledge that it is not the intent of the Regional Board to require treatment or diversion of natural water bodies or to require treatment of natural sources of bacteria from undeveloped areas. Such requirements, if imposed by the Regional Board, could adversely affect valuable aquatic life and wildlife beneficial uses supported by natural water bodies in the Region.

Under the reference system/antidegradation implementation procedure, a certain frequency of exceedance of the single sample objectives shall be permitted on the basis of the observed exceedance frequency in the selected reference system(s) or the targeted water body. The reference system/antidegradation approach ensures that bacteriological water quality is at least as good as that of a reference system and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of the selected reference system(s).

Under the natural sources exclusion implementation procedure, after all anthropogenic sources of bacteria have been controlled such that they do not cause or contribute to an exceedance of the single sample objectives and natural sources have been identified and quantified, a certain frequency of exceedance of the single sample objectives shall be permitted based on the residual exceedance frequency in the specific water body. The residual exceedance frequency shall define the background level of exceedance due to natural sources. The ‘natural sources exclusion approach subject to the antidegradation policies may be used if an appropriate reference system cannot be identified due to unique characteristics of the target water body. These approaches are consistent with the State Antidegradation Policy (State Board Resolution No. 68-16) and with federal antidegradation requirements (40 CFR 131.12).”

### 2.2.1 Antidegradation

Both the State of California and the federal government have antidegradation policies for water quality. The State policy is formally referred to as the “Statement of Policy with Respect to Maintaining High Quality Waters in California” (State Board Resolution No. 68-16). This policy restricts degradation of surface or ground waters and protects water bodies where existing quality is higher than is necessary for the protection of beneficial uses. The federal Antidegradation Policy (40 CFR §131.12) was developed under the

Clean Water Act. This TMDL complies with antidegradation policies by requiring water quality adequate to support beneficial uses and by not setting any waste load allocations and load allocations above existing numbers of exceedance days.

## 2.3 Review of data

The majority of the available bacteria data were collected as part of the City of Los Angeles' Status and Trends monitoring program in the Los Angeles River Watershed. In addition to this data set, receiving water data collected as part of the Monitoring and Reporting Programs for the City of Los Angeles' LA-Glendale and D.C. Tillman Water Reclamation Plants and the Burbank Water Reclamation Plant were also analyzed as well as data from the mass emission and tributary instream monitoring stations under the Monitoring and Reporting Program of the County of Los Angeles' Municipal Separate Storm Sewer System Permit. The data that were analyzed covered the period from November 1997 to February 2008.

The data are expressed in terms of exceedance days of the Basin Plan REC-1 water quality objectives. Exceedance days are days on which sample bacteria densities exceed bacteria water quality objectives for the REC-1 beneficial use.

The data are further separated into wet and dry weather and summer and winter seasons for single sample limits. Summer months cover the months of April through October. Winter months cover the months of November through March. Wet weather days are defined as those days that experience 0.1 inch of rain or more and the three following days (LARWQCB, 2002b).

The Basin Plan implementation provisions for the bacteria objectives do not differentiate between wet and dry weather when applying the geometric mean objectives. As a result, dry and wet weather exceedances were not separately tallied for geometric means.

The calculation of the rolling 30-day geometric mean requires a statistically sufficient number of samples (generally, at least five equally spaced samples) (LARWQCB, 2001).

These data are summarized in terms of exceedance percentages, which are calculated as the sample exceedance count divided by the sample count. The exceedance count and sample count are also listed next to the exceedance percentage in parentheses (see Table 2-4). Newer data was not readily available for Rio Hondo Reach 2 and was not included in Table 2-4. Older data which includes 61 samples for coliform bacteria ranged for non-detect to 91,000 MPN/100 mL.

### Table 2-4 Los Angeles River Watershed Bacteria Exceedances

| | | Los Angeles River Reach 1 | Los Angeles River Reach 2 | Los Angeles River Reach 4 | Los Angeles River Reach 6 |
|---|---|---|---|---|---|
| | | November 1997 - February 2008 | January 2001 - February 2008 | October 1998 - February 2008 | October 1998 - February 2008 |
| | | Exceedance % | Exceedance % | Exceedance % | Exceedance % |
| Single Sample | Fecal Coliform | 86.2% (50/58) | 80.0% (4/5) | 58.1% (209/360) | 75.5% (542/718) |
| | *E. coli* | 83.1% (226/272) | 81.9% (443/541) | 52.8% (267/506) | 88.6% (304/343) |
| | Exceedance Days | 84.4% (276/327) | 82.3% (445/541) | 55.0% (476/866) | 79.7% (846/1061) |
| | Dry weather | 79.4% (189/238) | 79.3% (345/435) | 47.9% (373/779) | 78.3% (717/916) |
| | Wet weather | 91.6% (87/95) | 88.5% (100/113) | 72.0% (103/143) | 88.4% (129/146) |
| | Summer | 77.0% (134/174) | 79.2% (244/313) | 57.4% (290/505) | 84.0% (524/624) |
| | Winter | 89.3% (142/159) | 87.7% (201/229) | 51.2% (186/363) | 73.5% (322/438) |
| Geometric Means | Fecal Coliform | 100.0% (11/11) | N/A | 95.5% (592/620) | 98.7% 1233/1249) |
| | *E. coli* | 100.0% (22/22) | 100.0% (59/59) | 100.0% (71/71) | 100.0% (35/35) |
| | Exceedance Days | 100.0% (33/33) | 100.0% (59/59) | 95.9% (663/691) | 98.8% (1268/1284) |
| | Summer | 100.0% (3/3) | 100.0% (6/6) | 99.8% (432/433) | 99.5% (849/853) |
| | Winter | 100.0% (30/30) | 100.0% (53/53) | 88.8% (231/260) | 97.2% (419/431) |

| | | Aliso Canyon | Arroyo Seco Reach 1 | Bull Creek | Burbank Western Channel |
|---|---|---|---|---|---|
| | | January 2002 - February 2008 | January 2002 - February 2008 | January 2002 - February 2008 | January 2002 - February 2008 |
| | | Exceedance % | Exceedance % | Exceedance % | Exceedance % |
| Single Sample | Fecal Coliform | 80.0% (4/5) | 100.0% (10/10) | 100.0% (10/10) | 87.5% (14/16) |
| | *E. coli* | 91.5% (65/71) | 69.5% (66/95) | 64.6% (51/79) | 53.3% (48/90) |
| | Exceedance Days | 86.8% (66/76) | 72.5% (74/102) | 67.4% (58/86) | 57.3% (59/103) |
| | Dry weather | 86.2% (56/65) | 73.0% (65/89) | 65.3% (47/72) | 58.7% (54/92) |
| | Wet weather | 90.9% (10/11) | 69.2% (9/13) | 78.6% (11/14) | 45.5% (5/11) |
| | Summer | 86.0% (37/43) | 76.9% (50/65) | 77.6% (38/49) | 67.9% (38/56) |
| | Winter | 87.8% (29/33) | 64.9% (24/37) | 54.1% (20/37) | 44.7% (21/47) |
| Geometric Means | Fecal Coliform | N/A | N/A | N/A | N/A |
| | *E. coli* | N/A | 100.0% (64/64) | N/A | N/A |
| | Exceedance Days | N/A | 100.0% (64/64) | N/A | N/A |
| | Summer | N/A | 100.0% (64/64) | N/A | N/A |
| | Winter | N/A | N/A | N/A | N/A |

| | | Compton Creek | Rio Hondo Reach 1 | Tujunga Wash | Verdugo Wash Reach 1 |
|---|---|---|---|---|---|
| | | January 2002 - February 2008 | January 2002 - February 2008 | January 2002 - February 2007 | January 2002 - February 2007 |
| | | Exceedance % | Exceedance % | Exceedance % | Exceedance % |
| Single Sample | Fecal Coliform | 87.5% (14/16) | 90.9% (10/11) | 100.0% (4/4) | 100.0% (4/4) |
| | *E. coli* | 53.3% (48/90) | 69.1% (56/81) | 75.7% (56/74) | 89.9% (71/79) |
| | Exceedance Days | 57.3% (59/103) | 79.0% (64/81) | 76.0% (57/75) | 92.5% (74/80) |
| | Dry weather | 58.7% (54/92) | 78.3% (54/69) | 77.6% (52/67) | 92.8% (64/69) |
| | Wet weather | 45.5% (5/11) | 83.3% (10/12) | 62.5% (5/8) | 90.9% (10/11) |
| | Summer | 90.5% (38/42) | 49.2% (38/48) | 91.1% (41/45) | 95.8% (45/47) |
| | Winter | 63.4% (21/33) | 68.8% (22/32) | 55.2% (16/29) | 87.9% (29/33) |
| Geometric Means | Fecal Coliform | N/A | N/A | N/A | N/A |
| | *E. coli* | N/A | N/A | N/A | N/A |
| | Exceedance Days | N/A | N/A | N/A | N/A |
| | Summer | N/A | N/A | N/A | N/A |
| | Winter | N/A | N/A | N/A | N/A |

*Note: Exceedance % = Exceedance Count ÷ Sample Count

# 3 Numeric Targets

The TMDL includes numeric targets based on the bacteria objectives for fresh waters designated for water contact recreation (REC-1) (LARWQCB, 2001). These objectives are consistent with those recommended by the USEPA in "Ambient Water Quality for Bacteria – 1986" (USEPA, 1986).

The Basin Plan contains bacteria water quality objectives to protect the REC-1 and REC-2 beneficial uses. The objectives include geometric mean and single sample limits for indicator bacteria including fecal coliform and *E. coli* in fresh waters.

1. Geometric Mean Limits
    - **a. *E. coli* density shall not exceed 126/100 mL.**
    - b. Fecal coliform density shall not exceed 200/100 mL.

2. Single Sample Limits
    - **a. *E. coli* density shall not exceed 235/100 mL.**
    - b. Fecal coliform density shall not exceed 400/100 mL.

Regional Board staff is in the process of updating the bacteria objectives for freshwaters designated as REC-1 to remove redundancy and maintain consistency with USEPA's recommended criteria. The update of bacteria objectives will remove the fecal coliform objectives and use *E. coli* objectives as the sole indicator bacteria objective for freshwaters. To be consistent with the update of bacteria objectives, the numeric targets for this TMDL will be only the Basin Plan objectives for *E. coli* for REC-1 in freshwaters.

## 3.1 Alternative Targets Considered

Three alternatives were considered for developing the appropriate numeric targets to achieve the water quality standards:
(1) strict application of the water quality objectives as listed in the Basin Plan with no allowable exceedance, (2) the Natural Sources Exclusion Approach, and (3) the Reference System/Antidegradation Approach with specific exceedance day frequencies. The factors considered when selecting the recommended alternative included:

- Consistency with state and federal water quality laws and policies,
- Level of beneficial use protection,
- Consistency with current science regarding water quality necessary to protect the beneficial uses, and
- Practicability for the Los Angeles River Watershed.

## 3.2 Recommended Alternative

Some of these alternatives recognize that there are natural sources of bacteria, which may cause or contribute to exceedances of the water quality objectives for bacteria indicators (Schiff *et al.*, 2005). The Regional Board acknowledges in the implementation provisions for the bacteria objectives in the Basin Plan that it is not the intention of the Regional Board to require treatment or diversion of natural water bodies or to require treatment of natural sources of bacteria from undeveloped areas.

For this TMDL, alternative (3) is the recommended alternative because this alternative allows the Regional Board to avoid imposing requirements to divert natural coastal creeks or treat natural sources of bacteria from undeveloped areas. This approach includes allowable exceedance levels during dry weather and wet weather. This approach will be explored in greater detail in latter parts of the Staff Report.

The recommended numeric targets will be assessed as the allowable number of single sample exceedance days for each site because the frequency of single sample exceedances is most relevant to public health. The USEPA allows states to select the most appropriate measure to express the TMDL. Allowable exceedance days are considered an "appropriate measure" consistent with the definition in 40 CFR §130.2(i). The number of allowable exceedance days is calculated from reference reaches while observing strict antidegradation policies. Targets will apply at compliance monitoring locations (17 CCR §7961(b)).

Alternative 1 requires strict application of the water quality objectives as listed in the Basin Plan with no allowable exceedances. This alternative is not recommended. Strict application of objectives would fail to consider natural sources of bacteria and required treatment in excess of natural water quality levels.

Alternative 2 is a natural sources exclusion approach. Based on the implementation provisions for the bacteria objectives contained in the Basin Plan, this approach requires an identification and quantification of naturally-occurring sources of bacteria. Additionally, prior to applying this implementation approach, all anthropogenic sources must be controlled such that they do not cause or contribute to exceedances of the bacteria objectives. Once quantified, natural source levels become the baseline bacteria level. The exceedances caused by natural sources are used to quantify the allowable exceedance frequency and becomes the allowable exceedance frequency. However, information sufficient to quantify all naturally-occurring sources of indicator bacteria does not exist at this time.

## 3.3 Wet Weather

Wet weather is defined as days with 0.1 inch of rain or more plus three days following the rain event. REC-1 uses associated with the "swimmable" goal as expressed in the federal Clean Water Act are suspended through the High Flow Suspension (HFS) Basin Plan Amendment (LARWQCB, 2003b), which is applied to certain reaches and tributaries that are concrete-lined channels during days with greater than or equal to 0.5

inch of rain and the following 24 hours.  Table 3-1 includes the waterbodies in the Los Angeles River Watershed that are subject to the HFS.

**Table 3-1 Los Angeles River Reaches and Tributaries High Flow Suspension (HFS)**

| Stream Reach | Hydro Unit |
|---|---|
| Los Angeles River to Estuary | 405.12 |
| Los Angeles River | 405.15 |
| Los Angeles River | 405.21 |
| Rio Hondo below Spreading Grounds | 405.15 |
| Rio Hondo to Spreading Grounds | 405.15 |
| Rio Hondo | 405.41 |
| Verdugo Wash | 405.24 |
| Burbank Western Channel | 405.21 |
| Tujunga Wash | 405.21 |

### 3.4 The Continuing Process

The science of recreational water quality is rapidly advancing. The federal BEACH Act (40 CFR 32.1) requires USEPA to conduct a *Criteria Development Plan* (R/7-097-432). Under the ongoing *Plan*, the USEPA is conducting additional epidemiological studies and quantitative microbial risk assessments (QMRAs) for fresh- and marine waters impacted by point- and nonpoint sources (Boehm *et al.*, 2009). The assays being utilized by USEPA include *Enterococcus*, *E. coli*, and *Bacteroidales*. Under a legal settlement, USEPA is committed to issuing new and/or revised criteria by October 15, 2012. The State will likely have several years to implement these new/revised criteria after promulgation by USEPA. Therefore, during the expected timeframe for implementation of this TMDL, targets, themselves, may change and this TMDL may be revised by the Regional Board through a Basin Plan Amendment, if appropriate.

## 4 Source Assessment

The challenge of identifying and quantifying potential bacteria sources in the Los Angeles River watershed is large; the watershed includes over 1,000 miles of connected storm drain infrastructure, and a population of more than 10 million people. The sources of bacteria to the Los Angeles River from the 834-square mile watershed are many and possibly include, but are not limited to, domestic pets, horses, direct human inputs all contributing to the bacteria in the urban runoff, leaks and overflows from wastewater collection systems, illicit connections, failing septic systems, and sediments.

A TMDL requires an estimate of loadings from point sources and nonpoint sources. Point sources typically include discharges from a discrete human-engineered point (e.g., a pipe from a wastewater treatment plant or industrial facility). These types of discharges are regulated through a National Pollutant Discharge Elimination System (NPDES) permit, typically issued in the form of Waste Discharge Requirements (WDRs) issued by the Regional Board. These permits along with other permits are summarized in Table 4-1. Nonpoint sources include pollutants that reach waters from a number of diffuse sources.

However, the regulatory distinction between point and nonpoint sources is blurred in the Los Angeles Region. Storm drain system discharges may have elevated levels of indicator bacteria due to sanitary sewer leaks and spills, illicit connections of sanitary lines to the storm drain system, runoff from homeless encampments, pet waste, and illegal discharges from recreational vehicle holding tanks, among others. The indicator bacteria used to assess water quality are not specific to human sewage; therefore, fecal matter from animals and birds can also be a source of elevated levels of bacteria.

A comprehensive analysis of the potential sources of bacteria and pathogens in the watershed was generated by the CREST stakeholder group (CREST Appendix A). Monitoring datasets from various agencies in the watershed were compiled and analyzed as presented in CREST Appendix A. Available information for potential bacteria and pathogen sources in the watershed for which discharges are not well characterized (e.g., industrial discharges, onsite wastewater treatment systems, etc.) were also summarized by CREST.

## 4.1 Point Sources

Many point sources to the Los Angeles River are permitted by the Regional Board.

**Table 4-1 Summary of Permits in the Los Angeles River Watershed**

| **Permit Type** | **Number of Permits** |
|---|---|
| Municipal Storm Water and Urban Runoff | 2 |
| Major NPDES Discharges | 5 |
| WRPs | 3 |
| Industrial Storm Water | 1,384 |
| Construction Storm Water | 759 |
| Industrial Waste Water | 40 |
| Minor NPDES Discharges | 15 |
| General NPDES Discharges | 113 |
| Caltrans Storm Water | 1 |

(CREST, 2009a; LARWQCB, 2007)

### 4.1.1 Municipal Storm Water

There are currently three municipal separate storm sewer system (MS4) NPDES permits that cover discharges in the Los Angeles River Watershed. These include the Los Angeles County Permittees (excluding the City of Long Beach), City of Long Beach, and Caltrans permits, which are listed in Table 4-2. The Caltrans permit is a statewide storm water permit.

**Table 4-2 MS4 Permits in the Los Angeles River Watershed**

| Permit Number | Order Number | Permittee |
|---|---|---|
| CAS004001 | 01-182 | Los Angeles County Flood Control District, Los Angeles County, and 84 incorporated cities |
| CAS004003 | 99-060 | City of Long Beach |
| CAS000003 | 99-06 DWQ | Caltrans |

The Los Angeles County MS4 permit covers roughly 96% of the total urban watershed, the City of Long Beach permit covers approximately 3%, located in the downstream portion of the river, and the Caltrans permit covers approximately 6,950 acres, which is equivalent to around 1% of the urban watershed (CREST, 2009a; LARWQCB, 2005). The City of Los Angeles has estimated that there may be more than 1,980 storm drain outfalls that discharge to segments and tributaries of the river within the City of Los Angeles along with as many as 1,735 outfalls outside of the City of Los Angeles that discharge to the segments and tributaries (CREST, 2010). Many of these outfalls only flow during wet weather.

Ackerman *et al.* found that storm drains and tributaries contribute roughly 13% of the flow discharged by point sources in the Los Angeles River in dry weather, while WRPs contribute roughly 72% of the flow discharged by point sources during dry weather. With this flow, storm drains were contributing almost 90% of the *E. coli* loading from point sources to the river in dry weather (Ackerman *et al.*, 2003). The BSI Study found that non-point, in-channel sources contributed *E. coli* loading rates equal to or greater than point source inputs along one segment. E. *coli* concentrations were found to be as much as four orders of magnitude higher in storm drain discharges than in the WRP discharges.

During dry weather, flows into storm drains consist of residential and commercial runoff from activities such as over-irrigation, car washes, pavement cleaning, etc. Though MS4 permittees are required to have programs to prevent illicit discharges and connections, bacteria loading from these sources may also contribute to loading.

The CREST development team conducted extensive outfall monitoring and sampling in Reaches 2 and 4 of the Los Angeles River mainstem. The results were summarized in the Los Angeles River Bacteria Source Identification Study (BSI) study (CREST, 2008). Flow rates varied widely as well as loading per storm drain varied widely so that some outfalls with very low flows contributed very high loads (CREST, 2009a).

During wet weather, WRP discharges may account for as little as 1% of the total flow in the river (CREST, 2009a). SCCWRP conducted a storm water urban runoff study for the greater Los Angeles area (Stein *et al.*, 2007). The study found bacteria concentrations were typically orders of magnitude higher for highly developed watersheds (i.e., Los Angeles River Watershed) compared to undeveloped watersheds (i.e., Arroyo Sequit Watershed). The study also found that agricultural, industrial, and horse recreational land uses had the highest indicator bacteria concentrations observed though all land uses had concentrations well above the water quality objectives.

While there are many sources of indicator bacteria to the MS4, the MS4 is the principal source of bacteria to the Los Angeles River in both dry weather and wet weather.

#### 4.1.2 Major NPDES Discharges

There are five major NPDES dischargers in the Region. These five dischargers include three WRPs and two other facilities. The permittee descriptions are detailed in Table 4-3.

**Table 4-3 Major Dischargers in Los Angeles River Watershed**

| Permit Number | Order Number | Permittee | Facility |
|---|---|---|---|
| CA0052949 | R4-2005-0028 | Plains West Coast Terminals | Dominguez Hills Tank Farm |
| CA0001309 | R4-2009-0058 | The Boeing Company | Santa Susana Field Lab |
| CA0056227 | R4-2010-0060 | City of Los Angeles | Donald C. Tillman Water Reclamation Plant |
| CA0053953 | R4-2006-0092 | City of Los Angeles | Los Angeles-Glendale Water Reclamation Plant |
| CA0055531 | R4-2006-0085 | City of Burbank | Burbank Water Reclamation Plant |

Plains West Coast Terminals, LLC Dominguez Hills Tank Farm has a permitted discharge of up to 4.32 mgd of hydrostatic test water, fuel equipment wash water and storm water runoff to Compton Creek. The Boeing Company Santa Susana Field Lab discharges up to 160 mgd of storm water (based on the 24-hour duration, 10-year return storm event) mixed with industrial wastewater to Bell Creek via two discharge points (LARWQCB, 2005). Neither discharger is required to monitor for bacteria in their current permit and are not known to be a significant source of bacteria to the watershed.

##### 4.1.2.1 Wastewater Reclamation Plants

There are three main Water Reclamation Plants (WRP) that discharge into the Los Angeles River and a tributary, the Burbank Western Wash. These WRPs include the Donald C. Tillman Water Reclamation Plant, Los Angeles-Glendale Water Reclamation Plant, and the Burbank Water Reclamation Plant. During dry weather, effluent discharged from these plants accounts for roughly 72% of the flow in the river (Ackerman *et al.*, 2003). During wet weather, WRPs account for less than 1% of the total flow in the river (CREST, 2009a). These WRPs have a permitted effluent limit of 2.2

MPN/100 mL for bacteria, which is well below the levels necessary to protect the REC-1 beneficial use.

The Tillman plant discharges approximately 53 million gallons per day (mgd) to the Los Angeles River. Most of the flow is discharged directly into the Los Angeles River Reach 4. However, a portion of the flow goes into a recreational lake, which then drains into Bull Creek and Hayvenhurst Channel and back into the Los Angeles River Reach 5. Another portion of the flow goes to a wildlife lake, which then drains into Haskell Channel and ultimately back into the Los Angeles River Reach 5 (LARWQCB, 2005). Some of the flow is also discharged into the Japanese Garden near the main plant (CREST, 2009a).

The Los Angeles-Glendale plant discharges approximately 13 mgd directly into Reach 3 of the Los Angeles River in the Glendale Narrows downstream from Colorado Boulevard. Approximately four mgd of the treated wastewater is used for irrigation and industrial uses.

The Burbank Plant discharges approximately four mgd directly into the Burbank Western Channel. A significant portion of the effluent is reclaimed for irrigation and treated water is also used as cooling water for the Burbank Steam Power Plant.

Effluent limits in the NPDES permits for the three WRPs require (1) the median number of total coliform organisms in effluent not to exceed 2.2 per 100 milliliters and (2) the number of total coliform organisms cannot exceed 23 per 100 milliliters in more than one sample within any 30-day period. Consequently, the WRP are not considered to be a source of exceedances of the bacteria water quality objectives in the river.

### 4.1.3 Other Storm Water Permits

As of November 2008, there were approximately 1,384 permits issued under the Statewide Industrial Activities Storm Water General Permit in the watershed (CREST, 2009a) and 759 permits issued under the Statewide Construction Activities Storm Water General Permit (LARWQCB, 2007).

The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP will contain a site map(s) which shows the construction site perimeter, existing and proposed buildings, lots, roadways, storm water collection and discharge points, general topography both before and after construction, and drainage patterns across the project. The SWPPP must list Best Management Practices (BMPs) the discharger will use to protect storm water runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program; a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs; and a sediment monitoring plan if the site discharges directly to a water body listed on the 303(d) list for sediment. (SWRCB, 2010a)

The Industrial Storm Water General Permit, Order 97-03-DWQ (General Industrial Permit), is an NPDES permit that regulates discharges associated with 10 broad categories of industrial activities. The General Industrial Permit requires the implementation of management measures that will achieve the performance standard of best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT). The General Industrial Permit also requires the development of a SWPPP and a monitoring plan. Through the SWPPP, sources of pollutants are to be identified and the means to manage the sources to reduce storm water pollution are described. (SWRCB, 2010b).

#### 4.1.4 Other General NPDES Permits, Minor Individual NPDES Permits, and Industrial Waste Water Permits

The Regional Board has issued general NPDES permits for construction dewatering, industrial wastewater, petroleum fuel cleanup sites, volatile organic compounds (VOCs) cleanup sites, potable water, and hydrostatic test water. Currently, there are approximately 113 general NPDES permits, 15 minor individual NPDES permits, and 40 industrial waste water permits issued in watershed (CREST 2009a, LARWQCB, 2007). Discharges associated with non-process wastewater, petroleum fuel cleanup sites, volatile organic compounds (VOCs) cleanup sites, and hydrostatic test water do not typically require monitoring for bacteria and are not considered significant sources of bacteria to the watershed. Construction dewatering, potable water, and industrial waste water typically are required to monitor for bacteria under their permits. However, they are not usually given a permit limit, based on receiving water standards, unless reasonable potential can be established through a review of data. Discharges for all these activities tend to be infrequent.

### 4.2 Nonpoint Sources

#### 4.2.1 Septic Systems

The majority of sanitary sewer discharges in the watershed are to sanitary sewer collection systems and to a WRP; however onsite wastewater treatment systems (OWTS), also know as septic systems, are also still in use. OWTS are typically designed to treat small quantities of sewage waste typically from a single residence or small business. Many of the septic systems installed today are for parcels where sewer services are not readily available. Correctly sited, operated, and maintained OWTS are highly effective at removing bacteria. However, failure rates have been reported as high as 20% to 30% in the Malibu Creek Watershed (LARWQCB, 2004b). Failures have been attributed to improper siting, design, and maintenance. The City of Los Angeles has estimated that more than 10,000 septic systems are located in the watershed and the County of Los Angeles estimates that 1,200 septic systems may be located on County unincorporated lands (CREST, 2009b). With the current lack of information regarding the exact location and number of operating septic systems, and number of failed of septic systems, it is difficult to quantify the loading associated with septic systems to the watershed.

### 4.2.2 Sanitary Sewer Overflows

From September 2006 to August 2008, there were a total of 359 Sanitary Sewer Overflows (SSOs) reported in the watershed from which 371,410 gallons of untreated sewage were discharged into surface waters (CREST, 2009a). Based on inlet data from WRPs, this raw sewage has a median concentration in the millions of MPN/100 mL. The BSI study found that *E. coli* loading from an observed SSO was more than 1,000 times greater than the allowable instream loading in Reach 4 (CREST, 2009b). CREST estimated that the total indicator bacteria loading from these SSOs was $1.52 \times 10^{14}$ MPN/100mL of *E. coli*, which was estimated to be 2% of the total dry weather load and an even smaller percentage of the wet weather load.

### 4.2.3 Natural Sources

Natural sources of indicator bacteria are accounted for under the reference system approach for bacteria, and the targets for this TMDL allow for occasional exceedances due to natural non-point sources.

The dataset used to develop the targets for this TMDL included data from a Southern California Coastal Water Research Project (SCCWRP) study called *Fecal Indicator Bacteria in Reference Streams* (Technical Report 542; Tiefenthaler *et al.*, 2008). This dataset included sites representing a wide range of geological, hydrological, and biological conditions, and included samples from the headwaters of Arroyo Seco, which drain a portion of the Angeles National Forest. This is the only available data for natural runoff specific to the Los Angeles River watershed. The samples from the Arroyo Seco reference site exhibited a low rate of bacterial exceedance during dry weather - as was also observed in other natural areas in the same study. Dry weather concentrations of *E. coli* at the Arroyo Seco headwater site were orders of magnitude lower than those found in the Los Angeles River mainstem or any of its tributaries. The median *E. coli* concentration from the Arroyo Seco headwaters was non-detect (<10 MPN/100mL). Therefore, runoff from the hills of the watershed likely only contributes a very small portion of the dry weather loading

### 4.2.4 In-Channel Sources

Inputs from *within* the channels of the Los Angeles River and its tributaries are potential non-point sources of bacteria, including:

- Groundwater discharges
- Homeless Persons
- Illicit/illegal direct discharges
- Wildlife and birds
- Regrowth and/or suspension of sediment-associated bacteria
- Resuscitation of injured bacteria discharged with disinfected wastewater effluent

The cumulative impact of in-channel sources of *E. coli* during dry weather has been analyzed during two studies by the CREST stakeholder group, the Tier 2 Study (CREST,

2006) and the BSI Study (CREST, 2008). Both of these studies focused on Reaches 2 and 4 of the Los Angeles River, and used a mass balance approach to compare dry weather loading from in-channel sources to loading from all storm drains and tributaries. Overall, the BSI Study concluded that dry weather loading of *E. coli* from in-channel sources along Reach 4 was relatively small compared to discharges from tributaries and storm drains. In the case of Reach 2, on the other hand, dry weather loading of *E. coli* from storm drains and tributaries often accounted for a fraction of the *E. coli* in the Los Angeles River.

A variety of analyses were used by the BSI Study to assess and rank the potential causes of in-channel *E. coli* sources along Reach 2, as follows:

- **Groundwater –** Shallow groundwater sampled from multiple "weep holes" that discharge along Reach 2 was found to be non-detect for indicator bacteria, suggesting groundwater is not a significant in-channel source of *E. coli* along Reach 2.

- **Human fecal discharges –** Along the section of Reach 2 where in-channel sources were estimated to be the strongest (the segment between 6$^{th}$ Street and Rosecrans Avenue), measurements of human-specific *Bacteroidales* in the LA River exhibited little or no upstream/downstream increase. The potential effects of *Bacteroidales* decay were incorporated. Thus, it was concluded by the authors of the BSI study that in-channel sources of *E. coli* were non-human. This finding limits the potential for homeless persons, illicit discharges (e.g., from recreational vehicles), or leaking sewer infrastructure to be predominant in-channel sources along Reach 2.

- **Birds –** Birds were commonly observed by field personnel in the Los Angeles River channel between 6$^{th}$ Street and Rosecrans Avenue, and were classified as potentially important in-channel sources of bacteria. The Audubon Society describes the seven-mile lower portion of the River (north Long Beach through Compton and Paramount) as *"one of the most important shorebird stopover sites in southern California. During the summer, a thin sheet of water forms in the river channel, and becomes rich with algae and micro-invertebrates that attract shorebirds. This environment has replaced formerly extensive shorebird habitat once present in the vast marshes along the coast of the Los Angeles Basin (e.g., Long Beach/Wilmington)."*

- **Regrowth and persistence in sediments –** Sediment deposits are relatively uncommon along the concrete-lined Los Angeles River. However, notable exceptions include (1) large swaths of sediment near Washington Boulevard bridge in Reach 2 and (2) at "outlets" along the side of the low-flow channel along the lower portion of Reach 2. The potential for *E. coli* growth in sediment deposits is well documented. During the CREST Tier 2 Study (CREST, 2006), sediment bacteria concentrations were measured, and fecal coliform was two orders of magnitude (100x) more abundant in sediments than in water. In many cases, sediment bacteria are in a slimy matrix and may resuspend easily. Regrowth in sediments was considered to have moderate likelihood of being a significant component of the in-channel *E. coli* loading to Reach 2 by the BSI study.

- **Regrowth or resuscitation in the water column –** Under suitable conditions, traditional indicator bacteria may regrow or resuscitate in the water column. Regrowth occurs when indicator bacteria are generated in the environment. Resuscitation is when indicator bacteria that are initially viable-but-nonculturable become culturable. Resuscitation can occur after injury (but not death) by treatment or environmental stress. Laboratory studies under ideal conditions have highlighted the potential for post-disinfection resuscitation (Bolster et al., 2005; Rockabrand et al., 1999; Dukan et al., 1997), and a field study in Orange County concluded that bacteria were resuscitated to a degree after dry weather runoff was UV-treated (County of Orange, 2004). During the BSI Study, a simple approach was used to determine whether or not regrowth in the water column could be ruled out as an important *E. coli* source to Reach 2. Calculated (potential) in-channel *E. coli* growth rates from *E. coli* concentrations measured in Reach 2 were compared to reported literature values from laboratory studies to evaluate if growth was a potential source. Based on this comparison, regrowth or resuscitation in Reach 2 of the Los Angeles River during dry weather could not be ruled out. These results do not demonstrate that regrowth/resuscitation is occurring; instead, they highlight it as a potential source that could be further evaluated.

# 5 Linkage Analysis

As discussed in Section 4.1.1, dry weather urban runoff and storm water conveyed by storm drains are the primary sources of elevated bacterial indicator densities to the Los Angeles River Watershed during dry and wet weather. The linkage between the numeric targets and the allocations is supported by the following scientific findings:

1. In Southern California, in dry weather, local sources of bacteria principally drive exceedances (LARWQCB, 2002b; 2003b; 2004a).

2. Tiefenthaler ***et al.*** found that in natural streams bacteria levels were generally higher during lower flow condition (Tiefenthaler ***et al.***, 2008)

3. Ackerman ***et al.*** found that storm drains contribute roughly 13% of the flow in the Los Angeles River in dry weather, while WRPs account for roughly 72% of the flow in the river during dry weather. With this flow, storm drains were contributing almost 90% of the *E. coli* loading (Ackerman ***et al.***, 2003). *E. coli* concentrations were found to be as much as four orders of magnitude higher from storm drains than from the WRP discharges**.**

4. In the BSI study, the CREST team found that approximately 85% of the storm drain samples collected exceeded the *E. coli* objective. In the reaches investigated, *E. coli* loading from storm drains and tributaries greatly exceeded the allowable instream loading. The study also found that some of the loading in Reach 2 could not be attributed to the measured storm drain inputs.

5. In Southern California, in wet weather, upstream or watershed sources principally cause the bacteria exceedances (LARWQCB, 2002b; 2003c; 2004a).

6. During wet weather, WRP discharges may account for as little as 1% of the total flow in the river (CREST, 2009a).

7. Based on three experiments conducted by Noble *et al.* (1999) to mimic natural conditions in or near Santa Monica Bay (SMB), two in marine water and one in fresh water, bacteria degradation was shown to range from hours to days (Noble *et al.*, 1999). Based on the results of the marine water experiments, the model assumes a first-order decay rate for bacteria of 0.8 d-1 (or 0.45 per day). Degradation rates were shown to be as high as 1.0 d-1 (Noble *et al.*, 1999). These studies show that bacterial degradation and dilution during transport through the watershed do not significantly affect bacterial indicator densities in receiving waters. Decay is discussed further in Section 6.1 and 7 of the staff report.

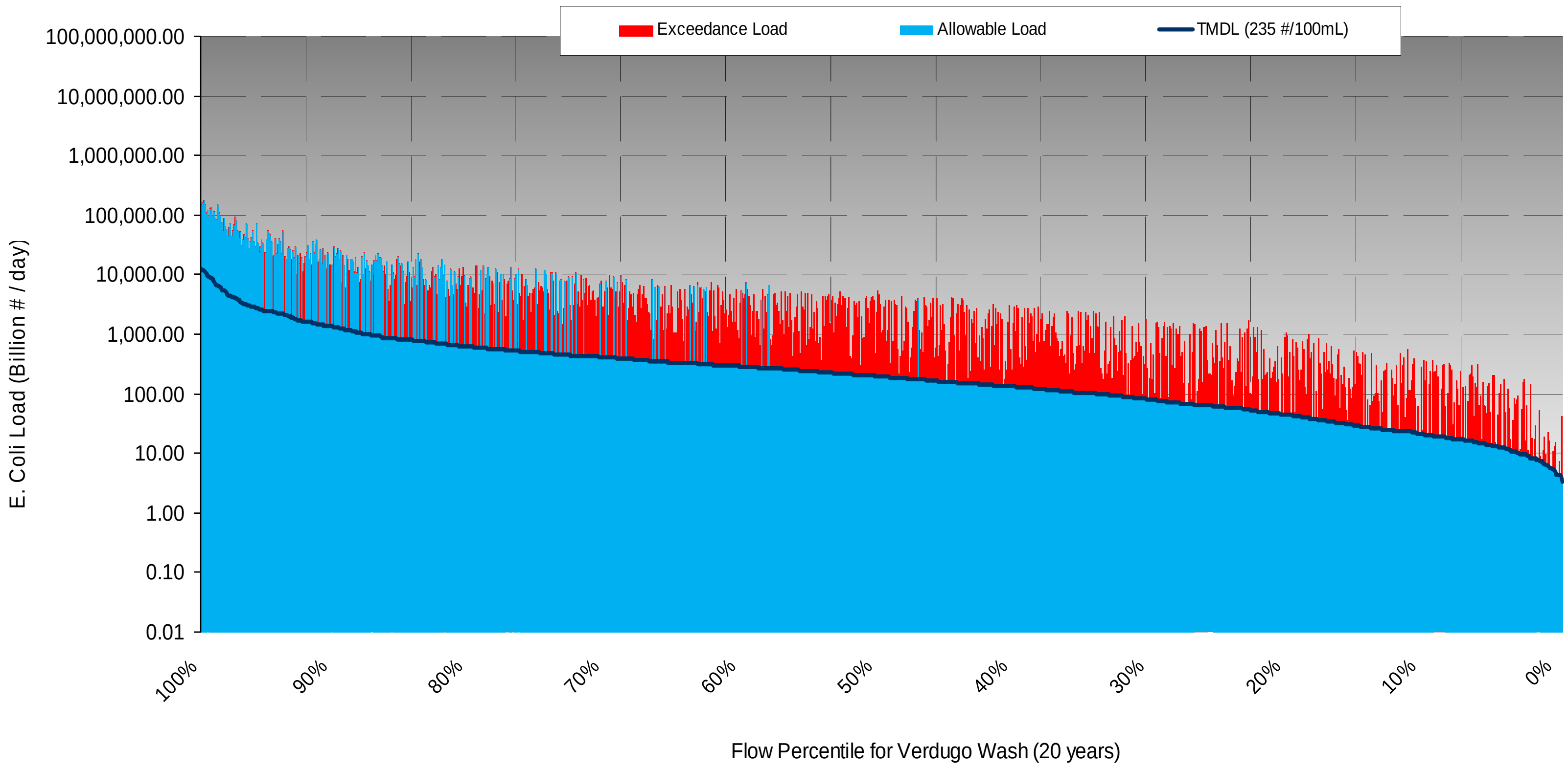
Load duration curves for dry weather in the Los Angeles River were generated by CREST and used to develop the interim allocations (see Section 6.1). USEPA and Tetra Tech Inc. have developed a load duration curve for wet weather in the Los Angeles River based on modeled wet weather data. The results are shown here to illustrate the percentage reduction which will be necessary to meet the final allocations listed in Table 6-3. An example load duration curve is also included for Verdugo Wash for illustration.

**Table 5-1 Estimated Modeled Percentage *E. coli* Load Reduction for Wet Weather**

| | Average Wet Days | HFS Based Allowable Exceedance Days | Modeled Annual Load | Modeled Annual Wet-Day Load | Adjusted Annual Wet-Day Load | Estimated Reduction Required | Percent Wet-Day Reduction |
|---|---|---|---|---|---|---|---|
| **Los Angeles River (Segment A)** | 44 | 15 | 241,286 | 235,132 | 59,617 | 55,602 | 93.3% |
| **Los Angeles River (Segment B)** | 56 | 15 | 3,913,215 | 3,609,176 | 953,479 | 893,062 | 93.7% |
| **Los Angeles River (Segment C)** | 49 | 15 | 1,298,652 | 1,216,736 | 362,057 | 330,161 | 91.2% |
| **Los Angeles River (Segment D)** | 60 | 15 | 823,497 | 810,904 | 165,871 | 156,458 | 94.3% |
| **Los Angeles River (Segment E)** | 56 | 15 | 1,240,920 | 1,187,661 | 275,675 | 258,746 | 93.9% |
| **Compton Creek** | 45 | 10 | 1,144,340 | 1,057,629 | 296,285 | 279,100 | 94.2% |
| **Rio Hondo** | 48 | 15 | 190,518 | 183,574 | 50,607 | 46,831 | 92.5% |
| **Arroyo Seco** | 58 | 10 | 723,910 | 694,094 | 186,671 | 166,623 | 89.3% |
| **Verdugo Wash** | 61 | 15 | 496,081 | 479,713 | 122,306 | 110,019 | 90.0% |
| **Burbank Western Channel** | 43 | 15 | 96,593 | 96,139 | 26,466 | 25,676 | 97.0% |
| **Tujunga Wash** | 58 | 15 | 981,052 | 949,003 | 211,337 | 192,725 | 91.2% |
| **Bull Creek** | 58 | 10 | 347,712 | 339,556 | 81,620 | 72,115 | 88.4% |
| **Aliso Canyon Wash** | 46 | 10 | 644,682 | 628,462 | 178,104 | 170,221 | 95.6% |
| **McCoy Canyon** | 43 | 10 | 143,201 | 142,326 | 39,399 | 38,053 | 96.6% |
| **Dry Canyon** | 48 | 10 | 62,159 | 61,171 | 12,245 | 10,418 | 85.1% |
| **Bell Creek** | 44 | 10 | 311,487 | 293,743 | 68,619 | 61,714 | 89.9% |

1) Percent reduction express as Estimated Reduction / Modeled Wet Day Load
2) *E. coli* loads expressed as Billion # / year

**Figure 5-1 Estimated Modeled Load Reduction Curve for Wet Weather for Verdugo Wash**



# 6 Allocations

Waste Load Allocations (WLAs) are allocations of bacteria loads to point sources and Load Allocations (LAs) are allocations of bacteria loads to nonpoint sources. In this TMDL, WLAs and LAs are set for (1) dry weather and (2) wet weather (defined as days of 0.1 inch of rain or more plus three days following the rain event).

Interim WLAs are set for MS4 dischargers as bacterial loads (MPN/day) and final WLAs and LAs are set for all dischargers as exceedance days - the number of daily or weekly sample days that may exceed single sample limits (see Section 2.2) at the appropriate monitoring sites. Final WLAs and LAs are expressed as allowable exceedance days because the bacteria density and frequency of single sample exceedances are the most relevant to public health protection. Allowable exceedance days are “appropriate measures” consistent with the definition in 40 CFR §130.2(i). Exceedances of the geometric mean limit are not permitted.

## 6.1 Interim Allocations: MS4 dischargers, dry weather

Interim allocations are set for MS4 dischargers for dry weather.

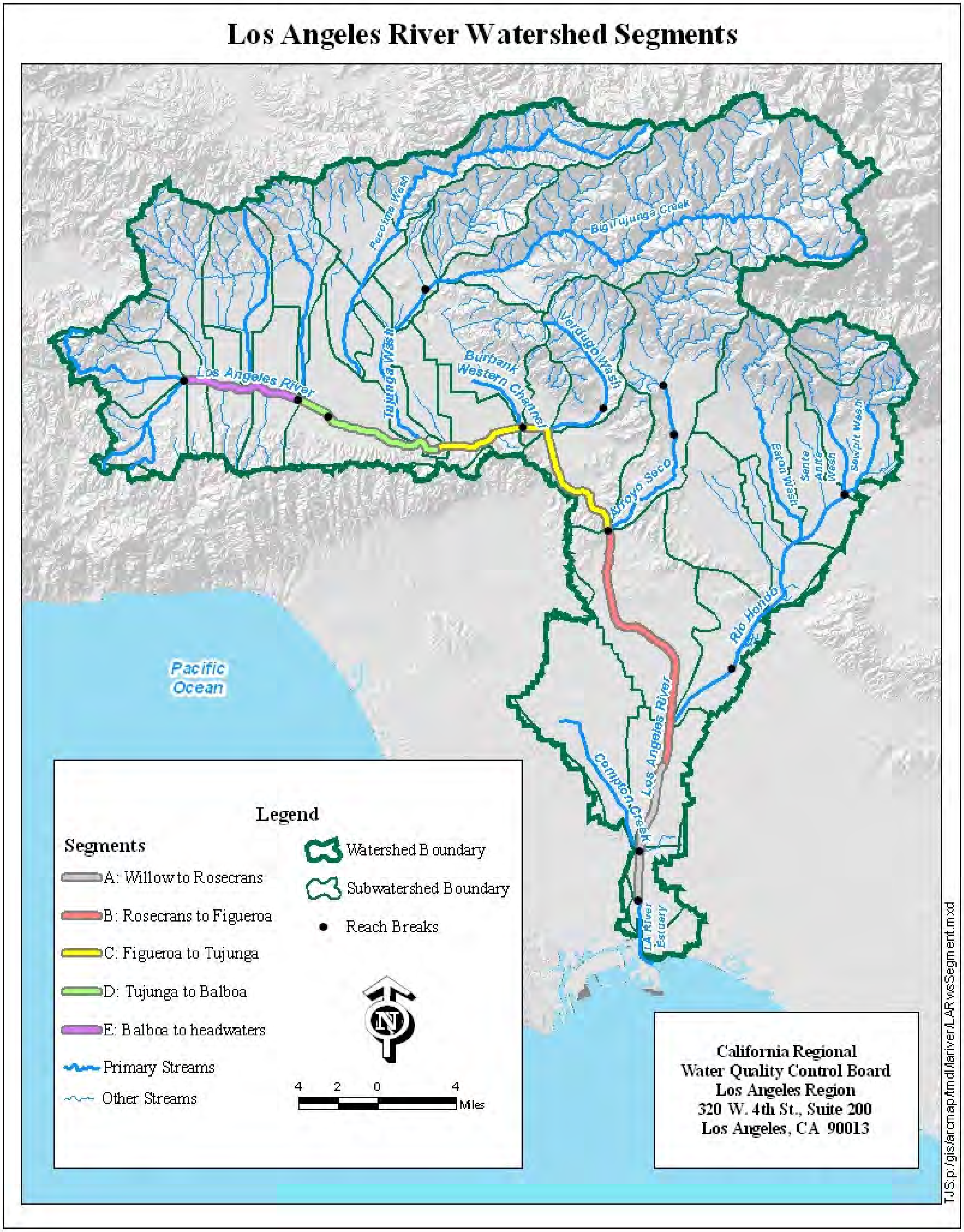
These allocations were generated using a load duration curve (LDC). A LDC is a simple method to calculate TMDLs and allocations. A load duration curve for dry weather used the measured flow rate and a reference concentration to generate a cumulative plot of the values. LDCs have been used in many TMDLs in the Region, including the Malibu Creek Bacteria TMDL.

The loading rate units and allocation units are in the bacterial concentration units of MPN/day.

The main stem of the river was broken down into segments for allocations based on the availability of flow data (see Figure 6-1).

- Segment A includes Reaches 1 and 2
- Segment B includes a portion of Reach 2
- Segment C includes Reaches 3 and 4
- Segment D includes Reaches 4 and 5
- Segment E includes Reach 6

**Figure 6-1 Los Angeles River Watershed Segment Map**



The average daily flows were calculated using the City of Los Angeles' Status and Trends data and used to plot the flow duration curves. The flow rates from the City of Los Angeles' Status and Trends data are summarized along with travel times in Table 1 of Section 6 of the CREST Technical Report.

The flow duration curve was multiplied by the water quality objective for *E. coli* to calculate the allowable instream loading. The allowable instream loading also considered bacteria decay and travel time in addition to flow rate. For this TMDL, a conservative decay rate of 0.09 $hour^{-1}$ was assumed (CREST, 2009a).

The load duration curve includes separate calculations for upstream reaches and tributaries. There are several reasons for using this strategy. Lower portions of the mainstem receive flow and loading from upper portions of the river. WLAs account for this instream loading. Some of the mainstem portion of the river and one tributary receive large, regular discharges of tertiary treated effluent (Section 4 of the Staff Report). Effluent from WRPs in the watershed must meet the permitted limit of not more than 2.2 per 100 milliliters as the median number of coliform organisms and not more than 23 per 100 milliliters as the maximum number of coliform organisms in not more than one sample within any 30-day period. Due to the large effluent volume and low bacteria limits, this effluent adds to the assimilative capacity of the river downstream from the discharge.

Therefore, the WLAs allocated per segment are essentially a percentage of the calculated median allowable instream loading minus the allowable upstream loading, the loading from tributaries, and the allowable WRP loading. The loading is required to be less than 110% of the calculation of the final conditions. This larger amount of loading allowed in the interim gives dischargers some additional flexibility especially considering the variable nature of bacteria loading levels from MS4 outfalls.

The resulting loads are the interim WLAs assigned to the Municipal Separate Storm Sewer System (MS4) Permittees within the specific segment or tributary and are summarized in Table 6-1.

**Table 6-1 Interim Waste Load Allocation by Segment and Tributary for MS4 Dischargers**

| River Segment or Tribuary | *E. Coli* Load ($10^9$ MPN/Day) |
|---|---|
| Los Angeles River Segment A | 301 |
| Los Angeles River Segment B | 518 |
| Los Angeles River Segment C | 463 |
| Los Angeles River Segment D | 454 |
| Los Angeles River Segment E | 32 |
| Aliso Canyon Wash | 23 |
| Arroyo Seco | 24 |
| Bell Creek | 14 |
| Bull Creek | 9 |
| Burbank Western Channel | 86 |
| Compton Creek | 7 |
| Dry Canyon | 7 |
| McCoy Canyon | 7 |
| Rio Hondo | 2 |
| Tujunga Wash | 10 |
| Verdugo Wash | 51 |

## 6.2 Final Allocations

### 6.2.1 Final Load Allocations

Lands not covered by a MS4 permit, such as the US Forest Service lands, California Department of Parks and Recreation lands, or National Park Service lands are assigned LAs. The dry weather LAs and wet weather LAs for single sample limits are listed in Table 6-3.

Onsite Waste Treatment Systems are assigned LAs of zero (0) days of allowable exceedances for both dry and wet weather for the single sample and rolling 30-day geometric mean limits.

In addition, sewer collection systems are assigned LAs of zero (0) days of allowable exceedances for both dry and wet weather for the single sample and rolling 30-day geometric mean limits.

### 6.2.2 Final Wasteload Allocations

General NPDES permits, individual NPDES permits, the Statewide Industrial Storm Water General Permit, the Statewide Construction Activity Storm Water General Permit, and WDR permittees in the Los Angeles River Watershed are assigned WLAs of zero (0) days of allowable exceedances for both dry and wet weather and for the single sample limits and the rolling 30-day geometric mean limits. Compliance with an effluent limit based on the water quality objective can be used to demonstrate compliance with the WLA. In addition, for permits which include stormwater effluent limitations for sites, which are measured in receiving waters, are assigned

WLA for those sites in accordance with the table for MS4 dischargers listed above, where the subwatershed drained, is open natural land and a demonstration has been made to the Regional Board that any exceedances are due to natural sources.

The three Water Reclamation Plants in the watershed, D.C. Tillman, Los Angeles-Glendale and Burbank, currently have NPDES permits that require (1) the median number of coliform organisms in effluent not to exceed 2.2 per 100 milliliters and (2) the number of coliform organisms not to exceed 23 per 100 milliliters in more than one sample within any 30-day period. The WLAs for WRPs are set equal to a 7-day median of 2.2 MPN/100mL of ***E. coli*** or a daily max of 235 MPN/100 mL to ensure zero (0) days of allowable exceedances. No exceedances of the geometric mean target shall be permitted. For MS4 dischargers, the dry weather and wet weather WLAs are expressed as allowable exceedances, discussed below and listed in Table 6-3.

#### 6.2.3 Allowable Exceedance Days

This TMDL sets the number of allowable exceedance days for each segment or tributary to ensure that two criteria are met (1) bacteriological water quality is at least as good as that of a largely undeveloped system, and (2) there is no degradation of existing bacteriological water quality. The number of allowable exceedance days is based on the single sample exceedance frequency at the reference system.

Regional Board Staff ensures that the two criteria above are met by using the smaller of two exceedance probabilities for any monitoring site multiplied by the number of dry days or wet days for the critical condition (see Section 8). An exceedance probability, P(E), is simply the probability that one or more single sample limits, described in Section 2.2, will be exceeded at a particular monitoring site, based on historical data.

#### 6.2.4 Calculating Dry Weather and Wet Weather Exceedance Probabilities

The dry weather exceedance probability is simply the probability that the sample limit will be exceeded on a dry weather day at a particular location. The wet weather exceedance probability is simply the probability that the sample limit will be exceeded on a wet weather day (see Section 2.4) at a particular location.

Monitoring data from October 2005 to May 2007 were used to determine the exceedance probability of the reference system for dry and wet weather. Samples were identified as dry or wet weather samples using rainfall data from LAX.

#### 6.2.5 Calculating Allowable Exceedance Days at a Targeted Location

As in previous bacterial TMDLs in the Los Angeles Region, allowable exceedance days were calculated with the smaller of the two exceedance probabilities, that of the targeted site or the reference site. In the case of this TMDL, the smaller of the exceedance probabilities for all sites was that of the reference site and that value was used in subsequent calculations, as described below.

To translate the exceedance probabilities into allowable exceedance days and exceedance-day reductions, the number of wet weather days and the number of dry weather days in the 90$^{th}$ percentile storm year, based on rainfall data from the Los Angeles International Airport (LAX) meteorological station, was used.

### 6.2.6 Reference System

As discussed in sections 1.2 and 3.2, the reference system/antidegradation approach is the recommended alternative; this approach ensures that water quality is at least comparable to that of the reference system and is also consistent with state and federal antidegradation policies. The reference system approach uses both the water quality objective exceedance probability for the reference system and reference dry and wet weather days from the reference year (see section 6.2.7) to determine the allowable number of exceedances days allocated.

Previously adopted bacteria TMDLs in the Region, which include the Santa Monica Bay Bacteria TMDLs among others, have employed Leo Carrillo Beach and its drainage area, Arroyo Sequit subwatershed, as the reference system (LARWQCB, 2002a; 2002b; 2003c; 2004a; 2006a). Early TMDLs developed in freshwater systems (e.g., Malibu Creek Bacteria TMDL and Ballona Creek Bacteria TMDL) also used the marine beach, Leo Carrillo, as the reference site due to the lack of bacteria data from freshwater reference systems in the Los Angeles region. In this TMDL, Regional Board staff proposes the use of freshwater reference data that is now available from southern California freshwater reference monitoring locations for the reference system. This TMDL, and the concurrently developed Santa Clara River Bacteria TMDL, will be the first bacteria TMDLs in the Region to use freshwater reference data to develop exceedance day allocations.

The Southern California Coastal Water Research Program (SCCWRP), a joint powers authority formed to conduct coastal environmental research, has conducted monitoring and analysis of freshwater reference sites throughout southern California. The monitoring was conducted from the fall of 2004 to the spring of 2007. This monitoring was summarized in three studies, which include the Natural Landscapes Study (Stein and Yoon, 2007), the Reference Stream Study (Tiefenthaler ***et al***., 2008), and the Wet Weather Reference Beach Study (Schiff ***et al***., 2006).

SCCWRP’s selection of reference sites was based on four criteria. These criteria include sites that: 1) have no less than 95% undeveloped drainage area; 2) possess a “relatively homogeneous setting”; 3) have “year-round or prolonged dry weather flow”; and 4) are located in watersheds that have not experienced fire during the previous three years. Of the sites sampled in the Reference Stream Study, three sites were deemed minimally impacted. As such, data from these three sites were excluded. The resulting data was compiled and used as the basis for determining the reference watershed exceedance probability (see Table 6-2).

**Table 6-2 Estimated Exceedance Probabilities for the Reference System**

| Single Sample *E. coli* Exceedance Probability | | |
|---|---|---|
| Water Quality Objective | Dry weather exceedance probability | Wet weather exceedance probability |
| 235 MPN/100 mL | 0.016 | 0.19 |

#### 6.2.7 Critical condition (reference year)

Based on an examination of historical rainfall data from the Los Angeles International Airport (LAX) meteorological station[1], Regional Board Staff propose using the 90$^{th}$ percentile storm year[2] in terms of wet weather days as the critical condition for determining the allowable wet weather exceedance days. The reference year of 1993 was chosen because it is the 90$^{th}$ percentile year in terms of wet weather days, based on 54 storm years (1948-2008) of rainfall data from LAX (see Appendix A). In the 1993 storm year, there were 75 wet weather days; therefore, there were 290 dry days.

### 6.3 Translating exceedance probabilities into estimated exceedance days during the critical condition

The estimated number of exceedance days during the critical condition (reference year) was calculated for the reference system by multiplying the site-specific exceedance probability by the estimated number of dry or wet days in the reference year. The site-specific exceedance probability is taken directly from the data analysis in Table 6-2. Based on 54 storm years of rainfall data from LAX meteorological station, 1993 is the reference year for both dry and wet weather.

$$E_{CC} = P(E)_i * days_{1993} \qquad \text{(Equation 6.1)}$$

Where $E_{CC}$ is the estimated number of exceedance days under the critical condition and $P(E)_i$ is the average probability of exceedance for any site. The average exceedance probability is appropriate, since the weekly sampling is systematic and the rain events are randomly distributed; therefore, sampling will be evenly spread over the dry weather and wet weather events (i.e., the rain day, day after, 2$^{nd}$ day after, 3$^{rd}$ day after)[3].
To estimate the number of exceedance days during the reference year ***given a weekly sampling regime***, the number of days was adjusted by solving for ***x*** in the following equation:

$$\frac{days_{1993}}{365 \text{ days}} = \frac{x}{52 \text{ weeks}} \qquad \text{(Equation 6.2)}$$

[1] The LAX meteorological station was used, since the station has the longest historical rainfall record in the Los Angeles region.
[2] The "storm year" is defined as November 1 to October 31.
[3] Also, note that the Southern California Coastal Water Research Project found no correlation between the day of the week and the percentage of samples exceeding the single sample objectives (Schiff *et al*., 2002).

Using Equation 6.1 and Equation 6.2, the exceedance probability of the reference system is translated to exceedance days as follows. Analysis of monitoring data for the reference system shows that the dry weather exceedance probability is 0.016 and the wet weather exceedance probability is 0.19. Per Equation 6.1, the exceedance probability of 0.016, for dry weather, is multiplied by 290 days, the number of dry weather days in the 1993 storm year, resulting in five (5) exceedance days when daily sampling is conducted. The exceedance probability of 0.19 for wet weather is multiplied by 75 days, the number of wet weather days in the 1993 storm year, resulting in 15 exceedance days when daily sampling is conducted.

Regional Board Staff recognizes that the number of dry weather days and wet weather days will change from year to year and, therefore, the exceedance probabilities of 0.016 for dry weather and 0.19 for wet weather will not always equate to 5 or 15 days, respectively. However, Regional Board Staff proposes setting the allowable number of exceedance days based on the reference year rather than adjusting the allowable number of exceedance days annually based on the number of dry or wet days in a particular year. This is because it would be difficult to design capture and/or treatment facilities to address such variability from year to year. Regional Board Staff expects that by designing controls for the 90th percentile storm year, during drier years there will most likely be fewer exceedance days than the maximum allowable.

To estimate the number of exceedance days at the reference system in the reference year under a weekly sampling regime for dry weather and wet weather, the number of days was adjusted by solving for *x* in Equation 6.2 as follows:

$$\frac{290\ \mathit{days}}{365\ \mathit{days}} = \frac{x}{52\ \mathit{weeks}} \qquad \text{(Equation 6.2 for dry weather)}$$

$$\frac{75\ \mathit{days}}{365\ \mathit{days}} = \frac{x}{52\ \mathit{weeks}} \qquad \text{(Equation 6.2 for wet weather)}$$

For dry weather, solving for *x* equals 41.9, which is then multiplied by 0.016, resulting in one (1) exceedance day during dry weather when weekly sampling is conducted. For wet weather, *x* equals 10.7 multiplied by 0.19, results in two (2) exceedance days during wet weather when weekly sampling is conducted. The allowable exceedances based on daily and weekly sampling are summarized in Table 6-3.

### 6.3.1 High Flow Suspension

Certain reaches and tributaries of the Los Angeles River are subject to a High Flow Suspension (HFS) of the recreational beneficial uses, which is applied to certain reaches and tributaries that are concrete-lined channels during days with greater than or equal to 0.5 inch of rain and the following 24 hours. During this period REC-1 and REC-2 beneficial uses are suspended for the affected reaches and tributaries (see Table 3-1).

For this TMDL, a different number of wet weather days based on the reference year is used in the calculation of allowable exceedance days for the reaches and tributaries subject to the HFS.

For the reference year, 75 wet weather days were observed. Of these 75 days, 26 days fall under the definition of a HFS day. These 26 days are excluded from the calculations, since the REC-1 use does not apply on these days in these reaches and tributaries. As such, the remaining number of wet weather days for HFS-affected reaches and tributaries is 49 days. The number dry weather days remains 290 days. With an adjustment to the number of wet weather days, the number of allowable wet weather exceedances for HFS affected reaches and tributaries is also adjusted. The resulting allowable exceedance for wet weather is 10 days based on daily sampling and 2 days based on weekly sampling. The final dry and wet weather allowable exceedances based on daily and weekly sampling are summarized in Table 6-3.

**Table 6-3 Allowable Exceedance Days for Daily and Weekly Sampling based on the Reference Year**

| Allowable Number of Exceedance Days | Daily Sampling | Weekly Sampling |
|---|---|---|
| Dry Weather | 5 | 1 |
| Non-HFS* Waterbodies Wet Weather | 15 | 2 |
| HFS Waterbodies Wet Weather | 10 (not including HSF days) | 2 (not including HSF days) |

*HFS = High Flow Suspension

# 7 Margin of Safety

This TMDL applies an implicit margin of safety for interim allocations through the use of conservative assumptions regarding the effect of *E. coli* discharges from storm drains on in-stream water quality and an explicit margin of safety for final waste load allocations.

Decay is almost always assumed in dry weather models used for bacteria TMDLs for storm drain discharge. The conservative assumption of no bacterial decay of storm drain loadings was assumed for this TMDL when determining the assimilative capacity of the river segments and tributaries. Therefore, storm drain discharges of *E. coli* could potentially be higher than the interim MS4 WLAs and the TMDL targets would still be met. By ignoring decay of *E. coli* in storm drains during calculation of the WLAs, an implicit margin of safety (MOS) is applied. While the MOS is implicit, its magnitude can be estimated for the river segments and tributary (see Table 7-1). A more detailed version of the table can be found in Section 6.6 of the Technical Report (CREST, 2009a).

**Table 7-1 Los Angeles River Segments and Tributary Margin of Safety**

| River Segment or Tributary | Margin of Safety in $10^9$ MPN/day | % of Allowable Interim Load |
|---|---|---|
| Los Angeles River Segment A | 71 | 21% |

| | | |
|---|---|---|
| Los Angeles River Segment B | 269 | 36% |
| Los Angeles River Segment C | 218 | 34% |
| Los Angeles River Segment D | 149 | 26% |
| Los Angeles River Segment E | 8 | 21% |
| Aliso Canyon Wash | 11 | 35% |
| Arroyo Seco | 7 | 25% |
| Bell Creek | 4 | 26% |
| Bull Creek | 8 | 52% |
| Burbank Western Channel | 42 | 35% |
| Compton Creek | 4 | 40% |
| Dry Canyon | 1 | 12% |
| McCoy Canyon | 1 | 12% |
| Rio Hondo | 7 | 82% |
| Tujunga Wash | 3 | 27% |
| Verdugo Wash | 14 | 23% |

The MOS for interim allocations was calculated by comparing the potential loading without decay against the interim WLA. The difference between the two numbers equates to the MOS. The potential loading without decay is calculated by applying the exponential decay equation (Equation 7.1) listed below.

$$C_f = C_o\, e_{-kt} \qquad \text{(Equation 7.1)}$$

Where $C_f$ is the downstream concentration, $C_o$ is the concentration assumed before decay, $_k$ is the exponential decay rate, and $_t$ is the travel time (CREST, 2009a).

An explicit margin of safety has been incorporated for final allocations in allowable exceedance days. Exceedances of the single sample objectives are allowed no more than 5% of the time on an annual basis, based on the cumulative allocations for dry and wet weather in Section 6. The Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (SWRCB, 2004) concludes that there are water quality impairments using a binomial distribution method, which lists waterbodies when the exceedances are between approximately 8 and 10 percent.

# 8 Critical Conditions

The critical condition is wet weather and, in particular, the 90$^{th}$ percentile storm year is the critical wet weather year.

The critical condition in a TMDL defines an extreme condition for the purpose of setting allocations to meet the TMDL numeric targets. The critical condition may also be thought of as an additional margin of safety because the allocations are set to meet the numeric target during an extreme (or above average) condition[4]. Unlike many TMDLs, the critical condition for bacteria loading is not during low-flow conditions or summer months, but rather during wet weather. This is because intermittent loading sources such as surface runoff will have the greatest impacts at high (i.e. storm) flows (USEPA, 2001). As discussed in Section 6.2.4, waters tend to exceed water quality standards more frequently in wet weather compared to dry weather even in systems that are mostly undeveloped.

To identify the critical condition within wet weather, in order to set the allowable number of exceedance days, described in Section 6, staff propose using the 90$^{th}$ percentile storm year in terms of wet days as the reference year. Staff selected the 90$^{th}$ percentile year for several reasons. First, selecting the 90$^{th}$ percentile year avoids an untenable situation where the reference system is frequently out of compliance. Second, selecting the 90$^{th}$ percentile year allows responsible jurisdictions and responsible agencies to plan for a 'worst-case scenario', as a critical condition is intended to allow. Finally, Regional Board Staff expects that there will be fewer exceedance days in drier years, since structural controls will be designed for the 90$^{th}$ percentile year.

The 90$^{th}$ percentile storm year in terms of wet days was identified by constructing a cumulative frequency distribution of annual wet weather days using historical rainfall data from LAX from 1947-2008. This rainfall database was chosen due to the extent of the database and to maintain consistency with the other bacteria TMDLs in the Los Angeles Region. With a 90$^{th}$ percentile storm year, only 10% of years should have more wet days than the 90$^{th}$ percentile year. The 90$^{th}$ percentile year in terms of wet days was 1993, which had 75 wet days. The number of wet days was selected instead of total rainfall because the TMDL's numeric target is based on number of days of exceedance, not on the magnitude of the exceedance.

# 9 Implementation Strategy

## 9.1 Introduction

This implementation strategy focuses principally on eliminating or reducing the fecal indicator bacteria-laden runoff entering the river though the MS4 and also on reducing fecal indicator bacteria from entering the MS4. The source assessment and the BSI study support that this approach will be effective and will address human health concerns.

As required by the Federal Clean Water Act, discharges of pollutants to the Los Angeles River from municipal storm water conveyances are prohibited, unless the discharges are in compliance with a NPDES permit. In December 2001, the Los Angeles County Municipal NPDES Storm Water Permit was re-issued jointly to Los Angeles County Flood Control District, Los Angeles County and 84 cities as co-permittees. The Los Angeles County Municipal Storm Water NPDES Permit and the Caltrans Storm Water Permit will be key implementation tools for this TMDL. Future storm water permits will be modified in order to address implementation and monitoring of this TMDL and to be consistent with the waste load allocations of this TMDL.

[4] Critical conditions are often defined in terms of flow, such as the seven-day-ten-year low flow (7Q10), but may also be defined in terms of rainfall amount, days of measurable rain, etc.

The Porter Cologne Water Quality Control Act prohibits the Regional Board from prescribing the method of achieving compliance with water quality standards, and likewise TMDLs (Water Code §13360). Below, staff has presented potential implementation strategies; however, there is no requirement to follow the particular strategies proposed herein as long as the maximum allowable exceedance days are not exceeded. The implementation strategies presented and the implementation schedule are the result of a stakeholder effort facilitated by CREST through which responsible agencies worked together to compile potential implementation scenarios and to provide cost estimates on the selected implementation options.

As a “certified regulatory program,” the Regional Board must satisfy the substantive requirements of 23 CCR § 3777(a), which requires a written report that includes a description of the proposed activity, an alternatives analysis, and an identification of mitigation measures to minimize any significant adverse impacts. Mitigation measures and the CEQA checklist are included in the Substitute Environmental Documents of the TMDL.

Over the course of TMDL implementation, the TMDL may be re-considered to incorporate new information from TMDL special studies, or address revisions to water quality standards, such as adoption of revised water quality objectives based on recommendations of USEPA.

The implementation of this TMDL should be coordinated with activities and BMPs that are implemented through other TMDLs that have already been adopted in the watershed (notably, the Los Angeles River Metals TMDL) and other activities including the Integrated Regional Water Management Plan and Los Angeles River Revitalization Plan. Implementation actions for other TMDLs may significantly contribute to the implementation efforts for this TMDL.

## 9.2 Potential Implementation Actions

A variety of methods exist to reduce bacteria concentrations and loadings. A successful strategy will include a combination of methods to reduce bacteria exceedances to acceptable levels and support beneficial uses.

### 9.2.1 Structural Implementation Actions

Structural actions or BMPs are designed to target specific land uses, sources, time periods or events.

#### 9.2.1.1 Dry Weather Structural BMPs

Dry weather structural BMPs vary in size and complexity. Several infrastructure improvements have been used, are currently used, and have been proposed as implementation methods.

- Low-flow diversions are designed to divert low flows to the local Water Reclamation Plants for treatment rather than discharging into surface waters. Low-flow diversions will reduce bacteria loading associated with these sources and are currently used to address bacterial impairments at numerous beaches throughout the region including many Santa Monica Bay beaches and Mother's Beach in the Marina del Rey Harbor (LARQWCB 2004a, 2003b, 2002b, 2002a).

- Retention, filtration, bioretention, and biofiltration are also implementation methods for dry weather.

#### 9.2.1.2 Wet Weather Structural BMPs

Storm water washes pollutants off roof-tops, pavement, streets, industrial areas, and lawns. Because of the much higher volume, exceedances of bacterial targets during wet weather will be more difficult to reduce than during dry weather, although many of the dry weather implementation methods will assist with wet weather implementation.

##### 9.2.1.2.1 Sub-Regional Structural BMPs

Sub-regional structural BMPs consist of a single or a series of BMPs designed to treat wet weather flows for limited sub-regions within the subwatershed. Sub-regions can vary in size from a small parking lot to several city blocks. These sub-regional implementation strategies often have multiple pollutant treatment potential. Listed below are a few sub-regional structural BMPs and a brief description of each:

- Vegetated biofiltration systems include swales, filter strips, bioretention areas, and storm water planters (McCoy *et al.*, 2006a). Vegetated systems involve the use of soils and vegetation to filter and treat storm water prior to discharge. Additional bioslopes, infiltration trenches, soil grading alterations, bioretention ponds, and the use of selective vegetation can further increase the efficiency of vegetative biofiltration systems.

- Local retention and infiltration improvements, like porous paving, retention ponds, cisterns, and infiltration pits, can promote retention and added infiltration of storm water rather than run-off over impervious surfaces (McCoy *et al.*, 2006).

##### 9.2.1.2.2 Regional Structural BMPs

Regional structural BMPs contain many similarities to sub-regional structural BMPs but differ in both the scope and scale of the implementation strategy. Treatment areas can range from several sub-regions to the entire subwatershed. Regional structural BMPs retain the multiple treatment potential of sub-regional BMPs. Listed below are a few regional structural BMPs and a brief description of each:

- Regional biofiltration systems, including surface flow and sub-surface flow wetlands, promote hydrolysis, oxidation, rhizodegradation, filtration through the aerobic and anaerobic zones of the soil matrix (Halverson, 2004). These systems can treat a variety of pollutants and can be utilized for flood mitigation.

- Regional infiltration and detention systems, including detention and infiltration basins, help reduce flow volume in lower stream areas and promote sedimentation (McCoy *et al.*, 2006).

### 9.2.2 Non-structural Best Management Practices

Non-structural BMPs are a broad-based description of implementation strategies not of an extensive structural nature. Non-structural BMPs are further categorized as administrative controls and outreach and education.

#### 9.2.2.1 Administrative Controls

Administrative controls include better enforcement of ordinances, such as pet waste disposal ordinances and litter ordinances; posting additional signage; feral cat population control; proposing stricter penalties for non-compliance; and other actions of an administrative nature for dry weather. Administrative controls require less initial investment of time, compared to structural BMPs, due to the lack of need for planning and capital required for dry weather implementation. However, long-term implementation may be more time intensive.

Wet weather administrative controls tend to be more costly and have a far greater scope and include post-construction storm water BMPs requirements and Low Impact Development (LID) requirements. Sub-regional and Region-wide plans for sheet-flow diversion may need to be developed. A green building program similar to one developed in the City of Santa Monica can help promote sustainability (McCoy and Hartwich, 2006).

#### 9.2.2.2 Outreach and Education

Outreach and education is potentially the most effective long-term implementation strategy for ensuring compliance with bacteria water quality standards. Information regarding the adverse impacts associated with illicit discharges, fishing waste, litter, and feral cat feeding should be made readily available to the general public. Wet weather outreach and education should target local planning groups, community groups, and agricultural organizations due to the region-wide effort necessary to control wet weather bacteria loading.

## 9.3 Responsible parties

Responsible Parties for each segment and tributary in the Los Angeles River Bacteria TMDL are shown in Table 9-1

**Table 9-1 Responsible Parties for Waste Load Allocations or Load Allocations in the Los Angeles River Bacteria TMDL**

| Responsible Entity | Los Angeles River Segment | | | | | Los Angeles River Tributary | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | Aliso Canyon Wash | Arroyo Seco | Bell Creek | Bull Creek | Burbank Western Channel | Compton Creek | Dry Canyon Creek | McCoy Canyon Creek | Rio Hondo | Tujunga Wash | Verdugo Wash |
| Alhambra | | √ | | | | | | | | | | | | √ | | |
| Arcadia | | | | | | | | | | | | | | √ | | |
| Bell | | √ | | | | | | | | | | | | | | |
| Bell Gardens | | √ | | | | | | | | | | | | √ | | |
| Bradbury | | | | | | | | | | | | | | √ | | |
| Burbank | | | √ | | | | | | | √ | | | | | | |
| Bureau of Land Management | | | | | √ | | | | | | | | | | | |
| Calabasas | | | | | | | | | | | | √ | √ | | | |
| CA Dept. of Parks and Recreation | | | | √ | √ | | | | | | | | | | | |
| Caltrans | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Carson | | | | | | | | | | | √ | | | | | |
| Commerce | | √ | | | | | | | | | | | | √ | | |
| Compton | √ | √ | | | | | | | | | √ | | | | | |
| Cudahy | | √ | | | | | | | | | | | | | | |
| Downey | | √ | | | | | | | | | | | | √ | | |
| Duarte | | | | | | | | | | | | | | √ | | |
| El Monte | | | | | | | | | | | | | | √ | | |
| Glendale | | √ | √ | | | | √ | | | √ | | | | | √ | √ |
| Hidden Hills | | | | | | | | √ | | | | | √ | | | |
| Huntington Park | | √ | | | | | | | | | √ | | | | | |
| Irwindale | | | | | | | | | | | | | | √ | | |

| Responsible Entity | Los Angeles River Segment | | | | | Los Angeles River Tributary | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | Aliso Canyon Wash | Arroyo Seco | Bell Creek | Bull Creek | Burbank Western Channel | Compton Creek | Dry Canyon Creek | McCoy Canyon Creek | Rio Hondo | Tujunga Wash | Verdugo Wash |
| La Cañada Flintridge | | | √ | | | | √ | | | | | | | | | √ |
| Lakewood | √ | | | | | | | | | | | | | | | |
| Long Beach | √ | | | | | | | | | | √ | | | | | |
| Los Angeles | | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | | √ | √ |
| Los Angeles County | √ | √ | √ | | √ | √ | √ | √ | √ | | √ | √ | √ | √ | √ | √ |
| Los Angeles County Flood Control | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Lynwood | √ | √ | | | | | | | | | √ | | | | | |
| Maywood | | √ | | | | | | | | | | | | | | |
| Monrovia | | | | | | | | | | | | | | √ | | |
| Montebello | | √ | | | | | | | | | | | | √ | | |
| Monterey Park | | √ | | | | | | | | | | | | √ | | |
| National Park Service | | | | √ | √ | | | | | | | | | | | |
| Paramount | √ | √ | | | | | | | | | | | | | | |
| Pasadena | | √ | √ | | | | √ | | | | | | | √ | | √ |
| Pico Rivera | | | | | | | | | | | | | | √ | | |
| Rosemead | | | | | | | | | | | | | | √ | | |
| San Fernando | | | | | | | | | | | | | | | √ | |
| San Gabriel | | | | | | | | | | | | | | √ | | |
| San Marino | | | | | | | | | | | | | | √ | | |
| Santa Clarita | | | | | | | | | √ | | | | | | | |
| Sierra Madre | | | | | | | | | | | | | | √ | | |

| **Responsible Entity** | **Los Angeles River Segment** | | | | | **Los Angeles River Tributary** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | Aliso Canyon Wash | Arroyo Seco | Bell Creek | Bull Creek | Burbank Western Channel | Compton Creek | Dry Canyon Creek | McCoy Canyon Creek | Rio Hondo | Tujunga Wash | Verdugo Wash |
| Signal Hill | √ | | | | | | | | | | | | | | | |
| South El Monte | | | | | | | | | | | | | | √ | | |
| South Gate | | √ | | | | | | | | | √ | | | √ | | |
| South Pasadena | | √ | | | | | √ | | | | | | | √ | | |
| State Land Commission | | | | | √ | | | | | | | | | | | |
| Temple City | | | | | | | | | | | | | | √ | | |
| U.S. Forest Service | | | | | | | √ | | √ | | | | | √ | √ | √ |
| Vernon | | √ | | | | | | | | | √ | | | | | |

## 9.4 Implementation: Dry weather

### 9.4.1 Dry Weather Implementation for Non-point Sources

Non-point sources in the watershed include onsite wastewater treatment systems (OWTS), in-channel sources, and runoff from the headwaters.

Lands not covered by a MS4 permit, such as the US Forest Service lands, California Department of Parks and Recreation lands, or National Park Service lands are assigned LAs equal to the number of allowable exceedances based on the reference system, as shown in Table 6-3. Discharges from the headwaters and natural land sources are accounted for with the exceedance day approach, which accounts for natural sources of bacteria from undeveloped areas. Thus the discharges of ***E. coli*** from these natural/non-point sources are "allocated" as LAs using allowable exceedance days. Responsible parties who are land owners or managers and not Permittees under an MS4 permit, such as the US Forest Service (US Department of Agriculture), California Department of Parks and Recreation, or National Park Service (US Department of Interior) are required to not cause or contribute to exceedances of bacterial standards in the Los Angeles River or its tributaries beyond the allowable number of exceedance days and, if necessary, deploy appropriate BMPs to ensure compliance.

Bacteria discharges from Onsite Wastewater Treatment Systems (OWTS) are assigned a Load Allocation (LA) of zero days of allowable exceedances of the ***E. coli*** targets. In some cases, municipalities are responsible for their own OWTS including permitting under a waiver of waste discharge requirements from the Regional Board. In some cases the Regional Board is responsible for permitting via waste discharge requirements. The LA is reasonable because OWTS Waste Discharge Requirements require compliance with groundwater objectives for bacteria. LAs for onsite wastewater treatment systems will be implemented through WDRs or waivers of WDRs.

LAs for other nonpoint sources such as horses/livestock, aquaculture, and golf courses, will be implemented through the Nonpoint Source Implementation and Enforcement Policy.

Sanitary sewer collection systems are assigned a Load Allocation (LA) of zero allowable exceedances. Discharges of untreated wastewater are illegal (i.e., sanitary sewer overflows). Sanitary sewer collection systems are often managed by multiple agencies and are covered under the Statewide General Waste Discharge Requirements for sanitary sewer overflows (SSOs) (WQO No. 2006-0003-DWA). Enrollees in this permit are required to report all SSOs for which their agency has responsibility to the State Water Resources Control Board's (SWRCB) SSO database and must develop and implement a system-specific Sewer System Management Plan which will serve to implement this TMDL.

### 9.4.2 Dry Weather Implementation for Point Sources

Point sources include water reclamation plants, general and individual industrial stormwater dischargers, individual wastewater dischargers, Municipal Separate Storm Sewer System (MS4) dischargers, and among other dischargers.

### 9.4.3 Water Reclamation Plants

Dry weather WLAs established for the three Water Reclamation Plans (WRP) in this TMDL (Donald C. Tillman, Los Angeles-Glendale, and Burbank) will be implemented through NPDES permits as end-of-pipe effluent limitations. Effluent limitations in the NPDES permits for the three WRPs currently require (1) the median number of total coliform organisms in effluent not to exceed 2.2 per 100 milliliters and (2) the number of total coliform organisms no to exceed 23 per 100 milliliters in more than one sample within any 30-day period The WLAs for WRPs are set equal to a 7-day median of 2.2 MPN/100mL of ***E. coli*** or a daily max of 2.2 MPN/100 mL multiplied by the discharge rate at the time of sampling to ensure zero (0) days of allowable exceedances for both dry and wet weather and for the single sample limits and the rolling 30-day geometric mean limits. The current coliform limits for these WRPs are sufficient, and no revisions to the WRP NPDES permits are necessary based on this TMDL. No additional actions are expected to be necessary for WRPs to be in compliance with the TMDL allocations.

### 9.4.4 General and Individual Industrial Stormwater NPDES Dischargers

General NPDES permits, individual NPDES permits, the Statewide Industrial Storm Water General Permit, the Statewide Construction Activity Storm Water General Permit, and WDR permittees in the Los Angeles River Watershed are assigned WLAs of zero (0) days of allowable exceedances for both dry and wet weather and for the single sample and the rolling 30-day geometric mean limits. Compliance with an effluent limit based on the water quality objective can be used to demonstrate compliance with the WLA. In addition, for permits which include stormwater effluent limitations for sites, which are measured in receiving waters, are assigned WLA for those sites in accordance with the table for MS4 dischargers listed above, where the subwatershed drained, is open natural land and a demonstration has been made to the Regional Board that any exceedances are due to natural sources.

### 9.4.5 MS4 Dry Weather Implementation

For each Los Angeles River segment and tributary addressed under this TMDL, group interim and final WLAs have been developed for the MS4 Permittees in the watershed including Caltrans. The group allocations will apply to all NPDES-regulated MS4 Permittees in the Los Angeles River watershed (MS4 Permittees in the watershed are Los Angeles County Flood Control District, Los Angeles County, and co-Permittees that discharge to the watershed, the City of Long Beach, and Caltrans).

For the interim dry-weather WLA, to account for the variability of bacterial discharges, unexpectedly high-loading outfalls may be excluded from interim compliance calculations under the following circumstances: If an outfall which was

> 1) loading *E. coli* at a rate less than the 25th percentile of outfalls during the monitoring events used to develop the Load Reduction Strategy (LRS), but, at the time of compliance monitoring, is
> 2) loading *E. coli* at a rate greater than 90th percentile of outfalls, and
> 3) actions are taken prior to the end of the first phase (i.e. 10 years after the beginning of the segment or tributary specific phase) such that the outfall is returned to a loading less than the 50th percentile of the outfalls at compliance monitoring,

then the 90th percentile data from the outfall can be excluded from the compliance loading calculations.

Likewise, if an outfall which was

> 1) the subject of a dry weather diversion is found, at the time of compliance monitoring, to be
> 2) contributing greater than 90th percentile loading rates, and
> 3) actions are taken such that the outfall is returned to a loading less than the 50th percentile of the outfalls at compliance monitoring, and a maintenance schedule for the diversion is submitted with the compliance report,

then the 90th percentile data from the outfall can be excluded from the compliance loading calculations.

MS4 dischargers can demonstrate compliance with the final dry weather WLAs by demonstrating that final WLA are met instream or by demonstrating one of the following conditions at outfalls to the receiving waters:

1. Flow-weighted concentration of *E. coli* in MS4 discharges during dry weather is less than or equal to 235 MPN/100mL, based on a weighted-average using flow rates from all measured outfalls;
2. Zero discharge during dry weather;
3. Demonstration of compliance as specified in the MS4 NPDES permit which may include the use of BMPs where the permit's administrative record supports that the BMPs are expected to be sufficient to implement the WLA in the TMDL, the use of calculated loading rates such that loading of *E. coli* to the segment or tributary during dry weather is less than or equal to a calculated loading rates that would not cause or contribute to exceedances based on a loading capacity representative of conditions at the time of compliance or other appropriate method.

In addition, individual or subgroups of MS4 dischargers can differentiate their dry weather discharges from other dischargers or upstream contributions by demonstrating at outfalls to the receiving waters or at segment, tributary or jurisdictional boundaries:

1. Flow-weighted concentration of *E. coli* in individual or subgroup MS4 discharge during dry weather is less than or equal to 235 MPN/100mL, based on a weighted-average using flow rates from all measured outfalls;
2. Zero discharge from individual or subgroup MS4 dischargers during dry weather;
3. Demonstration that the MS4 loading of *E. coli* to the segment or tributary during dry weather is less than or equal to a calculated loading rates that would not cause or contribute to exceedances based on the loading capacity representative of conditions at the time of compliance.

Loading rate calculations can be made using load duration curves, average daily flows in the several years previous to the calculation, water quality objective for *E. coli*, and may also consider an appropriate bacteria decay rate (e.g. conservative decay rate of 0.09 hour-1) and travel time.

The interim and final WLAs are group-based, shared among all MS4s that drain to a segment or tributary. However, WLA may be distributed based on proportional drainage area, upon approval of the Executive Officer. The interim WLA are expressed as the maximum *E. coli* load in MPN per day. The final WLAs are expressed as exceedance days of the numeric targets measured in the receiving water (i.e. river segment or tributary).

While MS4 Permittees can achieve WLAs by employing any viable and legal implementation strategy, a recommended implementation approach is presented below, called “MS4 Load Reduction Strategy” (LRS) and requires coordinated effort by all MS4 Permittees within a segment or tributary. Each LRS must quantitatively demonstrate that the actions contained within the LRS are sufficient to result in attainment of the ***final*** WLAs. The ***interim*** WLAs represent a minimum threshold that must be attained after those actions are taken, per the implementation schedule. An LRS shall be approved by the Regional Board Executive Officer prior to implementation.

Individual MS4 Permittees or subgroups of MS4 Permittees may choose to develop and implement an alternative implementation strategy, then the group-based WLAs may be distributed based on proportional drainage area, upon approval of the Executive Officer. In this case, the implementation approaches herein can still be followed based on the proportional WLAs. The implementation approaches herein, including the use of an MS4 Load Reduction Strategy, can still be followed based on the proportional WLAs.

For MS4 Permittees that choose to ***not*** follow an MS4 Load Reduction Strategy, there is no specific process to be followed, but the compliance schedule for attainment of final WLAs is shorter as a second implementation phase is not included in the schedule. Overall, MS4 Permittees who follow a LRS approach accept a tradeoff between a longer timeframe for compliance with final WLAs, but a more rigorous process by which Permittees must determine and document necessary implementation activities.

The LRS MS4 dry weather implementation strategy as described in the following establishes a stepwise and iterative process. This strategy establishes phases for implementation, both by prioritizing different segments of the river for implementation actions before others, as discussed below, and by allowing two full phases of implementation per segment.

In the first phase of implementation, a segment must meet the interim WLA expressed as *E. coli* loading and the LRS must be designed to meet the final WLA expressed as exceedance days of the numeric targets in the river segment or tributary, but due to the highly variable nature of bacterial sources, a full second phase of implementation is scheduled to ensure achievement of final WLAs.

A MS4 Load Reduction Strategy (LRS) is both [1] a suite of actions performed by MS4 Permittees along a Los Angeles River segment or tributary and [2] a document submitted to the Regional Board Executive Officer for approval. The document must describe the suite of actions that will be performed and demonstrate reasonable assurance of interim and final WLA attainment. A LRS may include 1) outfall methods such as structural methods like dry weather diversions, 2) source control and, in appropriate circumstances, 3) downstream methods to treat waters at the end of tributaries.

1) Structural methods are usually directed at specific outfalls. Dry weather diversions of storm drains to wastewater treatment plants or localized infiltration projects are structural methods.

2) Source control - Any approach to reduce bacteria in the MS4 will necessarily include some source control. Source control may be less costly and/or more reliable than the outfall-based approach while still attaining the WLAs. Source control relies heavily on "sustainable" types of actions that may be preferred by stakeholders including dry weather runoff management, low impact development, and sanitary surveys. Source control methods may include development of comprehensive, system-wide actions to reduce the volume of dry weather runoff discharged from MS4 outfalls. These flow rate reductions could potentially be achieved using non-structural controls/programs that reduce or eliminate dry weather runoff. Such programs may include enforced municipal ordinances regarding landscape irrigation (limiting excessive overflow and/or the types of plants that are allowed), low impact development ordinances that capture runoff from development/redevelopment, etc. A major challenge will be quantification of the effectiveness of non-structural controls/programs; the collected outfall monitoring data could be used in conjunction with pilot studies to quantify effectiveness before and after implementation. Source control methods could also include targeted investigations and abatement efforts (e.g., sanitary surveys) of problematic dry weather storm drain discharges. Human-specific bacterial indicators (e.g., *Bacteroidales*) data could be used in conjunction with *E. coli* data to target problematic discharges.

3) The downstream methods use a single structural control to directly reduce bacteria concentrations in receiving waters (e.g., constructing a treatment control at the mouth of a tributary just upstream of its confluence with the Los Angeles River), as opposed to constructing multiple controls at storm drain outfalls along the

segment or tributary. A downstream method will necessarily require a Use Attainability Analysis (UAA) to be a viable implementation approach.

The downstream-based method is included because it has the potential to lead to more reliable, faster, and less-expensive solutions for protection of recreational users when compared to a structural approach. Downstream-based approaches may be less expensive and require a shorter timeline because a single (though larger) solution can be installed within or adjacent to the segment/tributary as opposed to multiple projects at upstream outfalls. Downstream-based approaches may be more reliable and protective because they collect and treat all water (including MS4 runoff) at a single location upstream of potential recreational areas.

The downstream-based approach poses significant challenges, and may in fact not be feasible for any of the Los Angeles River segments or tributaries due to regulatory and/or engineering constraints, as described below.

- **In-stream project –** Create an in-stream project immediately upstream of a compliance point that provides in-stream treatment for bacteria reduction and perhaps has multiple benefits.
- **Treatment and discharge/reuse –** Divert flow immediately upstream of a TMDL compliance point (immediately prior to confluence with the Los Angeles River), treat and return to waterbody and/or reuse dry weather flow to supplement irrigation water supplies.
- **Divert and infiltrate –** Divert flow immediately upstream of a TMDL compliance point, and infiltrate diverted flow at a nearby site.
- **Diversion to WRP –** Divert all or a portion of a tributary or segment's surface runoff to the sanitary sewer for treatment by a WRP.

An evaluation of the feasibility of a downstream approach would include the following components:

- Technical feasibility
- Economic feasibility
- Regulatory acceptability under federal and state laws
- Environmental impacts
- Public acceptability

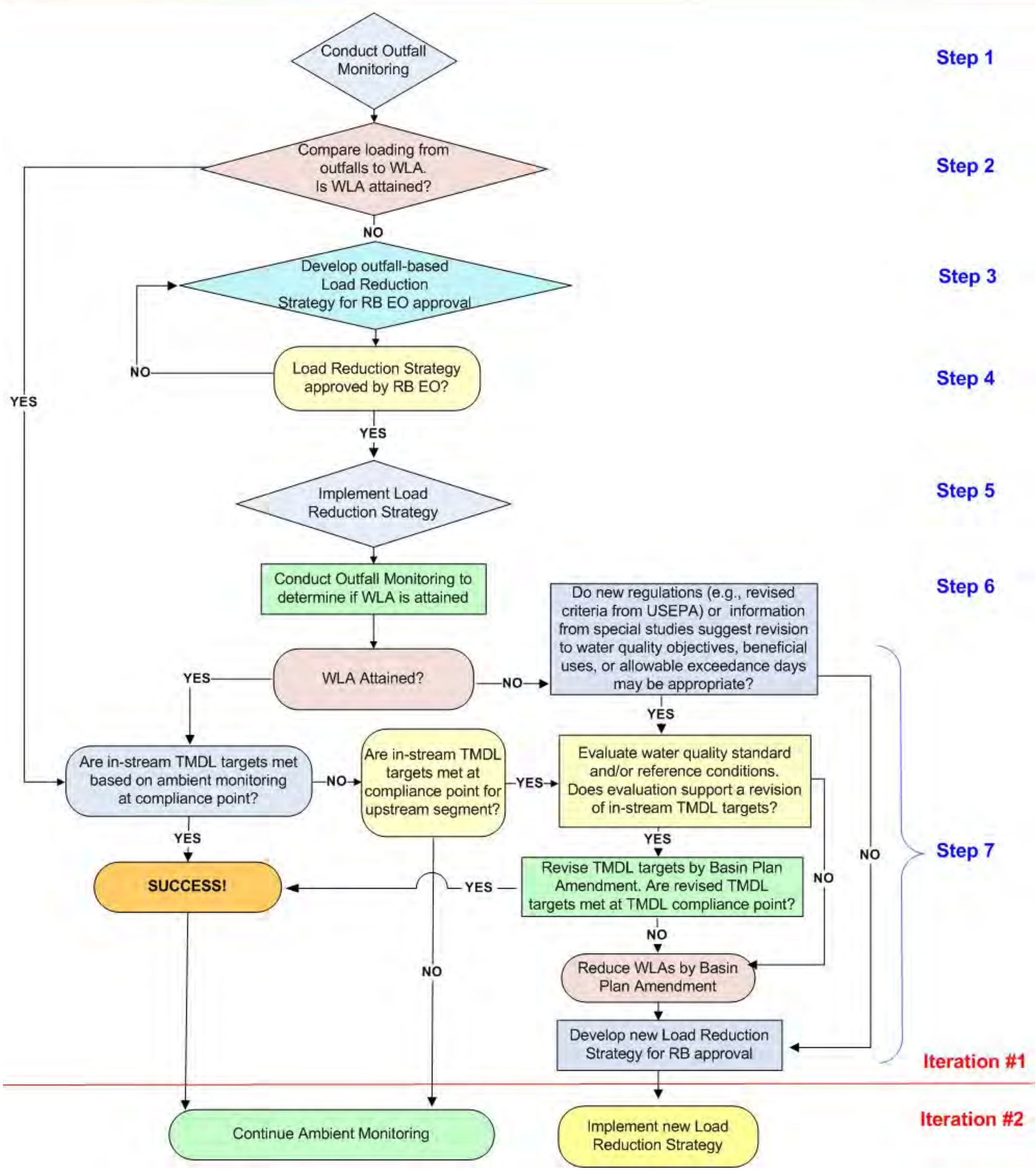
A downstream-based approach could be considered "infeasible" according to any of the above criteria. The regulatory and public acceptability components are likely the biggest hurdles for MS4- permittees that would pursue a downstream-based approach. In particular, the downstream-based approach will likely require the performance of a Use Attainability Analysis (UAA) to evaluate whether the upstream recreational uses are existing and/or attainable per 40 CFR§131.10(g). Otherwise, the portion of the segment or tributary that is just upstream of the downstream solution would remain out of compliance with the TMDL target (and

Basin Plan water quality objectives), potentially requiring additional actions in the future.

The MS4 Load Reduction Strategy to be submitted to the Regional Board Executive Officer for approval shall specify the proposed number, types and locations of actions that will be implemented to attain the MS4 WLA for a mainstem Los Angeles River segment or tributary. MS4 Permittees may use any combination of actions in a LRS as long as it is sufficiently demonstrated that the proposed suite of actions are expected to result in WLA attainment.

There are seven steps in using an LRS plan for a mainstem Los Angeles River segment or tributary. After outfall monitoring (Step 1) and comparison of existing *E. coli* loading to the WLA (Step 2), a LRS plan for attaining the WLA is developed (Step 3). Executive Officer approval is Step 4 and implementation of the plan is Step 5. Outfall monitoring and determination of success is Step 6. Step 7 identifies next steps. See Figure 7-1. All of the steps are described in greater detail in the CREST-developed Appendix 1.

**Figure 9-1 Los Angeles River Bacteria TMDL Outfall-based LRS Approach Flow Diagram**




WLA = Wasteload Allocation     RB EO = Regional Board Executive Officer

The MS4 LRS approach requires a significant investment in collection and analysis of outfall water quality data to develop the plan. Step 1 is the collection of that data, as described in more detail in the monitoring subsection, below. Essentially, every outfall in a segment or tributary is characterized so that the outfalls contributing the most to the exceedances and the health risk can be identified for priority action. The early investment in data collection and the evaluation of the data (Step 2) makes it more likely for the plan to succeed.

The LRS plan, itself (Step 3), includes several components:

- **Step 3, Part 1: Review of the data collected for the subject segment or tributary.**

- **Step 3, Part 2: Prioritization of storm drain outfalls for implementation actions.** The prioritization process uses the data collected in the outfall monitoring of Step 1. With these data, an evaluation is conducted to determine the most useful storm drains to target for dry weather diversions or other methods of reduction. The mathematical method used to make the prioritization is a Monte Carlo simulation [or equivalent] to (1) evaluate both the individual and cumulative *E. coli* loading rates from outfalls along a segment or tributary and (2) prioritize implementation actions based on these *E. coli* loading rates and, if desired, data for other indicators including source identification data (e.g., human *Bacteroidales*, human-specific viruses, etc.). Two categories of outfalls are identified:

    - ***Priority Outfalls:*** These are outfalls with relatively consistent, problematic discharges that both drive storm drain loading rates above the WLA and are considered to likely pose the highest risk to human health. As such, Priority Outfalls are the highest priority for source investigation and targeted implementation actions (i.e., structural controls).

    - ***Outlier Outfalls:*** These are outfalls that exhibit episodically high loading rates of *E. coli.* Outlier Outfalls are initially subject to follow-up investigations to identify the sources that could be leading the elevated loading rates.

  The detailed process for identifying Priority Outfalls and Outlier Outfalls is presented in CREST Appendix 1, using the Monte Carlo method and, using as an example, data collected from Segment B during the BSI Study (CREST, 2008).

- **Step 3, Part 3: Field assessment of feasibility of potential implementation actions and investigation of potential sources to Priority Outfalls –** Once priority outfalls are identified, a field assessment will be necessary to evaluate the feasibility of potential actions to provide assurance that proposed actions are implementable. Potential site constraints could include, but are not limited to, availability of land to construct a project, access to utilities, and proximity to wastewater infrastructure with available capacity. The additional purpose of a field assessment would be to conduct more detailed investigation of potential sources to determine if source elimination (e.g., from an illicit sanitary sewer connection), rather than a structural BMP to divert or manage the runoff, is required. Details regarding the actions that could be performed during the field assessment are provided in CREST Appendix 1.

- **Step 3, Part 4: Summarize field assessment and identify load reduction actions to be implemented –** This part of the LRS identifies proposed actions at Priority Outfalls and Outlier Outfalls and provides reasonable assurance that WLAs will be attained after the LRS is completed as follows:

  - ***Summarize results of field assessment at the Priority Outfalls:*** If a bacteria source was identified and abated, and therefore expected to reduce the loading of *E. coli* from a Priority Outfall (and eliminate the corresponding need for structural controls), then supporting field data shall be provided.

  - ***Identify proposed actions for Priority Outfalls:*** Permittees may choose whichever implementation actions are preferred to reduce or eliminate the *E. coli* loading from Priority Outfalls. The range of actions could include but are not limited to source control BMPs, low flow diversions, infiltration BMPs, and treatment BMPs as described in Appendix 1.

  - ***Demonstrate that implementation of actions at the Priority Outfalls will result in attainment of WLA:*** This component of the LRS provides reasonable assurance to the Regional Board Executive Officer that proposed implementation actions at the Priority Outfalls will result in attainment of the WLAs. Monte Carlo simulations similar to those utilized to identify Priority Outfalls could be used to demonstrate that implementation actions proposed for the Priority Outfalls will result in attainment of the WLAs. The expected performance (i.e., expected *E. coli* density and associated load from storm drain effluent) after a proposed BMP is installed could be input into the already-constructed Monte Carlo model. For proposed BMPs that do not completely eliminate the discharge, reliable data must be used to estimate expected BMP performance. If non-structural BMPs are a component of the Outfall-based LRS, then it may be necessary to perform pilot studies to sufficiently estimate expected effectiveness. Table 7.1 shows a hypothetical example of an LRS approach to Priority Outfalls for Segment B, based on data collected during the BSI Study (CREST, 2008). Appendix 1 provides additional details and hypothetical LRSs.

  - ***Establish timeline for implementation of actions at Priority Outfalls:*** A timeline for implementing the specific actions at Priority Outfalls must be provided in the LRS, including milestones during the course of LRS implementation. The proposed timeline for an LRS must be in accordance with the TMDL Implementation Schedule.

  - ***Identify proposed follow-up/investigation efforts at Outlier Outfalls:*** Outlier Outfalls and their corresponding drainage areas and storm drain networks shall be investigated to determine potential sources of *E. coli*, particularly human fecal sources that could have led to the episodic elevated bacteria loading rates. The proposed timeline for Outlier Outfall investigations in the LRS must be in accordance with the TMDL Implementation Schedule. A list of Outlier Outfalls along Segment B based on BSI Study data are presented in CREST Appendix 1.

**Table 9-2 Hypothetical LRS Approach to Priority Outfalls for Segment B based on Incorporating Treatment BMPs[1]**

| **Priority Outfall** | **Current Expected *E. coli* Loading Rate**[2] ($10^9$ MPN/day) | **Proposed LRS Action**[1] | **Expected *E. coli* Loading Rate after Proposed LRS Actions** ($10^9$ MPN/day) (% Reduction) | **Expected *E. coli* Loading Rate from all Segment B Outfalls after Proposed LRS Actions**[3] ($10^9$ MPN/day) |
|---|---|---|---|---|
| R2-A | 140 | Diversion | 0 (100%) | 883 |
| R2-K | 78 | Diversion | 0 (100%) | 742 |
| R2-02 | 31 | Wetland [4] | 15 (50%) | 694 |
| R2-06 | 29 | Media filter [5] | 10 (65%) | 637 |
| R2-J | 20 | Wetland [4] | 9 (50%) | 597 |
| R2-G | 15 | Diversion | 0 (100%) | 508 |
| R2-E | 12 | Diversion | 0 (100%) | 446 |

(see Appendix 1 for additional details)

**1 –** These actions are completely hypothetical for demonstration purposes only and have not been assessed for feasibility or desirability.
**2 –** Expected values are based on Monte Carlo simulation medians using data collected from the BSI Study.
**3 –** The expected *E. coli* loading from all outfalls ***prior*** to action is 1,431 x $10^9$ MPN per day. The expected post-action loading rates are cumulative based on employed BMPs, starting with a low flow diversion (LFD) at R2-A and ending with an LFD at R2-E. The MS4 WLA for Segment B is 472 x $10^9$ MPN per day.
**4 –** Median of 4 values reported by Clary *et al.* (2008) from the International Stormwater BMP Database (www.bmpdatabase.org). Reductions ranged fro m 0 to 98.5%. The average reduction was 38.4%.
**5–** Median of 12 values reported by Clary *et al.* (2008) from the International Stormwater BMP Database. Reductions ranged from 0 to 94.8%. The average reduction was 40.6%.

Following development, the LRS shall be submitted for Regional Board Executive Officer approval (Step 4). The EO will approve LRSs that follow the step-wise approaches, which are designed to provide reasonable assurance of WLA attainment.

Implementation of actions in the LRS (Step 5) will be initiated according to the schedule in the LRS.

Upon completion of the implementation actions identified in the LRS, outfall monitoring (Step 6) must be conducted to evaluate whether the LRS resulted in attainment of the WLAs. The goal of this monitoring is to characterize the ***E. coli*** loading from all flowing storm drain outfalls (Priority Outfalls, Outlier Outfalls, and all other outfalls) and determine if WLAs were attained after the LRS was implemented. The monitoring will be conducted in the same manner as under Step 1, as described below.

An evaluation of attainment of the WLAs and numeric targets is Step 7. Three scenarios are possible after Step 7.

- Scenario 1: MS4 interim WLA attained and numeric targets met (final WLAs)
  Under Scenario 1, the TMDL has been achieved for that segment and ambient monitoring continues.

- Scenario 2: MS4 WLA attained but in-stream targets are not met
  Under Scenario 2, the discharges and WLAs are re-evaluated and a second phase of implementation within the segment/tributary is undertaken, if necessary, and ambient monitoring continues.

- Scenario 3: MS4 WLA not attained and in-stream targets are not met
  Under Scenario 3, the discharges and WLAs are re-evaluated and a second phase of implementation is undertaken, and ambient monitoring continues.

### 9.4.6 Prioritization of segments; MS4 dry weather implementation

The MS4 LRS strategy establishes phases for implementation, both by allowing two full phases of implementation per segment and by setting different segments of the river to be implemented before others. This section describes the process used to prioritize MS4 implementation on five specific mainstem LA River segments and 11 tributaries. The concepts used in prioritization of TMDL implementation segments were evaluated during a September 2009 CREST stakeholder workshop. Through extensive discussions involving a broad spectrum of stakeholders, four primary locations where water contact activities are known or likely to occur were categorized as the highest priority.

- **Long Beach beaches:** Downstream of the extent of this TMDL, the beaches of Long Beach, are adjacent to the mouth of the Los Angeles River, and are subject to water contact by thousands of individuals each year.

- **Segment A and B of the Los Angeles River:** Much of this portion of the Los Angeles River has a path on the bank of the River[5], and while entering the channel is not permitted, water contact has been observed in these segments.

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[5] The Los Angeles River is a trapezoidal channel along Segment A and B (from Figueroa Street [upstream] to the mouth [downstream]). The walking/bike path is adjacent to the Los Angeles River, several hundred feet from the low-flow channel. Unlike other

- **Glendale Narrows:** The Narrows is a stretch of soft-bottom channel at the downstream end of Segment C. Horse riding and sunbathing are common in this portion of the LA River, and there are access points where individuals can get near or into the river.

- **Sepulveda Basin:** The Sepulveda Basin is another soft-bottom portion of the Los Angeles River, and adjacent to the Basin are recreational areas (Balboa Lake Park) and trails that provide access to the river.

**Table 9-3** presents a conceptual timeline of prioritization of TMDL implementation for the mainstem Los Angeles River segments and tributaries. The order in which the segments and tributaries of the Los Angeles River were prioritized over time was based on (1) the relative level of risk to recreational users given perceived differences in frequency of recreational activities[6] and (2) the extent of currently available water quality information that could expedite implementation actions to meet WLAs.

An important consideration for the timeline is the order of implementation actions in Los Angeles River segments versus tributaries. To allow for attainment of TMDL targets in the mainstem Los Angeles River earlier during the TMDL implementation timeline, implementation activities on tributaries are proposed to follow completion of initial work on the corresponding mainstem Los Angeles River segments. In other words, all Los Angeles River segments could have been addressed prior to any tributaries, but the loading from tributaries might have prevented attainment of TMDL targets in the mainstem Los Angeles River until later in the schedule. Thus, the proposed order for the implementation timeline is segment-tributary, segment-tributary instead of segment, segment, tributary, tributary.

While this prioritization shows a stepwise progression of BMP implementation through the various Los Angeles River segments and tributaries, MS4 Permittees may implement system-wide source control BMPs during all phases of implementation. In this manner, loading to some Los Angeles River segments or tributaries would be reduced prior to being addressed by structural BMPs, and in fact, system-wide source control efforts should ultimately reduce the effort for structural implementation actions. In addition, implementation of other TMDLs currently in effect in the Los Angeles River Watershed, in particular the Metals TMDL, will assist with achieving the targets and allocations of this TMDL.

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portions of the Los Angeles River, there is no fence between the path and the water along Segment A and B.

[6] The relative magnitude of recreational activities was based on discussions with stakeholders including non-governmental organizations. It was presumed that the lower reaches of the LA River (Reach 1 and Reach 2) are subject to the most frequent activity. It is noted that some of this user access is prohibited by Los Angeles County DPW. See http://ladpw.org/services/water/nowayout.pdf.

The following describes the reasoning for prioritizing the segments, and corresponding tributaries, as presented in **Table 9-3** (see Figure 6-1 for the extent and location of Los Angeles River segments and tributaries):

- **Priority 1:** Segment B: upper and middle Reach 2 – Figueroa Street to Rosecrans Avenue. Tributaries to Segment B include Rio Hondo and Arroyo Seco. Segment B was selected as the first priority for compliance efforts for three reasons:

  1) The availability of data to support a relatively rapid initiation of implementation actions. There is a large data set on the bacteria and virus loading from the storm drain outfalls collected by the recently completed Los Angeles River Bacteria Source Identification (BSI) Study (CREST, 2008). This dataset is essentially the Step 1 data collection of an MS4 LRS and will allow the MS4 Permittees to move forward with implementation efforts to reduce bacterial loads from priority storm drain outfalls to the main channel.

  2) Elevated recreational use compared to other Los Angeles River segments.

  3) Proximity to the downstream estuary, San Pedro Bay and Long Beach beaches. Reduction of bacterial loads to Segment B would not only be beneficial to recreational users within the Los Angeles River but would also be beneficial to recreational users of the Bay and Long Beach beaches.

  In addition, early reduction of MS4 bacteria discharges to segment B/Reach 2 will provide a better starting point for concurrently conducting optional special studies to more fully characterize all sources within this segment.

  **Priority 2:** Segment A: lower Reach 2 and Reach 1 – Rosecrans Avenue to Willow Street. Compton Creek is the only tributary to Segment A. Segment A, which is downstream of Segment B, was the next highest priority reach for compliance efforts due to its close proximity to the downstream estuary and beaches. As with Segment B, reduction of bacterial loads to Segment A would not only be beneficial to recreational users within the Los Angeles River but would also be beneficial to recreational users of the bay and Long Beach beaches.

- **Priority 3:** Segment E: Reach 6 – Los Angeles River headwaters to Balboa Boulevard. Tributaries to Segment E include McCoy Canyon, Dry Canyon, Bell Creek, and Aliso Canyon Wash. Segment E was chosen as the next priority because it is directly upstream of the Sepulveda Basin (Reach 5), which is a recreational area with water contact activities. Bacterial load reductions in Segment E are expected to result in improved water quality at the downstream Sepulveda Basin recreational area.

- **Priority 4:** Segment C: lower Reach 4 and Reach 3 – Tujunga Avenue to Figueroa Street. Tributaries to Segment C include Tujunga Wash, Burbank Western Channel, and Verdugo Wash. Segment C was selected as the next priority because of the potential for recreational use in the lower portion of the segment, the Glendale Narrows in Reach 3. Due to its soft bottom and ease of accessibility to the public, Glendale Narrows is a popular recreational area.

- **Priority 5:** Segment D: Reach 5 and upper Reach 4 – Balboa Boulevard to Tujunga Avenue. Bull Creek is the only tributary to Segment D. Segment D was placed as the final priority for implementation efforts because much of this the segment is the least accessible (due to the fenced, vertical concrete channel). While Reach 5 is contained in Segment D and provides recreational use opportunities, it was not prioritized earlier for implementation efforts because (1) it is anticipated that reductions in loadings that occur as a result of addressing Segment E (Reach 6) will also result in supporting attainment of instream targets in Reach 5 and (2) there are relatively few MS4 discharges to Reach 5.

**Table 9-3 Conceptual Schematic of Los Angeles River Bacteria TMDL Prioritized and Iterative Implementation Process for MS4 Permittees**

| **Timeline** | **Immediate Ongoing Actions** | **Implementation of LRS** | | **Implementation of Second LRS (if necessary) *** | |
|---|---|---|---|---|---|
| | Watershed-Wide Actions | Los Angeles River Mainstem | Tributaries | Los Angeles River Mainstem | Tributaries |
| Adoption of TMDL | LA River Watershed | Segment B | | | |
| ↓ | | Segment A | Segment B | Segment B | |
| | | Segment E | Segment A | Segment A | Segment B |
| | | Segment C | Segment E | Segment E | Segment A |
| | | Segment D | Segment C | Segment C | Segment E |
| | | | Segment D | Segment D | Segment C |
| Completion of TMDL | | | | | Segment D |

* – Implementation of additional BMPs as necessary to achieve WLA for each individual segment and/or tributary. If the WLA is achieved, then no additional actions are required for that segment or tributary.

## 9.5 Wet Weather Implementation

Grouped final WLAs for the MS4 Permittees in the watershed, including Caltrans, for wet weather are expressed as the allowable number of exceedance days. The group allocation applies to all MS4 Permittees in the Los Angeles River watershed (Los Angeles County Flood Control District, Los Angeles County and co-MS4 Permittees that discharge to the watershed, including the City of Long Beach, and Caltrans).

Because compliance with wet weather WLAs will depend upon BMPs designed to meet dry weather targets and because the wet weather WLAs for the entire stretch of river will not be achievable until after full implementation of the dry weather phases, wet weather compliance is required at the end of the implementation schedule for all segments and tributaries.

MS4 Permittees can achieve wet weather WLAs by employing any viable and legal implementation strategy.

As in other bacterial TMDLs developed in this Region, responsible jurisdictions and agencies must provide an Implementation Plan to the Regional Board outlining how each intends to cooperatively achieve compliance with the wet weather WLAs. The plan shall include implementation methods, an implementation schedule, and proposed milestones. The plan shall include a technically defensible quantitative linkage to the final wet weather WLAs. The linkage should include target reductions in stormwater runoff and/or *E. coli* bacteria. The plan shall include quantitative estimates of the water quality benefits provided by the proposed structural and non-structural BMPs. Responsible parties may propose wet weather load-based compliance at MS4 outfalls, which shall include an estimate of existing load and the allowable load from MS4 outfalls to attain the allowable number of exceedance days instream.

## 9.6 Implementation Schedule

Within 25 years of the effective date of the TMDL, compliance with the allowable number of exceedance days at all locations during dry weather and wet weather is required.

The longer schedule, as compared to that provided for in the Santa Monica Bay Beaches Bacteria TMDLs, and the Ballona Creek Bacteria TMDL, is warranted due to the number and scale of the foreseeable implementation measures. In the case of the Santa Monica Bay Beaches Bacteria TMDLs, responsible agencies had initiated dry weather implementation measures prior to TMDL adoption for many beaches, therefore a three-year schedule for summer dry weather was feasible for those beaches. The Ballona Creek watershed compliance periods are also much shorter than this TMDL's compliance periods, but the number of stream miles and the size of the watershed to be brought into compliance is also much smaller, see Table 9-4. The final compliance dates for this TMDL are based on foreseeable implementation and are reasonably consistent with the Ballona Creek Bacteria TMDL.

**Table 9-4 Comparison of the Size of the Ballona Creek and Los Angeles River Watersheds and the Corresponding TMDL Compliance Dates.**

| Watershed | Miles of Listed Stream in TMDL | Urbanized Watershed | Dry Weather Implementation Years | Wet Weather Implementation Years |
|---|---|---|---|---|
| Ballona Creek | 10 miles | 130 sq mi | 6 | 14 |
| Los Angeles | 127 (55 | 599 sq mi | 25 | 25 |

| | | | | |
|---|---|---|---|---|
| River | mainstem miles plus tributaries) | | | |

The schedule is sufficiently long to allow MS4 Permittees to use any of the compliance methods discussed, including outfall-directed actions, source control actions and if conditions warrant, downstream approaches. The time allowed for specific actions in the schedule – i.e., planning, implementing an estimated number of actions, assessing - is based on the experience of the MS4 Permittees in implementing other TMDLs.

The implementation schedule is phased both in terms of the segment-by-segment approach, as discussed above, and also within each segment by allowing two phases of implementation to achieve full compliance with the WLAs. The interim WLAs, based on bacterial loads (rather than exceedance days), have been developed to bring the River into compliance with the final exceedance day WLAs. A second phase is included in the schedule to allow for the high variability of bacterial loads and potentially changing conditions in the River over time; however, it is expected that the River will be largely in compliance by the time the first phase of implementation is complete.

The TMDL schedule requires completion of the first LRS phase and attainment of the interim WLA on all mainstem Los Angeles River segments and tributaries within 15.5 years, and a total timeline of 25 years to complete a second phase on the final segments addressed (Segments C and D and tributaries).

Implementation for Segments A and B, identified as the highest priority because of the potential influence on the beaches located in Long Beach, will be completed within 8 years of the effective date of the TMDL. Therefore, significantly improved water quality is expected at Long Beach beaches well before the complete implementation of the TMDL.

This schedule is based on the CREST-developed schedule. The time allotted for planning, implementing, and assessing are as determined by the CREST stakeholder group and the schedule includes a full second phase of implementation for all segments. This schedule differs from the CREST-developed schedule in four ways: 1) this schedule provides no gap between first and second phases for "reconsideration" of the TMDL because implementation does not need to stop if the TMDL is re-considered 2) only 3 years is provided for the second phase of implementation (versus 4 years) because it is expected that the river will largely be in compliance as a result of actions in the first phase, and any watershed-wide BMPs will be beginning to have effect, 3) only 2 years for the second evaluation (versus 3 years) because planning for the second evaluation can take place during implementation, 4) the final three segments (Segment C tributaries, Segment D and Segment D tributaries) have been moved up parallel in time to Segment C because watershed-wide BMPs will be beginning to have effect and BMPs implemented for the Los Angeles River Watershed Metals TMDL, which are designed to address multiple pollutants, will have effect.

Responsible parties in the Los Angeles River Watershed are currently implementing the Los Angeles River Watershed Metals TMDL, which requires compliance with wet weather metal targets by 2028 (within 22 years of the TMDL effective date). Interim goals were also established for the metals TMDL. Implementation plans developed for these TMDLs by the City of Los Angeles and County of Los Angeles include BMPs to address multiple pollutants including bacteria. Implementation of the metals TMDL will be complete before the bacterial TMDL and will address much of the bacterial impairment. So, it is expected that the segments scheduled for later implementation under this schedule will experience bacteria water quality improvements prior to the scheduled implementation phase.

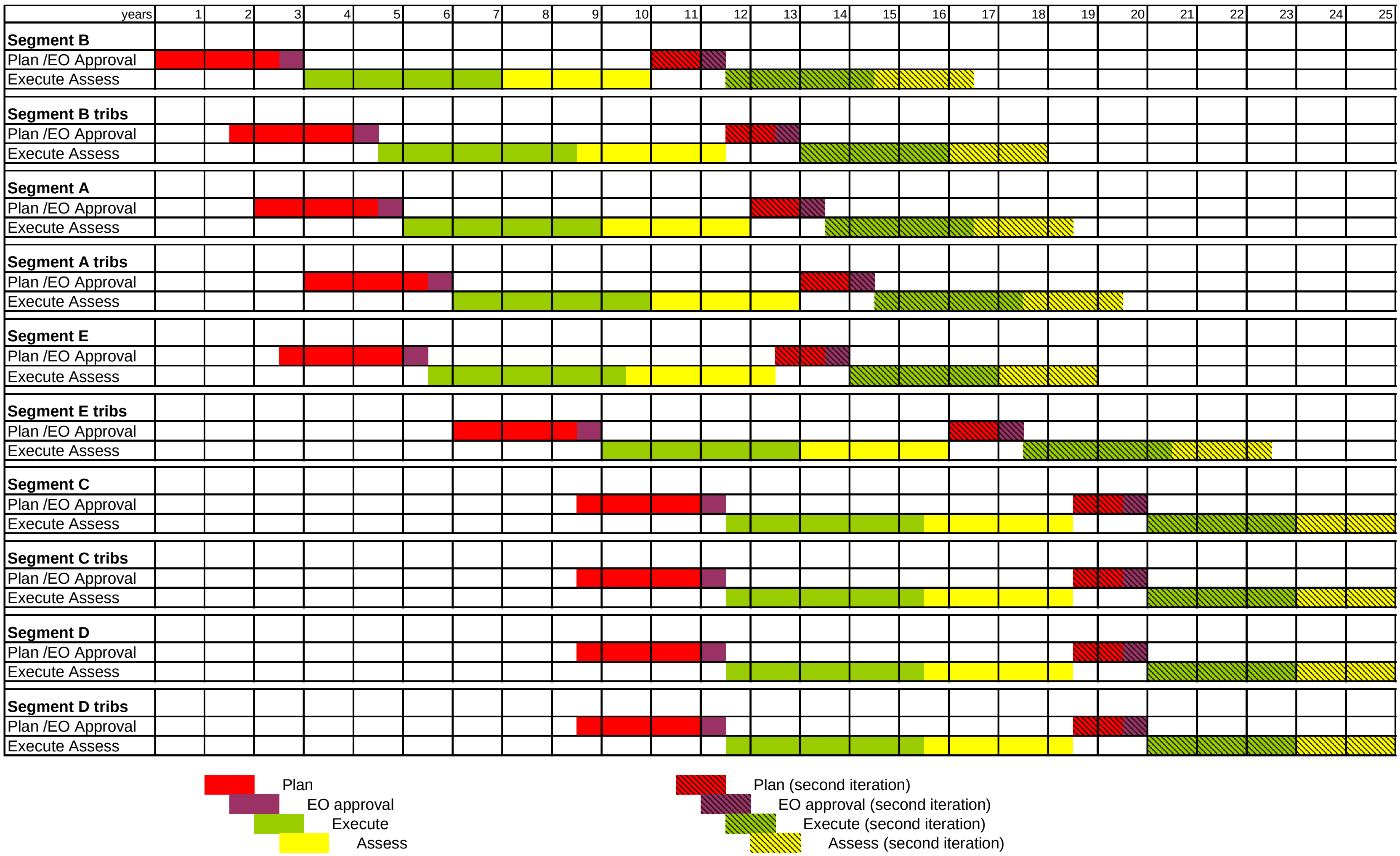
This schedule for dry weather, including interim allocations, is very detailed and phased due to the work of CREST which provided the significant scientific work and stakeholder input to support the detailed, phased, approach. For wet weather, the schedule is based on the Regional Board and stakeholder experiences in developing other bacterial TMDLs. The Ballona Creek Bacteria TMDL, Malibu Creek Bacteria TMDL and Santa Monica Bay Beaches Bacteria TMDL schedules allow approximately 15 to 18 years for wet weather compliance when following an Integrated Water Resources Approach to address multiple pollutants. For this TMDL, the very long time allowed for complete dry weather compliance due to the phased approach, itself, allows sufficient time for responsible parties to pursue and succeed with an integrated approach to achieve wet weather WLAs throughout the watershed. Therefore, the wet weather compliance schedule is set at 25 years.

**Figure 9-2 Implementation Schedule**

By year 10, all Segment A and B first phase actions taken Wet weather plans completed

By year 15.5, all Segments and tributaries first phase actions taken

By year 25, dry weather and wet weather compliance acheived




Note 1: The interim allocations based on bacterial loads (versus exceedance days) have been developed to bring the River in compliance with the exceedance day targets. A second phase is included in the schedule to allow for the high variability of bacterial loads and potentially changing conditions in the River; however, it is expected that the River will be largely in compliance by the time the first phase of implementation is complete.

**Table 9-5 Implementation Schedule for Los Angeles River Bacteria TMDL (watershed wide actions at are the end of the table)**

*Italics in this Table refer to Permittees using alternative compliance plan instead of an LRS*

| Implementation Action | Responsible Parties | Deadline |
|---|---|---|
| **Segment by Segment Schedule Dry Weather (Schedule for all river and wet weather is at the end of the Table)** | | |
| **SEGMENT B (upper and middle Reach 2 – Figueroa Street to Rosecrans Avenue) Dry Weather** | | |
| **First phase – Segment B** | | |
| Submit a Load Reduction Strategy (LRS) for Segment B *(or submit an alternative compliance plan)* | MS4 and Caltrans NPDES Permittees discharging to Segment B | 2.5 years after effective date of the TMDL |
| Approve LRS (or alternative compliance plan) | Regional Board, Executive Officer | 6 months after submittal of LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment B, if using LRS | 7 years after effective date of the TMDL |
| Achieve interim (or final) WLA and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment B, if using LRS | 10 years after effective date of the TMDL |
| *Achieve final WLA or demonstrate that non-compliance is due to upstream contributions and submit report to Regional Board* | *MS4 and Caltrans NPDES Permittees discharging to Segment B, if using alternative compliance plan* | *10 years after effective date of the TMDL* |
| **Second phase, if necessary – Segment B (LRS only)** | | |
| Submit a new LRS | MS4 and Caltrans NPDES Permittees discharging to Segment B | 11 years after effective date of the TMDL |
| Approve LRS | Regional Board, Executive Officer | 6 months after submittal of a second LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment B, if using LRS | 14.5 years after effective date of the TMDL |
| Achieve final WLAs in Segment B or demonstrate that non-compliance is only due to upstream contributions and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment B, if using LRS | 16.5 years after effective date of the TMDL |
| **SEGMENT B TRIBUTARIES (Rio Hondo and Arroyo Seco)** Dry Weather | | |
| **First phase – Segment B Tributaries (Rio Hondo and Arroyo Seco)** | | |
| Submit a Load Reduction Strategy (LRS) for Segment B tributaries *(or submit an alternative compliance plan)* | MS4 and Caltrans NPDES Permittees discharging to Segment B tributaries | 4 years after effective date of the TMDL |
| Approve LRS (or alternative compliance plan) | Regional Board, Executive Officer | 6 months after submittal of LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment B tributaries, if using LRS | 8.5 years after effective date of the TMDL |
| Achieve interim (or final) WLA and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment B tributaries, if using LRS | 11.5 years after effective date of the TMDL |
| *Achieve final WLA or demonstrate that non-compliance is only due to upstream contributions and submit report to Regional Board* | *MS4 and Caltrans NPDES Permittees discharging to Segment B tributaries, if using alternative compliance plan* | *11.5 years after effective date of the TMDL* |
| **Second phase, if necessary – SEGMENT B TRIBUTARIES (Rio Hondo and Arroyo Seco) (LRS only)** | | |
| Submit a new LRS | MS4 and Caltrans NPDES Permittees discharging to Segment B tributaries | 12.5 years after effective date of the TMDL |

| Implementation Action | Responsible Parties | Deadline |
|---|---|---|
| Approve LRS | Regional Board, Executive Officer | 6 months after submittal of a second LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment B tributaries, if using LRS | 16 years after effective date of the TMDL |
| Achieve final WLAs Segment B tributaries or demonstrate that non-compliance is due to upstream contributions and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment B tributaries, if using LRS | 18 years after effective date of the TMDL |
| **SEGMENT A (lower Reach 2 and Reach 1 – Rosecrans Avenue to Willow Street) Dry Weather** | | |
| **First phase – Segment A** | | |
| Submit a Load Reduction Strategy (LRS) for Segment A (or submit an alternative compliance plan) | MS4 and Caltrans NPDES Permittees discharging to Segment A | 4.5 years after effective date of the TMDL |
| Approve LRS (or alternative compliance plan) | Regional Board, Executive Officer | 6 months after submittal of LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment A, if using LRS | 9 years after effective date of the TMDL |
| Achieve interim (or final) WLA and and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment A, if using LRS | 12 years after effective date of the TMDL |
| *Achieve final WLA or demonstrate that non-compliance is due to upstream contributions and submit report to Regional Board* | *MS4 and Caltrans NPDES Permittees discharging to Segment A, if using alternative compliance plan* | *12 years after effective date of the TMDL* |
| **Second phase, if necessary – Segment A (LRS only)** | | |
| Submit a new LRS | MS4 and Caltrans NPDES Permittees discharging to Segment A | 13 years after effective date of the TMDL |
| Approve LRS | Regional Board, Executive Officer | 6 months after submittal of a second LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment A, if using LRS | 17.5 years after effective date of the TMDL |
| Achieve final WLAs in Segment A or demonstrate that non-compliance is due to upstream contributions | MS4 and Caltrans NPDES Permittees discharging to Segment A, if using LRS | 19.5 years after effective date of the TMDL |
| **SEGMENT A TRIBUTARY (Compton Creek) Dry Weather** | | |
| **First phase – Segment A Tributary** | | |
| Submit a Load Reduction Strategy (LRS) for Segment A tributary (or submit an alternative compliance plan) | MS4 and Caltrans NPDES Permittees discharging to Segment A tributary | 6 years after effective date of the TMDL |
| Approve LRS (or alternative compliance plan) | Regional Board, Executive Officer | 6 months after submittal of LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment A tributary if using LRS | 10.5 years after effective date of the TMDL |
| Achieve interim (or final) WLA and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment A tributary if using LRS | 13.5 years after effective date of the TMDL |
| *Achieve final WLA or demonstrate that non-compliance is due to upstream contributions and submit to Regional Board* | *MS4 and Caltrans NPDES Permittees discharging to Segment A tributary, if using alternative compliance plan* | *13.5 years after effective date of the TMDL* |
| **Second phase, if necessary – Segment A tributary (LRS only)** | | |

| Implementation Action | Responsible Parties | Deadline |
|---|---|---|
| Submit a new LRS | MS4 and Caltrans NPDES Permittees discharging to Segment A tributary | 14.5 years after effective date of the TMDL |
| Approve LRS | Regional Board, Executive Officer | 6 months after submittal of a second LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment A tributary, if using LRS | 18 years after effective date of the TMDL |
| Achieve final WLAs in Segment A tributary or demonstrate that non-compliance is due to upstream contributions and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment A tributary, if using LRS | 20 years after effective date of the TMDL |
| **SEGMENT E (Reach 6 – LA River headwaters [confluence with Bell Creek and Calabasas Creek] to Balboa Boulevard) Dry Weather** | | |
| **First phase – Segment E** | | |
| Submit a Load Reduction Strategy (LRS) for Segment E *(or submit an alternative compliance plan)* | MS4 and Caltrans NPDES Permittees discharging to Segment E | 5.5 years after effective date of the TMDL |
| Approve LRS (or alternative compliance plan) | Regional Board, Executive Officer | 6 months after submittal of LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment E, if using LRS | 10 years after effective date of the TMDL |
| Achieve interim (or final) WLA and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment E, if using LRS | 13 years after effective date of the TMDL |
| *Achieve final WLA or demonstrate that non-compliance is due to upstream contributions and submit to the Regional Board* | *MS4 and Caltrans NPDES Permittees discharging to Segment E, if using alternative compliance plan* | *13 years after effective date of the TMDL* |
| **Second phase, if necessary –Segment E, (LRS only)** | | |
| Submit a new LRS | MS4 and Caltrans NPDES Permittees discharging to Segment E | 14 years after effective date of the TMDL |
| Approve LRS | Regional Board, Executive Officer | 6 months after submittal of a second LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment E, if using LRS | 17.5 years after effective date of the TMDL |
| Achieve final WLAs in Segment E or demonstrate that non-compliance is due to upstream contributions and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment E, if using LRS | 19.5 years after effective date of the TMDL |
| **SEGMENT E TRIBUTARIES (Dry Canyon Creek, McCoy Creek, Bell Creek, and Aliso Canyon Wash)** | | |
| **First phase – Segment E Tributaries Dry Weather** | | |
| Submit a Load Reduction Strategy (LRS) for Segment E tributaries (or submit an alternative compliance plan) | MS4 and Caltrans NPDES Permittees discharging to Segment E tributaries | 9.5 years after effective date of the TMDL |
| Approve LRS (or alternative compliance plan) | Regional Board, Executive Officer | 6 months after submittal of LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment E tributaries if using LRS | 14 years after effective date of the TMDL |
| Achieve interim (or final) WLA and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment E tributaries, if using LRS | 17 years after effective date of the TMDL |

| Implementation Action | Responsible Parties | Deadline |
|---|---|---|
| *Achieve final WLA or demonstrate that non-compliance is due to upstream contributions and submit report to Regional Board* | *MS4 and Caltrans NPDES Permittees discharging to Segment E tributaries, if using alternative compliance plan* | *17 years after effective date of the TMDL* |
| **Second phase, if necessary – Segment E tributaries (LRS only)** | | |
| Submit a new LRS | MS4 and Caltrans NPDES Permittees discharging to Segment E tributaries | 18 years after effective date of the TMDL |
| Approve LRS | Regional Board, Executive Officer | 6 months after submittal of a second LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment E tributaries, if using LRS | 21.5 years after effective date of the TMDL |
| Demonstrate compliance with LRS | MS4 and Caltrans NPDES Permittees discharging to Segment E tributaries, if using LRS | 23.5 years after effective date of the TMDL |
| Achieve final WLAs in Segment E tributaries or demonstrate that non-compliance is due to upstream contributions and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment E tributaries, if using LRS | 23.5 years after effective date of the TMDL |
| **Segment C (lower Reach 4 and Reach 3 – Tujunga Avenue to Figueroa Street) Dry Weather**<br>**Segment C Tributaries (Tujunga Wash, Burbank Western Channel, and Verdugo Wash) Dry Weather**<br>**Segment D (Reach 5 and upper Reach 4 – Balboa Boulevard to Tujunga Avenue) Dry Weather**<br>**Segment D Tributaries (Bull Creek) Dry Weather** | | |
| **First phase – Segment C, Segment C Tributaries, Segment D, Segment D tributaries** | | |
| Submit a Load Reduction Strategies (LRS) for Segment C, Segment C tributaries, Segment D, Segment D tributaries *(or submit an alternative compliance plan)* | MS4 and Caltrans NPDES Permittees discharging to Segment C, Segment C tributaries, Segment D, Segment D tributaries | 11 years after effective date of the TMDL |
| Approve LRS (or alternative compliance plan) | Regional Board, Executive Officer | 6 months after submittal of LRS |
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment C, Segment C tributaries, Segment D, Segment D tributaries, if using LRS | 15.5 years after effective date of the TMDL |
| Achieve interim (or final) WLA and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment C, Segment C tributaries, Segment D, Segment D tributaries, if using LRS | 18.5 years after effective date of the TMDL |
| *Achieve final WLA or demonstrate that non-compliance is due to upstream contributions and submit report to Regional Board* | *MS4 and Caltrans NPDES Permittees discharging to Segment C, Segment C tributaries, Segment D, Segment D tributaries, if using alternative compliance plan* | *18.5 years after effective date of the TMDL* |
| **Second phase, if necessary - Segment C, Segment C Tributaries, Segment D, Segment D Tributaries (LRS only)** | | |
| Submit a new LRS | MS4 and Caltrans NPDES Permittees discharging to Segment C, Segment C tributaries, Segment D, Segment D tributaries | 19.5 years after effective date of the TMDL |
| Approve LRS | Regional Board, Executive Officer | 6 months after submittal of a second LRS |

| Implementation Action | Responsible Parties | Deadline |
|---|---|---|
| Complete implementation of LRS | MS4 and Caltrans NPDES Permittees discharging to Segment C, Segment C tributaries, Segment D, Segment D tributaries if using LRS | 23 years after effective date of the TMDL |
| Achieve final WLAs in Segment C, Segment C tributaries, Segment D, Segment D tributaries or demonstrate that non-compliance is due to upstream contributions and submit report to Regional Board | MS4 and Caltrans NPDES Permittees discharging to Segment C, Segment C tributaries, Segment D, Segment D tributaries if using LRS | 25 years after effective date of the TMDL |
| | | |
| **All Los Angeles River Segments and Tributaries** | | |
| Submit a Bacteria Coordinated Monitoring Plan (CMP) | All responsible parties | 1 year after the effective date of the TMDL |
| Conduct ambient water quality monitoring set forth in the CMP | All responsible parties | 6 months after approval of the CMP |
| Reconsider TMDL based upon technical studies or policy changes, including but not be limited to:<br>(1) Alterations to recreational beneficial use designations<br>(2) Revision of US EPA recommended bacteria criteria, Regional Board or State Board bacteria standards<br>(3) Expansion of the High Flow Suspension provisions of Chapter 2 (i.e. extension in duration or spatial extent). | Regional Board | 4 years after the effective date of the TMDL |
| Reconsider TMDL based upon technical studies or policy changes, including but not be limited to:<br>(1) Alterations to recreational beneficial use designations<br>(2) Revision of US EPA recommended bacteria criteria, Regional Board or State Board bacteria standards<br>(3) Expansion of the High Flow Suspension provisions of Chapter 2 (i.e. extension in duration or spatial extent).<br>(4) Technical evaluations of natural and anthropogenic sources of bacteria, including viable alternatives to defining natural or anthropogenic sources of bacteria<br>(5) Wet weather compliance options | Regional Board | 10 years after the effective date of the TMDL |
| Reconsider TMDL based upon technical studies or policy changes, including but not be limited to:<br>(1) Natural sources exclusion | Regional Board | Within one year of a demonstration that interim limits are met in a segment |
| Submit implementation plan for wet weather with interim milestones | All responsible parties | Within 10 years of the effective date of the TMDL |

| Implementation Action | Responsible Parties | Deadline |
|---|---|---|
| | | |
| Achieve final wet weather WLAs and LAs and submit report to Regional Board demonstrating wet weather and dry weather compliance. | All responsible parties | 25 years after effective date of the TMDL |

## 9.7 Monitoring

A monitoring program is necessary to determine compliance with the TMDL and to assess attainment of beneficial uses.

The monitoring will be conducted by the responsible MS4 Permittees. There are two types of monitoring:

- **Compliance Monitoring** to assess attainment of WLAs and to assess waterbody conditions in the Watershed, overall
- **Monitoring** in support of Load Reduction Strategies alternative compliance strategies and Wet Weather Implementation Plans.

### 9.7.1 Compliance Monitoring

The details of the ambient water monitoring program will be provided by the responsible parties in a Bacteria Coordinated Monitoring Plan (CMP), which must be submitted for Executive Officer approval per the TMDL implementation schedule.

- **Number of sites**: The CMP shall include at least one monitoring station in each Los Angeles River segment, reach and tributary addressed under this TMDL.
- **Measurements**: *E. coli* using USEPA-approved methods. Stakeholders may choose to monitor additional analytes such as human-specific indicators (e.g., human *Bacteroidales*) and pathogens (e.g., adenovirus), but these are not required.
- **Sample Collection Methods**: All samples shall be collected as grab samples.
- **Monitoring frequency**: Each segments, reaches and tributaries addressed under this TMDL shall be monitored monthly until the subject segment, reach or tributary is at the end of the execution part of its first implementation phase (i.e. 7 years after beginning the segment or tributary-specific phase). Monthly monitoring is sufficient to determine, minimally, if the segment, reach or tributary is in compliance with interim WLA (expressed as loads in MPN/day). Also, monthly monitoring will provide sufficient data to assess changes in bacteria concentrations over the course of the initial implementation time period.

  After the execution part of the first implementation phase, monitoring must be conducted weekly or more often to determine compliance with the instream targets (expressed in allowable number of exceedance days).

Over the course of TMDL implementation, it may be necessary to update or modify the CMP. Responsible parties may request changes via a letter to the Regional Board Executive Officer, and the Executive Officer may approve such changes.

For alternative compliance strategies, responsible parties pursuing an alternative compliance strategies shall propose monitoring to support the plan.

The Wet Weather Implementation Plans shall propose monitoring to support the Wet Weather Implementation Plans.
Monitoring for dischargers other than MS4 permittees to determine compliance with WLAs and LAs shall be established through monitoring and reporting programs conducted as part of the discharger's permit/waste discharge/waiver requirements and through implementation of the Nonpoint Source Implementation and Enforcement Policy, for nonpoint sources.

### 9.7.2 Load Reduction Strategy Monitoring

For MS4 Permittees that choose to comply with the dry weather components of this TMDL through implementation of an LRS, monitoring is also necessary for implementation planning purposes (e.g., to determine the locations and numbers of BMPs) and for assessment of compliance with the interim WLAs.

Implementation of an LRS requires dry weather outfall monitoring both before and after implementation of the LRS. Pre-LRS monitoring is used to estimate the *E. coli* loading from MS4 outfalls to the Los Angeles River segment or tributary, and determine the location and number of Priority Outfalls as well as to support the identification of the types of implementation actions that are expected to be necessary to attain the MS4 WLAs. Post-LRS monitoring is used to evaluate the effectiveness of the implementation actions (i.e., determine if the interim WLA is attained) and to plan and design for additional implementation actions to meet the interim or final WLAs, if necessary.

For each LRS, an outfall monitoring program with the following characteristics would be considered sufficient for development of an LRS:

- **Number of sites**: Outfall monitoring for each LRS shall take place at *all* MS4 outfalls that are discharging to a segment or tributary during a given monitoring event. For reference, Segment B, which is 13.7 miles long, had a maximum of 39 outfalls that were flowing during the BSI Study during one event. A total of 51 outfalls were observed to be flowing over the course of all monitoring events (i.e., some outfall discharges were intermittent). To avoid overwhelming laboratories and field staff, it is acceptable for a single snapshot of a Los Angeles River segment or tributary to be spread out over several days (i.e., all samples do not have to be collected one the same day).
- **Measurements**: *E. coli* by USEPA-approved methods and flow rate. Sufficient dilutions should be used to avoid "greater than" results for *E. coli*. During the BSI Study, greater than ten million ($10^7$) MPN per 100 mL were measured in a few dry weather discharges. Measurements of volumetric flow rate (e.g., in units of cubic feet

per second) of the discharge from each outfall shall be conducted using methods similar to those of the BSI Study (CREST, 2008). Monitoring of additional analytes such as human-specific indicators (e.g., human *Bacteroidales*) and pathogens (e.g., adenovirus) is encouraged but not required.

- **Sample Collection Methods**: All samples shall be collected as grab samples or instantaneous measurements.
- **Monitoring frequency**: For each LRS, at least six (6) snapshots shall be conducted for pre-LRS monitoring, and at least three (3) snapshots shall be conducted for post-LRS monitoring. To the extent practicable, given the TMDL implementation schedule, the dry weather snapshots shall be spread out over at least two seasons (e.g., summer and winter of the same year or multiple years). Note that six (6) pre-LRS snapshots plus three (3) post-LRS snapshots produces a total of nine (9) samples from all outfalls for each LRS, which would be available to assess attainment of the MS4 WLA. If the WLA is not attained, and follow-up actions are necessary under a new LRS, the three post-LRS snapshots provide additional information to develop the new LRS.
- **Period of monitoring**: Pre-LRS outfall monitoring should be initiated with sufficient time to incorporate results into the LRS for BMP planning. Initiation of outfall monitoring two years prior to submittal of the LRS should provide sufficient time to collect samples and utilize results for development of the LRS.

## 9.8 Special Studies and re-consideration of the TMDL

Special studies may fill potential data gaps. CREST has identified optional special studies in the stakeholder Technical Report that could support TMDL implementation. In addition, USEPA is examining existing and new indicator bacteria and may recommended new bacteria criteria. Tasks to be reviewed further during 2010 Triennial Review period, may potentially impact implementation of the TMDL including consideration of the application of REC-1 and REC-2 beneficial uses in specific instances.

Regional Board staff shall convene and oversee a workgroup, or shall participate in a stakeholder-led workgroup, to address technical and regulatory issues associated with the Los Angeles River Bacterial TMDL, which may include, where appropriate a re-evaluation of recreational uses in the Los Angeles River, re-evaluation of the high flow suspension on a site specific basis, prioritization of bacteria risk, re-evaluation of bacteria objectives for fresh water, re-evaluation of implementation provisions and compliance metrics. These re-evaluations support both this TMDL and also support many of the current triennial review priorities identified by the Board.

The workgroup shall provide technical input for stakeholder-led technical studies and may serve to provide technical input during the scoping and development of related Basin Plan Amendments that will be considered by the Regional Board.

# 10 Over the course of TMDL implementation, the TMDL shall be re-considered to incorporate new information from these stakeholder-led technical studies, or other scientific studies, or to address revisions to water quality standards, such as adoption of revised water quality objectives based on recommendations of USEPA a revised implementation schedule, revised. The schedule in Table 9.5 includes several specific re-consideration opportunities.Cost Considerations

This cost section includes a discussion of the costs in comparison to the costs associated with the Ballona Creek Watershed Bacteria TMDL including both dry and we weather implementation, specific project-type cost estimates, and a summary of the CREST-developed cost estimates for dry weather.

This section takes into account a reasonable range of economic factors in estimating potential costs associated with this TMDL. This analysis, together with the other sections of this staff report, CEQA checklist, response to comments, Basin Plan amendment and supporting documents, were completed in fulfillment of the applicable provisions of the California Environmental Quality Act (Public Resources Code Section 21159).[7]

This cost analysis focuses on compliance with the grouped waste load allocation by the MS4 and Caltrans stormwater permittees in the urbanized portion of the watershed. For the purposes of the cost analysis, the urbanized portion of the watershed is assumed to be 56% of the watershed or 467 square miles.

As implementation of projects and programs progresses, it is anticipated that the responsible parties will focus on the projects with the highest potential return first wherever possible, evaluate results and attempt to optimize the overall program effectiveness and costs. Therefore, it is possible that the TMDL could be achieved with substantially less capital and associated operation and maintenance costs than presented here. Conversely, there are a number of assumptions contained in the cost estimates that could ultimately result in greater capital or operation and maintenance costs for other components to achieve full compliance.

Most of the implementation components would be effective at helping reduce multiple pollutants, in particular metals and possibly trace toxic substances. Therefore, as implementation plans progress for all TMDLs in the watershed, close coordination between efforts is warranted, and the total cost of compliance with all TMDLs has the

[7] Because this TMDL implements existing water quality objectives, it does not "establish" water quality objectives and no further analysis of the factors identified in Water Code section 13241 is required. However, the staff notes that its CEQA analysis provides the necessary information to properly "consider" the factors specified in Water Code section 13241. As a result, the section 13241 analysis would at best be redundant.

potential to be significantly less than the sum of the individual costs estimated for each TMDL.

## 10.1 Implementation Cost in Comparison to Ballona Creek Bacteria TMDL

The City of Los Angeles and County of Los Angeles have prepared implementation plans for the Ballona Creek Bacteria TMDL and have included estimated costs (City of Los Angeles, 2009; County of Los Angeles, 2009).

Cities and agencies (including the Beverly Hills, Caltrans, Culver City, City of Los Angeles, Inglewood, Santa Monica, and West Hollywood) estimated $840,000,000 in TMDL implementation costs for total capital costs, including both structural and institutional BMPs, and $22,600,000 annually for operations and maintenance. These cities also calculated an additional 20 % for program management, administration and monitoring (for a total capital cost of $1,010,000,000 and $27,100,000 in operations and maintenance) and a 30% program contingency.

The County of Los Angeles prepared a separate implementation plan for unincorporated County areas. The County estimated total implementation costs for unincorporated County areas of $46,600,000.

In total, therefore, over the implementation schedule for the Ballona Creek Watershed Bacteria TMDL, the implementation could equal as much as $1.5 billion. The urbanized portion of the Los Angeles River Watershed is 3.59 times the size of the Ballona Creek Watershed (467 $mi^2$ vs. 130 $mi^2$). If costs of implementation are proportionally larger, costs for the Los Angeles River Watershed Bacteria TMDL could range up to $5.4 billion for full, inclusive, implementation costs. This is an elevated approximation as it does not include amortization over the long implementation period (or inflation) or discounting due to duplicity with other TMDLs or water conservation programs.

In the following descriptions, a summary of the costs for various components are presented. In reviewing these cost estimates, it should be noted that there are multiple additional benefits associated with the implementation. Many of the BMPs (both source control and treatment approaches) would also have the ability to reduce the amount of other contaminants in the runoff, which could assist in meeting the requirements of other Los Angeles River TMDLs, such as the metals TMDL, and other programs such as water conservation programs.

## 10.2 Implementation Costs by Project Types

### 10.2.1 Institutional Bacteria Source Control

Institutional source controls are measures that seek to reduce either the total flow or the amount of bacteria entering Los Angeles River. As these source controls are on an institutional level, the actual volume or concentration of bacteria that will be reduced cannot be precisely quantified.

Although not designed for bacteria, a number of similar source control measures were identified in the Ballona Creek Metals TMDL, with costs based on the entire Los Angeles Region, which has an area of 3,100 square miles. As the urbanized portion of the Los Angeles River Watershed is 467 square miles, the control measure costs were scaled down proportionally. The following represent the approximate values for the Los Angeles River Watershed for these source control measures:

- Enforcement of litter ordinances - $1.5 million per year;
- Public education - $0.7 million per year;
- Improved street cleaning - $1.1 million per year;
- Increased Storm Drain Cleaning - $4.0 million per year.

In addition to these source controls identified in the Metals TMDL, an estimated $3.6 million per year was added for additional for bacteria source control measures such as finding and eliminating hot spots, sewer overflows and other sources of elevated bacteria that may affect either dry or wet weather flows. Together this equals a total estimated annual cost of $10.9 million per year much of which can be shared with other TMDL implementation requirements.

Summary:

- Capital costs – NA;
- Operation and Maintenance Costs - $10.9 million (M)/yr.

10.2.2 Structural Flow Source Control Costs

Structural Flow Source Controls could include cisterns and rain barrels.

**Cisterns**

For developing a cost estimate for cisterns, it is assumed that cisterns will be installed only at schools and government facilities, since these types of controls are more easily implemented on these land uses, as opposed to at private homes, or commercial sites.

For the Ballona Creek Bacteria TMDL up to 2,260 cisterns to treat 2,500 acres were estimated; in the proportionally larger urbanized portion of the Los Angeles River Watershed, this translates to 8,140 cisterns to treat 9,000 acres. So, up to 8,140 cisterns could be installed in the Los Angeles River Watershed to manage the flow from all schools and government facilities. With a unit cost of $1/gallon as estimated in the City of Los Angeles Integrated Resources Plan (IRP), for the 10,000 gallon cisterns the total cost would be: $1/gallon * 10,000 gallons/cistern * 8,140 cisterns = $81.4 million.

Operation and maintenance costs for cisterns are based on the amount of water pumped. In order to estimate these costs, the volume of water, size of pump, and energy costs were assumed. In addition to determining that the 10,000 gallon cistern would, on average, be the appropriate size, it was determined that approximately 70,000 gallons per year of runoff would be captured by each cistern. Additional assumptions include:

- 3 horsepower pump;
- Flow rate of 10 gallons per minute;
- Unit energy cost of $0.10 per kilowatt-hour.

Using the standard equation of W=Power*Volume/Flow, which for these assumptions is: W = (3hp) * (.745kW/hp) * (70,000gal/yr/cistern) / ((10gal/min) * (60min/hr)) = 261 kW-hr/cistern/yr. For 8,140 cisterns and using an energy cost of $0.10 per kilowatt-hour, the total operation and maintenance cost for electrical power is $0.06 M/yr. A total O&M cost of $0.8 per year was estimated to allow for other operation, maintenance and replacement costs.

Summary:

- Capital costs – $81.4M;
- Operation and Maintenance Costs - $0.8 M/yr.

Where M/yr is million per year.

**Rain Barrels**

Rain barrels are a structural flow source control appropriate for residences.

The City of Los Angeles, Bureau of Sanitation, Watershed Protection Division (Stormwater Program) initiated a pilot program for free rainwater harvesting rain barrels for the Ballona Creek Watershed in July 2009 (City of Los Angeles, 2010). This program provided free 55 gallon rain barrels. The City received over 3,000 applications for 600 rain barrels. The cost of the barrel and installation was estimated at $250 a piece.

The program was funded by the Safe Neighborhood Parks, Clean Water, Clean Air and Coastal Protection Bond Act of 2000 (Proposition 12) through the Santa Monica Bay Restoration Commission (SMBRC) and the California Coastal Conservancy. The City has estimated 584,100 gallons can be collected from the 590 barrel pilot program. The City continues to develop its plans for expansion to other watersheds and to develop materials to support homeowners in installing their own rain barrels but no costs are available for watershed-wide implementation.

### 10.2.3 Subwatershed Infiltration Projects Costs

Local, on-site or subwatershed-based projects may be placed in parks, public land, vacant property, and other open spaces within the Los Angeles River Watershed. Assuming the urbanized portion of the Los Angeles River Watershed has a similar proportion of open space as the Ballona Creek watershed, the open space area, which might be available for available for infiltration projects is estimated at 51,000 acres. Although substantial portions of the 51,000 acres of the watershed may include areas where soils are poor for infiltration, where land use is not compatible or otherwise committed to other uses, or areas are unsuitable for other reasons, it was estimated that up to 5 percent of the open space might be suitable for neighborhood recharge. This results in the potential to develop up to 2,500 acres of land for some form of infiltration or recharge. The types of projects could vary significantly, but would generally focus on multiple benefits including water quality improvements, water conservation (either reduced water use or local recharge), and potentially recreation or aesthetic benefits.

In the areas where neighborhood recharge would be installed, a relatively moderate infiltration rate of 0.5 ft/day could be achieved since the soils in much of the coastal area are much less suitable for significant infiltration (per Los Angeles County DPW Hydrology Manual). Using this infiltration rate and the 2,500 acres of land, an estimated 406 mgd could be managed by implementation of infiltration projects.

A unit cost of $0.65 M/ac was assumed based on data developed under the Sun Valley Project as discussed in the IRP. Therefore, the total estimated capital cost for full implementation of this concept could be as high as $1.6 billion.

For operation and maintenance costs, information from the Sun Valley project was used to develop an average operation and maintenance cost for similar local/neighborhood recharge facilities of approximately $3,000/acre/yr. This would result in approximately $7.5 M/yr in operation and maintenance costs for 2,500 acres of neighborhood recharge facilities.

Summary:

- Capital Costs - $1.6 B;
- Operation and Maintenance Costs - $7.5 M/yr.

10.2.4 Sand Filters and Infiltration Trenches Costs

Sand filters or infiltration trenches in local watersheds are being considered for implementation of the Los Angeles River Metals TMDL, but would also contribute to bacteria removal. This section reviews the cost analysis conducted for the Los Angeles River Watershed Metals TMDL.

Sand filters are specifically designed to treat urban runoff in high density areas. These BMPs can also remove bacteria. USEPA reports that sand filters have a 76 percent removal rate for fecal coliform and infiltration trenches have a 90% removal rate for fecal coliform (USEPA, 1999). These BMPs can be designed to capture and treat at least 0.5 to 1 inch of runoff. The device could be designed to manage the entire dry weather flow. Additional flow exceeding the design capacity would be allowed to bypass the device and enter the storm drain untreated.

The Metals TMDL cost analysis assumed that 20% of the Los Angeles River Watershed would be treated by infiltration trenches and 20% of the watershed would be treated by sand filters.

**Table 10-1 Estimated Costs for Infiltration**

| | **Construction** | **Maintenance** |
|---|---|---|

| | **Costs ($ million)** | **Costs ($ million/year)** |
|---|---|---|
| Based on USEPA estimate (1997 dollars) | 544 | 109 |
| Based on FHWA estimate (1996 dollars) | 519 | Not reported |

(LARWQCB, 2005)

**Table 10-2 Estimated Costs for Austin and Delaware Sand**

| | Austin Sand Filter Construction Costs ($ million) | Austin Sand Filter Maintenance Costs ($ million/year) | Delaware Sand Filter Construction Costs ($ million) | Delaware Sand Filter Maintenance Costs ($ million/year) |
|---|---|---|---|---|
| Based on USEPA estimate (1997 dollars) | 553 | 28 | 329 | 16 |
| Based on FHWA estimate (1994 dollars) | 102 | Not reported | 418 | Not reported |

(LARWQCB, 2005)

### 10.2.5 Dry Weather Diversion Costs

This component involves diverting any remaining dry weather runoff that has reached the storm drain system to the wastewater collection system for treatment at the City of Los Angeles' Hyperion Treatment Plant or a County Sanitation District treatment plant. The Cities of Los Angeles and Santa Monica have already initiated diversion programs on many of the storm drains discharging to the Santa Monica Bay beaches. Based on the actual costs associated with these diversions, a unit cost per mgd of diversion capacity was estimated to be approximately $1.2 million. Adding on 30 percent to account for non-construction costs, including project management, design, construction management, startup, etc., a unit capital cost of $1.6 million per mgd was assumed.

The CREST Draft Dry Weather Implementation Plan estimates that as many as 122 storm drains will need to be diverted (if dry weather diversion is the only structural control used, with no reliance on source control), with an average flow of 0.15 cfs (about 100,000 gallons per day) per diversion, for a total flow of 12 mgd. This results in a capital cost of approximately $19.2 million.

The CREST hypothetical example developed for Segment B includes 4 dry weather diversions for the segment. If each segment and segment tributaries required a similar number of diversions, the total would be 40 diversions or as much as 6 mgd (stormdrains in tributaries carry much less flow, so this is a conservative assumption). This results in a capital cost of approximately $9.6 million.

Operation and maintenance costs were estimated from the constructed dry weather low flow diversions as presented in the IRP, using a unit operation and maintenance cost of about $34,000/mgd/yr. Using the figures of 12 mgd and 6 mgd of diverted flow, the total operation and maintenance cost estimate is $0.2- 0.4 M/yr.

Summary:

- Capital Costs - $9.6 - 19.2 M;

- Operation and Maintenance Costs - $0.2 - 0.4 M/yr.

### 10.2.6 Construct Urban Runoff Treatment Plant

The Ballona Creek Bacteria TMDL cost estimates included three cost estimates for urban runoff treatment plants. The implementation strategy for this TMDL does not require any such plant, but during implementation it is possible that responsible parties will consider addressing loads in this manner.

**Table 10-3 Example Urban Runoff Treatment Plant Costs**

| Example Project | Capacity | Capital Costs - M; | Operation and Maintenance Costs -M/yr. |
|---|---|---|---|
| NOTF *(*City of Los Angeles Bureau of Engineering 1995 *Ballona Creek Treatment Facility Feasibility Study and Preliminary Design)* | 440 cfs with storage Average flow of approximately 250 cfs for a duration of 2 hours. | $512 | $0.53 |
| West Los Angeles Subwatershed (*City of Los Angeles Ballona Creek Treatment Facility Feasibility Study and Preliminary Design)* | 100 cfs with storage Average flow of 175 cfs, with a duration of 2 hours | $343 | $0.35 |
| Windsow Hills | 25 cfs with storage Average flow of 40 cfs and a duration of 2 hours | $82 | $0.09 |

## 10.3 CREST Dry Weather Implementation Costs

The CREST development team in the Draft Dry Weather Implementation Plan for the TMDL presented a thorough cost analysis for dry weather, which is summarized here. CREST did not include costs of monitoring, but did include operation and maintenance costs over the TMDL implementation period.

CREST considered costs for implementation in three different ways:

1. Costs for an implementation strategy that focused on outfalls and the Load Reduction Strategies - CREST called this a “Conventional Strategy.” ‘Downstream’ solutions and source controls were not included in this analysis.

2. Costs for an implementation strategy focused on both outfall and downstream approaches – referred to as an “Alternative Strategy”. Source controls were not included in this analysis.

3. Costs for an implementation strategy focused on source controls – referred to as an “Integrated Strategy”. This included aggressive non-structural source control programs.

### 10.3.1 “Conventional Strategy”

The process and assumptions CREST used to estimate cost for the outfall-based LRS approach for all Los Angeles River segments and tributaries are listed below.

1. **Estimate the number of outfalls –** the total estimated number of outfalls in the watershed is approximately 3,700.

2. **Estimate the number of outfalls that flow during dry weather –** the estimated number of flowing outfalls is as follows:

- Mainstem Los Angeles River – approximately 280 flowing outfalls during dry weather
- Tributaries – approximately 330 flowing outfalls during dry weather

3. **Estimate the number of outfalls that may require *initial* actions/structural controls along the mainstem Los Angeles River –** using information generated during the BSI Study (CREST, 2008) in combination with a Monte Carlo analysis for Segment B, the number of outfalls along the mainstem Los Angeles River that would require elimination of flow and/or bacteria is estimated to be a minimum of 10%, or approximately 28 outfalls. A similar approach was used for Outlier Outfalls, leading to an estimate of 28 Outlier Outfall investigations over the course of TMDL implementation.

4. **Estimate the number of outfalls that will require *follow-up* actions/structural controls along the mainstem Los Angeles River** – for estimating purposes, it was assumed that after the initial projects were completed in accordance with an LRS, an additional 100% more controls would be needed for an ultimate total of 20% of outfalls (1 in 5) or approximately 28 additional.

5. **Estimate the total number of outfalls that will require structural controls along tributaries** – A minimum of approximately 33 outfalls to the tributaries of the Los Angeles River are estimated to require initial projects, and an additional 100% for follow-up projects for a total of 66 projects.

6. **Establish representative storm drain outfall flow rate –** a representative flow rate for storm drain outfalls of 0.15 cfs for each of the Priority Outfalls was estimated.

7. **Establish representative water quality conditions** – Representative values for Total Suspended Solids (TSS) and Biological Oxygen Demand (BOD) in dry weather storm drain discharges were established at 10 mg/L as these are also used to estimate treatment plant capacity costs.

8. **Create “typical” LFD design –** a “typical” LFD facility design for was created based on prior projects planned and designed by the City of Los Angeles BOS/BOE.

9. **Estimate distances from outfalls to wastewater infrastructure –** an average distance between major outfalls to the river and wastewater infrastructure within the vicinity of the river was estimated at an average distance of 300 feet.

10. **Conveyance and treatment capacity –** a cost basis was developed for acquiring incremental interceptor capacity and incremental treatment plant capacity for the dry weather flows based on the following factors: conveyance, treatment flow, BOD, and TSS.

11. **Develop overall capital costs –**The unit capital costs for a single LFD project in current (2009) dollars was estimated to be $1.7M not including conveyance and treatment capacity allowances (these were categorized as operation and maintenance costs). Costs for Outlier Outfall investigations were estimated as $100,000 per Outlier Outfall.

12. **Develop operation and maintenance costs –** once LFDs are on line, operation and maintenance costs (O&M) were assumed to begin starting with the completion of each LFD and continue through the end of the overall TMDL implementation period. Utilized factors included diversion flow rate, pumping and operation and maintenance costs, collection system maintenance costs, and treatment plant operation and maintenance costs.

13. **Compile costs –** the combination of capital cost and operation and maintenance costs were complied on an annual basis over the entire TMDL implementation time period based on the estimated timeline.

**Table 10-4 CREST "Conventional Strategy" – Estimated Total Costs (Capital and O&M, 2009 Dollars) for Treatment Facilities to Implement the Dry Weather Los Angeles River Bacteria TMDL**

| **Type of Implementation Cost** | **2009 dollars** |
|---|---|
| Diversion Facilities and Outlier Outfall Investigations (Capital Cost) | $217,000,000 |
| Conveyance Facilities (Capital Cost) | $30,000,000 |
| Treatment Capacity Cost (Capital Cost) | $21,000,000 |
| Total Capital Costs | $268,000,000 |
| Operation & Maintenance a | $320,000,000 |
| **Total TMDL Cost** a | **$588,000,000** |

a - The estimated total O&M cost is for the TMDL implementation period only. Efforts for O&M costs will likely continue indefinitely, with estimated annual costs exceeding $22,600,000 per year after the TMDL implementation period.

### 10.3.2 "Alternative Strategy"

The process and assumptions CREST used to estimate costs for the Alternative Strategy, which combines Outfall- and Downstream-based LRS approaches for all Los Angeles River segments and tributaries are listed below.

1. Outfall-based actions would be implemented for the following segments and tributaries:

Segment A, Segment B, Segment C, Segment D and Compton Creek

2. Downstream solutions would be implemented near the downstream end of the following tributaries just prior to the confluence with the mainstem Los Angeles River:

Rio Hondo
Arroyo Seco
Verdugo Wash
Burbank Western Channel (potentially implement upstream of the Burbank WRP discharge)
Tujunga Wash
Bull Creek

3. A Downstream Solution would also be implemented in Segment E of the mainstem Los Angeles River just upstream of the Sepulveda Basin, and no additional projects would be required on the tributaries to Segment E.

4. To develop an order-of-magnitude cost estimate for each Downstream Solution, the assumption was made that some type of off-line diversion and treatment facility would be constructed in the general vicinity of the diversion location, potentially on publicly owned land. A unit cost of these projects per mgd of flow capacity was developed for the Integrated Resources Plan (IRP) for both capital and operation and maintenance costs.

5. The assumed dry weather flow rates for each of the locations listed above, the estimated capital costs of each project, and the estimated operation and maintenance costs once the project was on-line are summarized in Table 10-5.

**Table 10-5 Locations, Sizes, and Costs for Downstream Solutions**

| **Location of Project** | **Flow Rate/Capacity** (mgd) | **Estimated Capital Cost** ($M 2009) | **Estimated Annual Operation and Maintenance Costs** ($/yr 2009) |
|---|---|---|---|
| Arroyo Seco | 2.50 | 18.0 | 875,000 |
| Rio Hondo | 0.16 | 1.2 | 56,000 |
| Verdugo Wash | 5.2 | 37.5 | 1,820,000 |
| Burbank Western Channel | 2.6 | 18.7 | 910,000 |
| Tujunga Wash | 1.0 | 7.2 | 350,000 |
| Bull Creek | 2.40 | 17.3 | 840,000 |
| LAR Segment E | 5.80 | 41.8 | 2,030,000 |

Total capital costs based on the Downstream Solutions identified in Table 10-5, plus the number of projects along the segments/tributaries subject to an Outfall-based approach, which includes 26 initial and 14 follow-up projects in Segments A, B, C, and D and Compton Creek are shown in Table 10-6.

**Table 10-6 Alternative Strategy – Estimated Total Costs (Capital and O&M, 2009 Dollars) for Treatment Facilities for Implementation of the Dry Weather Los Angeles River Bacteria TMDL**

| Type of Implementation Cost | 2009 dollars |
|---|---|
| Diversion Facilities and Outlier Outfall Investigations (Capital Cost) | $93,000,000 |
| Downstream Facilities (Capital Cost) | $141,000,000 |
| Conveyance Facilities (Capital Cost) | $13,000,000 |
| Treatment Capacity Cost (Capital Cost) | $9,000,000 |
| Total Capital Costs | $256,000,000 |
| Operation & Maintenance a | $335,000,000 |
| **Total TMDL Cost** a | **$591,000,000** |

a – The estimated total O&M cost is for the TMDL implementation period only. Efforts for O&M costs will likely continue indefinitely, with estimated annual costs exceeding $23,400,000 per year after the TMDL implementation period.

### 10.3.3 "Integrated Strategy"

Detailed cost estimates were not developed for the Integrated Strategy. The Integrated Strategy was assumed to cost less than the Conventional and Alternative Strategies, because a greater proportion of problematic discharges would be eliminated using less expensive non-structural efforts (e.g., cross connection elimination, repair of sanitary sewer lines, etc.) instead of structural controls at the outfalls (e.g., low flow diversions), which require long-term operation and maintenance.

The components of the Integrated Strategy that would drive costs include, but are not limited to, the following:

1. Sanitary surveys and other *E. coli* source identification efforts;

2. Efforts to eliminate *E. coli* and human-specific sources (cross connections, sewer line repairs, etc.);

3. Capital and O&M costs for structural controls at outfalls with problematic discharges that could not be eliminated using non-structural controls;

4. Efforts to develop and adopt non-structural programs; and

5. Salaries and benefits for municipal staff to implement non-structural programs, including enforcement actions.

#### 10.3.4 CREST Cost Summary

CREST dry weather cost estimates did not include costs of monitoring, but did include operation and maintenance costs over the TMDL implementation period.

In summary, CREST found that the estimated total capital costs for the Alternative Strategy were slightly lower than those estimated for the Conventional Strategy. The total capital cost for the Alternative Strategy was estimated to be $12,000,000 (5%) less than the Conventional Strategy. Assuming a 3% cost escalation (inflation), because the distribution of capital costs over time was different in the two strategies, the total capital cost for the Alternative Strategy was estimated to be $69,000,000 (15%) less than the Conventional Strategy.

| | |
|---|---|
| Conventional Strategy | $588,000,000 |
| Alternative Strategy | $591,000,000 |

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# Revision of the ~~Implementation Plan for Tillman, LA-Glendale, and Burbank POTWs in the~~ Total Maximum Daily Load for Metals for the Los Angeles River and its Tributaries

## Staff Report

~~January 5~~March 11, 2010

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# 1. Introduction

This staff report discusses the scientific and regulatory basis for a proposed Basin Plan amendment to revise ~~the implementation plan for~~ the Los Angeles River and Tributaries Metals Total Maximum Daily Load (TMDL). The proposed revision ~~extends~~ adjusts the ~~implementation schedule~~copper numeric targets and loading capacity for Reaches 1-4 of the river and the Burbank Western Channel and adjusts the copper waste load allocations (WLAs) for the three largest publicly owned treatment works (POTWs) in the watershed ~~and establishes interim copper waste load allocations (WLAs) for these POTWs~~.

## *1.1 History of the TMDL*

The Los Angeles Regional Board adopted the Los Angeles River and Tributaries Metals TMDL on June 2, 2005 under Resolution No. R05-006. The TMDL was subsequently approved by the State Water Resources Control Board (State Board), the Office of Administrative Law (OAL), and U.S. EPA. The effective date of the TMDL was January 11, 2006, when the Certificate of Fee Exemption was filed with the California Department of Fish and Game.

The Regional Board re-adopted the TMDL on September 6, 2007 by Resolution No. R07-014 in compliance with a writ of mandate issued by the Los Angeles County Superior Court in the matter of *Cities of Bellflower et al. v. State Water Resources Control Board et al.* (Los Angeles Superior Court # BS101732). The writ directed the Regional Board to consider alternatives to the project before re-adopting the TMDL. The writ was limited to this issue, and the TMDL was affirmed in all other respects. The only manner in which the re-adopted TMDL differs from the previous TMDL is in the new alternatives analysis and the implementation deadlines, which are now identified with actual calendar dates instead of the number of months or years from the "effective date of the TMDL."

The re-adopted TMDL was subsequently approved by State Board, OAL, and U.S. EPA. The effective date of the re-adopted TMDL is October 29, 2008. On May 7, 2009, the Regional Board voided and set aside the TMDL adopted under Resolution No. R05-006.

## *1.2 TMDL Requirements*

The technical basis for the TMDL adopted by Resolution No. R05-006 and re-adopted by Resolution No. R07-014 is contained in the June 2005 staff report entitled "Total Maximum Daily Loads for Metals – Los Angeles River and Tributaries."

### 1.2.1 TMDL Numeric Targets

The TMDL specifies numeric targets for cadmium, copper, lead, and zinc based on criteria in the California Toxics Rule (CTR). The CTR allows for the adjustment of certain metals criteria through the use of a water-effect ratio (WER) that accounts for site-specific chemical conditions. The chemical conditions of a waterbody, such as the amount of dissolved organic matter in the water, can affect the bioavailability of metals to aquatic life. Metals that are less bioavailable are less toxic. A WER thus represents the correlation between metals that are measured and metals that are biologically available and toxic to aquatic life.

A WER is a ratio calculated by dividing an appropriate measure of toxicity of a material, such as the EC50[1], in site water by the same measure of toxicity of the same material in laboratory dilution water. A WER greater than 1.0 means that the site water reduces the toxic effects of the pollutant being tested. A WER less than 1.0 means that the site water increases the toxic effects of the pollutant being tested. Most metals criteria contained in the CTR can be modified to reflect site-specific conditions by multiplying the CTR criteria by a site-specific WER.

No site-specific WERs had been developed for the Los Angeles River at the time the TMDL was adopted. Therefore, for those metals criteria containing a WER multiplier, a WER default value of 1.0 was assumed, as directed in the CTR, when setting the TMDL numeric targets and allocations.

The numeric targets were adjusted for site-specific hardness and converted from dissolved metals to total recoverable metals. Separate numeric targets for wet and dry weather were calculated. Dry-weather targets are based on chronic criteria or the criteria continuous concentration (CCC). Wet-weather targets are based on acute criteria or the criteria maximum concentration (CMC). Because the proposed TMDL revisions are related to ~~the implementation plan for~~ copper, only the copper numeric targets are discussed here. The dry-weather numeric targets for copper are presented in Table 1.

[1] EC50 is the 50% effect concentration, or the concentration of a pollutant that adversely affects 50% of the test species.

**Table 1. Dry-weather numeric targets for copper (µg/l) as presented in Table 3-1 of the June 2005 staff report. Reach-specific targets are based on chronic criteria (CCC) and 50th percentile hardness values for each reach. Conversion of dissolved to total recoverable metals is based on default or site-specific conversion factors.**

| Los Angeles River | Dissolved copper | Hardness (mg/L as $CaCO_3$) | Conversion factor | Total recoverable copper |
|---|---|---|---|---|
| LA Reach 6 | 29 | 702* | 0.96 | 30 |
| LA Reach 5 above Tillman | 29 | 702* | 0.96 | 30 |
| LA Reach 4 below Tillman | 19 | 246 | 0.74 | 26 |
| LA Reach 3 above LAG WRP | 22 | 282 | 0.96 | 23 |
| LA Reach 3 below LAG WRP | 21 | 278 | 0.80 | 26 |
| LA Reach 2 | 21 | 268 | 0.96 | 22 |
| LA Reach 1 | 22 | 282 | 0.96 | 23 |
| **Tributaries** | **Dissolved copper** | **Hardness (mg/L as $CaCO_3$)** | **Conversion factor** | **Total recoverable copper** |
| Bell | 29 | 702* | 0.96 | 30 |
| Tujunga | 19 | 246 | 0.96 | 20 |
| Verdugo Wash | 22 | 282 | 0.96 | 23 |
| Burbank (above WRP) | 25 | 326 | 0.96 | 26 |
| Burbank (below WRP) | 18 | 229 | 0.96 | 19 |
| Arroyo Seco | 21 | 268 | 0.96 | 22 |
| Compton Creek | 18 | 225 | 0.96 | 19 |
| Rio Hondo Reach 1 | 12 | 141 | 0.96 | 13 |

*Maximum hardness value for criteria adjustment is 400 mg/L

The wet-weather numeric targets for copper are presented in Table 2.

**Table 2. Wet-weather numeric targets for copper (µg/l) as presented in Table 3-4 of the June 2005 staff report. Targets are based on acute criteria (CMC) and 50th percentile hardness value at the Wardlow station in Reach 1 (80 mg/L as $CaCO_3$). Conversion of dissolved to total recoverable metals based on site-specific conversion factor.**

| Dissolved copper | Conversion factor | Total recoverable copper |
|---|---|---|
| 11 | 0.65 | 17 |

### 1.2.2 TMDL Allocations

The TMDL assigns WLAs for point sources and load allocations (LAs) for nonpoint sources in the watershed. The WLAs and LAs are interdependent and are calculated according to the following equation:

**TMDL = Σ (POTW WLAs) + Σ (Storm Water Sources WLAs) + Direct Air Deposition LA + Open Space LA** **Equation 1**

The Donald C. Tillman (Tillman), Los Angeles-Glendale (LA-Glendale), and Burbank water reclamation plants are the three largest POTWs in the Los Angeles River watershed. The final copper WLAs for these POTWs are shown in Table 3.

**Table 3. Copper waste load allocations for three POTWs (µg/l total recoverable metals)**

| Facility | Design Flow (cfs) | Type of WLA | Copper WLA |
|---|---|---|---|
| **Tillman** | 124 | Concentration-based | 26 µg/L |
| | | Mass-based | 7.8 kg/day |
| **Glendale** | 31 | Concentration-based | 26 µg/L |
| | | Mass-based | 2.0 kg/day |
| **Burbank** | 14 | Concentration-based | 19 µg/L |
| | | Mass-based | 0.64 kg/day |

The concentration-based and mass-based copper WLAs apply at all times in dry weather. The mass-based copper WLAs are based on the design flows of the POTWs at the time of TMDL development. In wet weather, the mass-based copper WLAs do not apply when influent flows exceed the current design capacity of the treatment plants.

### 1.2.3 TMDL Implementation

The POTW copper WLAs are implemented through National Pollution Discharge Elimination System (NPDES) permits. The TMDL specifies that compliance schedules may allow up to five years in NPDES permits to meet WLA-based permit requirements. The TMDL also specifies that POTWs requiring advanced treatment to meet WLAs may be allowed an extension up to January 11, 2016. POTWs requesting an extension must submit work plans for the installation of advanced treatment by January 11, 2010.

The TMDL allows for voluntary special studies, including WER studies, to evaluate the uncertainties and assumptions made during TMDL development. The results of these studies are due by January 11, 2010. The Regional Board intends to reconsider the TMDL by January 11, 2011 to re-evaluate the WLAs and the implementation schedule based on the results of these special studies.

# 2. Background on Copper WER Development

## *2.1 2008 Copper WER Study*

On October 18, 2005, the City of Los Angeles Bureau of Sanitation and the City of Burbank submitted a work plan for a copper WER study in the Los Angeles River downstream of the Tillman, LA-Glendale and Burbank POTWs. The copper WER study included a public participation plan. As part of the plan, a technical advisory committee (TAC) and a stakeholder committee (SC) reviewed the work plan, work progress, and the final study report. The TAC included experts not affiliated with the project and the SC included Regional Board staff, other state and federal agency staff and other interested parties. Public participation and comments were also solicited through public workshops.

The study collected data from August 2005 to April 2006. The study was conducted in accordance with U.S. EPA's 2001 *Streamlined Water-Effect Ratio Procedure for Discharges of Copper* (Streamlined Procedure). In addition to the requirements of the Streamlined Procedure, the study included additional (above the minimum requirements) sampling events during dry weather conditions (the critical condition) and added toxicity testing for both wet and dry weather conditions to confirm the assumption that dry weather conditions are the critical condition. Two additional sampling stations were also included in Reaches 1 and 2 of the river, downstream of the POTWs, to ensure that copper WERs developed for the upstream reaches where the POTWs discharge would result in attainment of downstream water quality standards.

According to the Streamlined Procedure, to calculate a WER, side-by-side, laboratory water and site water toxicity tests are run to obtain the EC50 of a test species. The result may be expressed as either dissolved or total recoverable copper. After adjusting for any hardness differences between laboratory water and site water, the WER for the sample (sWER) is the lesser of (a) the site-water EC50 divided by the laboratory-water EC50, or (b) the site-water EC50 divided by the documented Species Mean Acute Value (the mean EC50 from a large number of published toxicity tests with laboratory water). The geometric mean of the two (or more) sWERs is the final WER.

The Cities' WER study used copper toxicity tests with a single sensitive species (*Ceriodaphnia dubia*) to develop dissolved copper EC50 data for the calculation of sWERs for the reaches of the river below the three POTWs, as well as for Reaches 1 and 2. The sWERs were grouped to calculate the final WERs based on variability in sampling location, weather conditions, and seasons. Variability was evaluated based on the raw toxicity test response data, as well as the sWERs. The analysis showed that sWERs for dry weather conditions were statistically lower than sWERs for wet weather conditions, leading to a lower or more stringent objective, confirming that dry weather was the critical condition. The study then grouped the dry weather sWERs for sites with statistically similar sWERs to calculate the final WERs. The resulting final WERs are shown in Table 4.

**Table 4. 2008 Copper WER Study Recommended Final WERs**

<table>
<tr><th>Sampling Site</th><th>Final WERs<br>(Geometric Mean of Dry Weather<br>Statistically Similar sWERs)</th></tr>
<tr><td>Tillman (Reach 4)</td><td rowspan="2">5.871</td></tr>
<tr><td>Burbank (Burbank Western Channel)</td></tr>
<tr><td>LA-Glendale (Reach 3)</td><td rowspan="3">3.958</td></tr>
<tr><td>Reach 2</td></tr>
<tr><td>Reach 1</td></tr>
</table>

On June 3, 2008, the City of Los Angeles Regulatory Affairs Division and the City of Burbank submitted the *Final Report for the Los Angeles River Copper WER Study*. The final report is included as Appendix A to this report.

The 2008 copper WERs were developed for specific reaches of the Los Angeles River with the intention that they could be used to support development of copper site-specific objectives or, in accordance with the "Policy for Implementation of Toxic Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California" (State Implementation Policy or SIP), directly incorporated into the NPDES permits for the three POTWs.

## *2.2 Watershed-Wide Copper WER Study*

On May 20, 2009, the City of Los Angeles Bureau of Sanitation Watershed Protection Division submitted a separate draft work plan for a copper WER to support implementation of the Los Angeles River and Tributaries Metals TMDL. The intention of this study is to complement the previous 2008 study by developing copper WERs for the entire Los Angeles River and its tributaries in order to revise TMDL copper WLAs for all sources in the watershed. The proposed study is geared towards a watershed-wide application of any resulting WERs. Given the broad geographic scope of the resulting WERs and their potential application in multiple board actions, they have a greater potential to impact the affected water bodies; therefore, the new study will include a more extensive data set than was used in the 2008 study. The applicable EPA guidance for the proposed WER study is the *Interim Guidance on the Determination and Use of Water-Effect Ratios for Metals* (U.S. EPA, 1994). The Streamlined Procedure is recommended only for situations where copper concentrations are elevated primarily by continuous point source effluents. The tributaries under consideration in the proposed watershed-wide study do not have copper concentrations elevated primarily by continuous point source effluents.

The proposed study also will include a public participation plan with a TAC and SC. The cities revised the May 20, 2009 work plan based on stakeholder and TAC comments and submitted it to the Regional Board on November 2, 2009. According to the revised work plan, the watershed-wide copper WER study will not be completed before August 2011.

# 3. Rationale for Revisions to TMDL ~~Implementation Plan~~

The current TMDL implementation schedule and permit provisions for the three facilities require that the Tillman, LA-Glendale and Burbank POTWs must achieve compliance with NPDES permit limits for copper based on the existing final copper WLAs by January 11, 2011. While the POTWs will not be able to meet the existing copper limits by January 11, 2011, the 2008 WER study demonstrates that the POTWs can discharge copper at levels higher than the existing WLA-based permit limits and still fully protect beneficial uses. Therefore, the POTWs have not submitted a work plan for the installation of advanced treatment in order to receive an extended implementation schedule. The Cities of Los Angeles and Burbank have requested that the Regional Board adjust the permit limits to reflect the 2008 WER study given these study findings. However, as will be discussed later, regardless of the WER, POTW effluent limitations must ensure that effluent concentrations and mass discharges do not exceed the levels of water quality that can be attained by performance of the facility's current treatment technologies.

Given that there is a metals TMDL for the Los Angeles River in effect with WLAs established for the three POTWs, the POTW permit limitations must be based on the existing WLAs in the TMDL. This is because the existence of WLAs takes precedent over the WER provisions in the SIP. Both state and federal law require that NPDES permits are consistent with any available WLAs (40 CFR 122.42 ; Cal. Water Code §13263).

In order to apply the copper WERs developed by the 2008 study to the copper effluent limitations in the NPDES permits for the three POTWs, the TMDL must be revised to adjust the copper WLAs based on the WERs. ~~However, because the WLAs for all point and nonpoint sources are interdependent, adjusting the final copper WLAs for the three major POTWs would necessitate adjusting the final copper WLAs for other sources in the watershed in order to achieve the TMDL (see equation 1). Furthermore, a~~As previously mentioned, the Streamlined Procedure is only applicable in situations where copper concentrations are elevated primarily by continuous point source effluents. Therefore, the copper WERs developed in the 2008 study, which were calculated according to the Streamlined Procedure, should not be used to adjust the final copper WLAs for sources other than the POTWs. Additional time and data would be needed to revise the final copper WLAs for all sources in the watershed. Therefore, it is necessary to wait for the completion of the watershed-wide copper WER study, as well as any other special studies, before revising all of the final copper WLAs for all sources. This will ensure that any revised final copper WLAs are scientifically defensible and protective of beneficial uses and downstream standards.

In the meantime, staff proposes to adjust only the copper WLAs for the three POTWs based on the 2008 WER study. According to Equation 1, if the WLAs for other sources remain based on a default WER of 1.0, and the POTW WLAs are increased by a WER, the numeric targets and loading capacity must be increased as well. The 2008 WER study demonstrates that the numeric targets and loading capacity of the reaches below the POTWs may be increased based on a WER and still fully protect beneficial uses. Therefore, staff proposes to adjust the numeric targets and loading capacity for the reaches included in the 2008 WER study (Reaches 1-4 and Burbank Western Channel) as well as the POTW copper WLAs, but not the allocations for other sources in the watershed. As a result a portion of the loading capacity will remain unallocated.

~~In the meantime, the current TMDL implementation schedule and permit provisions for the three facilities require that the Tillman, LA-Glendale and Burbank POTWs must achieve compliance with NPDES permit limits for copper based on the existing final~~

~~copper WLAs by January 11, 2011. The POTWs will not be able to meet the existing copper limits by January 11, 2011. However, neither will the POTWs submit a work plan for the installation of advanced treatment in order to receive an extended implementation schedule. This is because the 2008 WER study demonstrates that the POTWs can discharge copper at levels higher than the WLA-based permit limits and still fully protect beneficial uses. The study results indicate that, for copper, it may not be necessary to undertake capital improvement projects to attain the final WLAs, since WER-adjusted WLAs would be protective of beneficial uses. The Cities of Los Angeles and Burbank have requested that the Regional Board adjust the permit limits to reflect the 2008 WER study given these study findings. The only way to modify the POTWs' final permit limits to reflect the 2008 WER study is to modify the final copper WLAs for all sources, established in the TMDL, to reflect the 2008 WER study, which is not appropriate at this time for reasons previously discussed. Therefore, staff proposes an extension of the implementation schedule for the POTWs to allow them additional time to attain copper WLA-based permit limits with the clear expectation that the final copper WLAs may be revised in the future based on the 2008 WERs or subsequently developed watershed-wide WERs, and other data.~~

## 4. Proposed Changes

The proposed amendment revises the Los Angeles River Metals TMDL to adjust the numeric targets and loading capacity for certain reaches and the corresponding POTW WLAs based on the 2008 WER study. Because it is not appropriate to adjust the LAs and WLAs for other sources based on the 2008 WER study, the proposed TMDL revision only adjusts the copper targets for Reaches 1-4 of the River and the Burbank Western Channel and the copper WLAs for the Tillman WRP, LA-Glendale WRP, and Burbank WRP. The copper allocations for other sources remain based on the default WER value of 1.0 and the remaining portion of the loading capacity for Reaches 1-4 of the River and the Burbank Western Channel, which is increased by adjusting the numeric targets with the WER, will remain unallocated. At the time this TMDL is reconsidered per the implementation schedule in Table 7-13.2 of the Basin Plan, the WER for Reaches 1-4 and Burbank Western Channel may be modified or revert back to a default of 1.0 unless additional data have been collected that support application of a WER to all WLAs and LAs, or confirm continued application of the site-specific WER to the WLAs for the POTWs only.

~~The proposed amendment revises the Los Angeles River Metals TMDL to extend the implementation schedule for the Tillman, LA-Glendale, and Burbank POTWs to achieve their final WLAs until three years after the effective date of this amendment. Additionally, the proposed amendment revises the TMDL to incorporate interim copper WLAs for these POTWs, which shall apply in the meantime until compliance with the final copper WLAs is required. The extended implementation schedule will allow the POTWs additional time before the final copper WLAs apply and will allow for the completion of the watershed-wide WER study that may be used to adjust the final copper WLAs for all sources. The extended implementation schedule acknowledges the early~~

~~and cooperative efforts of the Cities of Los Angeles and Burbank to develop a copper WER. The three year implementation schedule for the interim copper WLAs is consistent with the required review period for state revision of water quality standards and related implementation provisions (40 CFR 131.20). The interim copper WLAs are based on the 2008 WER study, which was developed under the guidance of the TAC and Regional Board staff, and will protect water quality and beneficial uses until the final copper WLAs apply.~~

## *4.1 Calculation of ~~Interim~~ Revised Copper Numeric Targets, Loading Capacity, and WLAs*

The 2008 WER study final report proposed applying the final copper WER of 5.87 to the Tillman and Burbank POTWs and the final copper WER of 3.96 to the LA-Glendale POTW (Table 4). The report included an analysis of the protectiveness of WER-modified copper water quality objectives on downstream beneficial uses (Section 8 of the report). The analysis estimated the frequency that in-stream copper concentrations would exceed WER-modified water quality objectives for a given reach. However, staff does not believe that this analysis adequately demonstrates that upstream WER-modified objectives will attain downstream water quality standards. Therefore, staff proposes to apply the more protective downstream copper WER of 3.96 to ~~all upstream reaches~~Reaches 1-4 of the river and Burbank Western Channel when calculating the ~~interim~~ revised copper numeric targets, loading capacity, and WLAs.

The revised copper numeric targets for Reaches 1-4 of the river and Burbank Western Channel are based on the copper WER of 3.96 and the existing numeric targets for copper (Tables 1 and 2) according to the following equation:

**Revised Copper Numeric Target = Existing Copper Numeric Target x WER Equation 2**

The revised copper loading capacity for Reaches 1-4 of the river and Burbank Western Channel are based on the copper WER of 3.96 and the existing loading capacity for copper according to the following equation:

**Revised Copper Loading Capacity = Existing Copper Loading Capacity x WER Equation 3**

The ~~interim~~ revised copper WLAs for the Tillman, Burbank, and LA-Glendale POTWs are based on the copper WER of 3.96 and the ~~final~~ existing concentration-based WLA for copper (Table 3) according to the following equation:

**~~Interim~~ Revised Copper WLA = ~~final~~ Existing Copper WLA x Copper WER Equation ~~2~~4**

Regardless of the WER and the resulting adjusted WLAs, the effluent limitations for the Tillman, Burbank, and LA-Glendale POTWs shall ensure that effluent concentrations and mass discharges do not exceed the levels of water quality that can be attained by performance of the facility's treatment technologies existing at the time of permit issuance, reissuance, or modification. By restricting the effluent limitations for POTWs based on current treatment technologies, staff is considering recent improvements in the POTWs' effluent water quality.

The resulting interim WLAs for copper for the three POTWs are presented in Table 5. These apply at all times during dry and wet weather.

**Table 5. Interim WLAs for Copper for Three POTWs**

| Discharger | POTW Interim Copper WLAs (total recoverable metals) |
|---|---|
| Tillman | 26 x 3.96 = 103 µg /L |
| LA-Glendale | 26 x 3.96 = 103 µg /L |
| Burbank | 19 x 3.96 = 75 µg /L |

Permit writers may translate the interim copper WLAs into interim daily maximum and interim monthly average copper effluent limitations for the POTWs by using the 2008 WER of 3.96 to adjust the CTR criteria, and applying the effluent limitation procedures in Section 1.4 of the SIP or other applicable engineering practices authorized under federal regulations.

## *4.2 Proposed Changes to Implementation Schedule and Monitoring*

The proposed extension to the TMDL implementation schedule will allow for the interim copper WLAs for the Tillman, LA-Glendale, and Burbank POTWs to apply for up to three years following the effective date of this amendment. After that date, the final copper WLAs will apply.

Staff proposes that the copper WER of 3.96 for Reaches 1-4 of the river and Burbank Western Channel shall apply until the TMDL is reconsidered per the implementation schedule in 7.13-2 of the Basin Plan. At the time the TMDL is reconsidered, staff proposes that the WER for Reaches 1-4 and Burbank Western Channel may be modified or revert back to a default of 1.0 unless additional data have been collected that support application of a WER to all WLAs and LAs, or confirm continued application of the site-specific WER to the WLAs for the POTWs only. Any WER that is incorporated into a discharger's permit shall include an appropriate reopener that authorizes the Regional Board to modify the WER as appropriate to accommodate new information. Regardless of the WER, effluent concentrations and mass discharges shall not exceed the levels of water quality that can be attained by performance standards of a facility's current treatment technologies.

The Tillman, LA-Glendale, and Burbank POTWs must conduct additional receiving water monitoring to verify that water quality conditions for the interim copper WLA

~~implementation period~~ are similar to those of the 2008 copper WER study period. Monitoring is also required to determine if the WER-based ~~interim~~ copper WLAs will achieve downstream water quality standards. This additional monitoring shall be required through the POTWs' NPDES permit monitoring and reporting programs or other Regional Board required monitoring programs. The Regional Board will evaluate the WER-based ~~interim~~ copper WLAs based on potential changes in the chemical characteristics of the water body that could impact the calculation or application of the WER and will revise the WERs and ~~interim~~ copper WLAs, if necessary, to ensure protection of beneficial uses.

~~Finally, in the event that a watershed-wide copper WER study is not completed, the Regional Board will consider the results of the 2008 copper WER study as well as data from the receiving water monitoring described above for the purposes of adjusting the final copper WLAs for the POTWs when the TMDL is reconsidered.~~

## 5. References

City of Los Angeles Regulatory Affairs Division and the City of Burbank. 2008. Final Report for the Los Angeles River Copper WER Study, June 3, 2008.

City of Los Angeles Bureau of Sanitation Watershed Protection Division. 2009. Draft Work Plan for a WER to Support Implementation of the Los Angeles River and Tributaries Metals TMDL, May 20, 2009.

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U.S. EPA. 1994. Interim Guidance on the Determination and Use of Water-Effect Ratios for Metals. EPA 823-B-94-001.

U.S. EPA. 2000. 40 CFR Part 131 – Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. Federal Register, Vol. 65, No.97, May 18, 2000.

U.S. EPA. 2001. Streamlined Water-Effect Ratio Procedure for Discharges of Copper. EPA-822-R-01-005, March 2001.

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NEWS RELEASE

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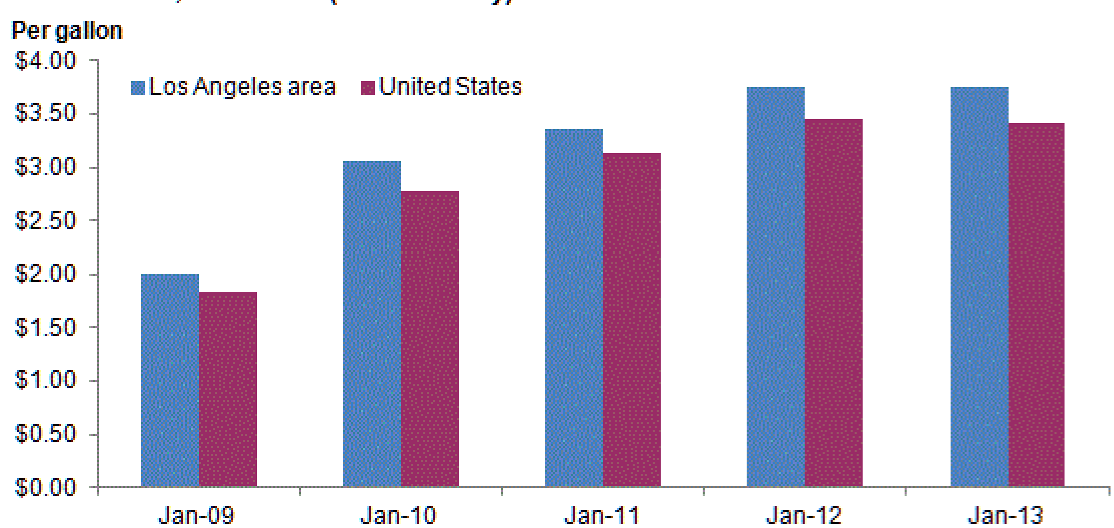
## AVERAGE ENERGY PRICES, LOS ANGELES AREA–JANUARY 2013

Gasoline prices averaged $3.749 a gallon in the Los Angeles area in January 2013, the U.S. Bureau of Labor Statistics reported today. Regional Commissioner Richard J. Holden noted that area gasoline prices were similar to last January when they averaged $3.747 per gallon. Los Angeles area households paid an average of 23.2 cents per kilowatt hour (kWh) of electricity in January 2013, up from 20.4 cents per kWh in January 2012. The average cost of utility (piped) gas at $1.013 per therm in January was similar to the $0.996 per therm spent last year. (Data in this release are not seasonally adjusted; accordingly, over-the-year-analysis is used throughout.)

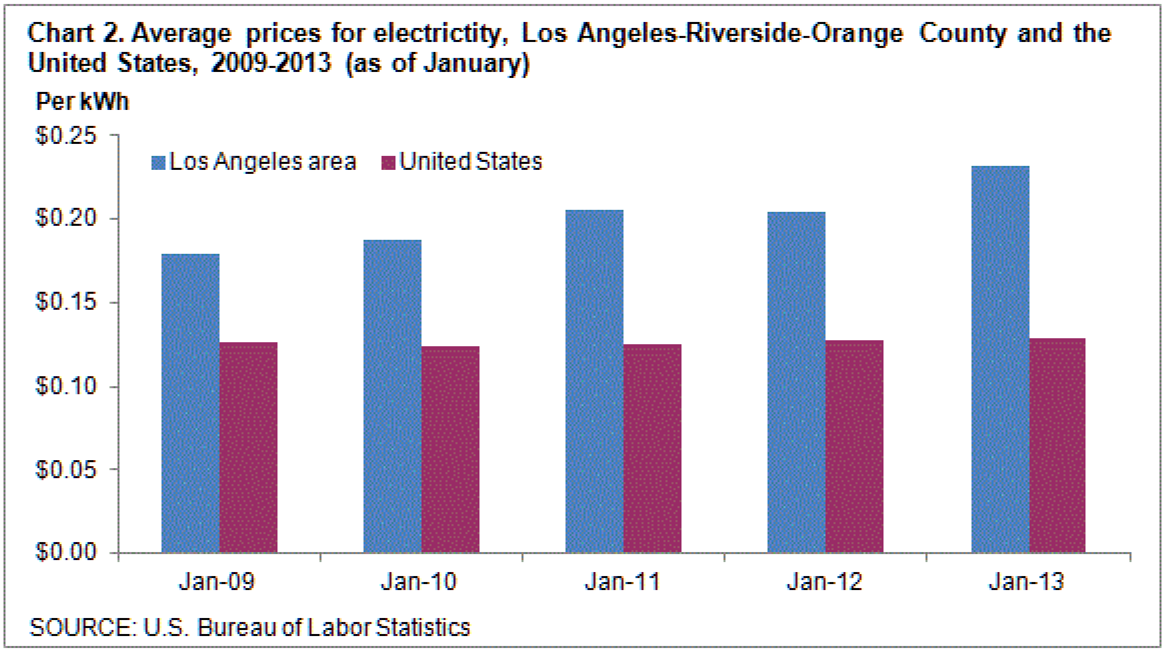
At $3.749 a gallon, Los Angeles area consumers paid 10.0 percent more than the $3.407 national average in January 2013. A year earlier, consumers in the Los Angeles area paid 8.7 percent more than the national average for a gallon of gasoline. The local price of a gallon of gasoline has exceeded the national average by more than six percent in the month of January in each of the past five years. (See chart 1.)

**Chart 1. Average prices for gasoline, Los Angeles-Riverside-Orange County and the United States, 2009-2013 (as of January)**

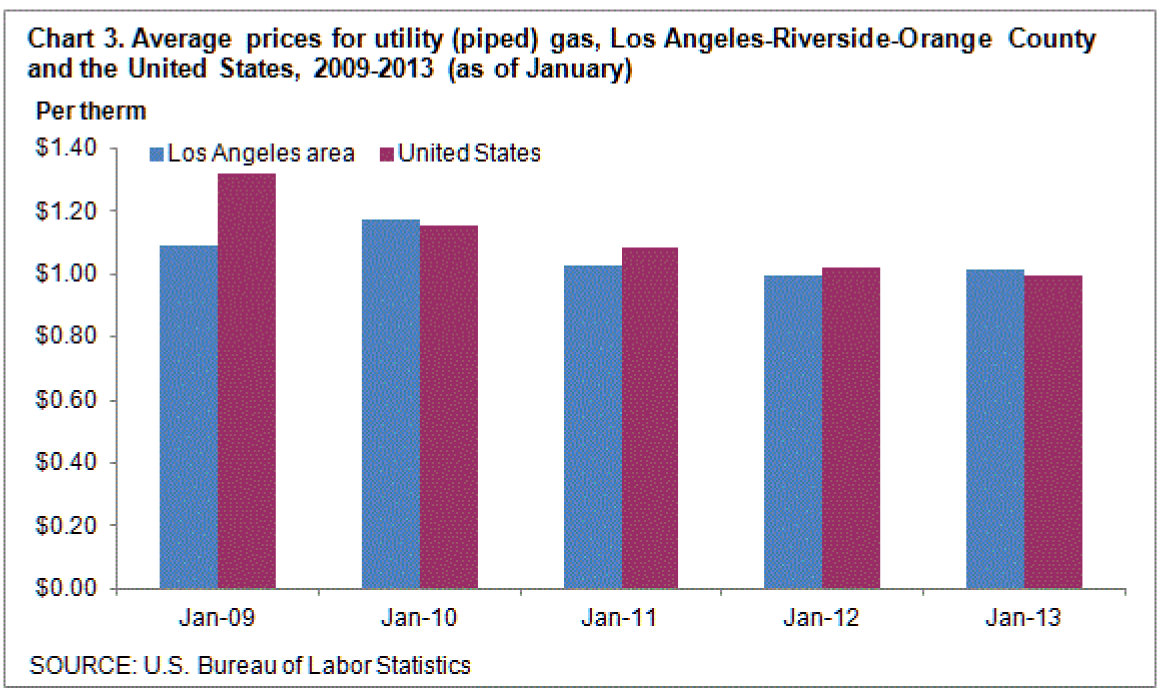



SOURCE: U.S. Bureau of Labor Statistics

The 23.2 cents per kWh Los Angeles households paid for electricity in January 2013 was 79.8 percent more than the nationwide average of 12.9 cents per kWh. Last January, electricity costs were 59.4 percent higher in Los Angeles compared to the nation. In the past five years, prices paid by Los Angeles area consumers for electricity exceeded the U.S. average by more than 42 percent in the month of January. (See chart 2.)




Prices paid by Los Angeles area consumers for utility (piped) gas, commonly referred to as natural gas, were $1.013 per therm, similar to the national average in January 2013 ($0.996 per therm). A year earlier, area consumers also paid close to the same price per therm for natural gas compared to the nation. In three of the past five years, the per therm cost for natural gas in January in the Los Angeles area has been within three percent of the U.S. average. (See chart 3.)



The Los Angeles-Riverside-Orange County, Calif. metropolitan area consists of Los Angeles, Orange, Riverside, San Bernardino and Ventura Counties in California.

## Technical Note

Average prices are estimated from Consumer Price Index (CPI) data for selected commodity series to support the research and analytic needs of CPI data users. Average prices for electricity, utility (piped) gas, and gasoline are published monthly for the U.S. city average, the 4 regions, the 3 population size classes, 10 region/size-class cross-classifications, and the 14 largest local index areas. For electricity, average prices per kilowatt-hour (kWh) and per 500 kWh are published. For utility (piped) gas, average prices per therm, per 40 therms, and per 100 therms are published. For gasoline, the average price per gallon is published. Average prices for commonly available grades of gasoline are published as well as the average price across all grades.

Price quotes for 40 therms and 100 therms of utility (piped) gas and for 500 kWh of electricity are collected in sample outlets for use in the average price programs only. Since they are for specified consumption amounts, they are not used in the CPI. All other price quotes used for average price estimation are regular CPI data.

With the exception of the 40 therms, 100 therms, and 500 kWh price quotes, all eligible prices are converted to a price per normalized quantity. These prices are then used to estimate a price for a defined fixed quantity.

The average price per kilowatt-hour represents the total bill divided by the kilowatt-hour usage. The total bill is the sum of all items applicable to all consumers appearing on an electricity bill including, but not limited to, variable rates per kWh, fixed costs, taxes, surcharges, and credits. This calculation also applies to the average price per therm for utility (piped) gas.

Information from this release will be made available to sensory impaired individuals upon request. Voice phone: 202-691-5200, Federal Relay Services: 800-877-8339.

**Table 1. Average prices for gasoline, electricty, and utility (piped) gas, Los Angeles-Riverside-Orange County and the United States, January 2012-January 2013, not seasonally adjusted**

| Year and month | Gasoline per gallon | | Electricity per kWh | | Utillity (piped) gas per therm | |
|---|---|---|---|---|---|---|
| | Los Angeles area | United States | Los Angeles area | United States | Los Angeles area | United States |
| 2012 | | | | | | |
| January | $3.747 | $3.447 | $0.204 | $0.128 | $0.996 | $1.021 |
| February | 4.013 | 3.622 | 0.204 | 0.128 | 0.931 | 0.986 |
| March | 4.394 | 3.918 | 0.204 | 0.127 | 0.931 | 0.978 |
| April | 4.257 | 3.976 | 0.204 | 0.127 | 0.883 | 0.951 |
| May | 4.333 | 3.839 | 0.204 | 0.129 | 0.978 | 0.907 |
| June | 4.037 | 3.602 | 0.193 | 0.135 | 1.054 | 0.927 |
| July | 3.800 | 3.502 | 0.193 | 0.133 | 1.053 | 0.943 |
| August | 4.073 | 3.759 | 0.193 | 0.133 | 1.072 | 0.960 |
| September | 4.175 | 3.908 | 0.193 | 0.133 | 1.027 | 0.953 |
| October | 4.499 | 3.839 | 0.211 | 0.128 | 1.052 | 0.962 |
| November | 3.924 | 3.542 | 0.211 | 0.127 | 0.995 | 0.994 |
| December | 3.677 | 3.386 | 0.211 | 0.127 | 1.042 | 1.004 |
| 2013 | | | | | | |
| January | 3.749 | 3.407 | 0.232 | 0.129 | 1.013 | 0.996 |

The State Water Project

# Final Delivery Reliability Report 2011

June 2012

State of California
Natural Resources Agency
Department of Water Resources





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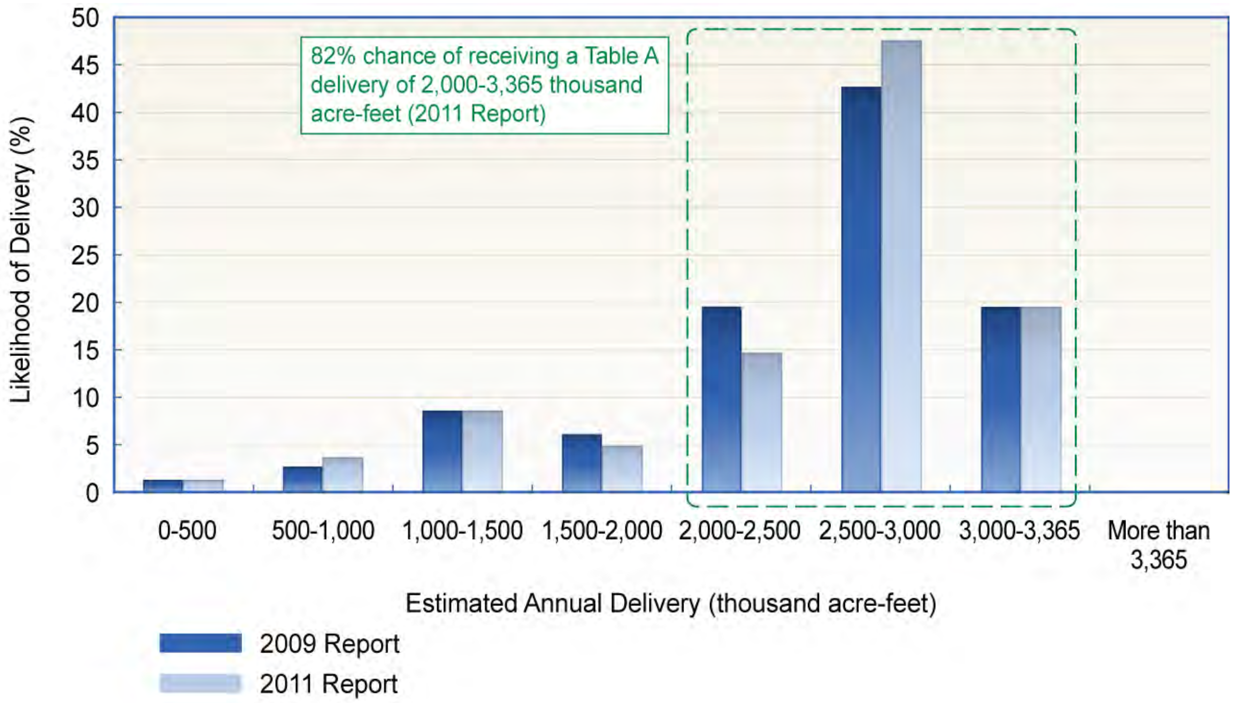


Figure 6-4. Estimated Likelihood of SWP Table A Water Deliveries (Existing Conditions)

Table 6-3. Estimated Average and Dry-Period Deliveries of SWP Table A Water (Existing Conditions), in Thousand Acre-Feet (Percent of Maximum SWP Table A Amount, 4,133 taf/year)

| | Long-term Average | Single Dry Year (1977) | 2-Year Drought (1976–1977) | 4- Year Drought (1931–1934) | 6-Year Drought (1987–1992) | 6-Year Drought (1929–1934) |
|---|---|---|---|---|---|---|
| 2009 Report | 2,483 (60%) | 302 (7%) | 1,496 (36%) | 1,402 (34%) | 1,444 (35%) | 1,398 (34%) |
| 2011 Report | 2,524 (61%) | 380 (9%) | 1,573 (38%) | 1,454 (35%) | 1,462 (35%) | 1,433 (35%) |

Table 6-4. Estimated Average and Wet-Period Deliveries of SWP Table A Water (Existing Conditions), in Thousand Acre-Feet (Percent of Maximum SWP Table A Amount, 4,133 taf/year)

| | Long-term Average | Single Wet Year (1983) | 2-Year Wet (1982–1983) | 4-Year Wet (1980–1983) | 6-Year Wet (1978–1983) | 10-Year Wet (1978–1987) |
|---|---|---|---|---|---|---|
| 2009 Report | 2,483 (60%) | 2,813 (68%) | 2,935 (71%) | 2,817 (68%) | 2,817 (68%) | 2,872 (67%) |
| 2011 Report | 2,524 (61%) | 2,886 (70%) | 2,958 (72%) | 2,872 (69%) | 2,873 (70%) | 2,833 (69%) |

# Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District

March, 2007

Robert C. Wilkinson, Ph.D.

**Note to Readers**

This report for West Basin Municipal Water District is an update and revision of an analysis and report by Robert Wilkinson, Fawzi Karajeh, and Julie Mottin (Hannah) conducted in April 2005. The earlier report, *Water Sources "Powering" Southern California: Imported Water, Recycled Water, Ground Water, and Desalinated Water*, was undertaken with support from the California Department of Water Resources, and it examined the energy intensity of water supply sources for both West Basin and Central Basin Municipal Water Districts. This analysis focuses exclusively on West Basin, and it includes new data for ocean desalination based on new engineering developments that have occurred over the past year and a half.


**Principal Investigator: Robert C. Wilkinson, Ph.D.**

Dr. Wilkinson is Director of the Water Policy Program at the Donald Bren School of Environmental Science and Management, and Lecturer in the Environmental Studies Program, at the University of California, Santa Barbara. His teaching, research, and consulting focuses on water policy, climate change, and environmental policy issues. Dr. Wilkinson advises private sector entities and government agencies in the U.S. and internationally. He currently served on the public advisory committee for California's 2005 State Water Plan, and he represented the University of California on the Governor's Task Force on Desalination.
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West Basin
Municipal Water District

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# Overview

Southern California relies on imported and local water supplies for both potable and non-potable uses. Imported water travels great distances and over significant elevation gains through both the California State Water Project (SWP) and Colorado River Aqueduct (CRA) before arriving in Southern California, consuming a large amount of energy in the process. Local sources of water often require less energy to provide a sustainable supply of water. Three water source alternatives which are found or produced locally and could reduce the amount of imported water are desalinated ocean water, groundwater, and recycled water. Groundwater and recycled water are significantly less energy intensive than imports, while ocean desalination is getting close to the energy intensity of imports.

Energy requirements vary considerably between these four water sources. All water sources require pumping, treatment, and distribution. Differences in energy requirements arise from the varying processes needed to produce water to meet appropriate standards. This study examines the energy needed to complete each process for the waters supplied by West Basin Municipal Water District (West Basin).

Specific elements of energy inputs examined in this study for each water source are as follows:

- Energy required to **import water** includes three processes: pumping California SWP and CRA supplies to water providers; treating water to applicable standards; and distributing it to customers.
- **Desalination of ocean water** includes three basic processes: 1) pumping water from the ocean or intermediate source (e.g. a powerplant) to the desalination plant; 2) pre-treating and then desalting water including discharge of concentrate; and 3) distributing water from the desalination plant to customers.
- **Groundwater** usage requires energy for three processes: pumping groundwater from local aquifers to treatment facilities; treating water to applicable standards; and distributing water from the treatment plant to customers. Additional injection energy is sometimes needed for groundwater replenishment.
- Energy required to **recycle water** includes three processes: pumping water from secondary treatment plants to tertiary treatment plants; tertiary treatment of the water, and distributing water from the treatment plant to customers.

The energy intensity results of this study are summarized in the table on the following page. They indicate that recycled water is among the least energy-intensive supply options available, followed by groundwater that is naturally recharged and recharged with recycled water. Imported water and ocean desalination are the most energy intensive water supply options in California. East Branch State Water Project water is close in energy intensity to desalination figures based on current technology, and at some points along the system, SWP supplies exceed estimated ocean desalination energy intensity. The following table identifies energy inputs to each of the water supplies including estimated energy requirements for desalination. Details describing the West Basin system operations are included in the water source sections. Note that the Title 22 recycled water energy figure reflects only the *marginal* energy required to treat secondary effluent wastewater which has been processed to meet legal discharge requirements, along with the energy to convey it to user

## Energy Intensity of Water Supplies for West Basin Municipal Water District

| | af/yr | Percentage of Total Source Type | kWh/af Conveyance Pumping | kWh/af MWD Treatment | kWh/af Recycled Treatment | kWh/af Groundwater Pumping | kWh/af Groundwater Treatment | kWh/af Desalination | kWh/af WBMWD Distribution | Total kWh/af | Total kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Imported Deliveries** | | | | | | | | | | | |
| State Water Project (SWP) [1] | 57,559 | 43% | 3,000 | 44 | NA | NA | NA | NA | 0 | 3,044 | 175,209,596 |
| Colorado River Aqueduct (CRA) [1] (other that replenishment water) | 76,300 | 57% | 2,000 | 44 | NA | NA | NA | NA | 0 | 2,044 | 155,957,200 |
| **Groundwater[2]** | | | | | | | | | | | |
| natural recharge | 19,720 | 40% | NA | NA | NA | 350 | 0 | NA | 0 | 350 | 6,902,030 |
| replenished with (injected) SWP water [1] | 9,367 | 19% | 3,000 | 44 | NA | 350 | 0 | NA | 0 | 3,394 | 31,791,598 |
| replenished with (injected) CRA water [1] | 11,831 | 24% | 2,000 | 44 | NA | 350 | 0 | NA | 0 | 2,394 | 28,323,432 |
| replenished with (injected) recycled water | 8,381 | 17% | 205 | 0 | 790 | 350 | 0 | NA | 220 | 1,565 | 13,116,278 |
| **Recycled Water** | | | | | | | | | | | |
| West Basin Treatment, Title 22 | 21,506 | 60% | 205 | NA | 0 | NA | NA | NA | 285 | 490 | 10,537,940 |
| West Basin Treatment, RO | 14,337 | 40% | 205 | NA | 790 | NA | NA | NA | 285 | 1,280 | 18,351,360 |
| **Ocean Desalination** | 20,000 | 100% | 200 | NA | NA | NA | NA | 3,027 | 460 | 3,687 | 82,588,800 |

Notes:

NA Not applicable

[1] Imported water based on percentage of CRA and SWP water MWD received, averaged over an 11-year period. Note that the figures for imports do not include an accounting for system losses due to evaporation and other factors. These losses clearly exist, and an estimate of 5% or more may be reasonable. The figures for imports above should therefore be understood to be conservative (that is, the actual energy intensity is in fact higher for imported supplies than indicated by the figures).

[2] Groundwater values include entire basin, West Basin service area covers approximately 86% of the basin. Groundwater values are specific to aquifer characteristics, including depth, within the basin.

# Energy Intensity of Water

Water treatment and delivery systems in California, including extraction of "raw water" supplies from natural sources, conveyance, treatment and distribution, end-use, and wastewater collection and treatment, account for one of the largest energy uses in the state.[1] The California Energy Commission estimated in its 2005 Integrated Energy Policy Report that approximately 19% of California's electricity is used for water related purposes including delivery, end-uses, and wastewater treatment.[2] The total energy embodied in a unit of water (that is, the amount of energy required to transport, treat, and process a given amount of water) varies with location, source, and use within the state. In many areas, the energy intensity may increase in the future due to limits on water resource extraction, and regulatory requirements for water quality, and other factors.[3] Technology improvements may offset this trend to some extent.

> ***Energy intensity*** is the total amount of energy, calculated on a whole-system basis, required for the use of a given amount of water in a specific location.

## The Water-Energy Nexus

Water and energy systems are interconnected in several important ways in California. Water systems both provide energy – through hydropower – and consume large amounts of energy, mainly through pumping. Critical elements of California's water infrastructure are highly energy-intensive. Moving large quantities of water long distances and over significant elevation gains, treating and distributing it within the state's communities and rural areas, using it for various purposes, and treating the resulting wastewater, accounts for one of the largest uses of electrical energy in the state.[4]

Improving the efficiency with which water is used provides an important opportunity to increase related energy efficiency. ("*Efficiency*" as used here describes the useful work or service provided by a given amount of water.) Significant potential economic as well as environmental benefits can be cost-effectively achieved in the energy sector through efficiency improvements in the state's water systems and through shifting to less energy intensive local sources. The California Public Utilities Commission is currently planning to include water efficiency improvements as a means of achieving energy efficiency benefits for the state.[5]

## Overview of Energy Inputs to Water Systems

There are four principle energy elements in water systems:

1. primary water extraction and supply delivery (imported and local)
2. treatment and distribution within service areas
3. on-site water pumping, treatment, and thermal inputs (heating and cooling)

4. wastewater collection, treatment, and discharge

Pumping water in each of these four stages is energy-intensive. Other important components of embedded energy in water include groundwater pumping, treatment and pressurization of water supply systems, treatment and thermal energy (heating and cooling) applications at the point of end-use, and wastewater pumping and treatment.[6]

***1. Primary water extraction and supply delivery***

Moving water from near sea-level in the Sacramento-San Joaquin Delta to the San Joaquin-Tulare Lake Basin, the Central Coast, and Southern California, and from the Colorado River to metropolitan Southern California, is highly energy intensive. Approximately 3,236 kWh is required to pump one acre-foot of SWP water to the end of the East Branch in Southern California, and 2,580 kWh for the West Branch. About 2,000 kWh is required to pump one acre foot of water through the CRA to southern California.[7] Groundwater pumping also requires significant amounts of energy depending on the depth of the source. (Data on groundwater is incomplete and difficult to obtain because California does not systematically manage groundwater resources.)

***2. Treatment and distribution within service areas***

Within local service areas, water is treated, pumped, and pressurized for distribution. Local conditions and sources determine both the treatment requirements and the energy required for pumping and pressurization.

***3. On-site water pumping, treatment, and thermal inputs***

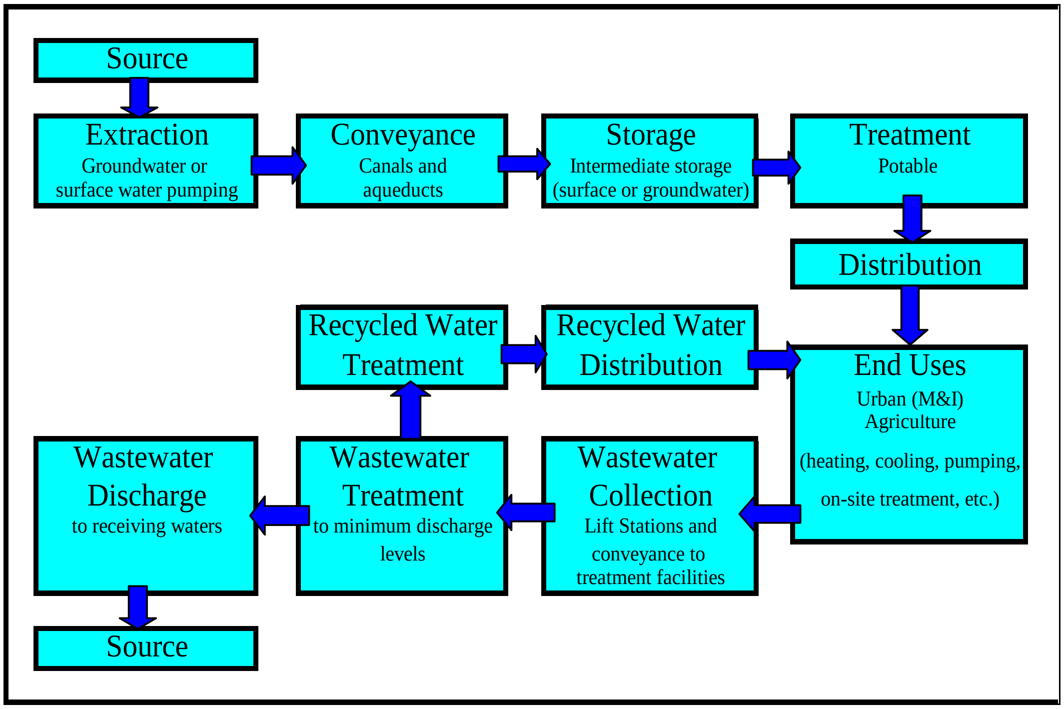
Individual water users use energy to further treat water supplies (e.g. softeners, filters, etc.), circulate and pressurize water supplies (e.g. building circulation pumps), and heat and cool water for various purposes.

***4. Wastewater collection, treatment, and discharge***

Finally, wastewater is collected and treated by a wastewater authority (unless a septic system or other alternative is being used). Wastewater is often pumped to treatment facilities where gravity flow is not possible, and standard treatment processes require energy for pumping, aeration, and other processes. (In cases where water is reclaimed and re-used, the calculation of total energy intensity is adjusted to account for wastewater as a *source* of water supply. The energy intensity generally includes the additional energy for treatment processes beyond the level required for wastewater discharge, plus distribution.)

The simplified flow chart below illustrates the steps in the water system process. A spreadsheet computer model is available to allow cumulative calculations of the energy inputs embedded at each stage of the process. This methodology is consistent with that applied by the California Energy Commission in its analysis of the energy intensity of water.

**Simplified Flow Diagram of Energy Inputs to Water Systems**




Source: Robert Wilkinson, UCSB[8]

## Calculating Energy Intensity

Total energy intensity, or the amount of energy required to facilitate the use of a given amount of water in a specific location, may be calculated by accounting for the summing the energy requirements for the following factors:

- imported supplies
- local supplies
- regional distribution
- treatment
- local distribution
- on-site thermal (heating or cooling)
- on-site pumping
- wastewater collection
- wastewater treatment

Water pumping, and specifically the long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity as noted above. Water use (based on embedded energy) is the next largest consumer of electricity in a typical Southern California home after refrigerators and air conditioners. Electricity required to support water service in the typical home in Southern California is estimated at between 14% to 19% of total residential energy demand.[9] If air conditioning is not a factor the figure is even higher. Nearly three quarters of this energy demand is for pumping imported water.

**Interbasin Transfers**

Some of California's water systems are uniquely energy-intensive, relative to national averages, due to the pumping requirements of major conveyance systems which move large volumes of water long distances and over thousands of feet in elevation lift. Some of the interbasin transfer systems (systems that move water from one watershed to another) are net energy producers, such as the San Francisco and Los Angeles aqueducts. Others, such as the SWP and the CRA require large amounts of electrical energy to convey water. On *average*, approximately 3,000 kWh is necessary to pump one AF of SWP water to southern California,[10] and 2,000 kWh is required to pump one AF of water through the CRA to southern California.[11]

Total energy savings for reducing the full embedded energy of *marginal* (e.g. imported) supplies of water used indoors in Southern California is estimated at about 3,500 kWh/af.[12] Conveyance over long distances and over mountain ranges accounts for this high marginal energy intensity. In addition to avoiding the energy and other costs of pumping additional water supplies, there are environmental benefits through reduced extractions from stressed ecosystems such as the delta.

## Imported Water:
## The State Water Project and the Colorado River Aqueduct

Water diversion, conveyance, and storage systems developed in California in the 20th century are remarkable engineering accomplishments. These water works move millions of AF of water around the state annually. The state's 1,200-plus reservoirs have a total storage capacity of more than 42.7 million acre feet (maf).[13] West Basin receives imported water from Northern California through the State Water Project and Colorado River water via the Colorado River Aqueduct. The Metropolitan Water District of Southern California delivers both of these imported water supplies to the West Basin.

**California's Major Interbasin Water Projects**


## The State Water Project

The State Water Project (SWP) is a state-owned system. It was built and is managed by the California Department of Water Resources (DWR). The SWP provides supplemental water for agricultural and urban uses.[14] SWP facilities include 28 dams and reservoirs, 22 pumping and generating plants, and nearly 660 miles of aqueducts.[15] Lake Oroville on the Feather River, the project's largest storage facility, has a total capacity of about 3.5 maf.[16] Oroville Dam is the tallest and one of the largest earth-fill dams in the United States.[17]

Water is pumped out of the delta for the SWP at two locations. In the northern Delta, Barker Slough Pumping Plant diverts water for delivery to Napa and Solano counties through the North Bay

Aqueduct.[18] Further south at the Clifton Court Forebay, water is pumped into Bethany Reservoir by the Banks Pumping Plant. From Bethany Reservoir, the majority of the water is conveyed south in the 444-mile-long Governor Edmund G. Brown California Aqueduct to agricultural users in the San Joaquin Valley and to urban users in Southern California. The South Bay Pumping Plant also lifts water from the Bethany Reservoir into the South Bay Aqueduct. [19]

The State Water Project is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year.[20] The energy required to operate the SWP is provided by a combination of DWR's own hydroelectric and other generation plants and power purchased from other utilities. The project's eight hydroelectric power plants, including three pumping-generating plants, and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power.

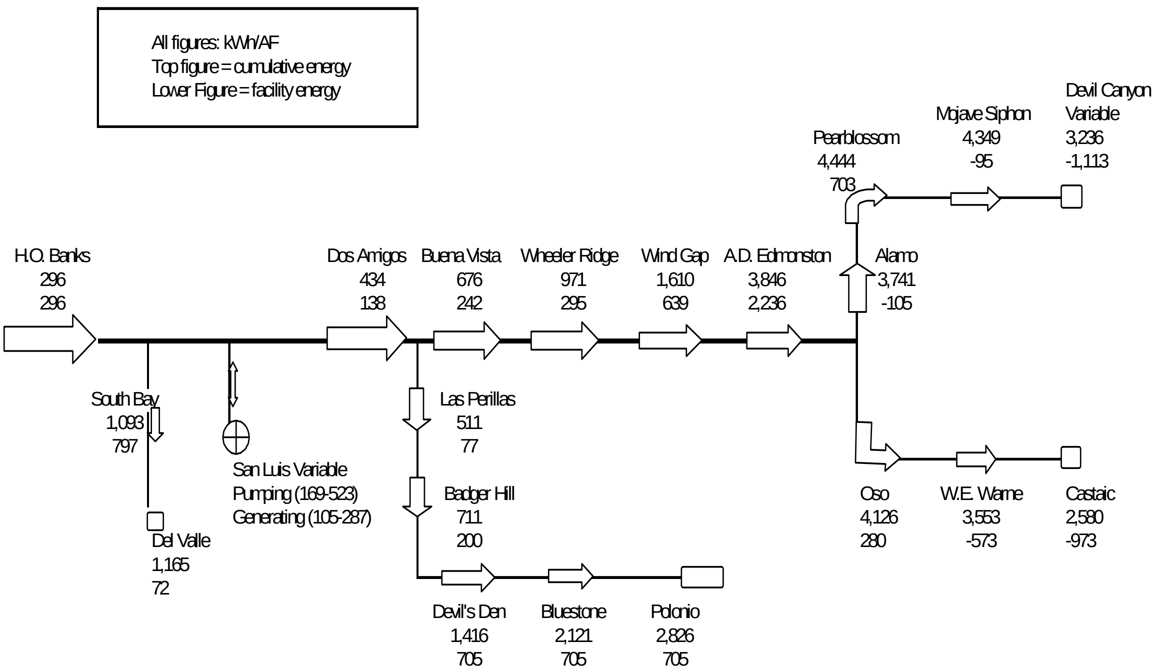
Energy requirements would be considerably higher if the SWP was delivering full contract volumes of water. The project delivered an average of approximately 2.0 mafy, or half its contracted volumes, throughout the 1980s and 1990s.[21] Since 2000 the volumes of imported water have generally increased.

The following map indicates the location of the pumping and power generation facilities on the SWP.

## Names and Locations of Primary State Water Delivery Facilities

The following schematic shows each individual pumping unit on the State Water Project, along with data for both the individual and cumulative energy required to deliver an AF of water to that point in the system. Note that the figures include energy recovery in the system, but they do not account for losses due to evaporation and other factors. These losses may be in the range of 5% or more. While more study of this issue is in order, it is important to observe that the energy intensity numbers are conservative (e.g. low) in that they assume that all of the water originally pumped from the delta reaches the ends of the system without loss.

**State Water Project**
**Kilowatt-Hours per Acre Foot Pumped**
(Includes Transmission Losses)




Source: Wilkinson, based on data from: California Department of Water Resources, State Water Project Analysis Office, Division of Operations and Maintenance, *Bulletin 132-97*, 4/25/97.

| EXISTING | TOTAL | Intake 600 cfs | perc rate 65 cfs 129acre-ft/day | Total Storage 531 acre-ft | | OPTION 1A |
|---|---|---|---|---|---|---|
| Date | | | Conserved | In Storage | | Date |
| | | | | 0 | | |
| 10/1/2004 | 0.70 | 0.70 | 0.70 | 0.00 | | 10/1/2004 |
| 10/2/2004 | 0.71 | 0.71 | 0.71 | 0.00 | | 10/2/2004 |
| 10/3/2004 | 0.71 | 0.71 | 0.71 | 0.00 | | 10/3/2004 |
| 10/4/2004 | 0.71 | 0.71 | 0.71 | 0.00 | | 10/4/2004 |
| 10/5/2004 | 0.67 | 0.67 | 0.67 | 0.00 | | 10/5/2004 |
| 10/6/2004 | 0.67 | 0.67 | 0.67 | 0.00 | | 10/6/2004 |
| 10/7/2004 | 0.66 | 0.66 | 0.66 | 0.00 | | 10/7/2004 |
| 10/8/2004 | 0.67 | 0.67 | 0.67 | 0.00 | | 10/8/2004 |
| 10/9/2004 | 0.71 | 0.71 | 0.71 | 0.00 | | 10/9/2004 |
| 10/10/2004 | 0.77 | 0.77 | 0.77 | 0.00 | | 10/10/2004 |
| 10/11/2004 | 0.70 | 0.70 | 0.70 | 0.00 | | 10/11/2004 |
| 10/12/2004 | 0.62 | 0.62 | 0.62 | 0.00 | | 10/12/2004 |
| 10/13/2004 | 0.65 | 0.65 | 0.65 | 0.00 | | 10/13/2004 |
| 10/14/2004 | 0.62 | 0.62 | 0.62 | 0.00 | | 10/14/2004 |
| 10/15/2004 | 0.71 | 0.71 | 0.71 | 0.00 | | 10/15/2004 |
| 10/16/2004 | 6.41 | 6.41 | 6.41 | 0.00 | | 10/16/2004 |
| 10/17/2004 | 116.19 | 116.19 | 116.19 | 0.00 | | 10/17/2004 |
| 10/18/2004 | 127.40 | 127.40 | 127.40 | 0.00 | | 10/18/2004 |
| 10/19/2004 | 546.76 | 546.76 | 129.00 | 417.76 | | 10/19/2004 |
| 10/20/2004 | 360.67 | 360.67 | 129.00 | 531.00 | | 10/20/2004 |
| 10/21/2004 | 1.42 | 1.42 | 129.00 | 403.42 | | 10/21/2004 |
| 10/22/2004 | 1.48 | 1.48 | 129.00 | 275.90 | | 10/22/2004 |
| 10/23/2004 | 1.39 | 1.39 | 129.00 | 148.29 | | 10/23/2004 |
| 10/24/2004 | 1.24 | 1.24 | 129.00 | 20.53 | | 10/24/2004 |
| 10/25/2004 | 1.12 | 1.12 | 21.65 | 0.00 | | 10/25/2004 |
| 10/26/2004 | 391.36 | 391.36 | 129.00 | 262.36 | | 10/26/2004 |
| 10/27/2004 | 121.75 | 121.75 | 129.00 | 255.11 | | 10/27/2004 |
| 10/28/2004 | 42.18 | 42.18 | 129.00 | 168.29 | | 10/28/2004 |
| 10/29/2004 | 0.74 | 0.74 | 129.00 | 40.03 | | 10/29/2004 |
| 10/30/2004 | 0.74 | 0.74 | 40.77 | 0.00 | | 10/30/2004 |
| 10/31/2004 | 0.71 | 0.71 | 0.71 | 0.00 | | 10/31/2004 |
| 11/1/2004 | 0.57 | 0.57 | 0.57 | 0.00 | | 11/1/2004 |
| 11/2/2004 | 1.07 | 1.07 | 1.07 | 0.00 | | 11/2/2004 |
| 11/3/2004 | 1.10 | 1.10 | 1.10 | 0.00 | | 11/3/2004 |
| 11/4/2004 | 1.27 | 1.27 | 1.27 | 0.00 | | 11/4/2004 |
| 11/5/2004 | 2.15 | 2.15 | 2.15 | 0.00 | | 11/5/2004 |
| 11/6/2004 | 1.09 | 1.09 | 1.09 | 0.00 | | 11/6/2004 |
| 11/7/2004 | 1.26 | 1.26 | 1.26 | 0.00 | | 11/7/2004 |
| 11/8/2004 | 2.66 | 2.66 | 2.66 | 0.00 | | 11/8/2004 |
| 11/9/2004 | 1.27 | 1.27 | 1.27 | 0.00 | | 11/9/2004 |
| 11/10/2004 | 15.76 | 15.76 | 15.76 | 0.00 | | 11/10/2004 |
| 11/11/2004 | 0.80 | 0.80 | 0.80 | 0.00 | | 11/11/2004 |
| 11/12/2004 | 0.68 | 0.68 | 0.68 | 0.00 | | 11/12/2004 |
| 11/13/2004 | 0.70 | 0.70 | 0.70 | 0.00 | | 11/13/2004 |
| 11/14/2004 | 0.56 | 0.56 | 0.56 | 0.00 | | 11/14/2004 |
| 11/15/2004 | 0.48 | 0.48 | 0.48 | 0.00 | | 11/15/2004 |
| 11/16/2004 | 0.47 | 0.47 | 0.47 | 0.00 | | 11/16/2004 |
| 11/17/2004 | 0.52 | 0.52 | 0.52 | 0.00 | | 11/17/2004 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11/18/2004 | 0.84 | 0.84 | 0.84 | 0.00 | | 11/18/2004 |
| 11/19/2004 | 1.94 | 1.94 | 1.94 | 0.00 | | 11/19/2004 |
| 11/20/2004 | 16.06 | 16.06 | 16.06 | 0.00 | | 11/20/2004 |
| 11/21/2004 | 1.41 | 1.41 | 1.41 | 0.00 | | 11/21/2004 |
| 11/22/2004 | 0.77 | 0.77 | 0.77 | 0.00 | | 11/22/2004 |
| 11/23/2004 | 0.53 | 0.53 | 0.53 | 0.00 | | 11/23/2004 |
| 11/24/2004 | 0.56 | 0.56 | 0.56 | 0.00 | | 11/24/2004 |
| 11/25/2004 | 0.61 | 0.61 | 0.61 | 0.00 | | 11/25/2004 |
| 11/26/2004 | 0.57 | 0.57 | 0.57 | 0.00 | | 11/26/2004 |
| 11/27/2004 | 14.33 | 14.33 | 14.33 | 0.00 | | 11/27/2004 |
| 11/28/2004 | 0.60 | 0.60 | 0.60 | 0.00 | | 11/28/2004 |
| 11/29/2004 | 0.24 | 0.24 | 0.24 | 0.00 | | 11/29/2004 |
| 11/30/2004 | 0.24 | 0.24 | 0.24 | 0.00 | | 11/30/2004 |
| 12/1/2004 | 0.50 | 0.50 | 0.50 | 0.00 | | 12/1/2004 |
| 12/2/2004 | 0.45 | 0.45 | 0.45 | 0.00 | | 12/2/2004 |
| 12/3/2004 | 0.29 | 0.29 | 0.29 | 0.00 | | 12/3/2004 |
| 12/4/2004 | 0.41 | 0.41 | 0.41 | 0.00 | | 12/4/2004 |
| 12/5/2004 | 15.28 | 15.28 | 15.28 | 0.00 | | 12/5/2004 |
| 12/6/2004 | 0.76 | 0.76 | 0.76 | 0.00 | | 12/6/2004 |
| 12/7/2004 | 4.62 | 4.62 | 4.62 | 0.00 | | 12/7/2004 |
| 12/8/2004 | 7.05 | 7.05 | 7.05 | 0.00 | | 12/8/2004 |
| 12/9/2004 | 0.50 | 0.50 | 0.50 | 0.00 | | 12/9/2004 |
| 12/10/2004 | 0.40 | 0.40 | 0.40 | 0.00 | | 12/10/2004 |
| 12/11/2004 | 0.40 | 0.40 | 0.40 | 0.00 | | 12/11/2004 |
| 12/12/2004 | 0.47 | 0.47 | 0.47 | 0.00 | | 12/12/2004 |
| 12/13/2004 | 0.51 | 0.51 | 0.51 | 0.00 | | 12/13/2004 |
| 12/14/2004 | 0.49 | 0.49 | 0.49 | 0.00 | | 12/14/2004 |
| 12/15/2004 | 0.44 | 0.44 | 0.44 | 0.00 | | 12/15/2004 |
| 12/16/2004 | 0.42 | 0.42 | 0.42 | 0.00 | | 12/16/2004 |
| 12/17/2004 | 0.51 | 0.51 | 0.51 | 0.00 | | 12/17/2004 |
| 12/18/2004 | 0.48 | 0.48 | 0.48 | 0.00 | | 12/18/2004 |
| 12/19/2004 | 0.38 | 0.38 | 0.38 | 0.00 | | 12/19/2004 |
| 12/20/2004 | 0.55 | 0.55 | 0.55 | 0.00 | | 12/20/2004 |
| 12/21/2004 | 0.58 | 0.58 | 0.58 | 0.00 | | 12/21/2004 |
| 12/22/2004 | 0.66 | 0.66 | 0.66 | 0.00 | | 12/22/2004 |
| 12/23/2004 | 0.39 | 0.39 | 0.39 | 0.00 | | 12/23/2004 |
| 12/24/2004 | 0.43 | 0.43 | 0.43 | 0.00 | | 12/24/2004 |
| 12/25/2004 | 0.49 | 0.49 | 0.49 | 0.00 | | 12/25/2004 |
| 12/26/2004 | 0.59 | 0.59 | 0.59 | 0.00 | | 12/26/2004 |
| 12/27/2004 | 183.46 | 183.46 | 129.00 | 54.46 | | 12/27/2004 |
| 12/28/2004 | 723.27 | 723.27 | 129.00 | 531.00 | | 12/28/2004 |
| 12/29/2004 | 431.95 | 431.95 | 129.00 | 531.00 | | 12/29/2004 |
| 12/30/2004 | 67.11 | 67.11 | 129.00 | 469.11 | | 12/30/2004 |
| 12/31/2004 | 364.66 | 364.66 | 129.00 | 531.00 | | 12/31/2004 |
| 1/1/2005 | 184.62 | 184.62 | 129.00 | 531.00 | | 1/1/2005 |
| 1/2/2005 | 232.17 | 232.17 | 129.00 | 531.00 | | 1/2/2005 |
| 1/3/2005 | 605.68 | 605.68 | 129.00 | 531.00 | | 1/3/2005 |
| 1/4/2005 | 196.14 | 196.14 | 129.00 | 531.00 | | 1/4/2005 |
| 1/5/2005 | 186.30 | 186.30 | 129.00 | 531.00 | | 1/5/2005 |
| 1/6/2005 | 185.18 | 185.18 | 129.00 | 531.00 | | 1/6/2005 |
| 1/7/2005 | 625.66 | 625.66 | 129.00 | 531.00 | | 1/7/2005 |
| 1/8/2005 | 712.20 | 712.20 | 129.00 | 531.00 | | 1/8/2005 |
| 1/9/2005 | 4211.74 | 1190.00 | 129.00 | 531.00 | | 1/9/2005 |
| 1/10/2005 | 6418.11 | 1190.00 | 129.00 | 531.00 | | 1/10/2005 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1/11/2005 | 4291.30 | 1190.00 | 129.00 | 531.00 | | 1/11/2005 |
| 1/12/2005 | 1585.64 | 1190.00 | 129.00 | 531.00 | | 1/12/2005 |
| 1/13/2005 | 808.96 | 808.96 | 129.00 | 531.00 | | 1/13/2005 |
| 1/14/2005 | 594.14 | 594.14 | 129.00 | 531.00 | | 1/14/2005 |
| 1/15/2005 | 488.64 | 488.64 | 129.00 | 531.00 | | 1/15/2005 |
| 1/16/2005 | 330.02 | 330.02 | 129.00 | 531.00 | | 1/16/2005 |
| 1/17/2005 | 248.60 | 248.60 | 129.00 | 531.00 | | 1/17/2005 |
| 1/18/2005 | 208.01 | 208.01 | 129.00 | 531.00 | | 1/18/2005 |
| 1/19/2005 | 165.70 | 165.70 | 129.00 | 531.00 | | 1/19/2005 |
| 1/20/2005 | 132.88 | 132.88 | 129.00 | 531.00 | | 1/20/2005 |
| 1/21/2005 | 218.27 | 218.27 | 129.00 | 531.00 | | 1/21/2005 |
| 1/22/2005 | 283.43 | 283.43 | 129.00 | 531.00 | | 1/22/2005 |
| 1/23/2005 | 278.64 | 278.64 | 129.00 | 531.00 | | 1/23/2005 |
| 1/24/2005 | 275.62 | 275.62 | 129.00 | 531.00 | | 1/24/2005 |
| 1/25/2005 | 270.89 | 270.89 | 129.00 | 531.00 | | 1/25/2005 |
| 1/26/2005 | 238.30 | 238.30 | 129.00 | 531.00 | | 1/26/2005 |
| 1/27/2005 | 129.24 | 129.24 | 129.00 | 531.00 | | 1/27/2005 |
| 1/28/2005 | 216.47 | 216.47 | 129.00 | 531.00 | | 1/28/2005 |
| 1/29/2005 | 129.24 | 129.24 | 129.00 | 531.00 | | 1/29/2005 |
| 1/30/2005 | 125.18 | 125.18 | 129.00 | 527.18 | | 1/30/2005 |
| 1/31/2005 | 117.93 | 117.93 | 129.00 | 516.11 | | 1/31/2005 |
| 2/1/2005 | 119.00 | 119.00 | 129.00 | 506.12 | | 2/1/2005 |
| 2/2/2005 | 133.82 | 133.82 | 129.00 | 510.93 | | 2/2/2005 |
| 2/3/2005 | 163.88 | 163.88 | 129.00 | 531.00 | | 2/3/2005 |
| 2/4/2005 | 78.60 | 78.60 | 129.00 | 480.60 | | 2/4/2005 |
| 2/5/2005 | 14.72 | 14.72 | 129.00 | 366.32 | | 2/5/2005 |
| 2/6/2005 | 21.33 | 21.33 | 129.00 | 258.65 | | 2/6/2005 |
| 2/7/2005 | 96.98 | 96.98 | 129.00 | 226.63 | | 2/7/2005 |
| 2/8/2005 | 174.41 | 174.41 | 129.00 | 272.04 | | 2/8/2005 |
| 2/9/2005 | 174.04 | 174.04 | 129.00 | 317.08 | | 2/9/2005 |
| 2/10/2005 | 174.79 | 174.79 | 129.00 | 362.87 | | 2/10/2005 |
| 2/11/2005 | 830.97 | 830.97 | 129.00 | 531.00 | | 2/11/2005 |
| 2/12/2005 | 56.42 | 56.42 | 129.00 | 458.42 | | 2/12/2005 |
| 2/13/2005 | 16.48 | 16.48 | 129.00 | 345.90 | | 2/13/2005 |
| 2/14/2005 | 155.37 | 155.37 | 129.00 | 372.27 | | 2/14/2005 |
| 2/15/2005 | 268.61 | 268.61 | 129.00 | 511.88 | | 2/15/2005 |
| 2/16/2005 | 143.85 | 143.85 | 129.00 | 526.73 | | 2/16/2005 |
| 2/17/2005 | 140.67 | 140.67 | 129.00 | 531.00 | | 2/17/2005 |
| 2/18/2005 | 244.54 | 244.54 | 129.00 | 531.00 | | 2/18/2005 |
| 2/19/2005 | 1004.59 | 1004.59 | 129.00 | 531.00 | | 2/19/2005 |
| 2/20/2005 | 2002.65 | 1190.00 | 129.00 | 531.00 | | 2/20/2005 |
| 2/21/2005 | 2692.06 | 1190.00 | 129.00 | 531.00 | | 2/21/2005 |
| 2/22/2005 | 2007.75 | 1190.00 | 129.00 | 531.00 | | 2/22/2005 |
| 2/23/2005 | 1528.09 | 1190.00 | 129.00 | 531.00 | | 2/23/2005 |
| 2/24/2005 | 1053.37 | 1053.37 | 129.00 | 531.00 | | 2/24/2005 |
| 2/25/2005 | 777.81 | 777.81 | 129.00 | 531.00 | | 2/25/2005 |
| 2/26/2005 | 613.02 | 613.02 | 129.00 | 531.00 | | 2/26/2005 |
| 2/27/2005 | 570.93 | 570.93 | 129.00 | 531.00 | | 2/27/2005 |
| 2/28/2005 | 459.03 | 459.03 | 129.00 | 531.00 | | 2/28/2005 |
| 3/1/2005 | 286.93 | 286.93 | 129.00 | 531.00 | | 3/1/2005 |
| 3/2/2005 | 302.73 | 302.73 | 129.00 | 531.00 | | 3/2/2005 |
| 3/3/2005 | 260.15 | 260.15 | 129.00 | 531.00 | | 3/3/2005 |
| 3/4/2005 | 328.14 | 328.14 | 129.00 | 531.00 | | 3/4/2005 |
| 3/5/2005 | 219.97 | 219.97 | 129.00 | 531.00 | | 3/5/2005 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3/6/2005 | 220.45 | 220.45 | 129.00 | 531.00 | | 3/6/2005 |
| 3/7/2005 | 191.24 | 191.24 | 129.00 | 531.00 | | 3/7/2005 |
| 3/8/2005 | 157.65 | 157.65 | 129.00 | 531.00 | | 3/8/2005 |
| 3/9/2005 | 160.50 | 160.50 | 129.00 | 531.00 | | 3/9/2005 |
| 3/10/2005 | 154.55 | 154.55 | 129.00 | 531.00 | | 3/10/2005 |
| 3/11/2005 | 134.94 | 134.94 | 129.00 | 531.00 | | 3/11/2005 |
| 3/12/2005 | 135.38 | 135.38 | 129.00 | 531.00 | | 3/12/2005 |
| 3/13/2005 | 144.09 | 144.09 | 129.00 | 531.00 | | 3/13/2005 |
| 3/14/2005 | 151.80 | 151.80 | 129.00 | 531.00 | | 3/14/2005 |
| 3/15/2005 | 165.62 | 165.62 | 129.00 | 531.00 | | 3/15/2005 |
| 3/16/2005 | 166.95 | 166.95 | 129.00 | 531.00 | | 3/16/2005 |
| 3/17/2005 | 170.92 | 170.92 | 129.00 | 531.00 | | 3/17/2005 |
| 3/18/2005 | 181.90 | 181.90 | 129.00 | 531.00 | | 3/18/2005 |
| 3/19/2005 | 206.46 | 206.46 | 129.00 | 531.00 | | 3/19/2005 |
| 3/20/2005 | 168.20 | 168.20 | 129.00 | 531.00 | | 3/20/2005 |
| 3/21/2005 | 160.75 | 160.75 | 129.00 | 531.00 | | 3/21/2005 |
| 3/22/2005 | 531.99 | 531.99 | 129.00 | 531.00 | | 3/22/2005 |
| 3/23/2005 | 164.11 | 164.11 | 129.00 | 531.00 | | 3/23/2005 |
| 3/24/2005 | 147.52 | 147.52 | 129.00 | 531.00 | | 3/24/2005 |
| 3/25/2005 | 133.72 | 133.72 | 129.00 | 531.00 | | 3/25/2005 |
| 3/26/2005 | 125.18 | 125.18 | 129.00 | 527.18 | | 3/26/2005 |
| 3/27/2005 | 125.93 | 125.93 | 129.00 | 524.11 | | 3/27/2005 |
| 3/28/2005 | 136.03 | 136.03 | 129.00 | 531.00 | | 3/28/2005 |
| 3/29/2005 | 114.37 | 114.37 | 129.00 | 516.37 | | 3/29/2005 |
| 3/30/2005 | 176.81 | 176.81 | 129.00 | 531.00 | | 3/30/2005 |
| 3/31/2005 | 221.82 | 221.82 | 129.00 | 531.00 | | 3/31/2005 |
| 4/1/2005 | 139.24 | 139.24 | 129.00 | 531.00 | | 4/1/2005 |
| 4/2/2005 | 16.41 | 16.41 | 129.00 | 418.41 | | 4/2/2005 |
| 4/3/2005 | 14.70 | 14.70 | 129.00 | 304.11 | | 4/3/2005 |
| 4/4/2005 | 111.57 | 111.57 | 129.00 | 286.68 | | 4/4/2005 |
| 4/5/2005 | 177.65 | 177.65 | 129.00 | 335.33 | | 4/5/2005 |
| 4/6/2005 | 180.33 | 180.33 | 129.00 | 386.66 | | 4/6/2005 |
| 4/7/2005 | 93.82 | 93.82 | 129.00 | 351.48 | | 4/7/2005 |
| 4/8/2005 | 13.27 | 13.27 | 129.00 | 235.76 | | 4/8/2005 |
| 4/9/2005 | 12.18 | 12.18 | 129.00 | 118.94 | | 4/9/2005 |
| 4/10/2005 | 11.26 | 11.26 | 129.00 | 1.20 | | 4/10/2005 |
| 4/11/2005 | 114.46 | 114.46 | 115.66 | 0.00 | | 4/11/2005 |
| 4/12/2005 | 125.34 | 125.34 | 125.34 | 0.00 | | 4/12/2005 |
| 4/13/2005 | 11.65 | 11.65 | 11.65 | 0.00 | | 4/13/2005 |
| 4/14/2005 | 14.13 | 14.13 | 14.13 | 0.00 | | 4/14/2005 |
| 4/15/2005 | 10.51 | 10.51 | 10.51 | 0.00 | | 4/15/2005 |
| 4/16/2005 | 10.27 | 10.27 | 10.27 | 0.00 | | 4/16/2005 |
| 4/17/2005 | 9.84 | 9.84 | 9.84 | 0.00 | | 4/17/2005 |
| 4/18/2005 | 10.27 | 10.27 | 10.27 | 0.00 | | 4/18/2005 |
| 4/19/2005 | 10.16 | 10.16 | 10.16 | 0.00 | | 4/19/2005 |
| 4/20/2005 | 9.35 | 9.35 | 9.35 | 0.00 | | 4/20/2005 |
| 4/21/2005 | 9.44 | 9.44 | 9.44 | 0.00 | | 4/21/2005 |
| 4/22/2005 | 9.16 | 9.16 | 9.16 | 0.00 | | 4/22/2005 |
| 4/23/2005 | 9.13 | 9.13 | 9.13 | 0.00 | | 4/23/2005 |
| 4/24/2005 | 9.18 | 9.18 | 9.18 | 0.00 | | 4/24/2005 |
| 4/25/2005 | 9.38 | 9.38 | 9.38 | 0.00 | | 4/25/2005 |
| 4/26/2005 | 8.29 | 8.29 | 8.29 | 0.00 | | 4/26/2005 |
| 4/27/2005 | 8.08 | 8.08 | 8.08 | 0.00 | | 4/27/2005 |
| 4/28/2005 | 189.53 | 189.53 | 129.00 | 60.53 | | 4/28/2005 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4/29/2005 | 8.95 | 8.95 | 69.48 | 0.00 | | 4/29/2005 |
| 4/30/2005 | 7.92 | 7.92 | 7.92 | 0.00 | | 4/30/2005 |
| 5/1/2005 | 7.60 | 7.60 | 7.60 | 0.00 | | 5/1/2005 |
| 5/2/2005 | 7.56 | 7.56 | 7.56 | 0.00 | | 5/2/2005 |
| 5/3/2005 | 7.81 | 7.81 | 7.81 | 0.00 | | 5/3/2005 |
| 5/4/2005 | 7.71 | 7.71 | 7.71 | 0.00 | | 5/4/2005 |
| 5/5/2005 | 34.20 | 34.20 | 34.20 | 0.00 | | 5/5/2005 |
| 5/6/2005 | 195.45 | 195.45 | 129.00 | 66.45 | | 5/6/2005 |
| 5/7/2005 | 426.39 | 426.39 | 129.00 | 363.85 | | 5/7/2005 |
| 5/8/2005 | 9.53 | 9.53 | 129.00 | 244.38 | | 5/8/2005 |
| 5/9/2005 | 43.48 | 43.48 | 129.00 | 158.86 | | 5/9/2005 |
| 5/10/2005 | 8.21 | 8.21 | 129.00 | 38.07 | | 5/10/2005 |
| 5/11/2005 | 7.17 | 7.17 | 45.24 | 0.00 | | 5/11/2005 |
| 5/12/2005 | 7.38 | 7.38 | 7.38 | 0.00 | | 5/12/2005 |
| 5/13/2005 | 6.63 | 6.63 | 6.63 | 0.00 | | 5/13/2005 |
| 5/14/2005 | 6.63 | 6.63 | 6.63 | 0.00 | | 5/14/2005 |
| 5/15/2005 | 6.82 | 6.82 | 6.82 | 0.00 | | 5/15/2005 |
| 5/16/2005 | 7.18 | 7.18 | 7.18 | 0.00 | | 5/16/2005 |
| 5/17/2005 | 281.43 | 281.43 | 129.00 | 152.43 | | 5/17/2005 |
| 5/18/2005 | 306.17 | 306.17 | 129.00 | 329.59 | | 5/18/2005 |
| 5/19/2005 | 7.92 | 7.92 | 129.00 | 208.52 | | 5/19/2005 |
| 5/20/2005 | 6.58 | 6.58 | 129.00 | 86.10 | | 5/20/2005 |
| 5/21/2005 | 6.14 | 6.14 | 92.24 | 0.00 | | 5/21/2005 |
| 5/22/2005 | 6.19 | 6.19 | 6.19 | 0.00 | | 5/22/2005 |
| 5/23/2005 | 6.27 | 6.27 | 6.27 | 0.00 | | 5/23/2005 |
| 5/24/2005 | 6.61 | 6.61 | 6.61 | 0.00 | | 5/24/2005 |
| 5/25/2005 | 6.31 | 6.31 | 6.31 | 0.00 | | 5/25/2005 |
| 5/26/2005 | 6.19 | 6.19 | 6.19 | 0.00 | | 5/26/2005 |
| 5/27/2005 | 6.14 | 6.14 | 6.14 | 0.00 | | 5/27/2005 |
| 5/28/2005 | 6.02 | 6.02 | 6.02 | 0.00 | | 5/28/2005 |
| 5/29/2005 | 6.15 | 6.15 | 6.15 | 0.00 | | 5/29/2005 |
| 5/30/2005 | 6.15 | 6.15 | 6.15 | 0.00 | | 5/30/2005 |
| 5/31/2005 | 242.35 | 242.35 | 129.00 | 113.35 | | 5/31/2005 |
| 6/1/2005 | 323.12 | 323.12 | 129.00 | 307.47 | | 6/1/2005 |
| 6/2/2005 | 67.71 | 67.71 | 129.00 | 246.17 | | 6/2/2005 |
| 6/3/2005 | 6.36 | 6.36 | 129.00 | 123.54 | | 6/3/2005 |
| 6/4/2005 | 6.41 | 6.41 | 129.00 | 0.95 | | 6/4/2005 |
| 6/5/2005 | 6.62 | 6.62 | 7.57 | 0.00 | | 6/5/2005 |
| 6/6/2005 | 6.47 | 6.47 | 6.47 | 0.00 | | 6/6/2005 |
| 6/7/2005 | 6.16 | 6.16 | 6.16 | 0.00 | | 6/7/2005 |
| 6/8/2005 | 6.42 | 6.42 | 6.42 | 0.00 | | 6/8/2005 |
| 6/9/2005 | 7.37 | 7.37 | 7.37 | 0.00 | | 6/9/2005 |
| 6/10/2005 | 6.26 | 6.26 | 6.26 | 0.00 | | 6/10/2005 |
| 6/11/2005 | 6.36 | 6.36 | 6.36 | 0.00 | | 6/11/2005 |
| 6/12/2005 | 6.38 | 6.38 | 6.38 | 0.00 | | 6/12/2005 |
| 6/13/2005 | 6.05 | 6.05 | 6.05 | 0.00 | | 6/13/2005 |
| 6/14/2005 | 243.48 | 243.48 | 129.00 | 114.48 | | 6/14/2005 |
| 6/15/2005 | 163.74 | 163.74 | 129.00 | 149.22 | | 6/15/2005 |
| 6/16/2005 | 7.13 | 7.13 | 129.00 | 27.35 | | 6/16/2005 |
| 6/17/2005 | 7.37 | 7.37 | 34.72 | 0.00 | | 6/17/2005 |
| 6/18/2005 | 6.67 | 6.67 | 6.67 | 0.00 | | 6/18/2005 |
| 6/19/2005 | 5.98 | 5.98 | 5.98 | 0.00 | | 6/19/2005 |
| 6/20/2005 | 5.93 | 5.93 | 5.93 | 0.00 | | 6/20/2005 |
| 6/21/2005 | 5.93 | 5.93 | 5.93 | 0.00 | | 6/21/2005 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6/22/2005 | 6.00 | 6.00 | 6.00 | 0.00 | | 6/22/2005 |
| 6/23/2005 | 7.06 | 7.06 | 7.06 | 0.00 | | 6/23/2005 |
| 6/24/2005 | 7.13 | 7.13 | 7.13 | 0.00 | | 6/24/2005 |
| 6/25/2005 | 7.15 | 7.15 | 7.15 | 0.00 | | 6/25/2005 |
| 6/26/2005 | 7.28 | 7.28 | 7.28 | 0.00 | | 6/26/2005 |
| 6/27/2005 | 7.05 | 7.05 | 7.05 | 0.00 | | 6/27/2005 |
| 6/28/2005 | 7.08 | 7.08 | 7.08 | 0.00 | | 6/28/2005 |
| 6/29/2005 | 6.20 | 6.20 | 6.20 | 0.00 | | 6/29/2005 |
| 6/30/2005 | 6.28 | 6.28 | 6.28 | 0.00 | | 6/30/2005 |
| 7/1/2005 | 6.82 | 6.82 | 6.82 | 0.00 | | 7/1/2005 |
| 7/2/2005 | 6.02 | 6.02 | 6.02 | 0.00 | | 7/2/2005 |
| 7/3/2005 | 6.21 | 6.21 | 6.21 | 0.00 | | 7/3/2005 |
| 7/4/2005 | 5.74 | 5.74 | 5.74 | 0.00 | | 7/4/2005 |
| 7/5/2005 | 6.78 | 6.78 | 6.78 | 0.00 | | 7/5/2005 |
| 7/6/2005 | 6.49 | 6.49 | 6.49 | 0.00 | | 7/6/2005 |
| 7/7/2005 | 5.93 | 5.93 | 5.93 | 0.00 | | 7/7/2005 |
| 7/8/2005 | 5.35 | 5.35 | 5.35 | 0.00 | | 7/8/2005 |
| 7/9/2005 | 5.30 | 5.30 | 5.30 | 0.00 | | 7/9/2005 |
| 7/10/2005 | 5.41 | 5.41 | 5.41 | 0.00 | | 7/10/2005 |
| 7/11/2005 | 5.56 | 5.56 | 5.56 | 0.00 | | 7/11/2005 |
| 7/12/2005 | 246.55 | 246.55 | 129.00 | 117.55 | | 7/12/2005 |
| 7/13/2005 | 151.88 | 151.88 | 129.00 | 140.43 | | 7/13/2005 |
| 7/14/2005 | 5.76 | 5.76 | 129.00 | 17.19 | | 7/14/2005 |
| 7/15/2005 | 6.52 | 6.52 | 23.71 | 0.00 | | 7/15/2005 |
| 7/16/2005 | 6.47 | 6.47 | 6.47 | 0.00 | | 7/16/2005 |
| 7/17/2005 | 5.98 | 5.98 | 5.98 | 0.00 | | 7/17/2005 |
| 7/18/2005 | 6.02 | 6.02 | 6.02 | 0.00 | | 7/18/2005 |
| 7/19/2005 | 5.94 | 5.94 | 5.94 | 0.00 | | 7/19/2005 |
| 7/20/2005 | 6.25 | 6.25 | 6.25 | 0.00 | | 7/20/2005 |
| 7/21/2005 | 6.31 | 6.31 | 6.31 | 0.00 | | 7/21/2005 |
| 7/22/2005 | 5.75 | 5.75 | 5.75 | 0.00 | | 7/22/2005 |
| 7/23/2005 | 5.70 | 5.70 | 5.70 | 0.00 | | 7/23/2005 |
| 7/24/2005 | 5.69 | 5.69 | 5.69 | 0.00 | | 7/24/2005 |
| 7/25/2005 | 5.71 | 5.71 | 5.71 | 0.00 | | 7/25/2005 |
| 7/26/2005 | 236.56 | 236.56 | 129.00 | 107.56 | | 7/26/2005 |
| 7/27/2005 | 144.69 | 144.69 | 129.00 | 123.25 | | 7/27/2005 |
| 7/28/2005 | 5.32 | 5.32 | 128.58 | 0.00 | | 7/28/2005 |
| 7/29/2005 | 5.99 | 5.99 | 5.99 | 0.00 | | 7/29/2005 |
| 7/30/2005 | 5.65 | 5.65 | 5.65 | 0.00 | | 7/30/2005 |
| 7/31/2005 | 5.48 | 5.48 | 5.48 | 0.00 | | 7/31/2005 |
| 8/1/2005 | 5.38 | 5.38 | 5.38 | 0.00 | | 8/1/2005 |
| 8/2/2005 | 5.11 | 5.11 | 5.11 | 0.00 | | 8/2/2005 |
| 8/3/2005 | 5.05 | 5.05 | 5.05 | 0.00 | | 8/3/2005 |
| 8/4/2005 | 5.00 | 5.00 | 5.00 | 0.00 | | 8/4/2005 |
| 8/5/2005 | 5.03 | 5.03 | 5.03 | 0.00 | | 8/5/2005 |
| 8/6/2005 | 5.27 | 5.27 | 5.27 | 0.00 | | 8/6/2005 |
| 8/7/2005 | 5.19 | 5.19 | 5.19 | 0.00 | | 8/7/2005 |
| 8/8/2005 | 5.22 | 5.22 | 5.22 | 0.00 | | 8/8/2005 |
| 8/9/2005 | 4.94 | 4.94 | 4.94 | 0.00 | | 8/9/2005 |
| 8/10/2005 | 4.95 | 4.95 | 4.95 | 0.00 | | 8/10/2005 |
| 8/11/2005 | 5.00 | 5.00 | 5.00 | 0.00 | | 8/11/2005 |
| 8/12/2005 | 5.10 | 5.10 | 5.10 | 0.00 | | 8/12/2005 |
| 8/13/2005 | 5.19 | 5.19 | 5.19 | 0.00 | | 8/13/2005 |
| 8/14/2005 | 5.35 | 5.35 | 5.35 | 0.00 | | 8/14/2005 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8/15/2005 | 37.78 | 37.78 | 37.78 | 0.00 | | 8/15/2005 |
| 8/16/2005 | 4.19 | 4.19 | 4.19 | 0.00 | | 8/16/2005 |
| 8/17/2005 | 4.11 | 4.11 | 4.11 | 0.00 | | 8/17/2005 |
| 8/18/2005 | 4.33 | 4.33 | 4.33 | 0.00 | | 8/18/2005 |
| 8/19/2005 | 4.46 | 4.46 | 4.46 | 0.00 | | 8/19/2005 |
| 8/20/2005 | 4.31 | 4.31 | 4.31 | 0.00 | | 8/20/2005 |
| 8/21/2005 | 4.32 | 4.32 | 4.32 | 0.00 | | 8/21/2005 |
| 8/22/2005 | 4.47 | 4.47 | 4.47 | 0.00 | | 8/22/2005 |
| 8/23/2005 | 4.24 | 4.24 | 4.24 | 0.00 | | 8/23/2005 |
| 8/24/2005 | 3.55 | 3.55 | 3.55 | 0.00 | | 8/24/2005 |
| 8/25/2005 | 3.84 | 3.84 | 3.84 | 0.00 | | 8/25/2005 |
| 8/26/2005 | 3.77 | 3.77 | 3.77 | 0.00 | | 8/26/2005 |
| 8/27/2005 | 3.89 | 3.89 | 3.89 | 0.00 | | 8/27/2005 |
| 8/28/2005 | 3.70 | 3.70 | 3.70 | 0.00 | | 8/28/2005 |
| 8/29/2005 | 3.62 | 3.62 | 3.62 | 0.00 | | 8/29/2005 |
| 8/30/2005 | 3.68 | 3.68 | 3.68 | 0.00 | | 8/30/2005 |
| 8/31/2005 | 3.79 | 3.79 | 3.79 | 0.00 | | 8/31/2005 |
| 9/1/2005 | 3.97 | 3.97 | 3.97 | 0.00 | | 9/1/2005 |
| 9/2/2005 | 4.07 | 4.07 | 4.07 | 0.00 | | 9/2/2005 |
| 9/3/2005 | 3.98 | 3.98 | 3.98 | 0.00 | | 9/3/2005 |
| 9/4/2005 | 3.82 | 3.82 | 3.82 | 0.00 | | 9/4/2005 |
| 9/5/2005 | 3.64 | 3.64 | 3.64 | 0.00 | | 9/5/2005 |
| 9/6/2005 | 4.15 | 4.15 | 4.15 | 0.00 | | 9/6/2005 |
| 9/7/2005 | 3.46 | 3.46 | 3.46 | 0.00 | | 9/7/2005 |
| 9/8/2005 | 3.64 | 3.64 | 3.64 | 0.00 | | 9/8/2005 |
| 9/9/2005 | 3.81 | 3.81 | 3.81 | 0.00 | | 9/9/2005 |
| 9/10/2005 | 3.97 | 3.97 | 3.97 | 0.00 | | 9/10/2005 |
| 9/11/2005 | 3.78 | 3.78 | 3.78 | 0.00 | | 9/11/2005 |
| 9/12/2005 | 3.75 | 3.75 | 3.75 | 0.00 | | 9/12/2005 |
| 9/13/2005 | 3.79 | 3.79 | 3.79 | 0.00 | | 9/13/2005 |
| 9/14/2005 | 3.71 | 3.71 | 3.71 | 0.00 | | 9/14/2005 |
| 9/15/2005 | 3.68 | 3.68 | 3.68 | 0.00 | | 9/15/2005 |
| 9/16/2005 | 3.70 | 3.70 | 3.70 | 0.00 | | 9/16/2005 |
| 9/17/2005 | 3.68 | 3.68 | 3.68 | 0.00 | | 9/17/2005 |
| 9/18/2005 | 3.61 | 3.61 | 3.61 | 0.00 | | 9/18/2005 |
| 9/19/2005 | 3.60 | 3.60 | 3.60 | 0.00 | | 9/19/2005 |
| 9/20/2005 | 23.51 | 23.51 | 23.51 | 0.00 | | 9/20/2005 |
| 9/21/2005 | 4.17 | 4.17 | 4.17 | 0.00 | | 9/21/2005 |
| 9/22/2005 | 3.99 | 3.99 | 3.99 | 0.00 | | 9/22/2005 |
| 9/23/2005 | 4.25 | 4.25 | 4.25 | 0.00 | | 9/23/2005 |
| 9/24/2005 | 4.26 | 4.26 | 4.26 | 0.00 | | 9/24/2005 |
| 9/25/2005 | 4.30 | 4.30 | 4.30 | 0.00 | | 9/25/2005 |
| 9/26/2005 | 4.30 | 4.30 | 4.30 | 0.00 | | 9/26/2005 |
| 9/27/2005 | 4.15 | 4.15 | 4.15 | 0.00 | | 9/27/2005 |
| 9/28/2005 | 3.51 | 3.51 | 3.51 | 0.00 | | 9/28/2005 |
| 9/29/2005 | 3.88 | 3.88 | 3.88 | 0.00 | | 9/29/2005 |
| 9/30/2005 | 4.09 | 4.09 | 4.09 | 0.00 | | 9/30/2005 |
| | **55,251.78** | **40,034.45** | **19,779.15** | | | |
| | | | | | | |

| | |
|---|---|
| Available Water | 55,251.78 |
| Could be saved in the past | 19,779.15 |
| Price of ac-ft water | 494 |

| OPTION | BENEFIT IN AF | BENEFIT IN $ | COST | COST/BENEFIT RATIO |
|---|---|---|---|---|
| 1A (perc. Rate 69 cfs) | 1,244 | 614,748 | 18,636,425 | 30.3 |
| 2A (perc. Rate 69 cfs) | 1,259 | 622,158 | 18,019,780 | 29.0 |
| 1B (perc. Rate 150 cfs) | 10,200 | 5,039,033 | 28,067,689 | 5.6 |
| 2B (perc. Rate 150 cfs) | 10,374 | 5,124,699 | 28,186,579 | 5.5 |

| SIZE OF THE TRENCH | AREA | NUMBER OF TRENCHE | TOTAL AREA |
|---|---|---|---|
| 30 (W) X 200 (L) | 6000 | 9 | 54000 |

| OPTION | Total surface area (ft2) | Area without trenches | % of area without trenches | % of trench area |
|---|---|---|---|---|
| **1A** | 3,782,369 | 3,728,369 | 98.6 | 1.1 |
| **2A** | 3,891,238 | 3,837,238 | 98.6 | 1.0 |
| **1B** | 3,279,673 | 3,225,673 | 98.4 | 1.2 |
| **2B** | 3,400,344 | 3,346,344 | 98.4 | 1.2 |

0.01*400+0.99*65= 68.35

| TOTAL | Intake 600 cfs / 1190 ac-ft | perc rate 69 cfs 137 acre-ft/day | Total Storage 889 acre-ft |
|---|---|---|---|
| | | Conserved | In Storage |
| | | | 0 |
| 0.70 | 0.70 | 0.70 | 0.00 |
| 0.71 | 0.71 | 0.71 | 0.00 |
| 0.71 | 0.71 | 0.71 | 0.00 |
| 0.71 | 0.71 | 0.71 | 0.00 |
| 0.67 | 0.67 | 0.67 | 0.00 |
| 0.67 | 0.67 | 0.67 | 0.00 |
| 0.66 | 0.66 | 0.66 | 0.00 |
| 0.67 | 0.67 | 0.67 | 0.00 |
| 0.71 | 0.71 | 0.71 | 0.00 |
| 0.77 | 0.77 | 0.77 | 0.00 |
| 0.70 | 0.70 | 0.70 | 0.00 |
| 0.62 | 0.62 | 0.62 | 0.00 |
| 0.65 | 0.65 | 0.65 | 0.00 |
| 0.62 | 0.62 | 0.62 | 0.00 |
| 0.71 | 0.71 | 0.71 | 0.00 |
| 6.41 | 6.41 | 6.41 | 0.00 |
| 116.19 | 116.19 | 116.19 | 0.00 |
| 127.40 | 127.40 | 127.40 | 0.00 |
| 546.76 | 546.76 | 137.00 | 409.76 |
| 360.67 | 360.67 | 137.00 | 633.43 |
| 1.42 | 1.42 | 137.00 | 497.85 |
| 1.48 | 1.48 | 137.00 | 362.32 |
| 1.39 | 1.39 | 137.00 | 226.72 |
| 1.24 | 1.24 | 137.00 | 90.96 |
| 1.12 | 1.12 | 92.07 | 0.00 |
| 391.36 | 391.36 | 137.00 | 254.36 |
| 121.75 | 121.75 | 137.00 | 239.11 |
| 42.18 | 42.18 | 137.00 | 144.29 |
| 0.74 | 0.74 | 137.00 | 8.03 |
| 0.74 | 0.74 | 8.77 | 0.00 |
| 0.71 | 0.71 | 0.71 | 0.00 |
| 0.57 | 0.57 | 0.57 | 0.00 |
| 1.07 | 1.07 | 1.07 | 0.00 |
| 1.10 | 1.10 | 1.10 | 0.00 |
| 1.27 | 1.27 | 1.27 | 0.00 |
| 2.15 | 2.15 | 2.15 | 0.00 |
| 1.09 | 1.09 | 1.09 | 0.00 |
| 1.26 | 1.26 | 1.26 | 0.00 |
| 2.66 | 2.66 | 2.66 | 0.00 |
| 1.27 | 1.27 | 1.27 | 0.00 |
| 15.76 | 15.76 | 15.76 | 0.00 |
| 0.80 | 0.80 | 0.80 | 0.00 |
| 0.68 | 0.68 | 0.68 | 0.00 |
| 0.70 | 0.70 | 0.70 | 0.00 |
| 0.56 | 0.56 | 0.56 | 0.00 |
| 0.48 | 0.48 | 0.48 | 0.00 |
| 0.47 | 0.47 | 0.47 | 0.00 |
| 0.52 | 0.52 | 0.52 | 0.00 |

| OPTION 2A | TOTAL | Intake 600 cfs / 1190 ac-ft | perc rate 69 cfs 137 acre-ft/day |
|---|---|---|---|
| Date | | | Conserved |
| | | | |
| 10/1/2004 | 0.70 | 0.70 | 0.70 |
| 10/2/2004 | 0.71 | 0.71 | 0.71 |
| 10/3/2004 | 0.71 | 0.71 | 0.71 |
| 10/4/2004 | 0.71 | 0.71 | 0.71 |
| 10/5/2004 | 0.67 | 0.67 | 0.67 |
| 10/6/2004 | 0.67 | 0.67 | 0.67 |
| 10/7/2004 | 0.66 | 0.66 | 0.66 |
| 10/8/2004 | 0.67 | 0.67 | 0.67 |
| 10/9/2004 | 0.71 | 0.71 | 0.71 |
| 10/10/2004 | 0.77 | 0.77 | 0.77 |
| 10/11/2004 | 0.70 | 0.70 | 0.70 |
| 10/12/2004 | 0.62 | 0.62 | 0.62 |
| 10/13/2004 | 0.65 | 0.65 | 0.65 |
| 10/14/2004 | 0.62 | 0.62 | 0.62 |
| 10/15/2004 | 0.71 | 0.71 | 0.71 |
| 10/16/2004 | 6.41 | 6.41 | 6.41 |
| 10/17/2004 | 116.19 | 116.19 | 116.19 |
| 10/18/2004 | 127.40 | 127.40 | 127.40 |
| 10/19/2004 | 546.76 | 546.76 | 137.00 |
| 10/20/2004 | 360.67 | 360.67 | 137.00 |
| 10/21/2004 | 1.42 | 1.42 | 137.00 |
| 10/22/2004 | 1.48 | 1.48 | 137.00 |
| 10/23/2004 | 1.39 | 1.39 | 137.00 |
| 10/24/2004 | 1.24 | 1.24 | 137.00 |
| 10/25/2004 | 1.12 | 1.12 | 92.07 |
| 10/26/2004 | 391.36 | 391.36 | 137.00 |
| 10/27/2004 | 121.75 | 121.75 | 137.00 |
| 10/28/2004 | 42.18 | 42.18 | 137.00 |
| 10/29/2004 | 0.74 | 0.74 | 137.00 |
| 10/30/2004 | 0.74 | 0.74 | 8.77 |
| 10/31/2004 | 0.71 | 0.71 | 0.71 |
| 11/1/2004 | 0.57 | 0.57 | 0.57 |
| 11/2/2004 | 1.07 | 1.07 | 1.07 |
| 11/3/2004 | 1.10 | 1.10 | 1.10 |
| 11/4/2004 | 1.27 | 1.27 | 1.27 |
| 11/5/2004 | 2.15 | 2.15 | 2.15 |
| 11/6/2004 | 1.09 | 1.09 | 1.09 |
| 11/7/2004 | 1.26 | 1.26 | 1.26 |
| 11/8/2004 | 2.66 | 2.66 | 2.66 |
| 11/9/2004 | 1.27 | 1.27 | 1.27 |
| 11/10/2004 | 15.76 | 15.76 | 15.76 |
| 11/11/2004 | 0.80 | 0.80 | 0.80 |
| 11/12/2004 | 0.68 | 0.68 | 0.68 |
| 11/13/2004 | 0.70 | 0.70 | 0.70 |
| 11/14/2004 | 0.56 | 0.56 | 0.56 |
| 11/15/2004 | 0.48 | 0.48 | 0.48 |
| 11/16/2004 | 0.47 | 0.47 | 0.47 |
| 11/17/2004 | 0.52 | 0.52 | 0.52 |

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|---|---|---|---|---|---|---|---|
| 0.84 | 0.84 | 0.84 | 0.00 | 11/18/2004 | 0.84 | 0.84 | 0.84 |
| 1.94 | 1.94 | 1.94 | 0.00 | 11/19/2004 | 1.94 | 1.94 | 1.94 |
| 16.06 | 16.06 | 16.06 | 0.00 | 11/20/2004 | 16.06 | 16.06 | 16.06 |
| 1.41 | 1.41 | 1.41 | 0.00 | 11/21/2004 | 1.41 | 1.41 | 1.41 |
| 0.77 | 0.77 | 0.77 | 0.00 | 11/22/2004 | 0.77 | 0.77 | 0.77 |
| 0.53 | 0.53 | 0.53 | 0.00 | 11/23/2004 | 0.53 | 0.53 | 0.53 |
| 0.56 | 0.56 | 0.56 | 0.00 | 11/24/2004 | 0.56 | 0.56 | 0.56 |
| 0.61 | 0.61 | 0.61 | 0.00 | 11/25/2004 | 0.61 | 0.61 | 0.61 |
| 0.57 | 0.57 | 0.57 | 0.00 | 11/26/2004 | 0.57 | 0.57 | 0.57 |
| 14.33 | 14.33 | 14.33 | 0.00 | 11/27/2004 | 14.33 | 14.33 | 14.33 |
| 0.60 | 0.60 | 0.60 | 0.00 | 11/28/2004 | 0.60 | 0.60 | 0.60 |
| 0.24 | 0.24 | 0.24 | 0.00 | 11/29/2004 | 0.24 | 0.24 | 0.24 |
| 0.24 | 0.24 | 0.24 | 0.00 | 11/30/2004 | 0.24 | 0.24 | 0.24 |
| 0.50 | 0.50 | 0.50 | 0.00 | 12/1/2004 | 0.50 | 0.50 | 0.50 |
| 0.45 | 0.45 | 0.45 | 0.00 | 12/2/2004 | 0.45 | 0.45 | 0.45 |
| 0.29 | 0.29 | 0.29 | 0.00 | 12/3/2004 | 0.29 | 0.29 | 0.29 |
| 0.41 | 0.41 | 0.41 | 0.00 | 12/4/2004 | 0.41 | 0.41 | 0.41 |
| 15.28 | 15.28 | 15.28 | 0.00 | 12/5/2004 | 15.28 | 15.28 | 15.28 |
| 0.76 | 0.76 | 0.76 | 0.00 | 12/6/2004 | 0.76 | 0.76 | 0.76 |
| 4.62 | 4.62 | 4.62 | 0.00 | 12/7/2004 | 4.62 | 4.62 | 4.62 |
| 7.05 | 7.05 | 7.05 | 0.00 | 12/8/2004 | 7.05 | 7.05 | 7.05 |
| 0.50 | 0.50 | 0.50 | 0.00 | 12/9/2004 | 0.50 | 0.50 | 0.50 |
| 0.40 | 0.40 | 0.40 | 0.00 | 12/10/2004 | 0.40 | 0.40 | 0.40 |
| 0.40 | 0.40 | 0.40 | 0.00 | 12/11/2004 | 0.40 | 0.40 | 0.40 |
| 0.47 | 0.47 | 0.47 | 0.00 | 12/12/2004 | 0.47 | 0.47 | 0.47 |
| 0.51 | 0.51 | 0.51 | 0.00 | 12/13/2004 | 0.51 | 0.51 | 0.51 |
| 0.49 | 0.49 | 0.49 | 0.00 | 12/14/2004 | 0.49 | 0.49 | 0.49 |
| 0.44 | 0.44 | 0.44 | 0.00 | 12/15/2004 | 0.44 | 0.44 | 0.44 |
| 0.42 | 0.42 | 0.42 | 0.00 | 12/16/2004 | 0.42 | 0.42 | 0.42 |
| 0.51 | 0.51 | 0.51 | 0.00 | 12/17/2004 | 0.51 | 0.51 | 0.51 |
| 0.48 | 0.48 | 0.48 | 0.00 | 12/18/2004 | 0.48 | 0.48 | 0.48 |
| 0.38 | 0.38 | 0.38 | 0.00 | 12/19/2004 | 0.38 | 0.38 | 0.38 |
| 0.55 | 0.55 | 0.55 | 0.00 | 12/20/2004 | 0.55 | 0.55 | 0.55 |
| 0.58 | 0.58 | 0.58 | 0.00 | 12/21/2004 | 0.58 | 0.58 | 0.58 |
| 0.66 | 0.66 | 0.66 | 0.00 | 12/22/2004 | 0.66 | 0.66 | 0.66 |
| 0.39 | 0.39 | 0.39 | 0.00 | 12/23/2004 | 0.39 | 0.39 | 0.39 |
| 0.43 | 0.43 | 0.43 | 0.00 | 12/24/2004 | 0.43 | 0.43 | 0.43 |
| 0.49 | 0.49 | 0.49 | 0.00 | 12/25/2004 | 0.49 | 0.49 | 0.49 |
| 0.59 | 0.59 | 0.59 | 0.00 | 12/26/2004 | 0.59 | 0.59 | 0.59 |
| 183.46 | 183.46 | 137.00 | 46.46 | 12/27/2004 | 183.46 | 183.46 | 137.00 |
| 723.27 | 723.27 | 137.00 | 632.73 | 12/28/2004 | 723.27 | 723.27 | 137.00 |
| 431.95 | 431.95 | 137.00 | 889.00 | 12/29/2004 | 431.95 | 431.95 | 137.00 |
| 67.11 | 67.11 | 137.00 | 819.11 | 12/30/2004 | 67.11 | 67.11 | 137.00 |
| 364.66 | 364.66 | 137.00 | 889.00 | 12/31/2004 | 364.66 | 364.66 | 137.00 |
| 184.62 | 184.62 | 137.00 | 889.00 | 1/1/2005 | 184.62 | 184.62 | 137.00 |
| 232.17 | 232.17 | 137.00 | 889.00 | 1/2/2005 | 232.17 | 232.17 | 137.00 |
| 605.68 | 605.68 | 137.00 | 889.00 | 1/3/2005 | 605.68 | 605.68 | 137.00 |
| 196.14 | 196.14 | 137.00 | 889.00 | 1/4/2005 | 196.14 | 196.14 | 137.00 |
| 186.30 | 186.30 | 137.00 | 889.00 | 1/5/2005 | 186.30 | 186.30 | 137.00 |
| 185.18 | 185.18 | 137.00 | 889.00 | 1/6/2005 | 185.18 | 185.18 | 137.00 |
| 625.66 | 625.66 | 137.00 | 889.00 | 1/7/2005 | 625.66 | 625.66 | 137.00 |
| 712.20 | 712.20 | 137.00 | 889.00 | 1/8/2005 | 712.20 | 712.20 | 137.00 |
| 4211.74 | 1190.00 | 137.00 | 889.00 | 1/9/2005 | 4211.74 | 1190.00 | 137.00 |
| 6418.11 | 1190.00 | 137.00 | 889.00 | 1/10/2005 | 6418.11 | 1190.00 | 137.00 |

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|---|---|---|---|---|---|---|---|---|
| 4291.30 | 1190.00 | 137.00 | 889.00 | | 1/11/2005 | 4291.30 | 1190.00 | 137.00 |
| 1585.64 | 1190.00 | 137.00 | 889.00 | | 1/12/2005 | 1585.64 | 1190.00 | 137.00 |
| 808.96 | 808.96 | 137.00 | 889.00 | | 1/13/2005 | 808.96 | 808.96 | 137.00 |
| 594.14 | 594.14 | 137.00 | 889.00 | | 1/14/2005 | 594.14 | 594.14 | 137.00 |
| 488.64 | 488.64 | 137.00 | 889.00 | | 1/15/2005 | 488.64 | 488.64 | 137.00 |
| 330.02 | 330.02 | 137.00 | 889.00 | | 1/16/2005 | 330.02 | 330.02 | 137.00 |
| 248.60 | 248.60 | 137.00 | 889.00 | | 1/17/2005 | 248.60 | 248.60 | 137.00 |
| 208.01 | 208.01 | 137.00 | 889.00 | | 1/18/2005 | 208.01 | 208.01 | 137.00 |
| 165.70 | 165.70 | 137.00 | 889.00 | | 1/19/2005 | 165.70 | 165.70 | 137.00 |
| 132.88 | 132.88 | 137.00 | 884.88 | | 1/20/2005 | 132.88 | 132.88 | 137.00 |
| 218.27 | 218.27 | 137.00 | 889.00 | | 1/21/2005 | 218.27 | 218.27 | 137.00 |
| 283.43 | 283.43 | 137.00 | 889.00 | | 1/22/2005 | 283.43 | 283.43 | 137.00 |
| 278.64 | 278.64 | 137.00 | 889.00 | | 1/23/2005 | 278.64 | 278.64 | 137.00 |
| 275.62 | 275.62 | 137.00 | 889.00 | | 1/24/2005 | 275.62 | 275.62 | 137.00 |
| 270.89 | 270.89 | 137.00 | 889.00 | | 1/25/2005 | 270.89 | 270.89 | 137.00 |
| 238.30 | 238.30 | 137.00 | 889.00 | | 1/26/2005 | 238.30 | 238.30 | 137.00 |
| 129.24 | 129.24 | 137.00 | 881.24 | | 1/27/2005 | 129.24 | 129.24 | 137.00 |
| 216.47 | 216.47 | 137.00 | 889.00 | | 1/28/2005 | 216.47 | 216.47 | 137.00 |
| 129.24 | 129.24 | 137.00 | 881.24 | | 1/29/2005 | 129.24 | 129.24 | 137.00 |
| 125.18 | 125.18 | 137.00 | 869.42 | | 1/30/2005 | 125.18 | 125.18 | 137.00 |
| 117.93 | 117.93 | 137.00 | 850.35 | | 1/31/2005 | 117.93 | 117.93 | 137.00 |
| 119.00 | 119.00 | 137.00 | 832.36 | | 2/1/2005 | 119.00 | 119.00 | 137.00 |
| 133.82 | 133.82 | 137.00 | 829.18 | | 2/2/2005 | 133.82 | 133.82 | 137.00 |
| 163.88 | 163.88 | 137.00 | 856.05 | | 2/3/2005 | 163.88 | 163.88 | 137.00 |
| 78.60 | 78.60 | 137.00 | 797.66 | | 2/4/2005 | 78.60 | 78.60 | 137.00 |
| 14.72 | 14.72 | 137.00 | 675.38 | | 2/5/2005 | 14.72 | 14.72 | 137.00 |
| 21.33 | 21.33 | 137.00 | 559.71 | | 2/6/2005 | 21.33 | 21.33 | 137.00 |
| 96.98 | 96.98 | 137.00 | 519.69 | | 2/7/2005 | 96.98 | 96.98 | 137.00 |
| 174.41 | 174.41 | 137.00 | 557.09 | | 2/8/2005 | 174.41 | 174.41 | 137.00 |
| 174.04 | 174.04 | 137.00 | 594.14 | | 2/9/2005 | 174.04 | 174.04 | 137.00 |
| 174.79 | 174.79 | 137.00 | 631.93 | | 2/10/2005 | 174.79 | 174.79 | 137.00 |
| 830.97 | 830.97 | 137.00 | 889.00 | | 2/11/2005 | 830.97 | 830.97 | 137.00 |
| 56.42 | 56.42 | 137.00 | 808.42 | | 2/12/2005 | 56.42 | 56.42 | 137.00 |
| 16.48 | 16.48 | 137.00 | 687.90 | | 2/13/2005 | 16.48 | 16.48 | 137.00 |
| 155.37 | 155.37 | 137.00 | 706.27 | | 2/14/2005 | 155.37 | 155.37 | 137.00 |
| 268.61 | 268.61 | 137.00 | 837.88 | | 2/15/2005 | 268.61 | 268.61 | 137.00 |
| 143.85 | 143.85 | 137.00 | 844.73 | | 2/16/2005 | 143.85 | 143.85 | 137.00 |
| 140.67 | 140.67 | 137.00 | 848.40 | | 2/17/2005 | 140.67 | 140.67 | 137.00 |
| 244.54 | 244.54 | 137.00 | 889.00 | | 2/18/2005 | 244.54 | 244.54 | 137.00 |
| 1004.59 | 1004.59 | 137.00 | 889.00 | | 2/19/2005 | 1004.59 | 1004.59 | 137.00 |
| 2002.65 | 1190.00 | 137.00 | 889.00 | | 2/20/2005 | 2002.65 | 1190.00 | 137.00 |
| 2692.06 | 1190.00 | 137.00 | 889.00 | | 2/21/2005 | 2692.06 | 1190.00 | 137.00 |
| 2007.75 | 1190.00 | 137.00 | 889.00 | | 2/22/2005 | 2007.75 | 1190.00 | 137.00 |
| 1528.09 | 1190.00 | 137.00 | 889.00 | | 2/23/2005 | 1528.09 | 1190.00 | 137.00 |
| 1053.37 | 1053.37 | 137.00 | 889.00 | | 2/24/2005 | 1053.37 | 1053.37 | 137.00 |
| 777.81 | 777.81 | 137.00 | 889.00 | | 2/25/2005 | 777.81 | 777.81 | 137.00 |
| 613.02 | 613.02 | 137.00 | 889.00 | | 2/26/2005 | 613.02 | 613.02 | 137.00 |
| 570.93 | 570.93 | 137.00 | 889.00 | | 2/27/2005 | 570.93 | 570.93 | 137.00 |
| 459.03 | 459.03 | 137.00 | 889.00 | | 2/28/2005 | 459.03 | 459.03 | 137.00 |
| 286.93 | 286.93 | 137.00 | 889.00 | | 3/1/2005 | 286.93 | 286.93 | 137.00 |
| 302.73 | 302.73 | 137.00 | 889.00 | | 3/2/2005 | 302.73 | 302.73 | 137.00 |
| 260.15 | 260.15 | 137.00 | 889.00 | | 3/3/2005 | 260.15 | 260.15 | 137.00 |
| 328.14 | 328.14 | 137.00 | 889.00 | | 3/4/2005 | 328.14 | 328.14 | 137.00 |
| 219.97 | 219.97 | 137.00 | 889.00 | | 3/5/2005 | 219.97 | 219.97 | 137.00 |

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|---|---|---|---|---|---|---|---|---|
| 220.45 | 220.45 | 137.00 | 889.00 | | 3/6/2005 | 220.45 | 220.45 | 137.00 |
| 191.24 | 191.24 | 137.00 | 889.00 | | 3/7/2005 | 191.24 | 191.24 | 137.00 |
| 157.65 | 157.65 | 137.00 | 889.00 | | 3/8/2005 | 157.65 | 157.65 | 137.00 |
| 160.50 | 160.50 | 137.00 | 889.00 | | 3/9/2005 | 160.50 | 160.50 | 137.00 |
| 154.55 | 154.55 | 137.00 | 889.00 | | 3/10/2005 | 154.55 | 154.55 | 137.00 |
| 134.94 | 134.94 | 137.00 | 886.94 | | 3/11/2005 | 134.94 | 134.94 | 137.00 |
| 135.38 | 135.38 | 137.00 | 885.32 | | 3/12/2005 | 135.38 | 135.38 | 137.00 |
| 144.09 | 144.09 | 137.00 | 889.00 | | 3/13/2005 | 144.09 | 144.09 | 137.00 |
| 151.80 | 151.80 | 137.00 | 889.00 | | 3/14/2005 | 151.80 | 151.80 | 137.00 |
| 165.62 | 165.62 | 137.00 | 889.00 | | 3/15/2005 | 165.62 | 165.62 | 137.00 |
| 166.95 | 166.95 | 137.00 | 889.00 | | 3/16/2005 | 166.95 | 166.95 | 137.00 |
| 170.92 | 170.92 | 137.00 | 889.00 | | 3/17/2005 | 170.92 | 170.92 | 137.00 |
| 181.90 | 181.90 | 137.00 | 889.00 | | 3/18/2005 | 181.90 | 181.90 | 137.00 |
| 206.46 | 206.46 | 137.00 | 889.00 | | 3/19/2005 | 206.46 | 206.46 | 137.00 |
| 168.20 | 168.20 | 137.00 | 889.00 | | 3/20/2005 | 168.20 | 168.20 | 137.00 |
| 160.75 | 160.75 | 137.00 | 889.00 | | 3/21/2005 | 160.75 | 160.75 | 137.00 |
| 531.99 | 531.99 | 137.00 | 889.00 | | 3/22/2005 | 531.99 | 531.99 | 137.00 |
| 164.11 | 164.11 | 137.00 | 889.00 | | 3/23/2005 | 164.11 | 164.11 | 137.00 |
| 147.52 | 147.52 | 137.00 | 889.00 | | 3/24/2005 | 147.52 | 147.52 | 137.00 |
| 133.72 | 133.72 | 137.00 | 885.72 | | 3/25/2005 | 133.72 | 133.72 | 137.00 |
| 125.18 | 125.18 | 137.00 | 873.89 | | 3/26/2005 | 125.18 | 125.18 | 137.00 |
| 125.93 | 125.93 | 137.00 | 862.83 | | 3/27/2005 | 125.93 | 125.93 | 137.00 |
| 136.03 | 136.03 | 137.00 | 861.85 | | 3/28/2005 | 136.03 | 136.03 | 137.00 |
| 114.37 | 114.37 | 137.00 | 839.22 | | 3/29/2005 | 114.37 | 114.37 | 137.00 |
| 176.81 | 176.81 | 137.00 | 879.04 | | 3/30/2005 | 176.81 | 176.81 | 137.00 |
| 221.82 | 221.82 | 137.00 | 889.00 | | 3/31/2005 | 221.82 | 221.82 | 137.00 |
| 139.24 | 139.24 | 137.00 | 889.00 | | 4/1/2005 | 139.24 | 139.24 | 137.00 |
| 16.41 | 16.41 | 137.00 | 768.41 | | 4/2/2005 | 16.41 | 16.41 | 137.00 |
| 14.70 | 14.70 | 137.00 | 646.11 | | 4/3/2005 | 14.70 | 14.70 | 137.00 |
| 111.57 | 111.57 | 137.00 | 620.68 | | 4/4/2005 | 111.57 | 111.57 | 137.00 |
| 177.65 | 177.65 | 137.00 | 661.33 | | 4/5/2005 | 177.65 | 177.65 | 137.00 |
| 180.33 | 180.33 | 137.00 | 704.66 | | 4/6/2005 | 180.33 | 180.33 | 137.00 |
| 93.82 | 93.82 | 137.00 | 661.48 | | 4/7/2005 | 93.82 | 93.82 | 137.00 |
| 13.27 | 13.27 | 137.00 | 537.76 | | 4/8/2005 | 13.27 | 13.27 | 137.00 |
| 12.18 | 12.18 | 137.00 | 412.94 | | 4/9/2005 | 12.18 | 12.18 | 137.00 |
| 11.26 | 11.26 | 137.00 | 287.20 | | 4/10/2005 | 11.26 | 11.26 | 137.00 |
| 114.46 | 114.46 | 137.00 | 264.66 | | 4/11/2005 | 114.46 | 114.46 | 137.00 |
| 125.34 | 125.34 | 137.00 | 253.00 | | 4/12/2005 | 125.34 | 125.34 | 137.00 |
| 11.65 | 11.65 | 137.00 | 127.65 | | 4/13/2005 | 11.65 | 11.65 | 137.00 |
| 14.13 | 14.13 | 137.00 | 4.78 | | 4/14/2005 | 14.13 | 14.13 | 137.00 |
| 10.51 | 10.51 | 15.29 | 0.00 | | 4/15/2005 | 10.51 | 10.51 | 30.29 |
| 10.27 | 10.27 | 10.27 | 0.00 | | 4/16/2005 | 10.27 | 10.27 | 10.27 |
| 9.84 | 9.84 | 9.84 | 0.00 | | 4/17/2005 | 9.84 | 9.84 | 9.84 |
| 10.27 | 10.27 | 10.27 | 0.00 | | 4/18/2005 | 10.27 | 10.27 | 10.27 |
| 10.16 | 10.16 | 10.16 | 0.00 | | 4/19/2005 | 10.16 | 10.16 | 10.16 |
| 9.35 | 9.35 | 9.35 | 0.00 | | 4/20/2005 | 9.35 | 9.35 | 9.35 |
| 9.44 | 9.44 | 9.44 | 0.00 | | 4/21/2005 | 9.44 | 9.44 | 9.44 |
| 9.16 | 9.16 | 9.16 | 0.00 | | 4/22/2005 | 9.16 | 9.16 | 9.16 |
| 9.13 | 9.13 | 9.13 | 0.00 | | 4/23/2005 | 9.13 | 9.13 | 9.13 |
| 9.18 | 9.18 | 9.18 | 0.00 | | 4/24/2005 | 9.18 | 9.18 | 9.18 |
| 9.38 | 9.38 | 9.38 | 0.00 | | 4/25/2005 | 9.38 | 9.38 | 9.38 |
| 8.29 | 8.29 | 8.29 | 0.00 | | 4/26/2005 | 8.29 | 8.29 | 8.29 |
| 8.08 | 8.08 | 8.08 | 0.00 | | 4/27/2005 | 8.08 | 8.08 | 8.08 |
| 189.53 | 189.53 | 137.00 | 52.53 | | 4/28/2005 | 189.53 | 189.53 | 137.00 |

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|---|---|---|---|---|---|---|---|---|
| 8.95 | 8.95 | 61.48 | 0.00 | | 4/29/2005 | 8.95 | 8.95 | 61.48 |
| 7.92 | 7.92 | 7.92 | 0.00 | | 4/30/2005 | 7.92 | 7.92 | 7.92 |
| 7.60 | 7.60 | 7.60 | 0.00 | | 5/1/2005 | 7.60 | 7.60 | 7.60 |
| 7.56 | 7.56 | 7.56 | 0.00 | | 5/2/2005 | 7.56 | 7.56 | 7.56 |
| 7.81 | 7.81 | 7.81 | 0.00 | | 5/3/2005 | 7.81 | 7.81 | 7.81 |
| 7.71 | 7.71 | 7.71 | 0.00 | | 5/4/2005 | 7.71 | 7.71 | 7.71 |
| 34.20 | 34.20 | 34.20 | 0.00 | | 5/5/2005 | 34.20 | 34.20 | 34.20 |
| 195.45 | 195.45 | 137.00 | 58.45 | | 5/6/2005 | 195.45 | 195.45 | 137.00 |
| 426.39 | 426.39 | 137.00 | 347.85 | | 5/7/2005 | 426.39 | 426.39 | 137.00 |
| 9.53 | 9.53 | 137.00 | 220.38 | | 5/8/2005 | 9.53 | 9.53 | 137.00 |
| 43.48 | 43.48 | 137.00 | 126.86 | | 5/9/2005 | 43.48 | 43.48 | 137.00 |
| 8.21 | 8.21 | 135.07 | 0.00 | | 5/10/2005 | 8.21 | 8.21 | 135.07 |
| 7.17 | 7.17 | 7.17 | 0.00 | | 5/11/2005 | 7.17 | 7.17 | 7.17 |
| 7.38 | 7.38 | 7.38 | 0.00 | | 5/12/2005 | 7.38 | 7.38 | 7.38 |
| 6.63 | 6.63 | 6.63 | 0.00 | | 5/13/2005 | 6.63 | 6.63 | 6.63 |
| 6.63 | 6.63 | 6.63 | 0.00 | | 5/14/2005 | 6.63 | 6.63 | 6.63 |
| 6.82 | 6.82 | 6.82 | 0.00 | | 5/15/2005 | 6.82 | 6.82 | 6.82 |
| 7.18 | 7.18 | 7.18 | 0.00 | | 5/16/2005 | 7.18 | 7.18 | 7.18 |
| 281.43 | 281.43 | 137.00 | 144.43 | | 5/17/2005 | 281.43 | 281.43 | 137.00 |
| 306.17 | 306.17 | 137.00 | 313.59 | | 5/18/2005 | 306.17 | 306.17 | 137.00 |
| 7.92 | 7.92 | 137.00 | 184.52 | | 5/19/2005 | 7.92 | 7.92 | 137.00 |
| 6.58 | 6.58 | 137.00 | 54.10 | | 5/20/2005 | 6.58 | 6.58 | 137.00 |
| 6.14 | 6.14 | 60.24 | 0.00 | | 5/21/2005 | 6.14 | 6.14 | 60.24 |
| 6.19 | 6.19 | 6.19 | 0.00 | | 5/22/2005 | 6.19 | 6.19 | 6.19 |
| 6.27 | 6.27 | 6.27 | 0.00 | | 5/23/2005 | 6.27 | 6.27 | 6.27 |
| 6.61 | 6.61 | 6.61 | 0.00 | | 5/24/2005 | 6.61 | 6.61 | 6.61 |
| 6.31 | 6.31 | 6.31 | 0.00 | | 5/25/2005 | 6.31 | 6.31 | 6.31 |
| 6.19 | 6.19 | 6.19 | 0.00 | | 5/26/2005 | 6.19 | 6.19 | 6.19 |
| 6.14 | 6.14 | 6.14 | 0.00 | | 5/27/2005 | 6.14 | 6.14 | 6.14 |
| 6.02 | 6.02 | 6.02 | 0.00 | | 5/28/2005 | 6.02 | 6.02 | 6.02 |
| 6.15 | 6.15 | 6.15 | 0.00 | | 5/29/2005 | 6.15 | 6.15 | 6.15 |
| 6.15 | 6.15 | 6.15 | 0.00 | | 5/30/2005 | 6.15 | 6.15 | 6.15 |
| 242.35 | 242.35 | 137.00 | 105.35 | | 5/31/2005 | 242.35 | 242.35 | 137.00 |
| 323.12 | 323.12 | 137.00 | 291.47 | | 6/1/2005 | 323.12 | 323.12 | 137.00 |
| 67.71 | 67.71 | 137.00 | 222.17 | | 6/2/2005 | 67.71 | 67.71 | 137.00 |
| 6.36 | 6.36 | 137.00 | 91.54 | | 6/3/2005 | 6.36 | 6.36 | 137.00 |
| 6.41 | 6.41 | 97.95 | 0.00 | | 6/4/2005 | 6.41 | 6.41 | 97.95 |
| 6.62 | 6.62 | 6.62 | 0.00 | | 6/5/2005 | 6.62 | 6.62 | 6.62 |
| 6.47 | 6.47 | 6.47 | 0.00 | | 6/6/2005 | 6.47 | 6.47 | 6.47 |
| 6.16 | 6.16 | 6.16 | 0.00 | | 6/7/2005 | 6.16 | 6.16 | 6.16 |
| 6.42 | 6.42 | 6.42 | 0.00 | | 6/8/2005 | 6.42 | 6.42 | 6.42 |
| 7.37 | 7.37 | 7.37 | 0.00 | | 6/9/2005 | 7.37 | 7.37 | 7.37 |
| 6.26 | 6.26 | 6.26 | 0.00 | | 6/10/2005 | 6.26 | 6.26 | 6.26 |
| 6.36 | 6.36 | 6.36 | 0.00 | | 6/11/2005 | 6.36 | 6.36 | 6.36 |
| 6.38 | 6.38 | 6.38 | 0.00 | | 6/12/2005 | 6.38 | 6.38 | 6.38 |
| 6.05 | 6.05 | 6.05 | 0.00 | | 6/13/2005 | 6.05 | 6.05 | 6.05 |
| 243.48 | 243.48 | 137.00 | 106.48 | | 6/14/2005 | 243.48 | 243.48 | 137.00 |
| 163.74 | 163.74 | 137.00 | 133.22 | | 6/15/2005 | 163.74 | 163.74 | 137.00 |
| 7.13 | 7.13 | 137.00 | 3.35 | | 6/16/2005 | 7.13 | 7.13 | 137.00 |
| 7.37 | 7.37 | 10.72 | 0.00 | | 6/17/2005 | 7.37 | 7.37 | 10.72 |
| 6.67 | 6.67 | 6.67 | 0.00 | | 6/18/2005 | 6.67 | 6.67 | 6.67 |
| 5.98 | 5.98 | 5.98 | 0.00 | | 6/19/2005 | 5.98 | 5.98 | 5.98 |
| 5.93 | 5.93 | 5.93 | 0.00 | | 6/20/2005 | 5.93 | 5.93 | 5.93 |
| 5.93 | 5.93 | 5.93 | 0.00 | | 6/21/2005 | 5.93 | 5.93 | 5.93 |

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|---|---|---|---|---|---|---|---|---|
| 6.00 | 6.00 | 6.00 | 0.00 | | 6/22/2005 | 6.00 | 6.00 | 6.00 |
| 7.06 | 7.06 | 7.06 | 0.00 | | 6/23/2005 | 7.06 | 7.06 | 7.06 |
| 7.13 | 7.13 | 7.13 | 0.00 | | 6/24/2005 | 7.13 | 7.13 | 7.13 |
| 7.15 | 7.15 | 7.15 | 0.00 | | 6/25/2005 | 7.15 | 7.15 | 7.15 |
| 7.28 | 7.28 | 7.28 | 0.00 | | 6/26/2005 | 7.28 | 7.28 | 7.28 |
| 7.05 | 7.05 | 7.05 | 0.00 | | 6/27/2005 | 7.05 | 7.05 | 7.05 |
| 7.08 | 7.08 | 7.08 | 0.00 | | 6/28/2005 | 7.08 | 7.08 | 7.08 |
| 6.20 | 6.20 | 6.20 | 0.00 | | 6/29/2005 | 6.20 | 6.20 | 6.20 |
| 6.28 | 6.28 | 6.28 | 0.00 | | 6/30/2005 | 6.28 | 6.28 | 6.28 |
| 6.82 | 6.82 | 6.82 | 0.00 | | 7/1/2005 | 6.82 | 6.82 | 6.82 |
| 6.02 | 6.02 | 6.02 | 0.00 | | 7/2/2005 | 6.02 | 6.02 | 6.02 |
| 6.21 | 6.21 | 6.21 | 0.00 | | 7/3/2005 | 6.21 | 6.21 | 6.21 |
| 5.74 | 5.74 | 5.74 | 0.00 | | 7/4/2005 | 5.74 | 5.74 | 5.74 |
| 6.78 | 6.78 | 6.78 | 0.00 | | 7/5/2005 | 6.78 | 6.78 | 6.78 |
| 6.49 | 6.49 | 6.49 | 0.00 | | 7/6/2005 | 6.49 | 6.49 | 6.49 |
| 5.93 | 5.93 | 5.93 | 0.00 | | 7/7/2005 | 5.93 | 5.93 | 5.93 |
| 5.35 | 5.35 | 5.35 | 0.00 | | 7/8/2005 | 5.35 | 5.35 | 5.35 |
| 5.30 | 5.30 | 5.30 | 0.00 | | 7/9/2005 | 5.30 | 5.30 | 5.30 |
| 5.41 | 5.41 | 5.41 | 0.00 | | 7/10/2005 | 5.41 | 5.41 | 5.41 |
| 5.56 | 5.56 | 5.56 | 0.00 | | 7/11/2005 | 5.56 | 5.56 | 5.56 |
| 246.55 | 246.55 | 137.00 | 109.55 | | 7/12/2005 | 246.55 | 246.55 | 137.00 |
| 151.88 | 151.88 | 137.00 | 124.43 | | 7/13/2005 | 151.88 | 151.88 | 137.00 |
| 5.76 | 5.76 | 130.19 | 0.00 | | 7/14/2005 | 5.76 | 5.76 | 130.19 |
| 6.52 | 6.52 | 6.52 | 0.00 | | 7/15/2005 | 6.52 | 6.52 | 6.52 |
| 6.47 | 6.47 | 6.47 | 0.00 | | 7/16/2005 | 6.47 | 6.47 | 6.47 |
| 5.98 | 5.98 | 5.98 | 0.00 | | 7/17/2005 | 5.98 | 5.98 | 5.98 |
| 6.02 | 6.02 | 6.02 | 0.00 | | 7/18/2005 | 6.02 | 6.02 | 6.02 |
| 5.94 | 5.94 | 5.94 | 0.00 | | 7/19/2005 | 5.94 | 5.94 | 5.94 |
| 6.25 | 6.25 | 6.25 | 0.00 | | 7/20/2005 | 6.25 | 6.25 | 6.25 |
| 6.31 | 6.31 | 6.31 | 0.00 | | 7/21/2005 | 6.31 | 6.31 | 6.31 |
| 5.75 | 5.75 | 5.75 | 0.00 | | 7/22/2005 | 5.75 | 5.75 | 5.75 |
| 5.70 | 5.70 | 5.70 | 0.00 | | 7/23/2005 | 5.70 | 5.70 | 5.70 |
| 5.69 | 5.69 | 5.69 | 0.00 | | 7/24/2005 | 5.69 | 5.69 | 5.69 |
| 5.71 | 5.71 | 5.71 | 0.00 | | 7/25/2005 | 5.71 | 5.71 | 5.71 |
| 236.56 | 236.56 | 137.00 | 99.56 | | 7/26/2005 | 236.56 | 236.56 | 137.00 |
| 144.69 | 144.69 | 137.00 | 107.25 | | 7/27/2005 | 144.69 | 144.69 | 137.00 |
| 5.32 | 5.32 | 112.58 | 0.00 | | 7/28/2005 | 5.32 | 5.32 | 112.58 |
| 5.99 | 5.99 | 5.99 | 0.00 | | 7/29/2005 | 5.99 | 5.99 | 5.99 |
| 5.65 | 5.65 | 5.65 | 0.00 | | 7/30/2005 | 5.65 | 5.65 | 5.65 |
| 5.48 | 5.48 | 5.48 | 0.00 | | 7/31/2005 | 5.48 | 5.48 | 5.48 |
| 5.38 | 5.38 | 5.38 | 0.00 | | 8/1/2005 | 5.38 | 5.38 | 5.38 |
| 5.11 | 5.11 | 5.11 | 0.00 | | 8/2/2005 | 5.11 | 5.11 | 5.11 |
| 5.05 | 5.05 | 5.05 | 0.00 | | 8/3/2005 | 5.05 | 5.05 | 5.05 |
| 5.00 | 5.00 | 5.00 | 0.00 | | 8/4/2005 | 5.00 | 5.00 | 5.00 |
| 5.03 | 5.03 | 5.03 | 0.00 | | 8/5/2005 | 5.03 | 5.03 | 5.03 |
| 5.27 | 5.27 | 5.27 | 0.00 | | 8/6/2005 | 5.27 | 5.27 | 5.27 |
| 5.19 | 5.19 | 5.19 | 0.00 | | 8/7/2005 | 5.19 | 5.19 | 5.19 |
| 5.22 | 5.22 | 5.22 | 0.00 | | 8/8/2005 | 5.22 | 5.22 | 5.22 |
| 4.94 | 4.94 | 4.94 | 0.00 | | 8/9/2005 | 4.94 | 4.94 | 4.94 |
| 4.95 | 4.95 | 4.95 | 0.00 | | 8/10/2005 | 4.95 | 4.95 | 4.95 |
| 5.00 | 5.00 | 5.00 | 0.00 | | 8/11/2005 | 5.00 | 5.00 | 5.00 |
| 5.10 | 5.10 | 5.10 | 0.00 | | 8/12/2005 | 5.10 | 5.10 | 5.10 |
| 5.19 | 5.19 | 5.19 | 0.00 | | 8/13/2005 | 5.19 | 5.19 | 5.19 |
| 5.35 | 5.35 | 5.35 | 0.00 | | 8/14/2005 | 5.35 | 5.35 | 5.35 |

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|---|---|---|---|---|---|---|---|---|
| 37.78 | 37.78 | 37.78 | 0.00 | | 8/15/2005 | 37.78 | 37.78 | 37.78 |
| 4.19 | 4.19 | 4.19 | 0.00 | | 8/16/2005 | 4.19 | 4.19 | 4.19 |
| 4.11 | 4.11 | 4.11 | 0.00 | | 8/17/2005 | 4.11 | 4.11 | 4.11 |
| 4.33 | 4.33 | 4.33 | 0.00 | | 8/18/2005 | 4.33 | 4.33 | 4.33 |
| 4.46 | 4.46 | 4.46 | 0.00 | | 8/19/2005 | 4.46 | 4.46 | 4.46 |
| 4.31 | 4.31 | 4.31 | 0.00 | | 8/20/2005 | 4.31 | 4.31 | 4.31 |
| 4.32 | 4.32 | 4.32 | 0.00 | | 8/21/2005 | 4.32 | 4.32 | 4.32 |
| 4.47 | 4.47 | 4.47 | 0.00 | | 8/22/2005 | 4.47 | 4.47 | 4.47 |
| 4.24 | 4.24 | 4.24 | 0.00 | | 8/23/2005 | 4.24 | 4.24 | 4.24 |
| 3.55 | 3.55 | 3.55 | 0.00 | | 8/24/2005 | 3.55 | 3.55 | 3.55 |
| 3.84 | 3.84 | 3.84 | 0.00 | | 8/25/2005 | 3.84 | 3.84 | 3.84 |
| 3.77 | 3.77 | 3.77 | 0.00 | | 8/26/2005 | 3.77 | 3.77 | 3.77 |
| 3.89 | 3.89 | 3.89 | 0.00 | | 8/27/2005 | 3.89 | 3.89 | 3.89 |
| 3.70 | 3.70 | 3.70 | 0.00 | | 8/28/2005 | 3.70 | 3.70 | 3.70 |
| 3.62 | 3.62 | 3.62 | 0.00 | | 8/29/2005 | 3.62 | 3.62 | 3.62 |
| 3.68 | 3.68 | 3.68 | 0.00 | | 8/30/2005 | 3.68 | 3.68 | 3.68 |
| 3.79 | 3.79 | 3.79 | 0.00 | | 8/31/2005 | 3.79 | 3.79 | 3.79 |
| 3.97 | 3.97 | 3.97 | 0.00 | | 9/1/2005 | 3.97 | 3.97 | 3.97 |
| 4.07 | 4.07 | 4.07 | 0.00 | | 9/2/2005 | 4.07 | 4.07 | 4.07 |
| 3.98 | 3.98 | 3.98 | 0.00 | | 9/3/2005 | 3.98 | 3.98 | 3.98 |
| 3.82 | 3.82 | 3.82 | 0.00 | | 9/4/2005 | 3.82 | 3.82 | 3.82 |
| 3.64 | 3.64 | 3.64 | 0.00 | | 9/5/2005 | 3.64 | 3.64 | 3.64 |
| 4.15 | 4.15 | 4.15 | 0.00 | | 9/6/2005 | 4.15 | 4.15 | 4.15 |
| 3.46 | 3.46 | 3.46 | 0.00 | | 9/7/2005 | 3.46 | 3.46 | 3.46 |
| 3.64 | 3.64 | 3.64 | 0.00 | | 9/8/2005 | 3.64 | 3.64 | 3.64 |
| 3.81 | 3.81 | 3.81 | 0.00 | | 9/9/2005 | 3.81 | 3.81 | 3.81 |
| 3.97 | 3.97 | 3.97 | 0.00 | | 9/10/2005 | 3.97 | 3.97 | 3.97 |
| 3.78 | 3.78 | 3.78 | 0.00 | | 9/11/2005 | 3.78 | 3.78 | 3.78 |
| 3.75 | 3.75 | 3.75 | 0.00 | | 9/12/2005 | 3.75 | 3.75 | 3.75 |
| 3.79 | 3.79 | 3.79 | 0.00 | | 9/13/2005 | 3.79 | 3.79 | 3.79 |
| 3.71 | 3.71 | 3.71 | 0.00 | | 9/14/2005 | 3.71 | 3.71 | 3.71 |
| 3.68 | 3.68 | 3.68 | 0.00 | | 9/15/2005 | 3.68 | 3.68 | 3.68 |
| 3.70 | 3.70 | 3.70 | 0.00 | | 9/16/2005 | 3.70 | 3.70 | 3.70 |
| 3.68 | 3.68 | 3.68 | 0.00 | | 9/17/2005 | 3.68 | 3.68 | 3.68 |
| 3.61 | 3.61 | 3.61 | 0.00 | | 9/18/2005 | 3.61 | 3.61 | 3.61 |
| 3.60 | 3.60 | 3.60 | 0.00 | | 9/19/2005 | 3.60 | 3.60 | 3.60 |
| 23.51 | 23.51 | 23.51 | 0.00 | | 9/20/2005 | 23.51 | 23.51 | 23.51 |
| 4.17 | 4.17 | 4.17 | 0.00 | | 9/21/2005 | 4.17 | 4.17 | 4.17 |
| 3.99 | 3.99 | 3.99 | 0.00 | | 9/22/2005 | 3.99 | 3.99 | 3.99 |
| 4.25 | 4.25 | 4.25 | 0.00 | | 9/23/2005 | 4.25 | 4.25 | 4.25 |
| 4.26 | 4.26 | 4.26 | 0.00 | | 9/24/2005 | 4.26 | 4.26 | 4.26 |
| 4.30 | 4.30 | 4.30 | 0.00 | | 9/25/2005 | 4.30 | 4.30 | 4.30 |
| 4.30 | 4.30 | 4.30 | 0.00 | | 9/26/2005 | 4.30 | 4.30 | 4.30 |
| 4.15 | 4.15 | 4.15 | 0.00 | | 9/27/2005 | 4.15 | 4.15 | 4.15 |
| 3.51 | 3.51 | 3.51 | 0.00 | | 9/28/2005 | 3.51 | 3.51 | 3.51 |
| 3.88 | 3.88 | 3.88 | 0.00 | | 9/29/2005 | 3.88 | 3.88 | 3.88 |
| 4.09 | 4.09 | 4.09 | 0.00 | | 9/30/2005 | 4.09 | 4.09 | 4.09 |
| **55,251.78** | **40,034.45** | **21,023.58** | | | | **55,251.78** | **40,034.45** | **21,038.58** |
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| Total Storage 904 acre-ft | OPTION 1B | TOTAL | | Intake 600 cfs / 1190 ac-ft | perc rate 142 cfs 282 acre-ft/day | Total Storage 1197 acre-ft |
|---|---|---|---|---|---|---|
| In Storage | Date | | | | Conserved | In Storage |
| 0 | | | | | | 0 |
| 0.00 | 10/1/2004 | 0.70 | 0.70 | 0.70 | 0.70 | 0.00 |
| 0.00 | 10/2/2004 | 0.71 | 0.71 | 0.71 | 0.71 | 0.00 |
| 0.00 | 10/3/2004 | 0.71 | 0.71 | 0.71 | 0.71 | 0.00 |
| 0.00 | 10/4/2004 | 0.71 | 0.71 | 0.71 | 0.71 | 0.00 |
| 0.00 | 10/5/2004 | 0.67 | 0.67 | 0.67 | 0.67 | 0.00 |
| 0.00 | 10/6/2004 | 0.67 | 0.67 | 0.67 | 0.67 | 0.00 |
| 0.00 | 10/7/2004 | 0.66 | 0.66 | 0.66 | 0.66 | 0.00 |
| 0.00 | 10/8/2004 | 0.67 | 0.67 | 0.67 | 0.67 | 0.00 |
| 0.00 | 10/9/2004 | 0.71 | 0.71 | 0.71 | 0.71 | 0.00 |
| 0.00 | 10/10/2004 | 0.77 | 0.77 | 0.77 | 0.77 | 0.00 |
| 0.00 | 10/11/2004 | 0.70 | 0.70 | 0.70 | 0.70 | 0.00 |
| 0.00 | 10/12/2004 | 0.62 | 0.62 | 0.62 | 0.62 | 0.00 |
| 0.00 | 10/13/2004 | 0.65 | 0.65 | 0.65 | 0.65 | 0.00 |
| 0.00 | 10/14/2004 | 0.62 | 0.62 | 0.62 | 0.62 | 0.00 |
| 0.00 | 10/15/2004 | 0.71 | 0.71 | 0.71 | 0.71 | 0.00 |
| 0.00 | 10/16/2004 | 6.41 | 6.41 | 6.41 | 6.41 | 0.00 |
| 0.00 | 10/17/2004 | 116.19 | 116.19 | 116.19 | 116.19 | 0.00 |
| 0.00 | 10/18/2004 | 127.40 | 127.40 | 127.40 | 127.40 | 0.00 |
| 409.76 | 10/19/2004 | 546.76 | 546.76 | 546.76 | 282.00 | 264.76 |
| 633.43 | 10/20/2004 | 360.67 | 360.67 | 360.67 | 282.00 | 343.43 |
| 497.85 | 10/21/2004 | 1.42 | 1.42 | 1.42 | 282.00 | 62.85 |
| 362.32 | 10/22/2004 | 1.48 | 1.48 | 1.48 | 64.32 | 0.00 |
| 226.72 | 10/23/2004 | 1.39 | 1.39 | 1.39 | 1.39 | 0.00 |
| 90.96 | 10/24/2004 | 1.24 | 1.24 | 1.24 | 1.24 | 0.00 |
| 0.00 | 10/25/2004 | 1.12 | 1.12 | 1.12 | 1.12 | 0.00 |
| 254.36 | 10/26/2004 | 391.36 | 391.36 | 391.36 | 282.00 | 109.36 |
| 239.11 | 10/27/2004 | 121.75 | 121.75 | 121.75 | 231.11 | 0.00 |
| 144.29 | 10/28/2004 | 42.18 | 42.18 | 42.18 | 42.18 | 0.00 |
| 8.03 | 10/29/2004 | 0.74 | 0.74 | 0.74 | 0.74 | 0.00 |
| 0.00 | 10/30/2004 | 0.74 | 0.74 | 0.74 | 0.74 | 0.00 |
| 0.00 | 10/31/2004 | 0.71 | 0.71 | 0.71 | 0.71 | 0.00 |
| 0.00 | 11/1/2004 | 0.57 | 0.57 | 0.57 | 0.57 | 0.00 |
| 0.00 | 11/2/2004 | 1.07 | 1.07 | 1.07 | 1.07 | 0.00 |
| 0.00 | 11/3/2004 | 1.10 | 1.10 | 1.10 | 1.10 | 0.00 |
| 0.00 | 11/4/2004 | 1.27 | 1.27 | 1.27 | 1.27 | 0.00 |
| 0.00 | 11/5/2004 | 2.15 | 2.15 | 2.15 | 2.15 | 0.00 |
| 0.00 | 11/6/2004 | 1.09 | 1.09 | 1.09 | 1.09 | 0.00 |
| 0.00 | 11/7/2004 | 1.26 | 1.26 | 1.26 | 1.26 | 0.00 |
| 0.00 | 11/8/2004 | 2.66 | 2.66 | 2.66 | 2.66 | 0.00 |
| 0.00 | 11/9/2004 | 1.27 | 1.27 | 1.27 | 1.27 | 0.00 |
| 0.00 | 11/10/2004 | 15.76 | 15.76 | 15.76 | 15.76 | 0.00 |
| 0.00 | 11/11/2004 | 0.80 | 0.80 | 0.80 | 0.80 | 0.00 |
| 0.00 | 11/12/2004 | 0.68 | 0.68 | 0.68 | 0.68 | 0.00 |
| 0.00 | 11/13/2004 | 0.70 | 0.70 | 0.70 | 0.70 | 0.00 |
| 0.00 | 11/14/2004 | 0.56 | 0.56 | 0.56 | 0.56 | 0.00 |
| 0.00 | 11/15/2004 | 0.48 | 0.48 | 0.48 | 0.48 | 0.00 |
| 0.00 | 11/16/2004 | 0.47 | 0.47 | 0.47 | 0.47 | 0.00 |
| 0.00 | 11/17/2004 | 0.52 | 0.52 | 0.52 | 0.52 | 0.00 |

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|---|---|---|---|---|---|---|---|
| 0.00 | | 11/18/2004 | 0.84 | 0.84 | 0.84 | 0.84 | 0.00 |
| 0.00 | | 11/19/2004 | 1.94 | 1.94 | 1.94 | 1.94 | 0.00 |
| 0.00 | | 11/20/2004 | 16.06 | 16.06 | 16.06 | 16.06 | 0.00 |
| 0.00 | | 11/21/2004 | 1.41 | 1.41 | 1.41 | 1.41 | 0.00 |
| 0.00 | | 11/22/2004 | 0.77 | 0.77 | 0.77 | 0.77 | 0.00 |
| 0.00 | | 11/23/2004 | 0.53 | 0.53 | 0.53 | 0.53 | 0.00 |
| 0.00 | | 11/24/2004 | 0.56 | 0.56 | 0.56 | 0.56 | 0.00 |
| 0.00 | | 11/25/2004 | 0.61 | 0.61 | 0.61 | 0.61 | 0.00 |
| 0.00 | | 11/26/2004 | 0.57 | 0.57 | 0.57 | 0.57 | 0.00 |
| 0.00 | | 11/27/2004 | 14.33 | 14.33 | 14.33 | 14.33 | 0.00 |
| 0.00 | | 11/28/2004 | 0.60 | 0.60 | 0.60 | 0.60 | 0.00 |
| 0.00 | | 11/29/2004 | 0.24 | 0.24 | 0.24 | 0.24 | 0.00 |
| 0.00 | | 11/30/2004 | 0.24 | 0.24 | 0.24 | 0.24 | 0.00 |
| 0.00 | | 12/1/2004 | 0.50 | 0.50 | 0.50 | 0.50 | 0.00 |
| 0.00 | | 12/2/2004 | 0.45 | 0.45 | 0.45 | 0.45 | 0.00 |
| 0.00 | | 12/3/2004 | 0.29 | 0.29 | 0.29 | 0.29 | 0.00 |
| 0.00 | | 12/4/2004 | 0.41 | 0.41 | 0.41 | 0.41 | 0.00 |
| 0.00 | | 12/5/2004 | 15.28 | 15.28 | 15.28 | 15.28 | 0.00 |
| 0.00 | | 12/6/2004 | 0.76 | 0.76 | 0.76 | 0.76 | 0.00 |
| 0.00 | | 12/7/2004 | 4.62 | 4.62 | 4.62 | 4.62 | 0.00 |
| 0.00 | | 12/8/2004 | 7.05 | 7.05 | 7.05 | 7.05 | 0.00 |
| 0.00 | | 12/9/2004 | 0.50 | 0.50 | 0.50 | 0.50 | 0.00 |
| 0.00 | | 12/10/2004 | 0.40 | 0.40 | 0.40 | 0.40 | 0.00 |
| 0.00 | | 12/11/2004 | 0.40 | 0.40 | 0.40 | 0.40 | 0.00 |
| 0.00 | | 12/12/2004 | 0.47 | 0.47 | 0.47 | 0.47 | 0.00 |
| 0.00 | | 12/13/2004 | 0.51 | 0.51 | 0.51 | 0.51 | 0.00 |
| 0.00 | | 12/14/2004 | 0.49 | 0.49 | 0.49 | 0.49 | 0.00 |
| 0.00 | | 12/15/2004 | 0.44 | 0.44 | 0.44 | 0.44 | 0.00 |
| 0.00 | | 12/16/2004 | 0.42 | 0.42 | 0.42 | 0.42 | 0.00 |
| 0.00 | | 12/17/2004 | 0.51 | 0.51 | 0.51 | 0.51 | 0.00 |
| 0.00 | | 12/18/2004 | 0.48 | 0.48 | 0.48 | 0.48 | 0.00 |
| 0.00 | | 12/19/2004 | 0.38 | 0.38 | 0.38 | 0.38 | 0.00 |
| 0.00 | | 12/20/2004 | 0.55 | 0.55 | 0.55 | 0.55 | 0.00 |
| 0.00 | | 12/21/2004 | 0.58 | 0.58 | 0.58 | 0.58 | 0.00 |
| 0.00 | | 12/22/2004 | 0.66 | 0.66 | 0.66 | 0.66 | 0.00 |
| 0.00 | | 12/23/2004 | 0.39 | 0.39 | 0.39 | 0.39 | 0.00 |
| 0.00 | | 12/24/2004 | 0.43 | 0.43 | 0.43 | 0.43 | 0.00 |
| 0.00 | | 12/25/2004 | 0.49 | 0.49 | 0.49 | 0.49 | 0.00 |
| 0.00 | | 12/26/2004 | 0.59 | 0.59 | 0.59 | 0.59 | 0.00 |
| 46.46 | | 12/27/2004 | 183.46 | 183.46 | 183.46 | 183.46 | 0.00 |
| 632.73 | | 12/28/2004 | 723.27 | 723.27 | 723.27 | 282.00 | 441.27 |
| 904.00 | | 12/29/2004 | 431.95 | 431.95 | 431.95 | 282.00 | 591.22 |
| 834.11 | | 12/30/2004 | 67.11 | 67.11 | 67.11 | 282.00 | 376.33 |
| 904.00 | | 12/31/2004 | 364.66 | 364.66 | 364.66 | 282.00 | 458.99 |
| 904.00 | | 1/1/2005 | 184.62 | 184.62 | 184.62 | 282.00 | 361.61 |
| 904.00 | | 1/2/2005 | 232.17 | 232.17 | 232.17 | 282.00 | 311.78 |
| 904.00 | | 1/3/2005 | 605.68 | 605.68 | 605.68 | 282.00 | 635.46 |
| 904.00 | | 1/4/2005 | 196.14 | 196.14 | 196.14 | 282.00 | 549.60 |
| 904.00 | | 1/5/2005 | 186.30 | 186.30 | 186.30 | 282.00 | 453.90 |
| 904.00 | | 1/6/2005 | 185.18 | 185.18 | 185.18 | 282.00 | 357.08 |
| 904.00 | | 1/7/2005 | 625.66 | 625.66 | 625.66 | 282.00 | 700.74 |
| 904.00 | | 1/8/2005 | 712.20 | 712.20 | 712.20 | 282.00 | 1130.94 |
| 904.00 | | 1/9/2005 | 4211.74 | 0.00 | 0.00 | 282.00 | 848.94 |
| 904.00 | | 1/10/2005 | 6418.11 | 0.00 | 0.00 | 282.00 | 566.94 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 904.00 | 1/11/2005 | 4291.30 | 0.00 | 0.00 | 282.00 | 284.94 |
| 904.00 | 1/12/2005 | 1585.64 | 1585.64 | 1190.00 | 282.00 | 1192.94 |
| 904.00 | 1/13/2005 | 808.96 | 808.96 | 808.96 | 282.00 | 1197.00 |
| 904.00 | 1/14/2005 | 594.14 | 594.14 | 594.14 | 282.00 | 1197.00 |
| 904.00 | 1/15/2005 | 488.64 | 488.64 | 488.64 | 282.00 | 1197.00 |
| 904.00 | 1/16/2005 | 330.02 | 330.02 | 330.02 | 282.00 | 1197.00 |
| 904.00 | 1/17/2005 | 248.60 | 248.60 | 248.60 | 282.00 | 1163.60 |
| 904.00 | 1/18/2005 | 208.01 | 208.01 | 208.01 | 282.00 | 1089.61 |
| 904.00 | 1/19/2005 | 165.70 | 165.70 | 165.70 | 282.00 | 973.32 |
| 899.88 | 1/20/2005 | 132.88 | 132.88 | 132.88 | 282.00 | 824.20 |
| 904.00 | 1/21/2005 | 218.27 | 218.27 | 218.27 | 282.00 | 760.46 |
| 904.00 | 1/22/2005 | 283.43 | 283.43 | 283.43 | 282.00 | 761.89 |
| 904.00 | 1/23/2005 | 278.64 | 278.64 | 278.64 | 282.00 | 758.54 |
| 904.00 | 1/24/2005 | 275.62 | 275.62 | 275.62 | 282.00 | 752.15 |
| 904.00 | 1/25/2005 | 270.89 | 270.89 | 270.89 | 282.00 | 741.04 |
| 904.00 | 1/26/2005 | 238.30 | 238.30 | 238.30 | 282.00 | 697.34 |
| 896.24 | 1/27/2005 | 129.24 | 129.24 | 129.24 | 282.00 | 544.58 |
| 904.00 | 1/28/2005 | 216.47 | 216.47 | 216.47 | 282.00 | 479.06 |
| 896.24 | 1/29/2005 | 129.24 | 129.24 | 129.24 | 282.00 | 326.30 |
| 884.42 | 1/30/2005 | 125.18 | 125.18 | 125.18 | 282.00 | 169.48 |
| 865.35 | 1/31/2005 | 117.93 | 117.93 | 117.93 | 282.00 | 5.41 |
| 847.36 | 2/1/2005 | 119.00 | 119.00 | 119.00 | 124.41 | 0.00 |
| 844.18 | 2/2/2005 | 133.82 | 133.82 | 133.82 | 133.82 | 0.00 |
| 871.05 | 2/3/2005 | 163.88 | 163.88 | 163.88 | 163.88 | 0.00 |
| 812.66 | 2/4/2005 | 78.60 | 78.60 | 78.60 | 78.60 | 0.00 |
| 690.38 | 2/5/2005 | 14.72 | 14.72 | 14.72 | 14.72 | 0.00 |
| 574.71 | 2/6/2005 | 21.33 | 21.33 | 21.33 | 21.33 | 0.00 |
| 534.69 | 2/7/2005 | 96.98 | 96.98 | 96.98 | 96.98 | 0.00 |
| 572.09 | 2/8/2005 | 174.41 | 174.41 | 174.41 | 174.41 | 0.00 |
| 609.14 | 2/9/2005 | 174.04 | 174.04 | 174.04 | 174.04 | 0.00 |
| 646.93 | 2/10/2005 | 174.79 | 174.79 | 174.79 | 174.79 | 0.00 |
| 904.00 | 2/11/2005 | 830.97 | 830.97 | 830.97 | 282.00 | 548.97 |
| 823.42 | 2/12/2005 | 56.42 | 56.42 | 56.42 | 282.00 | 323.39 |
| 702.90 | 2/13/2005 | 16.48 | 16.48 | 16.48 | 282.00 | 57.87 |
| 721.27 | 2/14/2005 | 155.37 | 155.37 | 155.37 | 213.24 | 0.00 |
| 852.88 | 2/15/2005 | 268.61 | 268.61 | 268.61 | 268.61 | 0.00 |
| 859.73 | 2/16/2005 | 143.85 | 143.85 | 143.85 | 143.85 | 0.00 |
| 863.40 | 2/17/2005 | 140.67 | 140.67 | 140.67 | 140.67 | 0.00 |
| 904.00 | 2/18/2005 | 244.54 | 244.54 | 244.54 | 244.54 | 0.00 |
| 904.00 | 2/19/2005 | 1004.59 | 1004.59 | 1004.59 | 282.00 | 722.59 |
| 904.00 | 2/20/2005 | 2002.65 | 0.00 | 0.00 | 282.00 | 440.59 |
| 904.00 | 2/21/2005 | 2692.06 | 0.00 | 0.00 | 282.00 | 158.59 |
| 904.00 | 2/22/2005 | 2007.75 | 0.00 | 0.00 | 158.59 | 0.00 |
| 904.00 | 2/23/2005 | 1528.09 | 1528.09 | 1190.00 | 282.00 | 908.00 |
| 904.00 | 2/24/2005 | 1053.37 | 1053.37 | 1053.37 | 282.00 | 1197.00 |
| 904.00 | 2/25/2005 | 777.81 | 777.81 | 777.81 | 282.00 | 1197.00 |
| 904.00 | 2/26/2005 | 613.02 | 613.02 | 613.02 | 282.00 | 1197.00 |
| 904.00 | 2/27/2005 | 570.93 | 570.93 | 570.93 | 282.00 | 1197.00 |
| 904.00 | 2/28/2005 | 459.03 | 459.03 | 459.03 | 282.00 | 1197.00 |
| 904.00 | 3/1/2005 | 286.93 | 286.93 | 286.93 | 282.00 | 1197.00 |
| 904.00 | 3/2/2005 | 302.73 | 302.73 | 302.73 | 282.00 | 1197.00 |
| 904.00 | 3/3/2005 | 260.15 | 260.15 | 260.15 | 282.00 | 1175.15 |
| 904.00 | 3/4/2005 | 328.14 | 328.14 | 328.14 | 282.00 | 1197.00 |
| 904.00 | 3/5/2005 | 219.97 | 219.97 | 219.97 | 282.00 | 1134.97 |

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|---|---|---|---|---|---|---|---|
| 904.00 | | 3/6/2005 | 220.45 | 220.45 | 220.45 | 282.00 | 1073.42 |
| 904.00 | | 3/7/2005 | 191.24 | 191.24 | 191.24 | 282.00 | 982.66 |
| 904.00 | | 3/8/2005 | 157.65 | 157.65 | 157.65 | 282.00 | 858.31 |
| 904.00 | | 3/9/2005 | 160.50 | 160.50 | 160.50 | 282.00 | 736.80 |
| 904.00 | | 3/10/2005 | 154.55 | 154.55 | 154.55 | 282.00 | 609.36 |
| 901.94 | | 3/11/2005 | 134.94 | 134.94 | 134.94 | 282.00 | 462.30 |
| 900.32 | | 3/12/2005 | 135.38 | 135.38 | 135.38 | 282.00 | 315.67 |
| 904.00 | | 3/13/2005 | 144.09 | 144.09 | 144.09 | 282.00 | 177.77 |
| 904.00 | | 3/14/2005 | 151.80 | 151.80 | 151.80 | 282.00 | 47.57 |
| 904.00 | | 3/15/2005 | 165.62 | 165.62 | 165.62 | 213.19 | 0.00 |
| 904.00 | | 3/16/2005 | 166.95 | 166.95 | 166.95 | 166.95 | 0.00 |
| 904.00 | | 3/17/2005 | 170.92 | 170.92 | 170.92 | 170.92 | 0.00 |
| 904.00 | | 3/18/2005 | 181.90 | 181.90 | 181.90 | 181.90 | 0.00 |
| 904.00 | | 3/19/2005 | 206.46 | 206.46 | 206.46 | 206.46 | 0.00 |
| 904.00 | | 3/20/2005 | 168.20 | 168.20 | 168.20 | 168.20 | 0.00 |
| 904.00 | | 3/21/2005 | 160.75 | 160.75 | 160.75 | 160.75 | 0.00 |
| 904.00 | | 3/22/2005 | 531.99 | 531.99 | 531.99 | 282.00 | 249.99 |
| 904.00 | | 3/23/2005 | 164.11 | 164.11 | 164.11 | 282.00 | 132.10 |
| 904.00 | | 3/24/2005 | 147.52 | 147.52 | 147.52 | 279.62 | 0.00 |
| 900.72 | | 3/25/2005 | 133.72 | 133.72 | 133.72 | 133.72 | 0.00 |
| 888.89 | | 3/26/2005 | 125.18 | 125.18 | 125.18 | 125.18 | 0.00 |
| 877.83 | | 3/27/2005 | 125.93 | 125.93 | 125.93 | 125.93 | 0.00 |
| 876.85 | | 3/28/2005 | 136.03 | 136.03 | 136.03 | 136.03 | 0.00 |
| 854.22 | | 3/29/2005 | 114.37 | 114.37 | 114.37 | 114.37 | 0.00 |
| 894.04 | | 3/30/2005 | 176.81 | 176.81 | 176.81 | 176.81 | 0.00 |
| 904.00 | | 3/31/2005 | 221.82 | 221.82 | 221.82 | 221.82 | 0.00 |
| 904.00 | | 4/1/2005 | 139.24 | 139.24 | 139.24 | 139.24 | 0.00 |
| 783.41 | | 4/2/2005 | 16.41 | 16.41 | 16.41 | 16.41 | 0.00 |
| 661.11 | | 4/3/2005 | 14.70 | 14.70 | 14.70 | 14.70 | 0.00 |
| 635.68 | | 4/4/2005 | 111.57 | 111.57 | 111.57 | 111.57 | 0.00 |
| 676.33 | | 4/5/2005 | 177.65 | 177.65 | 177.65 | 177.65 | 0.00 |
| 719.66 | | 4/6/2005 | 180.33 | 180.33 | 180.33 | 180.33 | 0.00 |
| 676.48 | | 4/7/2005 | 93.82 | 93.82 | 93.82 | 93.82 | 0.00 |
| 552.76 | | 4/8/2005 | 13.27 | 13.27 | 13.27 | 13.27 | 0.00 |
| 427.94 | | 4/9/2005 | 12.18 | 12.18 | 12.18 | 12.18 | 0.00 |
| 302.20 | | 4/10/2005 | 11.26 | 11.26 | 11.26 | 11.26 | 0.00 |
| 279.66 | | 4/11/2005 | 114.46 | 114.46 | 114.46 | 114.46 | 0.00 |
| 268.00 | | 4/12/2005 | 125.34 | 125.34 | 125.34 | 125.34 | 0.00 |
| 142.65 | | 4/13/2005 | 11.65 | 11.65 | 11.65 | 11.65 | 0.00 |
| 19.78 | | 4/14/2005 | 14.13 | 14.13 | 14.13 | 14.13 | 0.00 |
| 0.00 | | 4/15/2005 | 10.51 | 10.51 | 10.51 | 10.51 | 0.00 |
| 0.00 | | 4/16/2005 | 10.27 | 10.27 | 10.27 | 10.27 | 0.00 |
| 0.00 | | 4/17/2005 | 9.84 | 9.84 | 9.84 | 9.84 | 0.00 |
| 0.00 | | 4/18/2005 | 10.27 | 10.27 | 10.27 | 10.27 | 0.00 |
| 0.00 | | 4/19/2005 | 10.16 | 10.16 | 10.16 | 10.16 | 0.00 |
| 0.00 | | 4/20/2005 | 9.35 | 9.35 | 9.35 | 9.35 | 0.00 |
| 0.00 | | 4/21/2005 | 9.44 | 9.44 | 9.44 | 9.44 | 0.00 |
| 0.00 | | 4/22/2005 | 9.16 | 9.16 | 9.16 | 9.16 | 0.00 |
| 0.00 | | 4/23/2005 | 9.13 | 9.13 | 9.13 | 9.13 | 0.00 |
| 0.00 | | 4/24/2005 | 9.18 | 9.18 | 9.18 | 9.18 | 0.00 |
| 0.00 | | 4/25/2005 | 9.38 | 9.38 | 9.38 | 9.38 | 0.00 |
| 0.00 | | 4/26/2005 | 8.29 | 8.29 | 8.29 | 8.29 | 0.00 |
| 0.00 | | 4/27/2005 | 8.08 | 8.08 | 8.08 | 8.08 | 0.00 |
| 52.53 | | 4/28/2005 | 189.53 | 189.53 | 189.53 | 189.53 | 0.00 |

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|---|---|---|---|---|---|---|
| 0.00 | 4/29/2005 | 8.95 | 8.95 | 8.95 | 8.95 | 0.00 |
| 0.00 | 4/30/2005 | 7.92 | 7.92 | 7.92 | 7.92 | 0.00 |
| 0.00 | 5/1/2005 | 7.60 | 7.60 | 7.60 | 7.60 | 0.00 |
| 0.00 | 5/2/2005 | 7.56 | 7.56 | 7.56 | 7.56 | 0.00 |
| 0.00 | 5/3/2005 | 7.81 | 7.81 | 7.81 | 7.81 | 0.00 |
| 0.00 | 5/4/2005 | 7.71 | 7.71 | 7.71 | 7.71 | 0.00 |
| 0.00 | 5/5/2005 | 34.20 | 34.20 | 34.20 | 34.20 | 0.00 |
| 58.45 | 5/6/2005 | 195.45 | 195.45 | 195.45 | 195.45 | 0.00 |
| 347.85 | 5/7/2005 | 426.39 | 426.39 | 426.39 | 282.00 | 144.39 |
| 220.38 | 5/8/2005 | 9.53 | 9.53 | 9.53 | 153.93 | 0.00 |
| 126.86 | 5/9/2005 | 43.48 | 43.48 | 43.48 | 43.48 | 0.00 |
| 0.00 | 5/10/2005 | 8.21 | 8.21 | 8.21 | 8.21 | 0.00 |
| 0.00 | 5/11/2005 | 7.17 | 7.17 | 7.17 | 7.17 | 0.00 |
| 0.00 | 5/12/2005 | 7.38 | 7.38 | 7.38 | 7.38 | 0.00 |
| 0.00 | 5/13/2005 | 6.63 | 6.63 | 6.63 | 6.63 | 0.00 |
| 0.00 | 5/14/2005 | 6.63 | 6.63 | 6.63 | 6.63 | 0.00 |
| 0.00 | 5/15/2005 | 6.82 | 6.82 | 6.82 | 6.82 | 0.00 |
| 0.00 | 5/16/2005 | 7.18 | 7.18 | 7.18 | 7.18 | 0.00 |
| 144.43 | 5/17/2005 | 281.43 | 281.43 | 281.43 | 281.43 | 0.00 |
| 313.59 | 5/18/2005 | 306.17 | 306.17 | 306.17 | 282.00 | 24.17 |
| 184.52 | 5/19/2005 | 7.92 | 7.92 | 7.92 | 32.09 | 0.00 |
| 54.10 | 5/20/2005 | 6.58 | 6.58 | 6.58 | 6.58 | 0.00 |
| 0.00 | 5/21/2005 | 6.14 | 6.14 | 6.14 | 6.14 | 0.00 |
| 0.00 | 5/22/2005 | 6.19 | 6.19 | 6.19 | 6.19 | 0.00 |
| 0.00 | 5/23/2005 | 6.27 | 6.27 | 6.27 | 6.27 | 0.00 |
| 0.00 | 5/24/2005 | 6.61 | 6.61 | 6.61 | 6.61 | 0.00 |
| 0.00 | 5/25/2005 | 6.31 | 6.31 | 6.31 | 6.31 | 0.00 |
| 0.00 | 5/26/2005 | 6.19 | 6.19 | 6.19 | 6.19 | 0.00 |
| 0.00 | 5/27/2005 | 6.14 | 6.14 | 6.14 | 6.14 | 0.00 |
| 0.00 | 5/28/2005 | 6.02 | 6.02 | 6.02 | 6.02 | 0.00 |
| 0.00 | 5/29/2005 | 6.15 | 6.15 | 6.15 | 6.15 | 0.00 |
| 0.00 | 5/30/2005 | 6.15 | 6.15 | 6.15 | 6.15 | 0.00 |
| 105.35 | 5/31/2005 | 242.35 | 242.35 | 242.35 | 242.35 | 0.00 |
| 291.47 | 6/1/2005 | 323.12 | 323.12 | 323.12 | 282.00 | 41.12 |
| 222.17 | 6/2/2005 | 67.71 | 67.71 | 67.71 | 108.82 | 0.00 |
| 91.54 | 6/3/2005 | 6.36 | 6.36 | 6.36 | 6.36 | 0.00 |
| 0.00 | 6/4/2005 | 6.41 | 6.41 | 6.41 | 6.41 | 0.00 |
| 0.00 | 6/5/2005 | 6.62 | 6.62 | 6.62 | 6.62 | 0.00 |
| 0.00 | 6/6/2005 | 6.47 | 6.47 | 6.47 | 6.47 | 0.00 |
| 0.00 | 6/7/2005 | 6.16 | 6.16 | 6.16 | 6.16 | 0.00 |
| 0.00 | 6/8/2005 | 6.42 | 6.42 | 6.42 | 6.42 | 0.00 |
| 0.00 | 6/9/2005 | 7.37 | 7.37 | 7.37 | 7.37 | 0.00 |
| 0.00 | 6/10/2005 | 6.26 | 6.26 | 6.26 | 6.26 | 0.00 |
| 0.00 | 6/11/2005 | 6.36 | 6.36 | 6.36 | 6.36 | 0.00 |
| 0.00 | 6/12/2005 | 6.38 | 6.38 | 6.38 | 6.38 | 0.00 |
| 0.00 | 6/13/2005 | 6.05 | 6.05 | 6.05 | 6.05 | 0.00 |
| 106.48 | 6/14/2005 | 243.48 | 243.48 | 243.48 | 243.48 | 0.00 |
| 133.22 | 6/15/2005 | 163.74 | 163.74 | 163.74 | 163.74 | 0.00 |
| 3.35 | 6/16/2005 | 7.13 | 7.13 | 7.13 | 7.13 | 0.00 |
| 0.00 | 6/17/2005 | 7.37 | 7.37 | 7.37 | 7.37 | 0.00 |
| 0.00 | 6/18/2005 | 6.67 | 6.67 | 6.67 | 6.67 | 0.00 |
| 0.00 | 6/19/2005 | 5.98 | 5.98 | 5.98 | 5.98 | 0.00 |
| 0.00 | 6/20/2005 | 5.93 | 5.93 | 5.93 | 5.93 | 0.00 |
| 0.00 | 6/21/2005 | 5.93 | 5.93 | 5.93 | 5.93 | 0.00 |

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|---|---|---|---|---|---|---|---|---|
| 0.00 | | 6/22/2005 | 6.00 | 6.00 | 6.00 | 6.00 | 0.00 | |
| 0.00 | | 6/23/2005 | 7.06 | 7.06 | 7.06 | 7.06 | 0.00 | |
| 0.00 | | 6/24/2005 | 7.13 | 7.13 | 7.13 | 7.13 | 0.00 | |
| 0.00 | | 6/25/2005 | 7.15 | 7.15 | 7.15 | 7.15 | 0.00 | |
| 0.00 | | 6/26/2005 | 7.28 | 7.28 | 7.28 | 7.28 | 0.00 | |
| 0.00 | | 6/27/2005 | 7.05 | 7.05 | 7.05 | 7.05 | 0.00 | |
| 0.00 | | 6/28/2005 | 7.08 | 7.08 | 7.08 | 7.08 | 0.00 | |
| 0.00 | | 6/29/2005 | 6.20 | 6.20 | 6.20 | 6.20 | 0.00 | |
| 0.00 | | 6/30/2005 | 6.28 | 6.28 | 6.28 | 6.28 | 0.00 | |
| 0.00 | | 7/1/2005 | 6.82 | 6.82 | 6.82 | 6.82 | 0.00 | |
| 0.00 | | 7/2/2005 | 6.02 | 6.02 | 6.02 | 6.02 | 0.00 | |
| 0.00 | | 7/3/2005 | 6.21 | 6.21 | 6.21 | 6.21 | 0.00 | |
| 0.00 | | 7/4/2005 | 5.74 | 5.74 | 5.74 | 5.74 | 0.00 | |
| 0.00 | | 7/5/2005 | 6.78 | 6.78 | 6.78 | 6.78 | 0.00 | |
| 0.00 | | 7/6/2005 | 6.49 | 6.49 | 6.49 | 6.49 | 0.00 | |
| 0.00 | | 7/7/2005 | 5.93 | 5.93 | 5.93 | 5.93 | 0.00 | |
| 0.00 | | 7/8/2005 | 5.35 | 5.35 | 5.35 | 5.35 | 0.00 | |
| 0.00 | | 7/9/2005 | 5.30 | 5.30 | 5.30 | 5.30 | 0.00 | |
| 0.00 | | 7/10/2005 | 5.41 | 5.41 | 5.41 | 5.41 | 0.00 | |
| 0.00 | | 7/11/2005 | 5.56 | 5.56 | 5.56 | 5.56 | 0.00 | |
| 109.55 | | 7/12/2005 | 246.55 | 246.55 | 246.55 | 246.55 | 0.00 | |
| 124.43 | | 7/13/2005 | 151.88 | 151.88 | 151.88 | 151.88 | 0.00 | |
| 0.00 | | 7/14/2005 | 5.76 | 5.76 | 5.76 | 5.76 | 0.00 | |
| 0.00 | | 7/15/2005 | 6.52 | 6.52 | 6.52 | 6.52 | 0.00 | |
| 0.00 | | 7/16/2005 | 6.47 | 6.47 | 6.47 | 6.47 | 0.00 | |
| 0.00 | | 7/17/2005 | 5.98 | 5.98 | 5.98 | 5.98 | 0.00 | |
| 0.00 | | 7/18/2005 | 6.02 | 6.02 | 6.02 | 6.02 | 0.00 | |
| 0.00 | | 7/19/2005 | 5.94 | 5.94 | 5.94 | 5.94 | 0.00 | |
| 0.00 | | 7/20/2005 | 6.25 | 6.25 | 6.25 | 6.25 | 0.00 | |
| 0.00 | | 7/21/2005 | 6.31 | 6.31 | 6.31 | 6.31 | 0.00 | |
| 0.00 | | 7/22/2005 | 5.75 | 5.75 | 5.75 | 5.75 | 0.00 | |
| 0.00 | | 7/23/2005 | 5.70 | 5.70 | 5.70 | 5.70 | 0.00 | |
| 0.00 | | 7/24/2005 | 5.69 | 5.69 | 5.69 | 5.69 | 0.00 | |
| 0.00 | | 7/25/2005 | 5.71 | 5.71 | 5.71 | 5.71 | 0.00 | |
| 99.56 | | 7/26/2005 | 236.56 | 236.56 | 236.56 | 236.56 | 0.00 | |
| 107.25 | | 7/27/2005 | 144.69 | 144.69 | 144.69 | 144.69 | 0.00 | |
| 0.00 | | 7/28/2005 | 5.32 | 5.32 | 5.32 | 5.32 | 0.00 | |
| 0.00 | | 7/29/2005 | 5.99 | 5.99 | 5.99 | 5.99 | 0.00 | |
| 0.00 | | 7/30/2005 | 5.65 | 5.65 | 5.65 | 5.65 | 0.00 | |
| 0.00 | | 7/31/2005 | 5.48 | 5.48 | 5.48 | 5.48 | 0.00 | |
| 0.00 | | 8/1/2005 | 5.38 | 5.38 | 5.38 | 5.38 | 0.00 | |
| 0.00 | | 8/2/2005 | 5.11 | 5.11 | 5.11 | 5.11 | 0.00 | |
| 0.00 | | 8/3/2005 | 5.05 | 5.05 | 5.05 | 5.05 | 0.00 | |
| 0.00 | | 8/4/2005 | 5.00 | 5.00 | 5.00 | 5.00 | 0.00 | |
| 0.00 | | 8/5/2005 | 5.03 | 5.03 | 5.03 | 5.03 | 0.00 | |
| 0.00 | | 8/6/2005 | 5.27 | 5.27 | 5.27 | 5.27 | 0.00 | |
| 0.00 | | 8/7/2005 | 5.19 | 5.19 | 5.19 | 5.19 | 0.00 | |
| 0.00 | | 8/8/2005 | 5.22 | 5.22 | 5.22 | 5.22 | 0.00 | |
| 0.00 | | 8/9/2005 | 4.94 | 4.94 | 4.94 | 4.94 | 0.00 | |
| 0.00 | | 8/10/2005 | 4.95 | 4.95 | 4.95 | 4.95 | 0.00 | |
| 0.00 | | 8/11/2005 | 5.00 | 5.00 | 5.00 | 5.00 | 0.00 | |
| 0.00 | | 8/12/2005 | 5.10 | 5.10 | 5.10 | 5.10 | 0.00 | |
| 0.00 | | 8/13/2005 | 5.19 | 5.19 | 5.19 | 5.19 | 0.00 | |
| 0.00 | | 8/14/2005 | 5.35 | 5.35 | 5.35 | 5.35 | 0.00 | |

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|---|---|---|---|---|---|---|
| 0.00 | 8/15/2005 | 37.78 | 37.78 | 37.78 | 37.78 | 0.00 |
| 0.00 | 8/16/2005 | 4.19 | 4.19 | 4.19 | 4.19 | 0.00 |
| 0.00 | 8/17/2005 | 4.11 | 4.11 | 4.11 | 4.11 | 0.00 |
| 0.00 | 8/18/2005 | 4.33 | 4.33 | 4.33 | 4.33 | 0.00 |
| 0.00 | 8/19/2005 | 4.46 | 4.46 | 4.46 | 4.46 | 0.00 |
| 0.00 | 8/20/2005 | 4.31 | 4.31 | 4.31 | 4.31 | 0.00 |
| 0.00 | 8/21/2005 | 4.32 | 4.32 | 4.32 | 4.32 | 0.00 |
| 0.00 | 8/22/2005 | 4.47 | 4.47 | 4.47 | 4.47 | 0.00 |
| 0.00 | 8/23/2005 | 4.24 | 4.24 | 4.24 | 4.24 | 0.00 |
| 0.00 | 8/24/2005 | 3.55 | 3.55 | 3.55 | 3.55 | 0.00 |
| 0.00 | 8/25/2005 | 3.84 | 3.84 | 3.84 | 3.84 | 0.00 |
| 0.00 | 8/26/2005 | 3.77 | 3.77 | 3.77 | 3.77 | 0.00 |
| 0.00 | 8/27/2005 | 3.89 | 3.89 | 3.89 | 3.89 | 0.00 |
| 0.00 | 8/28/2005 | 3.70 | 3.70 | 3.70 | 3.70 | 0.00 |
| 0.00 | 8/29/2005 | 3.62 | 3.62 | 3.62 | 3.62 | 0.00 |
| 0.00 | 8/30/2005 | 3.68 | 3.68 | 3.68 | 3.68 | 0.00 |
| 0.00 | 8/31/2005 | 3.79 | 3.79 | 3.79 | 3.79 | 0.00 |
| 0.00 | 9/1/2005 | 3.97 | 3.97 | 3.97 | 3.97 | 0.00 |
| 0.00 | 9/2/2005 | 4.07 | 4.07 | 4.07 | 4.07 | 0.00 |
| 0.00 | 9/3/2005 | 3.98 | 3.98 | 3.98 | 3.98 | 0.00 |
| 0.00 | 9/4/2005 | 3.82 | 3.82 | 3.82 | 3.82 | 0.00 |
| 0.00 | 9/5/2005 | 3.64 | 3.64 | 3.64 | 3.64 | 0.00 |
| 0.00 | 9/6/2005 | 4.15 | 4.15 | 4.15 | 4.15 | 0.00 |
| 0.00 | 9/7/2005 | 3.46 | 3.46 | 3.46 | 3.46 | 0.00 |
| 0.00 | 9/8/2005 | 3.64 | 3.64 | 3.64 | 3.64 | 0.00 |
| 0.00 | 9/9/2005 | 3.81 | 3.81 | 3.81 | 3.81 | 0.00 |
| 0.00 | 9/10/2005 | 3.97 | 3.97 | 3.97 | 3.97 | 0.00 |
| 0.00 | 9/11/2005 | 3.78 | 3.78 | 3.78 | 3.78 | 0.00 |
| 0.00 | 9/12/2005 | 3.75 | 3.75 | 3.75 | 3.75 | 0.00 |
| 0.00 | 9/13/2005 | 3.79 | 3.79 | 3.79 | 3.79 | 0.00 |
| 0.00 | 9/14/2005 | 3.71 | 3.71 | 3.71 | 3.71 | 0.00 |
| 0.00 | 9/15/2005 | 3.68 | 3.68 | 3.68 | 3.68 | 0.00 |
| 0.00 | 9/16/2005 | 3.70 | 3.70 | 3.70 | 3.70 | 0.00 |
| 0.00 | 9/17/2005 | 3.68 | 3.68 | 3.68 | 3.68 | 0.00 |
| 0.00 | 9/18/2005 | 3.61 | 3.61 | 3.61 | 3.61 | 0.00 |
| 0.00 | 9/19/2005 | 3.60 | 3.60 | 3.60 | 3.60 | 0.00 |
| 0.00 | 9/20/2005 | 23.51 | 23.51 | 23.51 | 23.51 | 0.00 |
| 0.00 | 9/21/2005 | 4.17 | 4.17 | 4.17 | 4.17 | 0.00 |
| 0.00 | 9/22/2005 | 3.99 | 3.99 | 3.99 | 3.99 | 0.00 |
| 0.00 | 9/23/2005 | 4.25 | 4.25 | 4.25 | 4.25 | 0.00 |
| 0.00 | 9/24/2005 | 4.26 | 4.26 | 4.26 | 4.26 | 0.00 |
| 0.00 | 9/25/2005 | 4.30 | 4.30 | 4.30 | 4.30 | 0.00 |
| 0.00 | 9/26/2005 | 4.30 | 4.30 | 4.30 | 4.30 | 0.00 |
| 0.00 | 9/27/2005 | 4.15 | 4.15 | 4.15 | 4.15 | 0.00 |
| 0.00 | 9/28/2005 | 3.51 | 3.51 | 3.51 | 3.51 | 0.00 |
| 0.00 | 9/29/2005 | 3.88 | 3.88 | 3.88 | 3.88 | 0.00 |
| 0.00 | 9/30/2005 | 4.09 | 4.09 | 4.09 | 4.09 | 0.00 |
| | | **55,251.78** | | **32,894.45** | **29,979.63** | |

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| OPTION 2B | TOTAL | Intake 600 cfs / 1190 ac-ft | perc rate 142 cfs 282 acre-ft/day | Total Storage 1222 acre-ft |
|---|---|---|---|---|
| Date | | | Conserved | In Storage |
| | | | | 0 |
| 10/1/2004 | 0.70 | 0.70 | 0.70 | 0.00 |
| 10/2/2004 | 0.71 | 0.71 | 0.71 | 0.00 |
| 10/3/2004 | 0.71 | 0.71 | 0.71 | 0.00 |
| 10/4/2004 | 0.71 | 0.71 | 0.71 | 0.00 |
| 10/5/2004 | 0.67 | 0.67 | 0.67 | 0.00 |
| 10/6/2004 | 0.67 | 0.67 | 0.67 | 0.00 |
| 10/7/2004 | 0.66 | 0.66 | 0.66 | 0.00 |
| 10/8/2004 | 0.67 | 0.67 | 0.67 | 0.00 |
| 10/9/2004 | 0.71 | 0.71 | 0.71 | 0.00 |
| 10/10/2004 | 0.77 | 0.77 | 0.77 | 0.00 |
| 10/11/2004 | 0.70 | 0.70 | 0.70 | 0.00 |
| 10/12/2004 | 0.62 | 0.62 | 0.62 | 0.00 |
| 10/13/2004 | 0.65 | 0.65 | 0.65 | 0.00 |
| 10/14/2004 | 0.62 | 0.62 | 0.62 | 0.00 |
| 10/15/2004 | 0.71 | 0.71 | 0.71 | 0.00 |
| 10/16/2004 | 6.41 | 6.41 | 6.41 | 0.00 |
| 10/17/2004 | 116.19 | 116.19 | 116.19 | 0.00 |
| 10/18/2004 | 127.40 | 127.40 | 127.40 | 0.00 |
| 10/19/2004 | 546.76 | 546.76 | 282.00 | 264.76 |
| 10/20/2004 | 360.67 | 360.67 | 282.00 | 343.43 |
| 10/21/2004 | 1.42 | 1.42 | 282.00 | 62.85 |
| 10/22/2004 | 1.48 | 1.48 | 64.32 | 0.00 |
| 10/23/2004 | 1.39 | 1.39 | 1.39 | 0.00 |
| 10/24/2004 | 1.24 | 1.24 | 1.24 | 0.00 |
| 10/25/2004 | 1.12 | 1.12 | 1.12 | 0.00 |
| 10/26/2004 | 391.36 | 391.36 | 282.00 | 109.36 |
| 10/27/2004 | 121.75 | 121.75 | 231.11 | 0.00 |
| 10/28/2004 | 42.18 | 42.18 | 42.18 | 0.00 |
| 10/29/2004 | 0.74 | 0.74 | 0.74 | 0.00 |
| 10/30/2004 | 0.74 | 0.74 | 0.74 | 0.00 |
| 10/31/2004 | 0.71 | 0.71 | 0.71 | 0.00 |
| 11/1/2004 | 0.57 | 0.57 | 0.57 | 0.00 |
| 11/2/2004 | 1.07 | 1.07 | 1.07 | 0.00 |
| 11/3/2004 | 1.10 | 1.10 | 1.10 | 0.00 |
| 11/4/2004 | 1.27 | 1.27 | 1.27 | 0.00 |
| 11/5/2004 | 2.15 | 2.15 | 2.15 | 0.00 |
| 11/6/2004 | 1.09 | 1.09 | 1.09 | 0.00 |
| 11/7/2004 | 1.26 | 1.26 | 1.26 | 0.00 |
| 11/8/2004 | 2.66 | 2.66 | 2.66 | 0.00 |
| 11/9/2004 | 1.27 | 1.27 | 1.27 | 0.00 |
| 11/10/2004 | 15.76 | 15.76 | 15.76 | 0.00 |
| 11/11/2004 | 0.80 | 0.80 | 0.80 | 0.00 |
| 11/12/2004 | 0.68 | 0.68 | 0.68 | 0.00 |
| 11/13/2004 | 0.70 | 0.70 | 0.70 | 0.00 |
| 11/14/2004 | 0.56 | 0.56 | 0.56 | 0.00 |
| 11/15/2004 | 0.48 | 0.48 | 0.48 | 0.00 |
| 11/16/2004 | 0.47 | 0.47 | 0.47 | 0.00 |
| 11/17/2004 | 0.52 | 0.52 | 0.52 | 0.00 |

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|---|---|---|---|---|
| 11/18/2004 | 0.84 | 0.84 | 0.84 | 0.00 |
| 11/19/2004 | 1.94 | 1.94 | 1.94 | 0.00 |
| 11/20/2004 | 16.06 | 16.06 | 16.06 | 0.00 |
| 11/21/2004 | 1.41 | 1.41 | 1.41 | 0.00 |
| 11/22/2004 | 0.77 | 0.77 | 0.77 | 0.00 |
| 11/23/2004 | 0.53 | 0.53 | 0.53 | 0.00 |
| 11/24/2004 | 0.56 | 0.56 | 0.56 | 0.00 |
| 11/25/2004 | 0.61 | 0.61 | 0.61 | 0.00 |
| 11/26/2004 | 0.57 | 0.57 | 0.57 | 0.00 |
| 11/27/2004 | 14.33 | 14.33 | 14.33 | 0.00 |
| 11/28/2004 | 0.60 | 0.60 | 0.60 | 0.00 |
| 11/29/2004 | 0.24 | 0.24 | 0.24 | 0.00 |
| 11/30/2004 | 0.24 | 0.24 | 0.24 | 0.00 |
| 12/1/2004 | 0.50 | 0.50 | 0.50 | 0.00 |
| 12/2/2004 | 0.45 | 0.45 | 0.45 | 0.00 |
| 12/3/2004 | 0.29 | 0.29 | 0.29 | 0.00 |
| 12/4/2004 | 0.41 | 0.41 | 0.41 | 0.00 |
| 12/5/2004 | 15.28 | 15.28 | 15.28 | 0.00 |
| 12/6/2004 | 0.76 | 0.76 | 0.76 | 0.00 |
| 12/7/2004 | 4.62 | 4.62 | 4.62 | 0.00 |
| 12/8/2004 | 7.05 | 7.05 | 7.05 | 0.00 |
| 12/9/2004 | 0.50 | 0.50 | 0.50 | 0.00 |
| 12/10/2004 | 0.40 | 0.40 | 0.40 | 0.00 |
| 12/11/2004 | 0.40 | 0.40 | 0.40 | 0.00 |
| 12/12/2004 | 0.47 | 0.47 | 0.47 | 0.00 |
| 12/13/2004 | 0.51 | 0.51 | 0.51 | 0.00 |
| 12/14/2004 | 0.49 | 0.49 | 0.49 | 0.00 |
| 12/15/2004 | 0.44 | 0.44 | 0.44 | 0.00 |
| 12/16/2004 | 0.42 | 0.42 | 0.42 | 0.00 |
| 12/17/2004 | 0.51 | 0.51 | 0.51 | 0.00 |
| 12/18/2004 | 0.48 | 0.48 | 0.48 | 0.00 |
| 12/19/2004 | 0.38 | 0.38 | 0.38 | 0.00 |
| 12/20/2004 | 0.55 | 0.55 | 0.55 | 0.00 |
| 12/21/2004 | 0.58 | 0.58 | 0.58 | 0.00 |
| 12/22/2004 | 0.66 | 0.66 | 0.66 | 0.00 |
| 12/23/2004 | 0.39 | 0.39 | 0.39 | 0.00 |
| 12/24/2004 | 0.43 | 0.43 | 0.43 | 0.00 |
| 12/25/2004 | 0.49 | 0.49 | 0.49 | 0.00 |
| 12/26/2004 | 0.59 | 0.59 | 0.59 | 0.00 |
| 12/27/2004 | 183.46 | 183.46 | 183.46 | 0.00 |
| 12/28/2004 | 723.27 | 723.27 | 282.00 | 441.27 |
| 12/29/2004 | 431.95 | 431.95 | 282.00 | 591.22 |
| 12/30/2004 | 67.11 | 67.11 | 282.00 | 376.33 |
| 12/31/2004 | 364.66 | 364.66 | 282.00 | 458.99 |
| 1/1/2005 | 184.62 | 184.62 | 282.00 | 361.61 |
| 1/2/2005 | 232.17 | 232.17 | 282.00 | 311.78 |
| 1/3/2005 | 605.68 | 605.68 | 282.00 | 635.46 |
| 1/4/2005 | 196.14 | 196.14 | 282.00 | 549.60 |
| 1/5/2005 | 186.30 | 186.30 | 282.00 | 453.90 |
| 1/6/2005 | 185.18 | 185.18 | 282.00 | 357.08 |
| 1/7/2005 | 625.66 | 625.66 | 282.00 | 700.74 |
| 1/8/2005 | 712.20 | 712.20 | 282.00 | 1130.94 |
| 1/9/2005 | 4211.74 | 1190.00 | 282.00 | 1222.00 |
| 1/10/2005 | 6418.11 | 1190.00 | 282.00 | 1222.00 |

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|---|---|---|---|---|
| 1/11/2005 | 4291.30 | 1190.00 | 282.00 | 1222.00 |
| 1/12/2005 | 1585.64 | 1190.00 | 282.00 | 1222.00 |
| 1/13/2005 | 808.96 | 808.96 | 282.00 | 1222.00 |
| 1/14/2005 | 594.14 | 594.14 | 282.00 | 1222.00 |
| 1/15/2005 | 488.64 | 488.64 | 282.00 | 1222.00 |
| 1/16/2005 | 330.02 | 330.02 | 282.00 | 1222.00 |
| 1/17/2005 | 248.60 | 248.60 | 282.00 | 1188.60 |
| 1/18/2005 | 208.01 | 208.01 | 282.00 | 1114.61 |
| 1/19/2005 | 165.70 | 165.70 | 282.00 | 998.32 |
| 1/20/2005 | 132.88 | 132.88 | 282.00 | 849.20 |
| 1/21/2005 | 218.27 | 218.27 | 282.00 | 785.46 |
| 1/22/2005 | 283.43 | 283.43 | 282.00 | 786.89 |
| 1/23/2005 | 278.64 | 278.64 | 282.00 | 783.54 |
| 1/24/2005 | 275.62 | 275.62 | 282.00 | 777.15 |
| 1/25/2005 | 270.89 | 270.89 | 282.00 | 766.04 |
| 1/26/2005 | 238.30 | 238.30 | 282.00 | 722.34 |
| 1/27/2005 | 129.24 | 129.24 | 282.00 | 569.58 |
| 1/28/2005 | 216.47 | 216.47 | 282.00 | 504.06 |
| 1/29/2005 | 129.24 | 129.24 | 282.00 | 351.30 |
| 1/30/2005 | 125.18 | 125.18 | 282.00 | 194.48 |
| 1/31/2005 | 117.93 | 117.93 | 282.00 | 30.41 |
| 2/1/2005 | 119.00 | 119.00 | 149.41 | 0.00 |
| 2/2/2005 | 133.82 | 133.82 | 133.82 | 0.00 |
| 2/3/2005 | 163.88 | 163.88 | 163.88 | 0.00 |
| 2/4/2005 | 78.60 | 78.60 | 78.60 | 0.00 |
| 2/5/2005 | 14.72 | 14.72 | 14.72 | 0.00 |
| 2/6/2005 | 21.33 | 21.33 | 21.33 | 0.00 |
| 2/7/2005 | 96.98 | 96.98 | 96.98 | 0.00 |
| 2/8/2005 | 174.41 | 174.41 | 174.41 | 0.00 |
| 2/9/2005 | 174.04 | 174.04 | 174.04 | 0.00 |
| 2/10/2005 | 174.79 | 174.79 | 174.79 | 0.00 |
| 2/11/2005 | 830.97 | 830.97 | 282.00 | 548.97 |
| 2/12/2005 | 56.42 | 56.42 | 282.00 | 323.39 |
| 2/13/2005 | 16.48 | 16.48 | 282.00 | 57.87 |
| 2/14/2005 | 155.37 | 155.37 | 213.24 | 0.00 |
| 2/15/2005 | 268.61 | 268.61 | 268.61 | 0.00 |
| 2/16/2005 | 143.85 | 143.85 | 143.85 | 0.00 |
| 2/17/2005 | 140.67 | 140.67 | 140.67 | 0.00 |
| 2/18/2005 | 244.54 | 244.54 | 244.54 | 0.00 |
| 2/19/2005 | 1004.59 | 1004.59 | 282.00 | 722.59 |
| 2/20/2005 | 2002.65 | 1190.00 | 282.00 | 1222.00 |
| 2/21/2005 | 2692.06 | 1190.00 | 282.00 | 1222.00 |
| 2/22/2005 | 2007.75 | 1190.00 | 282.00 | 1222.00 |
| 2/23/2005 | 1528.09 | 1190.00 | 282.00 | 1222.00 |
| 2/24/2005 | 1053.37 | 1053.37 | 282.00 | 1222.00 |
| 2/25/2005 | 777.81 | 777.81 | 282.00 | 1222.00 |
| 2/26/2005 | 613.02 | 613.02 | 282.00 | 1222.00 |
| 2/27/2005 | 570.93 | 570.93 | 282.00 | 1222.00 |
| 2/28/2005 | 459.03 | 459.03 | 282.00 | 1222.00 |
| 3/1/2005 | 286.93 | 286.93 | 282.00 | 1222.00 |
| 3/2/2005 | 302.73 | 302.73 | 282.00 | 1222.00 |
| 3/3/2005 | 260.15 | 260.15 | 282.00 | 1200.15 |
| 3/4/2005 | 328.14 | 328.14 | 282.00 | 1222.00 |
| 3/5/2005 | 219.97 | 219.97 | 282.00 | 1159.97 |

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|---|---|---|---|---|
| 3/6/2005 | 220.45 | 220.45 | 282.00 | 1098.42 |
| 3/7/2005 | 191.24 | 191.24 | 282.00 | 1007.66 |
| 3/8/2005 | 157.65 | 157.65 | 282.00 | 883.31 |
| 3/9/2005 | 160.50 | 160.50 | 282.00 | 761.80 |
| 3/10/2005 | 154.55 | 154.55 | 282.00 | 634.36 |
| 3/11/2005 | 134.94 | 134.94 | 282.00 | 487.30 |
| 3/12/2005 | 135.38 | 135.38 | 282.00 | 340.67 |
| 3/13/2005 | 144.09 | 144.09 | 282.00 | 202.77 |
| 3/14/2005 | 151.80 | 151.80 | 282.00 | 72.57 |
| 3/15/2005 | 165.62 | 165.62 | 238.19 | 0.00 |
| 3/16/2005 | 166.95 | 166.95 | 166.95 | 0.00 |
| 3/17/2005 | 170.92 | 170.92 | 170.92 | 0.00 |
| 3/18/2005 | 181.90 | 181.90 | 181.90 | 0.00 |
| 3/19/2005 | 206.46 | 206.46 | 206.46 | 0.00 |
| 3/20/2005 | 168.20 | 168.20 | 168.20 | 0.00 |
| 3/21/2005 | 160.75 | 160.75 | 160.75 | 0.00 |
| 3/22/2005 | 531.99 | 531.99 | 282.00 | 249.99 |
| 3/23/2005 | 164.11 | 164.11 | 282.00 | 132.10 |
| 3/24/2005 | 147.52 | 147.52 | 279.62 | 0.00 |
| 3/25/2005 | 133.72 | 133.72 | 133.72 | 0.00 |
| 3/26/2005 | 125.18 | 125.18 | 125.18 | 0.00 |
| 3/27/2005 | 125.93 | 125.93 | 125.93 | 0.00 |
| 3/28/2005 | 136.03 | 136.03 | 136.03 | 0.00 |
| 3/29/2005 | 114.37 | 114.37 | 114.37 | 0.00 |
| 3/30/2005 | 176.81 | 176.81 | 176.81 | 0.00 |
| 3/31/2005 | 221.82 | 221.82 | 221.82 | 0.00 |
| 4/1/2005 | 139.24 | 139.24 | 139.24 | 0.00 |
| 4/2/2005 | 16.41 | 16.41 | 16.41 | 0.00 |
| 4/3/2005 | 14.70 | 14.70 | 14.70 | 0.00 |
| 4/4/2005 | 111.57 | 111.57 | 111.57 | 0.00 |
| 4/5/2005 | 177.65 | 177.65 | 177.65 | 0.00 |
| 4/6/2005 | 180.33 | 180.33 | 180.33 | 0.00 |
| 4/7/2005 | 93.82 | 93.82 | 93.82 | 0.00 |
| 4/8/2005 | 13.27 | 13.27 | 13.27 | 0.00 |
| 4/9/2005 | 12.18 | 12.18 | 12.18 | 0.00 |
| 4/10/2005 | 11.26 | 11.26 | 11.26 | 0.00 |
| 4/11/2005 | 114.46 | 114.46 | 114.46 | 0.00 |
| 4/12/2005 | 125.34 | 125.34 | 125.34 | 0.00 |
| 4/13/2005 | 11.65 | 11.65 | 11.65 | 0.00 |
| 4/14/2005 | 14.13 | 14.13 | 14.13 | 0.00 |
| 4/15/2005 | 10.51 | 10.51 | 10.51 | 0.00 |
| 4/16/2005 | 10.27 | 10.27 | 10.27 | 0.00 |
| 4/17/2005 | 9.84 | 9.84 | 9.84 | 0.00 |
| 4/18/2005 | 10.27 | 10.27 | 10.27 | 0.00 |
| 4/19/2005 | 10.16 | 10.16 | 10.16 | 0.00 |
| 4/20/2005 | 9.35 | 9.35 | 9.35 | 0.00 |
| 4/21/2005 | 9.44 | 9.44 | 9.44 | 0.00 |
| 4/22/2005 | 9.16 | 9.16 | 9.16 | 0.00 |
| 4/23/2005 | 9.13 | 9.13 | 9.13 | 0.00 |
| 4/24/2005 | 9.18 | 9.18 | 9.18 | 0.00 |
| 4/25/2005 | 9.38 | 9.38 | 9.38 | 0.00 |
| 4/26/2005 | 8.29 | 8.29 | 8.29 | 0.00 |
| 4/27/2005 | 8.08 | 8.08 | 8.08 | 0.00 |
| 4/28/2005 | 189.53 | 189.53 | 189.53 | 0.00 |

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|---|---|---|---|---|
| 4/29/2005 | 8.95 | 8.95 | 8.95 | 0.00 |
| 4/30/2005 | 7.92 | 7.92 | 7.92 | 0.00 |
| 5/1/2005 | 7.60 | 7.60 | 7.60 | 0.00 |
| 5/2/2005 | 7.56 | 7.56 | 7.56 | 0.00 |
| 5/3/2005 | 7.81 | 7.81 | 7.81 | 0.00 |
| 5/4/2005 | 7.71 | 7.71 | 7.71 | 0.00 |
| 5/5/2005 | 34.20 | 34.20 | 34.20 | 0.00 |
| 5/6/2005 | 195.45 | 195.45 | 195.45 | 0.00 |
| 5/7/2005 | 426.39 | 426.39 | 282.00 | 144.39 |
| 5/8/2005 | 9.53 | 9.53 | 153.93 | 0.00 |
| 5/9/2005 | 43.48 | 43.48 | 43.48 | 0.00 |
| 5/10/2005 | 8.21 | 8.21 | 8.21 | 0.00 |
| 5/11/2005 | 7.17 | 7.17 | 7.17 | 0.00 |
| 5/12/2005 | 7.38 | 7.38 | 7.38 | 0.00 |
| 5/13/2005 | 6.63 | 6.63 | 6.63 | 0.00 |
| 5/14/2005 | 6.63 | 6.63 | 6.63 | 0.00 |
| 5/15/2005 | 6.82 | 6.82 | 6.82 | 0.00 |
| 5/16/2005 | 7.18 | 7.18 | 7.18 | 0.00 |
| 5/17/2005 | 281.43 | 281.43 | 281.43 | 0.00 |
| 5/18/2005 | 306.17 | 306.17 | 282.00 | 24.17 |
| 5/19/2005 | 7.92 | 7.92 | 32.09 | 0.00 |
| 5/20/2005 | 6.58 | 6.58 | 6.58 | 0.00 |
| 5/21/2005 | 6.14 | 6.14 | 6.14 | 0.00 |
| 5/22/2005 | 6.19 | 6.19 | 6.19 | 0.00 |
| 5/23/2005 | 6.27 | 6.27 | 6.27 | 0.00 |
| 5/24/2005 | 6.61 | 6.61 | 6.61 | 0.00 |
| 5/25/2005 | 6.31 | 6.31 | 6.31 | 0.00 |
| 5/26/2005 | 6.19 | 6.19 | 6.19 | 0.00 |
| 5/27/2005 | 6.14 | 6.14 | 6.14 | 0.00 |
| 5/28/2005 | 6.02 | 6.02 | 6.02 | 0.00 |
| 5/29/2005 | 6.15 | 6.15 | 6.15 | 0.00 |
| 5/30/2005 | 6.15 | 6.15 | 6.15 | 0.00 |
| 5/31/2005 | 242.35 | 242.35 | 242.35 | 0.00 |
| 6/1/2005 | 323.12 | 323.12 | 282.00 | 41.12 |
| 6/2/2005 | 67.71 | 67.71 | 108.82 | 0.00 |
| 6/3/2005 | 6.36 | 6.36 | 6.36 | 0.00 |
| 6/4/2005 | 6.41 | 6.41 | 6.41 | 0.00 |
| 6/5/2005 | 6.62 | 6.62 | 6.62 | 0.00 |
| 6/6/2005 | 6.47 | 6.47 | 6.47 | 0.00 |
| 6/7/2005 | 6.16 | 6.16 | 6.16 | 0.00 |
| 6/8/2005 | 6.42 | 6.42 | 6.42 | 0.00 |
| 6/9/2005 | 7.37 | 7.37 | 7.37 | 0.00 |
| 6/10/2005 | 6.26 | 6.26 | 6.26 | 0.00 |
| 6/11/2005 | 6.36 | 6.36 | 6.36 | 0.00 |
| 6/12/2005 | 6.38 | 6.38 | 6.38 | 0.00 |
| 6/13/2005 | 6.05 | 6.05 | 6.05 | 0.00 |
| 6/14/2005 | 243.48 | 243.48 | 243.48 | 0.00 |
| 6/15/2005 | 163.74 | 163.74 | 163.74 | 0.00 |
| 6/16/2005 | 7.13 | 7.13 | 7.13 | 0.00 |
| 6/17/2005 | 7.37 | 7.37 | 7.37 | 0.00 |
| 6/18/2005 | 6.67 | 6.67 | 6.67 | 0.00 |
| 6/19/2005 | 5.98 | 5.98 | 5.98 | 0.00 |
| 6/20/2005 | 5.93 | 5.93 | 5.93 | 0.00 |
| 6/21/2005 | 5.93 | 5.93 | 5.93 | 0.00 |

| | | | | |
|---|---|---|---|---|
| 6/22/2005 | 6.00 | 6.00 | 6.00 | 0.00 |
| 6/23/2005 | 7.06 | 7.06 | 7.06 | 0.00 |
| 6/24/2005 | 7.13 | 7.13 | 7.13 | 0.00 |
| 6/25/2005 | 7.15 | 7.15 | 7.15 | 0.00 |
| 6/26/2005 | 7.28 | 7.28 | 7.28 | 0.00 |
| 6/27/2005 | 7.05 | 7.05 | 7.05 | 0.00 |
| 6/28/2005 | 7.08 | 7.08 | 7.08 | 0.00 |
| 6/29/2005 | 6.20 | 6.20 | 6.20 | 0.00 |
| 6/30/2005 | 6.28 | 6.28 | 6.28 | 0.00 |
| 7/1/2005 | 6.82 | 6.82 | 6.82 | 0.00 |
| 7/2/2005 | 6.02 | 6.02 | 6.02 | 0.00 |
| 7/3/2005 | 6.21 | 6.21 | 6.21 | 0.00 |
| 7/4/2005 | 5.74 | 5.74 | 5.74 | 0.00 |
| 7/5/2005 | 6.78 | 6.78 | 6.78 | 0.00 |
| 7/6/2005 | 6.49 | 6.49 | 6.49 | 0.00 |
| 7/7/2005 | 5.93 | 5.93 | 5.93 | 0.00 |
| 7/8/2005 | 5.35 | 5.35 | 5.35 | 0.00 |
| 7/9/2005 | 5.30 | 5.30 | 5.30 | 0.00 |
| 7/10/2005 | 5.41 | 5.41 | 5.41 | 0.00 |
| 7/11/2005 | 5.56 | 5.56 | 5.56 | 0.00 |
| 7/12/2005 | 246.55 | 246.55 | 246.55 | 0.00 |
| 7/13/2005 | 151.88 | 151.88 | 151.88 | 0.00 |
| 7/14/2005 | 5.76 | 5.76 | 5.76 | 0.00 |
| 7/15/2005 | 6.52 | 6.52 | 6.52 | 0.00 |
| 7/16/2005 | 6.47 | 6.47 | 6.47 | 0.00 |
| 7/17/2005 | 5.98 | 5.98 | 5.98 | 0.00 |
| 7/18/2005 | 6.02 | 6.02 | 6.02 | 0.00 |
| 7/19/2005 | 5.94 | 5.94 | 5.94 | 0.00 |
| 7/20/2005 | 6.25 | 6.25 | 6.25 | 0.00 |
| 7/21/2005 | 6.31 | 6.31 | 6.31 | 0.00 |
| 7/22/2005 | 5.75 | 5.75 | 5.75 | 0.00 |
| 7/23/2005 | 5.70 | 5.70 | 5.70 | 0.00 |
| 7/24/2005 | 5.69 | 5.69 | 5.69 | 0.00 |
| 7/25/2005 | 5.71 | 5.71 | 5.71 | 0.00 |
| 7/26/2005 | 236.56 | 236.56 | 236.56 | 0.00 |
| 7/27/2005 | 144.69 | 144.69 | 144.69 | 0.00 |
| 7/28/2005 | 5.32 | 5.32 | 5.32 | 0.00 |
| 7/29/2005 | 5.99 | 5.99 | 5.99 | 0.00 |
| 7/30/2005 | 5.65 | 5.65 | 5.65 | 0.00 |
| 7/31/2005 | 5.48 | 5.48 | 5.48 | 0.00 |
| 8/1/2005 | 5.38 | 5.38 | 5.38 | 0.00 |
| 8/2/2005 | 5.11 | 5.11 | 5.11 | 0.00 |
| 8/3/2005 | 5.05 | 5.05 | 5.05 | 0.00 |
| 8/4/2005 | 5.00 | 5.00 | 5.00 | 0.00 |
| 8/5/2005 | 5.03 | 5.03 | 5.03 | 0.00 |
| 8/6/2005 | 5.27 | 5.27 | 5.27 | 0.00 |
| 8/7/2005 | 5.19 | 5.19 | 5.19 | 0.00 |
| 8/8/2005 | 5.22 | 5.22 | 5.22 | 0.00 |
| 8/9/2005 | 4.94 | 4.94 | 4.94 | 0.00 |
| 8/10/2005 | 4.95 | 4.95 | 4.95 | 0.00 |
| 8/11/2005 | 5.00 | 5.00 | 5.00 | 0.00 |
| 8/12/2005 | 5.10 | 5.10 | 5.10 | 0.00 |
| 8/13/2005 | 5.19 | 5.19 | 5.19 | 0.00 |
| 8/14/2005 | 5.35 | 5.35 | 5.35 | 0.00 |

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|---|---|---|---|---|
| 8/15/2005 | 37.78 | 37.78 | 37.78 | 0.00 |
| 8/16/2005 | 4.19 | 4.19 | 4.19 | 0.00 |
| 8/17/2005 | 4.11 | 4.11 | 4.11 | 0.00 |
| 8/18/2005 | 4.33 | 4.33 | 4.33 | 0.00 |
| 8/19/2005 | 4.46 | 4.46 | 4.46 | 0.00 |
| 8/20/2005 | 4.31 | 4.31 | 4.31 | 0.00 |
| 8/21/2005 | 4.32 | 4.32 | 4.32 | 0.00 |
| 8/22/2005 | 4.47 | 4.47 | 4.47 | 0.00 |
| 8/23/2005 | 4.24 | 4.24 | 4.24 | 0.00 |
| 8/24/2005 | 3.55 | 3.55 | 3.55 | 0.00 |
| 8/25/2005 | 3.84 | 3.84 | 3.84 | 0.00 |
| 8/26/2005 | 3.77 | 3.77 | 3.77 | 0.00 |
| 8/27/2005 | 3.89 | 3.89 | 3.89 | 0.00 |
| 8/28/2005 | 3.70 | 3.70 | 3.70 | 0.00 |
| 8/29/2005 | 3.62 | 3.62 | 3.62 | 0.00 |
| 8/30/2005 | 3.68 | 3.68 | 3.68 | 0.00 |
| 8/31/2005 | 3.79 | 3.79 | 3.79 | 0.00 |
| 9/1/2005 | 3.97 | 3.97 | 3.97 | 0.00 |
| 9/2/2005 | 4.07 | 4.07 | 4.07 | 0.00 |
| 9/3/2005 | 3.98 | 3.98 | 3.98 | 0.00 |
| 9/4/2005 | 3.82 | 3.82 | 3.82 | 0.00 |
| 9/5/2005 | 3.64 | 3.64 | 3.64 | 0.00 |
| 9/6/2005 | 4.15 | 4.15 | 4.15 | 0.00 |
| 9/7/2005 | 3.46 | 3.46 | 3.46 | 0.00 |
| 9/8/2005 | 3.64 | 3.64 | 3.64 | 0.00 |
| 9/9/2005 | 3.81 | 3.81 | 3.81 | 0.00 |
| 9/10/2005 | 3.97 | 3.97 | 3.97 | 0.00 |
| 9/11/2005 | 3.78 | 3.78 | 3.78 | 0.00 |
| 9/12/2005 | 3.75 | 3.75 | 3.75 | 0.00 |
| 9/13/2005 | 3.79 | 3.79 | 3.79 | 0.00 |
| 9/14/2005 | 3.71 | 3.71 | 3.71 | 0.00 |
| 9/15/2005 | 3.68 | 3.68 | 3.68 | 0.00 |
| 9/16/2005 | 3.70 | 3.70 | 3.70 | 0.00 |
| 9/17/2005 | 3.68 | 3.68 | 3.68 | 0.00 |
| 9/18/2005 | 3.61 | 3.61 | 3.61 | 0.00 |
| 9/19/2005 | 3.60 | 3.60 | 3.60 | 0.00 |
| 9/20/2005 | 23.51 | 23.51 | 23.51 | 0.00 |
| 9/21/2005 | 4.17 | 4.17 | 4.17 | 0.00 |
| 9/22/2005 | 3.99 | 3.99 | 3.99 | 0.00 |
| 9/23/2005 | 4.25 | 4.25 | 4.25 | 0.00 |
| 9/24/2005 | 4.26 | 4.26 | 4.26 | 0.00 |
| 9/25/2005 | 4.30 | 4.30 | 4.30 | 0.00 |
| 9/26/2005 | 4.30 | 4.30 | 4.30 | 0.00 |
| 9/27/2005 | 4.15 | 4.15 | 4.15 | 0.00 |
| 9/28/2005 | 3.51 | 3.51 | 3.51 | 0.00 |
| 9/29/2005 | 3.88 | 3.88 | 3.88 | 0.00 |
| 9/30/2005 | 4.09 | 4.09 | 4.09 | 0.00 |
| | **55,251.78** | **40,034.45** | **30,153.04** | |
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| Watershed | Date | Waterbody | Station | Hardness | Antimony (dissolved) | Antimony (total) | Arsenic (dissolved) | Arsenic (total) | Barium (dissolved) | Barium (total) | Beryllium (dissolved) | Beryllium (total) | Cadmium (dissolved) | Cadmium (total) | Chromium (dissolved) | Chromium (total) | Cobalt (dissolved) | Cobalt (total) | Copper (dissolved) | Copper (total) | Lead (dissolved) | Lead (total) | Mercury (dissolved) | Mercury (total) | Nickel (dissolved) | Nickel (total) | Selenium (dissolved) | Selenium (total) | Silver (dissolved) | Silver (total) | Thallium (dissolved) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAR | 1/18/2005 | Tujunga Wash | Moorpark St. | 104 | ND | ND | 0.6 | 1.0 | 38.00 | 72.00 | ND | ND | ND | ND | 0.30 | 1.20 | ND | 1.6 | 6.0 | 8.0 | ND | 2.0 | ND | ND | 1.00 | 2.00 | 0.2 | 0.3 | ND | ND | ND |
| LAR | 2/15/2005 | Tujunga Wash | Moorpark St. | 394 | 2.00 | 3.00 | 1.5 | 1.8 | 33.00 | 40.00 | ND | ND | ND | ND | ND | 0.30 | ND | ND | ND | ND | ND | 4.0 | ND | ND | 1.00 | 1.00 | 0.4 | 0.4 | 0.3 | 0.4 | ND |
| LAR | 3/15/2005 | Tujunga Wash | Moorpark St. | 131 | 3.00 | 3.00 | 0.5 | 0.7 | 39.00 | 42.00 | ND | ND | ND | ND | 0.20 | 0.20 | ND | ND | 4.0 | 4.0 | ND | ND | ND | ND | 1.00 | 2.00 | 0.3 | 0.3 | ND | ND | ND |
| LAR | 4/19/2005 | Tujunga Wash | Moorpark St. | 217 | 3.00 | 2.00 | 0.8 | 0.8 | 65.00 | 76.00 | ND | ND | ND | ND | 1.00 | 1.10 | ND | ND | 8.0 | 9.0 | ND | ND | ND | ND | 2.00 | 2.00 | 0.4 | 0.5 | ND | ND | ND |
| LAR | 5/17/2005 | Tujunga Wash | Moorpark St. | 198 | 3.00 | 3.00 | 0.8 | 1.7 | 63.00 | 133.00 | ND | ND | ND | 0.3 | 0.90 | 4.00 | 0.7 | 2.7 | 6.0 | 14.0 | ND | 7.00 | ND | 0.025 | 3.00 | 6.00 | ND | 0.3 | ND | ND | ND |
| LAR | 6/7/2005 | Tujunga Wash | Moorpark St. | 178 | ND | ND | 1.5 | 20.5 | 55.00 | 1020.00 | ND | 1.5 | ND | 1.5 | 0.80 | 72.40 | ND | 46.8 | ND | 122.0 | 1.00 | 59.00 | ND | 0.022 | 2.00 | 54.00 | 0.5 | 2.4 | ND | ND | ND |
| LAR | 7/12/2005 | Tujunga Wash | Moorpark St. | 155 | ND | 2 | 2.2 | 10.0 | 60.00 | 1150.00 | ND | ND | ND | 1.3 | ND | 63.00 | 0.6 | 39.1 | 12.0 | 207.0 | ND | 85.00 | ND | 0.031 | 2.00 | 47.00 | 0.3 | 1.0 | ND | 0.6 | ND |
| LAR | 8/9/2005 | Tujunga Wash | Moorpark St. | 144 | ND | ND | 2.6 | 3.0 | 59.00 | 106.00 | ND | ND | ND | 0.6 | 0.80 | 2.40 | 0.2 | 1.7 | 17.0 | 37.0 | 2.00 | 2.00 | 0.052 | 0.059 | 3.00 | 4.00 | 0.3 | 0.3 | ND | ND | ND |
| LAR | 9/13/2005 | Tujunga Wash | Moorpark St. | 110 | 2 | ND | 2.4 | 3.0 | 36.00 | 44.00 | ND | ND | 0.500 | 0.500 | 0.40 | 0.70 | 1.0 | 0.9 | 17.0 | 21.0 | 3.00 | 5.00 | ND | ND | 3.00 | 3.00 | 0.3 | 0.4 | ND | ND | 1.0 |
| LAR | 10/11/2005 | Tujunga Wash | Moorpark St. | 144 | ND | ND | 2.1 | 2.5 | 42.00 | 46.00 | ND | ND | 0.400 | 0.400 | 0.80 | 0.40 | 0.8 | 0.8 | 20.0 | 22.0 | 4.00 | 2.00 | ND | ND | 4.00 | 4.00 | 0.3 | 0.3 | ND | ND | 2.0 |
| LAR | 11/8/2005 | Tujunga Wash | Moorpark St. | 122 | ND | ND | 2.5 | 2.9 | 30.00 | 32.00 | ND | ND | 1.000 | 0.800 | 1.30 | 1.50 | 0.3 | 0.2 | 16.0 | 19.0 | 8.00 | 10.00 | ND | ND | 2.00 | 3.00 | 0.2 | 0.2 | ND | ND | ND |
| LAR | 12/14/2005 | Tujunga Wash | Moorpark St. | 166 | 2.00 | 2.00 | 2.1 | 2.1 | 42.00 | 42.00 | ND | ND | 0.300 | 0.400 | 0.50 | 0.30 | 0.3 | 0.2 | 17.0 | 17.0 | 2.00 | 1.00 | ND | ND | 2.00 | 3.00 | 0.2 | 0.2 | ND | ND | ND |
| LAR | 1/17/2006 | Tujunga Wash | Moorpark St. | 172 | ND | ND | 0.7 | 1.4 | 45.00 | 45.00 | ND | ND | ND | ND | 0.50 | 0.60 | 0.4 | 0.3 | 11.0 | 13.0 | ND | ND | ND | ND | 2.00 | 2.00 | 0.2 | 0.3 | ND | ND | ND |
| LAR | 2/14/2006 | Tujunga Wash | Moorpark St. | 193 | 3 | ND | 2.3 | 3.0 | 40.00 | 46.00 | ND | ND | 0.400 | 0.500 | 0.10 | 0.50 | 0.5 | 0.6 | 12.0 | 19.0 | ND | 1.00 | ND | ND | 2.00 | 4.00 | 0.2 | 0.2 | ND | ND | ND |
| LAR | 3/21/2006 | Tujunga Wash | Moorpark St. | 65.2 | -- | -- | 0.8 | 2.4 | 22.00 | 40.00 | -- | -- | ND | ND | 0.40 | 2.30 | -- | -- | 6.0 | 10.0 | ND | 2.00 | -- | -- | 1.00 | 3.00 | 0.2 | 0.2 | ND | ND | -- |
| LAR | 4/25/2006 | Tujunga Wash | Moorpark St. | 125 | -- | -- | 2.0 | 1.7 | 31.30 | 33.00 | -- | -- | 0.340 | ND | 0.73 | 0.68 | -- | -- | 18.0 | 21.0 | 8.40 | 12.90 | -- | -- | 2.26 | 2.84 | 0.4 | 0.4 | ND | ND | -- |
| LAR | 5/16/2006 | Tujunga Wash | Moorpark St. | 147 | -- | -- | 1.0 | 1.4 | 42.10 | 53.10 | -- | -- | ND | 0.370 | 0.60 | 0.78 | -- | -- | 13.0 | 17.0 | 1.10 | ND | -- | -- | 2.78 | 3.64 | 0.3 | 0.4 | ND | ND | -- |
| LAR | 6/13/2006 | Tujunga Wash | Moorpark St. | 128 | -- | -- | 1.8 | 2.0 | 43.20 | 51.70 | -- | -- | 0.340 | 0.500 | ND | ND | -- | -- | 18.0 | 23.0 | ND | 2.80 | -- | -- | 4.06 | 4.64 | 0.2 | 0.2 | ND | ND | -- |
| LAR | 7/10/2006 | Tujunga Wash | Moorpark St. | 152 | -- | -- | 2.6 | 2.9 | 69.40 | 109.00 | -- | -- | 0.640 | 10.600 | 1.01 | 3.19 | -- | -- | 34.0 | 63.0 | 1.10 | 144.00 | -- | -- | 5.20 | 8.40 | 0.1 | 0.2 | ND | ND | -- |
| LAR | 8/15/2006 | Tujunga Wash | Moorpark St. | 173 | -- | -- | 3.3 | 3.7 | 65.60 | 80.00 | -- | -- | 0.710 | 0.540 | 0.81 | 1.40 | -- | -- | 24.0 | 32.0 | 1.60 | 2.40 | -- | -- | 7.14 | 10.20 | 0.3 | 0.3 | 0.28 | 0.48 | -- |
| LAR | 9/12/2006 | Tujunga Wash | Moorpark St. | 116 | -- | -- | 2.5 | 2.8 | 49.30 | 55.80 | -- | -- | 1.360 | 1.480 | 4.94 | 1.07 | -- | -- | 18.0 | 16.0 | 2.60 | 6.60 | -- | -- | 4.88 | 6.96 | 0.2 | 0.2 | 0.52 | 0.59 | -- |
| LAR | 10/10/2006 | Tujunga Wash | Moorpark St. | 148 | -- | -- | 2.1 | 2.3 | 47.20 | 50.50 | -- | -- | ND | 0.720 | 0.54 | 0.88 | -- | -- | 26.0 | 29.0 | 2.50 | 1.60 | -- | -- | 4.28 | 4.60 | 0.2 | 0.2 | ND | ND | -- |
| LAR | 11/14/2006 | Tujunga Wash | Moorpark St. | 205 | -- | -- | 4.9 | 5.4 | 41.60 | 59.80 | -- | -- | 1.690 | 3.790 | 1.77 | 2.37 | -- | -- | 24.0 | 35.0 | 5.80 | 38.50 | -- | -- | 9.19 | 13.20 | 0.2 | 0.2 | ND | ND | -- |
| LAR | 12/12/2006 | Tujunga Wash | Moorpark St. | 139 | -- | -- | 1.3 | 1.5 | 42.10 | 44.00 | -- | -- | ND | ND | 0.39 | 0.40 | -- | -- | 12.0 | 13.0 | ND | ND | -- | -- | 1.80 | 2.16 | 0.2 | 0.2 | ND | ND | -- |
| LAR | 1/16/2007 | Tujunga Wash | Moorpark St. | 201 | -- | -- | 1.4 | 1.4 | 55.80 | 56.90 | -- | -- | ND | ND | 1.44 | 1.33 | -- | -- | 24.0 | 25.0 | AE | ND | -- | -- | 3.92 | 5.32 | 0.4 | 0.3 | 0.03 | 0.03 | -- |
| LAR | 2/13/2007 | Tujunga Wash | Moorpark St. | 117 | -- | -- | 0.8 | 0.6 | 45.20 | 38.60 | -- | -- | 0.390 | 0.410 | 0.89 | 1.03 | -- | -- | 21.0 | 20.0 | 1.90 | 2.30 | -- | -- | 2.98 | 2.34 | 0.2 | 0.2 | 0.17 | 0.3 | -- |
| LAR | 3/13/2007 | Tujunga Wash | Moorpark St. | 206 | -- | -- | 1.8 | 1.8 | 48.90 | 54.30 | -- | -- | ND | ND | 1.83 | 1.57 | -- | -- | 45.0 | 51.0 | 3.00 | 5.40 | -- | -- | 7.40 | 6.98 | 0.4 | 0.3 | 0.03 | 0.03 | -- |
| LAR | 4/10/2007 | Tujunga Wash | Moorpark St. | 210 | -- | -- | 6.2 | 6.4 | 73.90 | 101.00 | -- | -- | ND | 0.700 | 0.61 | 2.32 | -- | -- | 30.0 | 46.0 | 1.80 | 7.00 | -- | -- | 4.24 | 7.12 | 0.3 | 0.3 | 0.66 | 0.62 | -- |
| LAR | 5/15/2007 | Tujunga Wash | Moorpark St. | 279 | -- | -- | 3.9 | 5.1 | 81.20 | 108.00 | -- | -- | ND | 0.460 | 0.68 | 1.56 | -- | -- | 49.0 | 71.0 | ND | 3.80 | -- | -- | 5.47 | 8.94 | 0.2 | 0.2 | 0.32 | 0.33 | -- |
| LAR | 6/12/2007 | Tujunga Wash | Moorpark St. | 142 | -- | -- | 4.0 | 3.5 | 52.40 | 74.20 | -- | -- | 0.420 | 0.540 | 0.25 | 1.30 | -- | -- | 35.0 | 59.0 | 3.10 | 4.80 | -- | -- | 6.04 | 7.23 | -- | -- | 0.28 | 0.22 | -- |
| LAR | 7/10/2007 | Tujunga Wash | Moorpark St. | 171 | -- | -- | 1.0 | 1.1 | 58.10 | 82.90 | -- | -- | 0.480 | 0.470 | 0.72 | 1.46 | -- | -- | 24.0 | 39.0 | 3.40 | 5.10 | -- | -- | 5.57 | 5.96 | 0.4 | 0.6 | 0.03 | 0.03 | -- |
| LAR | 8/14/2007 | Tujunga Wash | Moorpark St. | 239 | -- | -- | 2.4 | 4.1 | 84.80 | 110.00 | -- | -- | ND | ND | 0.52 | 1.45 | -- | -- | 21.0 | 36.0 | ND | 1.80 | -- | -- | 5.65 | 7.14 | 0.3 | 0.4 | 0.03 | 0.03 | -- |
| LAR | 9/11/2007 | Tujunga Wash | Moorpark St. | 171 | -- | -- | 3.0 | 3.2 | 61.50 | 62.20 | -- | -- | ND | ND | 0.51 | 0.55 | -- | -- | 32.0 | 35.0 | 1.10 | 2.10 | -- | -- | 4.78 | 6.70 | 0.2 | 0.1 | 0.03 | 0.03 | -- |
| LAR | 4/29/2008 | Tujunga Wash | Moorpark St. | 210 | -- | -- | 3.6 | 4.8 | 48.90 | 54.90 | -- | -- | 0.106 | 0.046 | 2.94 | 3.04 | -- | -- | 25.0 | 26.3 | 1.88 | 1.71 | -- | -- | 4.18 | 4.40 | 0.4 | 0.4 | 0.04 | 0.04 | -- |
| LAR | 5/13/2008 | Tujunga Wash | Moorpark St. | 156 | -- | -- | 4.6 | 5.2 | 38.50 | 44.00 | -- | -- | 0.010 | 0.010 | 1.62 | 1.70 | -- | -- | 16.5 | 19.2 | 0.84 | 1.48 | -- | -- | 0.10 | 0.10 | 0.3 | 0.2 | 0.04 | 0.04 | -- |
| LAR | 6/17/2008 | Tujunga Wash | Moorpark St. | 247 | -- | -- | 3.5 | 4.1 | 101.00 | 106.00 | -- | -- | 0.010 | 0.010 | 1.17 | 1.39 | -- | -- | 40.8 | 42.2 | 1.50 | 2.01 | -- | -- | 6.95 | 7.47 | 0.4 | 0.4 | 0.04 | 0.04 | -- |
| LAR | 7/15/2008 | Tujunga Wash | Moorpark St. | 171 | -- | -- | 6.1 | 6.3 | 68.60 | 77.10 | -- | -- | 0.010 | 0.010 | 3.70 | 4.37 | -- | -- | 34.7 | 40.7 | 1.50 | 2.47 | -- | -- | 4.97 | 5.47 | 0.4 | 0.4 | 0.04 | 0.091 | -- |
| LAR | 8/12/2008 | Tujunga Wash | Moorpark St. | 161 | -- | -- | 7.1 | 8.4 | 58.10 | 69.20 | -- | -- | 0.010 | 0.010 | 2.69 | 2.85 | -- | -- | 35.3 | 41.4 | 0.93 | 1.73 | -- | -- | 6.10 | 6.18 | 0.3 | 0.3 | 0.04 | 0.194 | -- |

| Thallium (total) | Zinc (dissolved) | Zinc (total) |
|---|---|---|
| ND | ND | 13.0 |
| ND | 4.0 | 11.0 |
| ND | ND | 5.0 |
| ND | 8.0 | 20.0 |
| ND | 4.0 | 58.0 |
| ND | 4.0 | 385.0 |
| ND | 5.0 | 739.0 |
| ND | 12.0 | 44.0 |
| 2.0 | 14.0 | 29.0 |
| ND | AE | 34.0 |
| ND | 27.0 | 57.0 |
| 1.0 | 15.0 | 19.0 |
| ND | 13.0 | 32.0 |
| ND | 20.0 | 56.0 |
| -- | 4.0 | 26.0 |
| -- | 12.0 | 23.0 |
| -- | 9.0 | 37.0 |
| -- | 12.0 | 47.0 |
| -- | 16.0 | 186.0 |
| -- | 21.0 | 84.0 |
| -- | 12.0 | 43.0 |
| -- | 17.0 | 59.0 |
| -- | 22.0 | 84.0 |
| -- | 14.0 | 28.0 |
| -- | 15.0 | 36.0 |
| -- | 22.0 | 30.0 |
| -- | 34.0 | 36.0 |
| -- | 24.0 | 101.0 |
| -- | 63.0 | 163.0 |
| -- | 19.0 | 77.0 |
| -- | 46.0 | 50.0 |
| -- | 16.0 | 74.0 |
| -- | 27.0 | 38.0 |
| -- | 30.3 | 36.6 |
| -- | 14.0 | 23.2 |
| -- | 18.8 | 25.7 |
| -- | 20.3 | 36.9 |
| -- | 12.7 | 24.9 |

**CITY OF LOS ANGELES - DEPARTMENT OF PUBLIC WORKS - BUREAU OF SANITATION**
**WATERSHED PROTECTION DIVISION – POLLUTION ASSESSMENT SECTION**
**Status and Trends Monitoring in L.A. River Tributaries**
**Fecal Indicator Bacteria**

| **Date** | **Weather** | ***Tujunga Wash*** (@ Moorpark St. Overpass) | | |
|---|---|---|---|---|
| m/d/y | Wet/Dry | **Total Coliform** (MPN/100 mL) | ***E. coli*** (MPN/100 mL) | **Enterococcus** (MPN/100 mL) |
| 1/10/2002 | Dry | 110,000 | 73,000 | 16,000 |
| 1/24/2002 | Dry | 4,000 | 630 | 440 |
| 2/14/2002 | Dry | 2,500 | 200 | 110 |
| 3/14/2002 | Dry | 3,200 | 300 | 750 |
| 4/11/2002 | Dry | 12,000 | 630 | 540 |
| 5/16/2002 | Dry | 34,000 | 2,600 | 4,600 |
| 6/13/2002 | Dry | 140,000 | 2,700 | 6,900 |
| 7/11/2002 | Dry | 13,000 | 310 | 140 |
| 8/15/2002 | Dry | > **240,000** | 7,400 | > **24,000** |
| 9/12/2002 | Dry | > **240,000** | 1,200 | 3,600 |
| 10/10/2002 | Dry | 12,000 | 200 | 1,100 |
| 11/14/2002 | Dry | 6,300 | 410 | 590 |
| 12/20/2002 | Wet | 170,000 | 14,000 | 24,000 |
| 1/16/2003 | Dry | 13,000 | 310 | 750 |
| 2/13/2003 | Wet | 39,000 | 92,000 | AE |
| 3/13/2003 | Dry | 19,000 | 200 | 230 |
| 4/10/2003 | Dry | 65,000 | 1,400 | 1,200 |
| 5/15/2003 | Dry | 12,000 | 750 | 1,000 |
| 6/12/2003 | Dry | 240,000 | 4,100 | 1,900 |
| 7/9/2003 | Dry | > **240,000** | 7,900 | 5,500 |
| 8/20/2003 | Dry | > **240,000** | 3,600 | 5,500 |
| 9/11/2003 | Dry | > **240,000** | 1,900 | 700 |
| 10/15/2003 | Dry | 73,000 | 1,400 | 880 |
| 11/5/2003 | Wet | 11,000 | 310 | 86 |
| 12/11/2003 | Dry | 13,000 | 200 | 130 |
| 1/15/2004 | Dry | 410 | < ***100*** | AE |
| 2/12/2004 | Dry | 1,700 | 100 | 200 |
| 3/9/2004 | Dry | 65,000 | 300 | 220 |
| 4/13/2004 | Dry | 73,000 | 2,900 | 1,200 |
| 5/11/2004 | Dry | 92,000 | 1,500 | 1,700 |
| 6/15/2004 | Dry | > **240,000** | 10,000 | 3,200 |
| 7/28/2004 | Dry | > **240,000** | 6,800 | 6,900 |
| 8/17/2004 | Dry | > **240,000** | 2,600 | 3,800 |
| 9/14/2004 | Dry | > **240,000** | 980 | 1,400 |
| 10/19/2004 | Wet | > **240,000** | 61,000 | > **24,000** |
| 11/16/2004 | Dry | 10,000 | 740 | 390 |
| 12/21/2004 | Dry | 7,100 | 520 | 220 |
| 1/18/2005 | Dry | 6,200 | < ***100*** | 31 |
| 2/15/2005 | Wet | 28,000 | < ***100*** | 41 |
| 3/15/2005 | Dry | 200 | < ***100*** | < ***10*** |
| 4/19/2005 | Dry | 7,500 | 1,400 | 52 |
| 5/17/2005 | Dry | 31,000 | < ***100*** | 160 |
| 6/7/2005 | Dry | 92,000 | 1,900 | 3,000 |
| 7/12/2005 | Dry | > **240,000** | 20,000 | 20,000 |
| 8/9/2005 | Dry | 87,000 | 520 | 180 |
| 9/13/2005 | Dry | 200,000 | 310 | 41 |
| 10/11/2005 | Dry | > **240,000** | 1,100 | 400 |
| 11/8/2005 | Dry | 7,300 | 310 | 200 |
| 12/14/2005 | Dry | 8,100 | < ***100*** | 250 |
| 1/17/2006 | Wet | 2,000 | < ***100*** | 140 |
| 2/14/2006 | Dry | 5,200 | 300 | 240 |
| 3/21/2006 | Wet | 5,300 | < ***100*** | 31 |
| 4/25/2006 | Dry | 7,300 | < ***100*** | 2,100 |
| 5/16/2006 | Dry | 4,200 | 410 | 190 |
| 6/13/2006 | Dry | > **240,000** | 200 | 130 |
| 7/10/2006 | Dry | > **240,000** | 300 | 780 |
| 8/15/2006 | Dry | > **240,000** | 1,400 | 3,000 |
| 9/12/2006 | Dry | 5,300 | < ***100*** | 170 |
| 10/10/2006 | Dry | 100,000 | 1,500 | 720 |
| 11/14/2006 | Dry | 26,000 | 6,000 | 250 |
| 12/12/2006 | Wet | 200,000 | 1,300 | 280 |
| 1/16/2007 | Dry | 3,100 | 100 | 10 |
| 2/13/2007 | Wet | 7,700 | 410 | 85 |
| 3/13/2007 | Dry | 520 | < ***100*** | 120 |
| 4/10/2007 | Dry | 16,000 | 850 | 150 |
| 5/15/2007 | Dry | > **240,000** | 4,400 | 2,500 |
| 6/12/2007 | Dry | 240,000 | 520 | 230 |
| 7/10/2007 | Dry | > **240,000** | 1,600 | 540 |
| 8/14/2007 | Dry | > **240,000** | 1,600 | 590 |
| 9/11/2007 | Dry | 240,000 | 1,300 | 220 |
| 8/12/2008 | Dry | > **240,000** | 3,400 | 2,900 |
| 9/23/2008 | Dry | > **240,000** | 860 | 500 |

# CITY OF LOS ANGELES - BUREAU OF SANITATION
## WATERSHED PROTECTION DIVISION
## LOS ANGELES RIVER METALS TMDL
## MONTHLY MONITORING OF METALS AT LOS ANGELES RIVER STATIONS
## DRY-WEATHER GRAB SAMPLES

CITY OF LOS ANGELES - BUREAU OF SANITATION
WATERSHED PROTECTION DIVISION
LOS ANGELES RIVER METALS TMDL
DRY-WEATHER GRAB SAMPLES

| SAMPLE DATE | LOCATION | WATERBODY | CONSTITUENT | METHOD | UNITS | RESULT | BASE | QUAL | MDL | RML | ML |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/7/2008 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 219 | 219 | | | | |
| 10/7/2008 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 34 | 34 | | 0.08 | 2.5 | 0.5 |
| 10/7/2008 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 34.3 | 34.3 | | 0.08 | 2.5 | 0.5 |
| 10/7/2008 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 0.39 | | 0.11 | 2.5 | 0.5 |
| 10/7/2008 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.26 | | 0.11 | 2.5 | 0.5 |
| 10/7/2008 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 23.2 | 23.2 | | 0.4 | 5 | 1 |
| 10/7/2008 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 22.3 | 22.3 | | 0.4 | 5 | 1 |
| 11/12/2008 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 175 | 175 | | | | |
| 11/12/2008 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 19.1 | 19.1 | | 0.08 | 2.5 | 0.5 |
| 11/12/2008 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 23.4 | 23.4 | | 0.08 | 2.5 | 0.5 |
| 11/12/2008 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 0.98 | | 0.11 | 2.5 | 0.5 |
| 11/12/2008 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.52 | | 0.11 | 2.5 | 0.5 |
| 11/12/2008 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 18.6 | 18.6 | | 0.4 | 5 | 1 |
| 11/12/2008 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 12.7 | 12.7 | | 0.4 | 5 | 1 |
| 12/9/2008 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 299 | 299 | | | | |
| 12/9/2008 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 27.8 | 27.8 | | 0.08 | 2.5 | 0.5 |
| 12/9/2008 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 24.1 | 24.1 | | 0.08 | 2.5 | 0.5 |
| 12/9/2008 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | ND | 0.055 | < | 0.11 | 2.5 | 0.5 |
| 12/9/2008 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | ND | 0.055 | < | 0.11 | 2.5 | 0.5 |
| 12/9/2008 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 11.1 | 11.1 | | 0.4 | 5 | 1 |
| 12/9/2008 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 9.53 | 9.53 | | 0.4 | 5 | 1 |
| 1/13/2009 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 215 | 215 | | | | |
| 1/13/2009 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 11.6 | 11.6 | | 0.08 | 2.5 | 0.5 |
| 1/13/2009 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 11.1 | 11.1 | | 0.08 | 2.5 | 0.5 |
| 1/13/2009 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 0.19 | | 0.11 | 2.5 | 0.5 |
| 1/13/2009 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | ND | 0.055 | < | 0.11 | 2.5 | 0.5 |
| 1/13/2009 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 19.2 | 19.2 | | 0.4 | 5 | 1 |
| 1/13/2009 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 18.5 | 18.5 | | 0.4 | 5 | 1 |
| 4/14/2009 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | | mg/L | 305 | 305 | | 0.05 | 0.4 | 0.2 |
| 4/14/2009 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 143 | 143 | | 0.08 | 2.5 | 0.5 |
| 4/14/2009 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | AE | AE | | 0.08 | 2.5 | 0.5 |
| 4/14/2009 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 671 | 671 | | 0.11 | 2.5 | 0.5 |



Legend: ND - Not Detected    DNQ - Detected, but Not Quantified    .

# CITY OF LOS ANGELES - BUREAU OF SANITATION
# WATERSHED PROTECTION DIVISION
# LOS ANGELES RIVER METALS TMDL
# MONTHLY MONITORING OF METALS AT LOS ANGELES RIVER STATIONS
# DRY-WEATHER GRAB SAMPLES

| SAMPLE DATE | LOCATION | WATERBODY | CONSTITUENT | METHOD | UNITS | RESULT | BASE | QUAL | MDL | RML | ML |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4/14/2009 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | AE | AE | | 0.11 | 2.5 | 0.5 |
| 4/14/2009 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 868 | 868 | | 0.4 | 5 | 1 |
| 4/14/2009 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | AE | AE | | 0.4 | 5 | 1 |
| 5/12/2009 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 253 | 253 | | | | |
| 5/12/2009 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 17.9 | 17.9 | | 0.08 | 2.5 | 0.5 |
| 5/12/2009 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 16.8 | 16.8 | | 0.08 | 2.5 | 0.5 |
| 5/12/2009 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 1 | | 0.11 | 2.5 | 0.5 |
| 5/12/2009 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.69 | | 0.11 | 2.5 | 0.5 |
| 5/12/2009 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 11.8 | 11.8 | | 0.4 | 5 | 1 |
| 5/12/2009 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 11.2 | 11.2 | | 0.4 | 5 | 1 |
| 6/8/2009 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 149 | 149 | | | | |
| 6/8/2009 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 13.2 | 13.2 | | 0.08 | 2.5 | 0.5 |
| 6/8/2009 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 12 | 12 | | 0.08 | 2.5 | 0.5 |
| 6/8/2009 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 0.43 | | 0.11 | 2.5 | 0.5 |
| 6/8/2009 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.17 | | 0.11 | 2.5 | 0.5 |
| 6/8/2009 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 6.64 | 6.64 | | 0.4 | 5 | 1 |
| 6/8/2009 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 5.5 | 5.5 | | 0.4 | 5 | 1 |
| 7/6/2009 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | | mg/L | 215 | 215 | | | | |
| 7/6/2009 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 29.6 | 29.6 | | 0.08 | 2.5 | 0.5 |
| 7/6/2009 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 24.8 | 24.8 | | 0.08 | 2.5 | 0.5 |
| 7/6/2009 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 1.47 | | 0.11 | 2.5 | 0.5 |
| 7/6/2009 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.85 | | 0.11 | 2.5 | 0.5 |
| 7/6/2009 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 20 | 20 | | 0.4 | 5 | 1 |
| 7/6/2009 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 11.3 | 11.3 | | 0.4 | 5 | 1 |
| 8/3/2009 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | | mg/L | 249 | 249 | | | | |
| 8/3/2009 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 16.6 | 16.6 | | 0.08 | 2.5 | 0.5 |
| 8/3/2009 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 14 | 14 | | 0.08 | 2.5 | 0.5 |
| 8/3/2009 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 2.68 | 2.68 | | 0.11 | 2.5 | 0.5 |
| 8/3/2009 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.69 | | 0.11 | 2.5 | 0.5 |
| 8/3/2009 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 4.19 | | 0.4 | 5 | 1 |
| 8/3/2009 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | ND | 0.2 | < | 0.4 | 5 | 1 |
| 9/14/2009 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 232 | 232 | | | | |
| 9/14/2009 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 25.5 | 25.5 | | 0.08 | 2.5 | 0.5 |
| 9/14/2009 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 17.9 | 17.9 | | 0.08 | 2.5 | 0.5 |
| 9/14/2009 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 1.11 | | 0.11 | 2.5 | 0.5 |
| 9/14/2009 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.62 | | 0.11 | 2.5 | 0.5 |
| 9/14/2009 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 13.4 | 13.4 | | 0.4 | 5 | 1 |
| 9/14/2009 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 11.2 | 11.2 | | 0.4 | 5 | 1 |



Legend: ND - Not Detected DNQ - Detected, but Not Quantified .

# CITY OF LOS ANGELES - BUREAU OF SANITATION
## WATERSHED PROTECTION DIVISION
## LOS ANGELES RIVER METALS TMDL
## MONTHLY MONITORING OF METALS AT LOS ANGELES RIVER STATIONS
## DRY-WEATHER GRAB SAMPLES

| SAMPLE DATE | LOCATION | WATERBODY | CONSTITUENT | METHOD | UNITS | RESULT | BASE | QUAL | MDL | RML | ML |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/16/2009 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 218 | 218 | | | | |
| 11/16/2009 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 56 | 56 | | 0.08 | 2.5 | 0.5 |
| 11/16/2009 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 47.4 | 47.4 | | 0.08 | 2.5 | 0.5 |
| 11/16/2009 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 1.4 | | 0.11 | 2.5 | 0.5 |
| 11/16/2009 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.74 | | 0.11 | 2.5 | 0.5 |
| 11/16/2009 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 59.4 | 59.4 | | 0.4 | 5 | 1 |
| 11/16/2009 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 53.3 | 53.3 | | 0.4 | 5 | 1 |
| 1/5/2010 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 260 | 260 | | | | |
| 1/5/2010 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 16 | 16 | | 0.08 | 2.5 | 0.5 |
| 1/5/2010 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 16 | 16 | | 0.08 | 2.5 | 0.5 |
| 1/5/2010 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 0.33 | | 0.11 | 2.5 | 0.5 |
| 1/5/2010 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.18 | | 0.11 | 2.5 | 0.5 |
| 1/5/2010 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 11.3 | 11.3 | | 0.4 | 5 | 1 |
| 1/5/2010 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 11.9 | 11.9 | | 0.4 | 5 | 1 |
| 5/10/2010 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 207 | 207 | | | | |
| 5/10/2010 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 24.3 | 24.3 | | 0.08 | 2.5 | 0.5 |
| 5/10/2010 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 21.3 | 21.3 | | 0.08 | 2.5 | 0.5 |
| 5/10/2010 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 0.51 | | 0.11 | 2.5 | 0.5 |
| 5/10/2010 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.24 | | 0.11 | 2.5 | 0.5 |
| 5/10/2010 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 11.9 | 11.9 | | 0.4 | 5 | 1 |
| 5/10/2010 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 8.84 | 8.84 | | 0.4 | 5 | 1 |
| 6/7/2010 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 217 | 217 | | | | |
| 6/7/2010 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 27.8 | 27.8 | | 0.08 | 1.2 | 0.5 |
| 6/7/2010 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 25.5 | 25.5 | | 0.08 | 1.2 | 0.5 |
| 6/7/2010 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 6.12 | 6.12 | | 0.11 | 1.2 | 0.5 |
| 6/7/2010 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | 5.96 | 5.96 | | 0.11 | 1.2 | 0.5 |
| 6/7/2010 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 14.4 | 14.4 | | 0.4 | 2.5 | 1 |
| 6/7/2010 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 11 | 11 | | 0.4 | 2.5 | 1 |
| 7/19/2010 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 124 | 124 | | | | |
| 7/19/2010 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 52.5 | 52.5 | | 0.09 | 1.2 | 0.5 |
| 7/19/2010 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 48 | 48 | | 0.09 | 1.2 | 0.5 |
| 7/19/2010 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 1.27 | 1.27 | | 0.06 | 1.2 | 0.5 |
| 7/19/2010 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.75 | | 0.06 | 1.2 | 0.5 |
| 7/19/2010 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 21.9 | 21.9 | | 0.2 | 2.5 | 1 |
| 7/19/2010 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 6.87 | 6.87 | | 0.2 | 2.5 | 1 |
| 8/23/2010 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 164 | 164 | | | | |
| 8/23/2010 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 46 | 46 | | 0.09 | 1.2 | 0.5 |
| 8/23/2010 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 42.5 | 42.5 | | 0.09 | 1.2 | 0.5 |



Legend: ND - Not Detected DNQ - Detected, but Not Quantified .

## CITY OF LOS ANGELES - BUREAU OF SANITATION
## WATERSHED PROTECTION DIVISION
## LOS ANGELES RIVER METALS TMDL
## MONTHLY MONITORING OF METALS AT LOS ANGELES RIVER STATIONS
## DRY-WEATHER GRAB SAMPLES

| SAMPLE DATE | LOCATION | WATERBODY | CONSTITUENT | METHOD | UNITS | RESULT | BASE | QUAL | MDL | RML | ML |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/23/2010 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 0.95 | | 0.06 | 1.2 | 0.5 |
| 8/23/2010 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.52 | | 0.06 | 1.2 | 0.5 |
| 8/23/2010 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 8.76 | 8.76 | | 0.2 | 2.5 | 1 |
| 8/23/2010 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 5.06 | 5.06 | | 0.2 | 2.5 | 1 |
| 9/20/2010 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 264 | 264 | | | | |
| 9/20/2010 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 25 | 25 | | 0.09 | 1.2 | 0.5 |
| 9/20/2010 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 22.7 | 22.7 | | 0.09 | 1.2 | 0.5 |
| 9/20/2010 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 0.84 | | 0.06 | 1.2 | 0.5 |
| 9/20/2010 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.5 | | 0.06 | 1.2 | 0.5 |
| 9/20/2010 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 14.4 | 14.4 | | 0.2 | 2.5 | 1 |
| 9/20/2010 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 10.7 | 10.7 | | 0.2 | 2.5 | 1 |
| 4/12/2011 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 136 | 136 | | | | |
| 4/12/2011 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 2.27 | 2.27 | | 0.09 | 1.2 | 0.5 |
| 4/12/2011 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 1.79 | 1.79 | | 0.09 | 1.2 | 0.5 |
| 4/12/2011 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 0.58 | | 0.06 | 1.2 | 0.5 |
| 4/12/2011 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.06 | | 0.06 | 1.2 | 0.5 |
| 4/12/2011 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 1.96 | | 0.2 | 2.5 | 1 |
| 4/12/2011 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.45 | | 0.2 | 2.5 | 1 |
| 6/20/2011 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 149 | 149 | | | | |
| 6/20/2011 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 26.7 | 26.7 | | 0.09 | 1.2 | 0.5 |
| 6/20/2011 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 24.4 | 24.4 | | 0.09 | 1.2 | 0.5 |
| 6/20/2011 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 1.2 | 1.2 | | 0.06 | 1.2 | 0.5 |
| 6/20/2011 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.77 | | 0.06 | 1.2 | 0.5 |
| 6/20/2011 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 20 | 20 | | 0.2 | 2.5 | 1 |
| 6/20/2011 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 12.4 | 12.4 | | 0.2 | 2.5 | 1 |
| 7/18/2011 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 173 | 173 | | | | |
| 7/18/2011 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 20.8 | 20.8 | | 0.04 | 0.5 | 0.5 |
| 7/18/2011 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 11 | 11 | | 0.04 | 0.5 | 0.5 |
| 7/18/2011 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 4.1 | 4.1 | | 0.01 | 0.5 | 0.5 |
| 7/18/2011 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.4 | | 0.01 | 0.5 | 0.5 |
| 7/18/2011 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 52.1 | 52.1 | | 0.15 | 1 | 1 |
| 7/18/2011 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 5.68 | 5.68 | | 0.15 | 1 | 1 |
| 8/29/2011 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 129 | 129 | | | | |
| 8/29/2011 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 327 | 327 | | 0.04 | 0.5 | 0.5 |
| 8/29/2011 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 305 | 305 | | 0.04 | 0.5 | 0.5 |
| 8/29/2011 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 1.88 | 1.88 | | 0.01 | 0.5 | 0.5 |
| 8/29/2011 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | 1.01 | 1.01 | | 0.01 | 0.5 | 0.5 |
| 8/29/2011 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 32.2 | 32.2 | | 0.15 | 1 | 1 |



Legend: ND - Not Detected DNQ - Detected, but Not Quantified .

**CITY OF LOS ANGELES - BUREAU OF SANITATION**
**WATERSHED PROTECTION DIVISION**
**LOS ANGELES RIVER METALS TMDL**
**MONTHLY MONITORING OF METALS AT LOS ANGELES RIVER STATIONS**
**DRY-WEATHER GRAB SAMPLES**

| SAMPLE DATE | LOCATION | WATERBODY | CONSTITUENT | METHOD | UNITS | RESULT | BASE | QUAL | MDL | RML | ML |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/29/2011 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 20.6 | 20.6 | | 0.15 | 1 | 1 |
| 9/26/2011 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 180 | 180 | | | | |
| 9/26/2011 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 25.8 | 25.8 | | 0.04 | 0.5 | 0.5 |
| 9/26/2011 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 21.3 | 21.3 | | 0.04 | 0.5 | 0.5 |
| 9/26/2011 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 0.7 | 0.7 | | 0.01 | 0.5 | 0.5 |
| 9/26/2011 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.4 | | 0.01 | 0.5 | 0.5 |
| 9/26/2011 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 14 | 14 | | 0.15 | 1 | 1 |
| 9/26/2011 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 9.68 | 9.68 | | 0.15 | 1 | 1 |
| 10/24/2011 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 155 | 155 | | | | |
| 10/24/2011 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 50.9 | 50.9 | | 0.09 | 1.2 | 0.5 |
| 10/24/2011 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 26 | 26 | | 0.09 | 1.2 | 0.5 |
| 10/24/2011 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 7.26 | 7.26 | | 0.06 | 1.2 | 0.5 |
| 10/24/2011 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.37 | | 0.06 | 1.2 | 0.5 |
| 10/24/2011 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 115 | 115 | | 0.2 | 2.5 | 1 |
| 10/24/2011 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 22.5 | 22.5 | | 0.2 | 2.5 | 1 |
| 2/28/2012 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 90.4 | 90.4 | | | | |
| 2/28/2012 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 6.92 | 6.92 | | 0.04 | 0.5 | 0.5 |
| 2/28/2012 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 5.84 | 5.84 | | 0.04 | 0.5 | 0.5 |
| 2/28/2012 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | DNQ | 0.38 | | 0.01 | 0.5 | 0.5 |
| 2/28/2012 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.21 | | 0.01 | 0.5 | 0.5 |
| 2/28/2012 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 10.6 | 10.6 | | 0.15 | 1 | 1 |
| 2/28/2012 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 8.13 | 8.13 | | 0.15 | 1 | 1 |
| 5/21/2012 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 161 | 161 | | | | |
| 5/21/2012 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 35.1 | 35.1 | | 0.04 | 0.5 | 0.5 |
| 5/21/2012 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 31.8 | 31.8 | | 0.04 | 0.5 | 0.5 |
| 5/21/2012 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 0.74 | 0.74 | | 0.01 | 0.5 | 0.5 |
| 5/21/2012 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | DNQ | 0.44 | | 0.01 | 0.5 | 0.5 |
| 5/21/2012 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 17.8 | 17.8 | | 0.15 | 1 | 1 |
| 5/21/2012 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 12.4 | 12.4 | | 0.15 | 1 | 1 |
| 6/18/2012 | LAR 1-3 | Tujunga Wash | TOTAL HARDNESS | EPA 200.7 | mg/L | 285 | 285 | | | | |
| 6/18/2012 | LAR 1-3 | Tujunga Wash | COPPER (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 29.2 | 29.2 | | 0.04 | 0.5 | 0.5 |
| 6/18/2012 | LAR 1-3 | Tujunga Wash | COPPER (DISSOLVED) | EPA 200.8 | ug/L | 26.6 | 26.6 | | 0.04 | 0.5 | 0.5 |
| 6/18/2012 | LAR 1-3 | Tujunga Wash | LEAD (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 0.97 | 0.97 | | 0.01 | 0.5 | 0.5 |
| 6/18/2012 | LAR 1-3 | Tujunga Wash | LEAD (DISSOLVED) | EPA 200.8 | ug/L | 0.6 | 0.6 | | 0.01 | 0.5 | 0.5 |
| 6/18/2012 | LAR 1-3 | Tujunga Wash | ZINC (TOTAL RECOVERABLE) | EPA 200.8 | ug/L | 16.1 | 16.1 | | 0.15 | 1 | 1 |
| 6/18/2012 | LAR 1-3 | Tujunga Wash | ZINC (DISSOLVED) | EPA 200.8 | ug/L | 11.2 | 11.2 | | 0.15 | 1 | 1 |



Legend: ND - Not Detected DNQ - Detected, but Not Quantified .

# CITY OF LOS ANGELES - BUREAU OF SANITATION
## WATERSHED PROTECTION DIVISION
## LOS ANGELES RIVER METALS TMDL
## MONTHLY MONITORING OF METALS AT LOS ANGELES RIVER STATIONS
## DRY-WEATHER GRAB SAMPLES

| |
|---|
| |
| |
| |
| |
| **SAMPLE_ID** |
| HT123065-5 |
| HT123065-5 |
| HT123065-5 |
| HT123065-5 |
| HT123065-5 |
| HT123065-5 |
| HT123065-5 |
| HT124352-3 |
| HT124352-3 |
| HT124352-3 |
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| HT125395-5 |
| HT125395-5 |
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| HT125395-5 |
| HT125395-5 |
| HT125395-5 |
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| HT126615-6 |
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| HT126615-6 |
| HT126615-6 |
| HT126615-6 |
| HT126615-6 |
| HT126615-6 |
| HT129868-3 |
| HT129868-3 |
| HT129868-3 |
| HT129868-3 |



Legend: ND - Not Detected DNQ - Detected, but Not Quantified .

CITY OF LOS ANGELES - BUREAU OF SANITATION
WATERSHED PROTECTION DIVISION
LOS ANGELES RIVER METALS TMDL
MONTHLY MONITORING OF METALS AT LOS ANGELES RIVER STATIONS
DRY-WEATHER GRAB SAMPLES

| SAMPLE_ID |
|---|
| HT129868-3 |
| HT129868-3 |
| HT129868-3 |
| HT130856-4 |
| HT130856-4 |
| HT130856-4 |
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| HT135158-3 |
| HT135158-3 |
| HT135158-3 |
| HT135158-3 |
| HT135158-3 |
| HT135158-3 |
| HT135158-3 |



Legend: ND - Not Detected DNQ - Detected, but Not Quantified .

CITY OF LOS ANGELES - BUREAU OF SANITATION
WATERSHED PROTECTION DIVISION
LOS ANGELES RIVER METALS TMDL
MONTHLY MONITORING OF METALS AT LOS ANGELES RIVER STATIONS
DRY-WEATHER GRAB SAMPLES

| SAMPLE_ID |
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| HT145550-3 |
| HT145550-3 |
| HT145550-3 |
| HT146752-3 |
| HT146752-3 |
| HT146752-3 |



Legend: ND - Not Detected DNQ - Detected, but Not Quantified .

# CITY OF LOS ANGELES - BUREAU OF SANITATION
# WATERSHED PROTECTION DIVISION
# LOS ANGELES RIVER METALS TMDL
# MONTHLY MONITORING OF METALS AT LOS ANGELES RIVER STATIONS
# DRY-WEATHER GRAB SAMPLES

| SAMPLE_ID |
|---|
| HT146752-3 |
| HT146752-3 |
| HT146752-3 |
| HT146752-3 |
| HT147766-3 |
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| HT159923-3 |
| HT159923-3 |
| HT159923-3 |
| HT159923-3 |
| HT159923-3 |
| HT159923-3 |



Legend: ND - Not Detected    DNQ - Detected, but Not Quantified    .

**CITY OF LOS ANGELES - BUREAU OF SANITATION**
**WATERSHED PROTECTION DIVISION**
**LOS ANGELES RIVER METALS TMDL**
**MONTHLY MONITORING OF METALS AT LOS ANGELES RIVER STATIONS**
**DRY-WEATHER GRAB SAMPLES**

| SAMPLE_ID |
|---|
| HT159923-3 |
| HT160964-3 |
| HT160964-3 |
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| HT161933-3 |
| HT166350-3 |
| HT166350-3 |
| HT166350-3 |
| HT166350-3 |
| HT166350-3 |
| HT166350-3 |
| HT166350-3 |
| HT169169-3 |
| HT169169-3 |
| HT169169-3 |
| HT169169-3 |
| HT169169-3 |
| HT169169-3 |
| HT169169-3 |
| HT170062-3 |
| HT170062-3 |
| HT170062-3 |
| HT170062-3 |
| HT170062-3 |
| HT170062-3 |
| HT170062-3 |



Legend: ND - Not Detected DNQ - Detected, but Not Quantified .

# Appendix 7-H: Peck Water Conservation Improvements Supporting Documents

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**GROUNDWATER ASSESSMENT STUDY**
**METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA**

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|---|---|

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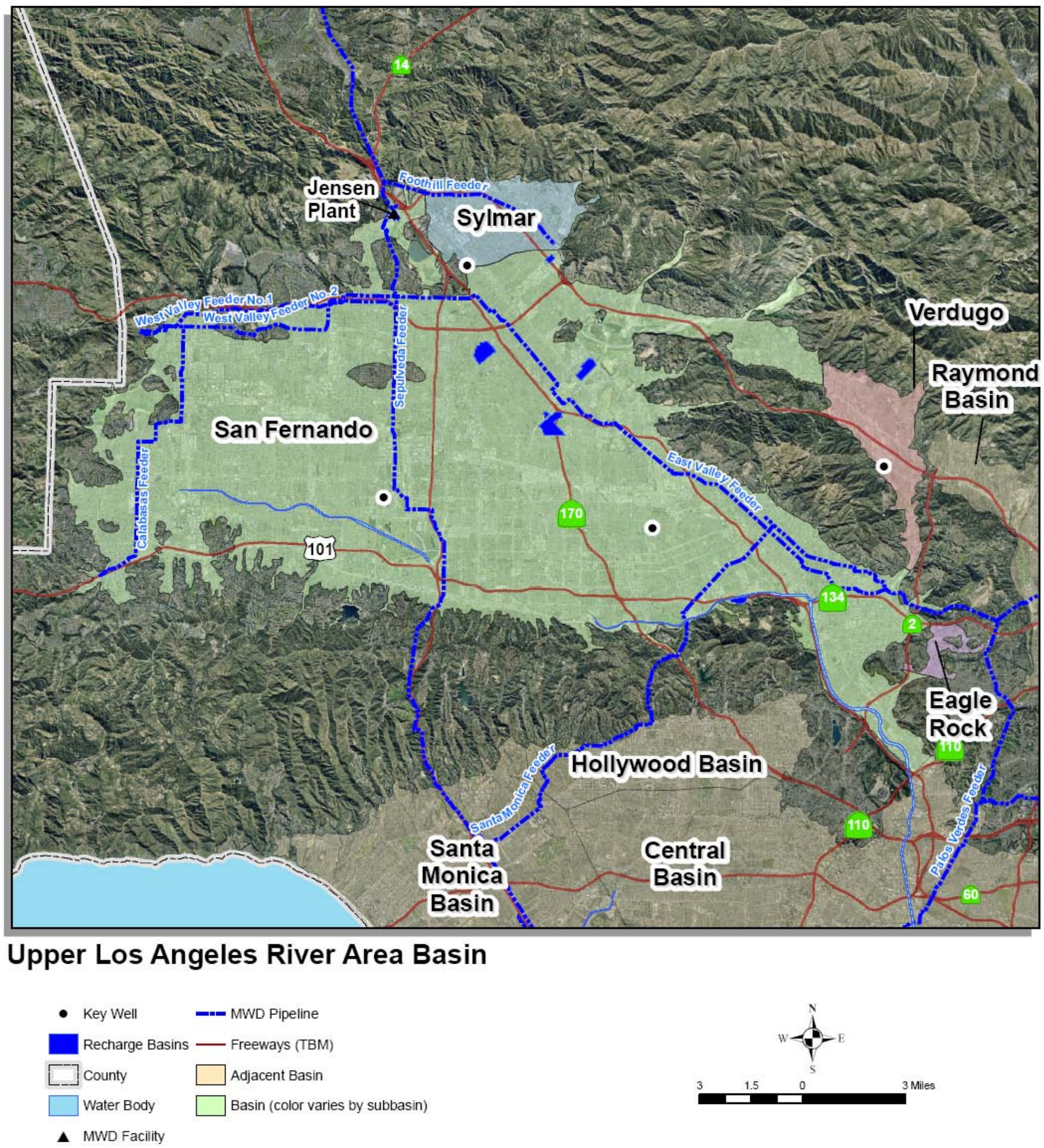
**APPENDICES**

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

**Figure 2-1**
**Map of the ULARA Basins**



## BASIN CHARACTERIZATION

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

### Basin Producing Zones and Storage Capacity

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

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

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

### Safe Yield/Long Term Balance of Recharge and Discharge

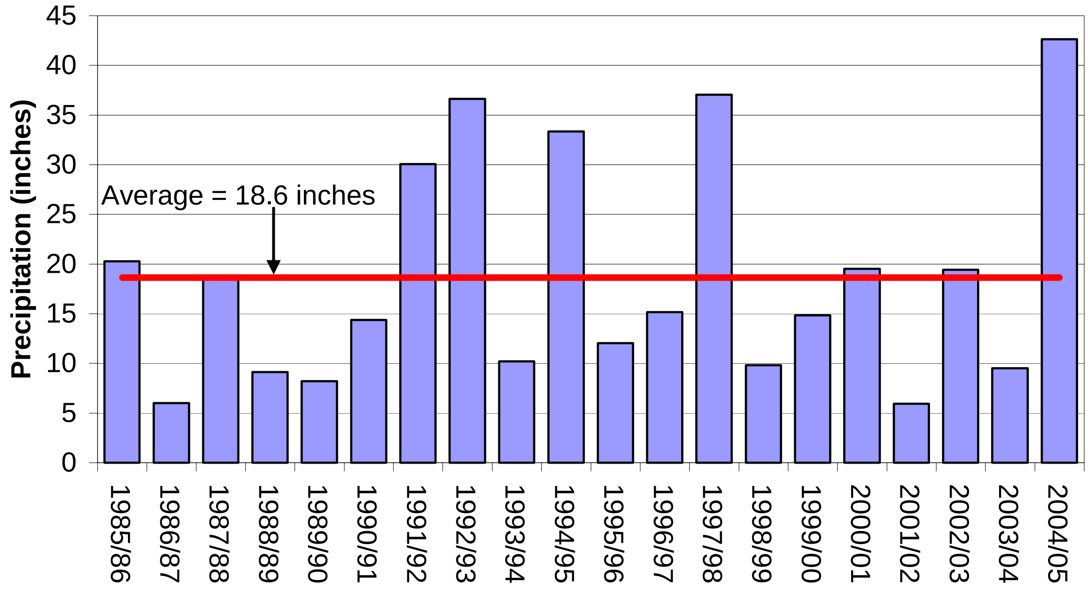
The primary inflows to the ULARA groundwater basins are imported water and natural precipitation and runoff during the rain season. Because the runoff is seasonal in nature, natural recharge is limited. **Figure 2-2** provides the historical precipitation data from the San Fernando Basin between the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

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

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

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

**Figure 2-2**
**Historical Precipitation in the ULARA Basins**

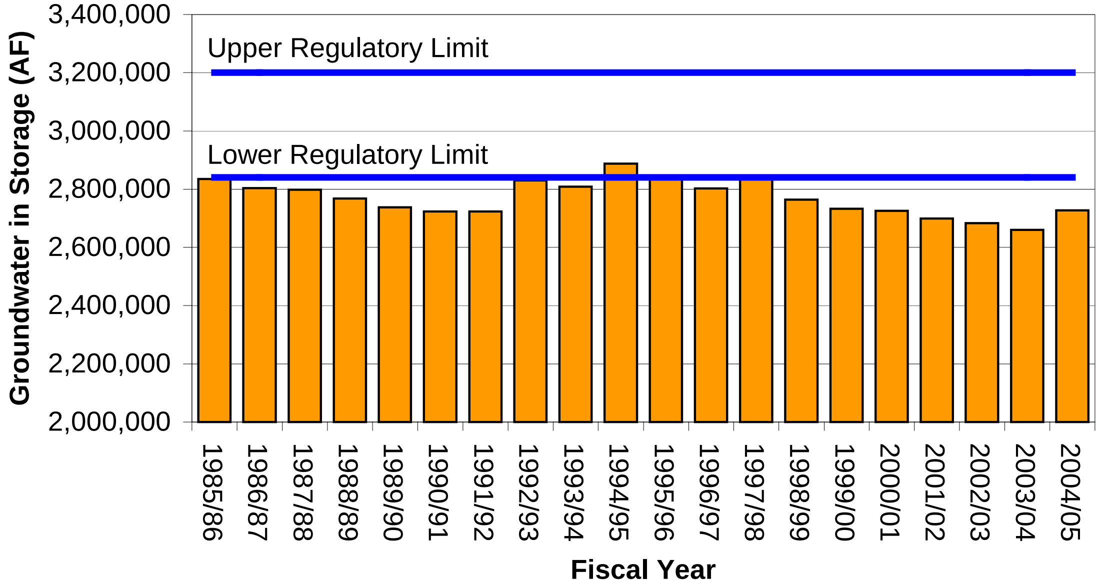



Source: ULARA, 2006

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

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

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




## GROUNDWATER MANAGEMENT

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

### Basin Governance

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

The 1979 Judgment upheld the Pueblo Water Rights of the city of Los Angeles to all groundwater in the San Fernando Basin derived from precipitation within the ULARA and all surface and groundwater underflows from the Sylmar and Verdugo basins (Watermaster, 2005). Furthermore the cities of Burbank, Glendale and Los Angeles were given rights to all San Fernando groundwater derived from water imported by these cities from outside the ULARA and either spread or delivered within the San Fernando Basin. Return credits are granted in the San Fernando Basin. The city of San Fernando was not granted return flow rights in the San Fernando Basin because they where not able to import water until becoming a member of Metropolitan in 1971. The Judgment also contains provisions and stipulations regarding storage of water, stored water credit and arrangements for physical solution water for certain parties (Watermaster, 2006a). There are no storage rights in either the Verdugo or the Eagle Rock Basins.

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

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

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

### Interactions with Adjoining Basins

Groundwater outflow from the Verdugo Basin into the San Fernando Basin occurs beneath Verdugo Wash at the extreme eastern edge of the ULARA. Groundwater outflow from the ULARA occurs through the Los Angeles River Narrows in the southeast corner of the San Fernando Basin where approximately 400 AF of underflow passes downstream into the Central Basin. In addition, approximately 2,000 to 4,000 AFY of rising groundwater leaves the San Fernando Basin as surface flow into the Central Basin (Watermaster, 2007). An average of about 300 to 400 AF of underflow passes into the Raymond Basin from the Verdugo Basin (DWR, 2004 and Geomatrix, 2005). These flows are accounted for in each basin's adjudication so there are no separate agreements regarding these flows.

## WATER SUPPLY FACILITIES AND OPERATIONS

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

### Active Production Wells

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

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

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

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

**U.S. Environmental Protection Agency**

# Los Angeles Area Lakes TMDLs
*March 2012*

***Section 4 Peck Road Park Lake TMDLs***

# 4 Peck Road Park Lake TMDLs

Peck Road Park Lake (#CAL4053100020000303195323) is listed as impaired for chlordane, DDT, eutrophication (originally on the consent decree, but not on current 303(d) list), lead, odor, organic enrichment/ low dissolved oxygen, and trash (SWRCB, 2010). In addition, dieldrin and PCB impairments have been identified by new data analyses since the 2008-2010 303(d) list data cut off. This section of the TMDL report describes the impairments and the TMDLs developed to address them: nutrients (see Section 4.2), organochlorine (OC) pesticides and PCBs (Sections 4.4 through 4.7), and trash (Section 4.8). Nutrient TMDLs are identified here based on existing conditions since nitrogen and phosphorus levels are achieving the chlorophyll *a* target level. Comparison of metals data to their associated hardness-dependent water quality objectives indicates that lead is currently achieving numeric targets at Peck Road Park Lake; therefore, a TMDL is not included for this pollutant. Analyses for lead are presented below (Section 4.3).

## 4.1 Environmental Setting

Peck Road Park Lake is located in the Los Angeles River Basin (HUC 18070105) in the city of Arcadia (Figure 4-1). The lake was originally a gravel pit that was converted to a lake and park in 1975 by the Los Angeles County Parks and Recreation Department (Figure 4-2). Recreation is primarily limited to fishing; trout are periodically stocked by the California Department of Fish and Game (CDFG, 2009). Visitors are not allowed to boat or swim in the lake. Bird feeding is another recreational activity at Peck Road Park Lake. While no bird feeding has been observed during recent fieldwork, birds do feed from trash cans and food litter at the park. The Arcadia Golf Course is located on the northwest shoreline and a recreational path encircles the lake. Restrooms in the park are connected to the city sewer system.

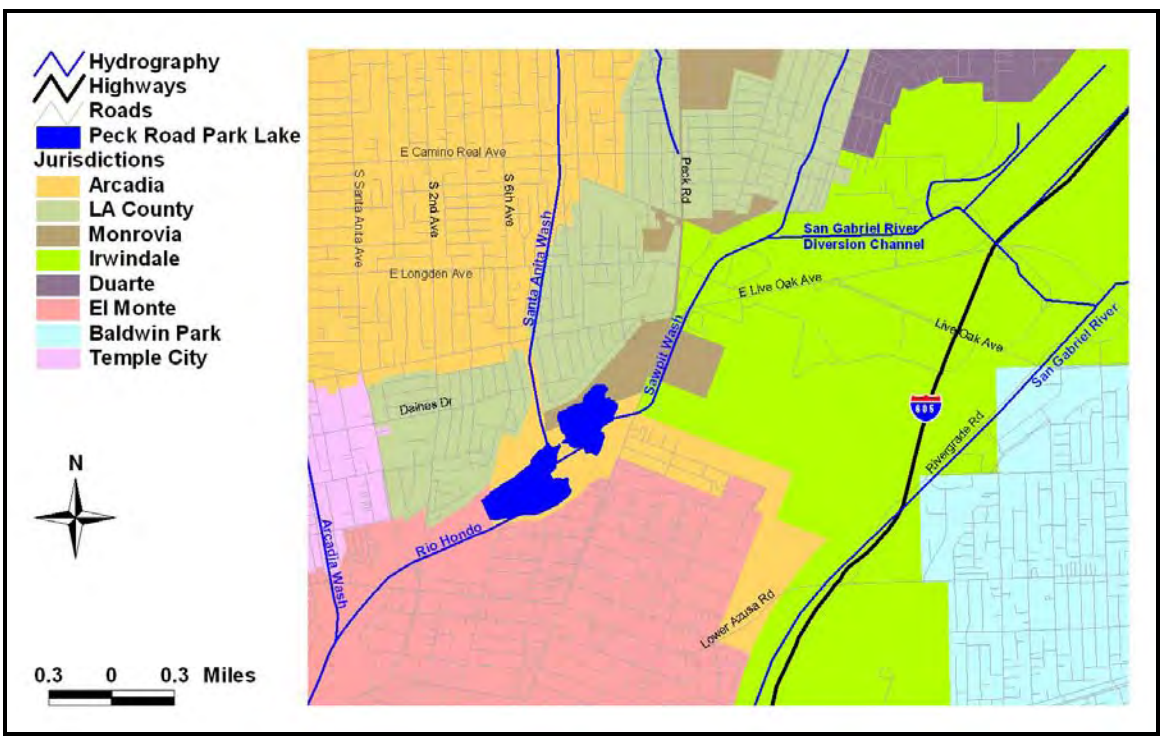



Figure 4-1. **Location of Peck Road Park Lake**

Two basins (north and south) connected by a narrow waterway have a surface area of 87.4 acres (based on Southern California Association of Governments [SCAG] 2005 land use), average depth of 30 feet (depth was calculated as an average of 2008 and 2009 sampling depths), and total volume of 2,622 acre-feet (calculated from the land use estimated surface area and average sampling depths). Inflows to the Lake include Sawpit Wash (Figure 4-3), Santa Anita Wash (Figure 4-4), and diversions from the Santa Fe Flood Control Basin. Water leaving Peck Road Park Lake discharges into Rio Hondo Wash. There is no known use of algaecide in this lake. Additional characteristics of the watershed are summarized below.

Figure 4-2. **Views of Peck Road Park Lake (Northern end on left; Southern lobe on right)**

Figure 4-3. **Sawpit Wash**

Figure 4-4. **Santa Anita Wash**

### 4.1.1 Elevation, Storm Drain Networks, and TMDL Subwatershed Boundaries

The Peck Road Park Lake watershed (23,564 total acres) ranges in elevation from 74 meters to 1,738 meters. The TMDL subwatershed boundaries selected for Peck Road Park Lake were based on more discrete boundaries obtained from the county of Los Angeles that were aggregated to three larger drainages. The subwatershed draining the western part of the watershed via Santa Anita Wash is 12,686 acres; the eastern subwatershed draining to Sawpit Wash is 10,557 acres. There is a mining operation in the southern part of the eastern watershed that has been removed from the loading analysis as it acts like a sink and does not drain towards the lake. The area surrounding the lake comprises 321 acres. Each subwatershed drains to a storm sewer system so all allocations except for trash will be wasteload allocations (Figure 4-5) (note: atmospheric deposition will be included as a load allocation). The spatial coverage for the storm drain network was obtained from the county of Los Angeles and is labeled on the figure accordingly. The trash TMDL includes load allocations due to direct dumping of trash along the shoreline and in the water by park visitors in the park area indicated in Figure 4-16 in the trash TMDL section.

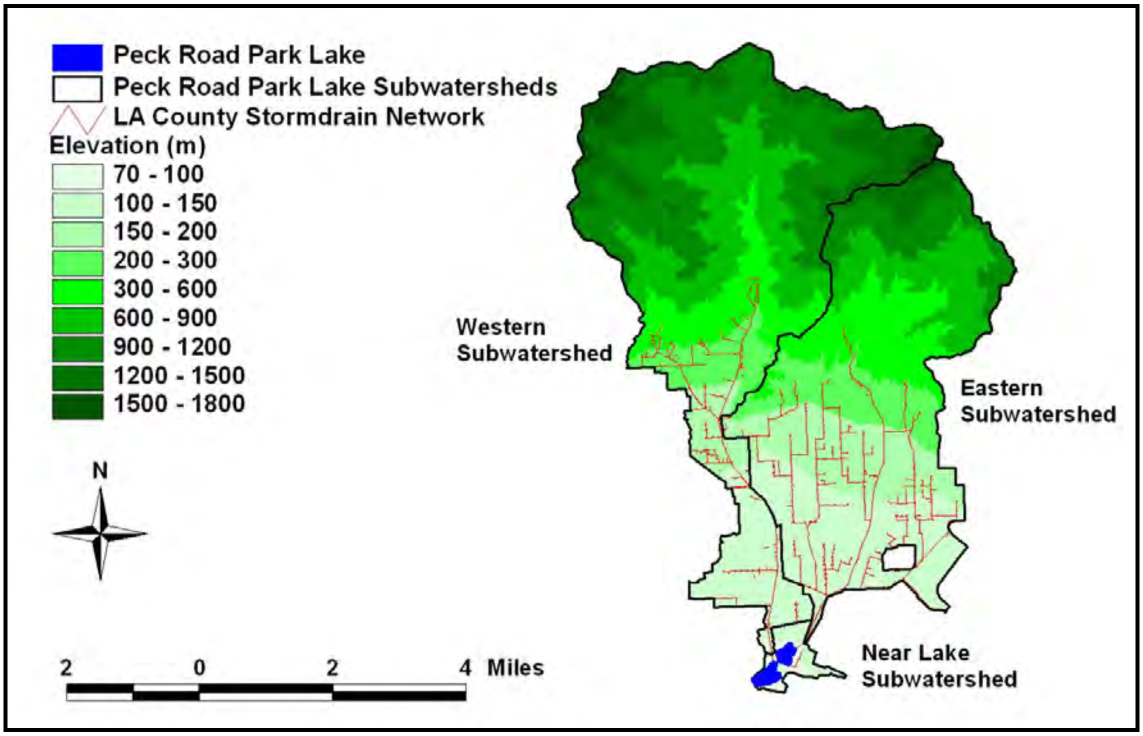



Figure 4-5. **Elevation, Storm Drain Networks, and TMDL Subwatershed Boundaries for Peck Road Park Lake**

### 4.1.2 MS4 Permittees

Figure 4-6 shows the MS4 stormwater permittees in the Peck Road Park Lake watershed. The western subwatershed is comprised of the county of Los Angeles, Sierra Madre, Arcadia, Monrovia, Angeles National Forest, and Caltrans areas. The eastern subwatershed is comprised of the county of Los Angeles, Monrovia, Duarte, Bradbury, Arcadia, Irwindale, Angeles National Forest, and Caltrans areas. The county of Los Angeles, Monrovia, Irwindale, Arcadia, and El Monte comprise the drainage around the lake. The park area is comprised of 152 acres adjacent to the lake.

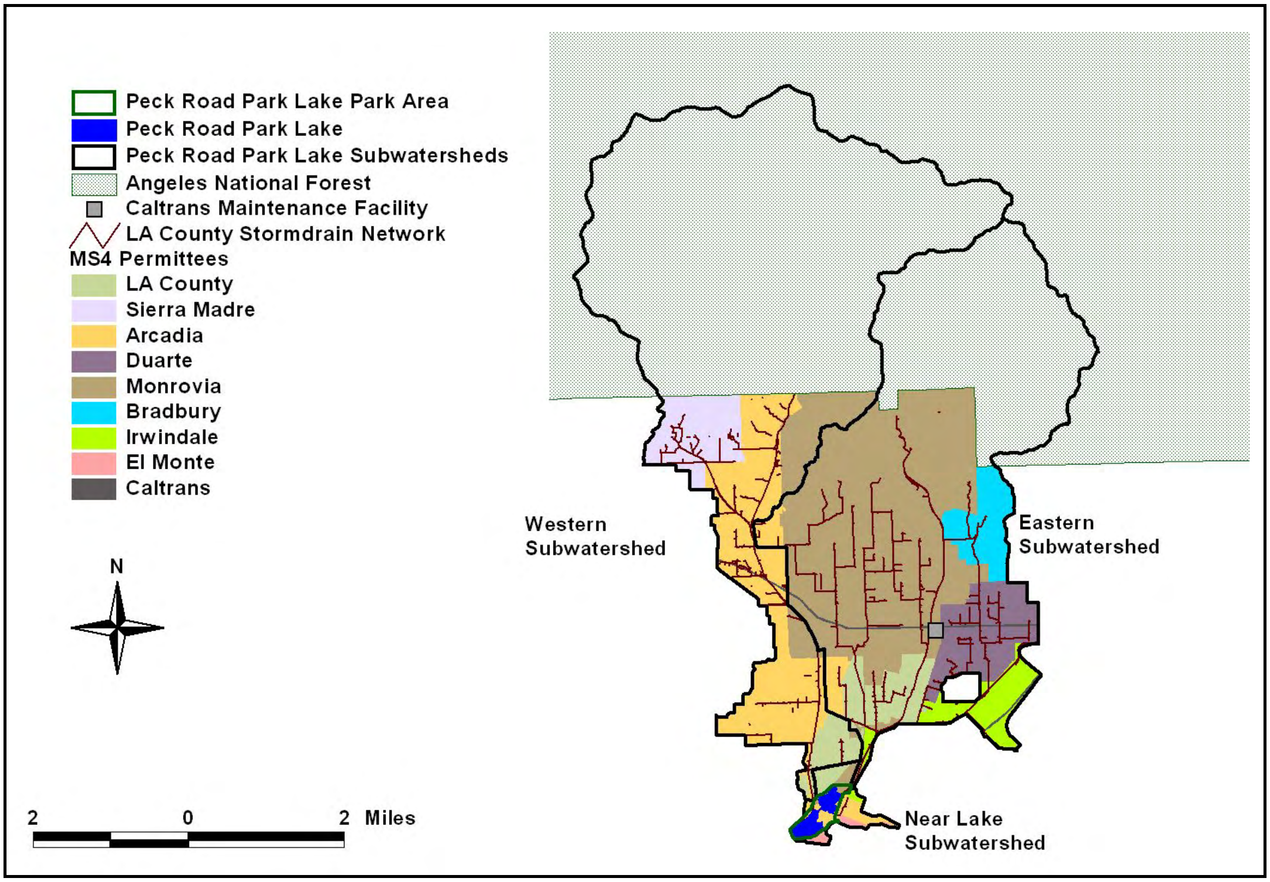



Figure 4-6. **MS4 Permittees and the Storm Drain Network in the Peck Road Park Lake Subwatersheds**

### 4.1.3 Non-MS4 NPDES Dischargers

There are several additional NPDES permits (non-MS4) in the Peck Road Park Lake watershed (Table 4-1). These include 53 dischargers covered under a general industrial stormwater permit (see Section 3.1 for a detailed discussion of these permit types) located throughout the watershed (Figure 4-7) that result in 510 disturbed acres. These permits were identified by querying excel files of permits from the Regional Board website (Excel files for each watershed are available from this link, www.waterboards.ca.gov/losangeles/water_issues/programs/regional_program/index.shtml#watershed, accessed on October 5, 2009). Specific information is not available regarding these dischargers; however, they are assigned existing loads and wasteload allocations based on their area (industrial stormwater) and their disturbed area (construction stormwater). There is one general NPDES permit for discharge of groundwater from potable water well maintenance activities, which will receive a concentration-based wasteload allocation.

**Table 4-1. Non-MS4 Permits in the Peck Road Park Lake Watershed**

| Type of NPDES Permit | Number of Permits | Subwatershed | Jurisdiction | Disturbed Area |
|---|---|---|---|---|
| General Industrial Stormwater (Order No. 97-03-DWQ, CAS000001) | 24 | Eastern | Duarte | 33.0 |

| Type of NPDES Permit | Number of Permits | Subwatershed | Jurisdiction | Disturbed Area |
|---|---|---|---|---|
| General Industrial Stormwater (Order No. 97-03-DWQ, CAS000001) | 10 | Eastern | Irwindale | 19.5 |
| General Industrial Stormwater (Order No. 97-03-DWQ, CAS000001) | 16 | Eastern | Monrovia | 133.5 |
| General Industrial Stormwater (Order No. 97-03-DWQ, CAS000001) | 1 | Near Lake | Arcadia | 14 |
| General Industrial Stormwater (Order No. 97-03-DWQ, CAS000001) | 1 | Western | Arcadia | 310 |
| General Industrial Stormwater (Order No. 97-03-DWQ, CAS000001) | 1 | Western | Sierra Madre | 0 |
| General NPDES Permit for Potable Groundwater Well Discharges to Surface Water (Order No. R4-2003-0108, CAG994005) | 1 | Eastern | Arcadia | 0 |

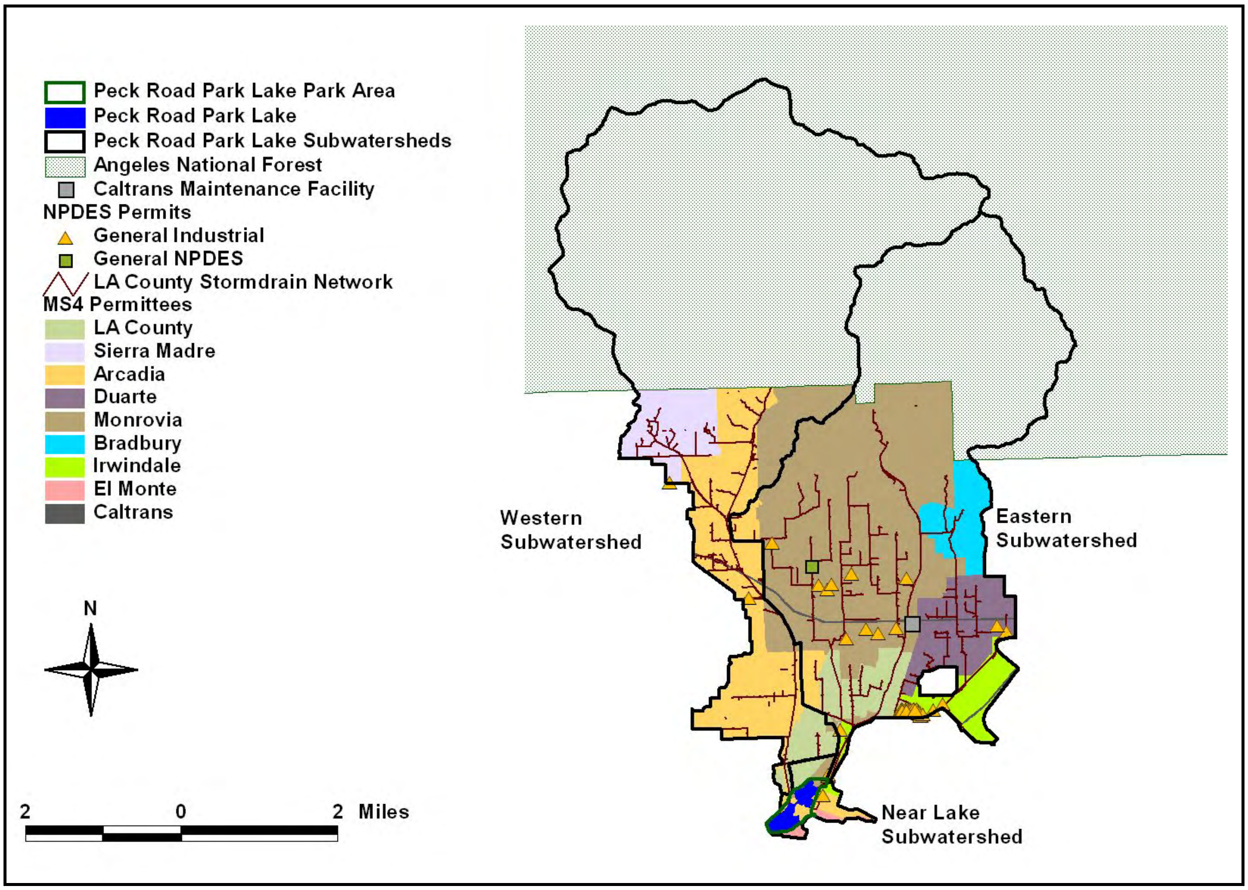



Figure 4-7. **Non-MS4 Permits in the Peck Road Park Lake Subwatersheds**

### 4.1.4 Land Uses and Soil Types

Several of the analyses for the Peck Road Park Lake watershed include source loading estimates obtained from the Los Angeles River Basin LSPC Model discussed in Appendix D (Wet Weather Loading) of this TMDL report. Land uses identified in the Los Angeles River Basin LSPC model are shown in Figure 4-8. Upon review of the SCAG 2005 database as well as current satellite imagery, it was evident that a portion of the areas classified by the LSPC model as agriculture were inaccurate. Land use classifications were changed to accurately reflect the conditions identified in the more recent data. Approximately 82 acres classified by LSPC as agriculture corresponded to orchards, vineyards, and horse farms and were not altered. However, approximately 27 acres of agriculture were reclassified as open space and 28 acres were reclassified as residential. All areas within the Caltrans jurisdiction were simulated as industrial since the Los Angeles River Basin LSPC model grouped transportation uses into the industrial category. Table 4-2, Table 4-3, and Table 4-4 summarize the land use areas for each TMDL subwatershed and jurisdiction.

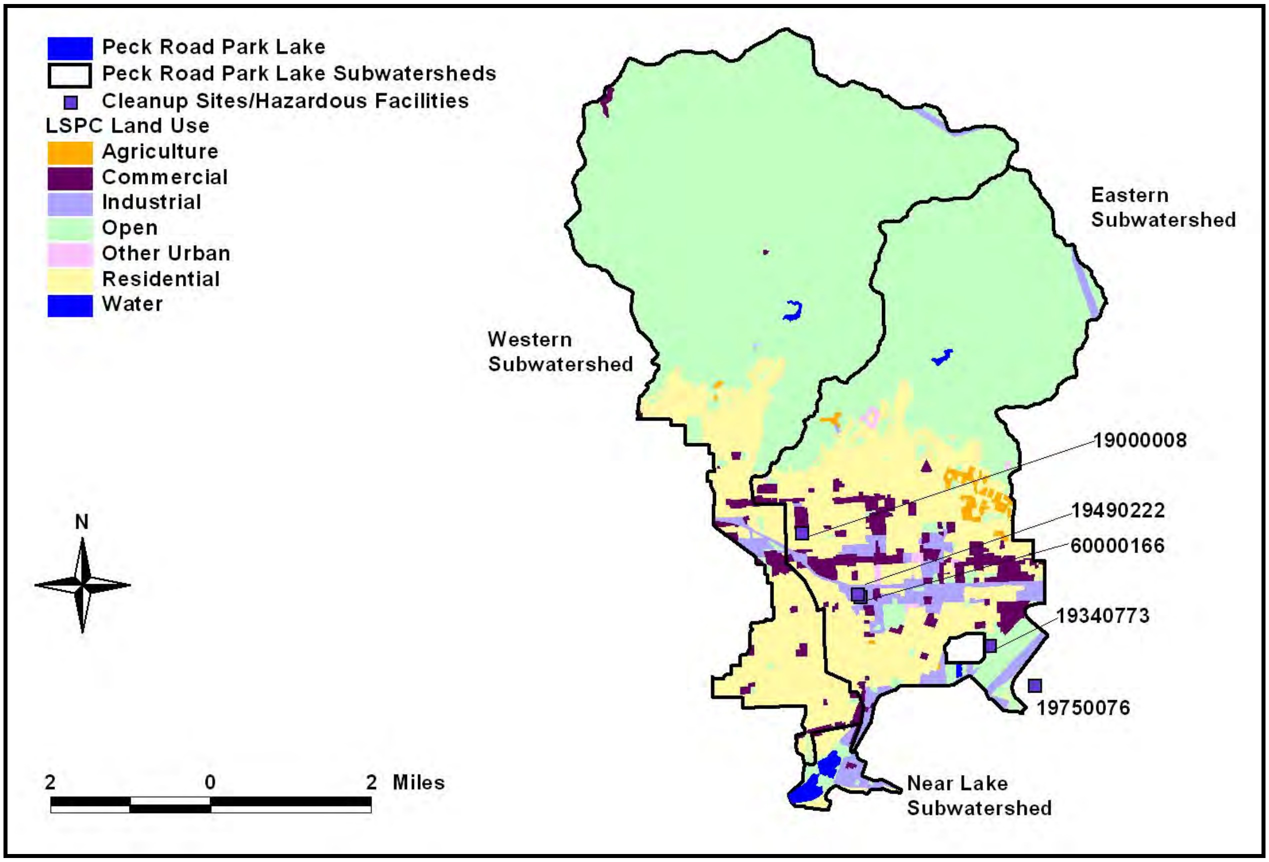



Figure 4-8. **LSPC Land Use Classes for the Peck Road Park Lake Subwatersheds**

**Table 4-2. Land Use Areas (ac) Draining from Western Subwatershed of Peck Road Park Lake**

| Land Use | County of Los Angeles | Sierra Madre | Arcadia | Monrovia | Caltrans | Angeles National Forest | Total |
|---|---|---|---|---|---|---|---|
| Agriculture | 0 | 4.19 | 0 | 0 | 0 | **0** | **4.19** |
| Commercial | 34.8 | 2.62 | 124 | 13.0 | 0 | **0** | **175** |
| Industrial | 0 | 0 | 70.4 | 0.319 | 16.9 | **0** | **87.6** |
| Open | 3.50 | 377 | 319 | 483 | 0 | **9,104** | **10,286** |
| Other Urban | 0 | 0 | 0.053 | 0 | 0 | **0** | **0.053** |
| Residential | 207 | 296 | 1,516 | 114 | 0 | **0** | **2,133** |
| **Total** | **245** | **679** | **2,030** | **611** | **16.9** | **9,104** | **12,686** |

**Table 4-3. Land Use Areas (ac) Draining from Eastern Subwatershed of Peck Road Park Lake**

| Land Use | County of Los Angeles | Monrovia | Duarte | Bradbury | Arcadia | Irwindale | Caltrans | Angeles National Forest | Total |
|---|---|---|---|---|---|---|---|---|---|
| Agriculture | 0 | 0 | 0 | 78.1 | 0 | 0 | 0 | 0 | 78.1 |
| Commercial | 24.8 | 430 | 232 | 0 | 33.9 | 12.7 | 0 | 0 | 733 |
| Industrial | 1.27 | 407 | 107 | 0 | 0 | 180 | 78.4 | 0 | 774 |
| Open | 5.29 | 1,419 | 53.5 | 229 | 16.0 | 274 | 0 | 3,511 | 5,508 |
| Other Urban | 0 | 51.0 | 1.74 | 2.90 | 1.71 | 0 | 0 | 0 | 57.3 |
| Residential | 467 | 2,149 | 424 | 193 | 158 | 15.5 | 0 | 0 | 3,406 |
| **Total** | **499** | **4,456** | **818** | **503** | **209** | **483** | **78.4** | **3,511** | **10,557** |

**Table 4-4. Land Use Areas (ac) Draining from Near Lake Subwatershed of Peck Road Park Lake**

| Land Use | County of Los Angeles | Monrovia | Irwindale | Arcadia | El Monte | Total |
|---|---|---|---|---|---|---|
| Agriculture | 0 | 0 | 0 | 0 | 0 | **0** |
| Commercial | 7.10 | 7.90 | 0 | 3.86 | 0 | **18.9** |
| Industrial | 0.0003 | 14.4 | 13.9 | 69.7 | 10.2 | **108** |
| Open | 0.233 | 24.6 | 0.187 | 61.6 | 0.984 | **87.5** |
| Other Urban | 0 | 0 | 0 | 0 | 0 | **0** |
| Residential | 60.4 | 1.30 | 0 | 4.18 | 40.9 | **107** |
| **Total** | **67.7** | **48.1** | **14.1** | **139** | **52.1** | **321** |

There are four Resource Conservation and Recovery Act (RCRA) cleanup sites within the Peck Road Park Lake watershed, and an additional RCRA cleanup site is located within 0.3 miles of the watershed. None of the active sites are expected to contribute to the existing nutrient, OC pesticides and PCBs, or trash impairments; however, some of the previously remediated locations may have historically contributed PCB loadings. In addition, as identified in Table 4-5, several facilities have the potential to discharge lead, but lead is currently meeting numeric targets in Peck Road Park Lake (Section 4.3). Table 4-5 summarizes the available information regarding these sites, which are illustrated in Figure 4-8.

**Table 4-5. RCRA Cleanup Sites Located within or near the Peck Road Park Lake Watershed**

| Envirostor # | Facility Name | Cleanup Status | Potential Contaminants of Concern |
|---|---|---|---|
| 19750076 | Alpha II/Irwindale | No further action | Lead, polychlorinated biphenyls (PCBs), cadmium |
| 60000166 | Metric Machining | Active | Arsenic, motor oil, polycyclic aromatic hydrocarbons (PAHs) |
| 19490222 | So Cal Gas/Monrovia Mgp | Active | Lead, arsenic, polycyclic aromatic hydrocarbons (PAHs), cyanide |
| 19340773 | Southwest Products/Irwindale | No further action | Benzene |
| 19000008 | Trotter Apartments | Certified | Lead |

Figure 4-9 shows the predominant soils identified by STATSGO in the Peck Road Park Lake subwatersheds. The most predominant soil type is Sobrante-Exchequer-Cieneba (MUKEY 660501), which is a hydrologic group C soil characterized as moderately-fine to fine-textured soils having low infiltration rates when wet and consisting chiefly of soils having a layer that impedes downward movement of water. In the headwaters of the watershed there is a small area of Tollhouse-Rock outcrop-Etsel family-Bakeoven soil, a hydrologic group D soil (MUKEY 660505), which has high runoff potential, very low infiltration rates, and consists chiefly of clay soils. The middle section of the watershed is comprised of Zamora-Urban land-Ramona soil (MUKEY 660480) for which the STATSGO database does not list the hydrologic soil group. Soil Urban land-Sorrento-Hanford (MUKEY 660473) makes up the southern part of the watershed. This soil is a hydrologic group B soil, which has moderate infiltration rates and moderately coarse textures.

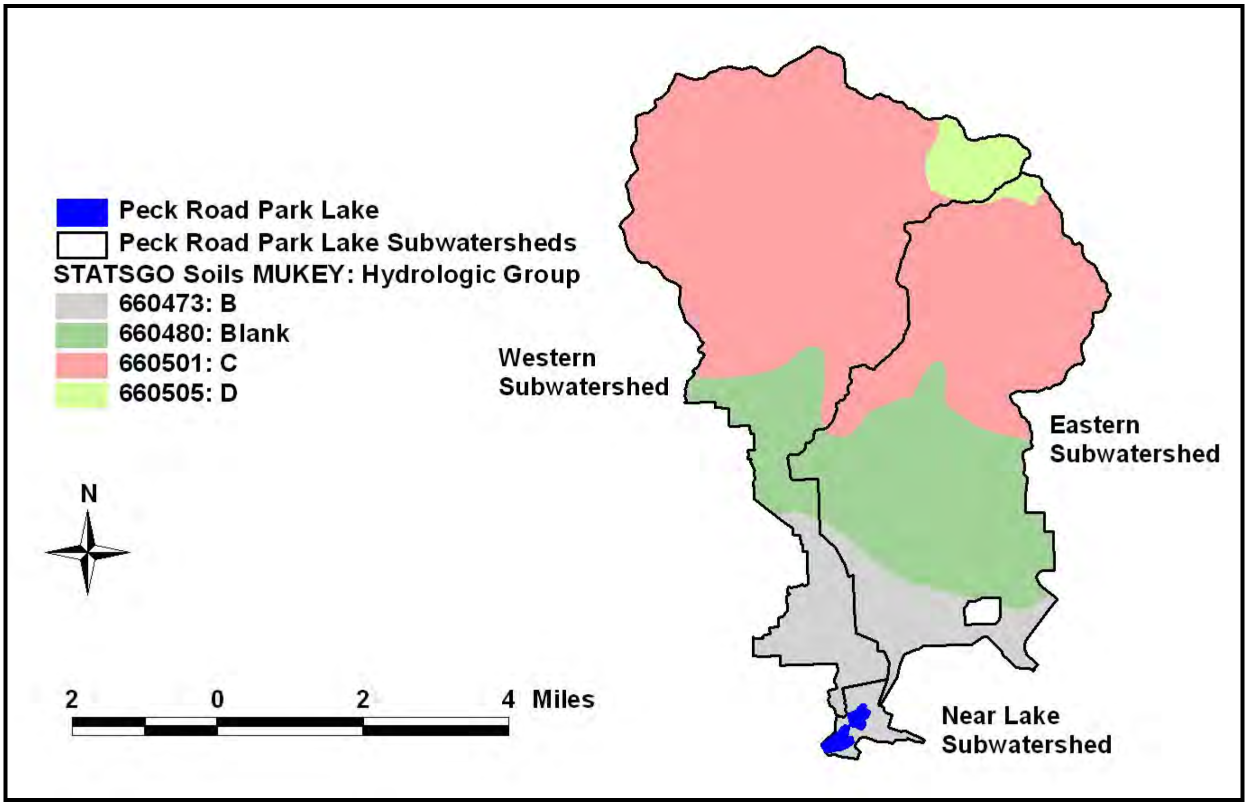



Figure 4-9. **STATSGO Soil Types Present in the Peck Road Park Lake Subwatersheds**

### 4.1.5 Additional Inputs

The 1994 Urban Lakes Study identified diversions of flow from the San Gabriel River as the primary source of water to Peck Road Park Lake. Based on data provided by the Los Angeles County Public Works Department, diversions provide an average of 8,737 ac-ft of water to Peck Road Park Lake annually. A small area of parkland is irrigated; however, it is greater than 600 ft from the lake and all of the water is expected to percolate into the ground and not reach the lake. It is therefore not included in the analysis.

## 4.2 Nutrient-Related Impairments

A number of the assessed impairments for Peck Road Park Lake may be associated with nutrients and eutrophication. Nutrient-related impairments for Peck Road Park Lake include odor and organic enrichment/low dissolved oxygen (DO) (SWRCB, 2010). The loading of excess nutrients enhances algal growth (eutrophication). Algae produce oxygen during photosynthesis but remove oxygen during respiration processes that occur in the absence of sunlight. Death and decay of large amounts of algae may cause odor problems by creating an anoxic environment that results in the release of sulfuric compounds.

### 4.2.1 Beneficial Uses

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality

Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. Peck Road Park Lake was not identified specifically in the Basin Plan; therefore, the beneficial uses associated with the downstream segment (Rio Hondo below Spreading Grounds) apply: REC1, REC2, WARM, WILD, MUN, and GWR (personal communication, Regional Board, December 22, 2009). Descriptions of these uses are listed in Section 2 of this TMDL report. Elevated nutrient levels are currently impairing the REC1, REC2, and WARM uses by stimulating algal growth that may form mats that impede recreational and drinking water use, alter pH and dissolved oxygen (DO) levels alter biology that impair the aquatic life use, and cause odor and aesthetic problems. At high enough concentrations WILD and MUN uses could become impaired.

### 4.2.2 Numeric Targets

The Basin Plan for the Los Angeles Region (LARWQCB, 1994) outlines the numeric targets and narrative criteria that apply to Peck Road Park Lake. The following targets apply to the odor and organic enrichment/low DO (see Section 2 for additional details and Table 4-6 for a summary):

- The Basin Plan addresses excess aquatic growth in the form of a narrative objective for nutrients. Excessive nutrient (e.g., nitrogen and phosphorous) concentrations in a waterbody can lead to nuisance effects such as algae, odors, and scum. The objective specifies, "waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses." The Regional Board has not adopted numeric targets for biostimulatory nutrients or chlorophyll *a* in Peck Road Park Lake; however, as described in Tetra Tech (2006), summer (May – September) mean and annual mean chlorophyll *a* concentrations of 20 µg/L are selected as the maximum allowable level consistent with full support of contact recreational use and is also consistent with supporting warm water aquatic life. The mean chlorophyll *a* target must be met at half of the Secchi depth during the summer (May – September) and annual averaging periods.

- The Basin Plan states that "waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible aquatic resources, cause nuisance, or adversely affect beneficial uses."

- The Basin Plan states "at a minimum the mean annual dissolved oxygen concentrations of all waters shall be greater than 7 mg/L, and no single determinations shall be less than 5.0 mg/L, except when natural conditions cause lesser concentrations." In addition, the Basin Plan states, "the dissolved oxygen content of all surface waters designated as WARM shall not be depressed below 5 mg/L as a result of waste discharges." Deep lakes that thermally stratify during the summer months, such as Peck Road Park Lake, must meet the DO target in the epilimnion of the water column.

  The epilimnion is the upper stratum of more or less uniformly warm, circulating, and fairly turbulent water during summer stratification. The epilimnion floats above a cold relatively undisturbed region called the hypolimnion. The stratum between the two is the metalimnion and is characterized by a thermocline, which refers to the plane of maximum rate of decrease of temperature with respect to depth. For the purposes of these TMDLs, the presence of stratification will be defined by whether there is a change in lake temperature greater than 1 degree Celsius per meter. Deep lakes, such as Peck Road Park Lake, must meet the DO and pH targets in the water column from the surface to 0.3 meters above the bottom of the lake when the lake is not stratified. However, when stratification occurs (i.e., a thermocline is present) then the DO and pH targets must be met in the epilimnion, the portion of the water column above the thermocline.

- The Basin Plan states that "the pH of inland surface waters shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges. Ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharge." Deep lakes that thermally stratify during the summer months, such as Peck Road Park Lake, must meet the pH target in the epilimnion of the water column.

Nitrogen and phosphorus target concentrations within the lake are based on existing conditions as explained in Sections 4.2.5 and 4.2.6:

- 0.76 mg-N/L summer season average (May – September) and annual average
- 0.076 mg-P/L summer season average (May – September) and annual average

**Table 4-6. Nutrient-Related Numeric Targets for Peck Road Park Lake**

| Parameter | Numeric Target | Notes |
|---|---|---|
| Chlorophyll *a* | 20 µg/L summer average (May – September) and annual average | |
| Dissolved Oxygen | 7 mg/L minimum mean annual concentrations and<br>5 mg/L single sample minimum except when natural conditions cause lesser concentrations | |
| pH | The pH of inland surface waters shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges. Ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharge. (Basin Plan)<br>6.5 – 9.0 (EPA's 1986 Recommended Criteria) | The existing water quality criteria for pH is very broad and in cases where waste discharges are not causing the alteration of pH it allows for a wider range of pH than EPA's recommended criteria. For this reason, EPA's recommended criteria is included as a secondary target for pH. |
| Total Nitrogen | 0.76 mg-N/L summer average (May – September) and annual average | Conservatively based on existing conditions, which are maintaining chlorophyll *a* levels below the target of 20 µg/L |
| Total Phosphorous | 0.076 mg-P/L summer average (May – September) and annual average | Based on an in-lake TN to TP ratio of 10, typical of natural systems |

## 4.2.3 Summary of Monitoring Data

Water quality in Peck Road Park Lake has been monitored since the early 1990s. This section summarizes the monitoring data relevant to the nutrient impairments. Additional details regarding monitoring are discussed in Appendix G (Monitoring Data).

The southern basin was sampled during the 1992-93 monitoring period in support of the Urban Lakes Study. Nutrient levels were analyzed at relatively high detection limits. Of the 90 orthophosphate samples collected, only one exceeds the detection limit of 0.1 mg-P/L. This measurement was collected at a depth of 8 meters and had a value of 0.4 mg-P/L. Only 1 of 90 total phosphorus samples exceeded the detection limit of 0.1 mg-P/L: at a depth of 5 meters the TP measurement was 0.9 mg-P/L. Three nitrite samples exceeded the detection limit for this dataset of 0.1 mg-N/L. All three had values of 0.2 mg-N/L and were located at depths ranging from 7 to 14 meters. For nitrate, 23 samples were less than the detection limit (0.1 mg-N/L) and the maximum nitrate concentration measured was 1.1 mg-N/L. Twelve measurements of Total Kjeldahl Nitrogen (TKN), which includes the organic and ammonia species of nitrogen, were less than the detection limit (0.1 mg-N/L) and the maximum TKN concentration observed was 2.0 mg-N/L. For ammonium, 55 out of 90 measurements were less than the detection limit (0.1 mg-N/L) and 35 samples ranged from 0.1 mg-N/L to 1.2 mg-N/L. pH ranged from 7.3 to 8.8. The summary table lists chlorophyll *a* concentrations ranging from <1 µg/L to 19 µg/L with an average of

8 µg/L. The graphs displaying the depth profile data for Peck Road Park Lake show that dissolved oxygen typically declines to 0 mg/L during the summer months at depths greater than 5 meters. At depths less than 5 meters, dissolved oxygen concentrations were typically around 7 mg/L during the summer months. The study reported a “fishy” smell around the lake.

The Regional Board completed its Water Quality Assessment and Documentation Report for waterbodies in the Los Angeles Region in 1996 (LARWQCB, 1996). The summary table for Peck Road Park Lake states that dissolved oxygen (DO) was not supporting the aquatic life use: 195 measurements of DO were collected in the lake with concentrations ranging from 0.2 mg/L to 15.2 mg/L. The accompanying database does not contain the raw data associated with these measurements, so depth, temperature, date, and time cannot be established. The summary table also lists the odor impairment as not supporting both contact and non-contact recreation uses.

On June 17, 2008, the Regional Board sampled water quality from the middle of each lobe of Peck Road Park Lake (shoreline sampling is not discussed in this section but is described in Appendix G, Monitoring Data). Ammonia concentrations ranged from less than the detection limit (0.1 mg-N/L) to 0.437 mg-N/L. TKN ranged from 1.2 mg-N/L to 2.08 mg-N/L. Nitrite concentrations were less than the detection limit (0.1 mg-N/L) in both basins; nitrate was less than the detection limit (0.1 mg-N/L) in the southern basin and 0.24 mg-N/L in the northern basin. Orthophosphate and total phosphate measurements in both basins were less than the detection limits (0.4 mg-P/L and 0.5 mg-P/L, respectively). Field data were collected in both basins at depths ranging from the water surface to 2.5 meters. Temperature varied by approximately 1 ºC in the south basin and approximately 4 ºC in the north basin over the sampling depth. Dissolved oxygen in the lake was greater than 17 mg/L at all depths except in the northern basin at a depth of 2.5 meters where the concentration was 3 mg/L. pH measurements in the lake ranged from 8.0 to 9.4, although the meter was not calibrated due to equipment malfunction. Chlorophyll *a* measurements in the lake ranged from 4.0 µg/L to 11.4 µg/L. The field notes for this event did not mention odor.

Four sites were sampled by the Regional Board on December 11, 2008; samples were collected from the surface at each site. Measurements of TKN, nitrite, orthophosphate, and total phosphate were less than the detection limits at each site (1.0 mg-N/L, 0.1 mg-N/L, 0.4 mg-P/L, and 0.5 mg-P/L, respectively). Ammonia concentrations ranged from 0.209 mg-N/L to 0.273 mg-N/L; nitrate ranged from 0.162 mg-N/L to 0.287 mg-N/L. Chlorophyll *a* ranged from 1.8 µg/L to 4.0 µg/L. Field data were collected from the surface to 2.0 meters. DO ranged from 2.21 mg/L to 6.20 mg/L (field notes indicate that the meter was not calibrated prior to sampling and field team questioned accuracy of these readings). pH ranged from 7.47 to 7.81.

Water quality monitoring was also conducted by the USEPA and Regional Board on August 5, 2009 in both basins. Ammonia, TKN, nitrate, and nitrite were less than the detection limits (0.03 mg-N/L, 0.456 mg-N/L, 0.01 mg-N/L, and 0.01 mg-N/L, respectively). Orthophosphate ranged from 0.0112 mg-P/L to 0.0135 mg-P/L, and total phosphorus ranged from 0.022 mg-P/L to 0.116 mg-P/L. Chlorophyll *a* ranged from 5.3 µg/L to 8.0 µg/L. DO in the epilimnion was greater than 8 mg/L in both basins. pH ranged from 8.17 to 8.71 in the epilimnion. Field notes report “an unappealing smell that is hard to describe in both the channel connecting the northern and southern lobes and in the northern lobe of Peck Road Park Lake. This smell could possibly be coming from the water or from the industry buildings which are close to the shore of the northern lobe of the lake.”

On September 30, 2010, additional sampling was conducted at the mid-lake sites. Ammonia concentrations were below the detection limit of 0.03 mg-N/L. Nitrite ranged from 0.041 to 0.043 mg-N/L, and nitrate was below the detection limit of 0.01 mg-N/L. TKN ranged from 0.562 to 0.634 mg-N/L. Orthophosphate and total phosphorus ranged from 0.02 mg-P/L to 0.04 mg-P/L. Chlorophyll *a* ranged from 6.7 µg/L to 13.4 µg/L. During this event, two continuous monitoring probes were deployed over a 24-hour period. At an average depth of 0.6 meters, DO concentrations during the 24-hour period ranged from 8.6 mg/L to 10.1 mg/L. pH ranged from about 8.5 to 8.8. On September 30, 2010, DO measurements collected from the surface of the lake ranged from 8.5 mg/L to 10.9 mg/L. At 2 meters above the bottom, DO ranged from 0.2 to 4.0 mg/L.

In summary, Peck Road Park Lake has been sampled several times over the past two decades. Slight exceedances of the pH target have been observed in the lake and may be due to natural conditions. DO levels in the epilimnion are typically greater than 7 mg/L and impairment due to low DO is not evident in either the historic or recent sampling events (DO levels do approach zero in the deeper waters but no exceedances have been observed relative to the target depths). Readings collected in December 2008 were collected with an uncalibrated meter. Chlorophyll *a* concentrations are relatively low and no measurements greater than 19 µg/L (historic data) have been reported. The maximum chlorophyll *a* concentration measured recently is 13.4 µg/L and the average concentration is 6.2 µg/L. It does not appear, based on these data, that excessive nutrient loading is causing an impairment. It is unlikely that the source of the odor reported at Peck Road Park Lake is due to elevated nutrient and algal biomass levels. They are likely associated with the trash impairment addressed in Section 4.8. The nutrient TMDLs for Peck Road Park Lake presented in Section 4.2.6 are based on existing conditions.

### 4.2.4 Source Assessment

The source assessment for Peck Road Park Lake includes load estimates from the surrounding watershed (Appendix D, Wet Weather Loading; Appendix F, Dry Weather Loading) and atmospheric deposition (Appendix E, Atmospheric Deposition) (Table 4-7). Watershed loading accounts for 55.5 percent of the total nitrogen load and 80.2 percent of the total phosphorus load. Diversions from the San Gabriel River to Peck Road Park Lake (via the eastern subwatershed) contribute 41.1 percent of the total nitrogen load and 15.3 percent of the total phosphorus load. All existing loads to Peck Road Park Lake are summarized in Table 4-7.

**Table 4-7. Summary of Average Annual Flows and Nutrient Loading to Peck Road Park Lake**

| Subwatershed | Responsible Jurisdiction | Input | Flow (ac-ft/yr) | Total Phosphorus (lb-P/yr) (percent of total load) | Total Nitrogen (lb-N/yr) (percent of total load) |
|---|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 206 | 383 (2.0) | 2,320 (1.2) |
| Eastern | Bradbury | MS4 Stormwater[1] | 291 | 497 (2.6) | 3,223 (1.7) |
| Eastern | Caltrans | State Highway Stormwater[1] | 99.9 | 158 (0.8) | 1,165 (0.6) |
| Eastern | Duarte | MS4 Stormwater[1] | 850 | 1,540 (8.0) | 9,616 (5.1) |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 34.9 | 55.1 (0.3) | 432 (0.2) |
| Eastern | Irwindale | MS4 Stormwater[1] | 325 | 496 (2.6) | 3,487 (1.9) |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 20.6 | 32.5 (0.2) | 255 (0.1) |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 488 | 924 (4.8) | 5,532 (2.9) |
| Eastern | Monrovia | MS4 Stormwater[1] | 3,527 | 6,243 (32.3) | 38,736 (20.7) |

| Subwatershed | Responsible Jurisdiction | Input | Flow (ac-ft/yr) | Total Phosphorus (lb-P/yr) (percent of total load) | Total Nitrogen (lb-N/yr) (percent of total load) |
|---|---|---|---|---|---|
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 141 | 223 (1.2) | 1,748 (0.9) |
| Eastern | Angeles National Forest | Stormwater[1] | 309 | 92.5 (0.5) | 2,692 (1.4) |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 8,737 | 2,960 (15.3) | 76,970 (41.1) |
| Near Lake | Arcadia | MS4 Stormwater[1] | 102 | 158 (0.8) | 1,115 (0.6) |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 14.8 | 23.4 (0.1) | 183 (0.1) |
| Near Lake | El Monte | MS4 Stormwater[1] | 52.8 | 96.2 (0.5) | 602 (0.3) |
| Near Lake | Irwindale | MS4 Stormwater[1] | 17.8 | 28.2 (0.1) | 207 (0.1) |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 68.1 | 129 (0.7) | 773 (0.4) |
| Near Lake | Monrovia | MS4 Stormwater[1] | 38.0 | 60.4 (0.3) | 415 (0.2) |
| Western | Arcadia | MS4 Stormwater[1] | 1,493 | 2,840 (14.7) | 16,334 (8.7) |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 328 | 517 (2.7) | 4,058 (2.2) |
| Western | Caltrans | State Highway Stormwater[1] | 21.6 | 34.2 (0.2) | 251 (0.1) |
| Western | County of Los Angeles | MS4 Stormwate[1]r | 248 | 467 (2.4) | 2,818 (1.5) |
| Western | Monrovia | MS4 Stormwater[1] | 275 | 425 (2.2) | 2,678 (1.4) |
| Western | Sierra Madre | MS4 Stormwater[1] | 406 | 695 (3.6) | 4,254 (2.3) |
| Western | Angeles National Forest | Stormwater[1] | 802 | 240 (1.2) | 6,981 (3.7) |
| Lake Surface | | Atmospheric Deposition[3] | 139 | NA | 69 (0.04) |
| **Total** | | | **19,034** | **19,319** | **186,914** |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. The disturbed area associated with general construction and general industrial stormwater permittees (510 acres) was subtracted out of the appropriate city areas and allocated to these permits.

[3] Loads for atmospheric deposition are based on direct precipitation to the lake (calculated by the annual average precipitation multiplied by the surface area of the lake).

### 4.2.5 Linkage Analysis

The linkage analysis defines the connection between numeric targets and identified pollutant sources and may be described as the cause-and-effect relationship between the selected indicators, the associated numeric targets, and the identified sources. This provides the basis for estimating total assimilative capacity and any needed load reductions.

To simulate the impacts of nutrient loading on Peck Road Park Lake, the nutrient numeric endpoints (NNE) BATHTUB Tool was set up and calibrated to lake-specific conditions. The NNE BATHTUB Tool is a version of the US Army Corps of Engineers (USACE) BATHTUB model and was developed to support risk-based nutrient numeric endpoints in California (Tetra Tech, 2006).

BATHTUB is a steady-state model that calculates nutrient concentrations, chlorophyll *a* concentration (or algal density), turbidity, and hypolimnetic oxygen depletion based on nutrient loadings, hydrology, lake morphometry, and internal nutrient cycling processes. BATHTUB uses a typical mass balance modeling approach that tracks the fate of external and internal nutrient loads between the water column, outflows, and sediments. External loads can be specified from various sources including stream inflows, nonpoint source runoff, atmospheric deposition, groundwater inflows, and point sources. Internal nutrient loads from cycling processes may include sediment release and macrophyte decomposition. The net sedimentation rates for nitrogen and phosphorus reflect the balance between settling and resuspension of nitrogen and phosphorus within the waterbody. Thus, internal loading is implicitly accounted for in the model. Since BATHTUB is a steady-state model, it focuses on long-term average conditions rather than day-to-day variations in water quality.

Target nutrient loads and resulting allocations are determined based on the secondary target – summer mean chlorophyll *a* concentration. The NNE spreadsheet tool allows the user to specify a chlorophyll *a* target and predicts the probability that current conditions will exceed the target, as well as showing a matrix of allowable nitrogen and phosphorus loading combinations to meet the target. The user-defined chlorophyll *a* target can be input directly by the user, or can be calculated based on an allowable change in water transparency measured as Secchi depth. Appendix A (Nutrient TMDL Development) describes additional details on the NNE BATHTUB Tool and its use in determining allowable loads of nitrogen and phosphorus.

In addition to loading rates of nitrogen and phosphorus, the NNE BATHTUB Tool requires basic bathymetry data for the simulation of chlorophyll *a* during the summer. For Peck Road Park Lake, the following inputs apply: surface area of 87.4 acres, average depth of 30 ft, and volume of 2,622 ac-ft. Based on the phosphorus turnover ratio for this lake (Walker, 1987), the summer averaging period is appropriate (i.e., loads delivered from May through September are input to the model rather than annual loads). Without adjusting calibration factors in the model (calibration factors on net sedimentation rates set to 1), the average annual loads presented in Section 4.2.4 yield total nitrogen, total phosphorus, and chlorophyll *a* concentrations of 1.19 mg-N/L, 0.077 mg-P/L, and 12.8 µg/L, respectively.

Average conditions for Peck Road Park Lake with regard to algal stimulation are assessed based on measurements collected between the surface and twice the observed Secchi depth. Average annual observed total nitrogen, total phosphorus, and chlorophyll *a* concentrations over the assessment depth (4.2 meters) are 0.76 mg-N/L, 0.05 mg-P/L, and approximately 6 µg/L, respectively, assuming measurements less than detection are equal to half the detection limit. Even with simulated nitrogen and phosphorus concentrations 2 to 3 times higher than those observed in the lake (i.e., calibration factors left at 1), simulated chlorophyll *a* (12.8 µg/L) remains below the target concentration of 20 µg/L. Calibrating the NNE BATHTUB Tool would result in lower simulated concentrations of nitrogen, phosphorus, and chlorophyll *a*. Thus, the NNE BATHTUB Tool indicates that Peck Road Park Lake is not directly impaired by elevated nutrient loads or excessive algal growth. (Since the calibration factor on the net phosphorus sedimentation rate would have been adjusted even lower during calibration, the method described in Appendix A (Nutrient TMDL Development) was used to estimate internal loading. Based on the inflow concentrations, in-lake concentrations, and residence time of this system, the internal loading calculation resulted in a negative number which indicates that settling is more dominant than resuspension, and internal loading of phosphorus is insignificant relative to other sources.)

Based on historic and recent monitoring data, Peck Road Park Lake is not impaired by low DO or excessive nutrient loading (Section 4.2.3). Though odor has been noted as a problem at the lake, it is likely not due to eutrophication as no algal blooms have been observed in the lake and chlorophyll *a* concentrations are relatively low. To protect Peck Road Park Lake from degradation, nutrient loading should remain at or below existing levels as an antidegradation measure to ensure future loading does not increase the chlorophyll *a* concentration.

### 4.2.6 TMDL Summary

A waterbody's loading capacity represents the maximum load of a pollutant that can be assimilated without violating water quality standards (40 CFR 130.2(f)). This is the maximum nutrient load consistent with meeting the numeric target of 20 µg/L of chlorophyll *a* as a summer average. The methodology for determining the loading capacity is described briefly in this section. For more detail, refer to Appendix A (Nutrient TMDL Development).

Based on observed levels of chlorophyll *a* and DO in Peck Road Park Lake, existing levels of nitrogen and phosphorus loading are resulting in attainment of both the chlorophyll *a* and DO targets. Monitoring data indicate that the average in-lake total nitrogen concentration is 0.76 mg-N/L (Appendix G, Monitoring Data). Because the majority of in-lake phosphorous samples have been less than the detection limits for the analytical laboratory, the phosphorus target concentration is based on an in-lake ratio of total nitrogen concentration to total phosphorus concentration close to 10. This ratio was selected to match that typically observed in natural systems and to balance biomass growth and prevent limitation by one nutrient (Thomann and Mueller, 1987). The corresponding in-lake concentrations of nitrogen and phosphorus are

- 0.76 mg-N/L summer average (May – September) and annual average
- 0.076 mg-P/L summer average (May – September) and annual average

To prevent degradation of this waterbody, nutrient TMDLs will be allocated based on existing loading. These TMDLs are broken down into wasteload allocations (WLAs), load allocations (LAs), and Margins of Safety (MOS) using the general TMDL equation. Note that the MOS is zero because these TMDLs are equal to the existing load.

$$TMDL = \sum WLA + LA + MOS$$

For total nitrogen, the allocatable load is equal to the existing load and is divided among WLAs and LAs. The resulting TMDL equation for total nitrogen is then:

186,914 lb-N/yr = 186,845 lb-N/yr + 69.3 lb-N/yr + 0 lb-N/yr

For total phosphorus, the allocatable load is equal to the existing load and allocated to WLAs only: LAs are zero as explained in Section 4.2.6.2. The resulting TMDL equation for total phosphorous is then:

19,319 lb-P/yr = 19,319 lb-P/yr + 0 lb-P/yr + 0 lb-P/yr

Allocations are assigned for these TMDLs by requiring equal percentage reductions of all sources. Details associated with WLAs, LAs, and MOS are presented in the following three sections.

As previously mentioned, in-lake concentrations of nitrogen and phosphorus have been determined for the lake based on recent and historical monitoring data (see Section 4.2.5). These in-lake concentrations reflect internal cycling processes (see Appendix A, Nutrient TMDL Development) and, therefore, differ from concentrations associated with various inflows. Nutrient concentrations associated with the WLA and LA inputs are described below. These values are provided as examples as they are calculated based on existing flow volumes (and will need to be recalculated if flow volumes change). Because the input concentrations do not consider internal cycling processes and are based on existing flow volumes, they do not match the allowable in-lake nitrogen and phosphorous concentrations.

#### 4.2.6.1 Wasteload Allocations

Responsible jurisdictions are encouraged to consider the construction of wetland systems and bioswales (or other retention or treatment options) to treat the stormwater and supplemental water flows entering the lake, as well as stormwater diversion and infiltration using methods such as porous pavements and rain gardens. Implementing these options can reduce the lake's nutrient loads and, in the case of recirculation through constructed wetlands, reduce in-lake nutrient concentrations. Additionally, persons that apply algaecides as part of an overall lake management strategy must comply with the Aquatic Pesticide General Permit (General Permit Order No. 2004-0009-DWQ, CAG990005).

Local jurisdictions have performed studies on nearby waterbodies that may be considered when evaluating nutrient-reduction strategies for this lake. For example, the City of Los Angeles has modeled expected nutrient concentration reductions to stormwater flows to Echo Park Lake from constructed wetlands, and construction is currently underway. Information about this and other City of Los Angeles water quality improvement projects are available on Proposition O website: http://www.lapropo.org/sitefiles/lariver.htm. The Peck Road Park Lake watershed drains to a series of storm drains prior to discharging to the lake. Therefore, all nutrient loads associated with the surrounding drainage area are assigned wasteload allocations (WLAs). The Caltrans areas and facilities that operate under a general industrial stormwater permit also receive WLAs.

Relevant permit numbers are

- County of Los Angeles (including the cities of Arcadia, Bradbury, Duarte, Irwindale, Monrovia, and Sierra Madre): Board Order 01-182 (as amended by Order No. R4-2006-0074 and R4-2007-0042), CAS004001
- Caltrans: Order No 99-06-DWQ, CAS000003
- General Industrial Stormwater: Order No. 97-03-DWQ, CAS000001

WLAs are presented in Table 4-8. Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available WLAs. These TMDLs establish WLAs at their point of discharge. Note that WLAs are equal to existing loading rates because no reductions in loading are required. These loading values (in pounds per year) represent the TMDLs wasteload allocations (Table 4-8). All responsible jurisdictions must meet the WLAs as a mass load except for storm water permittees under the general industrial stormwater permit and the general NPDES permit for the Colorado Well Aquifer (Order No. R4-2003-0108, CAG994005), that are receiving concentration-based WLAs. In Table 4-8 below, permittees under these general permits must meet the concentration values to achieve compliance with the WLAs. The phosphorous and nitrogen WLA concentrations are based on the average targeted concentrations of nutrients (allowable load divided by inflow volume): 0.37 mg-P/L and 3.61 mg-N/L. Each wasteload allocation must be met at the point of discharge. A three-year average will be used to evaluate compliance. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met in the lake, then the total phosphorous and total nitrogen allocations are considered attained.

**Table 4-8. Wasteload Allocations of Phosphorus and Nitrogen Loading to Peck Road Park Lake**

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation Total Phosphorus (lb-P/yr)[4] | Wasteload Allocation Total Nitrogen (lb-N/yr)[4] |
|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 383 | 2,320 |
| Eastern | Bradbury | MS4 Stormwater[1] | 497 | 3,223 |
| Eastern | Caltrans | State Highway Stormwater[1] | 158 | 1,165 |
| Eastern | Duarte | MS4 Stormwater[1] | 1,540 | 9,616 |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 55.1<br>(0.37 mg/L P)[2] | 432<br>(3.61 mg/L N)[2] |
| Eastern | General Groundwater Discharge Permittees[3] | Groundwater Discharge | 0.37 mg/L P[3] | 3.61 mg/L N[3] |
| Eastern | Irwindale | MS4 Stormwater[1] | 496 | 3,487 |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale)[3] | General Industrial Stormwater[1] | 32.5<br>(0.37 mg/L P)[2] | 255<br>(3.61 mg/L N)[2] |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 924 | 5,532 |
| Eastern | Monrovia | MS4 Stormwater[1] | 6.243 | 38,736 |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia)[3] | General Industrial Stormwater[1] | 223 | 1,748 |
| Eastern | Angeles National Forest | Stormwater[1] | 92.5 | 2,692 |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 2,960 | 76,970 |
| Near Lake | Arcadia | MS4 Stormwater[1] | 158 | 1,115 |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia)[3] | General Industrial Stormwater[1] | 23.4<br>(0.37 mg/L P)[2] | 183<br>(3.61 mg/L N)[2] |
| Near Lake | El Monte | MS4 Stormwater[1] | 96.2 | 602 |
| Near Lake | Irwindale | MS4 Stormwater[1] | 28.2 | 207 |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 129 | 773 |
| Near Lake | Monrovia | MS4 Stormwater[1] | 60.4 | 415 |
| Western | Arcadia | MS4 Stormwater[1] | 2,840 | 16,334 |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia)[3] | General Industrial Stormwater[1] | 517<br>(0.37 mg/L P)[2] | 4,058<br>(3.61 mg/L N)[2] |
| Western | Caltrans | State Highway Stormwater[1] | 34.2 | 251 |

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation Total Phosphorus (lb-P/yr)[4] | Wasteload Allocation Total Nitrogen (lb-N/yr)[4] |
|---|---|---|---|---|
| Western | County of Los Angeles | MS4 Stormwater[1] | 467 | 2,818 |
| Western | Monrovia | MS4 Stormwater[1] | 425 | 2,678 |
| Western | Sierra Madre | MS4 Stormwater[1] | 695 | 4,254 |
| Western | Angeles National Forest | Stormwater[1] | 240 | 6,981 |
| **Total** | | | **19,319** | **186,845** |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. The disturbed area associated with general construction and general industrial stormwater permittees (510 acres) was subtracted out of the appropriate city areas and allocated to these permits. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations (see footnote #3).

[3] For these responsible jurisdictions, the concentration-based WLA will be used to evaluate compliance.

[4] Each wasteload allocation must be met at the point of discharge. A three year average will be used to evaluate compliance. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met in the lake, then the total phosphorous and total nitrogen allocations are considered attained.

### 4.2.6.2 Load Allocations

Atmospheric deposition of nitrogen to the lake surface is a nonpoint source and is assigned a load allocation (LA). Table 4-9 presents the LAs for atmospheric deposition, which are equivalent to existing loading rates because no reductions in loading are required. Atmospheric deposition does not contribute significant loads of phosphorus (Appendix E, Atmospheric Deposition). These loading values (in pounds per year) represent the TMDL load allocations (Table 4-9). Each load allocation must be met at the point of discharge. A three-year average will be used to evaluate compliance. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met in the lake, then the total phosphorous and total nitrogen allocations are considered attained.

**Table 4-9. Load Allocations of Nitrogen Loading to Peck Road Park Lake**

| Input | Load Allocation Total Phosphorus (lb-P/yr)[1] | Load Allocation Total Nitrogen (lb-N/yr)[1] |
|---|---|---|
| Atmospheric Deposition (to the lake surface)[2] | NA | 69 |
| **Total** | **NA** | **69** |

[1] Each load allocation must be met at the point of discharge. A three year average will be used to evaluate compliance. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met in the lake, then the total phosphorous and total nitrogen allocations are considered attained.

[2] Loads for atmospheric deposition are based on direct precipitation to the lake (calculated by the annual average precipitation multiplied by the surface area of the lake).

### 4.2.6.3 Margin of Safety

TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. This lake is currently achieving the in-lake chlorophyll *a* target and TMDLs are being established at the existing loads. This conservative anti-degradation measure is the implicit margin of safety for these TMDLs.

#### 4.2.6.4 Critical Conditions/Seasonality

TMDLs must include consideration of critical conditions and seasonal variation to ensure protection of the designated uses of the waterbody at all times. Critical conditions for nutrient impaired lakes typically occur during the warm summer months when water temperatures are elevated and algal growth rates are high. Elevated temperatures not only reduce the saturation levels of DO, but also increase the toxicity of ammonia and other chemicals in the water column. Excessive rates of algal growth may cause large swings in DO, elevated pH, odor, and aesthetic problems. Loading of nutrients to lakes during winter months are often biologically available to fuel algal growth in summer months. These nutrient TMDLs account for summer season critical conditions by using the NNE Bathtub model to calculate possible annual loading rates consistent with meeting the summer chlorophyll *a* target concentration of 20 µg/L. These TMDLs are based on existing conditions as an anti-degradation measure since nitrogen and phosphorus levels are currently achieving the chlorophyll *a* target level. These TMDLs therefore protect for critical conditions.

#### 4.2.6.5 Daily Load Expression

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. These TMDLs present a maximum daily load according to the guidelines provided by USEPA (2007). Because the majority of nutrient loading to Peck Road Park Lake occurs during wet weather events that deliver pollutant loads from both the surrounding watershed and diversions from the San Gabriel River, the daily maximum allowable loads of nitrogen and phosphorus are calculated from the maximum daily storm flow rate (estimated from the 99$^{th}$ percentile flow) to the Lake multiplied by the average allowable concentrations consistent with achieving the long-term loading targets. These maximum loads must be met each day of the year because the annual loads specified by the TMDLs must also be achieved. The WLA and LA loads presented above are annual loading caps that cannot be exceeded.

No USGS gage currently exists in the Peck Road Park Lake watershed, but there is a gage downstream. USGS Station 11101250, Rio Hondo above Whittier Narrows Dam, was selected as a surrogate for flow determination. The 99$^{th}$ percentile flow was chosen to represent the peak flow for this drainage. Choosing the 99$^{th}$ percentile flow eliminates errors due to outliers and is reasonable for development of a daily load expression.

The USGS StreamStats program was used to determine the 99$^{th}$ percentile flow for Rio Hondo (952 cfs) (Wolock, 2003). To estimate the peak flow to Peck Road Park Lake from the surrounding watershed, the 99$^{th}$ percentile flow for Rio Hondo was scaled down by the ratio of drainage areas (23,564 acres/58,368 acres; Peck Road Park Lake watershed area/Rio Hondo watershed area at the gage). The resulting peak flow estimate for Peck Road Park Lake is 384 cfs. The 99$^{th}$ percentile diverted flow from the San Gabriel River to Peck Road Park Lake is 328 cfs. Therefore, the total peak daily flow rate is 712 cfs.

The average allowable concentrations of phosphorus and nitrogen were calculated from the allowable loads (19,319 lb-P/yr and 186,914 lb-N/yr, respectively) divided by the total volume reaching the lake from runoff and diversions (19,034 ac-ft) (Table 4-7). Multiplying the average allowable concentrations (0.37 mg-P/L for phosphorous and 3.61 mg-N/L for nitrogen) by the 99$^{th}$ percentile peak daily flow (712 cfs) yields the daily maximum load associated with wet weather runoff. The wet weather runoff daily maximum allowable loads of phosphorus and nitrogen for Peck Road Park Lake are 1,433 lb-P/d and 13,868 lb-N/d, respectively. These loads are associated with the MS4 stormwater permittees and the water diversion. As described above, in order to achieve in-lake nutrient targets as well as annual load-based allocations, the maximum allowable daily loads cannot be discharged to the lake every day. The WLA and LA loads presented above are annual loading caps that cannot be exceeded.

#### 4.2.6.6 Future Growth

Much of the Peck Road Park Lake watershed remains in forested and other undisturbed land uses. As development occurs in this watershed, best management practices (BMPs) will be required such that loading rates are consistent with the allocations established by these TMDLs. Therefore, no load allocation has been set aside for future growth. It is unlikely that any dischargers of significant nutrient loading will be permitted in the watershed.

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

## 4.3 Lead Impairment

Peck Road Park Lake was listed as impaired for lead in 1996 based on an assessment in the Regional Board's Water Quality Assessment and Documentation Report (LARWQCB, 1996). Consistent with project plan recommendations provided in California's Impaired Waters Guidance (SWRCB, 2005), USEPA and local agencies collected 30 additional samples (12 wet weather) between December 2008 and September 2010 to evaluate current water quality conditions. There were zero dissolved lead exceedances in 30 samples (Appendix G, Monitoring Data). USEPA also collected two sediment samples during September 2010 to further evaluate lake conditions. There were zero sediment lead exceedances of the 128 ppm freshwater (Probable Effect Concentrations) sediment target (Appendix G, Monitoring Data). Therefore, Peck Road Park Lake meets lead water quality standards, and USEPA concludes that preparing a TMDL for lead is unwarranted at this time. USEPA recommends that Peck Road Park Lake not be identified as impaired by lead in California’s next 303(d) list.

## 4.4 PCB Impairment

Polychlorinated biphenyls (PCBs) consist of a family of many related congeners. The individual congeners are often referred to by their “BZ” number. Environmental analyses may address individual congeners, homologs (groups of congeners with the same number of chlorine atoms), equivalent concentrations of the commercial mixtures of PCBs known by the trade name Aroclors, or total PCBs. The environmental measurements and targets described in this section are in terms of total PCBs, defined as the “sum of all congener or isomer or homolog or Aroclor analyses” (CTR, 40 CFR 131.38(b)(1) footnote v).

The PCB impairment of Peck Road Park Lake affects beneficial uses related to recreation, municipal water supply, wildlife health, and fish consumption. PCBs are no longer in production. While some loading of PCBs continues to occur in watershed runoff, the primary source of PCBs in the water column and aquatic life in Peck Road Park Lake is from historic loads stored in the lake sediments. Like other organochlorine compounds, PCBs accumulate in aquatic organisms and biomagnify in the food chain. As a result, low environmental exposure concentrations can result in unacceptable levels in higher trophic level fish in the lake.

## 4.4.1 Problem Statement

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. Peck Road Park Lake was not identified specifically in the Basin Plan; therefore, the beneficial uses associated with the downstream segment (Rio Hondo below Spreading Grounds) apply: REC1, REC2, WARM, WILD, MUN, and GWR (personal communication, Regional Board, December 22, 2009). Descriptions of these uses are listed in Section 2 of this TMDL report. Elevated levels of PCBs potentially impair the REC1, REC2, WARM, WILD, and MUN uses by causing toxicity to aquatic organisms and raising fish tissue concentrations to levels that are unsafe for human consumption (which can result in fish consumption advisories) and impairing sport fishing recreational uses.

## 4.4.2 Numeric Targets

The Basin Plan designates water column concentrations associated with MUN and WARM beneficial uses. There are no numeric criteria specified for sediment or fish tissue concentrations of PCBs in the Basin Plan. For the purposes of this TMDL, additional numeric targets for these endpoints are based on the consensus-based sediment quality guidelines defined in MacDonald et al. (2000) and the fish tissue concentration goal, referred to as the fish contaminant goal (FCG), defined by OEHHA (2008) for fish consumption. The numeric targets used for PCBs are listed below. The fish tissue concentration goal was also used to back calculate site-specific targets in sediment, with the most stringent target applying. See Section 2 of this TMDL report for additional details.

The water column criteria for PCBs in the Basin Plan are associated with a specific beneficial use. For waters designated MUN, the Basin Plan lists a maximum contaminant level of 0.0005 mg/L, or 0.5 μg/L, total PCBs in water. The Plan also contains a narrative criterion that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Each waterbody addressed in this report is designated WARM, at a minimum, and must meet this requirement. A chronic criterion for the sum of PCB compounds in freshwater systems to protect aquatic life is included in the CTR as 0.014 μg/L (USEPA, 2000a). The CTR also provides a human health-based water quality criterion for the consumption of both water and organisms and organisms only of 0.00017 μg/L (0.17 ng/L). The human health criterion of 0.17 ng/L is the most restrictive applicable criteria specified for water column concentrations and is selected as the water column target.

For sediment, the consensus-based sediment quality guidelines provided in MacDonald et al. (2000) for the threshold effects concentration (TEC) for total PCBs in sediment is 59.8 μg/kg dry weight. The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. This target is designed to protect benthic dwelling organisms and explicitly does not consider "the potential for bioaccumulation in aquatic organisms nor the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans)." The existing sediment PCB concentrations in Peck Road Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Thus, a separate sediment target calculation based on a biota-sediment accumulation factor (BSAF) is carried out to ensure that fish tissue concentration goals are met.

The fish contaminant goal for PCBs defined by OEHHA (2008) is 3.6 ppb wet weight in muscle tissue (filets). Elevated fish tissue concentrations are largely attributable to foodweb bioaccumulation derived from contaminated sediment. A biota-sediment accumulation factor (BSAF) approach is appropriate to correlate sediment and fish tissue targets. For total PCBs, the corresponding sediment concentration target determined using the BSAF is 1.29 µg/kg dry weight, as described in detail in Section 4.4.5. All applicable targets are shown below in Table 4-10. For sediment, the lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target.

**Table 4-10. PCB Targets Applicable to Peck Road Park Lake**

| Medium | Source | Target |
|---|---|---|
| Fish (ppb wet weight) | OEHHA FCG | 3.6 |
| Sediment (µg/kg dry weight) | Consensus-based TEC | 59.8 |
| Sediment (µg/kg dry weight) | BSAF-derived target | 1.29 |
| Water (ng/L) | CTR | 0.17 |

Note: Shaded cells represent the selected targets for this TMDL.

### 4.4.3 Summary of Monitoring Data

This section summarizes the monitoring data for Peck Road Park Lake related to the PCB impairment. Additional details regarding monitoring data are discussed in Appendix G (Monitoring Data).

For PCBs, as well as other organochlorine compounds, sample analyses include both a detection limit and a method reporting limit. For example, a typical detection limit for total PCBs in sediment reported by UCLA is 0.53 µg/kg dry weight, while the reporting limit is 15 µg/kg dry weight.

Water column sampling was conducted as part of an organics study performed by UCLA (funded by a grant managed by the Regional Board) in the summer of 2008 at five locations (six samples) and again in the fall of 2008 at two locations (three samples) in Peck Road Park Lake and its tributaries. Three of the samples collected during the summer were below detectable levels (1.5 – 1.58 ng/L; which is greater than the ambient water quality criterion of 0.17 ng/L), while two samples collected in the summer of 2008 and both samples collected in the fall of 2008 had detections of PCB congeners, but at levels too low to be quantified (at reporting limits of 15 – 16.67 ng/L). As the detection limit is greater than the CTR target these samples are greater than the ambient water quality criterion of 0.17 ng/L.

Additional water column sampling was conducted by the Regional Board on December 11, 2008 at four in-lake locations in Peck Road Park Lake. All four sites sampled were below detectable concentrations of PCBs (1 ng/L; the detection limit is above the water quality criterion). A summary of the water column data is shown in Table 4-11.

**Table 4-11. Summary of Water Column Samples for PCBs in Peck Road Park Lake**

| Station | Average Water Concentration (ng/L)[1] | Number of Samples | Number of Samples above Detection Limits | Number of Samples between Detection and Reporting Limits |
|---|---|---|---|---|
| Sawpit Wash | [8.64] | 2 | 2 | 2 |
| Santa Anita Wash | [4.31] | 3 | 2 | 2 |
| North Basin Outfall | (0.76) | 2 | 0 | 0 |
| North Basin | (0.60) | 2 | 0 | 0 |
| South Basin | [2.30] | 2 | 1 | 1 |
| South Basin East | (0.50) | 1 | 0 | 0 |

| Station | Average Water Concentration (ng/L)[1] | Number of Samples | Number of Samples above Detection Limits | Number of Samples between Detection and Reporting Limits |
|---|---|---|---|---|
| South Basin West Side | (0.50) | 1 | 0 | 0 |
| In-Lake Average[2] | [2.37] | | | |
| Water Column Target | 0.17 | | | |

[1] Total PCBs in a sample represents the sum of all quantified PCB congeners, including results reported below the method reporting limit. If all congeners were non-detect, the total is represented as one-half the detection limit. Results of any laboratory duplicate analyses of the same sample were averaged. Results for each station represent the average of individual samples. Results in parentheses indicate that the sample average is based only on the detection limits of the samples and that no PCBs were quantified in any of the collected samples. Sample averages based only on detected results below the reporting limit plus non-detects are shown in square brackets.

[2] Overall average is the average of individual station averages (excludes the tributary samples).

Concentrations of PCBs on suspended sediment were also analyzed at two in-lake stations during the summer and fall of 2008 as part of the UCLA study; one location was analyzed during the summer and two during the fall. During the summer event, PCB congener BZ-110 was detected below reporting limits (51.35 µg/kg dry weight), and the fall sampling detected congeners, including BZ-138 and BZ-180, but each was below reporting limits (23.63 µg/kg to 144.23 µg/kg dry weight).

Porewater was sampled as part of the UCLA study in the summer and fall of 2008. During the summer event, two of the four PCB samples were less than the detection limit of 15 ng/L, while the other two samples had detected, but not reportable concentrations (<150 ng/L). The three sites sampled for porewater during the fall of 2008 were all below the detection limit of 15 ng/L for total PCBs. Three porewater suspended sediment samples collected in the summer of 2008 were below reportable levels for total PCBs (22.55 µg/kg to 66.03 µg/kg dry weight), and one sample was below the detection limit of 9.25 µg/kg dry weight.

Suspended solids (TSS) from Peck Road Park Lake were collected in the summer and fall of 2008. In summer of 2008, only one station had enough suspended matter to perform the analysis. None of the pesticides were detected in the sample (detection limit of 5.14 µg/kg dry weight). PCB-110 was detected, but not within reportable limits (reporting limit of 51.35 µg/kg dry weight). In fall 2008, samples were analyzed at two stations with detection limits ranging from 2.36 µg/kg to 20.41 µg/kg dry weight. In one sample, PCB congener BZ-138 was detected, but not within reportable limits (reporting limit of 23.63 µg/kg dry weight), while BZ-180 was detected in the other sample, but below reporting limits (reporting limit of 144.23 µg/kg dry weight).

UCLA also collected bed sediment samples at four locations in Peck Road Park Lake in summer and fall 2008. Samples related to tributaries were collected in the lake near the tributary outfall. Two of the nine lake sediment samples collected during 2008 had reportable levels of PCBs, with a maximum of 276 µg/kg dry weight (in excess of the consensus-based TEC value of 59.8 µg/kg dry weight). Four in-lake locations were sampled by USEPA and the county of Los Angeles on November 16, 2009; total PCB concentrations ranged from 1.0 µg/kg to 23.3 µg/kg dry weight. All lake stations were averaged to estimate an exposure concentration of 12.28 µg/kg dry weight total PCBs (with non-detects included at one-half the detection limit for each sample). Stations located near outfalls, are taken as an estimate of the concentrations on incoming sediment. A summary of the sediment data is shown in Table 4-12.

Fish tissue concentrations of total PCBs from Peck Road Park Lake have been analyzed in largemouth bass (SWAMP and TSMP) by composite samples consisting of filet tissue from five fish. Total PCB concentrations in the fish tissue resulted in concentrations of 22.7 and 55.3 ppb, in two largemouth bass composite samples taken during the summer of 2007, while an April 2010 composite resulted in a concentration of 25.3 ppb total PCBs, both in excess of the fish tissue target for total PCBs (FCG of 3.6 ppb). Earlier analyses for PCB Aroclor analyzed from 1986-1992 resulted in nondetectable concentrations (at an unreported detection limit) in all four largemouth bass samples. Considering only data collected in the past 10 years, the average concentration of PCBs in largemouth bass was 34.4 ppb. This average is based on the three largemouth bass composite samples collected in 2007 and 2010 with an average lipid fraction of 0.54 percent. Recent fish-tissue data for Peck Road Park Lake are summarized in Table 4-13. Bottom-feeding fish data (e.g., carp) are not available for Peck Road Park Lake.

**Table 4-12. Summary of Sediment Samples for PCBs in Peck Road Park Lake, 2008-2009**

| Station | Average Sediment Concentration (µg/kg dry weight)[1] | Number of Samples | Number of Samples above Detection Limits | Number of Samples between Detection and Reporting Limits |
|---|---|---|---|---|
| Near Sawpit Wash | 5.89 | 1 | 1 | 0 |
| Near Santa Anita Wash | 49.52 | 3 | 2 | 0 |
| North Basin | 7.12 | 4 | 3 | 1 |
| South Basin | [5.07] | 3 | 2 | 2 |
| North Inlet | [1.00] | 1 | 1 | 1 |
| South Inlet | [5.10] | 1 | 1 | 1 |
| In-Lake Average[2] | 12.28 | | | |
| Influent Average | 15.38 | | | |
| Consensus-based TEC | 59.8 | | | |

[1] Total PCBs in a sample represents the sum of all quantified PCB congeners, including results reported below the method reporting limit. If all congeners were non-detect, the total is represented as one-half the detection limit. Results of any laboratory duplicate analyses of the same sample were averaged. Results for each station represent the average of individual samples. Results in parentheses indicate that the sample average is based only on the detection limits of the samples and that no PCBs were quantified in any of the collected samples. Sample averages based only on detected results below the reporting limit plus non-detects are shown in square brackets.
[2] Overall average is the average of individual station averages.

**Table 4-13. Summary of Recent Fish Tissue Samples for PCBs in Peck Road Park Lake**

| Sample Date | Fish Species | Total PCBs (ppb wet weight)[1] |
|---|---|---|
| 6 June 2007 | Largemouth Bass | 55.3 |
| 6 June 2007 | Largemouth Bass | 22.7 |
| 19 April 2010 | Largemouth Bass | 25.3 |
| 2007 – 2010 Average | | 34.4 |
| FCG | | 3.6 |

[1] Composite samples of filet from five individuals.

In sum, recent fish tissue samples collected from Peck Road Park Lake are an order of magnitude greater than the OEHHA fish consumption guidelines for total PCBs. Measured concentrations in sediment are below the consensus-based TEC. Concentrations in water have not exceeded method reporting limits; however, several recent samples were above detection limits that themselves exceed the CTR criterion.

### 4.4.4 Source Assessment

PCBs in Peck Road Park Lake are primarily due to historical loading and storage within the lake sediments, with some ongoing contribution by watershed wet weather loads. Dry weather loading is assumed to be negligible because hydrophobic contaminants primarily move with particulate matter that is mobilized by higher flows. Stormwater loads from the watershed were estimated based on simulated sediment load and observed PCB concentrations on sediment near inflows to the lake.

Watershed loads of PCBs may arise from spills from industrial and commercial uses, improper disposal, and atmospheric deposition. Industrial and commercial spills will tend to be associated with specific land areas, such as older industrial districts, junk yards, and transformer substations. Improper disposal could have occurred at various locations (indeed, waste PCB oils were sometimes used for dust control on dirt roads in the 1950s). Atmospheric deposition occurs across the entire watershed.

There is no definitive information on specific sources of elevated PCB load within the watershed at this time. Therefore, an average concentration of sediment is applied to all contributing areas. The average concentration of PCBs on incoming sediment was estimated to be 15.38 µg/kg dry weight and the estimated annual sediment load to Peck Road Park Lake is 990.3 tons/yr, including sediment delivered through the water diversion (see Appendix D, Wet Weather Loading). The resulting estimated wet weather load of PCBs is approximately 13.8 g/yr. Table 4-14 shows the annual PCB load estimated from each jurisdiction.

**Table 4-14. Total PCB Loads Estimated for Each Jurisdiction and Subwatershed in the Peck Road Park Watershed (g/yr)**

| Subwatershed | Responsible Jurisdiction | Input | Sediment Load (tons/yr) | Total PCB Load (g/yr) | Percent of Total Load |
|---|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 12.1 | 0.17 | 1.22% |
| Eastern | Bradbury | MS4 Stormwater[1] | 44.4 | 0.62 | 4.48% |
| Eastern | Caltrans | State Highway Stormwater[1] | 9.6 | 0.13 | 0.96% |
| Eastern | Duarte | MS4 Stormwater[1] | 57.2 | 0.80 | 5.78% |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 0.8 | 0.01 | 0.08% |
| Eastern | Irwindale | MS4 Stormwater[1] | 23.3 | 0.33 | 2.36% |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 1.6 | 0.02 | 0.16% |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 28.6 | 0.40 | 2.89% |
| Eastern | Monrovia | MS4 Stormwater[1] | 200 | 2.80 | 20.24% |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 16.3 | 0.23 | 1.65% |
| Eastern | Angeles National Forest | Stormwater[1] | 12.1 | 0.17 | 1.22% |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 379 | 5.29 | 38.31% |
| Near Lake | Arcadia | MS4 Stormwater[1] | 7.6 | 0.11 | 0.77% |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 1.7 | 0.02 | 0.17% |

| Subwatershed | Responsible Jurisdiction | Input | Sediment Load (tons/yr) | Total PCB Load (g/yr) | Percent of Total Load |
|---|---|---|---|---|---|
| Near Lake | El Monte | MS4 Stormwater[1] | 3.5 | 0.05 | 0.36% |
| Near Lake | Irwindale | MS4 Stormwater[1] | 1.7 | 0.02 | 0.17% |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 4.0 | 0.06 | 0.41% |
| Near Lake | Monrovia | MS4 Stormwater[1] | 2.6 | 0.04 | 0.26% |
| Western | Arcadia | MS4 Stormwater[1] | 68.1 | 0.95 | 6.88% |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 37.8 | 0.53 | 3.82% |
| Western | Caltrans | State Highway Stormwater[1] | 2.1 | 0.03 | 0.21% |
| Western | County of Los Angeles | MS4 Stormwater[1] | 14.7 | 0.21 | 1.49% |
| Western | Monrovia | MS4 Stormwater[1] | 9.3 | 0.13 | 0.94% |
| Western | Sierra Madre | MS4 Stormwater[1] | 19.9 | 0.28 | 2.01% |
| Western | Angeles National Forest | Stormwater[1] | 31.4 | 0.44 | 3.18% |
| **Total Load from Watershed** | | | **990.3** | **13.7** | **100%** |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. The disturbed area associated with general construction and general industrial stormwater permittees (510 acres) was subtracted out of the appropriate city areas and allocated to these permits.

As described in Appendix E (Atmospheric Deposition), Section E.5, the net atmospheric deposition of PCBs directly to the lake surface is estimated to be close to zero, with deposited loads balanced by volatilization losses. Atmospheric deposition onto the watershed is implicitly included in the estimates of watershed load.

### 4.4.5 Linkage Analysis

The linkage analysis provides the quantitative basis for determining the loading capacity of PCBs into Peck Road Park Lake consistent with achieving water quality standards. The loading capacity is used to calculate the TMDL and corresponding allocations of that load to permitted point sources (wasteload allocations) and nonpoint sources (load allocations).

Lake sediments are often the predominant source of PCBs in biota. The bottom sediment serves as a sink for organochlorine compounds that can be recycled through the aquatic life cycle. PCBs are strongly sorbed to sediments and have long half-lives in sediment and water. Incoming loads of PCBs will mainly be adsorbed to particulates from stormwater runoff (eroded sediments from legacy contamination sites or from atmospheric deposition).

The use of bioaccumulation models and the fish tissue data in Peck Road Park Lake are discussed in detail in Appendix H (Organochlorine Compounds TMDL Development) and Appendix G (Monitoring Data), respectively. The existing sediment PCB concentrations in Peck Road Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Therefore, a sediment target to achieve FCGs is calculated based on biota-sediment bioaccumulation (a BSAF approach), using the ratio of the FCG to existing fish tissue concentrations of 3.6/34.4 = 0.105. This ratio is applied to the observed in-lake sediment concentration of 12.28 µg/kg dry weight to obtain the site-specific sediment target concentration to achieve fish tissue goals of 1.29 µg/kg dry weight. The fish tissue-based target concentrations were calculated using only recent data (collected in the past 10 years) because the loads and exposure concentrations of PCBs are likely to have declined steadily since the cessation of production and use of the chemical. The resulting fish-tissue based concentration of PCBs in the sediment of Peck Road Park Lake is shown in Table 4-15.

The BSAF-derived sediment target is less than the consensus-based sediment quality guideline TEC of 59.8 µg/kg dry weight. (The consensus-based sediment quality guideline is for the protection of benthic organisms, and explicitly does not address bioaccumulation and human-health risks from the consumption of contaminated fish.) The lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target. In addition, the CTR criterion for human health (0.17 ng/L) is the selected numeric target for the water column and protects both aquatic life and human health.

**Table 4-15. Fish Tissue-Based Total PCB Concentration Targets for Sediment in Peck Road Park Lake**

| Total PCB Concentration | Sediment (µg/kg dry weight) |
|---|---|
| Existing | 12.28 |
| BSAF-derived target | 1.29 |
| Required Reduction | 89.5% |

The toxicant loading model described in Appendix H (Organochlorine Compounds TMDL Development) can be used to estimate the loading rate that would be required to yield the existing sediment concentration under steady-state conditions. This yields an estimate that a load of 1,005 g/yr would be required to maintain observed sediment concentrations under steady-state conditions. The estimated current watershed loading rate is 13.8 g/yr, or 1.4 percent of this amount. Therefore, impairment due to elevated fish tissue concentrations of PCBs in Peck Road Park Lake is primarily due to the storage of historic loads of PCBs in the lake sediment.

## 4.4.6 TMDL Summary

Because PCB impairment in Peck Road Park Lake is predominantly due to historic loads stored in the lake sediment, this impairment is not amenable to a direct calculation of loading capacity expressed as mass per unit time. Instead, allocations are first assigned on a concentration basis, with the goal of attaining the concentrations identified above for water and sediment, as well as fish tissue. The concentration targets apply to water and sediment entering the lake and within the lake.

The PCB TMDL will be allocated to ensure achievement of the loading capacity. TMDLs are broken down into the wasteload allocations (WLAs), load allocations (LAs), and Margins of Safety (MOS) using the general TMDL equation.

$$TMDL = \sum WLA + LA + MOS$$

Note that since this TMDL is being expressed as a concentration in sediment, in this scenario, the loading capacity is equal to 1.29 µg/kg dry weight total PCBs. The wasteload allocations and load allocations are also equal to 1.29 µg/kg dry weight total PCBs in sediment. There is no explicit MOS. Allocations are assigned for this TMDL by requiring equal concentrations of all sources. Details associated with the WLAs, LAs, and MOS are presented in the following three sections.

### 4.4.6.1 Wasteload Allocations

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs). This TMDL establishes WLAs at their point of discharge. This TMDL also establishes alternative wasteload allocations for total PCBs ("Alternative WLAs if the Fish Tissue Target is Met") described in Section 4.4.6.1.2. The alternative wasteload allocations will supersede the wasteload allocations in Section 4.4.6.1.1 if the conditions described in Section 4.4.6.1.2 are met.

#### *4.4.6.1.1 Wasteload Allocations*

The entire watershed of Peck Road Park Lake is contained in MS4 jurisdictions, and watershed loads are therefore assigned WLAs. The Caltrans areas and facilities that operate under a general industrial stormwater permit also receive WLAs.

Relevant permit numbers are

- County of Los Angeles (including the cities of Arcadia, Bradbury, Duarte, Irwindale, Monrovia, and Sierra Madre): Board Order 01-182 (as amended by Order No. R4-2006-0074 and R4-2007-0042), CAS004001
- Caltrans: Order No 99-06-DWQ, CAS000003
- General Industrial Stormwater: Order No. 97-03-DWQ, CAS000001

PCBs in water flowing into Peck Road Park Lake are below detection limits, and most PCB load is expected to move in association with sediment. Therefore, no separate wasteload allocation or reduction is explicitly assigned to the Colorado Well Aquifer (Order No. R4-2003-0108, CAG994005) as it is not expected to deliver sediment loads. The suspended sediment in water flowing into the lake is assigned wasteload allocations. Additionally, the TMDL establishes wasteload allocations for PCBs in the water column equal to the CTR based water column target. The CTR based water column target includes both dissolved PCBs and PCBs associated with suspended sediment. The existing concentration of sediment entering the lake is 15.38 µg/kg dry weight. Therefore, a reduction of 91.6 percent [(15.38 – 1.29)/15.38*100] is required on the sediment-associated load from the watershed.

The wasteload allocations are shown in Table 4-16 and each wasteload allocation must be met at the point of discharge.

**Table 4-16. Wasteload Allocations for Total PCBs in Peck Road Park Lake**

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation for PCBs Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for PCBs in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 1.29 | 0.17 |
| Eastern | Bradbury | MS4 Stormwater[1] | 1.29 | 0.17 |
| Eastern | Caltrans | State Highway Stormwater[1] | 1.29 | 0.17 |
| Eastern | Duarte | MS4 Stormwater[1] | 1.29 | 0.17 |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 1.29 | 0.17 |
| Eastern | Irwindale | MS4 Stormwater[1] | 1.29 | 0.17 |

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation for PCBs Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for PCBs in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 1.29 | 0.17 |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 1.29 | 0.17 |
| Eastern | Monrovia | MS4 Stormwater[1] | 1.29 | 0.17 |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 1.29 | 0.17 |
| Eastern | Angeles National Forest | Stormwater[1] | 1.29 | 0.17 |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 1.29 | 0.17 |
| Near Lake | Arcadia | MS4 Stormwater[1] | 1.29 | 0.17 |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 1.29 | 0.17 |
| Near Lake | El Monte | MS4 Stormwater[1] | 1.29 | 0.17 |
| Near Lake | Irwindale | MS4 Stormwater[1] | 1.29 | 0.17 |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 1.29 | 0.17 |
| Near Lake | Monrovia | MS4 Stormwater[1] | 1.29 | 0.17 |
| Western | Arcadia | MS4 Stormwater[1] | 1.29 | 0.17 |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 1.29 | 0.17 |
| Western | Caltrans | State Highway Stormwater[1] | 1.29 | 0.17 |
| Western | County of Los Angeles | MS4 Stormwater[1] | 1.29 | 0.17 |
| Western | Monrovia | MS4 Stormwater[1] | 1.29 | 0.17 |
| Western | Sierra Madre | MS4 Stormwater[1] | 1.29 | 0.17 |
| Western | Angeles National Forest | Stormwater[1] | 1.29 | 0.17 |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

#### *4.4.6.1.2 Alternative Wasteload Allocations if the Fish Tissue Target is Met*

The wasteload allocations listed in Table 4-16 will be superseded, and the wasteload allocations in Table 4-17 will apply, if:

1. The responsible jurisdictions submit to USEPA and the Regional Board material describing that the fish tissue target of 3.6 ppb wet weight has been met for the preceding three or more years. A

demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five largemouth bass each measuring at least 350mm in length,

2. The Regional Board Executive Officer approves the request and applies the alternative wasteload allocations in Table 4-17, and
3. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

Each wasteload allocation must be met at the point of discharge.

**Table 4-17. Alternative Wasteload Allocations for Total PCBs in Peck Road Park Lake if the Fish Tissue Target is Met**

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation for PCBs Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for PCBs in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 59.8 | 0.17 |
| Eastern | Bradbury | MS4 Stormwater[1] | 59.8 | 0.17 |
| Eastern | Caltrans | State Highway Stormwater[1] | 59.8 | 0.17 |
| Eastern | Duarte | MS4 Stormwater[1] | 59.8 | 0.17 |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 59.8 | 0.17 |
| Eastern | Irwindale | MS4 Stormwater[1] | 59.8 | 0.17 |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 59.8 | 0.17 |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 59.8 | 0.17 |
| Eastern | Monrovia | MS4 Stormwater[1] | 59.8 | 0.17 |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 59.8 | 0.17 |
| Eastern | Angeles National Forest | Stormwater[1] | 59.8 | 0.17 |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 59.8 | 0.17 |
| Near Lake | Arcadia | MS4 Stormwater[1] | 59.8 | 0.17 |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 59.8 | 0.17 |
| Near Lake | El Monte | MS4 Stormwater[1] | 59.8 | 0.17 |
| Near Lake | Irwindale | MS4 Stormwater[1] | 59.8 | 0.17 |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 59.8 | 0.17 |
| Near Lake | Monrovia | MS4 Stormwater[1] | 59.8 | 0.17 |
| Western | Arcadia | MS4 Stormwater[1] | 59.8 | 0.17 |
| Western | General Industrial Stormwater Permittees (in | General Industrial Stormwater[1] | 59.8 | 0.17 |

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation for PCBs Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for PCBs in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| | the city of Arcadia) | | | |
| Western | Caltrans | State Highway Stormwater[1] | 59.8 | 0.17 |
| Western | County of Los Angeles | MS4 Stormwater[1] | 59.8 | 0.17 |
| Western | Monrovia | MS4 Stormwater[1] | 59.8 | 0.17 |
| Western | Sierra Madre | MS4 Stormwater[1] | 59.8 | 0.17 |
| Western | Angeles National Forest | Stormwater[1] | 59.8 | 0.17 |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

### 4.4.6.2 Load Allocations

This TMDL establishes load allocations (LAs) at their point of discharge. This TMDL also establishes alternative load allocations for total PCBs ("Alternative LAs if the Fish Tissue Target is Met") described in Section 4.4.6.2.2. The alternative load allocations will supersede the load allocations in Section 4.4.6.2.1 if the conditions described in Section 4.4.6.2.2 are met.

#### *4.4.6.2.1 Load Allocations*

No part of the watershed of Peck Road Park Lake is outside MS4 jurisdiction; therefore no LAs are assigned to watershed loads. No load is allocated to atmospheric deposition of PCBs.

The legacy PCB stored in lake sediment is the major cause of use impairment due to elevated fish tissue concentrations, and is assigned a load allocation. The in-lake allocation is in concentration terms: specifically, the responsible jurisdiction (County of Los Angeles) should achieve a PCB concentration of 1.29 µg/kg dry weight in lake bottom sediments (Table 4-18).

**Table 4-18. Load Allocations for Total PCBs in Peck Road Park Lake**

| Subwatershed | Responsible Jurisdiction | Input | Load Allocation (µg/kg dry weight) |
|---|---|---|---|
| Lake Surface | County of Los Angeles | Lake bottom sediments | 1.29 |

#### *4.4.6.2.2 Alternative Load Allocations if the Fish Tissue Target is Met*

The load allocations listed in Table 4-18 will be superseded, and the load allocations in Table 4-19 will apply, if:

1. The responsible jurisdiction submits to USEPA and the Regional Board material describing that the fish tissue target of 3.6 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five largemouth bass each measuring at least 350mm in length,

2. The Regional Board Executive Officer approves the request and applies the alternative load allocations in Table 4-19, and
3. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

**Table 4-19. Alternative Load Allocations for Total PCBs in Peck Road Park Lake if the Fish Tissue Target is Met**

| Subwatershed | Responsible Jurisdiction | Input | Load Allocation (µg/kg dry weight) |
|---|---|---|---|
| Lake Surface | County of Los Angeles | Lake bottom sediments | 59.8 |

### 4.4.6.3 Margin of Safety

TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. This TMDL contains an implicit MOS based on conservative assumptions. The allocations are set based on the lower of either the BSAF-derived sediment target or the consensus-based TEC sediment target to ensure achievement of the OEHHA FCG target in fish tissue. The selected BSAF-derived target concentration in sediment is considerably lower than the consensus-based TEC target.

### 4.4.6.4 Critical Conditions/Seasonality

TMDLs must include consideration of critical conditions and seasonal variation to ensure protection of the designated uses of the waterbody at all times. This TMDL protects beneficial uses by reducing fish tissue concentrations to the FCG target and protecting benthic biota in sediment. Because fish bioaccumulate PCBs, concentrations in tissues of edible sized game fish integrate exposure over a number of years. As a result, overall average loading is more important for the attainment of standards than instantaneous or daily concentrations. WLAs and LAs in this TMDL are assigned as concentrations and protect during all seasons and in both high and low flow conditions. This TMDL therefore protects for critical conditions.

### 4.4.6.5 Daily Load Expression

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. This TMDL includes a maximum daily load estimated according to the guidelines provided by USEPA (2007).

Because the PCB WLAs are expressed as concentrations on sediment, the daily maximum allowable load is calculated from the maximum daily sediment load multiplied by the TMDL WLA concentration. The maximum daily sediment load is estimated from the 99$^{th}$ percentile daily flow and the sediment event mean concentration that yields the estimated annual sediment load.

No USGS gage currently exists in the Peck Road Park Lake watershed. USGS Station 11101250, on the Rio Hondo River above the Whittier Narrows Dam, was selected as a surrogate for flow determination. The 99$^{th}$ percentile flow was chosen to represent the peak flow for this drainage. Choosing the 99$^{th}$ percentile flow eliminates errors due to outliers and is reasonable for development of a daily load expression.

The USGS StreamStats program was used to determine the 99$^{th}$ percentile flow for the Rio Hondo (952 cfs) (Wolock, 2003). To estimate the peak flow to Peck Road Park Lake, the 99$^{th}$ percentile flow for the Rio Hondo was scaled down by the ratio of drainage areas (23,564 acres/58,368 acres; Peck Road Park Lake watershed area/Rio Hondo watershed area at the gage). The resulting peak flow estimate for Peck Road Park Lake is 384 cfs. The 99$^{th}$ percentile diverted flow from the San Gabriel River to Peck Road Park Lake is 328 cfs. Therefore, the total peak daily flow rate is 712 cfs.

The event mean concentration of sediment in stormwater (71.7 mg/L) was calculated from the estimated existing watershed sediment load of 990.3tons/yr (Table 4-14) divided by the stormwater flow volume entering the lake (10,158 ac-ft, Table 4-7). Multiplying the sediment event mean concentration by the 99$^{th}$ percentile peak daily flow (712 cfs) yields a daily maximum sediment load from stormwater of 137.7 tons/d. Applying the wasteload allocation concentration of 1.29 ng total PCBs per dry g of sediment yields the stormwater daily maximum allowable load of 0.161 g/d of total PCBs. This load is associated with the MS4 stormwater permittees and the water diversion. The maximum allowable daily load must be met on all days, and the concentration-based WLAs must be met to ensure compliance with the TMDL.

#### 4.4.6.6 Future Growth

USEPA regulates PCBs under the Toxic Substances Control Act (TSCA), which generally bans the manufacture, use, and distribution in commerce of the chemicals in products at concentrations of 50 parts per million or more, although TSCA allows USEPA to authorize certain uses, such as to rebuild existing electrical transformers during the transformers' useful life. Therefore, no additional allowance is made for future growth in the PCB TMDL.

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

## 4.5 Chlordane Impairment

Total chlordane consists of a family of related chemicals, including cis- and trans-chlordane, oxychlordane, trans-nonachlor, and cis-nonachlor. Observations and targets discussed in this section all refer to total chlordane. Chlordane was used as a pesticide in field, commercial, and residential uses. Chlordane is no longer in production, but persists in the environment from legacy loads.

The chlordane impairment of Peck Road Park Lake affects beneficial uses related to recreation, municipal water supply, wildlife health, and fish consumption. While some loading of chlordane continues to occur in watershed runoff, the primary source of chlordane in the water column and aquatic life in Peck Road Park Lake is from historic loads stored in the lake sediments. Chlordane, like other organochlorine compounds, accumulates in aquatic organisms and biomagnifies in the food chain. As a result, low environmental concentrations can result in unacceptable levels in higher trophic level fish in the lake. The approach for chlordane is similar to that for PCBs.

### 4.5.1 Beneficial Uses

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. Peck Road Park Lake was not identified specifically in the Basin Plan; therefore, the beneficial uses associated with the downstream segment (Rio Hondo below Spreading Grounds) apply: REC1, REC2, WARM, WILD, MUN, and GWR (personal communication, Regional Board, December 22, 2009). Descriptions of these uses are listed in Section 2 of this TMDL report. Elevated levels of chlordane are currently impairing the REC1, REC2 and WARM uses by causing toxicity to aquatic organisms and raising fish tissue concentrations to levels that are unsafe for human consumption (which can result in fish consumption advisories) and impairing sport fishing recreational uses. At high enough concentrations WILD and MUN uses could become impaired.

### 4.5.2 Numeric Targets

The Basin Plan designates water column concentrations associated with MUN and WARM beneficial uses. There are no numeric criteria specified for sediment or fish tissue concentrations of chlordane listed in the Basin Plan. For the purposes of this TMDL, additional numeric targets for these endpoints are based on the consensus-based sediment quality guidelines defined in MacDonald et al. (2000) and the fish tissue concentration goal, referred to as the fish contaminant goal (FCG), for chlordane defined by the Office of Environmental Health Hazard Assessment (OEHHA) for fish consumption. The numeric targets used for chlordane are listed below. The fish tissue concentration goal was also used to back calculate site-specific targets in sediment, with the most stringent target applying. See Section 2 of this TMDL report for additional details.

The water column criteria for chlordane in the Basin Plan are associated with a specific beneficial use. For waters designated MUN, the Basin Plan lists a maximum contaminant level of 0.0001 mg/L, or 0.1 µg/L. The Basin Plan also contains a narrative criterion that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Acute and chronic criterion for chlordane in freshwater systems are defined by the California Toxics Rule as 2.4 µg/L and 0.0043 µg/L, respectively (USEPA, 2000a). The CTR also includes human health criteria for the consumption of water and organisms and for the consumption of organisms only as 0.00057 µg/L and 0.00059 µg/L, respectively (USEPA, 2000a). For Peck Road Park Lake, the Regional Board has determined that the appropriate human health criterion is 0.00059 µg/L (0.59 ng/L) as the MUN use is not an existing use and may be removed.

For sediment, the consensus-based sediment quality guidelines provided in Macdonald et al. (2000) for the threshold effects concentration (TEC) for chlordane is 3.24 µg/kg dry weight. The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. This target is designed to protect benthic dwelling organisms and explicitly does not consider "the potential for bioaccumulation in aquatic organisms nor the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans)." The existing sediment chlordane concentrations in Peck Road Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Thus, a separate sediment target calculation based on a biota-sediment accumulation factor (BSAF) is carried out to ensure that fish tissue concentration goals are met.

The fish contaminant goal for chlordane defined by OEHHA (2008) is 5.6 ppb wet weight in muscle tissue (filets). Elevated fish tissue concentrations are largely attributable to foodweb bioaccumulation derived from contaminated sediment. A biota-sediment accumulation factor (BSAF) approach is appropriate to correlate sediment and fish tissue targets. For chlordane, the corresponding sediment concentration determined using the BSAF is 1.73 µg/kg dry weight, as described in Section 4.5.5. All applicable targets are shown below in Table 4-20. For sediment, the lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target.

**Table 4-20. Total Chlordane Targets Applicable to Peck Road Park Lake**

| Medium | Source | Target |
|---|---|---|
| Fish (ppb wet weight) | OEHHA FCG | 5.6 |
| Sediment (ng /dry g) | Consensus-based TEC | 3.24 |
| Sediment (µg/kg dry weight) | BSAF-derived target | 1.73 |
| Water (ng/L) | CTR | 0.59 |

Note: Shaded cells represent the selected targets for this TMDL.

### 4.5.3 Summary of Monitoring Data

This section summarizes the monitoring data for Peck Road Park Lake related to the chlordane impairment. Additional details regarding monitoring data are discussed in Appendix G (Monitoring Data).

Water column sampling was conducted as part of an organics study performed by UCLA (funded by a grant managed by the Regional Board) in the summer of 2008 at five locations (six samples) and again in the fall of 2008 at two locations (three samples) in Peck Road Park Lake. These samples measured cis- and trans-chlordane, but not oxychlordane or nonachlor. All of these samples were less than sample detection limits (1.5 – 1.67 ng/L; note that the detection limit for chlordane is higher than the water quality criterion of 0.59 ng/L). Additional water column sampling was conducted by the Regional Board on December 11, 2008 at four in-lake locations in Peck Road Park Lake, including the oxychlordane and nonachlor components. All four samples were below the detection limit (1 ng/L, which is also above the water quality criterion). A summary of the water column data is shown in Table 4-21. (Note that these results are identical to those shown for PCBs because all samples were non-detect and the detections limits were the same for chlordane and PCBs.)

**Table 4-21. Summary of Water Column Samples for Total Chlordane in Peck Road Park Lake**

| Station | Average Water Concentration (ng/L) | Number of Samples | Number of Samples Above Detection Limits[1] |
|---|---|---|---|
| Sawpit Wash | (0.81)[2] | 2 | 0 |
| Santa Anita Wash | (0.78) | 3 | 0 |
| North Basin Outfall | (0.76) | 2 | 0 |
| North Basin | (0.60) | 2 | 0 |
| South Basin | (0.60) | 2 | 0 |
| South Basin East | (0.50) | 1 | 0 |
| South Basin West Side | (0.50) | 1 | 0 |
| In-Lake Average[3] | (0.60) | | |
| Water Column Target | 0.59 | | |

[1] Non-detect samples were included in reported averages at one-half of the sample detection limit.

[2] Numbers in parentheses indicate that the sample is based only on the detection limits of the samples, and that no chlordane were detected in any of the collected samples.

[3] Overall average is the average of individual station averages.

In 2008, concentrations of chlordane on suspended sediment were analyzed in the summer at one location and in the fall at two locations as part of the UCLA study. All three samples were below detectable limits (2.26 µg/kg to 20.41 µg/kg dry weight). Porewater was sampled by UCLA in both the summer and fall of 2008. Specifically, chlordane concentrations in the porewater sampled at four sites during the summer of 2008 and three sites during the fall were all less than the detection limit of 15 ng/L. All four porewater suspended sediment samples collected in the summer of 2008 were below detectable levels (2.26 µg/kg to 9.25 µg/kg dry weight).

UCLA also collected sediment samples at four locations in Peck Road Park Lake in summer and fall 2008. As with the water column analyses by UCLA, these report cis- and trans-chlordane, but not oxychlordane or nonachlor. Only one of nine lake sediment samples was above the detection limit (which ranged from 0.34 µg/kg to 0.72 µg/kg dry weight) with a maximum of 7.1 µg/kg dry weight (in excess of the consensus-based TEC for sediment of 3.24 µg/kg dry weight).

Four in-lake sediment locations were sampled by USEPA and the county of Los Angeles on November 16, 2009, resulting in concentrations from 1.0 µg/kg to 19.5 µg/kg dry weight, with three of the four samples exceeding the consensus-based TEC of 3.24 µg/kg dry weight. These analyses do include oxychlordane and nonachlor. All lake stations were averaged to estimate an exposure concentration for chlordane in Peck Road Park Lake sediments of 4.14 µg/kg dry weight (with non-detects included at one-half the detection limit for each sample). Stations located near outfalls, are taken as an estimate of the concentrations on incoming sediment. A summary of the sediment data is shown in Table 4-22.

**Table 4-22. Summary of Sediment Samples for Total Chlordane in Peck Road Park Lake**

| Station | Average Sediment Concentration (ng dry/g)[1] | Number of Samples | Number of Samples above Detection Limits | Number of Samples between Detection Limit and Reporting Limit |
|---|---|---|---|---|
| Near Sawpit Wash | (0.19) | 1 | 0 | 0 |
| Near Santa Anita Wash | (0.23) | 3 | 0 | 0 |
| North Basin | 5.96 | 4 | 2 | 0 |
| South Basin | 6.30 | 3 | 1 | 0 |
| North Inlet | [1.00] | 1 | 1 | 1 |
| South Inlet | 11.20 | 1 | 1 | 0 |
| In-Lake Average[2] | 4.14 | | | |
| Influent Average | 3.15 | | | |
| Consensus-based TEC | 3.24 | | | |

[1] Total chlordane in a sample represents the sum of all reported measurements for alpha and gamma chlordane, oxychlordane, and cis- and trans-nonachlor, including results reported below the method reporting limit. If all components were non-detect, the total is represented as one-half the detection limit. Results of any laboratory duplicate analyses of the same sample were averaged. Results for each station represent the average of individual samples. Results in parentheses indicate that the sample average is based only on the detection limits of the samples and that no chlordane quantified in any of the collected samples. Sample averages based only on detected results below the reporting limit plus non-detects are shown in square brackets.

[2] Overall average is the average of individual station averages.

Fish tissue concentrations of total chlordane from Peck Road Park Lake have been analyzed in largemouth bass (SWAMP and TSMP). Four largemouth bass samples collected between 1986 and 1992 ranged from non-detect to 42 ppb with an average of 21 ppb, well in excess of the FCG for chlordane

(5.6 ppb). Because chlordane is no longer in use, fish tissue concentrations are likely to have declined since these samples were taken. Recent fish tissue concentrations of chlordane have been analyzed in largemouth bass in two composite samples of filet tissue from five fish collected in summer 2007 and another composite sample collected in April 2010 (Table 4-23). These had an average total chlordane concentration of 13.44 ppb, in excess of the FCG. The average lipid fraction was 0.54 percent. Data from bottom-feeding fish (e.g., carp) are not available for Peck Road Park Lake.

**Table 4-23. Summary of Recent Fish Tissue Samples for Total Chlordane in Peck Road Park Lake**

| Sample Date | Fish Species | Total Chlordane (ppb wet weight)[1] |
|---|---|---|
| 6 June 2007 | Largemouth Bass | 19.212 |
| 6 June 2007 | Largemouth Bass | 8.637 |
| 19 April 2010 | Largemouth Bass | 12.465 |
| 2007 - 2010 Average | | 13.44 |
| FCG | | 5.6 |

[1]Composite sample of filets from five individuals.

In sum, recent fish tissue concentrations in Peck Road Park Lake are consistently above the FCG in the three available largemouth bass composite samples. The average concentration in sediment is below the consensus-based TEC, although individual samples exceed the TEC. Water column samples have all been below detection limits.

### 4.5.4 Source Assessment

Chlordane in Peck Road Park Lake is primarily due to historical loading and storing within the lake sediments, with some ongoing contribution by watershed wet weather loads. Dry weather loading is assumed to be negligible because hydrophobic contaminants primarily move with particulate matter that is mobilized by higher flows. Stormwater loads from the watershed were estimated based on simulated sediment load and observed chlordane concentrations on sediment near inflows to the lake. Watershed loads of chlordane may arise from past pesticide applications, improper disposal, and atmospheric deposition. Pesticide applications were most likely associated with agricultural, commercial, and residential areas. Improper disposal could have occurred at various locations, while atmospheric deposition occurs across the entire watershed.

There is no definitive information on specific sources within the watershed at this time. Therefore, an average concentration of sediment is applied to all contributing areas. The average concentration of chlordane on incoming sediment was estimated to be 3.15 μg/kg dry weight (Table 4-22), and the annual sediment load to Peck Road Park Lake is 990.3 tons/yr, including sediment delivered through the water diversion (see Appendix D, Wet Weather Loading). The resulting estimated wet weather load of chlordane is approximately 2.83 g/yr (Table 4-24).

**Table 4-24. Total Chlordane Loads Estimated for Each Jurisdiction and Subwatershed in the Peck Road Park Lake Watershed (g/yr)**

| Subwatershed | Responsible Jurisdiction | Input | Sediment (tons/yr) | Total Chlordane Load (g/yr) | Percent of Total Load |
|---|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 12.1 | 0.034 | 1.22% |
| Eastern | Bradbury | MS4 Stormwater[1] | 44.4 | 0.127 | 4.48% |
| Eastern | Caltrans | State Highway Stormwater[1] | 9.6 | 0.027 | 0.96% |
| Eastern | Duarte | MS4 Stormwater[1] | 57.2 | 0.163 | 5.78% |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 0.8 | 0.002 | 0.08% |
| Eastern | Irwindale | MS4 Stormwater[1] | 23.3 | 0.067 | 2.36% |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 1.6 | 0.005 | 0.16% |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 28.6 | 0.082 | 2.89% |
| Eastern | Monrovia | MS4 Stormwater[1] | 200 | 0.573 | 20.24% |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 16.3 | 0.047 | 1.65% |
| Eastern | Angeles National Forest | Stormwater[1] | 12.1 | 0.035 | 1.22% |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 379 | 1.084 | 38.31% |
| Near Lake | Arcadia | MS4 Stormwater[1] | 7.6 | 0.022 | 0.77% |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 1.7 | 0.005 | 0.17% |
| Near Lake | El Monte | MS4 Stormwater[1] | 3.5 | 0.010 | 0.36% |
| Near Lake | Irwindale | MS4 Stormwater[1] | 1.7 | 0.005 | 0.17% |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 4.0 | 0.012 | 0.41% |
| Near Lake | Monrovia | MS4 Stormwater[1] | 2.6 | 0.007 | 0.26% |
| Western | Arcadia | MS4 Stormwater[1] | 68.1 | 0.195 | 6.88% |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 37.8 | 0.108 | 3.82% |
| Western | Caltrans | State Highway Stormwater[1] | 2.1 | 0.006 | 0.21% |
| Western | County of Los Angeles | MS4 Stormwater[1] | 14.7 | 0.042 | 1.49% |
| Western | Monrovia | MS4 Stormwater[1] | 9.3 | 0.026 | 0.94% |

| Subwatershed | Responsible Jurisdiction | Input | Sediment (tons/yr) | Total Chlordane Load (g/yr) | Percent of Total Load |
|---|---|---|---|---|---|
| Western | Sierra Madre | MS4 Stormwater[1] | 19.9 | 0.057 | 2.01% |
| Western | Angeles National Forest | Stormwater[1] | 31.4 | 0.090 | 3.18% |
| **Total Load from Watershed** | | | **990.3** | **2.83** | **100%** |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. The disturbed area associated with general construction and general industrial stormwater permittees (510 acres) was subtracted out of the appropriate city areas and allocated to these permits.

As described in Appendix E (Atmospheric Deposition), Section E.5, the net atmospheric deposition of chlordane directly to the lake surface is estimated to be close to zero, with deposited loads balanced by volatilization losses. Atmospheric deposition onto the watershed is implicitly included in the estimates of watershed load.

### 4.5.5 Linkage Analysis

The linkage analysis provides the quantitative basis for determining the loading capacity of total chlordane into Peck Road Park Lake. The loading capacity is used to estimate the TMDL and corresponding allocations of that load to permitted point sources (wasteload allocations) and other nonpoint sources (load allocations).

Lake sediments are often the predominant source of total chlordane in biota. The bottom sediment serves as a sink for organochlorine compounds that can be recycled through the aquatic life cycle. Chlordanes are strongly sorbed to sediments and have long half-lives in sediment and water. Incoming loads of total chlordane will mainly be adsorbed to particulates from stormwater runoff (eroded sediments from legacy contamination sites or from atmospheric deposition).

The use of bioaccumulation models and the fish tissue data in Peck Road Park Lake are discussed in detail in Appendix H (Organochlorine Compounds TMDL Development) and Appendix G (Monitoring Data), respectively. The existing sediment chlordane concentrations in Peck Road Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Therefore, a sediment target to achieve FCGs is calculated based on biota-sediment bioaccumulation (a BSAF approach), using the ratio of the FCG to existing fish tissue concentrations of 5.6/13.44 = 0.417. This ratio is applied to the observed sediment concentration of 4.14 μg/kg dry weight to obtain the site-specific sediment target concentration to achieve fish tissue goals of 1.73 μg/kg dry weight. The fish tissue-based target concentrations were calculated using only recent data (collected in the past 10 years) because the loads and exposure concentrations of chlordane are likely to have declined steadily since the cessation of production and use of the chemical. The resulting target concentration of chlordane in the sediment in Peck Road Park Lake is shown in Table 4-25.

**Table 4-25. Fish Tissue-Based Chlordane Concentration Targets for Sediment in Peck Road Park Lake**

| Total Chlordane Concentration | Sediment (µg/kg dry weight) |
|---|---|
| Existing | 4.14 |
| BSAF-derived Target | 1.73 |
| Required Reduction | 58.2% |

The BSAF-derived sediment target is less than the consensus-based TEC of 3.24 µg/kg dry weight. (The consensus-based sediment quality guideline is for the protection of benthic organisms, and explicitly does not address bioaccumulation and human-health risks from the consumption of contaminated fish.) The lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target. In addition, the CTR criterion for human health (0.59 ng/L) is the selected numeric target for the water column and protects both aquatic life and human health.

The toxicant loading model described in Appendix H (Organochlorine Compounds TMDL Development) can be used to estimate the loading rate required to yield the existing sediment concentration under steady-state conditions. This yields an estimate that a load of 696 g/yr would be required to maintain observed sediment concentrations under steady state conditions. The estimated watershed loading rate is 2.83 g/yr, or 0.4 percent of this amount. Therefore, impairment due to elevated fish tissue concentrations of chlordane in Peck Road Park Lake is primarily due to the storage of historic loads of chlordane in the lake sediment.

## 4.5.6 TMDL Summary

Because chlordane impairment in Peck Road Park Lake is predominantly due to historic loads stored in the lake sediment, this impairment is not amenable to a standard, load-based TMDL analysis. Instead, allocations are first assigned on a concentration basis, with the goal of attaining the concentrations identified above for water and sediment, as well as fish tissue (The concentration targets apply to water and sediment entering the lake and within the lake.

The chlordane TMDL will be allocated to ensure achievement of the loading capacity. TMDLs are broken down into the wasteload allocations (WLAs), load allocations (LAs), and Margins of Safety (MOS) using the general TMDL equation.

$$TMDL = \sum WLA + LA + MOS$$

Note that since this TMDL is being expressed as a concentration in sediment, in this scenario, the loading capacity is equal to 1.73 µg/kg dry weight chlordane. The wasteload allocations and load allocations are also equal to 1.73 µg/kg dry weight chlordane in sediment. There is no explicit MOS. Allocations are assigned for this TMDL by requiring equal concentrations of all sources. Details associated with the WLAs, LAs, and MOS are presented in the following three sections.

### 4.5.6.1 Wasteload Allocations

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs). This TMDL establishes WLAs at their point of discharge. This TMDL also establishes alternative wasteload allocations for chlordane (“Alternative WLAs if the Fish Tissue Target is Met”) described in Section 4.5.6.1.2. The alternative wasteload allocations will supersede the wasteload allocations in Section 4.5.6.1.1 if the conditions described in Section 4.5.6.1.2 are met.

#### *4.5.6.1.1 Wasteload Allocations*

The entire watershed of Peck Road Park Lake is contained in MS4 jurisdictions, and therefore receives WLAs. The Caltrans areas and facilities that operate under a general industrial stormwater permit also receive WLAs.

Relevant permit numbers are

- County of Los Angeles (including the cities of Arcadia, Bradbury, Duarte, Irwindale, Monrovia, and Sierra Madre): Board Order 01-182 (as amended by Order No. R4-2006-0074 and R4-2007-0042), CAS004001
- Caltrans: Order No 99-06-DWQ, CAS000003
- General Industrial Stormwater: Order No. 97-03-DWQ, CAS000001

Total chlordane concentrations in water flowing into Peck Road Park Lake are below detection limits, and most chlordane load is expected to move in association with sediment. Therefore no separate wasteload allocation or reduction is explicitly assigned to the Colorado Well Aquifer (Order No. R4-2003-0108, CAG994005) as it is not expected to deliver sediment loads. On the other hand, the suspended sediment in the water flowing into the lake is assigned wasteload allocations. Additionally, the TMDL establishes wasteload allocations for chlordane in the water column equal to the CTR based water column target. The CTR based water column target includes both dissolved chlordane and chlordane associated with suspended sediment. The existing concentration of sediment entering the lake is 3.15 µg/kg dry weight. Therefore, a reduction of (3.15 – 1.73)/3.15 = 45.1 percent is required on the sediment-associated load from the watershed.

The wasteload allocations are shown in Table 4-26 and each wasteload allocation must be met at the point of discharge.

**Table 4-26. Wasteload Allocations for Total Chlordane in Peck Road Park Lake**

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation for Total Chlordane Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for Chlordane in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 1.73 | 0.59 |
| Eastern | Bradbury | MS4 Stormwater[1] | 1.73 | 0.59 |
| Eastern | Caltrans | State Highway Stormwater[1] | 1.73 | 0.59 |
| Eastern | Duarte | MS4 Stormwater[1] | 1.73 | 0.59 |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 1.73 | 0.59 |
| Eastern | Irwindale | MS4 Stormwater[1] | 1.73 | 0.59 |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 1.73 | 0.59 |
| Eastern | County of Los | MS4 Stormwater[1] | 1.73 | 0.59 |

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation for Total Chlordane Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for Chlordane in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| | Angeles | | | |
| Eastern | Monrovia | MS4 Stormwater[1] | 1.73 | 0.59 |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 1.73 | 0.59 |
| Eastern | Angeles National Forest | Stormwater[1] | 1.73 | 0.59 |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 1.73 | 0.59 |
| Near Lake | Arcadia | MS4 Stormwater[1] | 1.73 | 0.59 |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 1.73 | 0.59 |
| Near Lake | El Monte | MS4 Stormwater[1] | 1.73 | 0.59 |
| Near Lake | Irwindale | MS4 Stormwater[1] | 1.73 | 0.59 |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 1.73 | 0.59 |
| Near Lake | Monrovia | MS4 Stormwater[1] | 1.73 | 0.59 |
| Western | Arcadia | MS4 Stormwater[1] | 1.73 | 0.59 |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 1.73 | 0.59 |
| Western | Caltrans | State Highway Stormwater[1] | 1.73 | 0.59 |
| Western | County of Los Angeles | MS4 Stormwater[1] | 1.73 | 0.59 |
| Western | Monrovia | MS4 Stormwater[1] | 1.73 | 0.59 |
| Western | Sierra Madre | MS4 Stormwater[1] | 1.73 | 0.59 |
| Western | Angeles National Forest | Stormwater[1] | 1.73 | 0.59 |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

#### *4.5.6.1.2 Alternative Wasteload Allocations if the Fish Tissue Target is Met*

The wasteload allocations listed in Table 4-26 will be superseded, and the wasteload allocations in Table 4-27 will apply, if:

1. The responsible jurisdictions submit to USEPA and the Regional Board material describing that the fish tissue target of 5.6 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five largemouth bass each measuring at least 350mm in length,
2. The Regional Board Executive Officer approves the request and applies the alternative wasteload allocations in Table 4-27, and
3. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

Each wasteload allocation must be met at the point of discharge.

**Table 4-27. Alternative Wasteload Allocations for Total Chlordane in Peck Road Park Lake if the Fish Tissue Target is are Met**

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation for Total Chlordane Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for Chlordane in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 3.24 | 0.59 |
| Eastern | Bradbury | MS4 Stormwater[1] | 3.24 | 0.59 |
| Eastern | Caltrans | State Highway Stormwater[1] | 3.24 | 0.59 |
| Eastern | Duarte | MS4 Stormwater[1] | 3.24 | 0.59 |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 3.24 | 0.59 |
| Eastern | Irwindale | MS4 Stormwater[1] | 3.24 | 0.59 |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 3.24 | 0.59 |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 3.24 | 0.59 |
| Eastern | Monrovia | MS4 Stormwater[1] | 3.24 | 0.59 |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 3.24 | 0.59 |
| Eastern | Angeles National Forest | Stormwater[1] | 3.24 | 0.59 |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 3.24 | 0.59 |
| Near Lake | Arcadia | MS4 Stormwater[1] | 3.24 | 0.59 |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 3.24 | 0.59 |
| Near Lake | El Monte | MS4 Stormwater[1] | 3.24 | 0.59 |
| Near Lake | Irwindale | MS4 Stormwater[1] | 3.24 | 0.59 |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 3.24 | 0.59 |
| Near Lake | Monrovia | MS4 Stormwater[1] | 3.24 | 0.59 |
| Western | Arcadia | MS4 Stormwater[1] | 3.24 | 0.59 |

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation for Total Chlordane Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for Chlordane in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 3.24 | 0.59 |
| Western | Caltrans | State Highway Stormwater[1] | 3.24 | 0.59 |
| Western | County of Los Angeles | MS4 Stormwater[1] | 3.24 | 0.59 |
| Western | Monrovia | MS4 Stormwater[1] | 3.24 | 0.59 |
| Western | Sierra Madre | MS4 Stormwater[1] | 3.24 | 0.59 |
| Western | Angeles National Forest | Stormwater[1] | 3.24 | 0.59 |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

### 4.5.6.2 Load Allocations

This TMDL establishes load allocations (LAs) at their point of discharge. This TMDL also establishes alternative load allocations for chlordane ("Alternative LAs if the Fish Tissue Target is Met") described in Section 4.5.6.2.2. The alternative load allocations will supersede the load allocations in Section 4.5.6.2.1 if the conditions described in Section 4.5.6.2.2 are met.

#### *4.5.6.2.1 Load Allocations*

No part of the Peck Road Park Lake watershed is located outside of an MS4 jurisdiction; therefore no LAs are assigned to watershed loads. No load is allocated to net direct atmospheric deposition of chlordane. The legacy chlordane stored in lake sediment is the major cause of use impairment due to elevated fish tissue concentrations, and is assigned a load allocation. The in-lake allocation is in concentration terms: specifically, the responsible jurisdictions (County of Los Angeles) should achieve a total chlordane concentration of 1.73 µg/kg dry weight of lake bottom sediments (Table 4-28).

**Table 4-28. Load Allocations for Total Chlordane in Peck Road Park Lake**

| Subwatershed | Responsible Jurisdiction | Input | Load Allocation (µg/kg dry weight) |
|---|---|---|---|
| Lake Surface | County of Los Angeles | Lake bottom sediments | 1.73 |

#### *4.5.6.2.2 Alternative Load Allocations if the Fish Tissue Target is Met*

The load allocations listed in Table 4-28 will be superseded, and the load allocations in Table 4-29 will apply, if:

1. The responsible jurisdiction submits to USEPA and the Regional Board material describing that the fish tissue target of 5.6 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five largemouth bass each measuring at least 350mm in length,
2. The Regional Board Executive Officer approves the request and applies the alternative load allocations in Table 4-29, and
3. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

**Table 4-29. Alternative Load Allocations for Total Chlordane in Peck Road Park Lake if the Fish Tissue Target is Met**

| Subwatershed | Responsible Jurisdiction | Input | Load Allocation (µg/kg dry weight) |
|---|---|---|---|
| Lake Surface | County of Los Angeles | Lake bottom sediments | 3.24 |

### 4.5.6.3 Margin of Safety

TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. This TMDL contains an implicit MOS based on conservative assumptions. The allocations are set based on the lower of either the BSAF-derived sediment target or the consensus-based TEC sediment target to ensure achievement of the OEHHA FCG target in fish tissue. The selected BSAF-derived target concentration in sediment is considerably lower than the consensus-based TEC target.

### 4.5.6.4 Critical Conditions/Seasonality

TMDLs must include consideration of critical conditions and seasonal variation to ensure protection of the designated uses of the waterbody at all times. This TMDL protects beneficial uses by reducing fish tissue concentrations to the FCG target and protecting benthic biota in sediment. Because fish bioaccumulate chlordane, concentrations in tissues of edible sized game fish integrate exposure over a number of years. As a result, overall average loading is more important for the attainment of standards than instantaneous or daily concentrations. WLAs and LAs in this TMDL are assigned as concentrations and protect during all seasons and in both high and low flow conditions. This TMDL therefore protects for critical conditions.

### 4.5.6.5 Daily Load Expression

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. This TMDL includes a maximum daily load estimated according to the guidelines provided by USEPA (2007).

Because the PCB WLAs are expressed as concentrations on sediment, the daily maximum allowable load is calculated from the maximum daily sediment load multiplied by the TMDL WLA concentration. The maximum daily sediment load is estimated from the 99$^{th}$ percentile daily flow and the sediment event mean concentration that yields the estimated annual sediment load.

No USGS gage currently exists in the Peck Road Park Lake watershed. USGS Station 11101250, on the Rio Hondo River above the Whittier Narrows Dam, was selected as a surrogate for flow determination. The 99$^{th}$ percentile flow was chosen to represent the peak flow for this drainage. Choosing the 99$^{th}$ percentile flow eliminates errors due to outliers and is reasonable for development of a daily load expression.

The USGS StreamStats program was used to determine the 99$^{th}$ percentile flow for the Rio Hondo (952 cfs) (Wolock, 2003). To estimate the peak flow to Peck Road Park Lake, the 99$^{th}$ percentile flow for the Rio Hondo was scaled down by the ratio of drainage areas (23,564 acres/58,368 acres; Peck Road Park Lake watershed area/Rio Hondo watershed area at the gage). The resulting peak flow estimate for Peck Road Park Lake is 384 cfs. The 99$^{th}$ percentile diverted flow from the San Gabriel River to Peck Road Park Lake is 328 cfs. Therefore, the total peak daily flow rate is 712 cfs.

The event mean concentration of sediment in stormwater (71.7 mg/L) was calculated from the estimated existing watershed sediment load of 990.3tons/yr (Table 4-14) divided by the stormwater flow volume reaching the lake (10,158 ac-ft, Table 4-7). Multiplying the sediment event mean concentration by the 99$^{th}$ percentile peak daily flow (712 cfs) yields a daily maximum sediment load from stormwater of 137.7 tons/d. Applying the wasteload allocation concentration of 1.73 ng total chlordane per dry g of sediment yields the stormwater daily maximum allowable load of 0.216 g/d of total chlordane. This load is associated with the MS4 stormwater permittees and the water diversion. The maximum allowable daily load must be met on all days, and the concentration-based WLAs must be met to ensure compliance with the TMDL.

#### 4.5.6.6 Future Growth

The manufacture and use of chlordane is currently banned. Therefore, no additional allowance is made for future growth in the chlordane TMDL.

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

## 4.6 DDT IMPAIRMENT

Dichlorodiphenyltrichloroethane (DDT) is a synthetic organochlorine insecticide once used throughout the world to control insects. Technically DDT consists of two isomers, 4,4’-DDT and 2,4’-DDT, of which the former is the most toxic. In the environment, DDT breaks down to form two related compounds: DDD (tetrachlorodiphenylethane) and DDE (dichlorodiphenyl-dichloroethylene). DDD and DDE often predominate in the environment and USEPA (2000c) recommends that fish consumption guidelines be based on the sum of DDT, DDD, and DDE – collectively referred to as total DDTs.

The DDT impairment of Peck Road Park Lake affects beneficial uses related to recreation, municipal water supply, wildlife health, and fish consumption. DDT, like PCBs and chlordane, is an organochlorine compound that is strongly sorbed to sediment and lipids, and is no longer in production. As such, the approach for the DDT impairment is similar to that for PCBs and chlordane.

### 4.6.1 Beneficial Uses

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. Peck Road Park Lake was not identified specifically in the Basin Plan; therefore, the beneficial uses associated with the downstream segment (Rio Hondo below Spreading Grounds) apply: REC1, REC2, WARM, WILD, MUN, and GWR (personal communication, Regional Board, December 22, 2009). Descriptions of these uses are listed in Section 2 of this TMDL report. Elevated levels of DDT are currently impairing the REC1, REC2 and WARM uses by causing toxicity to aquatic organisms and raising fish tissue concentrations to levels that are unsafe for human consumption (which can result in fish consumption advisories) and impair sport fishing recreational uses. At high enough concentrations WILD and MUN uses could become impaired.

### 4.6.2 Numeric Targets

Targets for DDT are complex because of the many different ways in which the compound is measured. The Basin Plan designates water column concentrations associated with MUN and WARM beneficial uses for several DDTs. There are no numeric criteria specified for sediment or fish tissue concentrations of DDTs listed in the Basin Plan. For the purposes of this TMDL, additional numeric targets for these endpoints are based on the consensus-based sediment quality guidelines defined in MacDonald et al. (2000) and the fish tissue concentration goal, referred to as the fish contaminant goal (FCG), defined by OEHHA (2008) for fish consumption. The numeric targets used for DDTs are listed below. The fish tissue concentration goal was also used to back calculate site-specific targets in sediment, with the most stringent target applying. See Section 2 of this TMDL report for additional details.

The water column criteria for DDT in the Basin Plan are associated with a specific beneficial use. The Basin Plan also contains a narrative criterion that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Each waterbody addressed in this report is designated WARM, at a minimum, and must meet this requirement. Acute and chronic criteria for 4,4'-DDT in freshwater systems are included in the CTR as 1.1 μg/L and 0.001 μg/L, respectively (USEPA, 2000a). CTR criteria are considered protective of aquatic life. Acute and chronic values for other DDT compounds were not specified. The CTR also includes human health criteria for 4,4'-DDT for the consumption of water and organisms or organisms only as 0.00059 μg/L for both uses (USEPA, 2000a). Because the human health criterion is the most restrictive applicable criterion, a water column target of 0.00059 μg/L (0.59 ng/L) for 4,4'-DDT is the appropriate target. The CTR also specifies a criterion of 0.59 ng/L for 4,4'-DDE (for both consumption of water and organisms or organisms only), while for 4,4'-DDD the criteria are 0.83 ng/L for consumption of water and organisms and 0.84 ng/L for consumption of organisms only. For Peck Road Park Lake, the Regional Board has determined that the appropriate human health criterion for 4,4'-DDD is 0.00084 μg/L (0.84 ng/L) as the MUN use is not an existing use. The CTR does not specify a criterion for total DDTs. For this TMDL the DDT, DDD, and DDE targets in CTR are selected as water column targets.

For sediment, the consensus-based sediment quality guidelines provided in MacDonald et al. (2000) for the threshold effects concentration (TEC) for 4,4'- plus 2,4'-DDT is 4.16 μg/kg dry weight, and the TEC for total DDTs is 5.28 μg/kg dry weight. The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. These targets are designed to protect benthic dwelling organisms and explicitly do not consider "the potential for bioaccumulation in aquatic organisms nor the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans)." Thus, a separate sediment target calculation based on a biota-sediment accumulation factor (BSAF) is carried out to ensure that fish tissue concentration goals are met.

The fish contaminant goal for total DDTs defined by OEHHA (2008) is 21 ppb wet weight in muscle tissue (filets). Elevated fish tissue concentrations are largely attributable to foodweb bioaccumulation derived from contaminated sediment. A biota-sediment accumulation factor (BSAF) approach is appropriate to correlate sediment and fish tissue targets. For DDTs, the corresponding sediment concentration target determined using the BSAF is 6.90 µg/kg dry weight, as described in further detail in Section 4.6.5. All applicable targets are shown below in Table 4-30. For sediment, the lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target.

**Table 4-30. DDT Targets Applicable to Peck Road Park Lake**

| Medium | Source | 4,4'-DDT | 4,4'-DDT + 2,4'-DDT | DDE[1] | DDD[1] | Total DDTs |
|---|---|---|---|---|---|---|
| Fish (ppb wet weight) | OEHHA FCG | | | | | 21 |
| Sediment (µg/kg dry weight) | Consensus-based TEC | | 4.16 | 3.16[1] | 4.88[1] | 5.28 |
| Sediment (µg/kg dry weight) | BSAF-derived target | | | | | 6.90 |
| Water (ng/L) | CTR | 0.59 | | 0.59[1] | 0.84[1] | |

[1] CBSQG specifies sediment targets for total DDE and total DDD. The CTR specifies water column targets specifically for 4,4'-DDE and 4,4'-DDD.

Note: Shaded cells represent the selected targets for this TMDL.

## 4.6.3 Summary of Monitoring Data

This section summarizes the monitoring data for Peck Road Park Lake related to the DDT impairment. Additional details regarding monitoring data are discussed in Appendix G (Monitoring Data).

Water column sampling was conducted as part of an organics study performed by UCLA (funded by a grant managed by the Regional Board) in the summer of 2008 at five locations (six samples) and again in the fall of 2008 at two locations (three samples) in Peck Road Park Lake. These analyses quantified only the 4,4' isomers of DDT, DDD, and DDE. All samples collected as part of the UCLA study during the summer and fall, were less than the sample detection limits (3.0 – 3.3 ng/L, all higher than the water quality criteria of 0.59 – 0.84 ng/L). Additional water column sampling was conducted by the Regional Board on December 11, 2008 at four in-lake locations in Peck Road Park Lake, including both the 4,4' and 2,4' isomers. All four sites sampled were below detectable levels of DDT (1 ng/L, which is also higher than the water quality criterion). A summary of the water column data is shown in Table 4-31.

**Table 4-31. Summary of Water Column Samples for Total DDTs in Peck Road Park Lake**

| Station | Average Water Concentration (ng/L) | Number of Samples | Number of Samples Above Detection Limits[1] |
|---|---|---|---|
| Sawpit Wash | (1.62)[1] | 2 | 0 |
| Santa Anita Wash | (1.56) | 3 | 0 |
| North Basin Outfall | (1.52) | 2 | 0 |
| North Basin | (1.0) | 2 | 0 |
| South Basin | (1.0) | 2 | 0 |

| Station | Average Water Concentration (ng/L) | Number of Samples | Number of Samples Above Detection Limits[1] |
|---|---|---|---|
| South Basin East | (0.50) | 1 | 0 |
| South Basin West Side | (0.50) | 1 | 0 |
| In-Lake Average[3] | (0.80) | | |
| Water Column Target | 0.59 | | |

[1] Non-detect samples were included in reported averages at one-half of the sample detection limit.

[2] Numbers in parentheses indicate that sample is based only on the detection limits of the samples, and that no DDTs were detected in any of the collected samples.

[3] Overall average is the average of individual station averages (excludes the tributary samples).

Concentrations of total DDTs on suspended sediment were also analyzed by UCLA in the summer and fall of 2008. One in-lake location was analyzed in the summer and two in the fall; all three samples were below detectable limits for DDT (4.73 μg/kg to 40.82 μg/kg dry weight). Porewater samples were collected during the summer and fall of 2008; DDT concentrations in all of the porewater samples were less than the detection limit of 30 ng/L. All four porewater suspended sediment samples collected in the summer of 2008 were below detectable levels (4.51 μg/kg to 18.50 μg/kg dry weight).

UCLA also collected bed sediment samples at four locations in Peck Road Park Lake in summer and fall 2008. As with the UCLA water column samples, these included only the 4,4' isomers. Only one of nine sediment samples collected in 2008 (average of 10.2 μg/kg dry weight) was above method reporting limits for DDTs; two samples were detected at less than the reporting limits (which ranged from 6.87 μg/kg to 13.06 μg/kg dry weight). Four in-lake locations were sampled by USEPA and the county of Los Angeles on November 16, 2009. Three of four samples were above the detection limit (1 μg/kg dry weight), with a maximum of 11.8 μg/kg dry weight (in excess of the consensus-based TEC for sediment of 4.16 μg/kg dry weight).

All lake stations were averaged to estimate an exposure concentration of 5.09 μg/kg dry weight total DDTs (with non-detects included at one-half the detection limit for each sample). Stations located near outfalls are taken as an estimate of the concentrations on incoming sediment. The lake-wide average of 5.09 μg/kg dry weight is slightly less than the consensus-based TEC of 5.28 μg/kg dry weight. A summary of the sediment data is shown in Table 4-32.

**Table 4-32. Summary of Sediment Samples for Total DDTs in Peck Road Park Lake, 2008-2009**

| Station | Average Sediment Concentration (μg/kg dry weight)[1] | Number of Samples | Number of Samples above Detection Limits | Number of Samples between Detection and Reporting Limits |
|---|---|---|---|---|
| Near Sawpit Wash | 10.22 | 1 | 1 | 0 |
| Near Santa Anita Wash | [0.54] | 3 | 1 | 1 |
| North Basin | 3.94 | 4 | 2 | 1 |
| South Basin | 4.32 | 3 | 1 | 0 |
| North Inlet | (0.50) | 1 | 0 | 0 |
| South Inlet | 11.0 | 1 | 1 | 0 |

| Station | Average Sediment Concentration (µg/kg dry weight)[1] | Number of Samples | Number of Samples above Detection Limits | Number of Samples between Detection and Reporting Limits |
|---|---|---|---|---|
| In-Lake Average[2] | 5.09 | | | |
| Influent Average | 5.57 | | | |
| Consensus-based TEC | 5.28 | | | |

[1] Total DDT in a sample represents the sum of all reported measurements for DDT, DDE, and DDD isomers, including results reported below the method reporting limit. If all components were non-detect, the total is represented as one-half the detection limit. Results of any laboratory duplicate analyses of the same sample were averaged. Results for each station represent the average of individual samples. Results in parentheses indicate that the sample average is based only on the detection limits of the samples and that no chlordane quantified in any of the collected samples. Sample averages based only on detected results below the reporting limit plus non-detects are shown in square brackets.

[2] Overall average is the average of individual station averages.

Fish tissue concentrations of DDT from Peck Road Park Lake have been analyzed in largemouth bass (by TSMP and SWAMP). Total DDT concentrations in fish tissue collected between 1986 and 1992 ranged up to 39 ppb, with an average of 26.5 ppb, in excess of the FCG of 21 ppb. Because DDT is no longer in use, fish tissue concentrations are likely to have declined since these samples were taken. Considering only data collected in the past 10 years, the average concentration of total DDTs in largemouth bass was 15.5 ppb, at an average lipid content of 0.54 percent. This average is based on two largemouth bass composite samples (each containing filets from five individual fish) collected by SWAMP in the summer of 2007 and an additional composite collected in April 2010. Based on the current data, average fish tissue levels of total DDTs are less than the FCG of 21 ppb (Table 4-33). Data from bottom-feeding fish (e.g., carp) are not available for Peck Road Park Lake.

**Table 4-33. Summary of Recent Fish Tissue Samples for Total DDTs in Peck Road Park Lake**

| Sample Date | Fish Taxa | Total DDTs (ppb wet weight)[1] |
|---|---|---|
| 6 June 2007 | Largemouth Bass | 24.4 |
| 6 June 2007 | Largemouth Bass | 9.0 |
| 19 April 2010 | Largemouth Bass | 13.109 |
| 2007 Average | | 15.5 |
| FCG | | 21 |

[1] Composite sample of filets from five individuals.

In sum, the average of recent fish tissue samples collected from Peck Road Park Lake is approximately 25 percent lower than the FCG, although one of three composite samples exceeded the FCG. Measured concentrations in sediment are within 2 percent of the consensus-based TEC with several samples based on half of the detection limit. However, individual stations had concentrations well above the TEC, indicating that the lake continues to be impaired by DDT. Concentrations in water were less than the detection limits.

## 4.6.4 Source Assessment

Total DDTs present in Peck Road Park Lake are primarily due to historical loading and storage within the lake sediments, with some ongoing contribution by watershed wet weather loads. Dry weather loading is assumed to be negligible because hydrophobic contaminants primarily move with particulate matter that is mobilized by higher flows. Stormwater loads from the watershed were estimated based on simulated sediment load and observed DDT concentrations on sediment data near inflows to the lake. Watershed loads of DDT may arise from past pesticide applications, improper disposal, and atmospheric deposition. Pesticide applications were most likely associated with agricultural, commercial, and residential areas. Improper disposal could have occurred at various locations, while atmospheric deposition occurs across the entire watershed.

There is no definitive information on specific sources of elevated DDT load within the watershed at this time. Therefore, an average concentration on sediment is applied to all contributing areas. The average concentration of total DDTs on incoming sediment was estimated to be 5.57 μg/kg dry weight (Table 4-32), and the annual sediment load to Peck Road Park Lake is 990.3 tons/yr, including sediment delivered through the water diversion (see Appendix D, Wet Weather Loading). The resulting estimated wet-weather load of total DDTs is approximately 5.0 g/yr (Table 4-34).

**Table 4-34. Total DDTs Loads Estimated for Each Jurisdiction and Subwatershed in the Peck Road Park Lake Watershed (g/yr)**

| Subwatershed | Responsible Jurisdiction | Input | Sediment (tons/yr) | Total DDTs Load (g/yr) | Percent of Total Load |
|---|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 12.1 | 0.061 | 1.22% |
| Eastern | Bradbury | MS4 Stormwater[1] | 44.4 | 0.224 | 4.48% |
| Eastern | Caltrans | State Highway Stormwater[1] | 9.6 | 0.048 | 0.96% |
| Eastern | Duarte | MS4 Stormwater[1] | 57.2 | 0.289 | 5.78% |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 0.8 | 0.004 | 0.08% |
| Eastern | Irwindale | MS4 Stormwater[1] | 23.3 | 0.118 | 2.36% |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 1.6 | 0.008 | 0.16% |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 28.6 | 0.145 | 2.89% |
| Eastern | Monrovia | MS4 Stormwater[1] | 200 | 1.013 | 20.24% |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 16.3 | 0.061 | 1.22% |
| Eastern | Angeles National Forest | Stormwater[1] | 12.1 | 1.917 | 38.31% |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 379 | 0.038 | 0.77% |
| Near Lake | Arcadia | MS4 Stormwater[1] | 7.6 | 0.009 | 0.17% |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 1.7 | 0.018 | 0.36% |
| Near Lake | El Monte | MS4 Stormwater[1] | 3.5 | 0.009 | 0.17% |
| Near Lake | Irwindale | MS4 Stormwater[1] | 1.7 | 0.020 | 0.41% |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 4.0 | 0.013 | 0.26% |

| Subwatershed | Responsible Jurisdiction | Input | Sediment (tons/yr) | Total DDTs Load (g/yr) | Percent of Total Load |
|---|---|---|---|---|---|
| Near Lake | Monrovia | MS4 Stormwater[1] | 2.6 | 0.344 | 6.88% |
| Western | Arcadia | MS4 Stormwater[1] | 68.1 | 0.191 | 3.82% |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 37.8 | 0.010 | 0.21% |
| Western | Caltrans | State Highway Stormwater[1] | 2.1 | 0.074 | 1.49% |
| Western | County of Los Angeles | MS4 Stormwater[1] | 14.7 | 0.047 | 0.94% |
| Western | Monrovia | MS4 Stormwater[1] | 9.3 | 0.100 | 2.01% |
| Western | Sierra Madre | MS4 Stormwater[1] | 19.9 | 0.159 | 3.18% |
| Western | Angeles National Forest | Stormwater[1] | 31.4 | 0.061 | 1.22% |
| **Total Load from Watershed** | | | **990.3** | **5.00** | **100%** |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. The disturbed area associated with general construction and general industrial stormwater permittees (510 acres) was subtracted out of the appropriate city areas and allocated to these permits.

As described in Appendix E (Atmospheric Deposition), Section E.5, the net atmospheric deposition of DDTs directly to the lake surface is estimated to be close to zero, with deposited loads balanced by volatilization losses. Atmospheric deposition onto the watershed is implicitly included in the estimates of watershed load.

### 4.6.5 Linkage Analysis

The linkage analysis provides the quantitative basis for determining the loading capacity for DDTs in Peck Road Park Lake consistent with achieving water quality standards. The loading capacity is used to calculate the TMDL and corresponding allocations of that load to permitted point sources (wasteload allocations) and nonpoint sources (load allocations).

Lake sediments are often the predominant source of DDT in biota. The bottom sediment serves as a sink for organochlorine compounds that can be recycled through the aquatic life cycle. DDT is strongly sorbed to sediment and has a long half-life in sediment and water. Incoming loads of DDT will mainly be adsorbed to particulates from stormwater runoff (eroded sediments from legacy contamination sites or from atmospheric deposition).

The use of bioaccumulation models and the fish tissue data in Peck Road Park Lake are discussed in detail in Appendix H (Organochlorine Compounds TMDL Development) and Appendix G (Monitoring Data), respectively. A sediment target to achieve FCGs is calculated based on biota-sediment bioaccumulation (a BSAF approach), using the ratio of the FCG to existing fish tissue concentrations of 21/15.5 = 1.355. This ratio is applied to the estimated lake sediment concentration of 5.09 µg/kg dry weight to obtain the site-specific sediment target concentration to maintain fish tissue goals of 6.90 µg/kg dry weight. The BSAF-derived sediment target is greater than the estimated existing sediment concentration because the average recent fish tissue concentration does not exceed the fish tissue based target concentration.

The fish tissue-based target concentrations were calculated using only recent data (collected in the past 10 years) because the loads and exposure concentrations of total DDT are likely to have declined steadily since the cessation of production and use of the chemical. The resulting fish tissue-based target concentrations of DDT in sediment of Peck Road Park Lake are shown in Table 4-35.

**Table 4-35. Fish Tissue-Based Total DDTs Concentration Targets for Sediment in Peck Road Park Lake**

| Total DDTs Concentration | Sediment (µg/kg dry weight) |
|---|---|
| Existing | 5.09 |
| BSAF-derived Target | 6.90 |
| Required Reduction | 0% |

The BSAF-derived sediment target is greater than the consensus-based TEC for total DDTs of 5.28 µg/kg dry weight. The consensus-based TEC of 5.28 µg/kg dry weight is therefore the most restrictive target and is used as the target in this TMDL. Selection of the consensus-based TEC target protects the benthic biota and ensures continued attainment of the fish tissue based target concentration. The estimated existing concentration in lake of 5.09 µg/kg is less than the TEC, which would imply that no reduction from existing in-lake sediment concentrations may be needed. However, the estimated influent concentration is greater than the TEC.

The toxicant loading model described in Appendix H (Organochlorine Compounds TMDL Development) can be used to estimate the loading rate that would be required to yield the existing sediment concentration under steady-state conditions. This yields an estimate that a load of 84 g/yr would be required to maintain observed sediment concentrations under steady-state conditions. The estimated current watershed loading rate is 5 g/yr, or 6 percent of this amount. Thus, concentrations of total DDTs in fish tissue in Peck Road Park Lake appear to be primarily due to the storage of historic loads of DDT in the lake sediment.

### 4.6.6 TMDL Summary

Because DDT impairment in Peck Road Park Lake is predominantly due to historic loads stored in the lake sediment, this impairment is not amenable to a standard, load-based TMDL analysis. Instead, allocations are first assigned on a concentration basis, with the goal of maintaining the existing concentrations identified above for water and sediment, as well as fish tissue. The concentration targets apply to water and sediment entering the lake and within the lake.

The DDT TMDL will be allocated to ensure achievement of the loading capacity. TMDLs are broken down into the wasteload allocations (WLAs), load allocations (LAs), and Margins of Safety (MOS) using the general TMDL equation.

$$TMDL = \sum WLA + LA + MOS$$

Note that since this TMDL is being expressed as a concentration in sediment, in this scenario, the loading capacity is equal to 5.28 µg/kg dry weight total DDTs. The wasteload allocations and load allocations are also equal to 5.28 µg/kg dry weight total DDTs in sediment. There is no explicit MOS. Allocations are assigned for this TMDL by requiring equal concentrations of all sources. Details associated with the WLAs, LAs, and MOS are presented in the following three sections.

#### 4.6.6.1 Wasteload Allocations

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs). The entire watershed of Peck Road Park Lake is contained in MS4 jurisdictions, and watershed loads are therefore assigned WLAs. The Caltrans areas and facilities that operate under a general industrial stormwater permit also receive WLAs.

Relevant permit numbers are

- County of Los Angeles (including the cities of Arcadia, Bradbury, Duarte, Irwindale, Monrovia, and Sierra Madre): Board Order 01-182 (as amended by Order No. R4-2006-0074 and R4-2007-0042), CAS004001
- Caltrans: Order No 99-06-DWQ, CAS000003
- General Industrial Stormwater: Order No. 97-03-DWQ, CAS000001

DDT in water flowing into Peck Road Park Lake is below detection limits, and most DDT load is expected to move in association with sediment. Therefore, no separate wasteload allocation or reduction is explicitly assigned to the Colorado Well Aquifer (Order No. R4-2003-0108, CAG994005)as it is not expected to deliver sediment loads. On the other hand, the suspended sediment in water flowing into the lake is assigned wasteload allocations. Additionally, the TMDL establishes wasteload allocations for DDT in the water column equal to the CTR based water column target. The CTR based water column target includes both dissolved DDT and DDT associated with suspended sediment. Each wasteload allocation applies at the point of discharge. The existing concentration of sediment entering the lake is 5.57 µg/kg dry weight. Therefore, a reduction of 5.2 percent [(5.57 – 5.28)/5.57*100] is required on the sediment-associated load from the watershed.

The wasteload allocations are shown in Table 4-36 and each wasteload allocation must be met at the point of discharge.

**Table 4-36. Wasteload Allocations for Total DDTs in Peck Road Park Lake**

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation for DDT Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for 4-4' DDT in the Water Column (ng/L)[3,4] |
|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 5.28 | 0.59[3] |
| Eastern | Bradbury | MS4 Stormwater[1] | 5.28 | 0.59 |
| Eastern | Caltrans | State Highway Stormwater[1] | 5.28 | 0.59 |
| Eastern | Duarte | MS4 Stormwater[1] | 5.28 | 0.59 |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 5.28 | 0.59 |
| Eastern | Irwindale | MS4 Stormwater[1] | 5.28 | 0.59 |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 5.28 | 0.59 |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 5.28 | 0.59 |
| Eastern | Monrovia | MS4 Stormwater[1] | 5.28 | 0.59 |

| Subwatershed | Responsible Jurisdiction | Input | Wasteload Allocation for DDT Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for 4-4' DDT in the Water Column (ng/L)[3,4] |
|---|---|---|---|---|
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 5.28 | 0.59 |
| Eastern | Angeles National Forest | Stormwater[1] | 5.28 | 0.59 |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 5.28 | 0.59 |
| Near Lake | Arcadia | MS4 Stormwater[1] | 5.28 | 0.59 |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 5.28 | 0.59 |
| Near Lake | El Monte | MS4 Stormwater[1] | 5.28 | 0.59 |
| Near Lake | Irwindale | MS4 Stormwater[1] | 5.28 | 0.59 |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 5.28 | 0.59 |
| Near Lake | Monrovia | MS4 Stormwater[1] | 5.28 | 0.59 |
| Western | Arcadia | MS4 Stormwater[1] | 5.28 | 0.59 |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 5.28 | 0.59 |
| Western | Caltrans | State Highway Stormwater[1] | 5.28 | 0.59 |
| Western | County of Los Angeles | MS4 Stormwater[1] | 5.28 | 0.59 |
| Western | Monrovia | MS4 Stormwater[1] | 5.28 | 0.59 |
| Western | Sierra Madre | MS4 Stormwater[1] | 5.28 | 0.59 |
| Western | Angeles National Forest | Stormwater[1] | 5.28 | 0.59 |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

[4] The target water column concentration of 0.59 ng/L specified in the CTR is for 4,4'-DDT. The CTR also specifies targets for DDE and DDD, but does not specify a target for total DDTs. The lowest DDT target is selected for the purposes of representing Total DDTs in this table. If analytical results that resolve individual DDT compounds are available, all of the CTR criteria should be applied individually.

### 4.6.6.2 Load Allocations

This TMDL establishes load allocations (LAs) at their point of discharge. No part of the Peck Road Park Lake watershed is outside MS4 jurisdiction; therefore no LAs are assigned to watershed loads. No load is allocated to atmospheric deposition of DDTs. The legacy DDT stored in lake sediment is the major cause of exposure to aquatic organisms and sport fish, and is assigned a load allocation. The in-lake allocation is in concentration terms: specifically, the responsible jurisdictions (County of Los Angeles) should achieve or maintain a total DDTs concentration of 5.28 µg/kg dry weight or less in lake bottom sediments (Table 4-37).

**Table 4-37. Load Allocations for Total DDT in Peck Road Park Lake**

| Subwatershed | Responsible Jurisdiction | Input | Load Allocation (µg/kg dry weight) |
|---|---|---|---|
| Lake Surface | County of Los Angeles | Lake bottom sediments | 5.28 |

#### 4.6.6.3 Margin of Safety

TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. This TMDL contains an implicit MOS based on conservative assumptions. The allocations are set based on the lower of either the BSAF-derived sediment target or the consensus-based TEC sediment target to ensure achievement of the OEHHA FCG target in fish tissue. The selected consensus-based TEC concentration in sediment is considerably lower than the BSAF-derived target.

#### 4.6.6.4 Critical Conditions/Seasonality

TMDLs must include consideration of critical conditions and seasonal variation to ensure protection of the designated uses of the waterbody at all times. This TMDL protects beneficial uses by reducing fish tissue concentrations to the FCG target and protecting benthic biota in sediment. Because fish bioaccumulate DDT, concentrations in tissues of edible sized game fish integrate exposure over a number of years. As a result, overall average loading is more important for the attainment of standards than instantaneous or daily concentrations. WLAs and LAs in this TMDL are assigned as concentrations and protect during all seasons and in both high and low flow conditions. This TMDL therefore protects for critical conditions.

#### 4.6.6.5 Daily Load Expression

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. This TMDL includes a maximum daily load estimated according to the guidelines provided by USEPA (2007).

Because the DDT WLAs are expressed as concentrations on sediment, the daily maximum allowable load is calculated from the maximum daily sediment load multiplied by the TMDL WLA concentration. The maximum daily sediment load is estimated from the $99^{th}$ percentile daily flow and the sediment event mean concentration that yields the estimated annual sediment load.

No USGS gage currently exists in the Peck Road Park Lake watershed. USGS Station 11101250, on the Rio Hondo River above the Whittier Narrows Dam, was selected as a surrogate for flow determination. The $99^{th}$ percentile flow was chosen to represent the peak flow for this drainage. Choosing the $99^{th}$ percentile flow eliminates errors due to outliers and is reasonable for development of a daily load expression.

The USGS StreamStats program was used to determine the $99^{th}$ percentile flow for the Rio Hondo (952 cfs) (Wolock, 2003). To estimate the peak flow to Peck Road Park Lake, the $99^{th}$ percentile flow for the Rio Hondo was scaled down by the ratio of drainage areas (23,564 acres/58,368 acres; Peck Road Park Lake watershed area/Rio Hondo watershed area at the gage). The resulting peak flow estimate for

Peck Road Park Lake is 384 cfs. The 99th percentile diverted flow from the San Gabriel River to Peck Road Park Lake is 328 cfs. Therefore, the total peak daily flow rate is 712 cfs.

The event mean concentration of sediment in stormwater (71.7 mg/L) was calculated from the estimated existing watershed sediment load of 990.3 tons/yr (Table 4-14) divided by the stormwater volume reaching the lake (10,158 ac-ft, Table 4-7). Multiplying the sediment event mean concentration by the 99th percentile peak daily flow (712 cfs) yields a daily maximum sediment load from stormwater of 137.7 tons/d. Applying the wasteload allocation concentration of 5.28 ng total DDT per dry g of sediment yields the stormwater daily maximum allowable load of 0.659 g/d of total DDT. This load is associated with the MS4 stormwater permittees and the water diversion. The maximum allowable daily load must be met on all days, and the concentration-based WLAs must be met to ensure compliance with the TMDL.

#### 4.6.6.6 Future Growth

The manufacture and use of DDT is currently banned. Therefore, no additional allowance is made for future growth in the DDT TMDL.

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

## 4.7 Dieldrin Impairment

Dieldrin is a chlorinated insecticide originally developed as an alternative to DDT and was in wide use from the 1950s to the 1970s. Dieldrin in the environment also arises from use of the insecticide aldrin. Aldrin is not itself toxic to insects, but is metabolized to dieldrin in the insect body. The use of both dieldrin and aldrin was discontinued in the 1970s.

The dieldrin impairment of Peck Road Park Lake affects beneficial uses related to recreation, municipal water supply, wildlife health, and fish consumption. Dieldrin, like PCBs, chlordane and DDT, is an organochlorine compound that is strongly sorbed to sediment and lipids and is no longer in production. As such, the approach for dieldrin impairment is similar to that for PCBs, chlordane, and DDT.

### 4.7.1 Beneficial Uses

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region’s Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. Peck Road Park Lake was not identified specifically in the Basin Plan; therefore, the beneficial uses associated with the downstream segment (Rio Hondo River below Spreading Grounds) apply: REC1, REC2, WARM, WILD, MUN, and GWR (personal communication, Regional Board, December 22, 2009). Descriptions of these uses are listed in Section 2 of this TMDL report. Elevated levels of dieldrin are currently impairing the REC1, REC2 and WARM uses by causing toxicity to aquatic organisms and raising fish tissue concentrations to levels that are unsafe for human consumption (which can result in fish consumption advisories) and impair sport fishing recreational uses. At high enough concentrations WILD and MUN uses could become impaired.

### 4.7.2 Numeric Targets

The Basin Plan designates water column concentrations associated with MUN and WARM beneficial uses. There are no numeric criteria specified for sediment or fish tissue concentrations of dieldrin in the Basin Plan. For the purposes of this TMDL, additional numeric targets for these endpoints are based on the consensus-based sediment quality guidelines defined in MacDonald et al. (2000) and the fish tissue concentration goal, referred to as the fish contaminant goal (FCG), defined by OEHHA (2008) for fish consumption. The numeric targets for dieldrin are listed below. The fish tissue concentration goal was also used to back calculate site-specific targets in sediment, with the most stringent target applying. See Section 2 of this TMDL report for additional details.

The water column criteria for dieldrin in the Basin Plan are associated with a specific beneficial use. The Basin Plan also contains a narrative criterion that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Acute and chronic criterion for the protection of aquatic life and wildlife in freshwater systems are included in the CTR for dieldrin as 0.24 µg/L and 0.056 µg/L, respectively (USEPA, 2000a). CTR criteria are considered protective of aquatic life. The CTR also provides a human health-based water quality criterion for the consumption of organisms only and the consumption of water and organisms as 0.00014 µg/L (0.14 ng/L). The human health criterion of 0.00014 µg/L (0.14 ng/L) is the most restrictive of the applicable criteria specified for water column concentrations and is selected as the water column target.

For sediment, the consensus-based sediment quality guidelines provided in MacDonald et al. (2000) for the threshold effects concentration (TEC) of dieldrin in sediment is 0.46 µg/kg. The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. This target is designed to protect benthic dwelling organisms and explicitly does not consider “the potential for bioaccumulation in aquatic organisms nor the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans).” The estimated existing sediment dieldrin concentrations in Peck Road Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Thus, a separate sediment target calculation based on a biota-sediment accumulation factor (BSAF) is carried out to ensure that fish tissue concentration goals are met.

The fish contaminant goal for dieldrin defined by the OEHHA (2008) is 0.46 ppb wet weight in muscle tissue (filets). Elevated fish tissue concentrations are largely attributable to foodweb bioaccumulation derived from contaminated sediment. A biota-sediment accumulation factor (BSAF) approach is appropriate to correlate sediment and fish tissue targets. For dieldrin, the corresponding sediment concentration target is estimated using the BSAF approach is 0.43 µg/kg dry weight, as described in detail in Section 4.7.5. All applicable targets are shown below in Table 4-38. For sediment, the lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target.

**Table 4-38. Dieldrin Targets Applicable to Peck Road Park Lake**

| Medium | Source | Target |
|---|---|---|
| Fish (ppb wet weight) | OEHHA FCG | 0.46 |
| Sediment (µg/kg dry weight) | Consensus-based TEC | 1.9 |
| Sediment (µg/kg dry weight) | BSAF-derived target | 0.43 |
| Water (ng/L) | CTR | 0.14 |

Note: Shaded cells represent the selected targets for this TMDL.

### 4.7.3 Summary of Monitoring Data

This section summarizes the monitoring data for Peck Road Park Lake related to the dieldrin impairment. Additional details regarding monitoring data are discussed in Appendix G (Monitoring Data).

Water column sampling was conducted as part of an organics study performed by UCLA (funded by a grant managed by the Regional Board) in the summer of 2008 at five locations (six samples) and again in the fall of 2008 at two locations (three samples) in Peck Road Park Lake. All samples collected as part of the UCLA study during the summer and fall, were less than the sample detection limit (3.0 ng/L to 3.3 ng/L; all greater than the water quality criterion of 0.14 ng/L). Additional water column sampling was conducted by the Regional Board on December 11, 2008 at four in-lake locations in Peck Road Park Lake. All four sites sampled had non-detectable concentrations of dieldrin (less than 1 ng/L, also greater than the water column criterion). A summary of the water column data is shown in Table 4-39.

**Table 4-39. Summary of Water Column Samples for Dieldrin in Peck Road Park Lake**

| Station | Average Water Concentration (ng/L)[2] | Number of Samples | Number of Samples Above Detection Limits[1] |
|---|---|---|---|
| Sawpit Wash | (1.62) | 2 | 0 |
| Santa Anita Wash | (1.56) | 3 | 0 |
| North Basin Outfall | (1.52) | 2 | 0 |
| North Basin | (1.0) | 2 | 0 |
| South Basin | (1.0) | 2 | 0 |
| South Basin East | (0.50) | 1 | 0 |
| South Basin West Side | (0.50) | 1 | 0 |
| In-Lake Average[3] | (0.80) | | |
| Water Column Target | 0.17 | | |

[1] Non-detect samples were included in reported averages at one-half of the sample detection limit.

[2] Numbers in parentheses indicate that sample is based only on the detection limits of the samples, and that no dieldrin was detected in any of the collected samples.

[3] Overall average is the average of individual station averages (excludes the tributary samples).

Concentrations of dieldrin on suspended sediment were also analyzed by UCLA in the summer and fall of 2008. One in-lake location was analyzed in the summer and two were sampled in the fall, all three samples were below detectable limits for dieldrin (4.73 µg/kg to 40.83 µg/kg dry weight). Porewater was sampled by UCLA in both the summer and fall of 2008. Specifically, dieldrin concentrations in the porewater sampled at four sites during the summer of 2008 were all less than the detection limit of 30 ng/L; three sites sampled during the fall of 2008 were also below the detection limit of 30 ng/L. All four porewater suspended sediments collected in the summer of 2008 were below detectable levels (4.51 µg/kg to 18.50 µg/kg dry weight).

UCLA also collected bed sediment samples at four locations in Peck Road Park Lake in summer and fall 2008 (Table 4-40). All nine sediment samples collected during 2008 resulted in dieldrin concentrations below the detection limit (which ranged from 0.69 µg/kg to 1.44 µg/kg dry weight). Four in-lake sediment locations were sampled by USEPA and the county of Los Angeles on November 16, 2009; all were below detection limit (1 µg/kg dry weight). The average of all samples with non-detects set equal to one-half of the individual sample detection limit is 0.49 µg/kg dry weight. Because dieldrin does appear in fish at levels greater than the FCG, and because these body burdens of dieldrin are believed to arise from the sediment, EPA decided to represent statistical estimates for the sediment concentrations of dieldrin by setting the concentration of non-detected samples to the detection limit. For an upper bound analysis the average with all samples set equal to the detection limit is 0.98 µg/kg dry weight. Stations located near outfalls are taken as an estimate of the concentrations on incoming sediment. The lake-wide average of <0.98 µg/kg dry weight for dieldrin is still less than the consensus-based TEC of 5.28 µg/kg dry weight.

**Table 4-40. Summary of Sediment Samples for Dieldrin in Peck Road Park Lake, 2008-2009**

| Station | Average Sediment Concentration (µg/kg dry weight)[1] | Number of Samples | Number of Samples Above Detection Limits[1] |
|---|---|---|---|
| Near Sawpit Wash | (0.74) | 1 | 0 |
| Near Santa Anita Wash | (0.90) | 3 | 0 |
| North Basin | (1.13) | 4 | 0 |
| South Basin | (1.11) | 3 | 0 |
| North Inlet | (1.00) | 1 | 0 |
| South Inlet | (1.00) | 1 | 0 |
| In-Lake Average[2] | (0.98) | | |
| Influent Average | (0.91) | | |
| Consensus-based TEC | 1.9 | | |

[1] Non-detect samples are included in reported averages at the detection limit. Numbers in round parentheses indicate a result is based only on the detection limits of the samples, and that no dieldrin was detected in any of the samples collected at that station.

[2] Overall average is the average of individual station averages.

Fish tissue concentrations for dieldrin from Peck Road Park Lake have been analyzed in largemouth bass (TSMP and SWAMP). Dieldrin concentrations in the fish tissue ranged from non-detect to 0.97 ppb. Two of the four samples of largemouth bass were taken in 1991 and 1992 and both were below detection limits (value not stated). Considering only data collected in the past 10 years, the average concentration of dieldrin in largemouth bass was 1.06 ppb, in excess of the FCG of 0.46 ppb. This average is based on the two largemouth bass composite samples (each containing filet tissue from five individual fish) collected by SWAMP in the summer of 2007 and an additional composite sample collected in April 2010, with an average lipid fraction of 0.54 percent. Recent fish-tissue data for Peck Road Park Lake are summarized in Table 4-41. Data from bottom-feeding fish (e.g., carp) are not available for Peck Road Park Lake.

**Table 4-41. Summary of Recent Fish Tissue Samples for Dieldrin in Peck Road Park Lake**

| Sample Date | Fish Taxa | Dieldrin (ppb wet weight)[1] |
|---|---|---|
| 6 June 2007 | Largemouth Bass | 0.965 |
| 6 June 2007 | Largemouth Bass | 0.542 |
| 19 April 2010 | Largemouth Bass | 1.66 |
| 2007 - 2010 Average | | 1.06 |
| FCG | | 0.46 |

[1] Composite sample of filets from five individuals.

In sum, recent fish tissue concentrations in Peck Road Park Lake are consistently above the FCG in largemouth bass composite samples. Sediment and water column concentrations have all been below detection limits.

### 4.7.4 Source Assessment

Dieldrin in Peck Road Park Lake is primarily due to historical loading and storage within the lake sediments, with some ongoing contribution by watershed wet weather loads. Dry weather loading is assumed to be negligible because hydrophobic contaminants primarily move with particulate matter that is mobilized by higher flows. Stormwater loads from the watershed could not be directly estimated because all sediment and water samples were below detection limits. Watershed loads of dieldrin may arise from past pesticide applications, improper disposal, and atmospheric deposition. Pesticide applications were most likely associated with agricultural, commercial, and residential areas. Improper disposal could have occurred at various locations.

There is no definitive information on specific sources within the watershed at this time. Therefore, an average concentration of sediment is applied to all contributing areas.

An upper-bound analysis for dieldrin is performed using the simulated sediment load and detection limit to determine the maximum potential loading rate of dieldrin from the watershed. The dieldrin sediment concentration is assigned as the upper bound estimate of concentration on influent sediment (0.91 µg/kg dry weight, calculated with non-detects set equal to the individual sample detection limits). The annual sediment load to Peck Road Park Lake, including sediment delivered through the water diversion (see Appendix D, Wet Weather Loading) is 990.3 tons/yr,. The resulting estimated upper bound on wet-weather load of dieldrin from the watershed is 0.82 g/yr or less (Table 4-42).

**Table 4-42. Maximum Potential Dieldrin Loads for Each Jurisdiction and Subwatershed in the Peck Road Park Lake Watershed (g/yr)**

| Subwatershed | Responsible Jurisdiction | Input | Sediment (tons/yr) | Total Dieldrin Load (g/yr) | Percent of Total Load |
|---|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 12.1 | <0.010 | 1.22% |
| Eastern | Bradbury | MS4 Stormwater[1] | 44.4 | <0.037 | 4.48% |
| Eastern | Caltrans | State Highway Stormwater[1] | 9.6 | <0.008 | 0.96% |
| Eastern | Duarte | MS4 Stormwater[1] | 57.2 | <0.047 | 5.78% |
| Eastern | General Industrial Stormwater Permittees[2] | General Industrial | 0.8 | <0.001 | 0.08% |

| Subwatershed | Responsible Jurisdiction | Input | Sediment (tons/yr) | Total Dieldrin Load (g/yr) | Percent of Total Load |
|---|---|---|---|---|---|
| | (in the city of Duarte) | Stormwater[1] | | | |
| Eastern | Irwindale | MS4 Stormwater[1] | 23.3 | <0.019 | 2.36% |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 1.6 | <0.001 | 0.16% |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 28.6 | <0.024 | 2.89% |
| Eastern | Monrovia | MS4 Stormwater[1] | 200.5 | <0.165 | 20.24% |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 16.3 | <0.013 | 1.65% |
| Eastern | Angeles National Forest | Stormwater[1] | 12.1 | <0.010 | 1.22% |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 379 | <0.313 | 38.31% |
| Near Lake | Arcadia | MS4 Stormwater[1] | 7.6 | <0.006 | 0.77% |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 1.7 | <0.001 | 0.17% |
| Near Lake | El Monte | MS4 Stormwater[1] | 3.5 | <0.003 | 0.36% |
| Near Lake | Irwindale | MS4 Stormwater[1] | 1.7 | <0.001 | 0.17% |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 4.0 | <0.003 | 0.41% |
| Near Lake | Monrovia | MS4 Stormwater[1] | 2.6 | <0.002 | 0.26% |
| Western | Arcadia | MS4 Stormwater[1] | 68.2 | <0.056 | 6.88% |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 37.8 | <0.031 | 3.82% |
| Western | Caltrans | State Highway Stormwater[1] | 2.1 | <0.002 | 0.21% |
| Western | County of Los Angeles | MS4 Stormwater[1] | 14.7 | <0.012 | 1.49% |
| Western | Monrovia | MS4 Stormwater[1] | 9.3 | <0.008 | 0.94% |
| Western | Sierra Madre | MS4 Stormwater[1] | 19.9 | <0.016 | 2.01% |
| Eastern | Angeles National Forest | Stormwater[1] | 31.4 | <0.026 | 3.18% |
| **Total Load from Watershed** | | | **990.3** | **<0.818** | **100%** |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. The disturbed area associated with general construction and general industrial stormwater permittees (510 acres) was subtracted out of the appropriate city areas and allocated to these permits.

As described in Appendix E (Atmospheric Deposition), Section E.5, the net atmospheric deposition of dieldrin directly to the lake surface is estimated to be close to zero, with deposited loads balanced by volatilization losses. Atmospheric deposition onto the watershed is implicitly included in the estimates of watershed load.

## 4.7.5 Linkage Analysis

The linkage analysis provides the quantitative basis for determining the loading capacity of dieldrin into Peck Road Park Lake consistent with achieving water quality standards. The loading capacity is used to calculate the TMDL and corresponding allocations of that load to permitted point sources (wasteload allocations) and nonpoint sources (load allocations).

Lake sediments are often the predominant source of dieldrin in biota. The bottom sediment serves as a sink for organochlorine compounds that can be recycled through the aquatic life cycle. Dieldrin is strongly sorbed to sediments and has a long half-life in sediment and water. Incoming loads of dieldrin will mainly be adsorbed to particulates from stormwater runoff (eroded sediments from legacy contamination sites or from atmospheric deposition).

The use of bioaccumulation models and the fish tissue data in Peck Road Park Lake are discussed in detail in Appendix H (Organochlorine Compounds TMDL Development) and Appendix G (Monitoring Data), respectively. The estimated existing sediment dieldrin concentrations in Peck Road Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Therefore, a sediment target based on biota-sediment bioaccumulation (a BSAF approach) is calculated using ratio of the FCG to existing fish tissue concentrations in largemouth bass of 0.46/1.06 = 0.434. Sediment concentrations of dieldrin in Peck Road Park Lake are reported as below detection limits ranging from 0.7 to 1.44 µg/kg dry weight. However, dieldrin is highly bioaccumulative, and low sediment concentrations can lead to unacceptable fish tissue concentrations (see Appendix H, Organochlorine Compounds TMDL Development). Using an estimated concentration of 0.98 µg/kg dry weight based on the average of the sample detection limits, the resulting target concentration would be 0.43 µg/kg dry weight to obtain FCGs. Calculation with a literature-based BSAF (Appendix G, Monitoring Data) suggests that even lower concentrations might be needed. However, the literature-based BSAF is highly uncertain and may not be directly applicable to conditions in Peck Road Park Lake. Therefore, the target based on the detection limits is used, with acknowledgment that the estimate may need to be refined if additional data are collected at lower detection limits. The resulting fish tissue-based target concentration of dieldrin in the sediment of Peck Road Park Lake is shown in Table 4-43.

**Table 4-43. Fish Tissue-Based Dieldrin Concentration Targets for Sediment in Peck Road Park Lake**

| Total Dieldrin Concentration | Sediment (µg/kg dry weight) |
|---|---|
| Existing | < 0.98 |
| BSAF-derived Target | 0.43 |
| Required Reduction | < 56.1% |

The BSAF-derived sediment target is less than the consensus-based sediment quality guideline of 1.9 µg/kg dry weight. (The consensus-based sediment quality guideline is for the protection of benthic organisms, and explicitly does not address bioaccumulation and human-health risks from the consumption of contaminated fish.) The lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target. In addition, the CTR criterion for human health (0.14 ng/L) is the selected numeric target for the water column and protects both aquatic life and human health.

## 4.7.6 TMDL Summary

Dieldrin was below detection limits in both water and sediment samples of Peck Road Park Lake and its tributaries. The concentration observed in fish is most likely due to historic loads stored in the lake sediment, which is not amenable to a standard, load-based TMDL analysis. Instead, allocations are first assigned on a concentration basis, with the goal of attaining the concentrations identified above for water and sediment, as well as fish tissue concentrations. The concentration targets apply to water and sediment entering the lake and within the lake.

The dieldrin TMDL will be allocated to ensure achievement of the loading capacity. TMDLs are broken down into the wasteload allocations (WLAs), load allocations (LAs), and Margins of Safety (MOS) using the general TMDL equation.

$$TMDL = \sum WLA + LA + MOS$$

Note that since this TMDL is being expressed as a concentration in sediment, in this scenario, the loading capacity is equal to 0.43 μg/kg dry weight dieldrin. The wasteload allocations and load allocations are also equal to 0.43 μg/kg dry weight dieldrin in sediment. There is no explicit MOS. Allocations are assigned for this TMDL by requiring equal concentrations of all sources. Details associated with the WLAs, LAs, and MOS are presented in the following three sections.

### 4.7.6.1 Wasteload Allocations

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs). This TMDL establishes WLAs at their point of discharge. This TMDL also establishes alternative wasteload allocations for dieldrin ("Alternative WLAs if the Fish Tissue Target is Met") described in Section 4.7.6.1.2. The alternative wasteload allocations will supersede the wasteload allocations in Section 4.7.6.1.1 if the conditions described in Section 4.7.6.1.2 are met.

#### *4.7.6.1.1 Wasteload Allocations*

The entire watershed of Peck Road Park Lake is contained in MS4 jurisdictions, and watershed loads are therefore assigned WLAs. The Caltrans areas and facilities that operate under a general industrial stormwater permit also receive WLAs.

Relevant permit numbers are

- County of Los Angeles (including the cities of Arcadia, Bradbury, Duarte, Irwindale, Monrovia, and Sierra Madre): Board Order 01-182 (as amended by Order No. R4-2006-0074 and R4-2007-0042), CAS004001
- Caltrans: Order No 99-06-DWQ, CAS000003
- General Industrial Stormwater: Order No. 97-03-DWQ, CAS000001

Measurements of dieldrin in sediment and water flowing into Peck Road Park Lake are below detection limits, but most dieldrin load is expected to move in association with sediment. Therefore no separate wasteload allocation or reduction is assigned to the Colorado Well Aquifer (Order No. R4-2003-0108, CAG994005) as it is not expected to deliver sediment loads. On the other hand, the suspended sediment in water flowing into the lake is assigned wasteload allocations. Additionally, the TMDL establishes wasteload allocations for dieldrin in the water column equal to the CTR based water column target. The CTR based water column target includes both dissolved dieldrin and dieldrin associated with suspended sediment. Comparing the sediment concentration target to the average detection limit for the influent samples of 0.91 μg/kg dry weight suggests that a reduction of approximately 53 percent in dieldrin loads is needed.

The wasteload allocations are shown in Table 4-44 and each wasteload allocation must be met at the point of discharge.

**Table 4-44. Wasteload Allocations for Dieldrin in Peck Road Park Lake**

| Sub-watershed | Responsible Jurisdiction | Input | Wasteload Allocation for Dieldrin Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for Dieldrin in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 0.43 | 0.14 |
| Eastern | Bradbury | MS4 Stormwater[1] | 0.43 | 0.14 |
| Eastern | Caltrans | State Highway Stormwater[1] | 0.43 | 0.14 |
| Eastern | Duarte | MS4 Stormwater[1] | 0.43 | 0.14 |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 0.43 | 0.14 |
| Eastern | Irwindale | MS4 Stormwater[1] | 0.43 | 0.14 |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 0.43 | 0.14 |
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 0.43 | 0.14 |
| Eastern | Monrovia | MS4 Stormwater[1] | 0.43 | 0.14 |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 0.43 | 0.14 |
| Eastern | Angeles National Forest | Stormwater[1] | 0.43 | 0.14 |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 0.43 | 0.14 |
| Near Lake | Arcadia | MS4 Stormwater[1] | 0.43 | 0.14 |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 0.43 | 0.14 |
| Near Lake | El Monte | MS4 Stormwater[1] | 0.43 | 0.14 |
| Near Lake | Irwindale | MS4 Stormwater[1] | 0.43 | 0.14 |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 0.43 | 0.14 |
| Near Lake | Monrovia | MS4 Stormwater[1] | 0.43 | 0.14 |
| Western | Arcadia | MS4 Stormwater[1] | 0.43 | 0.14 |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 0.43 | 0.14 |
| Western | Caltrans | State Highway Stormwater[1] | 0.43 | 0.14 |
| Western | County of Los Angeles | MS4 Stormwater[1] | 0.43 | 0.14 |
| Western | Monrovia | MS4 Stormwater[1] | 0.43 | 0.14 |

| Sub-watershed | Responsible Jurisdiction | Input | Wasteload Allocation for Dieldrin Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for Dieldrin in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| Western | Sierra Madre | MS4 Stormwater[1] | 0.43 | 0.14 |
| Western | Angeles National Forest | Stormwater[1] | 0.43 | 0.14 |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

#### *4.7.6.1.2 Alternative Wasteload Allocations if the Fish Tissue Target is Met*

The wasteload allocations listed in Table 4-44 will be superseded, and the wasteload allocations in Table 4-45 will apply, if:

1. The responsible jurisdictions submit to USEPA and the Regional Board material describing that the fish tissue target of 0.46 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five largemouth bass each measuring at least 350mm in length,
2. The Regional Board Executive Officer approves the request and applies the alternative wasteload allocations in Table 4-45, and
3. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

Each wasteload allocation must be met at the point of discharge.

**Table 4-45. Alternative Wasteload Allocations for Dieldrin in Peck Road Park Lake if the Fish Tissue Target is Met**

| Sub-watershed | Responsible Jurisdiction | Input | Wasteload Allocation for Dieldrin Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for Dieldrin in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| Eastern | Arcadia | MS4 Stormwater[1] | 1.90 | 0.14 |
| Eastern | Bradbury | MS4 Stormwater[1] | 1.90 | 0.14 |
| Eastern | Caltrans | State Highway Stormwater[1] | 1.90 | 0.14 |
| Eastern | Duarte | MS4 Stormwater[1] | 1.90 | 0.14 |
| Eastern | General Industrial Stormwater Permittees[2] (in the city of Duarte) | General Industrial Stormwater[1] | 1.90 | 0.14 |
| Eastern | Irwindale | MS4 Stormwater[1] | 1.90 | 0.14 |
| Eastern | General Industrial Stormwater Permittees (in the city of Irwindale) | General Industrial Stormwater[1] | 1.90 | 0.14 |

| Sub-watershed | Responsible Jurisdiction | Input | Wasteload Allocation for Dieldrin Associated with Suspended Sediment[3] (µg/kg dry weight) | Wasteload Allocation for Dieldrin in the Water Column[3] (ng/L) |
|---|---|---|---|---|
| Eastern | County of Los Angeles | MS4 Stormwater[1] | 1.90 | 0.14 |
| Eastern | Monrovia | MS4 Stormwater[1] | 1.90 | 0.14 |
| Eastern | General Industrial Stormwater Permittees (in the city of Monrovia) | General Industrial Stormwater[1] | 1.90 | 0.14 |
| Eastern | Angeles National Forest | Stormwater[1] | 1.90 | 0.14 |
| Diversion | Los Angeles County Department of Public Works | Water Diversion | 1.90 | 0.14 |
| Near Lake | Arcadia | MS4 Stormwater[1] | 1.90 | 0.14 |
| Near Lake | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 1.90 | 0.14 |
| Near Lake | El Monte | MS4 Stormwater[1] | 1.90 | 0.14 |
| Near Lake | Irwindale | MS4 Stormwater[1] | 1.90 | 0.14 |
| Near Lake | County of Los Angeles | MS4 Stormwater[1] | 1.90 | 0.14 |
| Near Lake | Monrovia | MS4 Stormwater[1] | 1.90 | 0.14 |
| Western | Arcadia | MS4 Stormwater[1] | 1.90 | 0.14 |
| Western | General Industrial Stormwater Permittees (in the city of Arcadia) | General Industrial Stormwater[1] | 1.90 | 0.14 |
| Western | Caltrans | State Highway Stormwater[1] | 1.90 | 0.14 |
| Western | County of Los Angeles | MS4 Stormwater[1] | 1.90 | 0.14 |
| Western | Monrovia | MS4 Stormwater[1] | 1.90 | 0.14 |
| Western | Sierra Madre | MS4 Stormwater[1] | 1.90 | 0.14 |
| Western | Angeles National Forest | Stormwater[1] | 1.90 | 0.14 |

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Discharges governed by the general construction and general industrial stormwater permits are currently located in the Cities of Arcadia, Duarte, Irwindale and Monrovia. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

### 4.7.6.2 Load Allocations

This TMDL establishes load allocations (LAs) at their point of discharge. This TMDL also establishes alternative load allocations for dieldrin (“Alternative LAs if the Fish Tissue Target is Met”) described in Section 4.7.6.2.2. The alternative load allocations will supersede the load allocations in Section 4.7.6.2.1 if the conditions described in Section 4.7.6.2.2 are met.

#### *4.7.6.2.1 Load Allocations*

No part of the watershed of Peck Road Park Lake is outside MS4 jurisdiction; therefore no LAs are assigned to watershed loads. No load is allocated to atmospheric deposition of dieldrin. The legacy dieldrin stored in lake sediment is the major cause of impairment associated with elevated fish tissue concentrations, and is assigned a load allocation. The in-lake allocation is in concentration terms: specifically, the responsible jurisdictions (County of Los Angeles) should achieve a dieldrin concentration of 0.43 µg/kg dry weight in lake bottom sediments (Table 4-46).

**Table 4-46. Load Allocations for Dieldrin in Peck Road Park Lake**

| Subwatershed | Responsible Jurisdiction | Input | Load Allocation (µg/kg dry weight) |
|---|---|---|---|
| Lake Surface | County of Los Angeles | Lake bottom sediments | 0.43 |

#### *4.7.6.2.2 Alternative Load Allocations if the Fish Tissue Target is Met*

The load allocations listed in Table 4-46 will be superseded, and the load allocations in Table 4-47 will apply, if:

1. The responsible jurisdiction submits to USEPA and the Regional Board material describing that the fish tissue target of 0.46 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five largemouth bass each measuring at least 350mm in length,
2. The Regional Board Executive Officer approves the request and applies the alternative load allocations in Table 4-47, and
3. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

**Table 4-47. Alternative Load Allocations for Dieldrin in Peck Road Park Lake if the Fish Tissue Target is Met**

| Subwatershed | Responsible Jurisdiction | Input | Load Allocation (µg/kg dry weight) |
|---|---|---|---|
| Lake Surface | County of Los Angeles | Lake bottom sediments | 1.90 |

### 4.7.6.3 Margin of Safety

TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. This TMDL contains an implicit MOS based on conservative assumptions. The allocations are set based on the lower of either the BSAF-derived sediment target or the consensus-based TEC sediment target to ensure achievement of the OEHHA FCG target in fish tissue. The selected BSAF-derived target concentration in sediment is considerably lower than the consensus-based TEC target.

#### 4.7.6.4 Critical Conditions/Seasonality

TMDLs must include consideration of critical conditions and seasonal variation to ensure protection of the designated uses of the waterbody at all times. This TMDL protects beneficial uses by reducing fish tissue concentrations to the FCG target and protecting benthic biota in sediment. Because fish bioaccumulate dieldrin, concentrations in tissues of edible sized game fish integrate exposure over a number of years. As a result, overall average loading is more important for the attainment of standards than instantaneous or daily concentrations. WLAs and LAs in this TMDL are assigned as concentrations and protect during all seasons and in both high and low flow conditions. This TMDL therefore protects for critical conditions.

#### 4.7.6.5 Daily Load Expression

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. This TMDL includes a maximum daily load estimated according to the guidelines provided by USEPA (2007).

Because the dieldrin WLAs are expressed as concentrations on sediment, the daily maximum allowable load is calculated from the maximum daily sediment load multiplied by the TMDL WLA concentration. The maximum daily sediment load is estimated from the 99$^{th}$ percentile daily flow and the sediment event mean concentration that yields the estimated annual sediment load.

No USGS gage currently exists in the Peck Road Park Lake watershed. USGS Station 11101250, on the Rio Hondo River above the Whittier Narrows Dam, was selected as a surrogate for flow determination. The 99$^{th}$ percentile flow was chosen to represent the peak flow for this drainage. Choosing the 99$^{th}$ percentile flow eliminates errors due to outliers and is reasonable for development of a daily load expression.

The USGS StreamStats program was used to determine the 99$^{th}$ percentile flow for the Rio Hondo (952 cfs) (Wolock, 2003). To estimate the peak flow to Peck Road Park Lake, the 99$^{th}$ percentile flow for the Rio Hondo was scaled down by the ratio of drainage areas (23,564 acres/58,368 acres; Peck Road Park Lake watershed area/Rio Hondo watershed area at the gage). The resulting peak flow estimate for Peck Road Park Lake is 384 cfs. The 99$^{th}$ percentile diverted flow from the San Gabriel River to Peck Road Park Lake is 328 cfs. Therefore, the total peak daily flow rate is 712 cfs.

The event mean concentration of sediment in stormwater (71.7 mg/L) was calculated from the estimated existing watershed sediment load of 990.3 tons/yr (Table 4-14) divided by the total stormflow volume reaching the lake (10,158 ac-ft, Table 4-7). Multiplying the sediment event mean concentration by the 99$^{th}$ percentile peak daily flow (712 cfs) yields a daily maximum sediment load from stormwater of 137.7 tons/d. Applying the wasteload allocation concentration of 0.43 ng dieldrin per dry g of sediment yields the stormwater daily maximum allowable load of 0.054 g/d of dieldrin. This load is associated with the MS4 stormwater permittees and the water diversion. The maximum allowable daily load must be met on all days, and the concentration-based WLAs must be met to ensure compliance with the TMDL.

#### 4.7.6.6 Future Growth

The manufacture and use of dieldrin is currently banned. Therefore, no additional allowance is made for future growth in the dieldrin TMDL.

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

## 4.8 TRASH IMPAIRMENT

### 4.8.1 Beneficial Uses

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. Peck Road Park Lake was not identified specifically in the Basin Plan; therefore, the beneficial uses associated with the downstream segment (Rio Hondo below Spreading Grounds) apply: REC1, REC2, WARM, WILD, MUN, and GWR (personal communication, Regional Board, December 22, 2009). Descriptions of these uses are listed in Section 2 of this TMDL report. Trash can potentially impair the REC1, REC2, and WARM in a variety of ways, including causing toxicity to aquatic organisms, damaging habitat, impairing aesthetics, and impeding recreation.

### 4.8.2 Numeric Targets

The numeric target is derived from the narrative water quality objective in the Los Angeles Basin Plan (LARWQCB, 1994) for floating material:

> *"Waters shall not contain floating materials, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses"*

and for solid, suspended, or settleable materials:

> *"Waters shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses."*

The numeric target for the Peck Road Park Lake Trash TMDL is 0 (zero) trash in or on the water and on the shoreline. Zero trash is defined as no allowable trash discharged into the waterbody of concern, shoreline, and channels. No information has been found to justify any value other than zero that would fully support the designated beneficial uses. Furthermore, court rulings have found that a numeric target of zero trash is legally valid (*City of Arcadia et al. v. Los Angeles Regional Water Quality Control Board et al. (2006) 135 Cal.App.4th 1392*). The numeric target was used to calculate the waste load allocations for point sources and load allocations for nonpoint sources, as described in the following sections of this report.

### 4.8.3 Summary of Monitoring Data

The existing beneficial uses are impaired by the accumulation of suspended and settled debris. Common items that were observed include plastic bags, plastic pieces, paper items, plastic and glass bottles, Styrofoam, bottle caps, and cigarette butts. Heavier debris has also been transported during storms or dumped on the shoreline or in the lake.

According to California's 2006 303(d) Impaired Waterbodies List, trash is causing water quality problems in Peck Road Park Lake. USEPA and Regional Water Quality Control Board staff confirmed the trash impairment during a site visit to Peck Road Park Lake on March 9, 2009. Staff conducted quantitative trash assessments and documented the trash impairment with photographs. Trash was observed in the lake, along shores and fences surrounding the lake, and at the outlet of storm drains discharging into the lake. Trash of major concern, found on March 9, 2009, included a chicken carcass with numerous egg shells (a biohazard) near the industrial facilities, furniture in the water, a large tattered blanket near the park, and a decomposing animal near Sawpit Wash.

Three quantitative trash assessments were conducted according to the Rapid Trash Assessment protocol which gives each shoreline a numeric score out of a possible 120 points (SWAMP, 2007). Higher scores correspond to cleaner areas, with 120 points representing a clean area. The severity of the trash problem was scored based upon the condition of the following parameters: level of trash, actual number of trash items found, threat to aquatic life, threat to human health, illegal dumping and littering, and accumulation of trash. Trash assessments were conducted within a 100 ft long by 10 ft wide area. If the shoreline was too steep, trash was observed from a distance. Any piece of trash visible from greater than 10 ft away was considered a large piece of trash. The site visit evaluated different land use types surrounding Peck Road Park Lake, including recreational use, industrial businesses, and urban runoff.

#### 4.8.3.1 Peck Road Park

In the park area near the parking lot were roughly 20 picnic tables with barbeque grills and four trash cans. More trash cans were placed near the bathroom but none were observed near the trail. These uncovered trash cans can be a source of trash because animals or wind may transport trash from the cans to the shoreline or lake. People were observed to be fishing, walking around the lake, sitting at picnic tables, and recreating near the water. Approximately 50 birds were observed in the park portion of Peck Road Park Lake. A 100-foot trash assessment was conducted on the beach near the bathroom and parking lot. The area scored a 48/120 with some trash items found in the water. Because this area is more accessible to the public, it might lead to greater picnicking activities and trash littering (Figure 4-10).

Figure 4-10. **Picnic Area near Quantitative Assessment Location #1**

#### 4.8.3.2 Industrial Area

Between 50-300 large pieces of trash were observed along 100 ft of shoreline in the industrial area surrounding Peck Road Park Lake. The area was too steep to appropriately conduct a quantitative trash assessment, but items observed from a distance included plastic bags, milk jugs, a tire, a cooler, metal cable, and industrial scraps. Figure 4-11 shows an example of the trash impairment along the northeastern shore of the lake. A chain link fence surrounds the industrial facilities, which acts as a buffer to trash entering the park. The trash accumulated near the fence does not appear to have been removed for a long period. Many dumpsters at the industrial sites were uncovered or overflowing with debris.

Some companies were notably tidier than others. A transient tarp shelter with over 100 pieces of large visible trash within 100 ft of the shelter was also noted.

Figure 4-11. **Evidence of Dumping near the Industrial Facilities**

#### 4.8.3.3 Sawpit Wash

The second quantitative trash assessment was conducted near the inlet of Sawpit Wash. This area scored a 12/120 due to a heavy accumulation of trash, evidence of trash dumping, and much trash debris found in the water. Water levels in the past were probably higher (i.e., during storm events) as evidenced by trash being stuck higher in branches (Figure 4-12). Specific items found included a semiconductor, pepper spray, a spray paint can, cigarette butts, furniture, and Styrofoam and plastic pieces.

Figure 4-12. **A Bird Lives amongst Trash near the Sawpit Wash Inlet to Peck Road Park Lake**

#### 4.8.3.4 Santa Anita Wash and Adjacent Area to the South

In general, the Santa Anita Wash area has a terraced grading. Visual assessment showed less than five larger pieces of trash per 100 ft. Residential homes, a school, and golf course were tidy and had fences enclosing their property. Dog excrement was observed along the bike trail. Although a large sediment buildup was observed next to a shopping cart, the amount of large visible trash was low near the lake inlet.

The third quantitative trash assessment was completed near Santa Anita Wash, which scored a 49/120. Grading was similar along most of the western shore except for a short beach area which was included in this assessment. Along this portion of the shore, a tree provided a physical space for trash to become entangled (Figure 4-13). Shorelines without any physical obstruction allowed trash to blow directly into the lake. Some trash items were observed in the water.

Locations of the three quantitative trash assessments are shown in Figure 4-14.

Note: Trash accumulates where physical space for entanglement such as branches are present, but likely blows directly into the lake along barren portions of the eastern shore of Peck Road Park Lake.

Figure 4-13. **Trash Accumulates near Santa Anita Wash**


Figure 4-14. **Quantitative Monitoring Locations at Peck Road Park Lake**

During a follow-up visit to Peck Road Park Lake on August 5, 2009, trash was similarly observed in the lake and on the shore. No quantitative surveys were conducted.

In summary, trash was present in and along the shore of Peck Road Park Lake during all visits. The main trash problems were near the park, industrial facilities, and storm drain outfalls.

## 4.8.4 Source Assessment

The major source of trash in Peck Road Park Lake is due to litter, which is intentionally or accidentally discarded in the lake and watershed. Potential sources can be categorized as point sources and nonpoint sources depending on the transport mechanisms. For example:

1. Storm drains: trash is deposited throughout the watershed and carried to various sections of the lake during and after rainstorms via storm drains. This is a point source.
2. Wind action: trash blown into the lake directly. This is a nonpoint source.
3. Direct disposal: direct dumping or littering into the lake. This is a nonpoint source.

Since the Peck Road Park Lake watershed includes residential areas, open space, parks, roads, and storm drains, both point and nonpoint sources contribute trash to the lake.

### 4.8.4.1 Point Sources

Trash conveyed by stormwater through storm drains to Peck Road Park Lake is evidenced by trash accumulation at the end of storm drains discharging to the lake.

Based on reports from similar watersheds, the amount and type of trash transported is a function of the surrounding land use. The city of Long Beach recorded trash quantity collected at the mouth of the Los Angeles River; the results suggest total trash amount is linearly correlated with precipitation (Figure 4-15, $R^2$=0.90, Signal Hill, 2006). A similar study found that the amount of gross pollutants entering the stormwater system is rainfall dependent but does not necessarily depend on the source (Walker and Wong, 1999). The amount of trash entering the stormwater system depends on the energy available to re-mobilize and transport deposited gross pollutants on street surfaces, rather than the amount of available gross pollutants deposited on street surfaces. Where gross pollutants exist, a clear relationship is established between the gross pollutant load in the stormwater system and the magnitude of the storm event. The limiting mechanism affecting the transport of gross pollutants, in the majority of cases, appears to be re-mobilization and transport processes (i.e., stormwater rates and velocities).

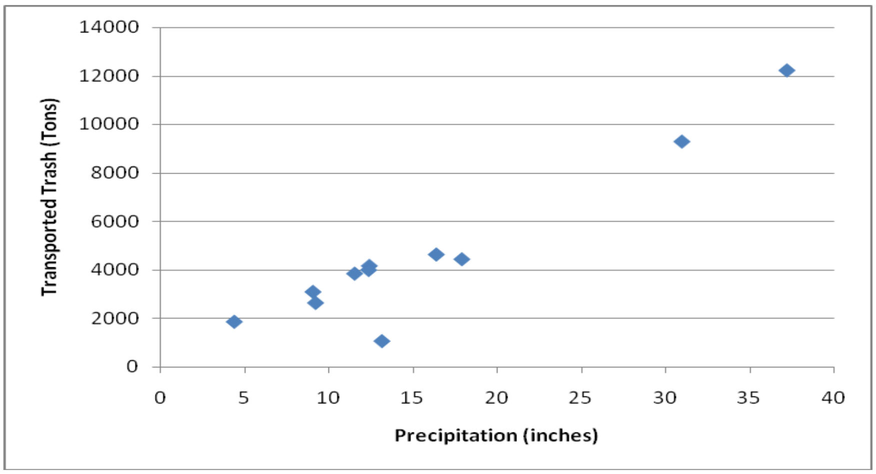



Figure 4-15. **Storm Debris Collection Summary for Long Beach (Signal Hill, 2006)**

In order to estimate trash generation rates, data from a comparable watershed were analyzed. The city of Calabasas completed a study on a Continuous Deflective Separation (CDS) unit installed to catch runoff from Calabasas Park Hills to Las Virgenes. The CDS unit is a hydrodynamic separator that uses vortex settling to remove sediment, trap debris and trash, and separate floatables such as oil and grease. It is assumed that this CDS unit prevented all trash from passing through. The calculated area drained by this CDS Unit is approximately 12.8 square miles. Regional Board staff estimated the waterbody's urbanized area to be 0.10 square miles. The results of this clean-out, which represents approximately half of the 1998-1999 rainy season, were 2,000 gallons of sludgy water and a 64-gallon bag two-thirds full of plastic food wrappers. Part of the trash accumulated in this CDS unit for over half of the rainy season is assumed to have decomposed due to the absence of paper products. Since the CDS unit was cleaned out after slightly more than nine months of use, it was assumed that this 0.10 square mile urbanized area produced a volume of 64 gallons of trash. Therefore, 640 gallons of trash were generated per square mile per year. This estimate is used to determine trash loads.

During the 1998/1999 and 1999/2000 rainy seasons, a Litter Management Pilot Study (LMPS) was conducted by Caltrans to evaluate the effectiveness of several litter management practices in reducing litter discharged from Caltrans stormwater conveyance systems. The LMPS employed four field study sites, each of which was measured with the amount of trash produced when separate BMPs were applied. The average total load for each site normalized by the total area of control catchments was 6,677 gallons/mi$^2$/yr. Other trash generation rates and studies exist, but the LMPS study is the most applicable to Peck Road Park Lake because of similar land use, population density, and average daily traffic conditions. Therefore, this analysis will use 6,677 gallons/mi$^2$/yr as the baseline estimate of trash for Caltrans roads.

Table 4-48 shows the current estimated volume of trash deposited within each of the responsible jurisdictions, in gallons per year, assuming a trash generation rate of 6,677 gallons of uncompressed trash/mi$^2$/yr for Caltrans and a trash generation rate of 640 gallons of uncompressed trash per square mile per year for other jurisdictions. For responsible jurisdictions that are only partially located in the watershed, the square mileage indicated is for the portion in the watershed only. The current loads need to be reduced 100 percent to meet the TMDL target of zero trash.

**Table 4-48. Peck Road Park Lake Estimated Point Source Trash Loads**

| Responsible Jurisdictions | Point Source Area (mi$^2$) | Current Point Source Trash Load (gal/yr) |
|---|---|---|
| Arcadia | 3.5 | 2300 |
| Bradbury | 0.79 | 500 |
| CA DOT (Caltrans) | 0.14 | 950 |
| Duarte | 1.7 | 1100 |
| El Monte | 0.077 | 49 |
| Irwindale | 0.78 | 500 |
| County of Los Angeles | 16 | 10000 |
| Monrovia | 13 | 8000 |
| Sierra Madre | 1.1 | 680 |

Note: For Caltrans: Current Point Source Trash Load (gal/yr) = Point Source Area (mi$^2$) * 6,677 (gal/ mi$^2$/yr). For all other jurisdictions: Current Point Source Trash Load (gal/yr) = Point Source Area (mi$^2$) * 640 (gal/ mi$^2$/yr)

### 4.8.4.2 Nonpoint Sources

Nonpoint source pollution is a source of trash in Peck Road Park Lake. Trash deposited in the lake from nonpoint sources is a function of transport via wind, wildlife, overland flow, and direct dumping.

Few studies have evaluated the relationship between wind strength and movement of trash from land surfaces to a waterbody. Lighter trash with a sufficient surface area to be blown in the wind, such as plastic bags, beverage containers, and paper or plastic food containers, are easily lifted and carried to waterbodies. Also, overland flow carries trash from the shoreline to waterbodies. Transportation of pollutants from one location to another is determined by the energy of both wind and overland stormwater flow.

Existing trash surrounding the lake is the fundamental cause of nonpoint source trash loading. Land use directly surrounding Peck Road Park Lake is low density single-family residential, industrial, and open space and recreational areas. Visitors may intentionally or accidentally discard trash to grass or trails in the park, which initiate the journey of trash to waterbodies via wind or overland water flow. Industrial facilities can contribute nonpoint sources of trash especially if dumpsters are overflowing and trash is not confined within a given area. Varying uses of the park are responsible for different degrees of trash impairment. For example, areas with picnic tables generate more trash than parking lots. Visitation rates are also likely linked to the amount of trash from nonpoint sources.

Table 4-49 summarizes the nonpoint source area and current estimate of nonpoint source trash loads for responsible jurisdictions (the park area and responsible jurisdictions are illustrated in Figure 4-16), assuming a trash generation rate of 640 gallons of uncompressed trash per square mile per year. The current loads need to be reduced 100 percent to meet the TMDL target of zero trash.

**Table 4-49. Peck Road Park Lake Estimated Nonpoint Source Trash Loads**

| Responsible Jurisdictions | Nonpoint Source Area ($mi^2$) | Current Nonpoint Source Trash Load (gal/year) |
|---|---|---|
| Arcadia | 0.18 | 118.0 |
| El Monte | 0.0048 | 3.1 |
| Irwindale | 0.00031 | 0.2 |
| County of Los Angeles | 0.00031 | 0.2 |
| Monrovia | 0.048 | 31 |

Note: Current Nonpoint Source Trash Load (gal/yr) = Nonpoint Source Area ($mi^2$) * 640 ($gal/mi^2/yr$)

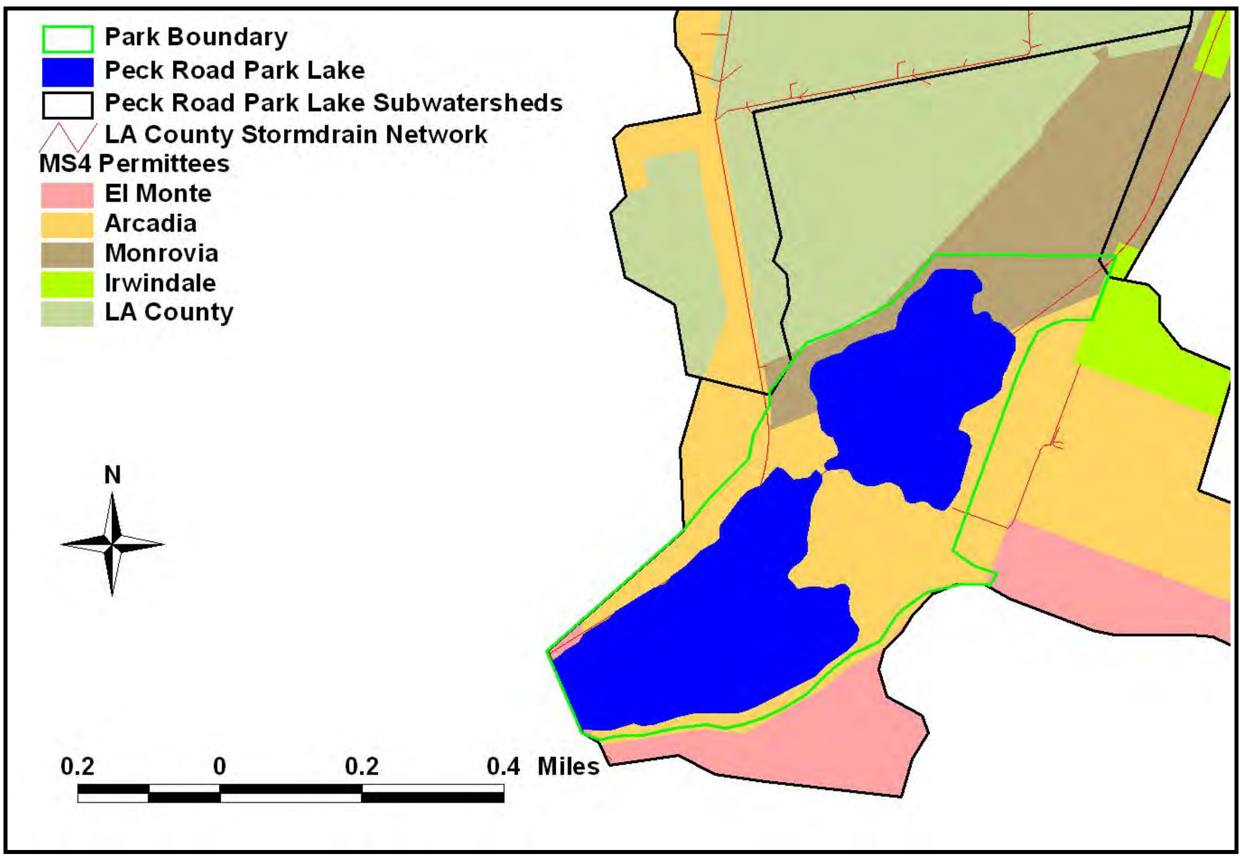



Figure 4-16. **Park Area Associated with Peck Road Park Lake**

## 4.8.5 Linkage Analysis

These TMDLs are based on numeric targets derived from narrative water quality objectives in the Los Angeles Basin Plan (LARWQCB, 1994) for floating materials and solid, suspended, or settleable materials. The narrative objectives state that waters shall not contain these materials in concentrations that cause nuisance or adversely affect beneficial uses. Since any amount of trash impairs beneficial uses, the loading capacity of Peck Road Park Lake is set to zero allowable trash.

## 4.8.6 TMDL Summary

Both point sources and nonpoint sources are identified as sources of trash in Peck Road Park Lake. For point sources, water quality standards are attained by assigning waste load allocations (WLAs) to permittees of the Los Angeles County Municipal Separate Storm Sewer System (MS4) Permit and Caltrans (hereinafter referred to as responsible jurisdictions); these WLAs will be implemented through permit requirements. For nonpoint sources, water quality standards are attained by assigning load allocations (LAs) to municipalities and agencies having jurisdictions over Peck Road Park Lake and its subwatershed. These LAs may be implemented through regulatory mechanisms that implement the State Board's 2004 Nonpoint Source Policy such as conditional waivers, waste discharge requirements, or prohibitions.

The TMDL of zero trash requires that current loads are reduced by 100%. Final WLAs and LAs are zero trash (Table 4-50).

**Table 4-50. Peck Road Park Lake Trash WLAs and LAs**

| Peck Road Park Lake | Allocation |
|---|---|
| Trash WLA | 0 |
| Trash LA | 0 |

### 4.8.6.1 Wasteload Allocations

The geographical boundary contributing to point sources is defined by watershed areas which contain conveyances discharging to the waterbodies of concern. Conveyances include, but are not limited to, natural and channelized tributaries, and stormwater drains and conveyances. Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs).

Wasteload allocations are set to zero allowable trash.

The permits affected are

- County of Los Angeles (includes all cities in Los Angeles County except Long Beach): Board Order 01-182 (as amended by Board Orders R4-2006-0074 and R4-2007-0042), CAS004001
- Caltrans: Order No 99-06-DWQ, CAS000003
- General Industrial Stormwater: Order No 97-03-DWQ, CAS000001

### 4.8.6.2 Load Allocations

Nonpoint source areas refer to locations where trash may be carried by overland flow, wildlife, or wind to waterbodies. Due to the transportation mechanism by wind, wildlife, and overland flow to relocate trash from land to waterbodies, the nonpoint source area may be smaller than the watershed. In addition, trash loadings frequently occur immediately around or directly into the lake making the load allocation a significant source of trash. According to the study by the city of Calabasas, the trash generation rate is 640 gallons per square mile per year from nonpoint sources areas (including, but not limited to, schools, commercial areas, residential areas, public services, roads, and open space and parks areas). Current trash rates were calculated in the nonpoint source section.

Load allocations (LAs) for nonpoint sources are zero trash. Zero is defined as no allowable trash found in and on the lake, and along the shoreline. According to the Porter-Cologne Act, load allocations may be addressed by the conditional waivers of WDRs, or WDRs. Responsible jurisdictions should monitor the trash quantity deposited in the vicinities of the waterbodies of concern as well as on the waterbody to comply with the load allocation.

The area adjacent to Peck Road Park Lake or defined as nonpoint sources includes parking lots, recreational areas, picnic areas, hiking trails, residential, commercial, industrial, roads, public facilities, and open space areas. Assuming that trash within a reasonable distance from Peck Road Park Lake has a high potential to reach the waterbody, the nonpoint source jurisdictions are Arcadia, El Monte, Irwindale, the county of Los Angeles, and Monrovia. All load allocations are set to zero allowable trash.

#### 4.8.6.3 Margin of Safety

A margin of safety (MOS) accounts for uncertainties in the TMDL analysis. The MOS can be expressed as an explicit mass load, or included implicitly in the WLAs and LAs that are allocated. Because this TMDL sets WLAs and LAs as zero trash, the TMDL includes an implicit MOS. Therefore, an explicit MOS is not necessary.

#### 4.8.6.4 Critical Conditions/Seasonality

Critical conditions for Peck Road Park Lake are based on three conditions that correlate with loading conditions:

- Major storms
- Wind advisories issued by the National Weather Service
- High visitation – On weekends and holidays from May 15 to October 15.

Critical conditions do not affect wasteload or load allocations because zero trash is a conservative target. However, implementation efforts should be heightened during critical conditions in order to ensure that no trash enters the waterbody.

#### 4.8.6.5 Future Growth

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

## 4.9 IMPLEMENTATION RECOMMENDATIONS

Implementation measures may be developed in the future by the Regional Board through an implementation plan, NPDES permits, or non-point source enforcement. This section describes USEPA's recommendations to the Regional Board as to the implementation procedures and regulatory mechanisms that could be used to provide reasonable assurances that water quality standards will be met. General information about various lake management strategies can be found in a USEPA document titled *Managing Lakes and Reservoirs (EPA 841-B-01-006)*. Lake management options that can reduce pollutant loading to lakes include but are not limited to: increasing the volume of the lake that is aerated; installing hydroponic islands to remove nutrients; increasing flow volume or circulation in the lake; reducing stormwater discharges by improved infiltration; treating stormwater or supplemental water inputs with a wetland system; alum treatment to immobilize nutrients in sediments; dredging in lake sediments; and/or fisheries management actions to reduce nutrient availability from sediments.

Additionally, responsible jurisdictions implementing these TMDLs are encouraged to utilize Los Angeles County's Structural Best Management Practice (BMP) Prioritization Methodology which helps identify priority areas for constructing BMP projects. The tool is able to prioritize based on multiple pollutants. The pollutants that it can prioritize includes bacteria, nutrients, trash, metals and sediment. Reducing sediment loads would reduce OC pesticides and PCBs delivery to the lake in many instances. More information about this prioritization tool is available at: labmpmethod.org.

If necessary, these TMDLs may be revised as the result of new information (See Section 4.10 Monitoring Recommendations).

### 4.9.1 Nonpoint Sources and the Implementation of Load Allocations

Regional Board may regulate nonpoint pollutant sources through the authority contained in sections 13263 and 13269 of the California Water Code, in conformance with the State Water Resources Control Board's Nonpoint Source Implementation and Enforcement Policy. Additionally, South Coast Air Quality Management District has authority to regulate air emissions throughout the basin that affect air deposition. Load allocations are expressed in Table 4-9, Table 4-18, Table 4-28, Table 4-37, Table 4-46, and Table 4-50 for nutrients, PCBs, chlordane, DDT, dieldrin, and trash, respectively.

### 4.9.2 Point Sources and the Implementation of Wasteload Allocations

Wasteload allocations apply to MS4, Caltrans, and General Industrial Stormwater permits as well as the San Gabriel River Water Diversion. Wasteload allocations are expressed in Table 4-8, Table 4-16, Table 4-26, Table 4-36, Table 4-44, and Table 4-50 for nutrients, PCBs, chlordane, DDT, dieldrin, and trash, respectively. The concentration and mass-based wasteload allocations will be incorporated into the Caltrans and Los Angeles County MS4 permits. Concentration-based wasteload allocations will be incorporated into the General Industrial Stormwater permit.

### 4.9.3 Source Control Alternatives

Responsible jurisdictions are encouraged to consider the construction of wetland systems and bioswales (or other retention or treatment options) to treat the stormwater and supplemental water flows entering the lake, as well as stormwater diversion and infiltration using methods such as porous pavements and rain gardens. Implementing these options can reduce the lake's nutrient loads and, in the case of recirculation through constructed wetlands, reduce in-lake nutrient concentrations. The City of Los Angeles has modeled expected nutrient concentration reductions to stormwater flows to Echo Park Lake from constructed wetlands, and construction is currently underway. Information about this and other City of Los Angeles water quality improvement projects are available on Proposition O website: http://www.lapropo.org/sitefiles/lariver.htm.

Peck Road Park Lake has nutrient-related, chlordane, dieldrin, DDT, PCBs, and trash impairments. While there are some management strategies that would address multiple impairments (i.e., sediment removal BMPs in upland areas), their differences warrant separate implementation and monitoring discussions.

#### 4.9.3.1 Nutrient-Related Impairments

To prevent degradation of this waterbody due to nutrient loading that may be associated with future land use changes, source reduction and pollutant removal BMPs, designed to reduce sediment loading, could be implemented throughout the watershed as these management practices will also reduce the nutrient loading associated with sediments. Dissolved loading associated with dry and wet weather runoff also contributes nutrient loading to Peck Road Park Lake. Some of the sediment reduction BMPs may also result in decreased concentrations of nitrogen and phosphorus in the runoff water. Storage of storm flows in wet or dry ponds may allow for adsorption and settling of nutrients from the water column. BMPs that provide filtration, infiltration, and vegetative uptake and removal processes may retain nutrient loads in the upland areas.

Education of park maintenance staff regarding the proper placement, timing, and rates of fertilizer application will also result in reduced nutrient loading to the lake. Staff should be advised to follow product guidelines regarding fertilizer amounts and to spread fertilizer when the chance of heavy precipitation in the following days is low. Encouraging pet owners to properly dispose of pet wastes will also reduce nutrient loading associated with fecal material that may wash directly into the lake or into storm drains that eventually discharge to the lake. Discouraging feeding of birds at the lake will reduce nutrient loading associated with excessive bird populations.

In order to meet the fine particulate ($PM_{2.5}$) and ozone ($O_3$) national ambient air quality standards by their respective attainment dates of 2015 and 2024, the South Coast Air Quality Management District and the California Air Resources Board have prepared an air quality management plan that commits to reducing nitrogen oxides (NOx, a precursor to both $PM_{2.5}$ and ozone) by over 85 percent by 2024. These reductions will come largely from the control of mobile sources of air pollution such as trucks, buses, passenger vehicles, construction equipment, locomotives, and marine engines. These reductions in NOx emissions will result in reductions of ambient NOx levels and atmospheric deposition of nitrogen to the lake surface.

#### 4.9.3.2 Organochlorine Pesticides and PCBs Impairments

The manufacture and use of chlordane, DDT, dieldrin, and PCBs are currently banned in the U.S. except for certain limited uses of PCBs authorized by USEPA. Therefore, no additional allowances for future growth are needed in the TMDLs. Source control BMPs and pollutant removal are the most suitable courses of action to reduce OC pesticides and PCBs in Peck Road Park Lake. The TMDL calculations performed for each pollutant (described above in their individual sections) indicated internal lake storage as the greatest contributing source and driving factor affecting fish tissue concentrations. Additionally, the current watershed loads are a small fraction of the total loading that would be required to maintain the current sediment concentrations in the lake under steady-state conditions. This indicates that historic loading is causing the elevated fish tissue concentrations. It also suggests that concentrations in fish will decline over time. The most effective remedial actions and/or implementation efforts will focus on addressing the internal lake storage, such as capping or removal of contaminated lake sediments. For chlordane and dieldrin, the current watershed loads may not need any further reduction from current levels.

When properly conducted, removal of contaminated lake sediments, or dredging, can be an effective remediation option. The object of sediment dredging is to eliminate the pollutants that have accumulated in sediments at the lake bottom. Dredging is optimal in waterbodies with known spatial distribution of contamination because sediment removal can focus on problem areas. However, no spatial pattern of pollutant contamination was apparent in Peck Road Park Lake. Removal of the contaminated sediments reduces the pollutants available to in-lake cycling by discontinuing exposure to benthic organisms and reducing water column loading, resulting in reduced bioaccumulation in higher trophic level fish. Potential negative effects of dredging include increased turbidity and lowered dissolved oxygen concentrations in the short term, and disturbance to the benthic community and reactivation of buried sediment and any associated pollutants.

In some cases, sediment capping may be appropriate to sequester contaminated sediments below an uncontaminated layer of sediment, clay, gravel, or media material. Capping is effective in restricting the mobility of OC pesticides and PCBs; however, it is most useful in deep lakes and is likely not a viable solution for some parts of Peck Road Park Lake. Capping implementation should be restricted to areas with sediments that can support the weight of a capped layer, and to areas where hydrologic conditions of the waterbody will not disturb the cap.

The in-lake options for remediation are costly, but would be the only way to achieve full use support in a short timeframe. It is, however, also true that the OC pesticides and PCBs in question are no longer manufactured and will tend to decline in concentration due to dilution by clean sediment and natural attenuation. Natural attenuation includes the chemical, biological, and physical processes that degrade compounds, or remove them from lake sediments in contact with the food chain, and reduce the concentrations and bioavailability of contaminants. These processes occur naturally within the environment and do not require additional remediation efforts; however, the half-lives of OC pesticides and PCBs in the environment are long, and natural attenuation often requires decades before observing significant improvement.

Loading from the watershed can also be expected to decline over time due to natural attenuation and gradual reduction in atmospheric deposition rates. While reductions are called for in watershed loads, these loads are a small fraction of the historic loads already stored in the lakes. Limited sampling has not identified any hotspots of elevated loading under current conditions. It may, however, be necessary to further investigate potential sources of OC pesticides and PCBs loading in the watershed, such as active and abandoned industrial sites, waste disposal areas, former chemical storage areas, and other potential hotspots.

#### 4.9.3.3 Trash Impairment

WLA may be complied with via full capture systems, partial capture systems, nonstructural BMPs, or any other lawful method which meets the target of zero trash. USEPA recommends the installation of full capture systems throughout the watershed. The Linear Radial, Inclined Screen, Baffle Box, and Catch Basin Insert are examples of full capture systems that fulfill the criteria of capturing all trash greater than 5 mm during flow less than the 1-year 1-hour storm. The Linear Radial utilizes a casing with louvers to serve as screens or mesh screen. Flows are routed through the louvers and into a vault. The Inclined Screen uses wedge-wire screen with the slotting perpendicular or parallel to the direction of flow. This device is configured with an influent trough to allow solids to settle. The Baffle Box applies a two-chamber concept: the first chamber utilizes an underflow weir to trap floatable solids, and the second chamber uses a bar rack to capture material. The catch basin has an opening cover screen which is a coarse mesh screen at street level that is paired with a catch basin insert, a 5 mm screen inside the catch basin which filters out smaller trash. USEPA recommends implementation plans be consistent with the Los Angeles River trash TMDL. A monitoring plan should be developed in order to understand the effectiveness of the implementation efforts.

LA may be complied with through the implementation of nonstructural BMPs or any other lawful methods which meet the target of zero trash. A minimum frequency of trash collection and assessment should be established at an interval that prevents trash from accumulating in deleterious amounts in between collections.

Trash should be prevented by providing effective public education about littering impacts. Signs dissuading littering and wildlife feeding along roadways and around the lake are recommended.

A city ban, tax, or incentive program reducing single-use plastic bags, Styrofoam containers, and other commonly discarded items which cannot decompose is recommended (Los Angeles County Department of Public Works, 2007).

Peck Road Park's grounds and facilities are maintained by the Los Angeles County Department of Parks and Recreation. Trash is currently collected and removed from the park twice a week. However, trash is not collected in locations unsafe to reach with court referral labor, such as steep slopes. The Los Angeles County Department of Parks and Recreation should continue to expand the current trash pickup program.

In particular, trash should be collected from all areas of the lake including shorelines with steeper slopes (e.g., northeastern region).

The Los Angeles County Flood Control District is responsible for the trash in the lake. Currently, no method exists to remove trash from the middle of the lake. Therefore, a regular in-lake trash pickup schedule should be implemented, in addition to reporting and scheduling immediate trash collection of dangerous items.

The prevention and removal of trash in Peck Road Park Lake will lead to enhanced aesthetics, improved water quality, and the protection of habitat.

## 4.10 Monitoring Recommendations

Although estimates of the loading capacity and allocations are based on best available data and incorporate a MOS, these estimates may potentially need to be revised as additional data are obtained. The mass-based loading capacity will be affected by changes in flow volumes; therefore, loading capacities may be reconsidered if significant volume reductions or additions occur.

To provide reasonable assurances that the assigned allocations will result in compliance with the chlorophyll *a*, fish tissue and trash targets, a commitment to continued monitoring and assessment is warranted. The purposes of such monitoring will be: 1) to determine compliance with wasteload and load allocations, 2) to determine if numeric targets are being attained, 3) to evaluate whether numeric targets and allocations need to be adjusted to attain beneficial uses, 4) to evaluate the efficacy of control measures instituted to achieve the needed load reductions, and 5) to document trends over time in algal densities and bloom frequencies, fish tissue organochlorine compounds concentrations and trash levels.

### 4.10.1 Nutrient Related Impairments

To assess compliance with the nutrient TMDLs, monitoring for nutrients and chlorophyll *a* should occur at least twice during the summer months and once in the winter. At a minimum, compliance monitoring should measure the following in-lake water quality parameters: ammonia, TKN or organic nitrogen, nitrate plus nitrite, orthophosphate, total phosphorus, total suspended solids, total dissolved solids and chlorophyll *a*. Measurements of the temperature, dissolved oxygen, pH and electrical conductivity should also be taken throughout the water column with a water quality probe along with Secchi depth measurement. All parameters must meet target levels at half the Secchi depth. Deep lakes, such as Peck Road Park Lake, must meet the DO and pH targets in the water column from the surface to 0.3 meters above the bottom of the lake when the lake is not stratified. However, when stratification occurs (i.e., a thermocline is present) then the DO and pH targets must be met in the epilimnion, the portion of the water column above the thermocline. Additionally, in order to accurately calculate compliance with wasteload allocations to the lake expressed in yearly loads, monitoring should include flow estimation or monitoring as well as the water quality concentration measurements. Wasteload allocations are assigned to stormwater inputs and the San Gabriel River Water Diversion. These sources should be measured near the point where they enter the lakes twice a year for at minimum: ammonia, TKN or organic nitrogen, nitrate plus nitrite, orthophosphate, total phosphorus, total suspended solids and total dissolved solids.

The nutrient-response analysis for Peck Road Park Lake indicates that existing levels of nitrogen and phosphorus loading are resulting in attainment of the summer average chlorophyll *a* target concentration of 20 µg/L and are not significantly impacting DO levels in the waterbody. As an antidegradation measure, nitrogen and phosphorus TMDLs are allocated based on existing loading. As an example of concentrations that responsible jurisdiction may need to target in order to meet and comply with the mass-based WLAs and LAs, this discussion provides concentrations calculated based on existing flow volumes (a recalculation is needed if flow volumes change). Assuming flow volumes remain at existing levels

(Table 4-7), the targeted concentrations of total phosphorus and total nitrogen may be 0.62 mg-P/L and 4.04 mg-N/L at the outlet of the eastern subwatershed and 0.54 mg-P/L and 3.85 mg-N/L at the outlet of the western subwatershed. Targeted concentrations in the runoff from the near lake subwatershed may be 0.62 mg-P/L and 4.13 mg-N/L. The targeted concentration for San Gabriel River diversion waters may be 0.12 mg-P/L and 3.24 mg-N/L. Assuming average precipitation depths, the targeted concentration of nitrogen in precipitation may be 0.182 mg-N/L. As stated above, these concentrations are provided as guidelines; however, mass-based WLAs must be achieved.

### 4.10.2 Organochlorine Pesticides and PCB Impairments

To assess compliance with the organochlorine compounds TMDLs, monitoring should include monitoring of fish tissue at least every three years as well as once yearly sediment and water column sampling. For the OC pesticides and PCBs TMDLs a demonstration that fish tissue targets have been met in any given year must at minimum include a composite sample of skin off fillets from at least five common carp each measuring at least 350mm in length. At a minimum, compliance monitoring should measure the following in-lake water quality parameters: total suspended sediments, total PCBs, total chlordane, total DDTs, and dieldrin; as well as the following in-lake sediment parameters: total organic carbon, total PCBs, total chlordane, total DDTs and dieldrin. Environmentally relevant detection limits should be used (i.e. detection limits lower than applicable target), if available at a commercial laboratory. Measurements of the temperature, dissolved oxygen, pH and electrical conductivity should also be taken throughout the water column with a water quality probe along with Secchi depth measurement. Wasteload allocations are assigned to stormwater inputs and the San Gabriel River Water Diversion. These sources should be measured near the point where they enter the lakes once a year during a wet weather event. Sampling should be designed to collect sufficient volumes of suspended solids to allow for the analysis of at minimum: total organic carbon, total suspended solids, total PCBs, total chlordane, total DDTs and dieldrin. Measurements of the temperature, dissolved oxygen, pH and electrical conductivity should also be taken.

WLAs and LAs for each pollutant were assigned to the sediment-associated load from the watershed as well as the lake sediments. The concentration-based WLAs and LAs for chlordane, total DDTs, dieldrin, and total PCBs are 4.14 μg/kg dry weight, 5.28 g/dry g, 0.43 g/dry g, and 1.29 μg/kg dry weight, respectively. The associated reductions from the watershed load needed to meet the WLAs are 45.1 percent for total chlordane, 5.2 percent for total DDTs, and 91.6 percent for total PCBs. A quantitative percent reduction cannot be estimated for dieldrin because all sediment samples were below detection limits (which are greater than the TMDL target concentration); however, the needed reduction appears to be on the order of 53 percent.

### 4.10.3 Trash

Responsible jurisdictions should monitor the trash quantity deposited in the vicinity of Peck Road Park Lake as well as on the waterbody to comply with the load allocation and to understand the effectiveness of various implementation efforts. Quarterly monitoring using the Rapid Trash Assessment Method is recommended. The trash TMDL target is zero trash; a 100 percent reduction is required.

Peck Spreading Basin Pump and Pipeline Project
Water Conservation Benefits

| | WY '04-'10 yearly avg (AF) | WY '04-'05 wet yr avg (AF) | WY '05-'10 avg water yr (AF) |
|---|---|---|---|
| Inflow to Peck (actual) | 18,658 | 63,002 | 9,789 |
| Santa Anita Wash (F194B) | 8,439 | 30,960 | 3,935 |
| Sawpit Wash (F193B) | 10,219 | 32,042 | 5,854 |
| | | | |
| Outflow from Peck (actual) | 5,962 | 16,449 | 3,864 |
| Drain (18CSG) | 1,208 | 0 | 1,450 |
| Spillway (18DSG) | 4,753 | 16,449 | 2,414 |
| | | | |
| Water Wasted at Rio Hondo (actual) (from Ops data) | 59,225 | 310,099 | 9,051 |
| | | | |
| Flow in SGR d/s of Santa Fe Dam (actual) (E281R) | 30,055 | 319,693 | 3,831 |
| | | | |
| W/O Pump, Water lost to d/s (theor) | 7,671 | 36,435 | 1,918 |
| | | | |
| Conserved from Percolation | 9,529 | 25,523 | 6,330 |
| **Conserved from Pumping*** | **2,694** | **5,554** | **1,811** |
| Total Conserved in Peck System | 12,223 | 31,077 | 8,142 |

*Amount of water that could be theoretically pumped based on WSE in Peck SB (above the spillway El. 315'), water wasted (both from Peck and Rio Hondo), flow in SGR (Capacity < 70 cfs or 140 AF)

September 27, 2012

Approved Christopher Stone
Christopher Stone

TO: Christopher Stone

FROM: Ken Zimmer
Water Conservation Planning Section
Water Resources Division

**PECK ROAD SPREADING BASIN PUMP STATION AND PIPELINE PROJECT CONCEPT REPORT**

Background

Peck Road Spreading Basin is located in the City of Arcadia within a blue line stream at the confluence of Santa Anita and Sawpit Washes. The spreading basin is supplied by uncontrolled storm flows from both washes, and occasionally imported water is routed through the basin. The spreading basin, also referred to as Peck Pit, actually consists of two deep pits that combine to form one basin with a total storage capacity of 3,260 acre-feet (AF). The facility is one of the largest water conservation facilities that recharges the Main San Gabriel Groundwater Basin.

The bike path around the basin drops down to elevation 300 feet when it parallels the spillway. The spillway is 15 feet higher than the bike path at this location, and discharges into the lined Rio Hondo Channel. The basin has one outlet located at elevation 300 feet, which also conveys flows to the Rio Hondo Channel.

The Peck Road Spreading Basin has very low percolation rates. Uncontrolled storm flows bring silts into the basin, which form a clogging layer of soil at the bottom of the basin. The deep nature of the basin makes it difficult to maintain. In addition, sediment has accumulated at the outlet of Santa Anita Wash which restricts flow in the basin between the two deep pits. Water levels have to exceed elevation 300 feet for water to flow freely between the two sections of the spreading basin.

The low percolation rate of Peck Road Spreading Basin limits the amount of water that can be captured for recharge. During large storms, once the spreading basin is full, the remaining storm flows pass over the spillway or are drained through a County-operated outlet at elevation 300 feet into the concrete-lined Rio Hondo Channel. During larger or less frequent storm events, the downstream Rio Hondo Coastal Basin Spreading Grounds typically has limited intake capacity and the water may be wasted to the ocean.

The spreading basin can be accessed by the public from the Peck Road Water Conservation Park. The park is maintained by the County of Los Angeles Department of Parks and Recreation, and provides the public with green areas, fishing, walking, and bicycle trails.

## The Project

The proposed improvements include sediment removal and constructing a pump station, pipeline, and outlet structure. The pump station at Peck Road Spreading Basin will convey stored water to the San Gabriel River between the Santa Fe Dam outlet and the 10 Freeway, where percolation rates are very high. The San Gabriel River is a soft-bottom channel, located approximately one and a half miles east of the spreading basin that recharges the Main San Gabriel Basin.

Two 25 cubic feet per second (cfs) vertical fixed turbine pumps are proposed to be placed inside a concrete underground pump station at the north end of Peck Road Spreading Basin and would pump during the storm season when the basin elevation is between 290 and 315 feet. The water will flow through 7,000 feet of 36-inch steel-lined reinforced concrete pipe along Clark Street as well as some Hansen Quarry private property in the City of Arcadia. Pipeline easements will need to be obtained for the areas where the new pipeline will be installed. The entire pipeline will be under pressure as the river is located at a higher elevation than the spreading basin. The pipeline will outlet into the San Gabriel River, where the water can percolate into the soft-bottom channel.

The proposed improvements will also remove approximately 101,000 cubic yards of sediment from the middle of Peck Road Spreading Basin near the outlet of the Santa Anita Wash. A large portion of the concrete-lined channel of the Santa Anita Wash has been buried under years of accumulated sediment. The sediment will be transported to Manning Pit in the City of Irwindale. The removal of sediment will allow the pump station to convey water from both pits.

Based on the available storage capacity of the spreading basin and historical data of the inflow into the basin, it is estimated that 1,800 AF of water in an average year and 3,400 AF of water in a wet year, could be pumped to recharge the Main San Gabriel Basin using the middle reach of the San Gabriel River. The majority of this conserved stormwater would otherwise be wasted to the ocean.

Currently Parks and Recreation is planning improvements at the Peck Road Water Conservation Park that include new pedestrian paths and roads, landscaping with native plants, and the addition of picnic and play areas. A joint effort between Public Works and Parks and Recreation will be pursued to discuss operations of the project that will both maximize water conservation and enhance the park's recreational activities.

Benefit Cost Analysis

The cost to construct the pump system and pipeline from the Peck Road Spreading Basin to the San Gabriel River is approximately $6,000,000. The estimated electricity cost to operate the pump is approximately $47,000 annually. The project will provide an annual stormwater conservation benefit during an average year of approximately $1,000,000 based on the current cost of $550 per AF for untreated imported water. The cost recovery period for this project is approximately six years.

The Main San Gabriel Basin Watermaster and the Upper San Gabriel Municipal Water District support the project and have been partners in the Integrated Regional Water Management Plan process to secure grant funding.

Environmental

The project is within a blue line stream and will require an environmental document. The environmental document will be prepared and all necessary regulatory permits will be obtained. During the course of the conceptual design, the Environmental Protection Agency issued Total Maximum Daily Load (TMDL) requirements for Peck Road Spreading Basin. At this time it is not known how these requirements may affect our ability to pump water from the basin to the San Gabriel River. Due to concerns with nutrients, organochlorine pesticides, and polychlorinated biphenyls it may be necessary to perform a full cleanout of Peck Road Spreading Basin along with the project, which is estimated to cost an additional $12,000,000.

Recommendation

The proposed project will increase the replenishment of groundwater in the Main San Gabriel Basin from storm runoff, therefore reducing the San Gabriel Valley's reliance on imported water. By pumping the water from the Peck Road Spreading Basin and recharging it into the San Gabriel River, an additional 1,800 AF on average could be conserved annually in addition to about 6,300 AF conserved from percolation in Peck Road Spreading Basin.

The Water Conservation Planning Section will continue to work with Watershed Management Division to address the TMDL issues at Peck Road Spreading Basin. If a full cleanout is required, the Water Conservation Planning Section will create a project concept report and conceptual plan for sediment removal. Final design will be delayed until these issues are resolved.

Several agencies have shown interest in the project including Parks and Recreation, Upper San Gabriel Valley Municipal Water District, and the Main San Gabriel Basin Watermaster. All interested parties will be approached to discuss cost sharing for project implementation and grants will be pursued.

AW:yg
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Attach.

## PECK ROAD SPREADING BASIN PUMP STATION AND PIPELINE PROJECT COST ESTIMATE

| Item | Unit | Quantity | Unit Price ($) | Sub Cost ($) | Cost ($) |
|---|---|---|---|---|---|
| Sediment Removal | | | | | 1,354,300 |
| Basin Dewatering | LS | 1 | 100,000 | 100,000 | |
| Clearing and Grubbing | LS | 1 | 25,000 | 25,000 | |
| Tree Removal | EA | 25 | 500 | 12,500 | |
| Unclassified Excavation | CY | 101,400 | 12 | 1,216,800 | |
| Pump | | | | | 1,340,400 |
| Vertical Turbine Pump (25 cfs) | LS | 2 | 275,000 | 550,000 | |
| Electrical and Control Equipment | LS | 1 | 300,000 | 300,000 | |
| Electrical Service for Pumps | LS | 1 | 100,000 | 100,000 | |
| Pump Station Structure | LS | 1 | 120,000 | 120,000 | |
| Pump Vault | CY | 80 | 3,000 | 240,000 | |
| 42" Reinforced Concrete Pipe | LF | 50 | 320 | 16,000 | |
| Inlet Structure | CY | 12 | 1,200 | 14,400 | |
| Pipeline | | | | | 3,175,200 |
| Storm Water Pollution Prevention Plan (SWPPP) | LS | 1 | 10,000 | 10,000 | |
| Implementation of SWPPP | LS | 1 | 100,000 | 100,000 | |
| AC Pavement Removal | SF | 70,000 | 1 | 70,000 | |
| Unclassified Excavation | CY | 2,500 | 20 | 50,000 | |
| Shoring | LF | 7,000 | 50 | 350,000 | |
| 36" Steel Lined Reinforced Concrete Pipe | LF | 7,000 | 350 | 2,450,000 | |
| Manholes | EA | 13 | 5,200 | 67,600 | |
| Trench Backfill Slurry | CY | 260 | 110 | 28,600 | |
| AC Pavement | TON | 700 | 70 | 49,000 | |
| Outlet Structure | | | | | 22,630 |
| Concrete | CY | 12 | 1,200 | 14400 | |
| RipRap (light class) | CY | 50 | 110 | 5500 | |
| Metal Hand Railing | LF | 30 | 91 | 2730 | |

| | |
|---|---|
| TOTAL | $5,892,530 |

**PECK ROAD SPREADING BASIN**
**PUMP AND PIPELINE CALCULATIONS**

<u>Pipeline</u>

Design Flow  Q = 50 cfs

Head  $h_f = 365' - 290' = 75\,ft$

Length  L = 6,969 ft

Coefficient  C = 100  (for concrete pipes)

Head Loss  $h_f = 3.022\,\frac{v^{1.85}L}{C^{1.85}d^{1.165}}$  (with $v = \frac{Q}{A}$)  Solve for diameter, d

$$75\,ft = 3.022\,\frac{\left(\frac{50\,ft^3/s}{\pi d^2/4\,ft^2}\right)^{1.85}(6969\,ft)}{(100)^{1.85}(d^{1.165})}$$

$$75\,ft = 3022\,d^{-4.865}$$

Diameter  $d \approx 2.68ft \approx 32.2\,in$  ➔Use 36" φ Pipe

Velocity  $v = \frac{Q}{A} = \frac{50ft^3/s}{\pi d^2/_4\,ft^2} = \frac{50\,ft^3/s}{\pi(3ft)^2/_4\,ft^2} = 7.07\,^{ft}/_{s}$

<u>Pump Calculations</u>

Flow  $Q = 50\,cfs$

Pipe Area  $A = \frac{\pi d^2}{4} = \frac{\pi(3\,ft)^2}{4} = 7.07\,ft^2$

Velocity  $v = \frac{Q}{A} = \frac{50\,^{ft^3}/_{s}}{7.07\,ft^2} = 7.07\,^{ft}/_{s}$

Head Losses

Static Head  $\Delta H = 365' - 290' = 75\,ft$

Velocity Head  $H_v = \frac{v^2}{2g} = \frac{(7.07\,^{ft}/_{s})^2}{2(32.2\,^{ft}/_{s^2})} = 0.78\,ft$

Friction Head  $H_f = f\,\frac{L}{d}\frac{v^2}{2g} = 0.017\,\left(\frac{6969ft}{3\,ft}\right)\left(\frac{\left(7.07^{ft}/_{s}\right)^2}{2\left(32.2\,^{ft}/_{s^2}\right)}\right) = 30.68\,ft$

Total Head  $TDH = \Delta H + H_v + H_f = 75 + 0.78 + 30.68 = 106.46\,ft$

➔ $Design\ pump\ for\ \approx 110\ feet$

Operation Costs

Pump Capacity $Q = 25\ CFS \times \frac{60\ sec}{1\ min} \times \frac{7.48\ gal}{1\ ft^3} = 11,220\ GPM$

Horse Power $HP = \frac{Total\ head \times Capacity}{3960 \times Efficiency} = \frac{110\ ft \times 11220\ GPM}{3960 \times 0.85} = 366.67\ HP$

KiloWatt-Hour $kWH = 366.67\ HP \times \frac{0.746\ kW}{1\ HP} \times \frac{15\ days\ pumping}{year} \times \frac{24\ hours}{1\ day} = 118{,}166 \frac{kWH}{yr}$

Electricity Cost $\frac{Cost}{yr} = Edison\ Rate \times \frac{kWH}{yr} = \frac{\$0.20}{KWH} \times 118{,}166 \frac{kWH}{yr} = \$23{,}633$

➔ *For two 25 cfs pumps, it'll cost about $47,266 to run the pumps in an average water year*

## PECK ROAD SPREADING BASIN WATER CONSERVED BENEFIT

| | | |
|---|---|---|
| Pump Capacity | **50** | cfs |
| Pump Invert | **290** | ft. elevation |
| Basin Invert | **280** | ft. elevation |

| YEAR | # days pumped | Pumped |
|---|---|---|
| WY 2009-10 | 18 | 1800 |
| Wet WY 2004-05 | 34 | 3,400 |

**U.S. Environmental Protection Agency**

# Los Angeles Area Lakes TMDLs
*March 2012*

***Cover, Table of Contents, Executive Summary, Section 1 Introduction, Section 2 Problem Statement, Section 3 Summary of Approach***

**U.S. Environmental Protection Agency**
**Region IX**

# Los Angeles Area Lakes Total Maximum Daily Loads for Nitrogen, Phosphorus, Mercury, Trash, Organochlorine Pesticides and PCBs

**Photo: Puddingstone Reservoir**

**Approved by:**

Alexis Strauss (signature)

**Alexis Strauss**
**Director, Water Division**
**EPA Region IX**

26 March 2012
**Date**

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# Executive Summary

The Los Angeles Regional Board identified 10 lakes in the Los Angeles region as impaired by algae, ammonia, chlordane, copper, DDT, eutrophication, lead, organic enrichment/low dissolved oxygen, mercury, odor, PCBs, pH and/or trash and placed them on California's 303(d) list of impaired waters requiring a Total Maximum Daily Load (TMDL) (LARWCQB, 1998). The United States Environmental Protection Agency (USEPA) Region IX subsequently entered into a consent decree with several environmental groups on March 22, 1999 that required development of TMDLs for these waterbody pollutant combinations by March 2012 (Heal the Bay Inc., et al. v. Browner C 98-4825 SBA). To meet the consent decree deadline, USEPA is establishing Total Maximum Daily Loads (TMDLs) in nine of these lakes in the Los Angeles region. For several lakes, USEPA concluded that ammonia, pH, copper and/or lead are currently meeting water quality standards and TMDLs are not required at this time. In other lakes, recent chlordane and dieldrin data indicate additional impairment. USEPA is establishing 33 TMDLs in all, as follows:

## NITROGEN AND PHOSPHORUS TMDLS

EPA is establishing eight total nitrogen and eight total phosphorus TMDLs for Peck Road Park Lake, Lincoln Park Lake, Echo Park Lake, Lake Calabasas, El Dorado Park Lakes, Legg Lakes, Puddingstone Reservoir and Santa Fe Dam Park Lake. The Los Angeles Regional Board identified eight lakes as impaired by algae, ammonia, eutrophication, organic enrichment/low dissolved oxygen, odor and/or pH. These various impairments stem from excess nitrogen and phosphorus in the lake, causing excess algae growth, which then impairs aquatic life and recreation uses. Chlorophyll *a* is used as an indicator of algal density and a target of 20 micrograms per liter was set in these TMDLs to protect beneficial uses. The impacts of nutrient loading on each impaired lake were estimated through scientific modeling of lake-specific conditions. This model generates site-specific nutrient loadings required to attain the chlorophyll *a* target at each lake. Data currently indicate Echo Park Lake, Peck Road Park Lake, Santa Fe Dam Park and the southern lake system of El Dorado Park Lakes are meeting the chlorophyll *a* target. In these lakes, USEPA is therefore assigning wasteload and load allocations to the responsible jurisdictions based on existing loading of nitrogen and phosphorus to each lake. Lake Calabasas, Legg Lakes, Lincoln Park Lake, Puddingstone Reservoir and the northern lake system of El Dorado Park Lakes are assigned wasteload and load allocations based on model outputs. To allow flexibility in implementing the nutrient TMDLs, responsible jurisdictions receiving required reductions have the option to submit a request to the Regional Board for alternative concentration-based wasteload allocations, with a Lake Management Plan to show how the water quality standards, chlorophyll *a* target and the concentration-based wasteload allocations will be achieved by improved lake management practices. These jurisdictions can receive alternative concentration-based wasteload allocations not to exceed 1.0 and 0.1 milligrams per liter total nitrogen and total phosphorus, respectively. For lakes not currently attaining the chlorophyll *a* target, this TMDL includes required reductions in total loading of 45 percent to 71 percent for total nitrogen and 23 percent to 62 percent for total phosphorus, depending on the lake.

## MERCURY TMDLS

EPA is establishing three mercury TMDLs for El Dorado Park Lakes, Puddingstone Reservoir and Lake Sherwood. Elevated fish tissue concentrations of methylmercury are impairing beneficial uses at Lake Sherwood, El Dorado Park Lakes and Puddingstone Reservoir. The concentrations of these pollutants in fish tissue exceed the State of California's Fish Contaminant Goals (FCGs) to protect human health. Mercury is a heavy metal that bioaccumulates and biomagnifies up the food chain. As fish grow, they accumulate more methylmercury in their tissue such that older and larger fish have higher concentrations of methylmercury than younger and smaller fish. The fish tissue target for these TMDLs, 0.22 parts per million methylmercury, is based on a 350 mm largemouth bass which is the most common size and the most common species caught by anglers in these lakes. These TMDLs assign wasteload and load allocations to responsible jurisdictions for total mercury as a mass per year. These TMDLs include a dissolved methylmercury target of 0.081 nanograms per liter based on a calculation of the maximum allowable concentration in the water column to attain the largemouth bass fish tissue target using nationally derived bioaccumulation factors. Required reductions in total mercury loading range from 47 percent to 72 percent, depending on the lake.

## Chlordane, Dieldrin, Total DDTs, and Total PCBs TMDLs

EPA is establishing 11 TMDLs for chlordane, dieldrin, total DDTs and total PCBs at Peck Road Park Lake, Echo Park Lake and Puddingstone Reservoir. Elevated fish tissue concentrations of organochlorine pesticides and PCBs are impairing the beneficial uses at Echo Park Lake, Peck Road Park Lake and Puddingstone Reservoir. The concentrations of these pollutants in fish tissue exceed the State of California's FCG targets. These types of pollutants have low solubility and a high affinity for organic solids and lipids, and tend to bioaccumulate and biomagnify up the food chain from sediment to fish tissue. Water column concentrations of these pollutants are extremely low and currently attaining water quality criteria. Wasteload and load allocations are therefore assigned as a concentration of a pollutant associated with suspended sediments. USEPA set sediment targets by calculating the maximum allowable concentrations in sediment to attain the fish tissue targets and choosing the lower of this value or a target to protect benthic organisms. In all but one case, the sediment value calculated to attain the fish tissue targets is lower and wasteload and load allocations are assigned to responsible jurisdictions based on that calculated value. Additionally, if responsible jurisdictions demonstrate that fish tissue targets are being attained, alternative sediment wasteload allocations, based on the target used to protect benthic organisms, go into effect. Required reductions in pollutant concentrations in sediment range from 5.2 percent to 99 percent depending on the particular pollutant and lake.

## Trash TMDLs

EPA is establishing three trash TMDLs in Peck Road Park Lake, Lincoln Park Lake and Echo Park Lake. Trash in lakes causes water quality problems including reduced habitat for aquatic life, direct harm to wildlife from ingestion or entanglement, and health impacts to people recreating near trash potentially contaminated with human or pet wastes. Since any amount of trash causes impairment, wasteload and load allocations assigned to responsible jurisdictions are set at zero trash.

***The following TMDLs are included in this document:***

- Peck Road Park Lake: nitrogen, phosphorus, chlordane, DDT, dieldrin, PCBs, trash
- Lincoln Park Lake: nitrogen, phosphorus, trash
- Echo Park Lake: nitrogen, phosphorus, chlordane, dieldrin, PCBs, trash
- Lake Calabasas: nitrogen, phosphorus
- El Dorado Park Lakes: nitrogen, phosphorus, mercury
- Legg Lakes (North, Center and Legg): nitrogen, phosphorus
- Puddingstone Reservoir: nitrogen, phosphorus, chlordane, DDT, PCBs, mercury, dieldrin
- Santa Fe Dam Park: nitrogen, phosphorus
- Lake Sherwood: mercury

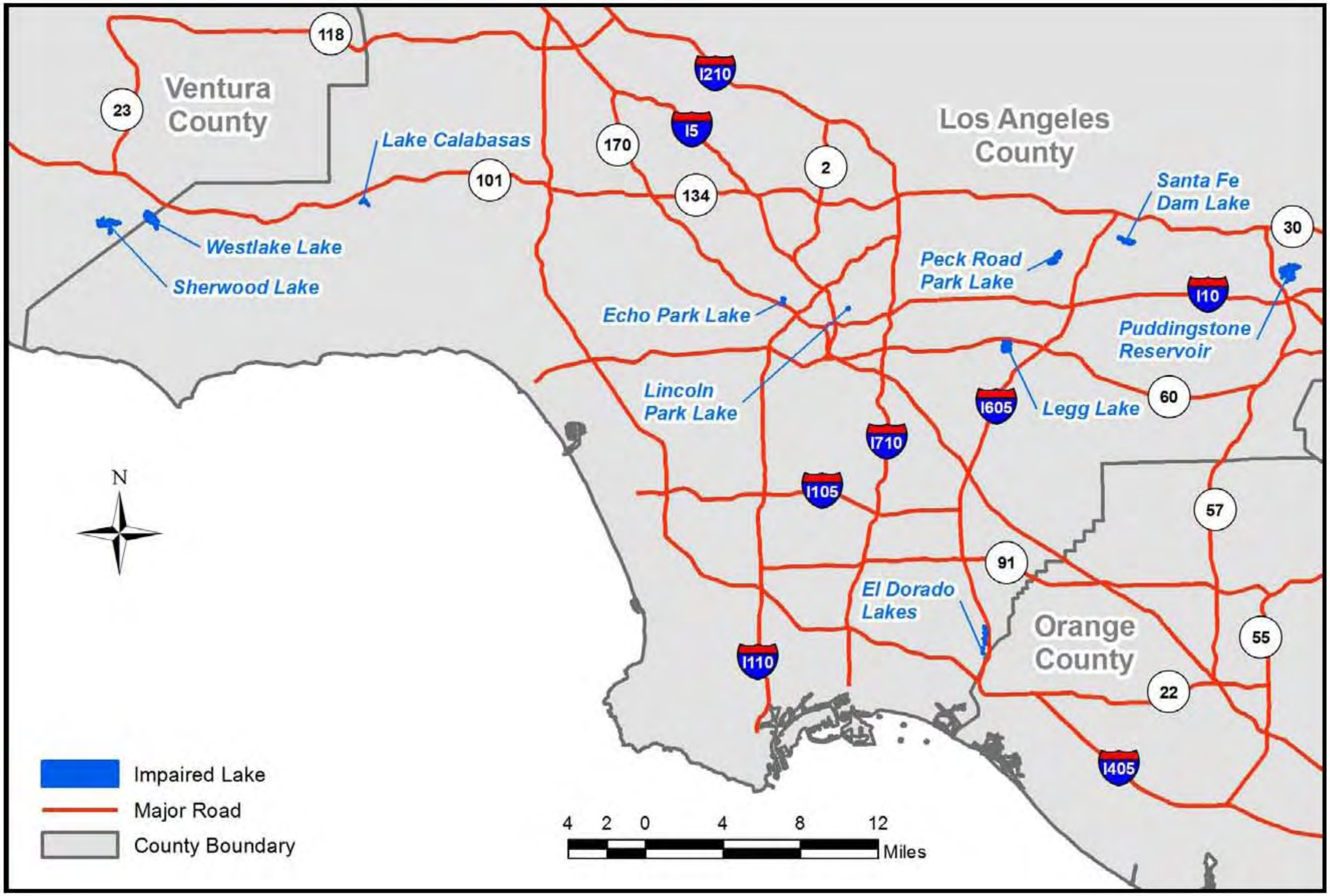


**Figure ES-1. Location of Ten Lakes in the Los Angeles Region**

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# 1 Introduction

The United States Environmental Protection Agency (USEPA) Region IX is establishing Total Maximum Daily Loads (TMDLs) in nine lakes in the Los Angeles Region. USEPA was assisted in this effort by the Los Angeles Water Quality Control Board (Regional Board). Tetra Tech produced the Technical Support Document to aid in the development of these TMDLs.

Numerous impaired lakes are addressed by these TMDLs. Each lake is located in the Los Angeles River Basin, San Gabriel River Basin, or Santa Monica Bay Basin (Figure 1-1). The identified pollutants are either categorized or individual; e.g., trash or mercury. Chlordane, dieldrin and DDT are organochlorine (OC) pesticides and have been grouped together with PCBs. Nutrient TMDLs are defined to address: algae, ammonia, eutrophication, low dissolved oxygen/organic enrichment, odor, and/or pH.

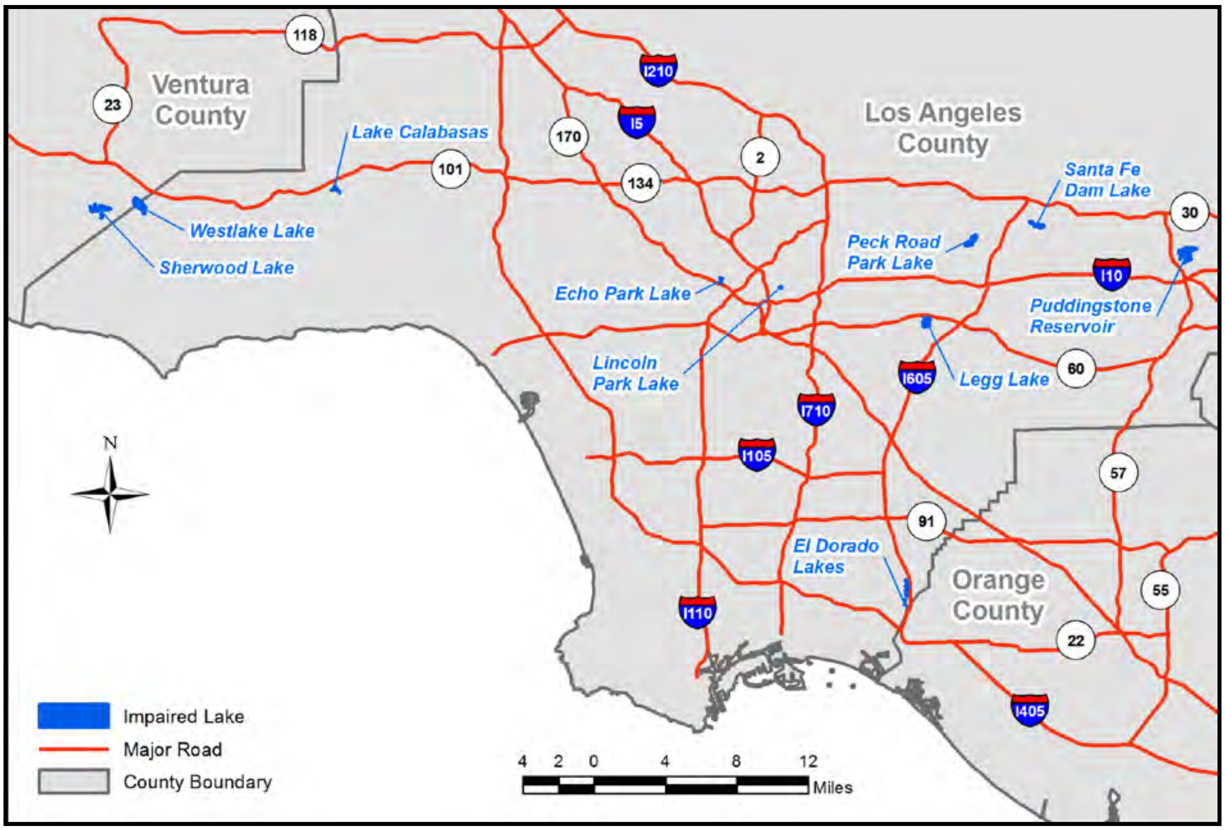


Figure 1-1. **Location of Ten Lakes in the Los Angeles Region**

The TMDLs included in this document are summarized below:

- Peck Road Park Lake: nitrogen, phosphorus, chlordane, DDT, dieldrin, PCBs, trash
- Lincoln Park Lake: nitrogen, phosphorus, trash
- Echo Park Lake: nitrogen, phosphorus, chlordane, dieldrin, PCBs, trash
- Lake Calabasas: nitrogen, phosphorus
- El Dorado Park Lakes: nitrogen, phosphorus, mercury

- Legg Lakes (North, Center and Legg): nitrogen, phosphorus
- Puddingstone Reservoir: nitrogen, phosphorus, chlordane, DDT, PCBs, mercury, dieldrin
- Santa Fe Dam Park: nitrogen, phosphorus
- Lake Sherwood: mercury

USEPA determined some lakes were not impaired for copper or lead, therefore we did not develop TMDLs for those metals. Information related to our findings of non-impairment is included within the lake specific sections as well as Appendix G (Monitoring Data). A full list of specific waterbody-pollutant combinations addressed by this document is included in Table 2-31.

This document is organized into the following sections and appendices to address the multiple lake/impairment combinations included in these TMDLs:

- Section 1 contains the introductory material, regulatory background, and description of the elements of a TMDL.
- Section 2 describes the problem statement in terms of water quality standards, beneficial uses, water quality objectives, and numeric targets. The 1998 basis of 303(d) listing and summary of impairments for each lake are also included in this section.
- Section 3 summarizes the approach that was used for the source assessment and linkage analysis for each impairment.
- Sections 4 through 13 contain the lake specific TMDL information including the environmental setting and the summaries of impairments, monitoring data, pollutant loading, and TMDL allocations.
- Section 14 contains references for this document.
- Appendix A (Nutrient TMDL Development) describes the model input and output for application of the NNE BATHTUB model in relation to the nutrient impairments.
- Appendix B (Internal Loading) describes the processes of internal loading, wind mixing, and bioturbation of the lake sediments.
- Appendix C (Mercury TMDL Development) explains the load allocation determinations for the mercury impairments.
- Appendix D (Wet Weather Loading) describes wet weather pollutant loading.
- Appendix E (Atmospheric Deposition) describes the estimation of pollutant loading from atmospheric deposition.
- Appendix F (Dry Weather Loading) describes dry weather pollutant loading.
- Appendix G (Monitoring Data) contains the monitoring data relevant to each lake and impairment.
- Appendix H (Organochlorine Compounds TMDL Development) describes the steady-state model for Organochlorine (OC) Pesticides (including chlordane, DDT, and dieldrin) and PCBs.

## 1.1 Regulatory Background

Section 303(d) of the Clean Water Act (CWA) requires that each state "shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters.

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in U.S. Environmental Protection Agency (USEPA) guidance (USEPA, 2000b). A TMDL is defined as the "sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the waterbody to assimilate pollutant loads (the Loading Capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis.

The USEPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. In California, the State Water Resources Control Board (State Board) and the nine Regional Boards are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to USEPA approval. If USEPA does not approve a TMDL submitted by a state, USEPA is required to establish a TMDL for that waterbody. The Regional Boards also hold regulatory authority for many of the instruments used to implement the TMDLs, such as National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs).

As part of its 1998 regional water quality assessments, the Regional Board identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWCQB, 1998). These are referred to as "listed" or "303(d) listed" waterbodies. A 13-year schedule for development of TMDLs in the Los Angeles Region was established in a consent decree approved between USEPA and several environmental groups on March 22, 1999 (Heal the Bay Inc., et al. v. Browner C 98-4825 SBA). For the purpose of scheduling TMDL development, the decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units.

This report addresses waterbody impairment combinations identified in Analytical Units 16, 17, 19, 20, 41, 42, 44, and 68 of the Consent Decree. Under the consent decree, USEPA must approve or establish these TMDLs by March 2012. The State is unlikely to complete adoption of these TMDLs in time to meet the consent decree deadline; therefore, USEPA is establishing these TMDLs.

USEPA performed a review and analysis of available monitoring data and information for pollutants and waterbodies within the analytical units in the consent decree described above. Historic data related to the 1998 list and current data related to the current 303(d) list were evaluated to determine if any water quality conditions had changed (either from impaired to non-impaired or vice versa). In certain cases, USEPA concluded that ammonia, pH, and metals (copper and lead) are currently achieving numeric targets and TMDLs are not required for these pollutants. These analyses and determinations of non-impairment are presented in the lake-specific chapters. Establishment of the TMDLs in this document thereby completes the requirement in the consent decree to address Analytical Units 16, 17, 19, 20, 41, and 42. It also partially addresses analytical units 44 and 68. In addition, these TMDLs incorporate impairments not included in the consent decree. There are several impairments for these waterbodies included on the 2008-2010 303(d) list (SWRCB, 2010), which was developed after the consent decree, as well as newly identified impairments not currently on the 303(d) list. USEPA is including TMDLs to address these additional impairments to more efficiently use agency resources and encourage expediency of restoration of water quality in these lakes.

Overall, this report includes an evaluation of available data to either confirm, establish, or refute impairment(s) for each waterbody. TMDLs have been developed to address the impairments. Table 2-31 summarizes the waterbody impairment combinations addressed by this report.

## 1.2 Elements of a TMDL

Guidance from USEPA (2000b) identifies seven elements of a TMDL. This report contains these seven elements in the following Sections or Appendices:

**1. Problem Statement.** Section 2 reviews the evidence used to include each waterbody on the 303(d) list. A description of the water quality standards, beneficial uses, water quality objectives, and numeric targets that form the basis for each listing was reviewed.

**2. Numeric Targets.** Section 2 also includes the numeric targets based on the numeric and narrative water quality objectives stated in the Basin Plan as well fish tissue guidelines and sediment quality guidelines. These targets are used for confirmation of impairments and calculation of TMDLs for mercury, OC Pesticides and PCBs, and trash. For the nutrient impairments, lake specific total nitrogen and total phosphorus targets are developed using the NNE BATHTUB model (described in Appendix A, Nutrient TMDL Development). Appendix C (Mercury TMDL Development) and Appendix H (Organochlorine Compounds TMDL Development) include additional details on the mercury and OC Pesticides and PCBs targets. Load reductions and pollutant allocations in these TMDLs are developed to ensure that these numeric targets for the impaired waterbodies are met.

**3. Source Assessment.** This step is a quantitative estimate of point sources and nonpoint sources of pollutant loading in each watershed. The source assessment considers seasonality and flow. The general approach for determining source assessments by pollutant is summarized in Section 3. Lake specific loading summaries by pollutant are included in the individual lake sections (Sections 4 through 13). More detailed information regarding modeling input and data sets used to quantify pollutant loading are described in Appendices B, C, D, F, and H.

**4. Linkage Analysis.** This analysis demonstrates how the sources of pollutant compounds in each waterbody are linked to the observed conditions in the impaired waterbody. The linkage analysis includes an assessment of critical conditions, which are periods when the changing pollutant sources and changing assimilative capacity of the waterbody combine to produce either extreme impairment conditions or conditions especially resistant to improvement. Section 3 describes the linkage analysis for each impairment, and more details are provided in the appendices.

**5. TMDLs and Pollutant Allocations.** The total loading capacity for each waterbody is determined as the amount of pollutant loading a waterbody can receive without causing impairment. A Margin of Safety (MOS) is set aside to account for inherent variability in modeling assumptions and datasets. The TMDL is set as the loading capacity minus the MOS. Each pollutant source is allocated an allowed quantity of pollutant loading that it may discharge. Allocations are designed such that the waterbody will not exceed numeric targets for any of the compounds or effects in any of its reaches. Point sources and areas draining to municipal separate stormwater systems (MS4s) are given waste load allocations, and nonpoint sources are given load allocations. TMDLs and pollutant allocations are described for each lake and impairment in Sections 4 through 13.

**6. Implementation Recommendations.** This element describes the plans, regulatory tools, or other mechanisms by which the waste load allocations and load allocations may be achieved. The Regional Board has responsibility to implement these TMDLs and incorporate them into permits. They may choose to develop implementation plans in a separate document(s) in the future.

**7. Monitoring Recommendations.** Monitoring each waterbody is recommended to ensure that the wasteload allocations and load allocations are achieved, that numeric targets are no longer exceeded, and that the secondary effects intended to be addressed by these TMDLs are being addressed.

# 2 Problem Statement

The lakes covered by this document are impacted by numerous impairments including nutrient-related impairments (algae, ammonia, eutrophication, low dissolved oxygen/organic enrichment, odor, pH), metals (copper and lead), mercury, trash, and OC Pesticides (chlordane, DDT, and dieldrin) and PCBs. This section describes the beneficial uses identified in the Water Quality Control Plan (Basin Plan) for each waterbody and discusses the applicable numeric targets for each beneficial use. It also includes water quality information (wherever possible) to describe the basis for each listing as provided by the Regional Board for the 1998 303(d) list. The reader will find discussion and summary of more recent monitoring data for each waterbody in the lake-specific chapters.

## 2.1 WATER QUALITY STANDARDS

California state water quality standards include of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives and numeric water quality criteria, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Boards in the Basin Plans. Numeric and narrative objectives are specified in each region's Basin Plan and numeric criteria are included in the California Toxics Rule (CTR), designed to be protective of the beneficial uses.

### 2.1.1 Beneficial Uses

The Water Quality Control Plan for the Los Angeles Region (LARWQCB, 1994) defines 11 beneficial uses for the 10 lakes addressed by this report:

**AGR - Agricultural Supply.** Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

**COLD - Cold Freshwater Habitat.** Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

**GWR - Ground Water Recharge.** Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

**MUN - Municipal and Domestic Supply.** Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

**NAV - Navigation.** Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

**RARE - Rare, Threatened, or Endangered Species.** Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

**REC1 - Water Contact Recreation.** Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, waterskiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

**REC2 - Non-contact Water Recreation.** Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

**WARM - Warm Freshwater Habitat.** Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

**WET - Wetland Habitat.** Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, streambank stabilization, and filtration and purification of naturally occurring contaminants.

**WILD - Wildlife Habitat.** Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

These uses are identified as existing (E), potential (P), or intermittent (I) uses. Table 2-1 contains the beneficial use designations relevant to this report (LARWQCB, 1994). All 10 lakes are designated REC1, REC2, and WARM. The majority are also designated WILD and MUN. Other uses include WET, GWR, COLD, RARE, AGR, and NAV. Potential beneficial uses marked with an asterisk (P*) in the Basin Plan (and in the table below) are indicted as a conditional use. Conditional designations are not recognized under federal law and are not water quality standards requiring TMDL development at this time. (See letter from Alexis Strauss [US EPA] to Celeste Cantú [State Board], Feb. 15, 2002.)

**Table 2-1. Beneficial Uses Designations for the Ten Lakes**

| Lake/Reservoir | REC1 | REC2 | WARM | WILD | MUN | WET | GWR | COLD | RARE | AGR | NAV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Peck Road Park Lake[1] | Pm | E | P | I | P* | | I | | | | |
| Lincoln Park Lake | P | E | P | E | P* | | | | | | |
| Echo Park Lake | P | E | P | E | P* | | | | | | |
| Lake Calabasas[2] | Pm | I | P | P | P* | | | | | | |
| El Dorado Park Lakes | E | E | P | E | P* | E | | | | | |
| North, Center, and Legg Lakes | E | E | E | E | P* | E | E | E | | | |
| Puddingstone Reservoir | E | E | E | E | E* | | E | E | E | E | |
| Santa Fe Dam Park Lake | P | I | I | E | P* | E | I | | | | |
| Lake Sherwood | E | E | E | E | P* | E | E | | | | E |
| Westlake Lake | E | E | E | E | P* | | | | | | E |

[1] Beneficial uses were not identified in the Basin Plan for Peck Road Park Lake. Therefore, the downstream segment's uses (Rio Hondo below Spreading Grounds) apply (Regional Board, personal communication, 12/22/2009).

[2] Beneficial uses were not identified in the Basin Plan for Lake Calabasas. Therefore, the downstream segment's uses (Arroyo Calabasas) apply (Regional Board, personal communication, 2/24/2009).

* Asterisked MUN designations are designated under SB 88-63 and RB 89-03. Some designations may be considered for exemptions at a later date.

m Access prohibited by Los Angeles County DPW in concrete-channelized areas.

E - Existing; P - Potential; I- Intermittent

### 2.1.2 Water Quality Objectives and Criteria

The Basin Plan describes numeric and narrative water quality objectives for beneficial uses in the Los Angeles Region (LARWQCB, 1994). The California Toxics Rule (CTR) includes numeric water quality criteria for certain human health and aquatic life designated uses. The objectives and criteria for the impairments addressed in this document are described below.

#### 2.1.2.1 Ammonia

The Basin Plan establishes numeric objectives for ammonia which are protective of fish (COLD and WARM), and wildlife (WILD) (see Basin Plan Tables 3-1 through 3-4). The objective for chronic exposure is based on a four-day average concentration while the objective for acute toxicity is based on a one-hour average concentration. These objectives are expressed as a function of pH and temperature because un-ionized ammonia ($NH_3$) is toxic to fish and other aquatic life.

#### 2.1.2.2 Bioaccumulation

The Basin Plan states that “toxic pollutants shall not be present at levels that will accumulate in aquatic life to levels which are harmful to aquatic life or human health.” To implement this narrative objective, the fish contaminant goals defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) were used to set numeric targets for mercury, chlordane, DDTs, dieldrin, and PCBs.

#### 2.1.2.3 Biostimulatory Substances (nutrients)

The Basin Plan addresses excess aquatic growth in the form of a narrative objective for nutrients. Excessive nutrient (e.g., nitrogen and phosphorous) concentrations in a waterbody can lead to nuisance effects such as algae, odors, and scum. The objective specifies, “waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.” To implement this narrative objective, the Numeric Nutrient Endpoint (NNE) BATHTUB model was used to define nitrogen and phosphorus target concentrations on a site specific basis that will not lead to nuisance conditions in the waterbody, such as excessive chlorophyll *a* concentrations.

#### 2.1.2.4 Chemical Constituents

The Basin Plan states that “chemical constituents in excessive amounts in drinking water are harmful to human health” and “surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use.” Specifically, waters designated MUN shall not have concentrations exceeding the following maximum contaminant levels: mercury, 0.002 mg/L; nitrate as $NO_3$, 45 mg/L; nitrate plus nitrite as N, 10 mg/L; nitrite as nitrogen, 1 mg/L; chlordane, 0.0001 mg/L; PCBs, 0.0005 mg/L. The Basin Plan provides maximum contaminant levels for additional pollutants; however, no others are relevant for these TMDLs. The CTR also includes criteria for some of these pollutants (see Section 2.1.2.5).

#### 2.1.2.5 California Toxics Rule

The CTR includes numeric water quality criteria for certain human health and aquatic life designated uses. The strictest applicable targets from those identified in the Basin Plan and CTR apply to the waterbodies in this report. The CTR includes criteria applicable to these lakes for: chlordane, copper, dieldrin, DDT, lead, mercury and PCBs. The specific criteria are described in Section 2.2.

### 2.1.2.6 Dissolved Oxygen

Adequate dissolved oxygen levels are required to support aquatic life. Dissolved oxygen requirements are dependent on the beneficial uses of the waterbody. The Basin Plan states "At a minimum (see specifics below) the mean annual dissolved oxygen concentrations of all waters shall be greater than 7 mg/L, and no single determinations shall be less than 5.0 mg/L except when natural conditions cause lesser concentrations." In addition, the Basin Plan states, "the dissolved oxygen content of all surface waters designated as WARM shall not be depressed below 5 mg/L as a result of waste discharges" and "the dissolved oxygen content of all surface waters designated as COLD shall not be depressed below 6 mg/L as a result of waste discharges."

### 2.1.2.7 Floating Material (trash)

The Basin Plan specifies that "waters shall not contain floating materials including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses."

### 2.1.2.8 Pesticides

The Basin Plan states that "no individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life." To implement this narrative objective, the fish contaminant goals defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) were used to set numeric targets for chlordane, DDTs, and dieldrin. The CTR also includes criteria for some of these pollutants (see Section 2.1.2.5).

### 2.1.2.9 pH

The Basin Plan states that "the pH of inland surface waters shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges. Ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharge." This narrative objective will be achieved, in nutrient- impaired lakes, by applying the Numeric Nutrient Endpoint (NNE) BATHTUB model, which was used to define nitrogen and phosphorus target concentrations on a site specific basis that will not lead to fluctuations of pH due to excessive algal growth in the waterbody.

### 2.1.2.10 Polychlorinated Biphenyls (PCBs)

The Basin Plan states that "the purposeful discharge of PCBs to waters of the Region, or at locations where the waste can subsequently reach waters of the Region, is prohibited. Pass-through or uncontrollable discharges to waters of the Region, or at locations where the waste can subsequently reach water of the Region, are limited to 70 pg/L (30-day average) for protection of human health and 14 ng/L and 30 ng/L (daily average) to protect aquatic life in inland fresh waters and estuarine waters respectively." In addition, OEHHA (2008) has published fish consumption guidelines for PCBs that were used to set fish tissue targets. The CTR also includes a criterion for PCBs (see Section 2.1.2.5).

### 2.1.2.11 Taste and Odor

The Basin Plan states that "waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible aquatic resources, cause nuisance, or adversely affect beneficial uses." This narrative objective will be achieved, as it relates to nutrient-related odor impairments, by applying the Numeric Nutrient Endpoint (NNE) BATHTUB model, which was used to define nitrogen and phosphorus target concentrations on a site specific basis that will not lead to nuisance algal growth in the waterbody. Additionally, trash TMDLs will further address this impairment in applicable lakes.

#### 2.1.2.12 Toxicity

The Basin Plan states that "all waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological response in human, plant, animal, or aquatic life."

#### 2.1.2.13 Antidegradation

State Board Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality Water in California," known as the "Antidegradation Policy," protects surface and ground waters from degradation. Any actions that can adversely affect water quality in all surface and ground waters must be consistent with the maximum benefit to the people of the state, must not unreasonably affect present and anticipated beneficial use of such water, and must not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the federal Antidegradation Policy (40 CFR 131.12). The proposed TMDLs will not degrade water quality, and will in fact improve water quality as they will lead to meeting the numeric water quality standards.

## 2.2 NUMERIC TARGETS

Numeric targets represent water column, sediment, or fish tissue concentrations that result in attainment of the water quality standards. For the TMDLs in this document, the targets are assigned based on either: 1) numeric water quality objectives outlined in the Basin Plan, 2) fish contaminant goals (FCG) defined by the Office of Environmental Health Hazard Assessment, 3) water concentrations defined by the California Toxics Rule (CTR), 4) consensus-based sediment quality guidelines defined by MacDonald et al. (2000), 5) bioaccumulation factor (BAF) or biota-sediment accumulation factor (BSAF) calculations to translate the FCGs into water and sediment targets respectively, or 6) interpretation of the Regional Board regarding narrative water quality objectives.

### 2.2.1 Ammonia

The Basin Plan expresses ammonia targets as a function of pH and temperature because un-ionized ammonia ($NH_3$) is toxic to fish and other aquatic life. In order to assess compliance with the standard, pH, temperature, and ammonia must be determined at the same time. The toxicity of ammonia increases with increasing pH and temperature; therefore, ammonia targets depend on the site specific pH and temperature as well as the presence or absence of early life stages (ELS) of aquatic life. For the purpose of this report, pH and temperature samples at the surface (less than 0.5 meters of depth) were used to determine the median temperature and $95^{th}$ percentile pH, which were then used to calculate chronic targets. Acute values were based entirely on the $95^{th}$ percentile pH. Any single day sample without a depth was assumed to be sampled at the surface and included within the target calculation.

A December 2005 Amendment to the Basin Plan assumes that ELS are present in any waterbody designated as COLD. Designated uses applied in the calculation of site-specific ammonia targets are presented in Table 2-2. The 30-day average target concentrations (criterion continuous concentration (CCC)) of ammonia for waterbodies with and without ELS can be calculated using Equations 2-1 and 2-2, respectively. Concentration targets are also presented in Tables 3-1 through 3-4 of the Basin Plan (LARWQCB, 1994). The four-day maximum average concentrations shall not exceed 2.5 times the 30-day average objective, while the one-hour acute level, with and without ELS, can be calculated with Equations 2-3 and 2-4, respectively (USEPA, 1999).

**Table 2-2. Temperature and pH Dependent Acute and Chronic Total Ammonia Targets (un-ionized ammonia target)**

| Lake (designated use) | Median Temperature (n = number of samples) | 95th% pH Values (n = number of samples) | Acute (1-hr Maximum Concentration) (mg-N/L)[1] | Four-day Ammonia Max Average (mg-N/L)[2] | Chronic Ammonia Target (mg-N/L)[3] |
|---|---|---|---|---|---|
| Lincoln Park (WARM, WILD) | 19.0 (n=8) | 9 (n=22) | 1.32 | 0.91 | 0.36 |
| Echo Park (WARM, WILD) | 19.7 (n=44) | 9.1 (n=60) | 1.14 | 0.76 | 0.30 |
| Calabasas (WARM) | 21.8 (n=144) | 9.4 (n=172) | 0.78 | 0.46 | 0.19 |
| El Dorado Park (WARM, WILD) | 16.2 (n=46) | 8.5 (n=46) | 3.20 | 2.44 | 0.98 |
| Legg (COLD)** | 16 (n=14) | 9.6 (n=30) | 0.42** | 0.56** | 0.23** |

Note: The median temperature and 95th percentile pH values were calculated from the observed surface depth data and used in the calculation of ammonia targets. These are presented as example calculations since the actual target is the water quality objective which is dependent on pH and temperature. When assessing compliance refer to the water quality objective as expressed in the Basin Plan.

[1] The acute criterion represents a short term one-hour maximum concentration.

[2] The four-day criterion is the maximum average concentration allowed in a four-day period.

[3] The chronic criterion is the maximum 30 day average.

**ELS assumed to be present.

**Equation 2-1**: 30-day average total ammonia concentration for waterbodies with ELS present.

$$\text{30-day Average Concentration} = \left(\frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}}\right) * MIN\left(2.85, 1.45 * 10^{0.028*(25-T)}\right)$$

**Equation 2-2**: 30-day average total ammonia concentration for waterbodies with ELS absent.

$$\text{30-day Average Concentration} = \left(\frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}}\right) * 1.45 * 10^{0.028*(25-MAX(T,7))}$$

**Equation 2-3**: Acute criteria for total ammonia-nitrogen for waterbodies with ELS absent (USEPA, 1999).

$$\text{Acute Limit} = \left(\frac{0.41}{1+10^{7.204-pH}}\right) + \left(\frac{58.4}{1+10^{pH-7.204}}\right)$$

**Equation 2-4**: Acute criteria for total ammonia-nitrogen for waterbodies with ELS present (USEPA, 1999).

$$\text{Acute Limit} = \left(\frac{0.267}{1+10^{7.204-pH}}\right) + \left(\frac{39.0}{1+10^{pH-7.204}}\right)$$

## 2.2.2 Chlordane

Targets associated with OC Pesticides and PCBs are provided to ensure protection of both human health and wildlife, consistent with the beneficial uses associated with the OC Pesticides and PCBs-impaired waterbodies. The OC Pesticides and PCBs targets considered for use in calculating the TMDLs are discussed below by media.

### 2.2.2.1 Selection of Water Quality Targets

Water column targets for OC Pesticides and PCBs are based on beneficial use. For waters designated MUN, the Basin Plan lists a maximum contaminant level associated with chlordane and PCBs. The Basin Plan also requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Each waterbody addressed in this document is designated WARM, at a minimum, and must meet this requirement. The WQOs intended to protect these beneficial uses defer to numeric water quality criteria included in the California Toxics Rule (CTR) (USEPA, 2000a). To meet the designated beneficial uses, the aquatic life and human health criteria must be met. Acute and chronic criterion in freshwater systems are considered protective of aquatic life. However, the most stringent water column targets are the criteria for protection of human health. The “water and organisms” criterion is applicable to Puddingstone Reservoir, where there is an existing MUN use, while the “organisms only” criterion is applicable to Echo Park Lake and Peck Road Park Lake. The CTR criteria for “water and organisms” or “organisms only” both account for human health risk associated with bioaccumulation directly from the water column.

### 2.2.2.2 Selection of Sediment Quality Targets

OC Pesticides and PCBs have an affinity for organic matter and will partition from water to organic substances such as sediment, benthic organisms, and fish. The levels of contamination in sediment are important because they are a crucial pathway for pollutant accumulation in fish and other edible species (such as clams and mussels). Partitioning of OC Pesticides and PCBs from water through fish skin is also important, but does not result in the high accumulation caused by the continuous ingestion of contaminated organisms in most fish species. Two target sediment concentrations have been identified that consider the protection of sediment biota and the potential for bioaccumulation in aquatic organisms, as well as the associated hazards to the species that consume aquatic organisms. Consensus-based threshold effect levels are described in Section 2.2.2.2.1 and are designed to protect benthic biota from excessive toxic pollutants. These sediment targets have been used in similar freshwater OC Pesticides and PCBs TMDLs in the Los Angeles region. The other type of sediment targets, included in section 2.2.2.2.2, were calculated to attain the fish tissue target based on a biota-sediment accumulation factor (BSAF). The lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target for each lake. Additionally, these TMDLs include alternative wasteload allocations to be applied when a sufficient demonstration has been made that the fish tissue targets are met. These targets are based on the consensus-based TEC values described below. Details on when each set of targets apply are included in the wasteload allocation section of each relevant lake chapter.

#### *2.2.2.2.1 Consensus-Based Sediment Quality Guidelines Threshold Effects Concentrations (consensus-based TECs)*

There are no WQOs in the Basin Plan for OC Pesticides and PCBs in sediments. Instead, the Regional Board assesses the quality of the lake sediments using the Probable Effects Concentration (PEC) values for the consensus-based sediment quality guidelines published by MacDonald et al. (2000). The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008). Sediment quality guidelines (SQGs) are developed from field and laboratory studies to predict the toxicity of pollutants on sediment-dwelling organisms. MacDonald et al. (2000) compiled a set of all published SQGs and used the resulting geometric mean value to establish CBSQGs for threshold and probable effect concentrations of individual contaminants. The PEC is the concentration at which harmful effects on sediment-dwelling organisms are expected to occur, whereas the threshold effect concentration (TECs) describes the level of contaminant that is not expected to have harmful effects on sediment-dwelling organisms. PECs are appropriate when assessing impairments, while TECs are more conservative and best used as the targets for the TMDLs. The consensus-based sediment quality guidelines are designed to protect benthic dwelling organisms.

##### *2.2.2.2.2 Biota-Sediment Accumulation Factor (BSAF)*

To ensure protection of both human health and wildlife, it is also important to consider the potential for bioaccumulation in aquatic organisms and the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans). Thus a separate target calculation was conducted to ensure that fish tissue concentration goals are supported by sediment concentration. The fish goals may be translated through biota-sediment accumulation factor (BSAF) calculations to estimate associated sediment targets. This is done on a site-specific basis.

Specifically, a sediment target to achieve FCGs (see Selection of Fish Targets below) can be calculated based on biota-sediment bioaccumulation (a BSAF approach), using the ratio of the FCG to existing fish tissue concentrations. This ratio is applied to the observed in-lake sediment concentration to obtain the site-specific sediment target concentration to achieve fish tissue goals. The fish tissue-based target concentrations were calculated using only recent data (collected in the past 10 years) because the loads and exposure concentrations are likely to have declined steadily since the cessation of production and use of the OC Pesticides and PCBs.

### 2.2.2.3 Selection of Fish Tissue Targets

Beneficial uses may also be impaired if concentrations of OC Pesticides and PCBs in fish tissue are sufficiently high to pose potential adverse health impacts from the ingestion of sport-caught or local fish. Tissue concentrations of OC Pesticides and PCBs biomagnify in the food chain. OC Pesticides and PCBs levels increase with the species' trophic level and organisms at the top of a food chain system will have the highest accumulation of OC Pesticides and PCBs (note: trophic levels describe the position an organism occupies in the food chain [i.e., what the organism eats and what eats the organism] and are described in greater detail below). The OC Pesticides and PCBs accumulation also increases with the age of the organisms and resides mostly in the lipid portions of the fish. The top predators and fatty fish species in a given lake system tend to have the highest concentrations of OC Pesticides and PCBs, but concentrations are also elevated in fish that feed directly in contaminated sediment. Top predators (such as bass) are often target species for sport fishermen. Risks to human health from the consumption of contaminated fish are based on long-term, cumulative effects, rather than concentrations in individual fish. Therefore, the criterion should not be applied to the extreme case of the most-contaminated fish within a target species; instead, the criterion is most applicable to average concentrations in top predator species and fish that are popular for consumption.

The Office of Environmental Health Hazard Assessment (OEHHA) describes fish contaminant goals (FCGs) as pollutant levels in fish that "pose no significant health risk to individuals consuming sport fish at a standard consumption rate of eight ounces per week (32 g/day), prior to cooking, over a lifetime…" OEHHA also states that FCGs provide a reasonable starting point for criteria development (OEHHA, 2008).

FCGs for OC Pesticides and PCBs are defined for carcinogenic and non- carcinogenic risks. The OEHHA (2008) applied the following methodology to calculate the two sets of FCGs:

> *For each chemical, the toxicological literature was reviewed to establish an acceptable non-cancer reference dose (RfD; an estimate of daily human exposure to a chemical that is likely to be without significant risk of adverse effects during a lifetime) and/or a cancer slope factor (an upper-bound estimate of the probability that an individual will develop cancer over a lifetime as a consequence of exposure to a given dose of a specific carcinogen).*

For all the OC Pesticides and PCBs of concern in these TMDLs, the FCG based on cancer risk is the lower of the two FCG sets and is selected as the target.

#### 2.2.2.4 Chlordane Numeric Targets

Total chlordane consists of a family of related chemicals, including cis- and trans-chlordane, oxychlordane, trans-nonachlor, and cis-nonachlor. As described above, water column targets for chlordane are based on beneficial use. For waters designated MUN, the Basin Plan lists a maximum contaminant level of 0.0001 mg/L, or 0.1 µg/L (100 ng/L). The Basin Plan also requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). This objective is addressed through the CTR water quality criteria.

Acute and chronic criteria for chlordane in freshwater systems are defined by the California Toxics Rule as 2.4 µg/L (2,400 ng/L) and 0.0043 µg/L (4.3 ng/L), respectively (USEPA, 2000a). CTR criteria are considered protective of aquatic life. The CTR also includes human health criteria for the consumption of water and organisms and for the consumption of organisms only as 0.00057 µg/L (0.57 ng/L) and 0.000059 µg/L (0.59 ng/L), respectively (USEPA, 2000a). California often implements these values on a 30 day average. Because the human health criterion for the consumption of water and organisms is the most restrictive criterion, a water column target of 0.00057 µg/L (0.57 ng/L) is the appropriate target for waterbodies with the MUN designated use (Puddingstone Reservoir). The human health criterion for the consumption of organisms only (0.000059 µg/L [0.59 ng/L]) is appropriate for waterbodies without an existing MUN designation (Echo Park Lake and Peck Road Park Lake).

Two target sediment concentrations for chlordane have been identified as potential targets (Section 2.2.2.2). There are no Basin Plan Objectives for toxicity levels in sediment; however sediment quality guidelines are reported by multiple agencies for the protection of sediment biota. MacDonald et al. (2000) compiled and evaluated the guidelines and derived consensus-based sediment quality guidelines that incorporate multiple recommendations. For chlordane, the consensus-based threshold effect concentration (TEC) is 3.24 µg/kg dry weight. The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. An additional sediment target based on bioaccumulation in fish was also calculated for each impaired lake to ensure that the FCG is met using the BSAF approach described in Section 2.2.2.2.2. The lower of the two sediment target values is applied in each lake.

Fish tissue targets are described above in Section 2.2.2.3. The fish contaminant goal for chlordane defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) is 5.6 ppb based on cancer risk (the FCG based on non-cancer risk is 100 ppb). The resulting total chlordane targets for each lake are shown in Table 2-3.

**Table 2-3. Total Chlordane Targets**

| Lake | Maximum Contaminant Level (ng/L) | Acute Criterion[1] (ng/L) | Chronic Criterion[2] (ng/L) | Criterion for Consumption of Water and Organisms (ng/L) | Human Health Criterion for Consumption of Organisms Only (ng/L) | Consensus-based TEC Sediment Target (µg/kg)[3] | BSAF-derived Sediment Target (µg/kg) | Fish Contaminant Goal (ppb) |
|---|---|---|---|---|---|---|---|---|
| Echo Park Lake | NA | 2,400 | 4.3 | 0.57 | 0.59 | 3.24 | 2.10 | 5.6 |
| Peck Road Park Lake | NA | 2,400 | 4.3 | 0.57 | 0.59 | 3.24 | 1.73 | 5.6 |
| Puddingstone Reservoir | 100 | 2,400 | 4.3 | 0.57 | 0.59 | 3.24 | 0.75 | 5.6 |

Note: Shaded cells represent the selected targets for each waterbody.

[1] The acute criterion is a short term average not to be exceeded more than once every three years on the average.

[2] The chronic criterion is the highest four day average not to be exceeded more than once every three years on average.

[3] The consensus-based TEC sediment target value was used for setting alternative wasteload allocations when sufficient demonstration that the fish tissue targets are met has been made. Details on when each set of targets apply are included in the wasteload allocation sections of each relevant lake chapter.

## 2.2.3 Chlorophyll *a*, Total Nitrogen, and Total Phosphorus

To address the water quality standard for biostimulatory substances (nitrogen and phosphorus), the Regional Board and USEPA have determined that an average summer (May – September) and annual mean chlorophyll *a* concentration of 20 µg/L will protect each waterbody from nuisance aquatic growth. For lakes that are not meeting the chlorophyll *a* target, the NNE BATHTUB model was used to assess target concentrations of nitrogen and phosphorus in each waterbody that will not result in an average summer (May – September) and annual mean chlorophyll *a* concentration exceeding 20 µg/L. The unique conditions in each lake result in unique total nitrogen and total phosphorus targets for each lake that will result in the targeted chlorophyll *a* concentration. For lakes where currently available data indicate the chlorophyll *a* target is being met, the total nitrogen and total phosphorus targets are set at existing nutrient levels. More information on nutrient targets is included below.

### 2.2.3.1 Chlorophyll *a* Numeric Targets

A summer mean chlorophyll *a* concentration of 25 µg/L represents a general consensus for the boundary between eutrophic and degraded hypereutrophic conditions (Welch and Jacoby, 2004), and average concentrations should be maintained below this level to protect WARM uses. Impairment of recreational uses can occur at somewhat lower levels. Carlson (1977) shows that an average chlorophyll *a* concentration of around 20 µg/L corresponds to a Secchi disc depth of 3 m. The work of Walker (1987) suggests that a mean chlorophyll *a* concentration of 25 µg/L is associated with severe algal blooms (concentration greater than 30 µg/L) occurring about one quarter of the time, while a mean concentration of 20 µg/L should reduce the frequency of severe blooms to about 15-20 percent of the time. Lake aesthetics and recreation potential are generally found to be impaired above about 20 or 25 µg/L chlorophyll *a* (Bachmann and Jones, 1974; Heiskary and Walker, 1988). Based on these and other lines of evidence, Tetra Tech (2006) recommended to the State Water Quality Control Board that summer average chlorophyll *a* concentrations be not greater than 25 µg/L to support WARM uses and not greater than 20 µg/L to support REC-1 uses.

#### 2.2.3.2 Total Nitrogen and Total Phosphorus Numeric Targets

As mentioned above the NNE BATHTUB Tool was used to calculate total nitrogen and total phosphorus targets for each lake. Appendix A (Nutrient TMDL Development) provides more details but a brief description is included here. The NNE BATHTUB tool finds combinations of N and P loading that result in predicted chlorophyll *a* being equal to the selected target. Similar to the chlorophyll *a* targets, the total nitrogen and total phosphorus targets are average summer (May – September) and annual mean values. Because algal growth can be limited by either N or P there is not a unique solution, and the Tool output supplies the user with a curve representing the loading combinations that will result in attainment of the selected chlorophyll *a* target. The loading combination that is predicted to result in an in-lake ratio of total nitrogen concentration to total phosphorus concentration close to 10 was selected. This ratio was chosen to match that typically observed in natural systems and to balance biomass growth and prevent limitation by one nutrient (Thomann and Mueller, 1987). A ratio of 10 typically limits the growth nuisance species, such as cyanobacteria (blue green algae) (Welch and Jacoby, 2004). For lakes with required reductions in loadings, maximum allowable alternative "Approved Lake Management Plan Wasteload Allocations" are also included. These alternative wasteload allocations are concentration-based and are based on USEPA's technical guidance to States not to set phosphorus criteria for lakes and reservoirs any higher than 0.1 mg/L total phosphorus (USEPA, 2000d). A ratio of 10 was then applied to select the corresponding maximum allowable total nitrogen target.

For lakes where the currently available data indicate that the chlorophyll *a* target is being met, the total nitrogen target is based on the existing conditions and the total phosphorus target is based on the typical ratio of 10 between phosphorus and nitrogen in natural systems. The in-lake nitrogen and phosphorus targets as well as the chlorophyll *a* target are summer (May – September) and annual average values. However, compliance with these targets for the lakes that are receiving targets based on existing conditions will be based on a three year average to account for year to year variability. Table 2-4 presents the total phosphorous and total nitrogen targets associated with each lake.

Measuring compliance with the nitrogen and phosphorus targets will occur differently for three categories of lakes. The first category includes lakes where the currently available data indicate that the chlorophyll *a* target is being met. In these lakes compliance with the total phosphorus and total nitrogen allocations is based on a three year average rather than a one year value. Additionally, if applicable water quality criteria for ammonia, dissolved oxygen, and pH and the chlorophyll *a* target are met then the total phosphorus and total nitrogen allocations are considered attained. The second category includes lakes that require reductions to achieve the chlorophyll *a* target and are heavily managed lakes that receive the majority of their water from supplemental water additions to the lake. Responsible jurisdictions that discharge to these lakes may opt to request that alternative wasteload and load allocations apply to them if they develop a lake management plan. In this scenario if applicable water quality criteria for ammonia, dissolved oxygen, and pH and the chlorophyll *a* target are met then the total phosphorus and total nitrogen allocations are considered attained. Finally, the third category of lake is for lakes that require reductions to achieve the chlorophyll *a* target but are not heavily managed lakes and do not receive the majority of their water from supplemental water additions. The only lake in this category is Puddingstone Reservoir. Responsible jurisdictions that discharge to this lake must meet the total phosphorus and total nitrogen allocations as well as the applicable water quality criteria for ammonia, dissolved oxygen, and pH and the chlorophyll *a* target in order to demonstrate compliance. Details are included in the individual lake chapters.

**Table 2-4. Total Phosphorus and Total Nitrogen Targets**

| Lake/Reservoir | Total Phosphorus Target (mg-P/L) | Total Nitrogen Target (mg-N/L) | Maximum Allowable Alternative target for Total Phosphorus (mg-P/L) | Maximum Allowable Alternative target Total Nitrogen (mg-N/L) |
|---|---|---|---|---|
| Peck Road Park Lake[1] | 0.071 | 0.71 | NA | NA |
| Lincoln Park Lake | 0.088 | 0.88 | 0.1[2] | 1.0[2] |
| Echo Park Lake[1] | 0.12 | 1.20 | NA | NA |
| Lake Calabasas | 0.066 | 0.66 | 0.1[2] | 1.0[2] |
| El Dorado Park Lakes Northern System | 0.069 | 0.69 | 0.1[2] | 1.0[2] |
| El Dorado Park Lakes Southern System[1] | 0.125 | 1.25 | NA | NA |
| Legg Lakes | 0.065 | 0.65 | 0.1[2] | 1.0[2] |
| Puddingstone Reservoir | 0.071 | 0.71 | 0.1 | 1.0 |
| Santa Fe Dam Park Lake[1] | 0.063 | 0.63 | NA | NA |

[1] Limited data indicate these lakes are meeting the chlorophyll *a* target so the total nitrogen and total phosphorus targets are based on existing conditions. In these lakes compliance with the total phosphorus and total nitrogen allocations is based on a three year average rather than a one year value. Additionally, if applicable water quality criteria for ammonia, dissolved oxygen, and pH and the chlorophyll *a* target are met then the total phosphorus and total nitrogen allocations are considered attained.

[2] In these lakes responsible jurisdictions can request that these alternative allocations are applied to them based on factors set out in the individual lake chapters' wasteload and load allocation sections. Additionally, if applicable water quality criteria for ammonia, dissolved oxygen, and pH and the chlorophyll *a* target are met then the total phosphorus and total nitrogen allocations under the alternative allocations scenario are considered attained.

## 2.2.4 Copper

The Basin Plan requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Acute and chronic criterion for copper and lead in freshwater systems are included in the California Toxics Rule (CTR) 40 CFR 131.38. (USEPA, 2000a). The CTR establishes short-term (acute) and long-term (chronic) aquatic life criteria for metals in both freshwater and saltwater. The acute criterion, defined in the CTR as the Criteria Maximum Concentration, equals the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects. The chronic criterion, defined in the CTR as the Criteria Continuous Concentration, equals the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects.

CTR freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness and/or water quality characteristics that are usually correlated with hardness can reduce or increase the toxicity of some metals. In order to assess compliance with the standards, copper and hardness should be determined at the same time. Hardness is used as a surrogate for a number of water quality characteristics, which affect the toxicity of metals in a variety of ways. Increasing hardness generally has the effect of decreasing the toxicity of metals. Water quality criteria to protect aquatic life may be calculated at different concentrations of hardness measured in milligrams per liter (mg/L) as calcium carbonate ($CaCO_3$). The CTR lists freshwater aquatic life criteria based on a hardness value of 100 mg/L and provides hardness dependent equations to calculate the freshwater aquatic life metals criteria using site-specific hardness data.

In the CTR, freshwater criteria for metals are expressed in terms of the dissolved fraction of the metal in the water column. These criteria were calculated based on methods in USEPA guidance (USEPA, 1985) developed under Section 304(a) of the CWA. This methodology is used to calculate the total recoverable fraction of metals in the water column and then appropriate conversion factors, included in the CTR, are applied to calculate the dissolved criteria.

The CTR allows for the adjustment of criteria through the use of a water-effect ratio (WER) to assure that the metals criteria are appropriate for the site-specific chemical conditions under which they are applied. A WER represents the ratio between metals that are measured and metals that are biologically available and toxic. The WER is used to account for site specific conditions that may alter the bioavailability of a toxicant with respect to laboratory water. For impaired waterbodies where no site specific data are available, a default WER of 1 can be assumed. The coefficients needed for hardness-based calculations are provided in the CTR and listed below in Table 2-5.

The equations for calculating the freshwater criteria for metals are:

$$\text{Acute Criterion} = \text{WER} \times \text{ACF} \times \text{EXP}[(m_a)(\ln(\text{hardness}))+b_a] \quad \textbf{Equation 2-5}$$

$$\text{Chronic Criterion} = \text{WER} \times \text{CCF} \times \text{EXP}[(m_c)(\ln(\text{hardness}))+b_c] \quad \textbf{Equation 2-6}$$

Where: WER = Water-Effect Ratio (assumed to be 1)

ACF = Acute conversion factor (to convert from the total to the dissolved fraction)

CCF = Chronic conversion factor (to convert from the total to the dissolved fraction)

$m_a$ = slope factor for acute criteria

$m_c$ = slope factor for chronic criteria

$b_a$ = y intercept for acute criteria

$b_c$ = y intercept for chronic criteria

**Table 2-5. Coefficients used in Formulas for Calculating CTR Freshwater Criteria for Copper**

| Metal | ACF | $m_a$ | $b_a$ | CCF | $m_C$ | $b_C$ |
|---|---|---|---|---|---|---|
| Copper | 0.960 | 0.9422 | -1.700 | 0.960 | 0.8545 | -1.702 |

Chronic copper freshwater targets for each lake are calculated based on the $50^{th}$ percentile of hardness values measured during copper sampling events, while the acute targets are calculated using the $90^{th}$ percentile hardness (Appendix G, Monitoring Data). These are presented as example calculations since the actual target varies with the hardness value measured during sample collection. Table 2-6 summarizes the acute and chronic criteria, as well as the human health criterion for the consumption of water and organisms from a waterbody, for each lake impaired by copper.

**Table 2-6. Hardness-Dependent Acute and Chronic Copper Targets**

| Lake | WER | 90th Percentile Hardness (mg/L as $CaCO_3$) | Acute Criterion[1] (µg/L dissolved fraction) | 50th Percentile Hardness (mg/L as $CaCO_3$) | Chronic Criterion[2] (µg/L dissolved fraction) | Human Health Criterion[3] (µg/L total fraction) |
|---|---|---|---|---|---|---|
| Echo Park Lake | 1 | 231 | 29.58 | 208 | 16.75 | 1,300 |
| El Dorado Park Lakes | 1 | 124 | 16.46 | 95 | 8.57 | 1,300 |
| Legg Lakes | 1 | 246 | 31.38 | 182 | 14.94 | 1,300 |
| Santa Fe Dam Park Lake | 1 | 131 | 17.33 | 100 | 8.96 | 1,300 |

Note: The median and 90th percentile hardness values were calculated from the observed data and used in the calculation of the chronic and acute targets, respectively. These are presented as example calculations since the actual target varies with the hardness value determined during sample collection.

[1] The acute criterion is a short term average not to be exceeded more than once every three years on the average.

[2] The chronic criterion is the highest four day average not to be exceeded more than once every three years on average.

[3] The human health criterion was specified for consumption of water and organisms. A human health criterion was not specified for consumption of organisms only.

### 2.2.5 Dieldrin

Selection of applicable OC Pesticides and PCBs targets are described above in Section 2.2.2.1 through Section 2.2.2.3. Water column targets for dieldrin are based on beneficial use (Section 2.2.2.1). Only one of the three dieldrin-impaired waters has an MUN designated use. The Basin Plan requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). This objective is addressed through the CTR water quality criteria.

Acute and chronic criteria for the protection of aquatic life in freshwater systems are included in the CTR for dieldrin as 0.24 µg/L (240 ng/L) and 0.056 µg/L (56 ng/L), respectively (USEPA, 2000a). CTR criteria are considered protective of aquatic life. The CTR also includes human health criterion for the consumption of organisms only and for the consumption of organisms and water as 0.00014 µg/L (0.14 ng/L) (USEPA, 2000a). California often implements these values on a 30 day average. Because the human health criterion for the consumption of organisms only is the most restrictive criterion, a water column target of 0.00014 µg/L (0.14 ng/L) is the appropriate target for waterbodies without an existing MUN designated use (Echo Park Lake and Peck Road Park Lake). For the MUN use specified in Puddingstone Reservoir the CTR criterion is based on consumption of organisms and water, but is also equal to 0.00014 µg/L (0.14 ng/L).

Two target sediment concentrations for dieldrin have been identified (Section 2.2.2.2). There are no Basin Plan Objectives for toxicity levels in sediment; however sediment quality guidelines are reported by multiple agencies for the protection of sediment biota. MacDonald et al. (2000) compiled and evaluated the guidelines and derived consensus-based sediment quality guidelines that incorporate multiple recommendations. For dieldrin, the consensus-based threshold effect concentration (TEC) is 1.9 µg/kg dry weight. The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. An additional sediment target based on bioaccumulation in fish was also calculated for each impaired lake to ensure that the FCG is met using the BSAF approach described in Section 2.2.2.2.2. The lower of the two sediment target values is applied in each lake. Additionally, these TMDLs include alternative wasteload allocations to be applied when a sufficient demonstration has been made that the fish tissue targets are met. These targets are based on the consensus-based TEC values. Details on when each set of targets apply are included in the wasteload allocation section of each relevant lake chapter.

Fish tissue targets are described above in Section 2.2.2.3. The fish contaminant goal for dieldrin defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) is 0.46 ppb based on cancer risk (the FCG based on non-cancer risk is 160 ppb). Similar to the sediment targets, the lowest fish tissue target value is applied in each lake. Table 2-7 summarizes the applicable targets for the two waterbodies listed for dieldrin addressed by this document.

**Table 2-7. Dieldrin Targets**

| Lake | Acute Criterion[1] (ng/L) | Chronic Criterion[2] (ng/L) | Human Health Criterion for Consumption of Organisms Only (ng/L) | Consensus-based TEC Sediment Target (µg/kg)[3] | BSAF-derived Sediment Target (µg/kg) | Fish Contaminant Goal (ppb) |
|---|---|---|---|---|---|---|
| Echo Park Lake | 240 | 56 | 0.14 | 1.90 | 0.80 | 0.46 |
| Peck Road Park Lake | 240 | 56 | 0.14 | 1.90 | 0.43 | 0.46 |
| Puddingstone Reservoir | 240 | 56 | 0.14 | 1.90 | 0.22 | 0.46 |

Note: Shaded cells represent the selected targets for each waterbody.

1 The acute criterion is a short term average not to be exceeded more than once every three years on the average.

2 The chronic criterion is the highest four day average not to be exceeded more than once every three years on average.

3 The consensus-based TEC sediment target value was used for setting alternative wasteload allocations when sufficient demonstration that the fish tissue targets are met has been made. Details on when each set of targets apply are included in the wasteload allocation sections of each relevant lake chapter.

## 2.2.6 Dissolved Oxygen

Targets for dissolved oxygen (DO) depend on whether or not the waterbody is designated COLD in addition to the minimum designation of WARM, as is the case with Puddingstone Reservoir. Waterbodies designated COLD have more stringent dissolved oxygen targets. Table 2-8 summarizes the DO targets for each lake listed as impaired by low DO. Targets are specified as minimum values not to be depressed due to waste discharges. Target depths for each lake were set by the Regional Board and USEPA based on site specific conditions. Shallow, well mixed lakes must meet the target in the water column from the surface to 0.3 meters above the bottom of the lake. Deeper lakes that thermally stratify during the summer months, such as Peck Road Park Lake and Puddingstone Reservoir, must meet the DO target throughout the epilimnion of the water column.

The epilimnion is the upper stratum of more or less uniformly warm, circulating, and fairly turbulent water during summer stratification. The epilimnion floats above a cold relatively undisturbed region called the hypolimnion. The stratum between the two is the metalimnion and is characterized by a thermocline, which refers to the plane of maximum rate of decrease of temperature with respect to depth. For the purposes of these TMDLs, the presence of stratification will be defined by whether there is a change in lake temperature greater than 1 degree Celsius per meter. Deep lakes must meet the DO target in the water column from the surface to 0.3 meters above the bottom of the lake when the lake is not stratified. However, when stratification occurs (i.e., a thermocline is present) then the DO target must be met in the epilimnion, the portion of the water column above the thermocline.

**Table 2-8. Dissolved Oxygen Targets**

| Lake/Reservoir | Minimum Mean Annual DO (mg/L)[1] | Minimum Instantaneous DO (mg/L)[2] | Target Depth (m) |
|---|---|---|---|
| Peck Road Park Lake | 7.0 | 5.0 | Throughout the epilimnion |
| Lincoln Park Lake | 7.0 | 5.0 | Surface to 0.3 meters above the bottom |
| Echo Park Lake | 7.0 | 5.0 | Surface to 0.3 meters above the bottom |
| Lake Calabasas | 7.0 | 5.0 | Surface to 0.3 meters above the bottom |
| El Dorado Park Lakes | 7.0 | 5.0 | Surface to 0.3 meters above the bottom |
| Legg Lakes | 7.0 | 6.0 | Surface to 0.3 meters above the bottom |
| Puddingstone Reservoir | 7.0 | 6.0 | Throughout the epilimnion |
| Santa Fe Dam Park Lake | 7.0 | 5.0 | Surface to 0.3 meters above the bottom |

[1] The mean annual dissolved oxygen concentration shall be greater than 7 mg/L except when natural conditions cause lesser concentrations.

[2] The dissolved oxygen content shall not be depressed below this level as a result of waste discharges.

### 2.2.7 DDT

Dichlorodiphenyltrichloroethane (DDT) is a synthetic organochlorine insecticide once used throughout the world to control insects. Technical DDT consists of two isomers, 4,4'-DDT and 2,4'-DDT, of which the former is most toxic. In the environment, DDT breaks down to form two related compounds: DDD (tetrachlorodiphenylethane) and DDE (dichlorodiphenyl-dichloroethylene). DDD and DDE often predominate in the environment and USEPA (2000c) recommends that fish consumption guidelines be based on the sum of DDT, DDD, and DDE – collectively referred to as total DDTs.

Selection of applicable OC Pesticides and PCBs targets are described above in Section 2.2.2.1 through Section 2.2.2.3. Water column targets for DDT are based on beneficial use (Section 2.2.2.1). The Basin Plan requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). This objective is addressed through the CTR water quality criteria. Acute and chronic criteria for 4,4'-DDT in freshwater systems are included in the CTR as 1.1 µg/L (1,100 ng/L) and 0.001 µg/L (1 ng/L), respectively (USEPA, 2000a). CTR criteria are considered protective of aquatic life. Acute and chronic values for other DDT compounds were not specified.

The CTR also includes human health criteria for the consumption of water and organisms or organisms only in several DDT compounds, but does not specify a target for total DDTs (USEPA, 2000a). California often implements these values on a 30 day average. These values include a water column target of 0.00059 µg/L (0.59 ng/L) for 4,4'-DDT for consumption of water and organisms as well as organisms only. The CTR also specifies a criterion of 0.00059 µg/L (0.59 ng/L) for 4,4'-DDE (for both consumption of water and organisms or organisms only), while for 4,4'-DDD the criteria are 0.00083 µg/L (0.83 ng/L) for consumption of water and organisms and 0.00084 µg/L (0.84 ng/L) for consumption of organisms only. The lowest applicable DDT target is selected for the purposes of representing Total DDTs. If analytical results that resolve individual DDT compounds are available, all of the CTR criteria should be applied individually. Because the human health criterion for the consumption of water and organisms is the most restrictive criterion, a water column target of 0.00059 µg/L (0.59 ng/L) is the appropriate target for waterbodies with the MUN designated use (Puddingstone Reservoir). The human health criterion for the consumption of organisms only (0.00059 µg/L [0.59 ng/L]) is appropriate for waterbodies without an existing MUN designated use (Peck Road Park Lake).

Two target sediment concentrations for total DDT have been identified (Section 2.2.2.2). There are no Basin Plan Objectives for toxicity levels in sediment; however sediment quality guidelines are reported by multiple agencies for the protection of sediment biota. MacDonald et al. (2000) compiled and evaluated the guidelines and derived consensus-based sediment quality guidelines that incorporate multiple recommendations. The consensus-based TEC for total DDTs is 5.28 μg/kg dry weight (MacDonald el al., 2000). Most data are provided for the total compound; therefore, the total DDTs TEC value is applicable for TMDL analyses. If data for individual compounds are available, separate TECs are also provided: for 4,4'- plus 2,4'-DDT the TEC is 4.16 μg/kg dry weight, for total DDE the TEC is 3.16 μg/kg dry weight, and the TEC for total DDD is 4.88 μg/kg dry weight. The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. An additional sediment target based on bioaccumulation in fish was also calculated for each impaired lake to ensure that the FCG is met using the BSAF approach described in Section 2.2.2.2.2. The lower of the two sediment target values is applied in each lake. Additionally, the Puddingstone Reservoir DDT TMDL includes alternative wasteload allocations to be applied when a sufficient demonstration has been made that the fish tissue targets are met. This target is based on the consensus-based TEC values. Details on when each set of targets apply are included in the wasteload allocation section of the Puddingstone Reservoir DDT impairment chapter.

Fish tissue targets are described above in Section 2.2.2.3. The fish contaminant goal for total DDT defined by the OEHHA is 21 ppb (OEHHA, 2008) based on cancer risk (the FCG based on non-cancer risk is 1,600 ppb). The advisory tissue levels are based on various levels of fish consumption. Table 2-9 summarizes the applicable targets for the two waterbodies listed for DDT addressed by this document.

**Table 2-9. DDT Target**

| Lake | Acute Criterion[1] for 4-4'-DDT (ng/L) | Chronic Criterion[2] for 4-4'-DDT (ng/L) | Human Health Criterion for Consumption of Water and Organisms (ng/L) | Human Health Criterion for Consumption of Organisms Only (ng/L) | Consensus-based TEC Sediment Target (μg/kg) | BSAF-derived Sediment Target (μg/kg) | Fish Contaminant Goal (ppb) |
|---|---|---|---|---|---|---|---|
| Peck Road Park Lake | 1,100 | 1 | 0.59 | 0.59[3] | 5.28 | 6.90 | 21 |
| Puddingstone Reservoir | 1,100 | 1 | 0.59[3] | 0.59 | 5.28[4] | 3.94 | 21 |

Note: Shaded cells represent the selected targets for each waterbody.

[1] The acute criterion is a short term average not to be exceeded more than once every three years on the average.

[2] The chronic criterion is the highest four day average not to be exceeded more than once every three years on the average.

[3] The target water column concentration of 0.59 ng/L specified in the CTR is for 4,4'-DDT. The CTR also specifies targets for DDE and DDD, but does not specify a target for total DDTs. The lowest DDT target is selected for the purposes of representing Total DDTs in this table. If analytical results that resolve individual DDT compounds are available, all of the CTR criteria should be applied individually.

[4] For Puddingstone Reservoir, the consensus-based TEC sediment target value was used for setting alternative wasteload allocations when sufficient demonstration that the fish tissue targets are met has been made. Details on when each set of targets apply are included in the wasteload allocation sections of the Puddingstone Reservoir DDT impairment chapter.

### 2.2.8 Lead

The Basin Plan requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). CTR 40 CFR 131.38 establishes short-term (acute) and long-term (chronic) aquatic life criteria for metals in both freshwater and saltwater (USEPA, 2000a). Refer to Section 2.2.4 for a detailed explanation of the procedure used to calculate metal targets. Coefficients for calculating lead criteria are listed in Table 2-10.

In addition to the CTR discussion in Section 2.2.4, the chronic and acute conversion factors for lead in freshwater are dependent on hardness and, therefore, should be calculated for each waterbody evaluated. In order to assess compliance with the standards, lead and hardness should be determined at the same time. The following equations can be used to calculate the acute and chronic lead conversion factors based on site-specific hardness data:

$$\text{Lead ACF} = 1.46203 - [(\ln\{\text{hardness}\})(0.145712)]$$ **Equation 2-7**

$$\text{Lead CCF} = 1.46203 - [(\ln\{\text{hardness}\})(0.145712)]$$ **Equation 2-8**

**Table 2-10. Coefficients Used in Formulas for Calculating CTR Freshwater Criteria for Lead**

| Metal | ACF | $m_a$ | $b_a$ | CCF | $m_C$ | $b_C$ |
|---|---|---|---|---|---|---|
| Lead | * | 1.273 | -1.460 | * | 1.273 | -4.705 |

*The ACF and CCF for lead are hardness-dependent, and are therefore calculated for each lake specifically (see Table 2-11).

Chronic lead freshwater targets for each lake are calculated based on the 50$^{th}$ percentile of hardness values measured during lead sampling events, while the acute targets are calculated using the 90$^{th}$ percentile hardness (Appendix G, Monitoring Data). These are presented as example calculations since the actual target varies with the hardness value measured during sample collection. Table 2-11 summarizes the acute and chronic criterion for each lake impaired by lead (note that CTR does not include a human health criterion for lead).

**Table 2-11. Hardness-Dependent Acute and Chronic Lead Targets**

| Lake | WER | 90th Percentile Hardness (mg/L as $CaCO_3$) | ACF[4] | Acute Criterion[1] (µg/L dissolved fraction) | 50th Percentile Hardness (mg/L as $CaCO_3$) | CCF[4] | Chronic Criterion[2] (µg/L dissolved fraction) |
|---|---|---|---|---|---|---|---|
| Peck Road Park Lake | 1 | 121 | 0.763 | 79.43 | 84 | 0.816 | 2.08 |
| Lincoln Park Lake | 1 | 332 | 0.616 | 231.75 | 315 | 0.624 | 8.55 |
| Echo Park Lake | 1 | 231 | 0.669 | 158.58 | 208 | 0.684 | 5.53 |
| El Dorado Park Lakes | 1 | 124 | 0.760 | 81.56 | 95 | 0.798 | 2.38 |
| Legg Lakes | 1 | 246 | 0.660 | 169.44 | 182 | 0.704 | 4.80 |
| Santa Fe Dam Park Lake | 1 | 131 | 0.752 | 86.54 | 100 | 0.791 | 2.52 |
| Westlake Lake | 1 | 468[3] | 0.589 | 280.85 | 336 | 0.614 | 9.14 |

Note: The median and 90th percentile hardness values were calculated from the observed data and used in the calculation of the chronic and acute targets, respectively. These are presented as example calculations since the actual target varies with the hardness value measured during sample collection.

[1] The acute criterion is a short-term average not to be exceeded more than once every three years on the average.

[2] The chronic criterion is the highest four-day average not to be exceeded more than once every three years on average.

[3] The 90th percentile hardness was greater than 400 mg/L. According to CTR, if hardness is over 400 mg/L, a hardness of 400 mg/L should be used with a default WER of 1.0. Therefore, hardness of 400 mg/L was used in the acute target calculations for Westlake Lake.

[4] Conversion factors are hardness dependent. Refer to Equation 2-7 and Equation 2-8 to calculate the ACF and CCF, respectively.

## 2.2.9 Mercury

Mercury targets are provided to ensure protection of both human health and wildlife, consistent with the beneficial uses associated with the mercury-impaired waterbodies. As discussed below, the human health targets are considered protective of wildlife; therefore, the values presented in Table 2-13 are used for TMDL calculations and confirmation of impairments.

**Table 2-12. Mercury Targets**

| Lake/Reservoir | Total Mercury Maximum Contaminant Level (µg/L) | Total Mercury Human Health Criterion for Consumption of Water and Organisms (µg/L total fraction) | Total Mercury Human Health Criterion for Consumption of Organisms Only (µg/L total fraction) | Dissolved Methyl-mercury Water Quality Targets (ng/L) | Methylmercury Fish Tissue Concentration in 350 mm (average length) Largemouth Bass (ppm) |
|---|---|---|---|---|---|
| El Dorado Park Lakes | 2.0 | 0.050 | 0.051 | 0.081 | 0.22 |
| Puddingstone Reservoir | 2.0 | 0.050 | 0.051 | 0.081 | 0.22 |
| Lake Sherwood | 2.0 | 0.050 | 0.051 | 0.081 | 0.22 |

Note: Shaded cells represent the selected targets for each waterbody.

### 2.2.9.1 Protection of Human Health

Fish tissue and water column targets for methylmercury and mercury are chosen based on applicable beneficial uses. For waters designated MUN, the Basin Plan lists a water column maximum contaminant level of 0.002 mg/L, or 2 μg/L. The California Toxics Rule (CTR) includes human health criteria for the consumption of water and organisms or organisms only as 0.050 μg/L and 0.051 μg/L, respectively (USEPA, 2000a). California often implements these values on a 30 day average. Because the human health criterion for the consumption of water and organisms is the most restrictive criterion, a water column target of 0.050 μg/L is the appropriate target for waterbodies with the MUN designated use (Puddingstone Reservoir). The human health criterion for the consumption of organisms only (0.051 μg/L) is appropriate for waterbodies without the MUN designated use (El Dorado Park lakes and Lake Sherwood).

The fish contaminant goal for methylmercury defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) is 220 ppb or 0.22 ppm. This concentration is a chronic target designed to protect human health from the cumulative effects of long-term exposure to contaminated fish. It is based on a consumption rate of 8 ounces of fish per week, prior to cooking and is more restrictive than the federal Clean Water Act (CWA) 304(a) guidance criterion for the protection of human health of 0.3 ppm (USEPA, 2001a). The assessment data available for the three mercury impaired lakes report concentrations of total mercury in fish tissue, of which most is in the form of methylmercury. Comparison of the assessment data to the methylmercury fish contaminant goal results in slightly conservative TMDL calculations and is considered part of the implicit margin of safety.

In addition, a water column target for dissolved methylmercury of 0.081 ng/L is applicable for all three mercury-impaired lakes. This value is calculated by dividing the fish contaminant goal (0.22 ppm) with a national bioaccumulation factor (for dissolved methylmercury) of 2,700,000 applicable for trophic level 4 fish (and multiplying by a factor of $10^6$ to convert from milligrams to nanograms) (USEPA, 2001a, Appendix A). A bioaccumulation factor or BAF is the ratio of the concentration of a chemical in the water column to the concentration of the chemical in fish tissue and are in units of liters per kilograms (L/kg).

The applicable numeric targets for these TMDLs are the California ambient water quality criterion of 50 ng/L or 51 ng/L total mercury in the water column, the calculated dissolved methylmercury water column concentration of 0.081 ng/L, and the OEHHA fish contaminant goal of 0.22 ppm methylmercury in fish tissue. As it is primarily methylmercury that accumulates in fish, the 0.22 ppm target may be applied to the total mercury concentration in the edible portion of fish. Total mercury concentrations in edible fish from each lake exceed the contaminant goal. Fish in each lake accumulate unacceptable tissue concentrations of mercury even though the ambient water column criterion appears to be met. The most restrictive target is the fish contaminant goal of 0.22 ppm methylmercury, and is selected as the primary numeric target for calculating these TMDLs.

Mercury bioaccumulates in the food chain, which means larger fish that consume smaller fish have higher concentrations. Within a lake fish community, top predators usually have higher mercury concentrations than forage fish, and size and tissue concentrations generally increase with age. Top predator fish (such as bass) are often target species for sport fishermen. Risks to human health from the consumption of mercury-contaminated fish are based on long-term, cumulative effects, rather than concentrations in individual fish. Therefore, the target is not applied to the extreme case of the most-contaminated fish within a target species; instead, the target is applied to average concentrations in a top predator species of a size likely to be caught and consumed.

Within each of the mercury-impaired lakes, the top predator sport fish, and also the fish with the highest reported tissue methylmercury body burden, is largemouth bass (*Micropterus salmoides*). Largemouth bass continue to bioaccumulate mercury with increasing size and age. The California Department of Fish and Game requires that anglers release largemouth bass less than 12 inches (305 mm) in length and that each angler keep no more than five fish per day. The largemouth bass caught for determination of fish tissue contaminant concentrations in these three lakes ranged in size from 200 to 598 mm in length, and exceedances of the fish contaminant goal occurred in largemouth bass ranging in length from 286 to 598 mm (Appendix G, Monitoring Data).

The range of length for assessing compliance with this fish tissue target is 325-375 mm for largemouth bass. However, an average of 350 mm largemouth bass is used for TMDL calculations. This length has been identified by two separate studies as the average length of largemouth bass caught with fishing lines from California lakes (personal communication, Aroon Melwani, San Francisco Estuary Institute (SFEI), to Valentina Cabrera-Stagno, US EPA Region IX, October 22, 2009). Setting the fish tissue target to this length protects human health over the average range of fish caught. Setting the fish tissue target to the minimum length where exceedances have been detected will be less protective of human health because all fish greater than that length may exceed the criterion. Setting the fish tissue target to the maximum length may be overly protective since most fish that are caught will be less than the maximum length.

**Error! Reference source not found.** above summarizes the applicable targets for the three waterbodies listed for mercury addressed by this document. The shaded cells in this table represent the selected targets for each waterbody. The fish tissue concentration targets are consistent; however, the water column targets differ. Specifically, Puddingstone Reservoir has an MUN designated use; therefore, the human health criterion for the consumption of water and organisms is appropriate (0.50 µg/L), while the target for El Dorado Park lakes and Lake Sherwood is 0.051 µg/L, associated with consumption of organisms only because these lakes do not have an existing MUN designated use so the criterion consistent with the REC-1 beneficial use is selected. The dissolved methylmercury water column target of 0.081 ng/L is applicable for all three lakes.

#### 2.2.9.2 Protection of Wildlife

Wildlife species that eat fish or other aquatic organisms containing mercury are potentially at risk from the toxic effects of mercury. This risk is a function of ecosystem dynamics and understanding the risk requires evaluation of the potential for contaminants to move through an ecosystem via trophic levels. Trophic levels describe the position an organism occupies in the food chain (i.e., what the organism eats and what eats the organism). In a simple example of an aquatic ecosystem, plants (or primary producers) are at the base of the food chain (trophic level 1), followed by primary consumers in trophic level 2 (i.e., herbivorous organisms (fish, snails, macroinvertebrates, etc.)), secondary consumers in trophic level 3 (i.e., invertebrate feeding fish, predatory macroinvertebrates, etc.), and tertiary consumers in trophic level 4 (i.e., fish-eating fish, water snakes, etc.). The top-level consumers are followed by top-level predators, such as eagles, raccoons, and other carnivorous animals. It is important to note that organisms above trophic level 1 (plants) often occupy a number of trophic levels. For example, turtles are considered trophic level 2 when they feed on vegetation, trophic level 3 when they eat herbivorous invertebrates and fish, and trophic level 4 when they feed on predatory fish. Generally, the trophic level for a carnivore is one level higher than the trophic level of the animal it eats.

To evaluate risk associated with the toxic effects of mercury, the fish tissue concentration target of 0.22 ppm methylmercury in largemouth bass (a trophic level 4 fish) of 350 mm in length was analyzed to see whether it is protective of wildlife species (Note: this is the average size largemouth bass caught by humans with fishing lines in California lakes based on a minimum catch size of 305 mm; therefore, 350 mm is considered a large fish because many smaller fish [less than 305 mm] are also part of trophic level 4). The analysis draws on previous studies conducted by US Fish and Wildlife Service (USFWS) to determine safe levels of mercury in fish tissue for wildlife in California and looks at both generic wildlife receptor categories and specific threatened and endangered species found at the mercury-impaired lakes. USFWS recommended that the analysis include the following six receptor categories: fish, small piscivorous birds, large piscivorous birds, insectivorous passerine birds, carnivorous waterfowl, and piscivorous mammals (personal communication, Katie Zeeman, USFWS Carlsbad Office, to Valentina Cabrera-Stagno, USEPA Region IX, October 1, 2009). The target was found to be protective of wildlife, as described below.

In deriving the national CWA 304(a) guidance criterion to protect human health, USEPA developed draft national bioaccumulation factors (BAFs) that describe the bioaccumulation and biomagnifications between trophic levels (USEPA, 2001a). The national BAFs are ratios (in L/kg) which relate the concentration of dissolved methylmercury in the water column to its expected concentration in commonly consumed aquatic organisms in a specified trophic level. In addition, food chain multipliers can be calculated from the national BAFs. Food chain multipliers are the ratio of the BAF for one trophic level to the BAF for the trophic level directly below (for example, the food chain multiplier from trophic level 3 to 4 is the BAF for trophic level 4 divided by the BAF for trophic level 3 (2,700,000/680,000 = 4)). The BAFs and calculated food chain multipliers are shown Table 2-13. Using the food chain multipliers, one can calculate trophic level 3 and 2 concentrations from a trophic level 4 target. The methylmercury concentrations calculated for trophic levels 2 and 3 based on the trophic level 4 target in these TMDLs (0.22 ppm methylmercury) are shown in Table 2-13 (i.e., trophic level 3 concentration is the trophic level 4 target divided by the food chain multiplier from trophic level 3 to 4 (0.22 ppm/4 = 0.055 ppm)). The target in trophic level 4 is set for a large sized fish and is lower for the trophic level as a whole. Using this number to estimate trophic level 3 and 2 concentrations is highly conservative and leads to overestimates of the trophic level 3 and 2 concentrations.

**Table 2-13. National Bioaccumulation Factors (BAFs) and Food Chain Multipliers**

| Bioaccumulation Factors and Food Chain Multipliers | Value |
|---|---|
| Draft National BAF for Trophic Level 4 | 2,700,000 L/kg |
| Draft National BAF for Trophic Level 3 | 680,000 L/kg |
| Draft National BAF for Trophic Level 2 | 120,000 L/kg |
| Food chain multiplier from trophic level 3 to 4 biota | 4 |
| Food chain multiplier from trophic level 2 to 3 biota | 5.7 |

**Table 2-14. Trophic Level Concentrations**

| Trophic Level | Methylmercury Fish Tissue Concentration (ppm wet weight) |
|---|---|
| Trophic Level 4 target concentration* | 0.22 |
| Calculated corresponding trophic level 3 concentration | 0.055 |
| Calculated corresponding trophic level 2 concentration | 0.0096 |

*Note: The TMDL target is actually set for a large sized fish (350 mm) not for the trophic level as a whole. The trophic level concentration as a whole is lower and consequently the trophic level 3 and 2 levels will be lower than the values presented above.

#### 2.2.9.2.1 Generic Wildlife Receptor Category Analysis

##### 2.2.9.2.1.1 Fish

When USFWS evaluated the USEPA national CWA 304(a) human health 0.3 ppm methylmercury criterion, it found that threatened and endangered fish species in California were not likely to be adversely affected (USFWS, 2003). Since the USEPA criterion is higher than the selected target (0.22 ppm methylmercury fish tissue guideline (OEHHA, 2008)), these TMDLs are protective of threatened and endangered freshwater fish species, and thus, in general protective of any freshwater fish species, that may be living in the mercury-impaired lakes.

##### 2.2.9.2.1.2 Small Piscivorous Birds

The Belted Kingfisher is a small piscivorous bird that has been previously evaluated by USFWS for a safe level of mercury. In the analysis of the numeric wildlife targets for the Guadalupe River Watershed TMDL, USFWS found that concentrations of 0.05 ppm methylmercury in 50-150 mm trophic level 3 fish would be protective of the Belted Kingfisher (USFWS, 2005). The fish tissue target in these TMDLs is expected to be as protective as those found necessary in the Guadalupe River Watershed TMDL analysis, for fish in the same size range and trophic level.

##### 2.2.9.2.1.3 Large Piscivorous Birds

The Bald Eagle is a large piscivorous bird that has been sighted (albeit rarely) at these mercury-impaired lakes. When USFWS evaluated the USEPA national CWA 304(a) human health 0.3 ppm methylmercury criterion, it found that a target of 0.3 ppm methylmercury in trophic level 4 fish would be protective of bald eagles (USFWS, 2003). The target for these TMDLs (0.22 ppm methylmercury fish contaminant goal (OEHHA, 2008)) is lower than the CWA 304(a) human health criterion and is therefore considered protective of large piscivorous birds.

##### 2.2.9.2.1.4 Insectivorous Passerine Birds

No studies on fish tissue mercury concentration impacts to insectivorous passerine bird species were readily available, so this endpoint was not assessed. The level of mercury anticipated to be in trophic level two species is very low (0.0096 ppm wet weight; Table 2-13.) and it is not expected to be a concern for insect-eating birds.

##### 2.2.9.2.1.5 Carnivorous Waterfowl

The Common Merganser is a carnivorous waterfowl that has been evaluated in previous USFWS studies for a safe level of mercury. In the evaluation of numeric wildlife targets for the Guadalupe River Watershed TMDL, USFWS found that concentrations of 0.1 ppm methylmercury in 150-350 mm trophic level 3 fish would be protective of the Common Merganser (USFWS, 2005). The level anticipated in these TMDLs for trophic level 3 fish (0.055 ppm; Table 2-13.) is about half of that number and is therefore protective of the Common Merganser and other carnivorous waterfowl.

##### 2.2.9.2.1.6 Piscivorous Mammals

Mink is a piscivorous mammal species that has been evaluated previously. USFWS previously evaluated mink. In its analysis of numeric wildlife targets for the Cache Creek and Sacramento-San Joaquin Delta Watersheds TMDL, USFWS found that concentrations of 0.077 ppm methylmercury in trophic level 3 fish smaller than 150 mm would be protective of mink (USFWS, 2004). The methylmercury level anticipated in these TMDLs for trophic level 3 fish (0.055 ppm; Table 2-13.) is well below that number and is therefore protective of piscivorous mammals.

#### 2.2.9.2.2 Specific Threatened and Endangered Species Analysis

Threatened and endangered species are considered separately for Lake Sherwood, Puddingstone Reservoir, and El Dorado Park lakes. Species lists were requested from USFWS for each of the mercury-impaired lakes. Audubon Society bird lists and the California Department of Fish and Game's California Natural Diversity Database were also consulted.

##### 2.2.9.2.2.1 Lake Sherwood

The USFWS Ventura Office indicated that the only federally listed or candidate species that may occur in proximity to Lake Sherwood is the endangered plant *Pentachaeta lyonii* (Lyon's pentachaeta) (Dellith, 2009). Additionally, a bird list provided by lake resident Mary Hansen did not include any federally listed or candidate species (personal communication, Mary Hansen to Valentina Cabrera-Stagno, USEPA Region IX, September 7, 2010). Plants will not be impacted by this fish tissue target.

##### 2.2.9.2.2.2 Puddingstone Reservoir

The USFWS Carlsbad Office indicated that the federally threatened fish species Santa Ana sucker (*Catostomus santaanae*) may exist in San Dimas Creek and feed in Puddingstone Reservoir. As explained in the generic wildlife receptor category analysis above (Section 2.2.9.2.1.1), fish species are not anticipated to be adversely affected by the proposed mercury target. In addition, the federally threatened coastal California Gnatcatcher (*Polioptila californica californica*) occupies habitat surrounding the reservoir and feeds on insects that could be affected by water quality (personal communication, Christine Medak, USFWS Carlsbad Office, to Valentina Cabrera-Stagno, USEPA Region IX, November 24, 2009). The coastal California Gnatcatcher has not been specifically analyzed. Of the species that USFWS has analyzed previously, its life history is most similar to California Clapper Rail another invertivore. When USFWS evaluated the USEPA CWA 304(a) human health 0.3 ppm methylmercury criterion, it found that a target of 0.3 ppm methylmercury in trophic level 4 fish would be protective of California Clapper Rail (USFWS, 2003). The target for these TMDLs (0.22 ppm methylmercury fish tissue guideline (OEHHA, 2008)) is lower than the CWA 304(a) criterion and is therefore considered to be protective of California Clapper Rail and likely of the coastal California Gnatcatcher.

##### 2.2.9.2.2.3 El Dorado Park Lakes

The USFWS Carlsbad Office did not respond to a request for species of concern at El Dorado Park lakes. The California Department of Fish and Game's California Natural Diversity Database (accessed on August 21, 2009) indicated the California Least Tern (*Sterna antillarum Browni*) may be the only rare or endangered avian species living in the area of the lakes. The Least Tern is also identified on the El Dorado Audubon Society's bird list as occasionally present in the summer (El Dorado Audubon Society, 2003). Fortunately, the California Least Tern was evaluated by USFWS in their 2003 evaluation of the USEPA CWA 304(a) human health 0.3 ppm methylmercury criterion. USFWS found that safe dietary levels for California Least Tern would be 0.005 ppm methylmercury wet weight for trophic level 2 fish, 0.03 ppm for trophic level 3 fish, and 0.12 ppm for trophic level 4 fish (USFWS, 2003). At first glance the trophic level 4 dietary value for California Least Tern looks lower than the chosen target of 0.22 ppm; however, terns are small birds that feed on small fish. The NatureServe Explorer online encyclopedia (accessed on November 24, 2009) indicates that this bird is both insectivorous and piscivorous and feeds on small fish generally less than 9 cm in length such as anchovy, topsmelt, surf-perch, killifish, and mosquitofish (NatureServe, 2009). No data exist for current concentrations of mercury in trophic level 4 fish in such a small size range (less than 90 mm) because the minimum fish size for the 2007 lakes survey was 200 mm. However, analyses have shown that fish size and mercury concentration generally have a linear relationship (Appendix C, Mercury TMDL Development), so smaller size fish will have lower mercury concentrations. Table 2-15 lists the concentration of mercury in all fish tissue samples less 250 mm in length at El Dorado Park lakes. Only total mercury was analyzed so the corresponding methylmercury concentrations will be slightly lower.

**Table 2-15. El Dorado Park Lakes Fish Tissue Concentrations for Fish <250 mm in Length**

| Fish Length (mm) | Total Mercury Concentration (ppm wet weight) |
|---|---|
| 206 | 0.15 |
| 219 | 0.13 |

As indicated in this table, existing concentrations for fish more than twice the size of the 90 mm California Least Tern's maximum prey size are close to the 0.12 ppm methylmercury safe level indentified by USFWS. Fish that are 90 mm in length or shorter are likely already meeting this target at El Dorado Park lakes. Additionally, the target for 350 mm trophic level 4 fish in these TMDLs will reduce mercury levels in all size classes. This will lead to even lower concentrations in these small size class fish. USFWS found that safe dietary levels for California Least Tern would be 0.005 ppm methylmercury wet weight for trophic level 2 fish and 0.03 ppm for trophic level 3 fish (USFWS, 2003). As described above, given that the trophic level 4 fish target is likely already being met at El Dorado Park lakes, it is likely that trophic levels 2 and 3 fish targets for tern are also being met in the small size class that California Least Tern prey upon.

### 2.2.10 PCBs

Polychlorinated biphenyls (PCBs) consist of a family of many related congeners. The individual congeners are often referred to by their "BZ" number. Environmental analyses may address individual congeners, homologs (groups of congeners with the same number of chlorine atoms), equivalent concentrations of the commercial mixtures of PCBs known as Aroclors, or total PCBs. The environmental measurements and targets described in this document are in terms of total PCBs, defined as the "sum of all congener or isomer or homolog or aroclor analyses" (CTR, 40 CFR 131.38(b)(1) footnote v).

Selections of applicable OC Pesticides and PCBs targets are described above in Section 2.2.2.1 through Section 2.2.2.3. Water column targets for PCBs are based on beneficial use (Section 2.2.2.1). For waters designated MUN, the Basin Plan lists a maximum contaminant level of 0.0005 mg/L, or 500 ng/L. The Plan also requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). This objective is addressed through the CTR water quality criteria.

A chronic criterion for the sum of PCB compounds in freshwater systems is included in the CTR as 0.014 µg/L (14 ng/L; USEPA, 2000a). The CTR also provides a human health criterion for the consumption of both water and organisms and organisms only of 0.00017 µg/L (0.17 ng/L). California often implements these values on a 30 day average. The human health criterion is the most restrictive of the criterion specified for water column concentrations and was selected as the target concentration for Echo Park Lake, Peck Road Park Lake, and Puddingstone Reservoir. CTR criteria are considered protective of aquatic life.

Two target sediment concentrations for total PCBs have been identified (Section 2.2.2.2). There are no Basin Plan Objectives for toxicity levels in sediment; however sediment quality guidelines are reported by multiple agencies for the protection of sediment biota. MacDonald et al. (2000) compiled and evaluated the guidelines and derived consensus-based sediment quality guidelines that incorporate multiple recommendations. The consensus-based TEC for total PCBs is 59.8 µg/kg dry weight, defined by CBSQG (MacDonald el al., 2000). The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. An additional sediment target based on bioaccumulation in fish was also calculated for each impaired lake to ensure that the FCG is met using the BSAF approach described in Section 2.2.2.2.2. The lower of the two sediment target values is applied in each lake. Additionally, these TMDLs include alternative wasteload allocations to be applied when a sufficient demonstration has been made that the fish tissue targets are met. These targets are based on the consensus-based TEC values. Details on when each set of targets apply are included in the wasteload allocation section of each relevant lake chapter.

Fish tissue targets are described above in Section 2.2.2.3. The fish contaminant goal for PCBs defined by the OEHHA (2008) is 3.6 ppb based on cancer risk (the FCG based on non-cancer risk is 63 ppb). Table 2-16 summarizes the applicable targets for the three waterbodies listed for total PCBs addressed by this document.

**Table 2-16. Total PCB Targets**

| Lake | Maximum Contaminant Level (ng/L) | Chronic Criterion[1] (ng/L) | Human Health Criterion[2] (ng/L) | Consensus-based TEC Sediment Target (µg/kg)[3] | BSAF-derived Sediment Target (µg/kg) | Fish Contaminant Goal (ppb) |
|---|---|---|---|---|---|---|
| Echo Park Lake | 500 | 14 | 0.17 | 59.8 | 1.77 | 3.6 |
| Peck Road Park Lake | 500 | 14 | 0.17 | 59.8 | 1.29 | 3.6 |
| Puddingstone Reservoir | 500 | 14 | 0.17 | 59.8 | 0.59 | 3.6 |

Note: Shaded cells represent the selected targets for each waterbody.

[1]The chronic criterion is the highest four day average not to be exceeded more than once every three years on the average.

[2]The human health criterion applies to both consumption of water and organisms and organisms only.

[3]The consensus-based TEC sediment target value was used for setting alternative wasteload allocations when sufficient demonstration that the fish tissue targets are met has been made. Details on when each set of targets apply are included in the wasteload allocation sections of each relevant lake chapter.

## 2.2.11 pH

As specified in the Basin Plan, lake waters must not be depressed below 6.5 or raised above 8.5 as a result of waste discharges or be changed by more than 0.5 units from the natural conditions as a result of waste discharges. These serve as the numeric targets for pH in these TMDLs.

Lakes listed as impaired by pH include Echo Park Lake, Lake Calabasas, El Dorado Park lakes, Legg Lake, and Santa Fe Dam Park Lake. Target depths for each lake were set by the Regional Board and USEPA based on site specific conditions. Shallow, well mixed lakes must meet the target in the water column from the surface to 0.3 meters above the bottom of the lake. Deeper lakes that thermally stratify during the summer months, such as Peck Road Park Lake and Puddingstone Reservoir, must meet the pH target throughout the epilimnion of the water column.

The epilimnion is the upper stratum of more or less uniformly warm, circulating, and fairly turbulent water during summer stratification. The epilimnion floats above a cold relatively undisturbed region called the hypolimnion. The stratum between the two is the metalimnion and is characterized by a thermocline, which refers to the plane of maximum rate of decrease of temperature with respect to depth.

For the purposes of these TMDLs, the presence of stratification will be defined by whether there is a change in lake temperature greater than 1 degree Celsius per meter. Deep lakes must meet the pH target in the water column from the surface to 0.3 meters above the bottom of the lake when the lake is not stratified. However, when stratification occurs (i.e., a thermocline is present) then the pH target must be met in the epilimnion, the portion of the water column above the thermocline.

### 2.2.12 Trash

The target for trash is "zero trash." Lakes listed as impaired by trash include Echo Park Lake, Peck Road Park Lake, Lincoln Park Lake, and Legg Lake. Legg Lake has an existing TMDL for trash, the remaining three lakes are addressed in this document.

## 2.3 BASIS FOR LISTING

The Los Angeles Regional Board provided the basis for listing each of the 10 lakes addressed in this document on the State's 303(d) list in its *Water Quality Assessment & Documentation Report* (LARWQCB, 1996). Waterbody-pollutant combinations found to be either not supporting or partially supporting a beneficial use were identified as impairments on the 303(d) list. Impairments in the *Water Quality Assessment & Documentation Report* (LARWQCB, 1996) are described relative to the USEPA 305(b) beneficial uses, which are broad federal beneficial use categories described under the federal guidance for 305(b) reporting. For consistency with the state of California beneficial use categories, the California beneficial uses for the waterbodies addressed in this document are related to federal beneficial uses as shown in Table 2-17. The California use "NAV" was not assessed in the report (LARWQCB, 1996). It should be noted that the water quality standards or assessment methodology used in the 1996 assessment report are often not the same as current standards used to confirm impairments and calculate TMDLs in this report. Current standards and targets selected in these TMDLs are summarized in Section 2.2 and included in specific lake chapters. Regional Board currently follows California's Impaired Waters Guidance (SWRCB, 2005) in making 303(d) listing and delisting decisions (SWRCB, 2005). One of the major differences between the assessment methodology employed in developing the 1996 *Water Quality Assessment & Documentation Report* and current practice is that the partially supporting category no longer exists.

**Table 2-17. Linkage Between California and Federal Beneficial Uses**

| Federal Beneficial Use | California Beneficial Use Code |
|---|---|
| Aquatic Life | WARM, WILD, WET, COLD, RARE |
| Primary Contact Recreation | REC1 |
| Secondary Contact Recreation | REC2 |
| Drinking Water Supply | MUN, GWR (where appropriate) |
| Agriculture | AGR, GWR (where appropriate) |
| Fish Consumption | REC1 |

This section summarizes the listing information by impairment. In some cases, more recent data may have resulted in additional impairments included on the 2008-2010 303(d) list (SWRCB, 2010) or identification of new impairments not currently on the 303(d) list. Data collected after the original listing are not included in this section, but are discussed in lake-specific sections of the report and are included in the summary in Table 2-31.

### 2.3.1 Algae

According to the *Water Quality Assessment & Documentation Report*, a waterbody was listed as impaired by algae if field observations indicated excessive growth impacting the primary or secondary contact recreation use (LARWQCB, 1996). Visual observations of algae were classified either as "none" or "significant amount observed." Waterbodies were considered "not supporting" these uses if field observations indicated impairment in more than 25 percent of observations. Waterbodies were considered "partially supporting" if field observations indicated impairment in 11 to 25 percent of observations. "Fully supporting" waterbodies had indications of impairment in less than 11 percent of observations. Lake assessments were completed during the University of California, Riverside urban lakes study (UC Riverside, 1994).

Two of the lakes addressed by this document were listed for impairment due to algae (Table 2-18). Both are listed as "not supporting" the primary and secondary contact recreation uses.

**Table 2-18. Listing Information for Lakes Impaired by Algae**

| Lake | Use: Support Status |
|---|---|
| Echo Park Lake | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting |
| El Dorado Park Lakes | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting |

### 2.3.2 Ammonia

Ammonia impairments in these lakes were based on the support status for aquatic life use, primary recreation, and secondary recreation (LARWQCB, 1996). Lakes classified as "not supporting" the aquatic life use were found to exceed the temperature/pH-based ammonia criteria in more than 10 percent of samples. Those classified as "partially supporting" exceeded criteria more than twice within a 6-year period, but in fewer than 10 percent of samples. A status of "fully supporting" resulted from no more than two violations of chronic criteria (acute criteria if no chronic criteria were available) within a 6-year period based on at least 20 grab or 1-day composite samples; if fewer than 20 samples were available, then best professional judgment was used considering the number of pollutants having violations and the magnitudes of the exceedance(s).

Lakes classified as not supporting the primary or secondary contact recreation use due to ammonia exceeded the taste and odor criterion of 0.037 mg/L in more than 25 percent of measurements. Partially supporting lakes exceeded the criterion in 11 to 25 percent of samples, and fully supporting lakes exceeded the criterion in less than 11 percent of samples.

Table 2-19 summarizes the federal beneficial uses and support status of the lakes impaired by ammonia. Summary statistics reported in the assessment report (LARWQCB, 1996) are also included. A value of "ND" indicates the sample concentration was non detect. The symbol "#" denotes that no standard deviation has been calculated because there was not a normal distribution or because there were less than three samples.

**Table 2-19. Listing Information for Lakes Impaired by Ammonia**

| Lake | Use: Support Status | Number of Samples, Range (mg/L), Average ± Standard Deviation (mg/L) |
|---|---|---|
| Lincoln Park Lake | Aquatic Life: Not Supporting<br>Primary Contact Recreation: Not Supporting | 28, ND - 1.14,<br>0.34 ± 0.32 |
| Echo Park Lake | Aquatic Life: Not Supporting<br>Primary Contact Recreation: Not Supporting | 31, ND - 0.71,<br>0.11# |
| Lake Calabasas | Aquatic Life: Not Supporting<br>Primary Contact Recreation: Not Supporting | 28, ND - 0.45,<br>0.06# |
| El Dorado Park Lakes | Aquatic Life: Not Supporting<br>Primary Contact Recreation: Not Supporting | 45, ND - 1.92,<br>0.30# |
| Legg Lakes | Aquatic Life: Partially Supporting | 43, ND - 0.35,<br>0.05# |

## 2.3.3 Chlordane

Chlordane impairments were assessed for both the aquatic life use and the fish consumption use against the Maximum Tissue Residue Level (MTRL) of 1.1 ppb (LARWQCB, 1996). MTRLs were established for fish filet samples by multiplying the human health water quality criteria in the CTR and the bioconcentration factor (BCF) for each substance. Waters with a support status of "not supporting" the fish consumption use were supposedly under a "no consumption" ban for fish and shellfish. Each water was also listed as "not supporting" the aquatic life use, indicating impairment of at least one assemblage of the biological community.

Fish tissue monitoring was conducted as part of the Toxic Substances Monitoring Program (TSMP). Summary data in the assessment report included the sample type, the year of sample collection, and the criterion exceeded by the sample (Table 2-20). Chlordane fish tissue samples were comprised of seven-fish composites for Peck Road Park Lake and six-fish composites for Puddingstone Reservoir. Samples from Peck Road Park Lake exceeded the MTRL in 1991 (14.1 ppb); samples from Puddingstone exceeded the MTRL in both 1991 (16.1 ppb) and 1992 (31.7 ppb).

**Table 2-20. Listing Information for Lakes Impaired by Chlordane**

| Lake/Reservoir | Use: Support Status | Sample Type (Year): Impairment (Criterion) |
|---|---|---|
| Peck Road Park Lake | Aquatic Life: Not Supporting<br>Fish Consumption: Not Supporting | Tissue ('91): chlordane (MTRLs)<br>Tissue ('92): No organic chemicals at elevated levels |
| Puddingstone Reservoir | Aquatic Life: Not Supporting<br>Fish Consumption: Not Supporting | Tissue ('91): chlordane (MTRLs)<br>Tissue ('92): chlordane (MTRLs) |

## 2.3.4 Copper

Copper impairments were assessed in relation to the aquatic life use. The criterion was based on a four-day average total recoverable copper concentration calculated from the following equation, which was based on USEPA National Ambient Water Quality Criteria published in 1986:

$$TotalCopper(\mu g / L) = \exp^{\{0.8545[\ln(hardness)]-1.465\}}$$ **Equation 2-9**

Four lakes addressed by this document were classified as "not supporting" the aquatic life use, indicating the criterion was exceeded in more than 10 percent of samples. The summary table provided in the *Water*

*Quality Assessment & Documentation Report* lists the maximum total recoverable copper concentration observed at each lake; corresponding hardness values were not provided (Table 2-21) (LARWQCB, 1996).

**Table 2-21. Listing Information for Lakes Impaired by Copper**

| Lake | Use: Support Status | Maximum Concentration of Total Recoverable Copper (µg/L) |
|---|---|---|
| Echo Park Lake | Aquatic Life: Not Supporting | 105 |
| El Dorado Park Lakes | Aquatic Life: Not Supporting | 99 |
| Legg Lakes | Aquatic Life: Not Supporting | 97 |
| Santa Fe Dam Park Lake | Aquatic Life: Not Supporting | 56 |

### 2.3.5 Dieldrin

Dieldrin impairments were not identified in the assessment report (LARWQCB, 1996), but were subsequently observed after sample collection and analyses. These impairments and analyses are discussed in greater detail in the Peck Road Park Lake, Echo Park Lake, and Puddingstone Reservoir sections.

### 2.3.6 Dissolved Oxygen

Dissolved oxygen impairments were assessed relative to the aquatic life use. A support status of “not supporting” was assigned to waterbodies where more than 25 percent of measurements exceeded the criteria; “partially supporting” waterbodies had exceedances observed in 11 to 25 percent of measurements.

Table 2-22 summarizes the beneficial uses and support status of the lakes impaired by dissolved oxygen. Summary statistics reported in the assessment report (LARWQCB, 1996) are also included.

**Table 2-22. Listing Information for Lakes Impaired by Low Dissolved Oxygen**

| Lake/Reservoir | Use: Support Status | Number of Samples, Range (mg/L), Average ± Standard Deviation (mg/L) |
|---|---|---|
| Peck Road Park Lake | Aquatic Life: Not Supporting | 195, 0.2 – 15.2, 6.0 ± 4.0 |
| Lincoln Park Lake | Aquatic Life: Partially Supporting | 78, 0.1 - 13.7, 6.9 ± 3.3 |
| Lake Calabasas | Aquatic Life: Partially Supporting | 92, 0.2-15.7, 8.7 ± 3.3 |
| Puddingstone Reservoir | Aquatic Life: Not Supporting | 187, 0.1-14.9, 4.3 ± 3.5 |

### 2.3.7 DDT

DDT impairments were assessed for both the aquatic life use and the fish consumption use against the MTRL for DDT (32 ppb) (LARWQCB, 1996). Waters with a support status of “not supporting” the fish consumption use were supposedly under a “no consumption” ban for fish and shellfish. Each water was also listed as “not supporting” the aquatic life use, indicating impairment of at least one biological community assemblage.

Fish tissue monitoring was conducted as part of the TSMP. Summary data in the assessment report included the sample type, the year of sample collection, and the criterion exceeded by the sample (Table 2-23). The DDT seven-fish composite tissue sample from Peck Road Park Lake exceeded the MTRL in 1991 with a concentration of 39 ppb; the six-fish composite sample from Puddingstone exceeded the MTRL in 1992 (36 ppb).

**Table 2-23. Listing Information for Lakes Impaired by DDT**

| Lake/Reservoir | Use: Support Status | Sample Type (Year): Impairment (Criterion) |
|---|---|---|
| Peck Road Park Lake | Aquatic Life: Not Supporting<br>Fish Consumption: Not Supporting | Tissue ('91): DDT (MTRLs)<br>Tissue ('92): No organic chemicals at elevated levels |
| Puddingstone Reservoir | Aquatic Life: Not Supporting<br>Fish Consumption: Not Supporting | Tissue ('91): DDT not at elevated levels<br>Tissue ('92): DDT (MTRLs) |

## 2.3.8 Eutrophication

The eutrophication impairment was based on an assessment of the aquatic life use. An assessment of “fully supporting” indicated functioning, sustainable biological communities (e.g., macroinvertebrates, fish, or algae) none of which had been modified significantly beyond the natural range of the reference condition. “Partially supporting” waterbodies had at least one assemblage that indicated less than full support with slight to moderate modification of the biological community noted. Waterbodies listed as “not supporting” had at least one assemblage indicating nonsupport with data clearly indicating severe modification of the biological community (LARWQCB, 1996).

Further information regarding the eutrophication impairment was not specified in the *Water Quality Assessment & Documentation Report*. Four lakes addressed by this document were considered impaired by eutrophication (Table 2-24).

**Table 2-24. Listing Information for Lakes Impaired by Eutrophication**

| Lake | Use: Support Status |
|---|---|
| Lincoln Park Lake | Aquatic Life: Not Supporting |
| Echo Park Lake | Aquatic Life: Not Supporting |
| Lake Calabasas | Aquatic Life: Not Supporting |
| El Dorado Park Lakes | Aquatic Life: Not Supporting |

## 2.3.9 Lead

Lead impairments were assessed in relation to the aquatic life use. The criterion was based on a four-day average total recoverable lead concentration calculated from the following equation, which was based on USEPA National Ambient Water Quality Criteria published in 1986:

$$TotalLead\,(\mu g/L) = \exp^{\{1.273[\ln(hardness)]-4.705\}} \qquad \textbf{Equation 2-10}$$

Seven lakes addressed by this document were classified as “not supporting” the aquatic life use, indicating the criterion was exceeded in more than 10 percent of samples. The summary table provided in the *Water Quality Assessment & Documentation Report*, lists the maximum total recoverable lead concentration observed at each lake; corresponding hardness values were not provided (Table 2-25) (LARWQCB, 1996).

**Table 2-25. Listing Information for Lakes Impaired by Lead**

| Lake | Use: Support Status | Maximum Concentration of Total Recoverable Lead (µg/L) |
|---|---|---|
| Peck Road Park Lake | Aquatic Life: Not Supporting | 73 |
| Lincoln Park Lake | Aquatic Life: Not Supporting | 94 |
| Echo Park Lake | Aquatic Life: Not Supporting | 105 |
| El Dorado Park Lakes | Aquatic Life: Not Supporting | 108 |
| Legg Lakes | Aquatic Life: Not Supporting | 70 |
| Santa Fe Dam Park Lake | Aquatic Life: Not Supporting | 51 |
| Westlake Lake | Aquatic Life: Not Supporting | 91 |

## 2.3.10 Mercury

Mercury impairments were assessed for the aquatic life use and fish consumption use. Three waterbodies were listed as "not supporting" the aquatic life use due to mercury impairment, indicating the criterion was exceeded in more than 10 percent of samples. Summary data for water column measurements were not provided in the assessment report.

Three criteria were used to assess the fish consumption use. The *Water Quality Assessment & Documentation Report* lists a Food and Drug Administration (FDA) action level for freshwater and marine fish of 1,000 ppb (1 ppm), a MTRL for inland surface waters of 1,000 ppb (1 ppm), and a range of Median International Standards (MIS) for freshwater fish and marine shellfish of 100 to 1,000 ppb (0.1 to 1 ppm) (LARWQCB, 1996). Three of the waterbodies addressed by this document were found "not supporting" the fish consumption use, indicating that a "no consumption" ban for fish or shellfish is in effect for the general population, or a subpopulation that could be at potentially greater risk, for one or more fish or shellfish species; or a commercial fishing or shellfishing ban is in effect.

Waterbodies designated MUN were also assessed for drinking water use against a criterion of 2 µg/L of total mercury. Each waterbody was found "fully supporting" this use, indicating that the median value of total mercury concentrations was less than the criterion.

Table 2-26 summarizes the listing information for the lakes addressed by this document that are impaired by mercury.

**Table 2-26. Listing Information for Lakes Impaired by Mercury**

| Lake/Reservoir | Use: Support Status | Sample Type (Year): Impairment (Criterion) |
|---|---|---|
| El Dorado Park Lake | Aquatic Life: Not Supporting | NA |
| Puddingstone Reservoir | Aquatic Life: Not Supporting<br>Fish Consumption: Not Supporting | Tissue ('91): mercury (MIS) |
| Lake Sherwood | Aquatic Life: Not Supporting<br>Fish Consumption: Not Supporting | Tissue ('91): mercury (MIS)<br>Tissue ('92): mercury (MTRLs,FDA) |

NA: Information not included for this waterbody.

### 2.3.11 Odor

The *Water Quality Assessment & Documentation Report* (LARWQCB, 1996) says that the odor impairments were based on observations recorded during the University of California, Riverside urban lakes study (UC Riverside, 1994). Waterbodies listed as "not supporting" either recreational beneficial use noted the "presence" of odor in more than 25 percent of observations.

Table 2-27 summarizes the support status for the lakes addressed by this document that are listed as impaired by odor. The University of California, Riverside urban lakes study (UC Riverside, 1994) described odors at each of these lakes as either fishy or related to ducks.

**Table 2-27. Listing Information for Lakes Impaired by Odor**

| Lake | Use: Support Status | Odor Description (UC Riverside, 1994) |
|---|---|---|
| Peck Road Park Lake | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting | Fishy |
| Lincoln Park Lake | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting | Ducks |
| Echo Park Lake | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting | Duck feces |
| Lake Calabasas | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting | Ducks |
| Legg Lakes | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting | Ducks |

### 2.3.12 PCBs

PCB impairments were assessed for both the aquatic life use and the fish consumption use against the MTRL of 2.2 ppb (LARWQCB, 1996). Waters with a support status of "not supporting" the fish consumption use were supposedly under a "no consumption" ban for fish and shellfish. Each water was also listed as "not supporting" the aquatic life use, indicating impairment of at least one biological community assemblage.

Fish tissue monitoring was conducted as part of the TSMP. Summary data in the assessment report included the sample type, the year of sample collection, and the criterion exceeded by the sample (Table 2-28). PCB fish tissue composite samples were comprised of three fish at each of the waterbodies impaired by PCBs addressed by this document. Samples collected at Puddingstone Reservoir exceeded the MTRL in both 1991 and 1992. Samples collected at Echo Park Lake exceeded the MTRLs in 1987 and 1992. The 1991 composite sample from Echo Park Lake did not have detectable levels of PCBs.

**Table 2-28. Listing Information for Lakes Impaired by PCBs**

| Lake/Reservoir | Use: Support Status | Sample Type (Year): Impairment (Criterion) |
|---|---|---|
| Echo Park Lake | Aquatic Life: Not Supporting<br>Fish Consumption: Not Supporting | Tissue ('91): No PCBs detected<br>Tissue ('92): PCBs (MTRLs) |
| Puddingstone Reservoir | Aquatic Life: Not Supporting<br>Fish Consumption: Not Supporting | Tissue ('91): PCBs (MTRLs)<br>Tissue ('92): PCBs (MTRLs) |

### 2.3.13 pH

In the 1996 *Water Quality Assessment & Documentation Report*, the criterion for assessing the aquatic life use with respect to pH was a range of 6.5 to 9.0 (LARWQCB, 1996). Five waterbodies addressed by this document were listed as "partially supporting" the aquatic life use, indicating that pH measurements were out of the allowable range in 11 to 25 percent of measurements. This report also presented a criterion for assessing the primary contact recreation use based on secondary MCLs for drinking water (ranging from pH of 6.5 to 8.5). Three of the five waterbodies were listed as "not supporting" this use, indicating that more than 25 percent of measurements were outside the allowable range. Three waterbodies were also listed as "not supporting" the drinking water use based on secondary MCL criteria. Table 2-29 summarizes the listing information for the five lakes addressed by this document that were impaired by pH.

**Table 2-29. Listing Information for Lakes Impaired by pH**

| Lake | Use: Support Status | Number of Samples, Range (mg/L), Average ± Standard Deviation (mg/L) |
|---|---|---|
| Echo Park Lake | Aquatic Life: Partially Supporting<br>Primary Contact Recreation: Not Supporting | 69, 7.0-9.4,<br>8.5 ± 0.5 |
| Lake Calabasas | Aquatic Life: Partially Supporting<br>Drinking Water: Not Supporting | 85, 7.4-9.3,<br>8.6 ± 0.4 |
| El Dorado Park Lakes | Aquatic Life: Partially Supporting<br>Primary Contact Recreation: Not Supporting | 116, 6.9-9.4,<br>8.5 ± 0.6 |
| Legg Lakes | Aquatic Life: Partially Supporting<br>Drinking Water: Not Supporting | 84, 7.6-8.9,<br>8.3 ± 0.3 |
| Santa Fe Dam Park Lake | Aquatic Life: Partially Supporting<br>Primary Contact Recreation: Not Supporting<br>Drinking Water: Not Supporting | 95, 7.5-9.6,<br>8.7 ± 0.3 |

### 2.3.14 Trash

Trash impairments were assessed for the primary and secondary contact recreation uses. Four lakes addressed by this document were listed as "not supporting" both recreation uses (Table 2-30), indicating that the presence of trash was observed during at least 25 percent of field observations (LARWQCB, 1996). The Regional Board has adopted a TMDL for trash for Legg Lake (LARWQCB, 2007).

**Table 2-30. Listing Information for Lakes Impaired by Trash**

| Lake | Use: Support Status |
|---|---|
| Peck Road Park Lake | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting |
| Lincoln Park Lake | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting |
| Echo Park Lake | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting |
| Legg Lakes | Primary Contact Recreation: Not Supporting<br>Secondary Contact Recreation: Not Supporting |

## 2.4 Summary of Impairments

This TMDL document addresses impairments for 10 lakes in the Los Angeles Region. Table 2-31 identifies the waterbody-pollutant combinations addressed by this document. Table 2-31 also identifies for each lake: the impairments governed by the consent decree entered in Heal the Bay Inc. v. Browner; impairments addressed by a previous TMDL; and impairments listed in a prior 303(d) list but not listed on the current 303(d) list. Table 2-31 also identifies five impairments (Peck Road Park Lake, for dieldrin and PCBs; Echo Park Lake, for chlordane and dieldrin; and Puddingstone Reservoir for dieldrin) which are not on the current 303(d) list but which, after consideration of more recent data, USEPA has determined to address by this TMDL document. Further, Table 2-31 identifies 15 listings on the current 303(d) list which, after consideration of more recent data, USEPA believes no longer meet the Federal requirements for listing; USEPA is recommending that those listings be omitted from the next 303(d) list.

**Table 2-31. Waterbody-pollutant Combinations for Ten Los Angeles Region Lakes**

| Lake/ Reservoir | Algae | Ammonia | Chlordane | Copper | DDT | Dieldrin | Eutrophication | Lead | Organic Enrichment / Low Dissolved Oxygen | Mercury | Odor | PCBs | pH | Trash |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Peck Road Park Lake | | | ● | | ● | ○ | ●/ | ●/ | ◑ | | ● | ○ | | ● |
| Lincoln Park Lake | | ● | | | | | ● | ●/ | ◑ | | ● | | | ● |
| Echo Park Lake | ● | ●/ | ○ | ●/ | | ○ | ● | ●/ | | | ◑ | ● | ●/ | ● |
| Lake Calabasas | | ● | | | ●/ | | ● | | ◑ | | ● | | ● | |
| El Dorado Park Lakes | ● | ● | | ●\ | | | ● | ●/ | | ● | | | ● | |
| Legg Lakes | | ●/ | | ●/ | | | | ●/ | | | ● | | ● | ◑\ |
| Puddingstone Reservoir | | | ● | | ● | ○ | | | ● | ● | | ● | | |
| Santa Fe Dam Park Lake | | | | ●/ | | | | ●/ | | | | | ●/ | |
| Lake Sherwood | ●\ | ●\ | | | | | ●\ | | ●\ | ● | | | | |
| Westlake Lake | ●\ | ●\ | | ●/ | | | ●\ | ●/ | ●\ | | | | | |

● Impairment included in the consent decree.

◑ Impairment listed since the consent decree and included in the 2008-2010 303(d) list.

○ Impairment identified by new data analyses (after the 2008-2010 303(d) list data cutoff).

/ Impairment is no longer identified as impaired and not included on the 303(d) list.

\ Impairment is addressed by another TMDL.

/ (dashed) No longer showing impairment in recent data analyses (see lake-specific chapters); USEPA recommends these impairments not be included in California's next 303(d) list.

# 3 Summary of Approach

The United States Environmental Protection Agency (USEPA) Region IX is establishing Total Maximum Daily Loads (TMDLs) for impairments in nine lakes in the Los Angeles Region. USEPA was assisted in this effort by the Los Angeles Water Quality Control Board (Regional Board). These lakes are currently on the State's 303(d) list for nutrient related impairments, mercury, OC Pesticides and PCBs, and trash and TMDLs have been developed to address these impairments.

This section of the TMDL report describes the general approach that was used to develop the TMDLs for each impairment. Lake specific information is contained in the individual sections devoted to each impaired lake.

## 3.1 GENERAL SOURCE ASSESSMENT

This section identifies the potential sources of pollutants that discharge into the impaired lakes. In general, pollutants can enter surface waters from both point and nonpoint sources. Point sources include discharges from a discrete human-engineered outfall. These discharges are regulated through National Pollutant Discharge Elimination System (NPDES) permits. Nonpoint sources, by definition, include pollutants that reach surface waters from a number of diffuse land uses and activities that are not regulated through NPDES permits. Specific sources for each lake are described in the lake chapters, while pollutant-specific sources are discussed in the appendices; the discussion below presents general information for point and nonpoint sources.

### 3.1.1 Point Sources

The NPDES permits in the watersheds draining to impaired lakes include municipal separate storm sewer system (MS4) permits, a California Department of Transportation (Caltrans) stormwater permit, general construction stormwater permits, general industrial stormwater permits, and a general NPDES permit (Table 3-1). Point sources associated with each lake are presented in the lake-specific chapters.

**Table 3-1. NPDES Permits in the Watersheds Draining to Impaired Lakes**

| Type of NPDES Permit | Number of Permits |
|---|---|
| Municipal Separate Storm Sewer System (MS4) | 3 |
| California Department of Transportation Stormwater | 1 |
| General Construction Stormwater | 1 |
| General Industrial Stormwater | 66 |
| General NPDES Permits (Groundwater Discharges) | 1 |
| **Total** | **72** |

#### 3.1.1.1 Stormwater Permits

Stormwater runoff is regulated through the City of Long Beach MS4 permit, the Los Angeles County MS4 permit, the Ventura County MS4 permit, the statewide stormwater permit issued to Caltrans, the statewide Construction Activities Stormwater General Permit, and the statewide Industrial Activities Stormwater General Permit. The permitting process defines these discharges as point sources because the stormwater is discharged from the end of a stormwater conveyance system. Since the industrial and construction stormwater discharges are governed under NPDES permits, these discharges are treated as point sources in these TMDLs.

#### 3.1.1.1.1 MS4 Stormwater Permits

In 1990, USEPA developed rules establishing Phase I of the NPDES stormwater program, designed to prevent pollutants from being washed by stormwater runoff into MS4s (or from being discharged directly into the MS4s) and then discharged into local waterbodies. Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or more) to implement a stormwater management program as a means to control polluted discharges.

Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipally owned operations, and hazardous waste treatment. Large and medium MS4 operators are required to develop and implement Stormwater Management Plans that address, at a minimum, the following elements:

- Structural control maintenance
- Areas of significant development or redevelopment
- Roadway runoff management
- Flood control related to water quality issues
- Municipally owned operations such as landfills and wastewater treatment plants
- Municipally owned hazardous waste treatment, storage, or disposal sites
- Application of pesticides, herbicides, and fertilizers
- Illicit discharge detection and elimination
- Regulation of sites classified as associated with industrial activity
- Construction site and post-construction site runoff control
- Public education and outreach

The Los Angeles County MS4 Permit was renewed in December 2001 (Regional Board Order No. 01-182; CAS004001) and is on a five-year renewal cycle. There are 85 co-permittees covered under this permit, including 84 incorporated cities and the County of Los Angeles. The City of Long Beach MS4 permit was renewed on June 30, 1999 (Order No. R4-99-060; CAS004003) and is on a five-year renewal cycle. It solely covers the City of Long Beach. The Ventura County MS4 Permit was renewed in July 2010 (Order R4 2010-0108; CAS004002) and is on a five-year renewal cycle. This permit covers 12 co-permittees, including 10 incorporated cities, the County of Ventura, and the Ventura County Flood Control District (Principal Permittee).

#### 3.1.1.1.2 Caltrans Stormwater Permit

Caltrans is regulated by a statewide stormwater discharge permit that covers all municipal stormwater activities and construction activities (State Board Order No. 99-06-DWQ; CAS000003). The Caltrans stormwater permit authorizes stormwater discharges from Caltrans properties such as the state highway system, park and ride facilities, and maintenance yards. The stormwater discharges from most of these Caltrans properties and facilities eventually end up in either a city or county storm drain.

#### 3.1.1.1.3 General Stormwater Permits

In 1990, USEPA issued regulations for controlling pollutants in stormwater discharges from industrial sites (40 Code of Federal Regulations [CFR] Parts 122, 123, and 124) equal to or greater than five acres. The regulations require dischargers of stormwater associated with industrial activity to obtain an NPDES permit and to implement Best Available Technology Economically Achievable (BAT) to reduce or prevent nonconventional and toxic pollutants, including metals, in stormwater discharges and authorized non-storm discharges. On December 8, 1999, USEPA expanded the NPDES program to include stormwater discharges from construction sites that resulted in land disturbances equal to or greater than one acre (40 CFR Parts 122, 123, and 124).

On April 17, 1997, the State Board issued a statewide general NPDES permit for Discharges of Stormwater Associated with Industrial Activities Excluding Construction Activities Permit (Order No. 97-03-DWQ; CAS000002). This Order regulates stormwater discharges and authorized non-stormwater discharges from 10 specific categories of industrial facilities, including but not limited to, manufacturing facilities, oil and gas mining facilities, landfills, and transportation facilities. Potential pollutants from an industrial site will depend on the type of facility and operations that take place at that facility.

During wet weather, runoff from industrial sites has the potential to contribute pollutant loadings. During dry weather, the potential contribution of pollutant loadings from industrial stormwater is low because non-stormwater discharges are prohibited or authorized by the permit only under the following circumstances: when they do not contain significant quantities of pollutants, where Best Management Practices (BMPs) are in place to minimize contact with significant materials and reduce flow, and when they are in compliance with Regional Board and local agency requirements.

On September 2, 2009, the State Board adopted the statewide general NPDES permit for Discharges of Stormwater Associated with Construction and Land Disturbance Activities (Order No. 2009-0009-DQW;CAS000002). This General Construction Permit became effective on July 1, 2010. During wet weather, runoff from construction sites has the potential to contribute pollutant loadings. During dry weather, the potential contribution of pollutant loadings is low because discharges of non-stormwater are authorized by the permit only where they do not cause or contribute to a violation of any water quality standard and are controlled through implementation of appropriate BMPs for elimination or reduction of pollutants.

### 3.1.1.2 Other NPDES Permits

There are two types of non-stormwater NPDES permits: individual and general permits. An individual NPDES permit is classified as either a major or a minor permit. Other than the MS4 and Caltrans stormwater permits, there are no major individual NPDES permits in the watersheds draining to the impaired lakes. The discharge flows associated with minor individual NPDES permits and general NPDES permits are typically less than 1 million gallons per day (MGD). General NPDES permits often regulate episodic discharges (e.g., dewatering operations) rather than continuous flows.

Pursuant to 40 CFR parts 122 and 123, the State Board and the regional boards have the authority to issue general NPDES permits to regulate a category of point sources if the sources involve the same or substantially similar types of operations, discharge the same type of waste, require the same type of effluent limitations, and require similar monitoring. The Regional Board has issued general NPDES permits for six categories of discharges: construction and project dewatering, petroleum fuel cleanup sites, volatile organic compounds (VOCs) cleanup sites, potable water, non-process wastewater, and hydrostatic test water.

There is one facility in the Peck Road Park Lake watershed associated with the potable water general NPDES permit. The general NPDES permit for Discharges of Groundwater from Potable Water Supply

Wells to Surface Waters (Order No. R4-2003-0108; CAG994005) covers discharges of groundwater from potable supply wells generated during well purging, well rehabilitation and redevelopment, and well drilling, construction and development. The applicable numeric effluent limitations for these facilities can be found in Order No. R4-2003-0108.

### 3.1.2 Nonpoint Sources

A nonpoint source is a source that discharges via sheet flow or natural discharges, as well as agricultural stormwater discharges and return flows from irrigated agriculture. Nonpoint sources include atmospheric deposition directly onto lakes, areas that do not drain to a storm drain system, irrigation of parkland, and agricultural flows. Specific sources are described in the lake-specific chapters.

## 3.2 POLLUTANT-SPECIFIC APPROACH

This section provides a brief description of the technical approach used to develop TMDLs for nutrient-related, mercury, OC Pesticides and PCBs, and trash impairments. More details on the nutrient, mercury, and OC Pesticides and PCBs analyses are provided in Appendix A (Nutrient TMDL Development), Appendix C (Mercury TMDL Development), and Appendix H (Organochlorine Compounds TMDL Development), respectively.

### 3.2.1 Nutrient-related Impairments

Excessive algae in the urban lakes of the Los Angeles Region has resulted in several waterbodies not supporting their designated beneficial uses associated with aquatic life and recreation (LARWQCB, 1996). Algal biomass can lead to impairment of swimming and wading activities. In addition, the proliferation of algae can result in loss of invertebrate taxa through habitat alteration (Biggs, 2000). Algal growth in some instances has produced algal mats in the lakes (UC Riverside, 1994); these mats may result in eutrophic conditions where fluctuations in dissolved oxygen concentration and pH negatively affect aquatic life in the waterbody. The decay of these mats may also cause problems with scum and odors that affect recreational uses of the affected waterbody. In addition, the concentration of ammonia, a nitrogen compound, has been present in concentrations exceeding objectives designed to protect aquatic life (LARWQCB, 1996).

#### 3.2.1.1 Source Assessment

Sources of nutrient loading to a lake may include both point and nonpoint sources. For purposes of allocations among nutrient sources, federal regulations distinguish between allocations for point sources regulated under NPDES permits (for which wasteload allocations are established) and nonpoint sources that are not regulated through NPDES permits (for which load allocations are established) (see 40 CFR 130.2). Point sources are discharges that occur at a defined point, or points, such as a pipe or storm drain outlet. Most point sources are regulated through the NPDES permitting process. Point sources include MS4 dischargers and other NPDES discharges as well as additional inputs such as groundwater wells or potable water sources. Nutrient loading from nonpoint sources originates from sources that do not discharge at a defined point, including direct atmospheric deposition and watershed loadings not associated with an MS4 system. Appendices D and F (Wet and Dry Weather Loading, respectively) describe how loading from these point and nonpoint sources was estimated.

#### 3.2.1.2 Linkage Analysis

To simulate the impacts of nutrient loading on each impaired lake, the Nutrient Numeric Endpoints (NNE) BATHTUB model was set up and calibrated to lake specific conditions (Appendix A, Nutrient TMDL Development, provides additional details). The NNE BATHTUB model is a risk-based approach for estimating site-specific nutrient numeric endpoints (NNE) for California waters (Tetra Tech, 2006). In recognizing the limitation of using ambient nutrient concentrations alone in predicting the impairment of beneficial uses, this approach uses secondary indicators. Secondary indicators are defined as parameters that are related to nutrient concentrations, but are more directly linked to beneficial uses than nutrient levels alone. The tool has been tested for several waterbodies in California as a series of case studies. The secondary indicator chosen to support TMDL development for these eight waterbodies is algal density, represented by chlorophyll *a*.

The NNE BATHTUB Tool was set up individually for each impaired lake. Bathymetry data for each lake were acquired from various sources to represent the general characteristics of the waterbody, such as surface area, volume, and average depth.

Cumulative nitrogen and phosphorus loads were input to each lake model as a sum of all known, quantifiable sources. Sources of loading resulting from wet weather are discussed in Appendix D; Appendix F summarizes the loading originating during dry weather conditions. Atmospheric deposition to each lake surface is quantified in Appendix E. Internal nutrient loading is discussed in Appendix B, but is not quantified directly due to lack of data (the BATHTUB model accounts for internal loading indirectly by using a net sedimentation rate (sedimentation minus resuspension)).

Once the bathymetry and loading inputs were set up, each model was calibrated to fit observed summer (May – September) mean concentrations of phosphorus, nitrogen, and chlorophyll *a*. The calibrated models were then used to determine the allowable loads of nitrogen and phosphorus that result in attainment of the chlorophyll *a* target concentration. Allowable loads were allocated among the wasteload allocations, load allocations, and margins of safety.

For Santa Fe Dam Park Lake, which is impaired by pH, the NNE BATHTUB Tool indicated that it is not directly impaired by elevated nutrient loads or excessive algal growth. To investigate the likely source of the pH impairment, a steady-state, chemical equilibrium model was also set up. Specifically, the geochemical speciation model, Visual MINTEQ V2.61 (Gustafsson, 2009), was used to investigate the pH conditions in the lake. The model was selected to perform pH simulation based on the available data for Santa Fe Dam Park Lake. The model requires total analytical concentrations and physical inputs to evaluate various geochemical reactions. The results were used to evaluate whether elevated pH was due to natural conditions, algal impacts, or the addition of chlorine in the form of sodium hypochlorite (NaOCl), for disinfection of the swim beach area.

### 3.2.2 Mercury Impairment

Mercury, like other metals, has great persistence due to its inability to be broken down. However, because bacterial processes can methylate it to create methylmercury, it also has some properties of a bioaccumulative organic chemical. Methylmercury is easily taken up by organisms and tends to bioaccumulate; it is very effectively transferred through the food web, magnifying at each trophic level. This can result in high levels of mercury in organisms high on the food chain, despite nearly unmeasurable quantities of mercury in the water column. While mercury can be toxic to fish and other aquatic organisms at high levels, the primary concerns at the levels found in these lakes are neurological and developmental effects in higher animals and humans. The two primary endpoints of concern are wildlife species that eat fish and people that consume sport fish.

Methylmercury is highly toxic to mammals, including people, and causes a number of adverse effects. Health studies and information showing neurotoxicity, particularly in developing organisms, are most abundant. The brain is the most sensitive organ for which suitable data are available to quantify a dose-response relationship. A study by the National Academy of Science (NRC, 2000) concluded that the population at highest risk is the children of women who consume large amounts of fish and seafood during pregnancy, and that the risk to that population may result in an increase in the number of children struggling to keep up in school and requiring remedial classes or special education (USEPA, 2001a). Each of the three lakes impaired by mercury have mercury levels in largemouth bass, a trophic level four species (see Section 2.2.9), above the recommended fish consumption guideline (OEHHA, 2008). Methylmercury is also toxic to fish-eating wildlife, including both mammals and birds. In addition to neurotoxic effects, methylmercury is implicated in reduced reproductive success in wildlife such as eagles, osprey, otter, and mink (Wiener et al., 2002).

#### 3.2.2.1 Source Assessment

Sources of mercury loading to a lake may include both point and nonpoint sources. For purposes of allocating among mercury sources, federal regulations distinguish between allocations for point sources regulated under NPDES permits (for which wasteload allocations are established) and nonpoint sources that are not regulated through NPDES permits (for which load allocations are established) (see 40 CFR 130.2). The most significant source of mercury in point source discharges is wastewater associated with the placement or removal of mercury amalgam dental fillings. Significant sources in the watershed include junkyards housing automobiles where mercury-containing switches have not been removed prior to crushing, and landfills where fluorescent light bulbs have not been properly disposed. Significant releases to the atmosphere may occur from coal-power plants, cement manufacturing facilities, oil refineries, and chlor-alkali plants.

Point sources are discharges that occur at a defined point, or points, such as a pipe or storm drain outlet. Most point sources are regulated through the NPDES permitting process. Point sources include MS4 dischargers and other NPDES discharges as well as additional inputs such as groundwater wells or potable water sources. Mercury loading from nonpoint sources originates from sources that do not discharge at a defined point, including direct atmospheric deposition, watershed loadings not associated with an MS4 system, methylation, and direct and indirect geologic sources. Appendices D and F (Wet and Dry Weather Loading, respectively) describe how loading from these point and nonpoint sources was estimated.

#### 3.2.2.2 Linkage Analysis

The linkage analysis defines the connection between numeric targets and identified pollutant sources and may be described as the cause-and-effect relationship between the selected indicators, the associated numeric targets, and the identified sources. This provides the basis for estimating total assimilative capacity and any needed load reductions. Specifically, models of watershed loading of mercury are combined with an estimated rate of bioaccumulation in the lake. This enables a translation between the numeric target (expressed as a fish tissue concentration of mercury) and mercury loading rates. The loading capacity is then determined via the linkage analysis as the mercury loading rate that is consistent with meeting the target fish tissue concentration. This process is described in detail in Appendix C (Mercury TMDL Development) and summarized below.

For the three mercury-impaired lakes addressed by this document, models of lake response and fish bioaccumulation have not been created at this time. Rather, it is assumed that, in the long term, fish tissue concentrations will respond approximately linearly to reductions in mercury load (see Appendix C, Mercury TMDL Development). Calculating the loading capacity first requires an estimate of the existing mercury concentration in largemouth bass, the predominant trophic level 4 fish in each waterbody. To do this, a linear regression analysis was performed on tissue concentrations versus length from data collected in each lake, which was then used to predict the existing concentration associated with the target size fish.

Both the observed data and the predicted concentrations show that mercury concentrations in largemouth bass typically exceed the target of 0.22 ppm in each lake. The target is established for a 350 mm largemouth bass to be measured in fish 325-375 mm in length. The predicted mercury concentration based on a one-sided 95 percent upper confidence limit on mean predictions about the regression line (95 percent UCL) for this length is compared to the target fish concentration to determine the required reduction in mercury loading, which includes a margin of safety as described in Appendix C (Mercury TMDL Development).

## 3.2.3 Organochlorine Pesticides and PCBs Impairments

Organochlorine (OC) Pesticides and PCBs are chemical substances that persist in the environment, bioaccumulate through the food web, and pose a risk of causing adverse effects to human health and the environment. In particular, they include a number of chlorinated legacy pollutants known or suspected to be carcinogenic and/or toxic to humans and wildlife. OC Pesticides and PCBs include a number of now-banned chlorinated pesticides (e.g., chlordane, dieldrin, and DDT) and polychlorinated biphenyls (PCBs) that are causes of impairment in Los Angeles Region lakes. OC Pesticides and PCBs are problematic because they do not break down easily, concentrate in organisms, and can be transported great distances. The primary concerns for the listed lakes are the high levels found in popularly consumed fish. Their continuous cycling in the food chain and accumulation in sediments creates difficulties in their removal from lake systems. While concentration in sediment and organisms may be high, concentrations in the water column are often undetectable.

The US has banned the manufacture or use of all the pollutants considered OC Pesticides (chlordane, DDT, and dieldrin) and PCBs that are listed as causes of impairment in the lakes. However, the past use of these chemicals was so widespread and unrestricted that there are still loads of these chemicals coming from waste and storage facilities as well as old equipment that used or contained the contaminants. Chlordane, DDT, and dieldrin were also widely applied for agricultural and domestic pest control purposes. Continued research and findings repeatedly demonstrate that these pollutants are ubiquitous.

### 3.2.3.1 Source Assessment

Sources of OC Pesticides and PCBs loading to a lake may include both point and nonpoint sources. All OC Pesticides and PCBs listed for the impaired lakes were banned from domestic and industrial use by the 1980s. Areas of concern include waste facilities that may contain old transformers, industrial sites, agriculture lands, and some residences that were treated heavily for pests (for example: chlordane was a popular termiticide in the 1970s). Even areas that do not have a history of OC Pesticides and PCBs use or storage are vulnerable due to atmospheric deposition, often derived from transcontinental transport.

Point sources are discharges that occur at a defined point, or points, such as a pipe or storm drain outlet. Most point sources are regulated through the NPDES permitting process. Point sources include MS4 dischargers and other NPDES discharges, as well as additional inputs such as groundwater wells or potable water sources. Loading from nonpoint sources originates from sources that do not discharge at a defined point, including direct atmospheric deposition and watershed loadings not associated with an MS4 system. The only sources of OC Pesticides and PCBs in the local area are watershed loadings, which were divided into wasteload allocations or load allocations, depending on the presence of storm drain systems in the drainage areas (i.e., areas draining to a storm drain will receive wasteload allocations). Atmospheric deposition is incorporated into the indirect loading from watershed runoff. Direct deposition to the lake surface is considered negligible. Appendix D (Wet Weather Loading) describes how loading from these point and nonpoint sources was estimated, and the calculated loadings and allocations are described in detail in Appendix H (Organochlorine Compounds TMDL Development).

#### 3.2.3.2 Linkage Analysis

The linkage analysis defines the connection between numeric targets and identified pollutant sources and may be described as the cause-and-effect relationship between the selected indicators, the associated numeric targets, and the identified sources. This provides the basis for estimating total assimilative capacity and any needed load reductions. Specifically, equilibrium models of watershed loading of OC Pesticides and PCBs, lake processes, and pollutant bioaccumulation in the fish have been developed. This enables a translation between numeric targets (expressed as a fish tissue concentration for each listed contaminant) and loading rates. This process is described in detail in Appendix H (Organochlorine Compounds TMDL Development) and summarized below.

The OC Pesticides and PCBs of concern have low solubility and a high affinity for organic solids and lipids. Thus, concentrations present in the sediment can result in unacceptable concentrations in fish tissue, due to food chain accumulation pathways that lead back to the lake sediment, even when concentrations in the water column are below criteria or non-detectable. The sediment concentration target is estimated using the Biota-Sediment Accumulation Factor (BSAF) of each contaminant. Starting from the fish tissue concentration target, the BSAF allows calculation of the necessary sediment concentration to support uses, and the allowable load to achieve the target sediment concentration. This is explained in detail in Appendix H (Organochlorine Compounds TMDL Development).

The target for fish tissue is provided by the 2008 Office of Environmental Health Hazard Assessment (OEHHA) Fish Contaminant Goal (FCG). The target fish concentrations are discussed further in Section 2 and Appendix H (Organochlorine Compounds TMDL Development). Addressing the fish tissue concentrations as the assessment endpoint also achieves most other applicable targets for sediment and water concentrations. The loading capacity for sediment-associated OC Pesticides and PCBs is then determined from the lower of the sediment concentration target to meet the FCG and any other applicable targets for sediment, such as the consensus-based sediment quality guidelines (MacDonald et al., 2000) designed to protect benthic organisms. This loading capacity is expressed as a sediment concentration (ng of pollutant per gram of dry sediment), which is applicable to both sediments already stored in the lake and new sediment washed into the lake. Runoff from the watershed must achieve this sediment concentration to satisfy the TMDL. Both wasteload allocations and load allocations may be translated into pollutant mass units by multiplying the OC Pesticides and PCBs concentration on sediment times the sediment load.

### 3.2.4 Trash Impairment

Trash in waterways causes significant water quality problems. Small and large floatables can inhibit the growth of aquatic vegetation, leading to shrinking spawning areas and habitats for fish and other living organisms. Wildlife living in lakes and riparian areas can be harmed by ingesting or becoming entangled in floating trash. With the exception of large items, settleables are not always obvious to the eye. This includes glass, cigarette butts, rubber, and construction debris. Settleables can be a problem for bottom feeders and can contribute to sediment contamination. Some debris (e.g., diapers, medical and household waste, and chemicals) are sources of bacteria and toxic substances.

For aquatic life, buoyant (floatable) materials tend to be more harmful than settleable elements, due to their ability to be transported throughout the waterbody and ultimately to the marine environment. Persistent elements such as plastics, synthetic rubber and synthetic cloth tend to be more harmful than degradable elements such as paper or organic waste. Glass and metal are less persistent because wave action and rusting can cause them to break into smaller pieces that are less sharp and harmful. Natural rubber and cloth can degrade but not as quickly as paper (USEPA, 2002). Smaller elements such as plastic resin pellets (a byproduct of plastic manufacturing) and cigarette butts can be ingested by a large number of small organisms which can then suffer malnutrition or internal injuries. Larger plastic elements such as plastic grocery bags are also harmful to larger aquatic life, which can mistake the trash for floating prey and ingest it, leading to starvation or suffocation.

Trash impaired waterbodies can threaten the health of people who swim and recreate in them. Of particular concern are bacteria and viruses associated with diapers, medical waste (e.g., used hypodermic needles and pipettes), and human or pet waste. Additionally, broken glass or sharp metal fragments in streams can cause puncture or laceration injuries. Such injuries can expose a person's bloodstream to microbes in the stream's water causing serious illnesses. Some trash items such as containers or tires can cause a pooling of water and create opportunities for mosquito production and increase health risks, such as encephalitis and West Nile virus.

Leaf litter is considered trash when there is evidence of intentional dumping. Leaves and pine needles in streams provide a natural source of food for organisms, but excessive amounts due to human influence can cause nutrient imbalance and oxygen depletion in streams. Clumps of leaf litter and yard waste from trash bags should be treated as trash during water quality assessments, and should not be confused with natural inputs of leaves to streams. In some instances, leaf litter may be trash if it originated from dense ornamental stands of nearby human planted trees that are overloading the stream's assimilative capacity for leaf inputs. Other biodegradable trash, such as food waste, can also negatively impact natural dissolved oxygen levels in the waterbodies.

Wildlife impacts due to trash occur in Peck Road Park Lake, Lincoln Park Lake, and Echo Park Lake. The two primary problems that trash poses to wildlife are entanglement and ingestion, with entanglement being the more common documented effect (Laist and Liffmann, 2000). Marine mammals, turtles, birds, fish, and crustaceans all have been affected by entanglement or ingestion of floatable debris. The most vulnerable species to floatable debris are those endangered or threatened by extinction.

Entanglement results when an animal becomes encircled or ensnared by debris. It can occur accidentally, or when the animal is attracted to the debris. Entanglement is harmful to wildlife for several reasons. Not only can it cause wounds leading to infections or loss of limbs, it can also cause strangulation or suffocation. In addition, entanglement can impair an animal's ability to swim, which can result in drowning, difficulty in moving, finding food, or escaping predators (USEPA, 2001a).

Ingestion occurs when an animal swallows floatable debris. It sometimes occurs accidentally, but usually animals feed on debris because it looks like food (e.g., plastic bags look like jellyfish, a prey item of sea turtles). Ingestion can lead to starvation or malnutrition if the ingested items block the intestinal tract and prevent digestion, or accumulate in the digestive tract, making the animal feel "full" and lessening its desire to feed. Ingestion of sharp objects can damage the mouth, digestive tract and/or stomach lining and cause infection or pain. Ingested items can also block air passages and prevent breathing, thereby causing death (USEPA, 2001a).

Common settled debris includes glass, cigarettes, rubber, and construction debris. Settleables are a problem for bottom feeders and dwellers and can contribute to sediment contamination.

In conclusion, trash in waterbodies can adversely affect humans, fish, and wildlife. Not all water quality effects of trash are equal in severity or duration. The water quality effects of trash depend on individual items and their buoyancy, degradability, size, potential health hazard, and potential hazards to fish and wildlife.

The prevention and removal of trash in waterbodies will ultimately lead to improved water quality, protection of aquatic life and habitat, improved opportunities for public recreational access and restoration activities, enhancement of public interest in the lakes, propagation of the vision of the watershed as a whole, and enhancement of the quality of life of riparian residents.

### 3.2.4.1 Source Assessment

The major source of trash in these lakes is due to litter, which is intentionally or accidentally discarded to the lake and watershed. Potential sources can be categorized as point sources and nonpoint sources depending on the transport mechanisms. For example:

1. Storm drains: trash deposited throughout the watershed and carried to various sections of the lake during and after rainstorms via storm drains. This is a point source.
2. Wind action: trash blown into the lake directly. This is a nonpoint source.
3. Direct disposal: direct dumping or littering into the lake. This is a nonpoint source.

#### *3.2.4.1.1 Point Sources*

Litter is the primary source of trash for point sources. This includes trash deposited throughout the watershed and carried to the waterbodies during and after rain events via storm drains.

#### *3.2.4.1.2 Nonpoint Sources*

Litter is also intentionally or accidentally discarded to the lake and shoreline. Trash deposited near the lake has the potential to be blown or transported by wildlife or overland flow into the lake. Trash directly dumped into the lake is also a nonpoint source.

### 3.2.4.2 Linkage Analysis

These TMDLs are based on numeric targets derived from narrative water quality objectives in the Los Angeles Basin Plan (LARWQCB, 1994) for floating materials and solid, suspended, or settleable materials. The narrative objectives state that waters shall not contain these materials in concentrations that cause nuisance or adversely affect beneficial uses. Since any amount of trash impairs beneficial uses, the loading capacity of all waterbodies is set to zero allowable trash.

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# NEWS RELEASE

WEST INFORMATION OFFICE
San Francisco, Calif.

**For release Friday, March 1, 2013** **13-396-SAN**

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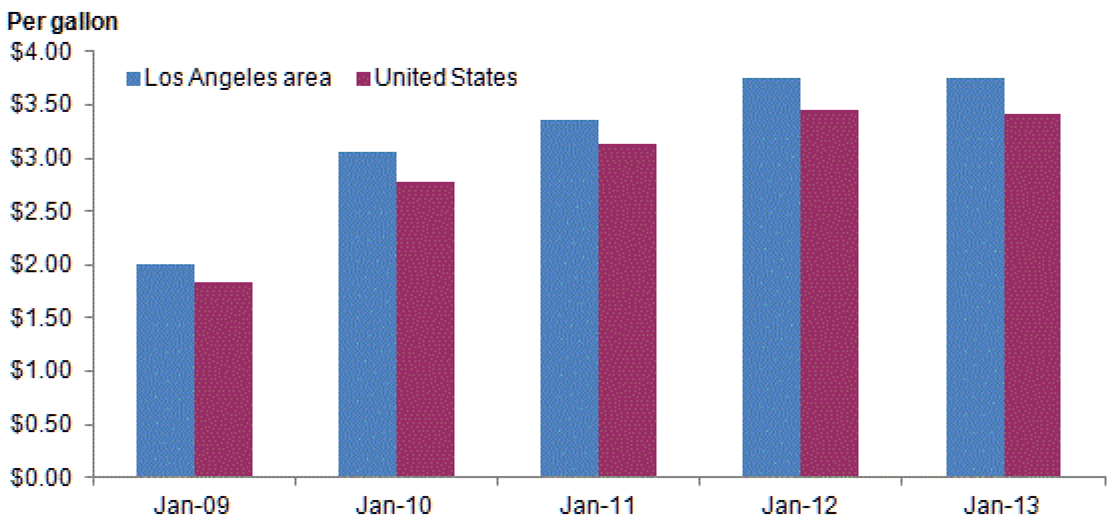
## AVERAGE ENERGY PRICES, LOS ANGELES AREA–JANUARY 2013

Gasoline prices averaged $3.749 a gallon in the Los Angeles area in January 2013, the U.S. Bureau of Labor Statistics reported today. Regional Commissioner Richard J. Holden noted that area gasoline prices were similar to last January when they averaged $3.747 per gallon. Los Angeles area households paid an average of 23.2 cents per kilowatt hour (kWh) of electricity in January 2013, up from 20.4 cents per kWh in January 2012. The average cost of utility (piped) gas at $1.013 per therm in January was similar to the $0.996 per therm spent last year. (Data in this release are not seasonally adjusted; accordingly, over-the-year-analysis is used throughout.)

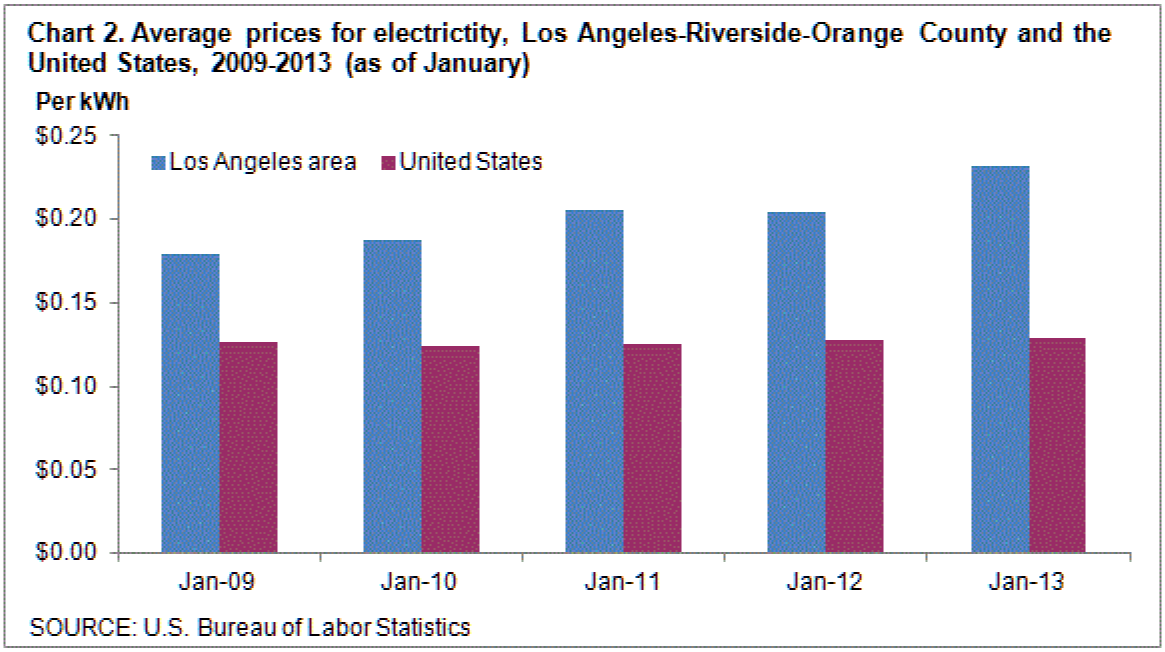
At $3.749 a gallon, Los Angeles area consumers paid 10.0 percent more than the $3.407 national average in January 2013. A year earlier, consumers in the Los Angeles area paid 8.7 percent more than the national average for a gallon of gasoline. The local price of a gallon of gasoline has exceeded the national average by more than six percent in the month of January in each of the past five years. (See chart 1.)

Chart 1. Average prices for gasoline, Los Angeles-Riverside-Orange County and the United States, 2009-2013 (as of January)

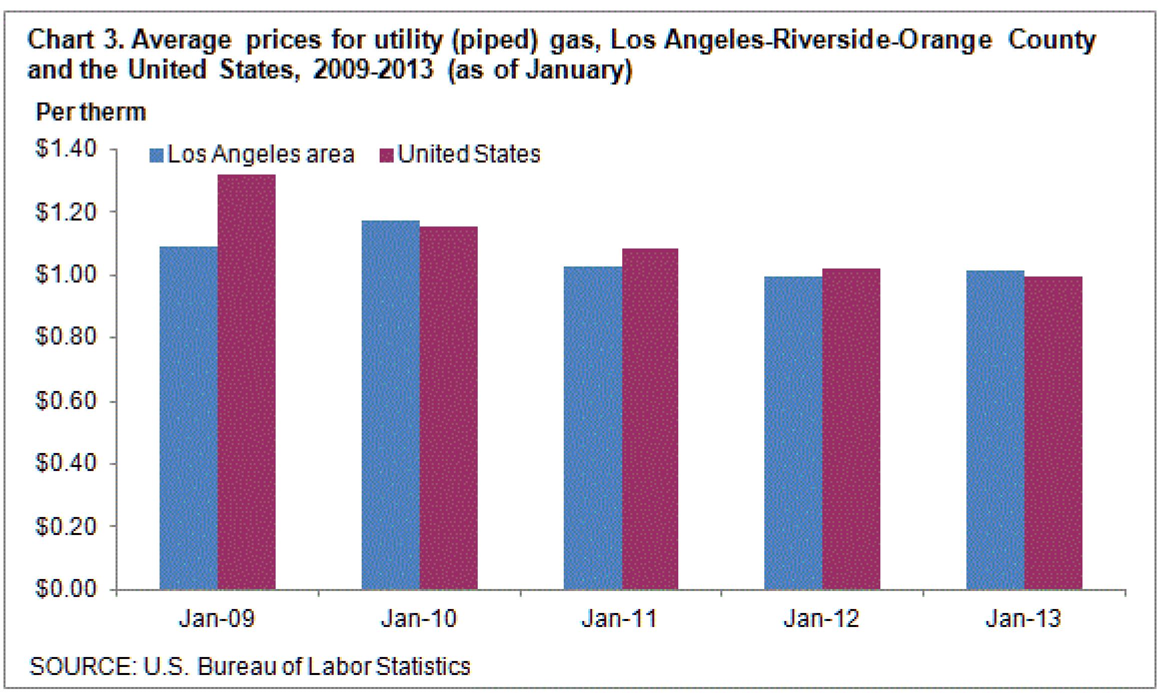



SOURCE: U.S. Bureau of Labor Statistics

The 23.2 cents per kWh Los Angeles households paid for electricity in January 2013 was 79.8 percent more than the nationwide average of 12.9 cents per kWh. Last January, electricity costs were 59.4 percent higher in Los Angeles compared to the nation. In the past five years, prices paid by Los Angeles area consumers for electricity exceeded the U.S. average by more than 42 percent in the month of January. (See chart 2.)




Prices paid by Los Angeles area consumers for utility (piped) gas, commonly referred to as natural gas, were $1.013 per therm, similar to the national average in January 2013 ($0.996 per therm). A year earlier, area consumers also paid close to the same price per therm for natural gas compared to the nation. In three of the past five years, the per therm cost for natural gas in January in the Los Angeles area has been within three percent of the U.S. average. (See chart 3.)



The Los Angeles-Riverside-Orange County, Calif. metropolitan area consists of Los Angeles, Orange, Riverside, San Bernardino and Ventura Counties in California.

## Technical Note

Average prices are estimated from Consumer Price Index (CPI) data for selected commodity series to support the research and analytic needs of CPI data users. Average prices for electricity, utility (piped) gas, and gasoline are published monthly for the U.S. city average, the 4 regions, the 3 population size classes, 10 region/size-class cross-classifications, and the 14 largest local index areas. For electricity, average prices per kilowatt-hour (kWh) and per 500 kWh are published. For utility (piped) gas, average prices per therm, per 40 therms, and per 100 therms are published. For gasoline, the average price per gallon is published. Average prices for commonly available grades of gasoline are published as well as the average price across all grades.

Price quotes for 40 therms and 100 therms of utility (piped) gas and for 500 kWh of electricity are collected in sample outlets for use in the average price programs only. Since they are for specified consumption amounts, they are not used in the CPI. All other price quotes used for average price estimation are regular CPI data.

With the exception of the 40 therms, 100 therms, and 500 kWh price quotes, all eligible prices are converted to a price per normalized quantity. These prices are then used to estimate a price for a defined fixed quantity.

The average price per kilowatt-hour represents the total bill divided by the kilowatt-hour usage. The total bill is the sum of all items applicable to all consumers appearing on an electricity bill including, but not limited to, variable rates per kWh, fixed costs, taxes, surcharges, and credits.  This calculation also applies to the average price per therm for utility (piped) gas.

Information from this release will be made available to sensory impaired individuals upon request. Voice phone: 202-691-5200, Federal Relay Services: 800-877-8339.

**Table 1. Average prices for gasoline, electricty, and utility (piped) gas, Los Angeles-Riverside-Orange County and the United States, January 2012-January 2013, not seasonally adjusted**

| Year and month | Gasoline per gallon | | Electricity per kWh | | Utillity (piped) gas per therm | |
|---|---|---|---|---|---|---|
| | Los Angeles area | United States | Los Angeles area | United States | Los Angeles area | United States |
| 2012 | | | | | | |
| January | $3.747 | $3.447 | $0.204 | $0.128 | $0.996 | $1.021 |
| February | 4.013 | 3.622 | 0.204 | 0.128 | 0.931 | 0.986 |
| March | 4.394 | 3.918 | 0.204 | 0.127 | 0.931 | 0.978 |
| April | 4.257 | 3.976 | 0.204 | 0.127 | 0.883 | 0.951 |
| May | 4.333 | 3.839 | 0.204 | 0.129 | 0.978 | 0.907 |
| June | 4.037 | 3.602 | 0.193 | 0.135 | 1.054 | 0.927 |
| July | 3.800 | 3.502 | 0.193 | 0.133 | 1.053 | 0.943 |
| August | 4.073 | 3.759 | 0.193 | 0.133 | 1.072 | 0.960 |
| September | 4.175 | 3.908 | 0.193 | 0.133 | 1.027 | 0.953 |
| October | 4.499 | 3.839 | 0.211 | 0.128 | 1.052 | 0.962 |
| November | 3.924 | 3.542 | 0.211 | 0.127 | 0.995 | 0.994 |
| December | 3.677 | 3.386 | 0.211 | 0.127 | 1.042 | 1.004 |
| 2013 | | | | | | |
| January | 3.749 | 3.407 | 0.232 | 0.129 | 1.013 | 0.996 |

The State Water Project

# Final Delivery Reliability Report 2011

June 2012

State of California
Natural Resources Agency
Department of Water Resources







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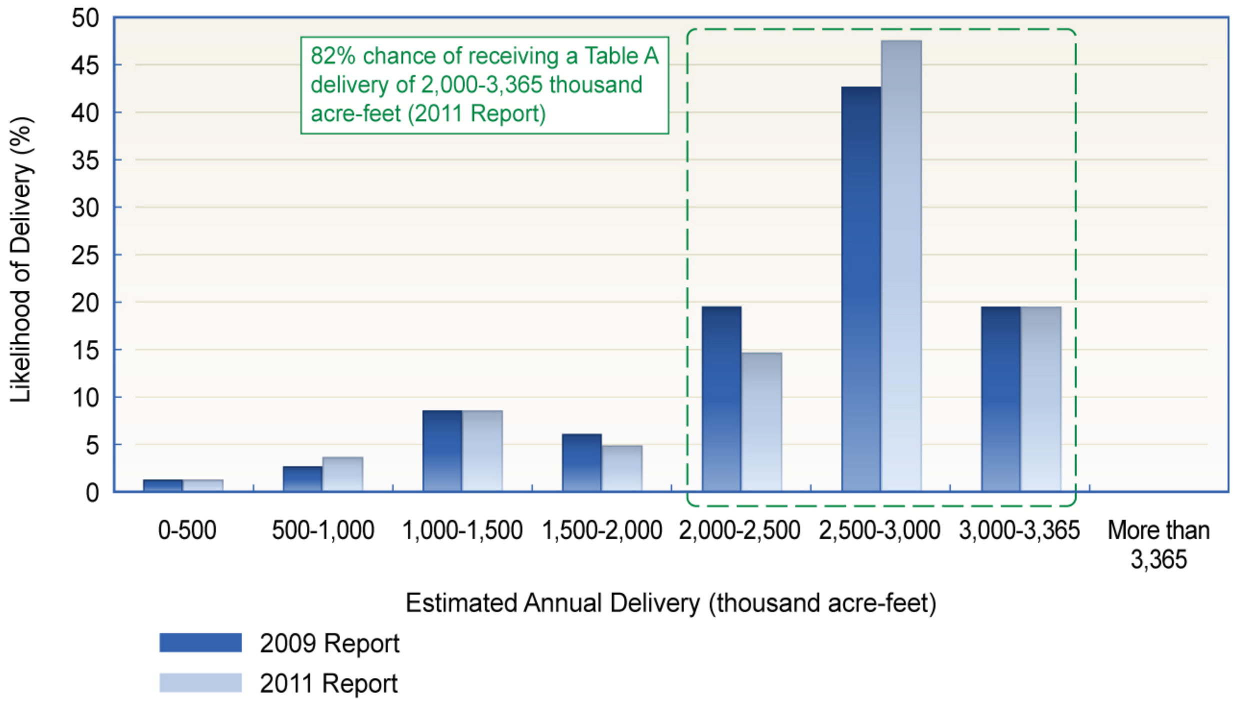


Figure 6-4. Estimated Likelihood of SWP Table A Water Deliveries (Existing Conditions)

Table 6-3. Estimated Average and Dry-Period Deliveries of SWP Table A Water (Existing Conditions), in Thousand Acre-Feet (Percent of Maximum SWP Table A Amount, 4,133 taf/year)

| | Long-term Average | Single Dry Year (1977) | 2-Year Drought (1976–1977) | 4- Year Drought (1931–1934) | 6-Year Drought (1987–1992) | 6-Year Drought (1929–1934) |
|---|---|---|---|---|---|---|
| 2009 Report | 2,483 (60%) | 302 (7%) | 1,496 (36%) | 1,402 (34%) | 1,444 (35%) | 1,398 (34%) |
| 2011 Report | 2,524 (61%) | 380 (9%) | 1,573 (38%) | 1,454 (35%) | 1,462 (35%) | 1,433 (35%) |

Table 6-4. Estimated Average and Wet-Period Deliveries of SWP Table A Water (Existing Conditions), in Thousand Acre-Feet (Percent of Maximum SWP Table A Amount, 4,133 taf/year)

| | Long-term Average | Single Wet Year (1983) | 2-Year Wet (1982–1983) | 4-Year Wet (1980–1983) | 6-Year Wet (1978–1983) | 10-Year Wet (1978–1987) |
|---|---|---|---|---|---|---|
| 2009 Report | 2,483 (60%) | 2,813 (68%) | 2,935 (71%) | 2,817 (68%) | 2,817 (68%) | 2,872 (67%) |
| 2011 Report | 2,524 (61%) | 2,886 (70%) | 2,958 (72%) | 2,872 (69%) | 2,873 (70%) | 2,833 (69%) |

# Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District

March, 2007

Robert C. Wilkinson, Ph.D.

**Note to Readers**

This report for West Basin Municipal Water District is an update and revision of an analysis and report by Robert Wilkinson, Fawzi Karajeh, and Julie Mottin (Hannah) conducted in April 2005. The earlier report, *Water Sources "Powering" Southern California: Imported Water, Recycled Water, Ground Water, and Desalinated Water*, was undertaken with support from the California Department of Water Resources, and it examined the energy intensity of water supply sources for both West Basin and Central Basin Municipal Water Districts. This analysis focuses exclusively on West Basin, and it includes new data for ocean desalination based on new engineering developments that have occurred over the past year and a half.

**Principal Investigator: Robert C. Wilkinson, Ph.D.**

Dr. Wilkinson is Director of the Water Policy Program at the Donald Bren School of Environmental Science and Management, and Lecturer in the Environmental Studies Program, at the University of California, Santa Barbara. His teaching, research, and consulting focuses on water policy, climate change, and environmental policy issues. Dr. Wilkinson advises private sector entities and government agencies in the U.S. and internationally. He currently served on the public advisory committee for California's 2005 State Water Plan, and he represented the University of California on the Governor's Task Force on Desalination.
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West Basin
Municipal Water District

**West Basin Municipal Water District**

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# Overview

Southern California relies on imported and local water supplies for both potable and non-potable uses. Imported water travels great distances and over significant elevation gains through both the California State Water Project (SWP) and Colorado River Aqueduct (CRA) before arriving in Southern California, consuming a large amount of energy in the process. Local sources of water often require less energy to provide a sustainable supply of water. Three water source alternatives which are found or produced locally and could reduce the amount of imported water are desalinated ocean water, groundwater, and recycled water. Groundwater and recycled water are significantly less energy intensive than imports, while ocean desalination is getting close to the energy intensity of imports.

Energy requirements vary considerably between these four water sources. All water sources require pumping, treatment, and distribution. Differences in energy requirements arise from the varying processes needed to produce water to meet appropriate standards. This study examines the energy needed to complete each process for the waters supplied by West Basin Municipal Water District (West Basin).

Specific elements of energy inputs examined in this study for each water source are as follows:

- Energy required to **import water** includes three processes: pumping California SWP and CRA supplies to water providers; treating water to applicable standards; and distributing it to customers.
- **Desalination of ocean water** includes three basic processes: 1) pumping water from the ocean or intermediate source (e.g. a powerplant) to the desalination plant; 2) pre-treating and then desalting water including discharge of concentrate; and 3) distributing water from the desalination plant to customers.
- **Groundwater** usage requires energy for three processes: pumping groundwater from local aquifers to treatment facilities; treating water to applicable standards; and distributing water from the treatment plant to customers. Additional injection energy is sometimes needed for groundwater replenishment.
- Energy required to **recycle water** includes three processes: pumping water from secondary treatment plants to tertiary treatment plants; tertiary treatment of the water, and distributing water from the treatment plant to customers.

The energy intensity results of this study are summarized in the table on the following page. They indicate that recycled water is among the least energy-intensive supply options available, followed by groundwater that is naturally recharged and recharged with recycled water. Imported water and ocean desalination are the most energy intensive water supply options in California. East Branch State Water Project water is close in energy intensity to desalination figures based on current technology, and at some points along the system, SWP supplies exceed estimated ocean desalination energy intensity. The following table identifies energy inputs to each of the water supplies including estimated energy requirements for desalination. Details describing the West Basin system operations are included in the water source sections. Note that the Title 22 recycled water energy figure reflects only the *marginal* energy required to treat secondary effluent wastewater which has been processed to meet legal discharge requirements, along with the energy to convey it to user

## Energy Intensity of Water Supplies for West Basin Municipal Water District

| | af/yr | Percentage of Total Source Type | kWh/af Conveyance Pumping | kWh/af MWD Treatment | kWh/af Recycled Treatment | kWh/af Groundwater Pumping | kWh/af Groundwater Treatment | kWh/af Desalination | kWh/af WBMWD Distribution | Total kWh/af | Total kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Imported Deliveries** | | | | | | | | | | | |
| State Water Project (SWP) [1] | 57,559 | 43% | 3,000 | 44 | NA | NA | NA | NA | 0 | 3,044 | 175,209,596 |
| Colorado River Aqueduct (CRA) [1] (other that replenishment water) | 76,300 | 57% | 2,000 | 44 | NA | NA | NA | NA | 0 | 2,044 | 155,957,200 |
| **Groundwater[2]** | | | | | | | | | | | |
| natural recharge | 19,720 | 40% | NA | NA | NA | 350 | 0 | NA | 0 | 350 | 6,902,030 |
| replenished with (injected) SWP water [1] | 9,367 | 19% | 3,000 | 44 | NA | 350 | 0 | NA | 0 | 3,394 | 31,791,598 |
| replenished with (injected) CRA water [1] | 11,831 | 24% | 2,000 | 44 | NA | 350 | 0 | NA | 0 | 2,394 | 28,323,432 |
| replenished with (injected) recycled water | 8,381 | 17% | 205 | 0 | 790 | 350 | 0 | NA | 220 | 1,565 | 13,116,278 |
| **Recycled Water** | | | | | | | | | | | |
| West Basin Treatment, Title 22 | 21,506 | 60% | 205 | NA | 0 | NA | NA | NA | 285 | 490 | 10,537,940 |
| West Basin Treatment, RO | 14,337 | 40% | 205 | NA | 790 | NA | NA | NA | 285 | 1,280 | 18,351,360 |
| **Ocean Desalination** | 20,000 | 100% | 200 | NA | NA | NA | NA | 3,027 | 460 | 3,687 | 82,588,800 |

Notes:

NA Not applicable

[1] Imported water based on percentage of CRA and SWP water MWD received, averaged over an 11-year period. Note that the figures for imports do not include an accounting for system losses due to evaporation and other factors. These losses clearly exist, and an estimate of 5% or more may be reasonable. The figures for imports above should therefore be understood to be conservative (that is, the actual energy intensity is in fact higher for imported supplies than indicated by the figures).

[2] Groundwater values include entire basin, West Basin service area covers approximately 86% of the basin. Groundwater values are specific to aquifer characteristics, including depth, within the basin.

# Energy Intensity of Water

Water treatment and delivery systems in California, including extraction of "raw water" supplies from natural sources, conveyance, treatment and distribution, end-use, and wastewater collection and treatment, account for one of the largest energy uses in the state.[1] The California Energy Commission estimated in its 2005 Integrated Energy Policy Report that approximately 19% of California's electricity is used for water related purposes including delivery, end-uses, and wastewater treatment.[2] The total energy embodied in a unit of water (that is, the amount of energy required to transport, treat, and process a given amount of water) varies with location, source, and use within the state. In many areas, the energy intensity may increase in the future due to limits on water resource extraction, and regulatory requirements for water quality, and other factors.[3] Technology improvements may offset this trend to some extent.

> ***Energy intensity*** is the total amount of energy, calculated on a whole-system basis, required for the use of a given amount of water in a specific location.

### The Water-Energy Nexus

Water and energy systems are interconnected in several important ways in California. Water systems both provide energy – through hydropower – and consume large amounts of energy, mainly through pumping. Critical elements of California's water infrastructure are highly energy-intensive. Moving large quantities of water long distances and over significant elevation gains, treating and distributing it within the state's communities and rural areas, using it for various purposes, and treating the resulting wastewater, accounts for one of the largest uses of electrical energy in the state.[4]

Improving the efficiency with which water is used provides an important opportunity to increase related energy efficiency. ("*Efficiency*" as used here describes the useful work or service provided by a given amount of water.) Significant potential economic as well as environmental benefits can be cost-effectively achieved in the energy sector through efficiency improvements in the state's water systems and through shifting to less energy intensive local sources. The California Public Utilities Commission is currently planning to include water efficiency improvements as a means of achieving energy efficiency benefits for the state.[5]

### Overview of Energy Inputs to Water Systems

There are four principle energy elements in water systems:

1. primary water extraction and supply delivery (imported and local)
2. treatment and distribution within service areas
3. on-site water pumping, treatment, and thermal inputs (heating and cooling)

4. wastewater collection, treatment, and discharge

Pumping water in each of these four stages is energy-intensive. Other important components of embedded energy in water include groundwater pumping, treatment and pressurization of water supply systems, treatment and thermal energy (heating and cooling) applications at the point of end-use, and wastewater pumping and treatment.[6]

***1. Primary water extraction and supply delivery***

Moving water from near sea-level in the Sacramento-San Joaquin Delta to the San Joaquin-Tulare Lake Basin, the Central Coast, and Southern California, and from the Colorado River to metropolitan Southern California, is highly energy intensive. Approximately 3,236 kWh is required to pump one acre-foot of SWP water to the end of the East Branch in Southern California, and 2,580 kWh for the West Branch. About 2,000 kWh is required to pump one acre foot of water through the CRA to southern California.[7] Groundwater pumping also requires significant amounts of energy depending on the depth of the source. (Data on groundwater is incomplete and difficult to obtain because California does not systematically manage groundwater resources.)

***2. Treatment and distribution within service areas***

Within local service areas, water is treated, pumped, and pressurized for distribution. Local conditions and sources determine both the treatment requirements and the energy required for pumping and pressurization.

***3. On-site water pumping, treatment, and thermal inputs***

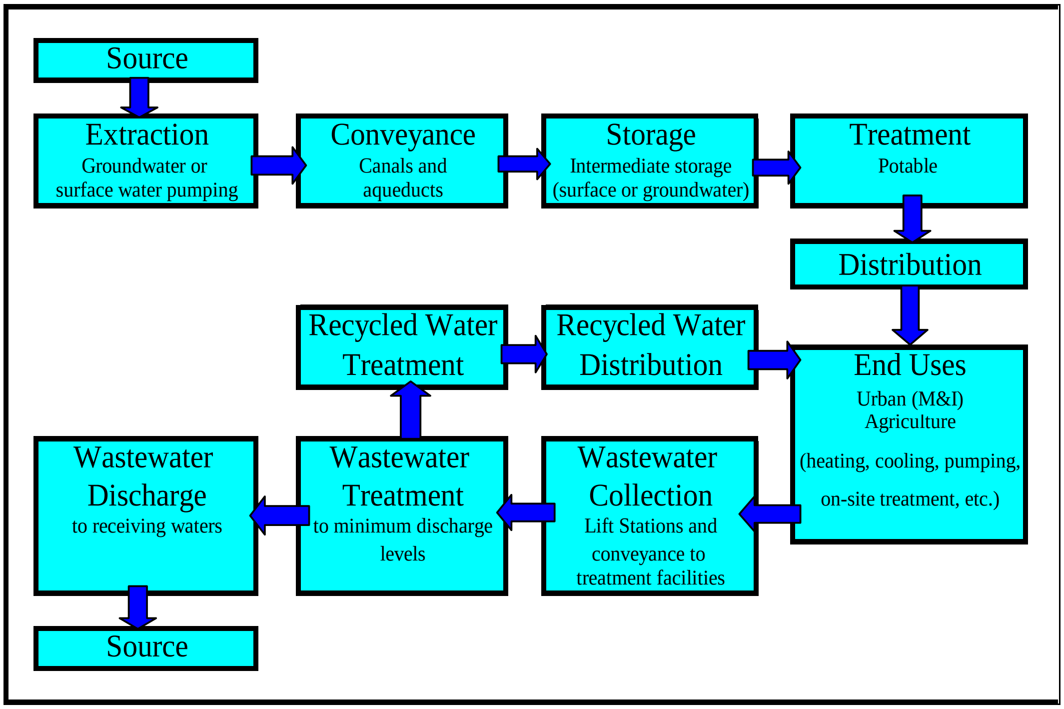
Individual water users use energy to further treat water supplies (e.g. softeners, filters, etc.), circulate and pressurize water supplies (e.g. building circulation pumps), and heat and cool water for various purposes.

***4. Wastewater collection, treatment, and discharge***

Finally, wastewater is collected and treated by a wastewater authority (unless a septic system or other alternative is being used). Wastewater is often pumped to treatment facilities where gravity flow is not possible, and standard treatment processes require energy for pumping, aeration, and other processes. (In cases where water is reclaimed and re-used, the calculation of total energy intensity is adjusted to account for wastewater as a *source* of water supply. The energy intensity generally includes the additional energy for treatment processes beyond the level required for wastewater discharge, plus distribution.)

The simplified flow chart below illustrates the steps in the water system process. A spreadsheet computer model is available to allow cumulative calculations of the energy inputs embedded at each stage of the process. This methodology is consistent with that applied by the California Energy Commission in its analysis of the energy intensity of water.

**Simplified Flow Diagram of Energy Inputs to Water Systems**




Source: Robert Wilkinson, UCSB[8]

## Calculating Energy Intensity

Total energy intensity, or the amount of energy required to facilitate the use of a given amount of water in a specific location, may be calculated by accounting for the summing the energy requirements for the following factors:

- imported supplies
- local supplies
- regional distribution
- treatment
- local distribution
- on-site thermal (heating or cooling)
- on-site pumping
- wastewater collection
- wastewater treatment

Water pumping, and specifically the long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity as noted above. Water use (based on embedded energy) is the next largest consumer of electricity in a typical Southern California home after refrigerators and air conditioners. Electricity required to support water service in the typical home in Southern California is estimated at between 14% to 19% of total residential energy demand.[9] If air conditioning is not a factor the figure is even higher. Nearly three quarters of this energy demand is for pumping imported water.

**Interbasin Transfers**

Some of California's water systems are uniquely energy-intensive, relative to national averages, due to the pumping requirements of major conveyance systems which move large volumes of water long distances and over thousands of feet in elevation lift. Some of the interbasin transfer systems (systems that move water from one watershed to another) are net energy producers, such as the San Francisco and Los Angeles aqueducts. Others, such as the SWP and the CRA require large amounts of electrical energy to convey water. On *average*, approximately 3,000 kWh is necessary to pump one AF of SWP water to southern California,[10] and 2,000 kWh is required to pump one AF of water through the CRA to southern California.[11]

Total energy savings for reducing the full embedded energy of *marginal* (e.g. imported) supplies of water used indoors in Southern California is estimated at about 3,500 kWh/af.[12] Conveyance over long distances and over mountain ranges accounts for this high marginal energy intensity. In addition to avoiding the energy and other costs of pumping additional water supplies, there are environmental benefits through reduced extractions from stressed ecosystems such as the delta.

## Imported Water:
## The State Water Project and the Colorado River Aqueduct

Water diversion, conveyance, and storage systems developed in California in the 20th century are remarkable engineering accomplishments. These water works move millions of AF of water around the state annually. The state's 1,200-plus reservoirs have a total storage capacity of more than 42.7 million acre feet (maf).[13] West Basin receives imported water from Northern California through the State Water Project and Colorado River water via the Colorado River Aqueduct. The Metropolitan Water District of Southern California delivers both of these imported water supplies to the West Basin.

**California's Major Interbasin Water Projects**


## The State Water Project

The State Water Project (SWP) is a state-owned system. It was built and is managed by the California Department of Water Resources (DWR). The SWP provides supplemental water for agricultural and urban uses.[14] SWP facilities include 28 dams and reservoirs, 22 pumping and generating plants, and nearly 660 miles of aqueducts.[15] Lake Oroville on the Feather River, the project's largest storage facility, has a total capacity of about 3.5 maf.[16] Oroville Dam is the tallest and one of the largest earth-fill dams in the United States.[17]

Water is pumped out of the delta for the SWP at two locations. In the northern Delta, Barker Slough Pumping Plant diverts water for delivery to Napa and Solano counties through the North Bay

Aqueduct.[18] Further south at the Clifton Court Forebay, water is pumped into Bethany Reservoir by the Banks Pumping Plant. From Bethany Reservoir, the majority of the water is conveyed south in the 444-mile-long Governor Edmund G. Brown California Aqueduct to agricultural users in the San Joaquin Valley and to urban users in Southern California. The South Bay Pumping Plant also lifts water from the Bethany Reservoir into the South Bay Aqueduct. [19]

The State Water Project is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year.[20] The energy required to operate the SWP is provided by a combination of DWR's own hydroelectric and other generation plants and power purchased from other utilities. The project's eight hydroelectric power plants, including three pumping-generating plants, and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power.

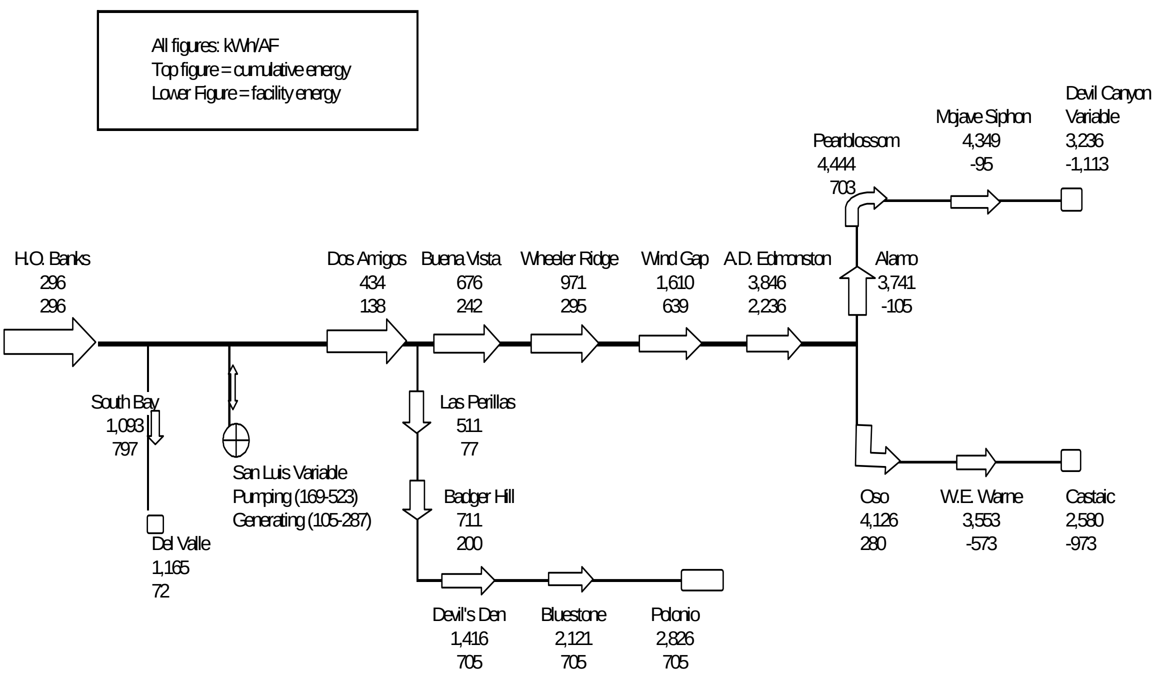
Energy requirements would be considerably higher if the SWP was delivering full contract volumes of water. The project delivered an average of approximately 2.0 mafy, or half its contracted volumes, throughout the 1980s and 1990s.[21] Since 2000 the volumes of imported water have generally increased.

The following map indicates the location of the pumping and power generation facilities on the SWP.

## Names and Locations of Primary State Water Delivery Facilities

The following schematic shows each individual pumping unit on the State Water Project, along with data for both the individual and cumulative energy required to deliver an AF of water to that point in the system. Note that the figures include energy recovery in the system, but they do not account for losses due to evaporation and other factors. These losses may be in the range of 5% or more. While more study of this issue is in order, it is important to observe that the energy intensity numbers are conservative (e.g. low) in that they assume that all of the water originally pumped from the delta reaches the ends of the system without loss.

**State Water Project**
**Kilowatt-Hours per Acre Foot Pumped**
(Includes Transmission Losses)




Source: Wilkinson, based on data from: California Department of Water Resources, State Water Project Analysis Office, Division of Operations and Maintenance, *Bulletin 132-97*, 4/25/97.